EFFECT OF CONTENT AREA READING STRATEGY ON ACHIEVEMENT IN SECONDARY AGRISCIENCE

By

TRAVIS DALE PARK

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

2005
This document is dedicated to my wife, Lacy, and our dog, Beaux.
ACKNOWLEDGMENTS

First of all, I would like to thank the faculty and staff in the Agricultural Education and Communication Department at the University of Florida. I have learned about research, teaching, and extension from this fine group of people. They have also taught a young person more about character, integrity, and professionalism than could have been imagined. My gratitude is extended to Dr. Ed Osborne, my committee chair, for his tireless efforts to guide this dissertation study, his continual challenge to my thinking about agriscience research, and his example as a mentor. I would also like to thank Dr. Rick Rudd, who lent an ear, a shoulder, and a kind word when I needed it most. I appreciate Dr. Howard Ladewig’s guidance and professionalism in methodology, as well as his intellectual thought processes and questioning skills. I am also grateful to Dr. Barbara Pace for our discussions about reading and her challenge of my research perspectives and patience as I attempted to learn a new content area.

I also must recognize Dr. Nick Place for his example as a professor and for providing opportunities to participate in extension activities while at UF. And, while he is no pool shark, I appreciate the intricacies of Dr. Glenn Israel and the wonderful opportunity to get to know him and study from him.

Secondly, I could never have gotten this far without the friendships and high-level discussions that were generated in 310 Rolfs Hall and various annexes. I truly appreciate and respect the example of all the doctoral graduates who have left Rolfs Hall to make their mark on the world and agricultural education, communication, leadership, and
extension. Whether it was John’s laughter, Grady’s pranks, Lisa’s friendship, Nicole’s 
honesty, Lori’s crises, or Chris’ highly philosophical friendship, I have taken something 
from each of you. Their examples, laughter, and friendship have meant the world. They 
made this an enjoyable ride.

The current group of 310 stall mates also deserves recognition. Kris and I have 
been through a bit together and it will be fun to graduate with her and see her career 
explode. I’ll also remember fondly Nick’s total enthusiasm, Wendy’s complexity, 
Steve’s friendship, Eric’s professionalism and love for his wife, Emily’s common 
interests in the Amish, and Curt’s damned personality. Everyone should thank David for 
bringing this group together with the parties at the Jones’ pool. I must also thank 
Amanda for her teaching example and work ethic. While the atmosphere has lightened, it 
is no less professional or challenging. They are a wonderful group of people who will 
continue to do great things and make a real difference in the lives of many students. Someday I hope that my children are blessed to have them as teachers.

Of course I need to thank my parents and family. Without the secure foundation 
from which to work, a person can accomplish but little. Fortunately, I have an extremely 
strong support group who sends cards, makes phone calls, and visits, although Norma 
spends way too much time down here. Joe and Bettye Lou Park are my inspirations in 
education and whom I strive to be like in making a family and becoming involved in a 
community. I would also like to thank my brothers Aaron and Jeremy and their families 
for just being. Daniel and Anna Marie may never read this, but they should know how 
much fun it is to play with them and anticipate seeing them. Last, but not least, I thank 
Grandma for always believing in the best of all of us and being my biggest champion.
Randy and Norma also deserve credit, beginning with the financial assistance to make the move to Florida as well as the visits and demanding that I drink a beer(s) on the beach. I thank them so much for helping keep all of this in perspective. I also want to thank Kipp and Jennifer for their encouragement and for providing an escape as we talked CUBS baseball.

This whole endeavor would never have happened without my wife, Lacy, and our dog, Beaux. Lacy provided so much encouragement, help, and consolation when things did not go right. Lacy sacrificed so much as our lives became entwined with the AEC Department. Many graduate students have Lacy to thank for helping bring them to UF and helping them graduate as well. I love her. Lacy’s heart of gold and determination to make everyone feel welcome and important is something that we could all learn from. We wanted to make a positive difference when we came to UF, and I think that we did it mostly out of Lacy’s efforts. She is my inspiration, my light, and the love of my life. Beaux’s pretty good, too, but not quite as cozy and a lot more slobbery.

The agriculture teachers in Indiana and the students and community in and around Tri-County School Corporation deserve recognition, for were it not for their examples and our collective experiences, I would have no foundation upon which to pose questions, no stories to share with prospective teachers, and no grounding for the “Ivory Tower.” Leaving home was difficult, and I hope that I make them proud, and please know that we are working to get back home. There are a couple of stops along the way; keep a cold Coke handy.

Thanks to Ray, John, Van, Dave, Pat, and George.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xiii</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>xiv</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>1 INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Introduction to the Study</td>
<td>1</td>
</tr>
<tr>
<td>Background of the Study</td>
<td>1</td>
</tr>
<tr>
<td>Need for Reading</td>
<td>2</td>
</tr>
<tr>
<td>Reading Failures</td>
<td>2</td>
</tr>
<tr>
<td>Secondary Reading</td>
<td>4</td>
</tr>
<tr>
<td>Reader</td>
<td>5</td>
</tr>
<tr>
<td>Text</td>
<td>6</td>
</tr>
<tr>
<td>Activity</td>
<td>7</td>
</tr>
<tr>
<td>Sociocultural context</td>
<td>7</td>
</tr>
<tr>
<td>Teacher</td>
<td>9</td>
</tr>
<tr>
<td>Problem Statement</td>
<td>10</td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>12</td>
</tr>
<tr>
<td>Statement of Objectives</td>
<td>12</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>12</td>
</tr>
<tr>
<td>Qualitative Inquiry</td>
<td>13</td>
</tr>
<tr>
<td>Significance of the Study</td>
<td>13</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>15</td>
</tr>
<tr>
<td>Gender</td>
<td>15</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>15</td>
</tr>
<tr>
<td>Socioeconomic Status (SES)</td>
<td>16</td>
</tr>
<tr>
<td>Grade Level</td>
<td>16</td>
</tr>
<tr>
<td>Grade Point Average (GPA)</td>
<td>16</td>
</tr>
<tr>
<td>Treatment Group</td>
<td>16</td>
</tr>
<tr>
<td>Comparison Group</td>
<td>16</td>
</tr>
<tr>
<td>Reading</td>
<td>16</td>
</tr>
<tr>
<td>Content Area Reading</td>
<td>17</td>
</tr>
</tbody>
</table>
Comprehension.................................................................17
Microperiod ........................................................................18
Motivation to Read ..........................................................18
Comprehension Portion of the Agriculture Post-Test ...............19
FCAT Reading Levels .......................................................19
Engaged Readers ...............................................................19
Struggling Readers ...........................................................19
Limitations of the Study ......................................................20
Summary ............................................................................21

2 REVIEW OF LITERATURE ...........................................................23

Introduction .........................................................................23
Philosophical Theories of Reading ........................................24
Schema Theory ....................................................................24
Reader-Response Theory ....................................................25
Sociocultural Theory of Reading .........................................26
Theoretical Framework for Comprehension ..........................27
Key Variables in This Study ................................................28
Sociocultural Context ........................................................28
Teacher ..............................................................................30
Attitude ............................................................................31
Teacher preparation and knowledge of strategies ..................33
Reader ................................................................................34
Gender .............................................................................36
Age / Grade Level ............................................................37
Ethnicity ...........................................................................37
Socioeconomic Status .....................................................38
Reading Ability ...............................................................39
Interest .............................................................................40
Prior Knowledge ............................................................40
Prior Reading Experiences ..............................................41
Activity .............................................................................42
Reading in the three microperiods .....................................42
Reading Strategies ..........................................................44
Reading Strategy Instruction .............................................44
Goals of Reading Strategy Instruction .................................48
Multiple Strategy Instruction ............................................49
Activating Prior Knowledge ..............................................50
Setting Purpose ..............................................................52
Reading and Thinking Aloud .............................................53
Organizing Information ....................................................54
Summarizing .................................................................59
Outcome Variables ..........................................................60
Comprehension .............................................................60
Motivation .........................................................................60
Motivation’s Impact on Strategy Use and Comprehension .......62
3 METHODS .................................................................................................................65

Introduction.................................................................................................................65
Research Design .........................................................................................................67
Procedures...................................................................................................................70
Population ...................................................................................................................72
Subject Selection: Agriscience Foundations Students .......................................72
Subject Selection: Agriscience Teachers ............................................................73
Sample Size .........................................................................................................73
Instrumentation and Data Collection ........................................................................74
Florida Comprehensive Assessment Test ............................................................75
Textbook ..............................................................................................................77
Lesson Plans and Agriscience Comprehension Assessments ................................78
Motivation to Read Assessment ..............................................................................79
Treatment Delivery Accountability ...........................................................................82
Analysis of Data ........................................................................................................82
Long Interviews ..........................................................................................................84
Summary .....................................................................................................................85

4 FINDINGS ..................................................................................................................87

Introduction.................................................................................................................87
Objective 1: Description of Participants.............................................................89
Gender ..........................................................................................................92
Grade level ...................................................................................................92
Ethnicity .......................................................................................................93
SES ...............................................................................................................94
GPA .............................................................................................................95
FCAT reading level ......................................................................................96
Motivation to read ........................................................................................96
Agriculture comprehension ..........................................................................97
Reading habits of students ...........................................................................98
Relationships between variables ................................................................100
Objective 2: Variance in Agricultural Post-Test Scores.................................103
Objective 3: Variance in the Motivation to Read Post-Test.............................105
Objective 4: Variance in Comprehension Scores of the Agriculture Post-Test105
Hypothesis Tests .......................................................................................................107
Teacher Interviews....................................................................................................107
Attributes of Agriscience Teachers and Agriscience Students.........................108
Agriscience teachers indicated an interest in helping students learn ..........108
Agriscience teachers stated that content area reading was important .........109
Agriscience teachers incorporated content area reading strategies ..........110
Agriscience teachers were not avid readers themselves and/or were poor
readers ...................................................................................................................112
Agriscience courses were populated with students possessing a wide range of reading abilities ................................................................. 112
Approaches to Instruction in Agriscience ........................................................ 113
Teachers used lecture-discussion, teacher-centered approaches to instruction ................................................................. 113
Reading was minimized in agriscience courses prior to initiating the study .................................................................................. 115
Agriscience Teachers and Their Use of Content Area Reading in Agriscience 117
Agriscience teachers had limited understanding about implementing CARS .................................................................................. 117
Agriscience teachers used a variety of other reading materials ................. 118
Teachers Participate in Professional Development Related to Content Area Reading ............................................................................ 119
Agriscience teachers need assistance with implementing CARS .............. 119
Pressures to Teach Reading ........................................................................ 120
Students’ Motivation to Read ...................................................................... 121
Student motivation to read was lacking ..................................................... 121
When teachers were interested in the reading and comfortable with using CARS, they were more effective with motivating students to read and use CARS ............................................................................ 123
Teachers indicated that they would continue to implement CARS in agriscience courses ........................................................................... 124
Summary ................................................................................................................... 124

5 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS .................... 126
Introduction ............................................................................................................... 126
Methods .................................................................................................................... 128
Summary of Findings ............................................................................................... 130
Research Objectives ............................................................................................... 130
Objective 1: Description of Students Participating in This Study .................. 130
Objective 2: Description of the Variance in Agriculture Post-Test Scores ...... 134
Objective 3: Description of the Variance in the Motivation to Read Score .... 135
Objective 4: Description of the Variance in the Agricultural Comprehension Scores .................................................................................. 135
Research Hypotheses ............................................................................................... 136
Research Questions................................................................................................... 136
Question 1: How do agriculture teachers perceive their role in developing students’ reading comprehension skills? ........................................ 137
Question 2: What are teacher’s reactions to implementing CARS in agriscience? .................................................................................. 137
Question 3: How do agriscience teachers model good literacy? ................. 138
Question 4: What strategies are effective in assisting agriscience teachers in implementing CARS? ......................................................... 138
Question 5: What are the barriers to reading instruction in agriscience? .... 139
Conclusions .............................................................................................................. 139
Discussion and Implications .................................................................................................... 140

Objective 1: Description of the Students Participating in This Study.............................. 140
  Conclusion 1A: students in Agriscience Foundations are generally ninth
  graders, White, male, and higher SES ........................................................................... 140
  Conclusion 1B: Students read below grade level ........................................................... 140
  Conclusion 1C: treatment group students read significantly more hours
  per week for pleasure and increased time per week of pleasure reading .................... 143
  Conclusion 1D: students are generally lacking in motivation to read........................... 144

Objective 2: Description of the Variance in Agriculture Post-Test ................................. 146
  Conclusion 2: demographic factors explain variance in agriculture post-
  test score ......................................................................................................................... 146

Objective 3: Description of the Variance in Motivation to Read Score............................ 147
  Conclusion 3: student characteristics do not significantly impact
  motivation to read ......................................................................................................... 147

Objective 4: Description of the Variance in Agricultural Comprehension
  Scores .................................................................................................................................. 148
  Conclusion 4: white students earning higher GPA and FCAT reading
  levels score higher on comprehension ......................................................................... 148

Conclusions Regarding the Hypotheses ............................................................................ 149
  H_a^1: Comprehension of Agricultural Concepts........................................................... 149
  H_a^2: Motivation to Read ............................................................................................. 151

Interviews .................................................................................................................................. 152
  Conclusion 6A: agriscience teachers had implemented few or no CARS ....... 153
  Conclusion 6B: limited knowledge of and confidence in using CARS ......... 154
  Conclusion 6C: comparison group teachers implement many strategies... 156
  Conclusion 6D: pressure to implement reading and CARS in agriscience 157
  Conclusion 6E: motivation to implement CARS ...................................................... 158

Recommendations for Practitioners .................................................................................. 159
Recommendations for Further Research ............................................................................ 161

APPENDIX

A  CORRESPONDENCE WITH TEACHERS .......................................................................... 162
B  DATA REPORTING FORMS ........................................................................................... 173
C  LESSON PLANS: COMPARISON GROUP ................................................................... 177
D  LESSON PLANS: TREATMENT GROUP ...................................................................... 229
E  PANEL OF EXPERTS ..................................................................................................... 340
F  INSTRUMENTS .............................................................................................................. 341
LIST OF REFERENCES ........................................................................................................ 349
BIOGRAPHICAL SKETCH .................................................................................................. 372
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1. Fry Readability</td>
<td>77</td>
</tr>
<tr>
<td>3-2. Canonical discriminant coefficients for the Adapted Motivations for Reading Questionnaire (n = 37)</td>
<td>81</td>
</tr>
<tr>
<td>4-1. Schools participating in the study</td>
<td>90</td>
</tr>
<tr>
<td>4-2. Instructional time on Agriscience Foundations lessons</td>
<td>91</td>
</tr>
<tr>
<td>4-3. Number of strategies employed</td>
<td>92</td>
</tr>
<tr>
<td>4-4. Student gender distribution</td>
<td>92</td>
</tr>
<tr>
<td>4-5. Student grade level distribution</td>
<td>93</td>
</tr>
<tr>
<td>4-6. Student ethnicity distribution</td>
<td>94</td>
</tr>
<tr>
<td>4-7. Student SES distribution as determined by free and reduced lunch counts</td>
<td>94</td>
</tr>
<tr>
<td>4-8. Student letter grade distribution</td>
<td>95</td>
</tr>
<tr>
<td>4-9. Student FCAT reading level distribution</td>
<td>96</td>
</tr>
<tr>
<td>4-10. Motivation to read assessment scores (n = 95)</td>
<td>97</td>
</tr>
<tr>
<td>4-11. Students’ agriculture pre- and post-test performance (percent correct)</td>
<td>98</td>
</tr>
<tr>
<td>4-12. Reading habits of students (n = 95)</td>
<td>99</td>
</tr>
<tr>
<td>4-13. Change in reading habits of students (n = 95)</td>
<td>100</td>
</tr>
<tr>
<td>4-14. Correlations between continuous variables</td>
<td>102</td>
</tr>
<tr>
<td>4-15. Point biserial correlations between categorical variables</td>
<td>103</td>
</tr>
<tr>
<td>4-16. Backward regression analysis to predict agriculture comprehension score</td>
<td>105</td>
</tr>
</tbody>
</table>
4-17. Backward regression analysis to predict comprehension portion of the agriculture post-test\textsuperscript{a}........................................................................................................................................106

5-1. School district level FCAT reading levels \((n = 1778)\textsuperscript{a}\). ........................................................................................................131
LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>A Heuristic for Thinking About Reading Comprehension</td>
<td>18</td>
</tr>
<tr>
<td>2-1</td>
<td>A Heuristic for Thinking About Reading Comprehension</td>
<td>27</td>
</tr>
<tr>
<td>2-2</td>
<td>Strategies of Proficient Readers</td>
<td>43</td>
</tr>
</tbody>
</table>
Abstract of Dissertation Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

EFFECT OF CONTENT AREA READING STRATEGY ON ACHIEVEMENT IN SECONDARY AGRICIENCE

By

Travis Dale Park

May 2005

Chair: Ed Osborne
Major Department: Agricultural Education and Communication

This study addressed improving agriscience students’ comprehension by implementing content area reading strategies (CARS). Objectives included describing grade level, gender, ethnicity, socioeconomic status (SES), grade point average (GPA), and Florida Comprehensive Assessment Test (FCAT) reading levels of students, and describing variance in agriculture comprehension and motivation to read explained by these characteristics.

Hypotheses included students’ (Ha¹) comprehension of agricultural concepts and (Ha²) motivation to read will be significantly greater using CARS versus those using teacher’s normal instruction. Questions leading qualitative inquiry included 1) how do agriculture teachers develop students’ reading comprehension skills, 2) how do teachers implement CARS, and 3) what are the barriers to reading instruction?

Independent variables were CARS versus the teacher’s normal instruction. Dependent variables were motivation to read and agriculture comprehension. Antecedent
variables were gender, grade level, ethnicity, and SES. FCAT reading levels, GPA, and agriculture and motivation pre-tests were covariates.

A quasi-experimental nonequivalent control group design determined the effect of implementing CARS on agricultural comprehension and attitude toward reading of a purposively selected sample (n = 95) of secondary agriscience students, enrolled in Agriscience Foundations in Florida. The study compared CARS instruction with the teacher’s normal instruction.

Over 60% of students read at the lowest two FCAT reading levels, while 11.6% read at the highest two levels. Students were generally lacking in motivation to read. Agriculture pre-test score, grade level, GPA, gender, ethnicity, and FCAT reading level predicted 65.0% of variance in agriculture post-test scores. Regression analysis did not produce a model that was statistically significant for motivation to read. GPA and FCAT reading level predicted 39.4% of variance in the comprehension portion post-test score. Because the treatment effect produced no significant correlations and was not significant in explaining the variance in any of the models, MANCOVA and ANCOVA procedures were not conducted.

Prior to the study, agriscience teachers implemented few or no CARS. They possessed limited knowledge and confidence in using CARS. Teachers in the comparison group implemented twice as many strategies, yet their students arrived at nearly the same level of agricultural comprehension and motivation as students in the treatment group.
CHAPTER 1
INTRODUCTION

Introduction to the Study

This study used a quasi-experimental nonequivalent control group design to determine the effect of implementing reading strategies on the agricultural content knowledge and attitude toward reading of secondary agriscience students, specifically students enrolled in the ninth-grade Agriscience Foundations course. The study utilized intact classes of ninth-grade students in six Florida high schools. The study focused on implementing reading strategies in each of the three micro-periods of reading: pre-reading, during reading, and post-reading (Snow, 2002). The study compared the set of reading strategies with the teacher’s normal routine of instruction.

Background of the Study

With assessment and accountability permeating our educational system, all teachers are being called upon to demonstrate their effectiveness in teaching and improving students’ achievement in math, science, and reading. Further, “adolescents entering the adult world in the 21st century will read and write more than any other time in human history” (Moore, Bean, Birdyshaw, & Rycik, 1999, p. 3). The world is teeming with text and information; thus students must employ many comprehension skills to navigate this complex of information. All high school graduates must possess skills necessary for understanding, creating, and applying meaning from text (Snow, 2002; Whipple, 1925), so reading must occur in all areas of learning (D’Arcangelo, 2002), including secondary agriscience.
Need for Reading

Adolescents need to have strong reading skills so they can excel in academics, create meaning in their environment, and productively function in society (Forget & Bottoms, 2000; Meltzer, 2001). Students need reading skills in careers, households, in citizenship, and in their personal lives (D’Arcangelo, 2002; Guthrie, 1988; Guthrie, Schafer, Wang, & Afflerbach, 1995; Meltzer). The reading and literacy development of adolescents prepares them for success and learning in school and throughout their lives beyond school (National Reading Panel [NRP], 2000; Vacca, 2002a).

Students need reading skills to analyze and comprehend the plethora of knowledge and facts available through the Internet and other media (Moore et al., 1999; Swafford & Kallus, 2002; Vacca, 2002b). Good readers can internalize information, make critical decisions, and form opinions (D’Arcangelo, 2002). Building students’ literacy skills empowers students to grow, improve, and develop; yet most secondary educational systems are not adequately preparing students to develop the types and levels of reading and literacy necessary for success.

Reading Failures

Reading is necessary for learning, yet students may not be obtaining the reading help that they need to be successful. Students in the United States compare poorly with their counterparts in other developed countries, especially where content knowledge and literacy are central to the curriculum (Snow, 2002). This lack of reading and comprehension ability in high school translates into failures later in life. Students are unprepared for the academic language encountered in college (Wright, 1998). Little advancement is being made in developing the reading skills of secondary students (Snow).
The basic level of reading indicates that students can demonstrate partial mastery of reading. They possess the prerequisite knowledge and skills necessary for performing at grade level but cannot demonstrate mastery of reading. Nationally, 32% of eighth grade boys and 19% of eighth grade girls cannot read at this basic level (National Center for Educational Statistics [NCES], 2001). This means that these students cannot understand texts, make interpretations, or relate to text concepts. At the twelfth grade, these figures are only slightly better: 26% of all students failing to read at the basic level, including 30% of boys and 17% of girls (NCES; Wirt et al., 2004). Further, since 1971 the reading ability of the nation’s 17-year-olds has remained relatively consistent, neither improving nor declining (NCES). Educators are making little advancement in teaching students how to comprehend and apply text, especially for struggling readers (Cappella & Weinstein, 2001).

One aspect of reading is the construction of meaning from text (Snow, 2002). Yet, fewer than five percent of adolescents, students in grades eight through twelve, can extend or elaborate the meanings of materials they read (Moore et al., 1999; NCES, 2001, 2003). This means that secondary students cannot combine information from their own background knowledge or information in other texts with material that they are currently reading in order to construct meaning and solve problems. They cannot generate new knowledge from text. They cannot construct meaning from text and are at risk for reading failure.

Failure to learn to read has contributed to students’ alienation from education (Vacca & Vacca, 2002). The children most at risk for reading failure are the poor and otherwise estranged from school (Cappella & Weinstein, 2001; Wirt et al., 2004;
Zimmerman & Brown, 2003). While a portion of students lack the basic reading skills and are alienated from school, almost all students need support in learning vocabulary, managing reading styles, developing a positive attitude toward literacy, and learning and applying reading strategies independently (Meltzer, 2001; Moore et al., 1999).

**Secondary Reading**

Reading in secondary schools and content areas is vital to students’ development of comprehension skills. Yet many students lack the requisite skills to understand and apply meaning from texts. Therefore they disengage with reading in the content areas and for pleasure. Further, content area texts often contain complex and difficult vocabulary, structure, and concepts (Kim, Vaughn, Wanzek, & Wei, 2004). The reading activities are also demanding and involve problem solving and critical thinking. Teachers are often unprepared to teach reading strategies and do not employ reading on a regular basis (Bintz, 1997; Cresson, 1999; Digisi, 1993; Menke & Davey, 1994). As the context of reading in secondary schools shifts with each passing period, students are required to shift knowledge, thinking skills, and contexts in order to comprehend coursework. Additionally, students often fail to realize the connection between reading in content areas and applications in their personal lives.

Readence, Bean, and Baldwin (1989) proposed assumptions and misconceptions about reading in content areas that must be overcome for learning to take place. These assumptions and misconceptions include:

1. Students have learned to read in elementary schools.
2. Students have sufficient prior knowledge to cope with important information in content text.
3. The processes involved in efficiently reading and comprehending in content texts are identical to those utilized in reading in elementary school.
4. Remedial reading classes will provide struggling readers with the necessary reading skills for success in subject-matter reading.

5. Content reading means teaching skills not directly related to subject areas.

6. Subject matter specialists are information dispensers.

**Reader**

As students move from middle to high school, demands on literacy skills increase, and students must become more adept at meeting the challenges of sophisticated content area reading and information (Baer & Nourie, 1993; Jacobs, 2002; Meltzer, 2001; Musthafa, 1996; Snow, 2002; Tomlinson, 1995). Whereas reading in elementary schools focuses on learning to read, secondary and content area reading focuses on reading to learn (Baer & Nourie; Moore et al., 1999). Although students have learned to read, they begin to struggle with reading comprehension after the fourth grade (Allington, 2002). After elementary school reading courses, students receive few opportunities for intensive instruction in reading and comprehension in middle or secondary school (Durkin, 1978; Forget & Bottoms, 2000; Meltzer; Snow). This lack of instruction contributes to the widening gap of reading abilities among students and their subsequent alienation from reading (Bryant, 2003; Baer & Nourie; Tovani & Keene, 2000).

These struggling, alienated readers develop a downward spiral of reading experiences (Cibrowski, 1995; Readence et al., 1989). They expend more time and energy in constructing meaning from text and exhibit a “labored and choppy reading style that strains their attention and interest” (Cibrowski, p. 96). Struggling readers over-attend to individual words and are unable to use context to predict meaning and develop comprehension. In essence, their mired attempts at comprehending text elicit poor performance and poor attitudes toward reading, resulting in less time spent reading. For
students who struggle with reading, “school becomes a period of life to endure, rather than a pathway to success” (Bean, 2001, ¶ 12).

Time spent reading is related to reading success and is associated with positive attitudes toward additional reading, increased knowledge of the world, and provisions for worthwhile life experiences. The National Assessment of Educational Progress (NAEP) Reading Report Card reported that students who read more for school and pleasure had higher average reading scores than students who did not read (Donahue, Voelkl, Campbell, & Mazzeo, 1999). However, the amount of time students dedicate to reading for pleasure declines through school (Guthrie, 2001; Moore et al., 1999, Readence, Bean, & Baldwin, 1998). Encouraging students to read is vital for their success even outside of school (Bean, 2001), yet content area teachers are rarely mentioned as positive role models for reading in secondary schools (Readence et al.).

Text

The structure and syntax of text become more complex and demanding in content areas (Allington, 2002). According to the Strategic Literacy Initiative (2001), “Reading is a different task when we read literature, science texts, historical analyses, newspapers, tax forms, [which is why] teaching students how to read texts in academic disciplines is a key part of teaching them these disciplines” (p. 1). While textbooks are the predominant form of reading material in classrooms, teachers also rely upon technical and trade books, magazines, newspapers, the Internet, and other electronic texts (Vacca & Vacca, 2002).

Understanding the language of content areas is essential to student comprehension and achievement. If students fail to grasp the language, then they fail to grasp the concepts in the language (Meltzer, 2001). Students must be able to learn from the language of expository texts, even when the topic is unfamiliar and the reading is
demanding (Alexander & Kulikowich, 1991; Barton, Heidema, & Jordan, 2002). Content area texts are conceptually dense and organized for information, thus demanding special reading skills for inference and critical thinking (Allington, 2002) and to discern the worthwhile information (Bean, 2001). Less skilled readers may require adaptive techniques to help in comprehending expository texts (Horton, Lovitt, & Bergerud, 1990). With the variety and difficulty of text materials found in secondary agriscience courses, navigating these challenging texts may be nearly impossible for some students without teacher assistance.

**Activity**

Students may realize they are poor readers but lack the knowledge of strategies to improve their reading abilities (D’Arcangelo, 2002; Forget & Bottoms, 2000; Horton et al., 1990). Many secondary students are at risk of reading failure and need reading instruction to continue to build their reading skills. They do not know how to read for comprehension and have not developed the skills necessary to learn effectively from text (Bulgren & Scanlon, 1997-98; D’Arcangelo; Forget & Bottoms; Horton et al.). Many older students do not receive the support needed to help them grow from fluent decoders into strategic readers (Vacca, 2002). Teachers must “adopt strategic teaching practices that will help students acquire both concepts critical to curricular content and learning strategies they need to be independent learners and processors of information” (Bulgren & Scanlon, p. 292).

**Sociocultural context**

The overarching goal of content area reading is to foster the development of active, engaged, independent readers and learners (Forget & Bottoms, 2000). Content area reading is difficult (Allington, 2002; Bryant, Ugel, & Thompson, 1999), especially as
students change classes, and they are required to shift the focus of their content knowledge (D’Arcangelo, 2002). Within the context of diverse content areas, students are expected to remember volumes of facts, figures, and information (Baer & Nourie, 1993). Content area reading emphasizes application, as well as reading to learn and comprehension of content area material (Baer & Nourie). These factors compound to make reading in the content area a challenge for many students. Thus, subject area teachers may be in the best position to teach how to read for learning and application (Readence et al., 1989).

The type of reading required for comprehension in different subject areas differs across content areas. Vocabulary and concepts in content areas are more specialized and technical in nature than reading for pleasure. New vocabulary words are introduced at a rapid pace and are vital for comprehension of the subject matter (Allington, 2002; Baer & Nourie, 1993). Beginning in the fourth grade, students encounter vocabulary that is less conversational and familiar, while being more specialized, technical, and abstract (Allington). “Content area reading . . . frequently covers concepts that extend beyond the knowledge of many children and adds to this difficulty by introducing [information] in rapid-fire fashion” (Baer & Nourie, p. 1). Further, in order for students to fully comprehend ideas and concepts in text, hands-on activities, field trips, discussions, and other experiences are often necessary for full comprehension, vocabulary development, and concept knowledge (Duke & Pearson, 2002).

Adolescents need well-developed reading instruction in content areas in order to improve comprehension and learning (Meltzer, 2001; Moore et al., 1999). Students should be able to question themselves about what they have read, synthesize information
from various sources, identify and understand vocabulary, recognize text structure and learn from that structure, organize information in class notes, interpret symbol systems in content areas, judge information for their own understanding, and evaluate authors’ ideas and perspectives (Snow, 2002; Vacca, 2002).

**Teacher**

In order to help students learn from textual information, teaching reading is every teacher’s responsibility. Good instruction is the most effective means of increasing student comprehension and developing skilled readers (Snow, 2002; Tomlinson, 1995). Because many content areas use text, the responsibility for teaching reading strategies belongs to all teachers in all subjects (Alexander & Kulikowich, 1991; Florida Department of Education [FDOE], 2004a; Vacca, 2002). Yet, few teachers employ reading strategies in their classrooms (Barry, 2002; Bean, 1997; Durkin, 1978; Irvin & Connors, 1989; Ivey, 2002; Menke & Davey, 1994; Morawski & Brunhuber, 1995).

Teachers have three primary reasons for failing to use reading strategies: 1) teachers feel inadequate to handle reading problems in their classrooms, 2) teachers feel that reading instruction infringes on content area time, and 3) many teachers deny the importance of reading techniques (Barry, 2002; Bean, 1997; Cresson, 1999; Digisi, 1993; Durkin, 1978; Moore et al., 1999; Rhoder, 2002; Snow, 2002; Stewart & O’Brien, 1989). These provide the reasons why many content area teachers do not teach or reinforce reading in their content area. Many teachers deny responsibility for teaching students to read and write (D’Arcangelo, 2002; Forget & Bottoms, 2000; Jacobs, 2002; Moore et al.; Vaughn, Klinger, & Bryant, 2001). Secondary teachers expect students to have the reading abilities necessary to read in the content areas (Readence et al., 1989; Snow). They perceive their primary function as preparing students in their subject area for high
school or college (D’Arcangelo; Forget & Bottoms; Jacobs; Moore et al.; Vacca, 2002). Some teachers even strive to minimize the amount of reading and writing in their classes (Allen, 2000; Cziko, 1998).

Content area teachers can make a difference in students’ education by incorporating reading strategies into mini-lessons as they teach their content area repertoire (Baer & Nourie, 1993; Vacca, 2002). Reading instruction includes “promoting active, mindful reading and teaching students to use strategies” (Rhoder, 2002, p. 498). Teachers can teach strategies that help activate students’ prior knowledge and clearly define the purposes for reading (McKenna & Robinson, 2002). This instruction in the development and use of reading strategies requires explanation, modeling, practice, and application (Vacca). Teaching collections or packages of reading comprehension strategies improves student comprehension of many kinds of texts (Duke & Pearson, 2002).

**Problem Statement**

Reading strategies are vitally important for all content areas, especially technical science areas such as agriscience. Reading correlates to comprehension and learning in the content area for many students; however, many high school students do not know how to read for comprehension (Forget & Bottoms, 2000; Moore et al., 1999; NCES, 2001; Snow, 2002). Research has demonstrated that when teachers infuse reading strategies into their content area lessons and develop structured reading assignments in the classroom, student performance and learning also increase (Forget & Bottoms; McKenna & Robinson, 2002; Meltzer, 2001; Moore et al.; Snow; Tomlinson, 1995; Vacca, 2002).

The primary problem addressed in this study was the continuing subpar reading performance of a large number of secondary students and the lack of research on
effective strategies for integrating content area reading in agriscience. Several reasons for focusing on reading improvement in high schools exist:

- All high school graduates are facing an increased need for a high degree of literacy, including the capacity to comprehend complex texts, yet comprehension outcomes are not improving.

- At an increasing rate, students in the United States are falling behind in comparison with students in other countries as they enter the later years of schooling when discipline-specific content and subject-matter learning are central to the curriculum.

- Little direct attention has been devoted to helping teachers develop the skills they need to promote reading comprehension and ensure content learning through reading (Snow, 2002, p. xi).

Several questions arise regarding content area reading comprehension and students’ attitudes toward reading in secondary agriscience:

- How can high school agriscience teachers improve students’ reading comprehension?

- What strategies are effective for improving adolescents’ comprehension of text in agriscience?

- How does strategy instruction in agriscience affect motivation to read?

- What is the agriscience teacher’s role in students’ comprehension and motivation to read.

- How do agriculture teachers perceive their role in assisting students in developing reading comprehension skills in agriscience?

- What are teacher’s reactions to implementing the content area reading strategies in agriscience? How effective are these efforts?

- How do agriscience teachers model good literacy?

- What strategies are effective in assisting agriscience teachers in implementing content area reading strategies?

- What are the barriers to reading instruction in agriscience?

The primary research question addressed in this study was, “How does implementing content area reading strategies that focus on the three micro-periods of
reading affect agriscience students’ knowledge of agricultural concepts and motivation to read?”

**Purpose of the Study**

The purpose of this study was to explore the effects of content area reading strategy instruction on agriculture comprehension and motivation to read. The study also attempted to gain insights into a description of students enrolled in Agriscience Foundations in Florida with regards to factors pertaining to reading achievement. Finally, the study attempted to investigate reasons how and why agriscience teachers implement or fail to implement content area reading strategies in their agriscience courses.

**Statement of Objectives**

The objectives of this study were:

1. Describe the grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students participating in this study.

2. Describe the variance in agriculture post-score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.

3. Describe the variance in motivation to read post-test score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.

4. Describe the variance in comprehension score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.

**Hypotheses**

For this study, research hypotheses included,

$H_{a1}$: Comprehension of agricultural concepts will be significantly greater for secondary agriscience students using reading strategies versus those students using the teacher’s traditional routine in agriscience classes.
H$_a^2$: Motivation to read will be significantly greater for secondary agriscience students using reading strategies versus those students using the teacher’s traditional routine in agriscience classes.

**Qualitative Inquiry**

This study also attempted to answer questions regarding agriscience teachers’ method of and reasons for implementing content area reading strategies in their Agriscience Foundations course. In order to accomplish this objective, the following questions led the long interview process with teachers:

1. How do agriculture teachers perceive their role in assisting students in developing reading comprehension skills in agriscience?

2. What are teachers’ reactions to implementing the content area reading strategies in agriscience? How effective are these efforts?

3. How do agriscience teachers model good literacy?

4. What strategies are effective in assisting agriscience teachers in implementing content area reading strategies?

5. What are the barriers to reading instruction in agriscience?

**Significance of the Study**

What does it mean to be literate in agriculture? Literacy is “the ability of the learner to perform reading and writing tasks” (National Institute of Health, 2002, p. 6). Literacy is the ability to interact with current knowledge, then create new knowledge and apply it to specific situations (B.G. Pace, personal communication, April 15, 2003). Literacy in a specific field depends upon the processes and knowledge of that field. Successful reading in agriculture necessitates students’ experiences and abilities in the food and fiber industry.

Since agriscience courses are offered as career and technical education (CTE) electives in most high schools, students enrolling in these courses are often more motivated to learn about the content area and may be more motivated to implement
reading strategies to gain the technical comprehension necessary for problem-solving in agriculture. However, CTE programs, such as school-based agricultural education, are less likely to employ communication skills, such as writing reports, reading texts, and presenting speeches (Forget & Bottoms, 2000). To further exacerbate the problems of comprehension, agriscience courses do not rely solely on textbooks, but integrate other sources of information (Gartin, Varner-Friddle, Lawrence, Odell, & Rinehart, 1994), challenging students to comprehend more complex and technical materials.

Agriscience programs have been striving to integrate math, reading, and science into classroom curricula (Belcher, McCaslin, & Headley, 1996). There is great need for improvement in integration of core academic subject matter in CTE courses, although teachers often face difficulty with integration and assessment of core subjects (Conroy & Walker, 2000; Gartin et al., 1994). The diversity of content domains and teacher knowledge of literacy presents challenges to “incorporating education in reading and writing in a vocational context” (Kakela, 1993, p. 390). Still, “literacy is a key to developing the transferable skills that are needed for vocations in the future” (Kakela, p. 390), including those in agriscience.

Rural students typically enroll in agriscience courses and may be at a disadvantage in terms of overall educational opportunities. Investigating the educational experiences and academic achievement of rural students compared to suburban and urban students, McDermott (1998) concluded that a higher proportion of rural students enroll in CTE courses than urban or suburban students. Rural students also struggle with reading comprehension, math, and science compared to other students.
Thus, this study holds significance for agricultural education for several reasons. Initially, the study proposes to investigate the efficacy of teaching the reading strategies in the agriscience context, which is unique from other secondary education contexts. Secondly, implementing a package of strategies tailored to the three micro-periods of reading has not been tested in agriscience. Thirdly, the length of the study, over two months, is longer than most other studies related to implementing reading strategies, yet researchers suggest that longer durations are necessary for successful strategy adoption. Fourthly, this set of reading strategies represents a flow of cognitive strategy use that makes sense—incorporating prior knowledge activation, making the reading processes visible through read-alouds, organizing text information with graphic organizers, and summarizing passages into usable chunks of knowledge.

Among the myriad of content area reading strategies available to teachers, this set of reading strategies simplifies reading comprehension instruction for secondary agriscience teachers, providing a usable set of strategies for students. Finally, this study provides evidence for strategy instruction and helpful research in boosting the comprehension and motivation to read of secondary students who struggle with reading expository passages.

**Definition of Terms**

**Gender**

Gender was operationally defined as being male or female.

**Ethnicity**

Ethnicity was operationally defined as White or minority, which includes American Indian or Alaskan native, Black or African American, Hispanic or Latino, Asian, Hawaiian or Pacific Islander, or other ethnic background.
Socioeconomic Status (SES)

Socioeconomic status (SES) was operationally defined as the level of school lunch subsidy provided a student. High SES includes students for whom no lunch financial subsidy was provided. Low SES includes students on free and reduced lunch programs.

Grade Level

Grade level was operationally defined as the student’s current grade level classification, most likely ninth grade, tenth grade, eleventh grade, or twelfth grade.

Grade Point Average (GPA)

Grade point average (GPA) was operationally defined as the cumulative earned grade average based upon a four-point scale.

Treatment Group

The treatment group was defined as those students taught using a prescribed curricula with content area reading strategies (CARS) embedded.

Comparison Group

The comparison group was defined as those students taught with the teacher’s normal routine of instruction.

Reading

Reading was operationally defined as an interactive constructive process in which the reader independently or socially draws on strategies, prior knowledge, and future goals to construct meaning from text (Barton et al., 2002; McKenna & Robinson, 2002; Ryder & Graves, 1994). Reading is a “recursive process that requires active engagement” (D’Arcangelo, 2002, p. 14). It is likened to a conversation between two parties (Durkin, 1993; Harris & Hodges, 1995; NRP, 2000; Ryder & Graves; Smith, 1982; Vacca & Vacca, 2002), the reader and the text within a specific context.
(International Reading Association (IRA), 1988; Kintch, 1998), where “the reader’s mind is alive with questions—cognitive questions” (Vacca & Vacca, p. 18).

**Content Area Reading**

Content area reading was operationally defined as reading that utilizes a set of pre-reading, during reading, and post-reading strategies to enhance comprehension of agricultural concepts. It is “the construction of flexible and usable knowledge” (Chapman, 2003, p. 4) within a content area.

**Comprehension**

Comprehension was operationally defined as the percentage of correct answers on the agriculture pre- and post-tests. It has been more commonly defined as “the process of simultaneously extracting and constructing meaning through interaction and involvement with written language” (Snow, 2002, p. 11, see Figure 1). It entails three elements: the reader, text, and activity. Comprehension involves prior knowledge, knowledge of text structures, and an active search of information for given purposes, such as solving problems. (Devine, 1986; Gillet & Temple, 2000; Pearson & Johnson, 1978; Ryder & Graves, 1994; Schoenbach, Greenleaf, Cziko, & Hurwitz, 1999). It often involves the construction of new knowledge (Hager & Gabel, 1993; Harris & Hodges, 1995; IRA, 1988; NRP, 2000; Park & Osborne, 2004; Rumelhart, 1977)
Microperiod

Comprehension occurs in three microperiods of reading (IRA, 1988; Snider, 1989; Snow, 2002). A microperiod was defined as one of the three consecutive episodes of reading: pre-reading, during reading, and post-reading.

Motivation to Read

Motivation to read was operationally defined as the scores obtained on the Adapted Motivations for Reading (Wigfield & Guthrie, 2004) pre- and post-tests. Motivation has been defined by other researchers as “those feelings that cause a reader to approach or avoid a reading situation” (Readence et al., 1989, p. 102). Motivation to read depends upon the expectation of successful performance when trying reasonably hard and the value available rewards for success (Good & Brophy, 1991). In this study, motivation to read was operationally defined as the student’s score on a 14-item Likert-type instrument where 1 equal very different from me and 4 equals a lot like me.
Comprehension Portion of the Agriculture Post-Test

The comprehension portion of the agriculture post-test was operationally defined as those comprehension assessment activities involving students reading a selected passage of related content text and then either constructing a concept map or writing a summary.

FCAT Reading Levels

The reading abilities of students in Florida are assessed using a standardized test, called the Florida Comprehensive Achievement Test (FCAT). For reading, students are assigned to one of five reading levels. The definition of the FCAT reading levels are

1. Reading level 5 was the level that “indicates that the student has success with the most challenging content of the Sunshine State Standards” (FDOE, 2004f, p. 4).
2. Reading level 4 was the level that “indicates that the student has success with the challenging content of the Sunshine State Standards” (FDOE, 2004f, p. 4). This is the first level of reading above grade level.
3. Reading level 3 was the level that “indicates that the student has partial success with the challenging content of the Sunshine State Standards, but performance is not consistent” (FDOE, 2004f, p. 4). This is generally considered reading at grade level.
4. Reading level 2 was the level that “indicates that the student has limited success with the challenging content of the Sunshine State Standards” (FDOE, 2004f, p. 4). This is generally considered reading below grade level.
5. Reading level 1 was “indicates that the student has little success with the challenging content of the Sunshine State Standards” (FDOE, 2004f, p. 4).

Engaged Readers

Engaged readers were readers who are intrinsically motivated to read for knowledge, enjoyment, or other purposes (Guthrie, 2001, 1996). These readers are often motivated to use reading strategies (Guthrie, 1996).

Struggling Readers

Struggling readers were operationally defined as readers for whom learning and comprehending from text is especially challenging (Readence et al., 1989).
Limitations of the Study

Like scholarly studies of similar complexity, limitations of this study exist and impact the generalizability of this particular study. First, because this study employed a quasi-experimental design using intact classes of students in a nonequivalent control group design, results are not generalizable to the larger population of all students, or those enrolled in secondary agriscience courses. Results of this study are limited only to those students participating in this study. Pure randomization and sample selection was neither possible, nor appropriate, due to the nature of agriscience courses, teachers’ willingness to implement strategies, experimentation with human subjects, and the inability to rearrange the students enrolled in intact classes.

Second, because reading comprehension is a contextualized creation of meaning, and strategies are also contextualized, this package of reading comprehension strategies may be best suited to investigations and teaching practice in agriscience. The set of reading strategies targets comprehension from expository text, where the main goal is learning agriscience concepts. These same strategies may not be appropriate for other disciplines or other genres of reading. Thus, generalizations of findings related to this set of reading strategy instruction to improve agriscience students’ comprehension may not be appropriate.

Another limitation of the study is the duration of the study. While a longer term study, perhaps a year or more, would have been preferable, the time constraints on this study were prohibitive. Further, with regard to timing, this study was limited in part to some of the participating schools experiencing school cancellations and delays due to Hurricanes Charlie, Frances, and Ivan.
While the researcher attempted to control for all extraneous variables related to comprehension of agriscience concepts and motivation to read, measuring changes in students’ comprehension and motivation to read were enormously complex undertakings. For example, the teacher’s attitude toward reading strategy instruction and his or her personal values toward reading may have affected reading strategy instruction. The teacher’s ability to instruct also factored into students’ comprehension and motivation to read. While attempting to normalize instruction through purposive selection of teachers and design of the curriculum, controlling for these complex variables is beyond the scope of this study. Additionally, other demographic variables may have influenced results of this study related to reading comprehension and motivation to read.

**Summary**

This chapter provided the background for research involving content area reading strategies to determine their effect on comprehension of agriscience concepts and motivation to read in secondary agriscience courses. Significance for the study and hypotheses were outlined. This study determined the effect of reading strategy instruction on students’ comprehension of agricultural concepts and motivation to read. The objectives of this study included:

1. Describe the grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students participating in this study.

2. Describe the variance in agriculture post-test score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.

3. Describe the variance in motivation to read post-test score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.
4. Describe the variance in agricultural comprehension score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.

For this study, research hypotheses included:

\( H_a^1 \): Comprehension of agricultural concepts will be significantly greater for secondary agriscience students using reading strategies versus those students using the teacher’s traditional routine in agriscience classes.

\( H_a^2 \): Motivation to read will be significantly greater for secondary agriscience students using reading strategies versus those students using the teacher’s traditional routine in agriscience classes.

Questions leading the qualitative inquiry include:

1. How do agriculture teachers perceive their role in assisting students in developing reading comprehension skills in agriscience?

2. What are teacher’s reactions to implementing the content area reading strategies in agriscience? How effective are these efforts?

3. How do agriscience teachers model good literacy?

4. What strategies are effective in assisting agriscience teachers in implementing content area reading strategies?

5. What are the barriers to reading instruction in agriscience?

The chapter also included operational definitions of terms related to reading, comprehension, and motivation to read. Finally, limitations of the study were discussed.

Chapter 2 will introduce and explain theoretical and conceptual frameworks for comprehension and motivation to read which guided this research. Additionally, empirical research related to comprehension, content area reading strategy instruction, and motivation to read will be addressed.
CHAPTER 2
REVIEW OF LITERATURE

Introduction

The primary purpose of this study was to determine the effect of implementing a set of reading strategies on students’ comprehension of agriscience concepts and motivation to read. Specifically, several hypotheses related to comprehension of agricultural concepts and motivation to read were investigated during this study.

This chapter presents a review of literature related to reading in content areas with a focus on comprehension and motivation to read. The focus is on literature describing theories of reading and empirical research related to reading comprehension and motivation to read. Research related to content area reading comprehension instruction, reading strategy use, and influences on the motivation to read are included in this chapter.

The independent variable in this study was reading strategy instruction, specifically, reading strategy instruction focusing on the three micro-periods of reading. Outlining the status of reading comprehension instruction, Pressley (2001) supposed that if different types of instruction improve comprehension, “it just might be sensible to do all of them” (¶ 1), thus justification for this set of reading strategies. Dependent variables for this study were comprehension of agriscience concepts and motivation to read. The antecedent variables were gender, ethnicity, socioeconomic status, grade level, GPA, and FCAT reading level.

This chapter reviews literature related to reading in content areas with the outcomes of comprehension and motivation to read. This chapter is divided into the following
major sections: philosophical theories of reading, an explanation of variables involved in this study, and the influence of reading strategy instruction on reading comprehension and motivation to read. The chapter focuses on literature describing theories of reading, and empirical research related to the sociocultural context of reading, teacher characteristics, reader attributes, content area reading strategy instruction, the activity of reading, reading comprehension and motivation to read. Research related to content area reading comprehension instruction, reading strategy use, factors associated with comprehension, and influences on the motivation to read is included in this chapter.

**Philosophical Theories of Reading**

**Schema Theory**

Schemata, or prior knowledge, are chunks of knowledge that exist in our minds and represent all that a person knows about a given concept (McKenna & Robinson, 2002, Rumelhart, 1980; Ryder & Graves, 1994; Vacca, 2002). They are the central guidance system in comprehension representing universal concepts and generalizations (Readence et al., 1989). The body of knowledge represented by schemata may include “experiences, conceptual understanding, attitudes, values, and skills that a reader brings to a text situation” (Vacca, p. 191).

Schemata allow a person “to construct actions or thoughts, to determine goals, and direct the flow of information to the mind” (Ryder & Graves, 1994, p. 140). The extent to which new information fits into existing schemata determines comprehension (Aubusbel, 1962; Ivie, 1998; Readence et al., 1989), thus prior knowledge and schemata must be activated prior to new reading (Vacca, 2002). Schemata are not stored as individual concepts, but are interconnected via many “intricate networks of associations” (McKenna & Robinson, 2002, p. 22).
Schemata change over time (Ryder & Graves, 1994). Modification of existing schema is the essence of learning and may require a student to “jettison misconceptions and restructure faulty schemata in light of new, sometimes discordant concepts” (Readence et al., p. 23). Schemata are altered in three main ways: new schemata may be formed, existing schemata may be altered, or existing schemata may be expanded (McKenna & Robinson, 2002). For agriscience teachers, especially those teaching students who come from non-agricultural backgrounds, activating prior knowledge of an agricultural subject is necessary to improve student comprehension.

**Reader-Response Theory**

Rosenblatt (1982, 1993) asserted that “reading is a transaction, a two-way process, involving a reader and a text at a particular time under a particular context” (p. 268, 1993). Reader response theory suggested that thought and feelings are portions of literacy. Readers interact with texts with emotion and intelligence (D’Arcangelo, 2002; Durkin, 1993; Harris & Hodges, 1995; NRP, 2000; Ryder & Graves, 1994; Smith, 1982; Vacca & Vacca, 2002). Different readers respond differently to different texts (Bryant et al., 1999; Guthrie, 1988; NRP; Rosenblatt). Reading text requires a dynamic intellectual response from the reader (Daisey, 1994; NRP; Rosenblatt; Vacca & Vacca).

Reader-response theory suggests that meaning does not reside in text, as is typical with an authoritarian view of text, but is constructed through the interactions of the reader with the text (Alvermann, 1989). Thus, readers are a primary portion in the creation of meaning (Alvermann; Daisey, 1994; Valencia, Pearson, Peters, & Wixon, 1989). In analyzing statewide reading assessments, Valencia et al. (1989) stated,

…readers build meaning by bringing together knowledge they already possess and information gained from the text … blend[ing] thoroughly the purposes they bring
to the task. The process is fluid; it varies from one reading situation to another [in terms of] motivation, interest, culture, task, setting, and text (p. 58).

That is, “text-based plans focused on a teacher-directed, discrete skills lesson; reader-based plans emphasized a student-centered, whole language lesson’ and interactive plans emphasized a teacher-directed lesson based on individual student differences” (p. 221).

**Sociocultural Theory of Reading**

Comprehension is more than just individual students and their reading; it is socially constructed through reading, writing, and speaking. Contextualized within the individual’s social networks and their learning communities (Moje, 1996), reading is a social activity among students as they collectively construct content and learning procedures (Rex, 2001). Reading occurs socially as students “discuss their personal relationships to reading in the discipline, the cognitive strategies they use to solve comprehension problems, the structure and language of particular types of texts, and the kinds of knowledge required to make sense of reading material” (Schoenbach, Braunger, Greenleaf, & Litman, 2003, p. 136).

Reading occurs within personal, sociocultural, and political contexts (Mann, 2000). Students are social beings with aspirations that contextualize and make particular pieces of information significant while reading. Social patterns in the classroom shape the volume and breadth of student reading (Guthrie et al., 1995). Reading activities are highly associated with social interactions among friends and family, strategies for comprehension and learning, classroom instruction, and teachers’ emphasis on reading (Guthrie et al.). Moje (1996) posited that teachers and students construct meaning through interactions with each other and text, and these interactions are based on past experiences, current situations, and future implications.
Theoretical Framework for Comprehension

In 1978, Delores Durkin initiated the conversation about quality reading instruction in school classrooms. After observing classrooms in grades three through six, Durkin determined that “almost no comprehension instruction was found” (p. 481), and time was spent assessing comprehension and in non-instruction situations. Content area teachers did not take advantage of opportunities to reinforce or teach reading comprehension strategies to their students. This landmark study alerted the reading community to the lack of reading comprehension instruction in content area classrooms.

More recently the RAND Reading Study Group (Snow, 2002) developed a research agenda for comprehension research, which provides the theoretical framework for thinking about and researching comprehension for this study. The group defined reading comprehension as, “the process of simultaneously extracting and constructing meaning through interaction and involvement with written language” (p. xiii). It is composed of three elements: reader, text, and activity or purpose for reading, which occur in a larger sociocultural context (see Figure 2).

![Figure 2-1. A Heuristic for Thinking About Reading Comprehension (Snow, 2002).]
The reader brings his or her cognitive capabilities, motivation, knowledge, and experiences to the reading processes (Snow, 2002). These characteristics vary from reader to reader and significantly impact the understanding of written material. The text includes the representation of information, including the surface code, text base, and mental models. Each different text varies in readability, vocabulary, structure, and content, thus impacting comprehension. The activity for reading involves the purposes, operations of reading, and outcomes of the reading comprehension processes. Outcomes can consist of solving problems, increasing knowledge, or engaging the reader.

The context of reading comprehension is comprised of the larger sociocultural environment in which the student encounters and navigates reading (Snow, 2002). This sociocultural context includes the teacher, but also extends beyond the classroom to encompass the community and world of the student. It involves social aspects of constructing meaning and the development of power within society.

**Key Variables in This Study**

Key factors in this study include the readers, the activity of reading including a package of reading strategies, and the teachers. The following sections of Chapter 2 will focus on research behind the variables related to this study, including teaching reading strategies, strategy use, motivation to read, and content area comprehension.

**Sociocultural Context**

Reading occurs in the context of a larger sociocultural context that shapes and is shaped by the reader (Snow, 2002). Included in the sociocultural context are economic resources, class membership, ethnicity, neighborhood, technology, and the school culture. The encompassing sociocultural context includes community- and school-wide factors, classroom culture, specific curriculum and instructional strategies, and classroom
interactions between students and between the students and teacher (Snow). For this study, the primary sociocultural factor is the teacher, his or her preparation in reading strategies, attitude toward reading, and personal reading. Guthrie (2001) proposed that classroom contexts can promote engaged reading. Teachers create contexts for engagement when they provide prominent knowledge goals, real-world connections to reading, meaningful choices about what, when, and how to read, and interesting texts that are familiar, vivid, important, and relevant. Teachers can further engagement by teaching reading strategies. A coherent classroom fuses these qualities (¶ I).

Strategy instruction should be adapted to the unique subject matter and educational context where literacy is constructed within each content area (Bean, 2001; DiCecco & Gleason, 2002; Kang, 2002; O’Brien, Stewart, & Moje, 1995). Teachers must realize that teaching content area reading strategies goes beyond the content—it teaches students strategies with which to navigate information, in essence, how to learn. Bean contextualized the implementation of reading strategies in recommending that they “be tailored according to how they best fit within specific, local learning contexts” (¶ 25).

The “specific, local learning context” includes getting to know students and their interests and incorporating them into lessons. Guthrie and Alao (1997) proposed that motivation to read is also contextual, where students may be motivated to read some texts in some situations, but not in others.

In an ethnographic study over the course of two years, Moje (1996) concluded that students did not transfer reading strategies from chemistry to other high school courses. Moje also concluded “that the strategies should be taught in each content area not only because the knowledge is domain specific, but because domains are imbued with social practices and purposes that shape the knowledge constructed in them” (p. 190). Moje’s (1996) findings supported the notion that teachers should explicitly teach the transfer of
strategies from one domain to another, because of the student’s “socially constructed assumptions about the nature of knowledge and the purpose of literacy in different content areas” (p. 190). Moje recommended that further research be conducted “developing deep understandings and building theory about the influence of contexts and purposes” (p. 191) on reading practices.

**Teacher**

Strategic reading requires strategic teaching, which puts “teachers in positions where their minds are the most valued educational resource” (Duffy, 1993, p. 245). Expert teachers possess a deep knowledge of the reading process and comprehension and possess skills and knowledge to implement research-based instructional strategies into teaching (Snow, 2002). The teacher’s personal reading habits, attitude toward reading, and expectations for reading affect student performance (Readence et al., 1989).

Teachers “encourage thinking processes that are essential for successful learning” (Readence et al., 1989, p. 8). Further, teachers influence strategy use (Moje, 1996; Sanchez, 2003). Students are seldom willing to expend the time and effort necessary to implement comprehension strategies, and many students initiate reading strategies only when directed by the teacher (Cuevas, 2003). Yet, assessing the current practices of reading instruction, Rieckhoff (1997) determined that little change had occurred in the amount of reading instruction provided students in intermediate grades since the Durkin study in 1978. Teachers often assessed comprehension, but did little to instruct students how to comprehend written materials. Teachers paid little attention to teaching students how to comprehend, instead believed that students should already possess skills at applying comprehension strategies.
### Attitude

Many teachers feel that reading is essential to learning in the content areas (Digisi, 1993; Morawski & Brunhuber, 1995). A survey of 213 secondary teachers found that they agreed with the importance of implementing practices to help struggling adolescent readers and would be receptive to training and information about content area reading strategies (Catone, 2001). Morawki and Brunhuber found that 63% of 214 teachers harbored positive feelings toward content area reading.

Surveying 215 British Columbia science teachers, Yore (1991) concluded that science teachers valued reading as an important learning strategy, and they generally accepted responsibility for teaching reading strategies. Studying 215 biology teachers, Digisi (1993) found that teachers viewed reading as essential to learning biology, especially for discussion in advanced courses and to reinforce concepts in basic biology courses. Reading was especially vital to learning scientific concepts. Examining content area reading instruction in five central Florida middle schools, Dillon (2003) found that the majority of teachers held positive attitudes toward inclusion of content area reading and engaged in content area reading instruction during some portion of their classes.

Teachers demonstrate their personal value on reading through modeling strategies and interactions with students (Bintz, 1997; Stephens, 2002). Teachers who model good reading skills and comprehension encourage their students (Forget & Bottoms, 2000; Ivey, 2002; NRP, 2000; Rhoder, 2002). Morawski (1995) recommended that teachers examine “their own beliefs, feelings, and behaviors related to the reading processes” (p. 342) as part of encouraging content area reading. “Teachers are placing more value on the notion that an interest in reading is ultimately an interest in learning” (Bintz, p. 18).
Investigating beliefs about reading, preparation for content area reading, and attitudes toward content area reading held by 130 Pennsylvania teachers, Jorgensen (2001) found a positive relationship between teachers’ beliefs about reading and practice \((r=.33)\), between important reading strategies and teacher practice \((r=.61)\), and between beliefs about reading and the need for training in content area reading strategies \((r=.45)\). Teachers realize the importance of content area reading, yet feel unprepared to teach and reinforce content area reading with students.

Teachers often cite reasons for failing to teach or reinforce reading such as, the strong need to teach content area material, the addition to curriculum, lack of obligation to teach content area reading, little or no training in content area reading strategies (Cresson, 1999; Digisi, 1993), and an attitude that content area reading is “not my job” (Bintz, 1997; McAloon, 1993-94; Simonson, 1995). Other teachers often reject content area reading because of their beliefs about secondary schools, misconceptions about reading as additional teaching material, and assumptions about teaching and learning (O’Brien & Stewart, 1990). In a qualitative investigation with 25 Midwestern preservice content area teachers, O’Brien and Stewart found that teachers rejected the notion that they are teachers of reading. The teachers did not see the relevance of reading to their particular discipline or how reading strategies could be implemented in their courses, suggesting that other courses were more appropriate for reinforcing reading.

The most resistant preservice teachers were those in agricultural education with 85% of them rejecting content area reading (O’Brien & Stewart, 1990). Agricultural education teachers viewed themselves as already reinforcing content area reading. Because of the perception as a hands-on discipline, they ignored reading as a teaching
tool. Science disciplines rejected prereading instruction and learning from text, as they believed that when reading was necessary, students could engage in reading independently. O’Brien and Stewart concluded that the merits of content reading were diluted by another institutionalized misconception—that a dichotomy of academic track versus vocational track curricula represents a clear, logical demarcation between book learning and hands-on, non-text approaches to acquiring content (p. 119).

In a qualitative study of middle and secondary school teachers, Bintz (1997) concluded “Teachers often feel unable or unwilling to teach reading in the content areas” (p. 12). Teachers try to avoid involving students in reading by assigning as little reading as possible, instead teaching around the textbook to ensure students understand key concepts. Secondary teachers continue to see themselves as purveyors of knowledge, not teachers of reading. Compounding the problem, “individuals who know the least about reading are being asked to teach reading to students who need it the most” (p. 17).

Teachers used different words to describe the same “reading nightmares”:

- Math teachers state that students can’t read and understand math problems;
- Science teachers state that students can’t read texts to conduct laboratory experiments;
- Home economics teachers state that students don’t understand and therefore can’t follow instructions;
- Industrial arts and vocational education teachers state that students can’t read and don’t follow procedures and thus often put themselves in physical danger when operating certain machinery and equipment;
- English teachers state that students can’t read and don’t comprehend poems, short stories, and novels (Bintz, 1997, p. 16).

In essence, “increasing numbers of middle and secondary school students do not perceive reading as meaningful, and thus do not value the act or the process” (p. 16).

**Teacher preparation and knowledge of strategies**

Teacher preparation plays a significant role in reading in the content areas and leads to improved student reading performance (Alexander & Kulikowich, 1991; Jackson & Cunningham, 1994-95; King, 1998; Meltzer, 2001; Snow, 2002; Williams, 2002).
Teachers who are prepared in the use of reading strategies are better able to teach about strategies, explain their importance, and demonstrate how to use them (Duffy, Roehler, Meloth, & Vavrus, 1986; Duffy et al., 1987) in order to assist struggling readers. However, the use of reading strategies often requires “substantial and intensive teacher preparation” (Williams, p. 255) and as many as 30 instances of practice before a new routine is implemented (Carriedo & Alonso-Tapia, 1995; Snow).

For some teachers, tensions exist between teachers’ beliefs and practices in content area reading (Bean, 2001). Mosenthal and Kirsch (1991) ascertained that “teachers have yet to place the acquisition of new knowledge and the integration of prior knowledge firmly at the core of content area reading instruction” (p. 61). Surveying 442 Texas teachers about the use of textbooks and content area reading strategies with students, Cresson (1999) found that social studies and English teachers were most likely to assign reading, while math and science teachers were least likely. Surveying 21 experienced teachers, 15 beginning teachers, and 25 preservice teachers, Menke and Davey (1994) found that experienced teachers provided more class time for reading than less experienced teachers, but used text less often to supplement instruction. Experienced teachers were more likely to teach students to use textbooks and employ cooperative learning techniques.

**Reader**

Readers possess several characteristics, including all of the capacities, abilities, knowledge, and experience that a person brings to reading (Snow, 2002). Capacities and abilities include “cognitive capacities (e.g., attention, memory, critical analytic ability, inferencing, visualization ability), motivation (purpose for reading, interest in the content being read, self-efficacy as a reader), and various types of knowledge (vocabulary,
domain, and topic knowledge, linguistic and discourse knowledge, knowledge of specific comprehension strategies)” (Snow, p. 13). As a reader begins, engages in, and completes a reading task, some or all of these abilities may change (NRP, 2000).

Proficient readers define their purpose(s) for reading, monitor the achievement of those purposes, and activate fix-up strategies if the purposes are not being met (Ryder & Graves, 1994). They possess knowledge of multiple strategies to help them retain, organize, and evaluate information that they read (Snow, 2002). They understand how to use strategies, employ them, and have enough background knowledge and cognitive capacity to profit from strategy use (Collins, 1994; Forget & Bottoms, 2000; Pressley, Snyder, & Carigula-Bull, 1987). Successful adolescent readers “increase their reading fluency and adjust their reading speed according to their reasons for reading” (Moore et al., 1999, p. 3). Thus, proficient reading involves a “constant, ongoing adaptation of many cognitive processes” (NRP, 2000, p. 4-7), where readers continually “adapt, adjust, modify, and test until they construct meaning and the problem is solved” (NRP, p. 4-47). Researchers know that good readers:

- Are active readers.
- Have clear goals in mind for their reading from the outset. They constantly evaluate whether the text, and their reading of it, is meeting their goals.
- Look over the text before they read, noting structure and text sections that might be most relevant to their reading goals.
- Frequently make predictions as they read about what is to come.
- Read selectively, continually making decisions about their reading.
- Construct, revise, and question the meaning they make as they read.
- Try to determine the meaning of unfamiliar words and concepts in the text.
- Draw from, compare, and integrate prior knowledge with text material.
• Monitor their understanding, making adjustments as necessary.
• Evaluate text quality and value, and intellectually and emotionally react to it.
• Read different kinds of texts differently.
• Attend closely to the setting and characters when reading narrative.
• Construct and revise summaries of what they have read.
• Use multiple strategies constantly (Duke & Pearson, 2002).

Gender

Gender plays a role in reading comprehension, where female students tend to excel (Donahue et al., 1999; NCES, 2000, 2001; Pomplun & Sundbye, 1999; Wirt et al., 2004). The NCES (2001) reported that the reading scale score was higher for females (269) than for males (258). In Florida males scored 251, while females scored 263, 12 points higher on reading achievement or 4.8% better (NCES, 2003). In Florida, 39% of eighth grade males, compared to 26% of females, scored below the basic level of reading achievement, indicating that students did not demonstrate mastery of prerequisite knowledge and skills necessary for grade-level work (NCES, 2003).

Further, academic resilience, the ability to improve a downward spiral of academic achievement through the course of schooling, is related to gender. Cappella and Weinstein (2001) studied 1,362 “at-risk” students in the National Educational Longitudinal Study of 1988 to determine predictive factors associated with high school students’ academic resilience. They found that being Caucasian and female, possessing an internal locus of control, coming from a family with a high socioeconomic status (SES), and enrolling in academic curriculum predicted academic resilience.
Age / Grade Level

Metacognitive ability and strategic learning are related to age and reading experience (Stewart & Tei, 1983). Learning is cyclical: the more a student knows, the more he or she can learn (McKenna & Robinson, 2002). Thus, the student’s age and volume of experiences related to the reading content affect the student’s ability to make connections and develop relationships between existing and new knowledge. Reading ability typically increases with age and accumulation of life experiences from which to draw upon in activating prior knowledge (McKenna & Robinson; Vacca, 2002). Studying 268 college students about knowledge domains using the Nelson-Denny Reading Test, Stanovich and Cunningham (1993) concluded that differences in exposure to information are significant contributors to differences in knowledge.

Ethnicity

Ethnicity plays a role in reading achievement among American high school students (Desimone, 1999). Pungello, Kupersmidt, Burchinal, and Patterson (1996) found that “multiplicative and cumulative risk factor models suggest that both low family income and minority ethnic status are important predictors of children’s academic achievement” (p. 762). Maruyama (2003) suggested that “at all levels, achievements and attainments of . . . students of color are substantially lower than levels of their peers” (p. 654). Craig, Connor, and Washington (2003) posited that “African American students are at high risk for reading failure” (p. 31). According to the National Assessment of Educational Progress, fourth grade African American and Hispanic students were more likely to read below the basic level than white students, 63% and 58% versus 27%, respectively (Donahue, Finnegan, Lutkus, Allen, & Campbell, 2001). Further, research
indicates that the gap in achievement between black and white students widens as students progress through school (Phillips, Crouse, & Ralph, 1998).

Regarding overall educational achievement, Demack, Drew, and Grimsley (2000) found that ethnicity differences produced larger difference than did gender. According to Taylor, Casten, Flickinger, Roberts, and Fulmore (1994), when 164 African American students in the Northeast felt discrimination, they tended to place less importance on academic achievement and engage less in their schoolwork.

**Socioeconomic Status**

Because students learn literacy and reading at home as well as in school (Duke & Purcell-Gates, 2003), SES of students plays a role in reading achievement (Desimone, 1999). Maruyama (2003) suggested that “at all levels, achievements and attainments of poor students . . . are substantially lower than levels of their peers” (p. 654). In a longitudinal study of 80,000 youth in England, Demack et al. (2000) found that SES had a more profound effect on overall educational achievement than either ethnicity or gender. Following students from seven months of age to 10 years, Walker, Greenwood, Hart, and Carta (1994) found that children from low-SES homes scored lower on standardized reading tests because they “were exposed less often than higher-SES children to diverse vocabulary through their parents’ attention and talking” (p.606).

Regarding reading, Denton and West (2002) found that half as many first grade students from poor families were proficient in understanding words in context than students from more affluent families. The 1998 National Assessment of Educational Progress (Donahue et al., 1999) found that over twice as many eighth and twelfth grade students qualifying for free or reduced lunches performed below the basic level than students without lunch subsidies (eighth grade, 44% versus 19%; twelfth grade, 43%
versus 20%). Pungello, Kupersmidt, Burchinal, and Patterson (1996) found that “multiplicative and cumulative risk factor models suggest that both low family income and minority ethnic status are important predictors of children’s academic achievement” (p. 762). They found that students from lower-SES homes experienced lower standardized reading scores than students from higher-SES homes.

**Reading Ability**

Constructing meaning from texts requires reading ability and an intellectual response from students (Vacca & Vacca, 2002). Students with deficiencies in the basic reading abilities (i.e., phonics and fluency) may experience difficulty with more advanced outcomes of reading, such as comprehension. Word-by-word reading hinders comprehension, thus poor readers toil with lessons about words, sounds, and letters, while good readers engage in lessons emphasizing meaning-making from text (Allington, 1983). Poor readers have difficulty comprehending, organizing, developing relationships, and remembering what they read (Beach, 1996), especially from different kinds of text. Poor readers often lack enough background knowledge in both the content and reading strategy use to apply appropriate reading strategies. Struggling readers “lack not only the cognitive confidence they need to succeed, they lack the emotional confidence to believe they can be successful and the social confidence to join a community of readers” (Beers, 2003, p. 4).

Students’ effort and ability to navigate texts while reading must be analyzed in order to better understand their reading capabilities (Duke & Pearson, 2002). A student’s reading ability is difficult to ascertain and measure (McKenna & Robinson, 2002) and may vary depending upon the type of text the student is reading. At best, many reading ability scales are general, progressive, and relative to a student’s grade level.
Brozo (1990) ascertained that many struggling secondary readers bring to the classroom “a long history of failure and, likely, a repertoire of strategies to avoid reading” (p. 327). Observations of high school classrooms and interviews with struggling readers suggest that poor readers develop coping strategies for hiding from reading, such as avoiding eye contact with the teacher, becoming disruptive, developing listening skills to offset reading deficiencies, relying on classmates for help, “forgetting” to bring texts to class, and using manipulative techniques for gaining favor with teachers (Brozo).

**Interest**

Students with natural curiosity and desire to learn may be more inclined to become actively engaged in texts as a source of satisfying their intellectual curiosity (D’Arcangelo, 2002; Hurst, 2001; Snow, 2002). Students who are curious ask questions and make judgments about the text, inferring about the author’s motives, ideas, and expected outcomes from the text. Self-initiated questioning improves reading comprehension (Duke & Pearson, 2002). Researchers have indicated a positive relationship between reader interest and comprehension (Asher, 1980; Baldwin, Peleg-Bruckner, & McClintock, 1985; Wigfield & Asher, 1984; Wilhelm, 2001), whereby students comprehend material better if it concerns topics that they like to read about. Baldwin et al. found student interest, especially among males, was a significant factor in reading comprehension, even when prior knowledge of the topic was low.

**Prior Knowledge**

Before a student can think about new content, they must consider what they already know in order to organize new information and make connections between the new and old knowledge (Collins, 1994; D’Arcangelo, 2002; Forget & Bottoms, 2000; Friend, 2001; Rhoder, 2002; Snow, 2002). Prior knowledge depends on the reader’s background,
experience, and word knowledge from a variety of reading sources (Bryant et al., 1999; Cibrowski, 1995; Snow). “Readers use background experiences and prior knowledge to construct meaning from text” (Alvermann, 1989, p. 142).

In a study of 211 sixth graders enrolled in science, 75 high school biology students, and 35 elementary education undergraduates in Texas, Alexander and Kulikowich (1991) found that a reader’s background knowledge, both of the content and strategies, and reasoning ability affected reading comprehension. Discussing the problems associated with teaching counter-intuitive scientific concepts, Hynd (1991) submitted that students have difficulty overcoming preconceived notions of experienced science concepts. Basically, “students seem to have a difficult time giving up their intuitive ideas even after instruction” (p. 597).

**Prior Reading Experiences**

Prior reading experiences play a role in reading performance (Snow, 2002). Students’ self-concept is impacted by past reading performances (Stanovich, 1986) and forged by peers’ value of reading (Readence et al., 1989). Students with successful prior reading experiences know, even subconsciously, how to rectify reading failures and employ these strategies on a regular basis (Snow). Students without these successful reading experiences lack an understanding of how to remedy failures in phonics, fluency, vocabulary, and comprehension.

Reading skills may be affected by the amount of reading practice and the type of learning to read instruction that a student has experienced (Snow, 2002). Practiced readers in many different forms of text and for many different reading purposes may be better able to comprehend technical and content area texts. The type of learning to read instruction plays a role in a student’s reading abilities. Secondary students who enter the
classroom with the basic strategies in phonics and fluency can be taught vocabulary and comprehension in the subject area.

**Activity**

Fundamental to any reading is the derivation of meaning from text (Collins, 1994). The content of meaning is “influenced by the text and by the reader’s prior knowledge and experience that are brought to bear on it” (NRP, 2000, p. 4-5). The knowledge gained from reading enables the reader to “make meanings of the text, to form memory representations of these meanings, and to use them to communicate information with others about what was read” (NRP, p. 4-5). In order to read critically, readers should draw inferences, analyze lines of reasoning, apply logic, weigh evidence, evaluate language, and relate different readings to each other (Moore, 2003). Considerable practice is necessary for a student to acquire fluency and comprehension (Snow, 2002).

Readers read for knowledge, application, and engagement (Snow, 2002). Reading assignments should be “challenging, but not frustrating” (Readence et al., 1989, p. 26). Classrooms should be print-rich and teachers should support student reading (McKenna & Robinson, 2002). In order to be supportive of reading, Duke and Pearson (2002) proposed that students be afforded quality time for reading, read real texts with real purposes, read a variety of texts, discuss words and their concepts and meanings, write texts for other audiences, and engage in quality discussion about written materials.

**Reading in the three microperiods**

Reading involves the interplay of three micro-periods—pre-reading, reading, and post-reading—that constitute microdevelopmental processes (Snow, 2002). During each of these periods, the reader develops and is developed by his or her application of previous knowledge, reading skills, and comprehension. Reading also has a
macrodevelopmental aspect (Snow). A reader’s purpose, questions, and engagement in reading may change throughout the entire process as they learn from the text, derive benefit from reading, and experience more challenging text.

Three points occur where students can initiate reading strategies: before reading, during reading, and after reading (see Figure 2, Ryder & Graves, 1994). Prior to reading, students can circumvent habits that inhibit comprehension, and teachers can provide scaffolding to assist learning with text, such as establishing purpose for reading, activating prior knowledge, and developing guiding questions for the reading. Strategic learning during reading involves monitoring reading and making sense of the passages. During reading, readers should question the author’s meaning of the passage, his or her intent, and challenge the author’s point of view. After reading, students can extend and elaborate on the author’s ideas. Here students share their ideas about the reading through discussion, writing, or other means of expression.

Figure 2-2. Strategies of Proficient Readers (Ryder & Graves, 1994, p. 175).
**Reading Strategies**

Instruction of individual reading strategies has been shown to have a positive effect on reading comprehension and motivation to read (Autrey, 1999; Black, 1995; Cariedo & Alosno-Tapia, 1995; Cooper, 1998; Druitt, 2002; Ferguson, 2001; Guthrie et al., 1995; Jackson & Cunningham, 1994-95; Kuehl, 2002; Laflamme, 1998; Leinhart, Zigmond, & Cooley, 1981; Little, 1999; Lynch, 2002; Mastropieri, Scruggs, & Graetz, 2003; Meyer & Poon, 2001; Moody, 1993; Rush, 2000; Shimizu, 1996; Simmonds, 1992; Ward-Washington, 2002). “Because meaning does not exist in text, but rather must be actively constructed, instruction in how to employ strategies is necessary to improve comprehension” (Snow, 2002, p. 32). Teaching reading strategies should be incorporated with content area instruction so students can understand the importance and application of strategies to learning (Pressley, Symons, McGoldrick, & Snyder, 1995; Rhoder, 2002). Teaching reading strategies improves awareness and use of strategies, as well as motivation to read (NRP, 2000).

**Reading Strategy Instruction**

Comprehension strategies are “procedures that guide students as they attempt to read and write” (NRP, 2000, p. 4-40). They are “procedural, purposeful, effortful, willful, essential, and facilitative in nature” (Jetton & Alexander, 2001, ¶ 17). “Strategy instruction is not blind, but informed by theory and research” (Vacca, 2002, p. 194). Highlighting a set of instructional strategies called Reading Apprentice, Schoenbach et al. (2003) suggested that effective strategies focus on “how we read and why we read in the ways we do” (p. 134).

Students who are not explicitly taught reading strategies are unlikely to learn, develop, and employ strategies spontaneously (NRP, 2000). Reading strategy instruction
requires a shift from didactic instruction to one that is more student-centered (Sinatra, 2000). The explicitness of strategy instruction has an effect on student comprehension, especially for low-achieving students (Snow, 2002). “Explicit instruction provides a clear explanation of the criterion task, encourages students to pay attention, activates prior knowledge, breaks the task into small steps, provides sufficient practice at every step, and incorporates teacher feedback” (p. 33).

Researchers (Bryant et al., 1999; Duke & Pearson, 2002; NRP, 2000) have proposed several models of strategy instruction. Bryant et al. outlined considerations to effective strategy instruction:

- provide explicit instruction to promote the acquisition and mastery of reading strategies; provide advance organizers in outline form, so students can examine the structure of the lesson’s content; model how to comprehend text and figure out the meaning of new words; prompt students to use reading strategies; provide daily and sustained instruction; require strategy mastery; help students learn when, where, and how to apply reading strategies to content-area text; have students practice strategies with a variety of materials; and recognize that strategy instruction is part of the total school curriculum and is applicable across content-area classes (p. 296).

In a meta-analysis of reading comprehension strategies, the NRP (2000) found eight strategies to be research-based. These comprehension strategies improve student recall, question answering and generation, and summarization of texts. They also show general gains on standardized comprehension tests. The eight strategies are:

- Comprehension monitoring in which the reader learns how to be aware or conscious of his or her understanding during reading and learns procedures to deal with problems in understanding as they arise.

- Cooperative learning in which readers work together to learn strategies in the context of reading.

- Graphic and semantic organizers that allow the reader to represent graphically (write or draw) the meanings and relationships of the ideas that underlie the words in the text.
• Story structure from which the reader learns to ask and answer who, what, where, when, and why questions about the plot and, in some cases, maps out the timeline, characters, and events in stories.

• Question answering in which the reader answers questions posed by the teacher and is given feedback on the correctness.

• Question generation in which the readers ask what, when, where, why, what will happen, how, and who questions.

• Summarization in which the reader attempts to identify and write the main or most important ideas that integrate or unite the other ideas or meanings of the text into a coherent whole.

• Multiple-strategy teaching in which the reader uses several of the procedures in interaction with the teacher over the text. Multiple-strategy teaching is effective when the procedures are used flexibly and appropriately by the reader or the teacher in naturalistic contexts (p. 4-6).

Ramos (1996) with 15 third- and fifth-grade students, Wolters (1997) with 379 junior high school students, Hess (1997) with 106 college students, Yu (1997) with 86 middle and high school students, Lenhart (1994) with 22 third grade students and 38 sixth grade students, and Ward-Washington (2002) with 81 eleventh-grade social studies students determined that reading strategy knowledge was the best predictor of reading achievement. Studying the effectiveness of metacognitive strategy instruction with 152 white and Hispanic, lower-middle-class Arizona sixth-grade students using a nonequivalent pretest-posttest control group design, Tregaskes and Daines (1989) concluded that students instructed with comprehension strategies increased their reading comprehension over the control. Walkovic (2004) studied eighth graders and found that student reported use of reading strategies accounted for 45% of the variance on the eighth-grade Pennsylvania System of School Assessment reading test.

Reading strategy instruction provides significant gains (Mothus, 2004; Simmonds, 1992), even for higher reading level students (Ferguson, 2001). Evaluating strategy
intervention to increase 98 eighth grade students’ comprehension, Mothus found that students participating in the intervention increased comprehension achievement scores more than one grade level, significantly more than the control. Further, significant predictors of school failure included reading comprehension. Studying 24 New York resource room teachers and their use of reading strategies, Simmonds determined that reading strategy instruction improved comprehension by nearly two standard deviations among 240 resource room students in grades one through nine. In determining the effect of metacognitive strategy instruction on 20 sixth-grade social studies students’ content area reading comprehension, Ferguson found significant differences in the effectiveness of metacognitive strategy instruction on comprehension for high-level readers, as well as low- and average-level readers.

Investigating the effectiveness of teaching different strategies for identifying important concepts in content area reading through two different studies, Carriedo and Alonso-Tapia (1995) explored strategy use with thirty-one 11- and 12-year-olds and one hundred-four 11- through 14-year-olds. Carriedo and Alonso-Tapia concluded that the measures for which training was directed garnered significant improvement, including knowledge of the topic and main idea characteristics, graphical representation of relations among text ideas, knowledge of text structures, and summarizing. In the second study with 11- through 14-year-olds, under direct instruction students perceived the main idea and topic of passages better than students without instruction. Additionally, directly instructed students were more aware of cognitive processes, more ably represent text structure, and developed higher metacognitive knowledge than students without direct instruction in reading strategies.
Attitude, confidence, and self-efficacy affect content area reading strategy use (Black, 1995; Kuehl, 2002). Examining strategies employed to accommodate for comprehension, Moran (1998) determined that motivators included self-efficacy, interest, commitment to the task, and overall confidence. Evaluating the effects of the C*A*C*T*U*S instructional model with post-secondary students, Simpson (1998) found that students utilized the strategy and began to increase their positive feelings toward their ability to succeed.

**Goals of Reading Strategy Instruction**

The goal of strategy instruction should be to enable students to select appropriate strategies, adapt them to particular texts, employ them to solve reading problems (Pressley, Johnson, Symons, McGoldrick, & Kurita, 1989; Wilhelm, 2001), and have them independently initiated by the student (Ellis, 1994; NRP, 2000; Snow, 2002). Factors concerning explicit comprehension strategy instruction and student use include developing purposes for reading, previewing texts, making predictions, activating background knowledge, thinking aloud, using text structure, creating visual representations, determining the important ideas, summarizing, generating questions, monitoring comprehension, modeling strategies, using multiple strategies, developing motivation to read, and guided and independent practicing of strategies (Duke & Pearson, 2002).

The type of strategy used for a particular text depends upon “the purpose for reading, the characteristics of the reader, and the characteristics of the text” (Ryder & Graves, 1994, p. 177). Students should have a choice of many reading strategies that are best suited for the specific text, applications, and student preference (Snow, 2002). Teachers should individualize reading strategies to match the specific needs of the
purpose for reading, the text, the learner, and the products of reading. Strategies should be selected upon the following three criteria: ease of instruction, flexibility, and comprehension monitoring (Palinscar, 1986).

Studying 324 Texas college students about reading goals and comprehension strategy use, Taraban, Rynearson, and Kerr (2000) concluded that reading goals and strategy use reliably discriminated between higher and lower grade-point averages (GPA), as well as ACT scores. The most frequently used strategies were looking for important information ($\mu = 3.40$), changing strategies ($\mu = 3.19$), determining the meaning of unknown words ($\mu = 3.14$), increasing attention ($\mu = 3.09$), and drawing on prior knowledge ($\mu = 3.05$). The higher GPA students used significantly more goals ($\mu = 2.86$) than lower GPA students ($\mu = 2.46$), and they used significantly more strategies ($\mu = 2.52$ versus 2.09, respectively).

Students desire reading strategy instruction. Studying 743 middle school and 1,043 high school students’ views of instructional practices using the Student Textbook Adaptation Evaluation Instrument, Schumm, Vaughn, and Saumell (1992) concluded that students appreciated teacher read-alouds, needed aid in setting purposes for reading and activating background knowledge, and used summaries. They concluded that students were not getting the instructional support for reading comprehension that they needed from teacher, especially high school teachers (also, Self, 1998). Further, even high achieving students desired textbook adaptations and reading strategy instruction.

Multiple Strategy Instruction

Effective reading does not rely upon a single strategy, but incorporates the coordination of several strategies (Baer & Nourie, 1993; Bean, 1997; Bos & Anders, 1992; Bulgren & Scanlon, 1997-98; Meltzer, 2001; Snow, 2002; Pressley & Wharton-
McDonald, 1997; Schoenbach, et al., 2003; Taraban et al., 2000; Vaughn, 2001) and involves the “constant, ongoing adaptation of many cognitive processes” (Williams, 2002, p. 244). Teaching a variety of reading strategies leads to “increased learning of the strategies, to specific transfer of learning, to increased retention and understanding of new passages, and, in some cases, to general improvements in comprehension” (NRP, 2000, p. 4-6).

With Virginia high school students, Morgan and Hosay (1991) determined that teaching a package of reading strategies (including prior knowledge activation, discussion, group learning, prediction, and summary) improved comprehension, led students to read more, bolstered critical reading, increased the variety of texts read, and improved standardized test scores. Similarly, in an ex post facto study of ninth grade students’ reading comprehension levels, Weedman (2003) determined a trend toward higher comprehension scores was generated when teaching students to use a package of four reciprocal teaching strategies.

**Activating Prior Knowledge**

Because prior knowledge and experiences vary from reader to reader, the meaning constructed from texts also varies among readers (Sammons & Davey, 1993-94). Teachers can accommodate for differences in prior reading experiences by appraising student’s existing knowledge of a subject and bringing all students up to a similar level (Pressley et al., 1995; Readence et al., 1989). Comprehension improves when prior knowledge is activated through pre-reading instruction (Cooper, 2000; Gaultney, 1995; Michiels-Bongaerts & Schmidt, 1995; Pate, 1995; Stevens, 1996; Zhu, 1996).

Researchers have posited that many readers do not “automatically relate [new] information to their prior knowledge, even if they have a wealth of knowledge that could
be related” (Pressley, 2001, ¶ 17; Paris & Lindauer, 1976). Activation of prior knowledge is especially recommended for poor readers who may not spontaneously relate their previous experience or knowledge to reading passages (Pressley et al., 1995), yet, teachers are often reluctant to teach pre-reading strategies (McAlloon, 1994).

Prior knowledge must be activated in order for a student to effectively read in content areas or the teacher must provide accurate background knowledge of the specific topic (Boyle & Maloney, 1991; Duke & Pearson, 2002; Gould, 1987; Jacobs, 2002; Knudsen, 2002; NRP, 2000; Pressley et al., 1995; Snider, 1989; Wilson & Anderson, 1986). Activating prior knowledge gives students a head start on learning by challenging them to “(a) think about what they already know about a subject, (b) acquire a general understanding of how the big ideas will fit together, and (c) increase their confidence and motivation to read more” (Cibrowski, 1995, p. 94). The goals of activating prior knowledge include facilitating learning, defining goals and objectives, directing attention, arousing curiosity, activating and extending prior knowledge, drawing on students’ existing knowledge, filling in gaps in students’ knowledge, clarifying misconceptions, identifying and presenting essential concepts and information, previewing vocabulary, and engaging critical thinking (Ryder & Graves).

McKeown, Beck, Sinatra, and Loxterman (1992) studied 48 fifth grade students and found that background knowledge was useful, especially when texts are coherent enough to “allow the reader to see the connections between the text information and previous knowledge so that the knowledge can be combined with the text information to create a meaningful representation” (p. 91). Akagawa (1996) determined that students
whose prior background knowledge was activated scored significantly better on recall, comprehension, and vocabulary tasks than students in control conditions.

Sometimes activating background knowledge is counterproductive to comprehension, especially when prior knowledge contradicts the text (Stevens, 1996). Studying 52 sixth grade students’ activation of background knowledge, Alvermann, Smith, and Readence (1985) determined that in some instances prior knowledge may interfere with reading comprehension instead of augmenting it, such as when students allowed their prior experiences and background knowledge to override conflicting information derived from text. Studying 62 undergraduate non-science majors, Alvermann and Hynd (1989) determined that activating background knowledge about unfamiliar topics was not beneficial to dispelling inaccurate information, because students’ inaccurate background knowledge overrode accurate text information. The researchers concluded that teachers should model comprehension of new concepts, especially those that conflict with the reader’s prior experiences or knowledge.

Investigating the use of the K-W-L and reciprocal teaching, Sisco (1992) found that students benefited from using the K-W-L and reciprocal teaching in their ability to execute strategies, in reading comprehension, and in their positive attitude toward reading. Implementing the K-W-L reading strategy in a college course, Fritz (2002) found that the strategy increased the quality and quantity of interactions between students, instructor, and subject matter.

**Setting Purpose**

“Readers need a personally relevant and socially significant purpose” (Wilhelm, 2001, p. 34) when they read. This purpose helps students comprehend textual material (D’Arcangelo, 2002; Snow, 2002). Purpose is influenced by prior knowledge and
interest in the reading subject (Snow). In a qualitative study of eleven under-prepared college freshmen, Verbeck (2003) determined that strategic readers were driven by purposes and goals for reading and possessed a stronger sense of self-efficacy. In order for a student to read critically and become actively engaged in the text, he or she must ask the question, “why” (Moore, 2003). Wilhelm (2001) concluded,

When students are actively taught to more competently read for important real-world purposes, they will be more motivated, they will become more competent, they will willingly converse with authors and others about he knowledge made available through texts, and they will be able to undertake the important kinds of democratic work—intellectual, moral, and physical—that reading, at its very best, can help us to do (p. 34).

**Reading and Thinking Aloud**

Reading or thinking aloud allows students to “see” the comprehension processes that engaged readers activate in order to understand text (Ivey & Broaddus, 2001; Schoenbach, Braunger, Greenleaf, & Litman, 2003). Modeling reading comprehension, a teacher can verbalize his or her thinking processes that are needed to overcome difficult words, monitor comprehension, and apply fix-up strategies. Think along is “an oral or written representation of a reader’s process of constructing meaning from, or in reaction to, text” (Ehlinger & Pritchard, 1994, p. 188).

Surveying 1,765 sixth-grade students in the mid-Atlantic and northeastern United States, Ivey and Broaddus (2001) determined that students valued teacher read-alouds (62% of students). Ivey and Broaddus concluded, “high-engagement reading…would include time to read, time to listen to teachers read, and access to personally interesting materials” (p. 370). Studying the cultural reading and motivations to read among 626
undergraduate students, Pavonetti (1997) concluded teachers who read aloud were the most positive motivational force in encouraging a student to read. In describing a lesson for ninth-grade science students, Richardson and Smith (1996-97) provided anecdotal evidence that students enjoyed read-alouds, even in an advanced science class.

Investigating the effect of think aloud statements on recall and comprehension scores of 72 fifth grade students, Younger (1995) found that poor readers benefited from read alouds more than good readers. Studying the effects of context and reading aloud on seventh grade students’ reading comprehension of expository text, Kucan (1998) concluded no differences on recall and questions answered, but transcripts of students’ talk indicated context-related processing differences. Specifically, individuals engaged in more paraphrasing, restating, and summarizing, while group members participated in more questioning, inferring, and exploring possibilities. Studying high school English language learners, Vega (2001) found that think-alouds allowed students to become active participants in monitoring reading comprehension, make learning more relevant, and help students take risks.

**Organizing Information**

Graphic organizers provide students with a meaningful and visual framework for taking notes, understanding relationships between concepts, and organizing ideas (Black, 1995; DiCecco & Gleason, 2002; Fisher, 2001; Ives, 2003; Kim, Vaughn, Wanzek, & Wei, 2004; Moore & Readence, 1984). They include semantic maps, semantic feature analysis, cognitive maps, story maps, framed outlines, and Venn diagrams. The foundation of graphic organizers is that the “visual and verbal organizational structure of the diagram consolidates information into a meaningful whole so students do not have the
impression that they are being taught a series of unrelated terms, facts, or concepts” (Horton, Lovitt, & Bergerud, 1990, p. 13).

Reading guides enhance a student’s comprehension (Alvermann & Swafford, 1989; Davis, Franks, & Franks, 2001; McKenna & Davis, 2002; Miller & George, 1992; Vidal-Abarca & Gilabert, 1995; Wood, Lapp, & Flood, 1992). They help students focus their attention on the specific purpose for reading (McKenna & Robinson, 2002). Guides also make the reading process active rather than passive. Students translate information gleaned from reading into their own language. Reading guides integrate reading and writing and provide a useful tool for review and aid for classroom discussion. Reading guides could include hierarchical guides, cluster guides, nonhierarchical guides, selective guides, point-of-view guides, and anticipation guides.

In a synthesis of research on graphic organizers, Moore and Readence (1984) determined an average effect size of 0.22, with a standard deviation of 0.58. Thus, learners treated with graphic organizers outperformed control groups by about two-tenths of a standard deviation. Moore and Readence concluded that graphic organizers produce little added learning, but the results may vary widely. However, graphic post organizers, those organizers presented after text seem to produce the most learning benefit, with a medium average effect size of 0.57 (SE = 0.17). Further, graphic organizers produced larger effect sizes when concerned with vocabulary as the outcome (μ = 0.68, SE = 0.19) and a smaller effect size when comprehension was concerned (μ = 0.29, SE = 0.06). Graphic organizers in secondary classes produced small effect sizes (μ = 0.14, SE = 0.05) and larger effect sizes for college students (μ = 0.66, SE = 0.16). Additionally, in the qualitative portion of the review, Moore and Readence found that teachers felt more
confident and better organized when presenting lessons using graphic organizers. They also noted that students felt that graphic organizers were not part of the flow of lessons, but rather an additional exercise; thus, in order to increase effectiveness, teachers should explain the reasoning behind graphic organizers and model their use.

Reviewing research related to the use of graphic organizers when comprehending and recalling expository text information, Griffin and Tulbert (1995) concluded that graphic organizers are most effective when used with expository text, as a postreading activity, and when used with vocabulary. Graphic post organizers are most effective when used with summarization, when modeled by the teacher, and students are provided guided practice and feedback on their organizers.

Conducting two experiments with graphic organizers and 153 undergraduate educational psychology students, Robinson and Kiewra (1995) concluded that students learned more hierarchical and coordinate relations, thus were more successful in applying knowledge and writing essays than if using outlines or text alone. In the first experiment with 111 students, the researchers found that students studying only text learned more nonrepresented facts ($\mu = 8.27$) than students using graphic organizers ($\mu = 6.92$), but the main effect for represented facts was not significant. Students using graphic organizers did learn significantly more ($F(1, 105) = 4.93$) relational information ($\mu = 3.35$) than students studying text only ($\mu = 1.65$). Thus, students using graphic organizers learned more relational knowledge than students studying text only. In the second experiment with 42 students, they determined that students did not differ on nonrepresented facts, but did differ on represented facts ($F(2, 39) = 7.44, MSE = 6.51$). Students using graphic organizers learned more represented information than students studying text alone.
Investigating the effect of graphic organizers on 427 ninth-grade students’ social studies achievement, Herbst (1996) found that using SQ3R with graphic organizers was the most effective learning strategy. Reviewing literature on graphic organizers, Monroe (1997) determined that using graphic organizers helped develop conceptual understanding through student engagement, helped make connections among concepts and words, and served as retrieval cues for existing schema. Investigating the effects of organizers with complete, partial, and skeletal information with 117 undergraduate students, Katayama (1998) found no significant differences between graphic organizers and traditional outlines on factual tests; however, students using graphic organizers performed significantly better on transfer tests than students using outlines. Sampling 38 second-grade students, Millet (2000) found that student comprehension improved when using graphic organizers.

Studying 26 Oregon middle school students with learning disabilities, DiCecco and Gleason (2002) found that students using graphic organizers provided significantly more relational statements and gained more relational knowledge from expository texts than students who did not use graphic organizers, with the positive effect of graphic organizers being “nearly universal” (p. 317). Further, students benefited from longer treatment with “more intensive and more explicitly aligned” (p. 317) instruction than in previous studies. DiCecco and Gleason concluded that teachers must model the use of graphic organizers with text relevant to the content area and provide guided practice for students. Additionally, instruction in summary writing may assist students in gaining relational and factual knowledge about concepts. DiCecco and Gleason suggested further research dealing with graphic organizers and domain knowledge, treatment periods of longer than
20 days, and ensure proper measurement of the kinds of knowledge (i.e. relational) which graphic organizers can provide.

In a meta-analysis of graphic organizer use among students with learning disabilities, Kang (2002) determined large effect sizes (.76) for graphic organizers when learning concepts from text. Results clearly indicated

(a) graphic organizers used before and after reading facilitated initial and subsequent learning of students with learning disabilities in content areas, (b) graphic organizer interventions produced very large effects (weighted mean effect size = 1.39) when used as substitutes for text materials, and (c) the use of experimenter-constructed graphic organizers for students with learning disabilities was effective in enhancing their learning in content areas (abstract).

However, students did not appear to transfer graphic organizers to other content areas.

In a synthesis of research on graphic organizers, Kim et al. (2004) posited that expository texts are especially challenging because of being information driven, containing unfamiliar vocabulary, and containing poor organization. They concluded that learning disabled students who used graphic organizers “demonstrated significantly higher scores on researcher-developed comprehension measures” (p. 112) than students without graphic organizers. Overall, the student-generated graphic organizers improved student comprehension more than expert-generated organizers. Still, regardless of whether the organizers were student-, teacher-, or expert-generated, the overall effect size was large; however, student-generated organizers garnered the largest effect sizes. Thus, the researchers concluded overall beneficial effects from the use of graphic organizers.

Other researchers (DiCecco & Gleason, 2002; Schorzman, 2001; Twyman, 2004; White, 2000) have found no significant difference when using graphic organizers. In determining the effect of using graphic organizers on reading comprehension of college business students, White found that graphic organizers did not improve reading
comprehension as measured by the Nelson-Denny Reading Test. Examining the effectiveness of the Directed Reading-Thinking Activity, the PReP strategy, and graphic organizers for reading comprehension with 103 sixth grade students, Schorzman found a significant difference between experimental and control groups in informal evaluations of comprehension but found no significant difference on formal evaluations. DiCecco & Gleason determined graphic organizers did not seem to assist students in recalling factual information. Concerning seventh grade students’ use of graphic organizers, Twyman (2004) revealed no statistical difference between groups on content vocabulary and content acquisition. However, when solving problems, students using graphic organizers performed statistically better than students without graphic organizers.

**Summarizing**

Summarization of text content is an effective means of improving students’ comprehension (Black, 1995; Friend, 1995; Guthrie et al., 1995; Hare & Borchardt, 1984). Investigating summarization with college students, Friend determined that students instructed in summarization strategies performed significantly better at including relevant, important ideas in the summary.

Several factors, including background knowledge, feedback, and the types of questions driving the summary, affect the quality of a student’s summary. Working with college students and the relationship between prior knowledge and summary writing, Kiewit (1997) concluded background knowledge and comprehension were significant predictors of summarization skill. With undergraduates’ proficiency at summarization, Schreiner (2002) concluded that feedback was necessary for improving performance on student summaries. Kaspar (1998) determined that generating and answering “why”
questions may facilitate the integration of novel information into summaries and aid in activation of prior knowledge.

Outcome Variables

Comprehension

Understanding text material is an outcome of reading in content areas. Comprehension instruction “promotes the ability to learn from text” (Snow, 2002, p. 29) and involves the “ability to activate one’s prior knowledge about a topic, self-question, identify main ideas and supporting details, paraphrase, and summarize” (Bryant et al., 1999, p. 296). Reading comprehension can be improved by teaching students to use specific cognitive strategies or to reason through barriers to comprehension when reading (NRP, 2000). Comprehension is built upon three principles: 1) the student’s prior knowledge; 2) the level of understanding to be achieved; and 3) the organization of information to aid long-term retention” (Readence et al., 1989, p. 123).

Improving content area reading with vital, relevant subject matter and strategy instruction translates into improvement in content area learning (Jones, 2001). Students’ abilities to read and learn vary greatly, thus teachers who employ and instruct students on appropriate reading strategies enable students to be more successful in their reading experiences (Fielding & Pearson, 1994).

Motivation

Instructing students how to use reading strategies to solve comprehension problems also affects their motivation to read (Choochom, 1995; Guthrie, 2001; Guthrie & Alao, 1997; Hurst, 2004; Knoll, 2000). In an overview of engagement and motivation for reading, Guthrie proposed that:
Engaged reading is a merger of motivation and thoughtfulness. Engaged readers seek to understand; they enjoy learning and they believe in their reading abilities. They are mastery oriented, intrinsically motivated, and have self-efficacy (¶ 1).

As a student becomes more engaged in reading, then he or she may take more ownership of reading, thus improving motivation (Snow, 2002). Factors affecting motivation include expectancy (certainty, time, and desirability) and incentives (material, symbolic, and psychological). “Because reading is an ongoing process rather than a discrete act, the initial decision to read becomes a decision to continue reading once the process begins” (McKenna, Kear, & Ellsworth, 1995, p. 938).

Guthrie and Alao (1997) proposed that a challenge to secondary educators is motivating students to read, because motivation to read for pleasure declines with age in some students. The researchers determined that students spend little free time reading on a daily basis, as little five minutes per day, and few students (about 10%) read for 30 minutes or more per day. However, Guthrie and Alao posited that less successful students lose their motivation to read because of unsuccessful reading episodes and lack of confidence.

In a national survey of 18,185 first- through sixth-grade students about their attitudes toward reading, McKenna et al. (1995) made two propositions: attitude affects reading ability, especially engagement and practice, and poor attitudes lead to aliteracy, or the choice not to read when given the opportunity. The researchers found that in general, “attitude toward reading both as a pastime and as a school-related undertaking was observed to grow increasingly negative as students passed from first to sixth grade” (p. 945). Also, this increasingly negative attitude is “clearly related to ability, and the trend is most rapid for least able readers. The attitudinal gap among ability levels widens
with age” (p. 952). Girls possessed significantly more positive attitudes toward recreational and academic reading than boys.

Concerning adolescents’ attitudes toward reading, Bean (2001) cited two themes: 1) a “steady decline in positive attitude toward reading by the middle grades,” and 2) the “strongest declines among less able readers” (¶ 14). He attributed this decline in attitude toward reading to “dull textbooks, a view of reading as work, and tracking” (Bean, ¶ 14), while discussions, journaling, book clubs, and field trips related to content improve motivation to read in the content area.

Motivation’s Impact on Strategy Use and Comprehension

The student’s motivation level impacts whether and how a student will use comprehension strategies (Choochom, 1995; Dole, Brown, & Trathen, 1996; Guthrie et al., 1996; Knoll, 2000; Pressley et al., 1995). Exploring the relationship between motivation and reading comprehension in 55 tenth grade students, Knoll found a correlation (0.73) between motivation and reading comprehension to indicate a strong relationship between the two. Examining the effect of motivational orientation and strategy use with 90 students in the seventh-, eighth-, and ninth-grades, Choochom concluded that intrinsically motivated students employed more strategies, exhibited greater frequency of self-regulation, and comprehended more from text.

High interest in the particular reading topic leads to high motivation, which leads to high comprehension (Hurst, 2004; Snow, 2002). In a qualitative study of three ‘at-risk’ ninth grade students, Hurst determined that motivation to read informational text depends on interesting materials, connections to the student’s life, and student self-selection of texts. Using qualitative interviews of 14 college students, Van Zile-Tamsen (1996) found that interest in the content motivated students to engage in self-regulation and strategy
use. Attitudes toward reading may be situational, yet it is “safe to assume . . . that individuals also possess a global attitude toward reading (McKenna et al., 1995, p. 934).

Qualitatively studying six middle school at-risk readers’ attitudes and perceptions of their own reading abilities, Cuevas (2003) concluded that attitude had little influence on reading engagement, though students with more positive attitudes earned higher grades in school. However, reading performance and attitude varied depending on the type and purpose of material being read. Still, all five students expressed a desire to improve their reading skills.

Motivation to read may be assessed through a variety of instruments including the Index of Engagement in Reading (Guthrie & Davis, 2004), the Motivations for Reading Questionnaire (Wigfield & Guthrie, 1997, 2004), Motivation to Read Profile (Gambrell, 1996), and the Estes Attitude Scale (Estes, 1971; Miller, 2002), among others.

Florida Comprehensive Assessment Test (FCAT) and Standardized Testing

In 2004, for the first time in the state’s history, more than half of Florida’s grades three through 10 students who took the FCAT were reading at or above grade level (FDOE, 2001, 2004a). Florida students showed improvement at every grade level, except grades eight and 10, where the number of students reading below grade level increased from 62% in 2001 to 66% in 2004, the highest level in four years (FDOE, 2004b, 2004c).

Summary

The primary purpose of this study was to determine the effects of implementing reading strategies on students’ reading comprehension and motivation to read. This chapter reviewed literature related to reading in content areas with the outcomes of comprehension and motivation to read. This chapter was divided into the following major sections: philosophical theories of reading, an explanation of variables involved in
this study, and the influence of reading strategy instruction on reading comprehension and motivation to read. The chapter focused on literature describing theories of reading, and empirical research related to the sociocultural context of reading, teacher characteristics, reader attributes, content area reading strategy instruction, the activity of reading, reading comprehension and motivation to read. Research related to content area reading comprehension instruction, reading strategy use, factors associated with comprehension, and influences on the motivation to read was included in this chapter.

The independent variables in this study were reading strategy instruction, specifically strategy use in the three microperiods of reading versus the teacher’s normal routine of instruction; total content area reading strategies employed; and instructional time. The dependent variables in this study were motivation to read and agricultural concept knowledge. The antecedent variables were gender, grade level, ethnicity, and socioeconomic status. GPA, FCAT reading levels, agricultural comprehension pre-test scores, and motivation to read pre-test scores were treated as covariates. The following chapter describes the specific methodology employed in the study.
CHAPTER 3
METHODS

Introduction

Chapter 1 described the need for research in agriscience on the effect of reading strategies on students’ comprehension of agricultural concepts and motivation to read. Chapter 1 also provided background about secondary reading, content area reading, and agriscience. Definitions of key terms related to reading in agriscience and reading strategy instruction were provided. Chapter 1 also identified the purposes and explained the significance of the study. The primary purpose of this study was to determine the effects of implementing a package of content area reading strategies that focuses on the three micro-periods of reading on students’ knowledge of agricultural concepts and motivation to read.

Chapter 2 presented a discussion of theories of reading and research related to reading comprehension, motivation to read, strategy instruction, and variables influencing student reading. Variables discussed included the reading strategy instruction, reading ability, prior reading experiences, and gender.

Chapter 3 explains the methods employed to accomplish the objectives and test the hypotheses of this study. The objectives of this study included

1. Describe the grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students participating in this study.

2. Describe the variance in agriculture post-test score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.
3. Describe the variance in motivation to read post-test score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.

4. Describe the variance in agricultural comprehension scores explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.

For this study, research hypotheses included:

\[ H_a^1 \]: Comprehension of agricultural concepts will be significantly greater for secondary agriscience students using reading strategies versus those students using the teacher’s traditional routine in agriscience classes.

\[ H_a^2 \]: Motivation to read will be significantly greater for secondary agriscience students using reading strategies versus those students using the teacher’s traditional routine in agriscience classes.

Questions leading the qualitative inquiry included:

1. How do agriculture teachers perceive their role in assisting students in developing reading comprehension skills in agriscience?

2. What are teacher’s reactions to implementing the content area reading strategies in agriscience? How effective are these efforts?

3. How do agriscience teachers model good literacy?

4. What strategies are effective in assisting agriscience teachers in implementing content area reading strategies?

5. What are the barriers to reading instruction in agriscience?

Chapter 3 specifically targets the research design, population, student sample, instrumentation, treatment, data collection procedures, and statistical analyses used in analyzing the data. The independent variables in this study were reading strategy instruction, specifically strategy use in the three microperiods of reading versus the teacher’s normal routine of instruction. Outlining the status of reading comprehension instruction, Pressley (2001) supposed that if different types of instruction improve comprehension, “it just might be sensible to do all of them” (¶ 1). The dependent variables in this study were motivation to read and agricultural concept knowledge. The
antecedent variables were gender, grade level, ethnicity, and socioeconomic status. GPA, FCAT reading levels, agricultural pre-test scores, and motivation to read pre-test scores were treated as covariates.

**Research Design**

Pressley (2003) proposed, “there are many reading instructional interventions that enjoy some support in true experiments” (p. 66). Unfortunately, because of the nature of this study, a true experiment was not possible. Thus, this study utilized a quasi-experimental design, specifically a variation of the nonequivalent control group design (Campbell & Stanley, 1963) with a pretest and a posttest. True random sampling of students and assignment to treatment and control groups was not possible. Therefore, using intact groups, or classes, of students follows other researchers’ work (Ary, Jacobs, & Razavieh, 2002; Campbell & Stanley; Gall, Gall, & Borg, 2003) recommendations for quasi-experimental research.

Gall et al. (2003) asserted that nonequivalent control group designs might involve groups that all receive a treatment. Thus, the treatments included reading strategy instruction ($X_1$) and the teacher’s normal routine of instruction ($X_2$). The essential features of this type of design were “nonrandom assignment of research participants to groups and administration of a pretest and posttest to all groups,” (p. 403) and random assignment of the treatment to intact groups (classes). The variation of the nonequivalent control group design followed this model:

\[
\begin{align*}
\text{Treatment} & \quad O_1 \quad X_1 \quad O_2 \\
\text{Comparison} & \quad O_1 \quad X_2 \quad O_2
\end{align*}
\]

The first observation ($O_1$) consisted of the Adapted Motivations for Reading Questionnaire (Wigfield & Guthrie, 1997, 2004) and an agricultural content knowledge
pretest. These assessments were conducted during the week prior to initiation of the reading strategy instruction while teaching lessons from the Florida Agriscience Foundations Lesson Plan Library (FDOE, 2003).

Upon selection of school sites, the researcher requested eighth-grade FCAT (FDOE, 2001) reading scores, middle school grade point averages, gender, ethnicity, free and reduced lunch data, and documented reading disabilities for participating students enrolled in Agriscience Foundations. Typically, the majority of students enrolled in this course is freshmen. Researchers maintained student confidentiality by asking teachers to provide an identifying code number to correspond to each student regarding FCAT scores, grade point averages, pretest scores, posttest scores, and all other data. All records provided to the researcher were thus coded with numbers, and no student names were provided to the researcher.

One of two treatments was utilized with each group: 1) reading strategy instruction or 2) the teacher’s normal routine of instruction of instruction. The reading strategy instruction served as the experimental treatment (X1), while the teacher’s normal routine of instruction served as the “comparison” treatment (X2) (Wilkinson & Task Force on Statistical Inference, 1999). Additionally, teachers taught the lessons in their traditional routine.

The second observation (O2) occurred at the end of the study, or approximately 20 class days later. It consisted of the Adapted Motivations for Reading Questionnaire (Wigfield & Guthrie, 1997, 2004) and agriculture quizzes for each of the individual lessons. These observations concluded the study.
Threats to internal validity identified by Campbell and Stanley (1963) included history, maturation, testing, instrumentation, regression, selection of subjects, mortality, and the interactions between selection and maturation. Nonequivalent control group designs control for all of the threats except regression and interactions. Regression refers to concerns in determining the effect of treatment on dependent variables when independent variables are known (Vogt, 1999). Regression is a concern when subjects self-select the group to which they participate, especially via extreme scores or a preference for the treatment. In this study, regression was not an issue, because intact classrooms were randomly assigned to the treatment and comparison groups.

The interaction between selection and maturation refers to differences in age and experience between subjects at the time of the experiment. To control for selection-maturation interactions, all students were studied at the same time during the school year with the same curriculum at the same grade level. Additional steps were taken to control for this interaction, including teachers instructing both an experimental and a comparison group and using multiple classroom settings.

Gall et al. (2003) stated that the main threat to internal validity is the possibility of group differences on posttests are due to preexisting differences in the groups, rather than the effects of the treatment. In order to control for this threat, they recommend analyzing covariance. In this study FCAT scores and middle school grade point averages were gathered and analyzed as covariates through ANCOVA and MANCOVA procedures.

For a quasi-experimental design, other factors could influence the outcome of the study and must be controlled. One such factor is the pedagogical prowess of the teacher. To control for teaching ability, all six cooperating teachers were approved as cooperating
teachers for University of Florida student interns and deemed “expert” teachers by the faculty in the Agricultural Education and Communication Department at the University of Florida. Each teacher taught two classes of Agriscience Foundations students. Course content was developed by the FDOE for freshmen classes and, therefore, was appropriate for students of this grade level. Cooperating teachers in the treatment group participated in professional development on reading strategy instruction, and all teachers participated in data collection procedures to ensure proper collection of data and study design (Boone, 1988; Myers, 2004). The unit of instruction was selected from the Agriscience Foundations curriculum (FDOE, 2001). Each treatment was randomly assigned to teachers.

**Procedures**

Researchers (DiCecco & Gleason, 2002; Guthrie, 2001; Pressley, 2001; Pressley & Allington, 1999; Taraban et al., 2000) proposed that reading strategy instruction should be investigated, especially within specific contexts. Pressley and Allington suggested that there is “not yet definitive literature on how to promote development of reading competence through instruction” (p. 17). Taraban et al. suggested that more study is needed to explore the effects of strategy use in specific contexts. These contexts present specific challenges to the researcher, namely ensuring proper delivery of the experimental and comparison treatments.

Procedures were taken to ensure conformity of teaching approaches with regard to reading strategy instruction and the teacher’s normal routine of instruction (Dyer, 1995; Myers, 2004). All teachers participated in professional development about reading strategy instruction and data collection procedures to ensure proper collection of data and study design. Additionally, treatment group teachers received lesson plans outlining how
to implement reading strategy instruction. Lesson plans included all necessary materials for proper implementation of the reading strategies including the lesson plan, transparency masters, assessments, and handouts.

Researchers have suggested that comprehension strategy instruction take place over the long-term, not a matter of weeks (DiCecco & Gleason, 2002; Friend, 1995; Guthrie, 2001; Pressley & Wharton-McDonald, 1997). Strategy instruction should include teacher modeling and explanation of the strategies, scaffolding of student learning the strategies, and providing students with information about transferring strategies to new situations (Pressley, 2003; Pressley & Wharton-McDonald).

The NRP (2000) proposed that instruction of cognitive strategies employed during reading consists of three macro-processes:

1. The development of an awareness and understanding of the reader’s own cognitive processes that are amenable to instruction and learning.
2. A teacher guiding the reader or modeling for the reader the actions that the reader can take to enhance the comprehension processes used during reading.
3. The reader practicing those strategies with the teacher assisting until the reader achieves a gradual internalization and independent mastery of those processes.

Duke and Pearson (2002) proposed a model of comprehension instruction:

1. An explicit description of the strategy and when and how it should be used.
2. Teacher and/or student modeling of the strategy in action.
3. Collaborative use of the strategy in action.
4. Guided practice using the strategy with gradual release of responsibility.
5. Independent use of the strategy.

Approximately one week prior to initiating experimentation, students completed the Adapted Motivations for Reading Questionnaire (Wigfield & Guthrie, 1997, 2004) and an agricultural content knowledge pretest. The agricultural content knowledge
pretest determined students’ initial levels of agricultural content knowledge. The pretest was created by selecting questions from individual lesson assessments. The reading motivation assessment determined students’ predisposition to read, reading habits, and amounts and kinds of reading.

The researcher determined a priori that a student must have attended 80% of the regularly scheduled classes while treatments were being delivered in order to remain in the study. Students failing to attend 80% of the classes were dropped from the study. At the conclusion of the study term, students completed the Adapted Motivations for Reading Questionnaire (Wigfield & Guthrie, 1997, 2004) and individual lessons quizzes to serve as posttests.

**Population**

Pressley (2001) suggested that one of the emerging issues with comprehension instruction is fine-tuning existing strategies for existing content areas. Further, comprehension instruction should prepare students to tackle real-world tasks, meaning the application of comprehension strategies for real purposes. Research (Pressley, 2003) suggests that experiments should include the students for whom instruction is targeted. Thus, the context for this experiment is within existing Florida high schools teaching secondary agriscience.

**Subject Selection: Agriscience Foundations Students**

The population of this study was all Florida high school students enrolled in Agriscience Foundations. Agriscience Foundations is a course offered primarily to ninth grade students in Florida’s secondary agricultural education programs. Students enrolled in this course are typically in the ninth-grade.
However, random selection of subjects was impossible due to existing course schedules. Thus, the precepts for quasi-experimental designs were enacted with intact groups of students and teachers and randomization of treatment to the classes. The investigator obtained student enrollment numbers in Agriscience Foundations for the fall semester of 2004 from the cooperating teachers.

Subject Selection: Agriscience Teachers

Agriscience teachers implemented the reading strategy instruction treatment with Agriscience Foundations courses during the 2004 fall semester. Schools and teachers were selected for the purpose of securing teachers who would ensure proper teaching of the treatments and provide accurate data in a timely fashion. All teachers used in this study were student teaching intern cooperating teachers and were deemed acceptable by the faculty in the Agricultural Education and Communication Department at the University of Florida. Teachers were purposively selected from the FAAE Teacher Directory 2003-2004 (Myers & Dyer, 2003). Once teachers were identified, the researcher contacted individual teachers and solicited their participation in the study. Correspondence with teachers participating in the study is found in Appendix A.

Sample Size

Gall et al. (2003) suggested determining a sample size where the researcher can discover differences and effects, and also avoid finding significance because of inflated sample sizes (Kelley & Maxwell, 2003). According to Olejnik (1984) four factors determine sample size: significance level, statistical power, analysis procedure, and effect size. Thus, Hays (1973) recommended the following calculation for sample size:

\[
 n = 2 \left( z_{1 - \alpha/2} - z_\beta \right)^2 / \Delta^2
\]
where \( z_{(1-\alpha/2)} \) equals the \( z \)-score for the desired alpha level (0.05), \( z_\beta \) equals the \( z \)-score for the desired power (0.80), and \( \Delta \) equals the effect size in standard deviation units. \( \Delta \) is computed using the formula

\[
\Delta = 2 \sqrt{w^2} / \sqrt{1 - w^2}
\]

where \( w^2 \) is the amount of variance of the dependent variable accounted for by the independent variable. The calculations for this study were

\[
\Delta = 2 \sqrt{0.10} / \sqrt{1 - 0.10} = 0.67
\]

\[
n = 2 \left[ 1.96 - (-1.28) \right]^2 / .67^2 = 46.8
\]

The 47 subjects in the study fell within the recommended range proposed by Olejnik (1984) for multivariate analyses.

The researcher determined that a minimum of 47 subjects was needed in each treatment to ensure adequate significance level, statistical power, analysis procedure, and effect size. However, other researchers (Boone, 1988; Dyer, 1995; Flowers, 1987; Myers, 2004) in similar studies determined that this type of study frequently experiences mortality rates as high as 50%. Thus, the sample size for each treatment was doubled to account for mortality.

**Instrumentation and Data Collection**

Instruments used to collect data for the dependent variables included the Florida Agriscience Foundations Lesson Plan Library (FDOE, 2003), the Adapted Motivations for Reading Questionnaire (Wigfield & Guthrie, 1997, 2004); and FCAT and GPA measures. Lesson plans were adapted from the Florida Agriscience Foundations Lesson Plan Library (FDOE, 2003) by the researcher. Each school’s guidance department reported students’ FCAT scores, grade point averages, ethnicity, and gender.
Data were collected from teachers at two different points in the study: after initial testing and at the end of the treatments. Teachers provided data in the form of report matrices (Appendix B) given to the researcher upon visits to the school site or emailed to the researcher, depending on the preference of the teacher and the researcher.

**Florida Comprehensive Assessment Test**

The Florida Comprehensive Assessment Test (FCAT) is part of Florida’s initiative on educational accountability and raising overall educational achievement. Scores on the FCAT are reported for each student showing “achievement levels, scale scores, and developmental scale scores…as well as performance on specific content strands; each student’s norm-referenced scores indicate the student’s ranking against national norms” (FDOE, 2004e, p. 8). Students must pass the reading and writing portions of the test before they graduate. The reading portion of the FCAT is presented at the reading level of the grade and determines students’ achievement in reading comprehension (FDOE, 2001). The eighth-grade FCAT reading test consists of 40% narrative text and 60% informational, or expository, text. The eighth-grade FCAT reading assessment contains multiple-choice, short-response, and extended-response questions. The ninth-grade FCAT reading assessment contains multiple-choice questions only. Questions on the reading portion of the test are drawn from “social studies, science, math, reading, health/physical education, the arts, and the workplace” (FDOE, 2004e, p. 10). The FCAT reporting scale is set to a mean of 300 with a standard deviation of 50, which spreads student scores along a scale from 100 to 500.

“FCAT scoring is built upon item response theory” (IRT) (FDOE, 2002, p. 4). IRT assumes that a respondent’s performance, high or low, is predicated on the individual’s true ability, characteristic, or construct, as measured by the instrument (Gall et al., 2003).
The statistic deemed most appropriate for providing summary-level information about student-level testing is student classification accuracy. Student classification is projected on five achievement levels, which are based on percentile rankings of achievement.

Point-biserial correlations were used to adjust for dichotomous responses. For the eighth-grade FCAT reading assessment, the minimum biserial correlation for the 21 informational items was 0.26 and the maximum was 0.67, meeting acceptable criteria for biserial correlations (FDOE, 2002). The $Q_l$ statistic is used as an index for how well theoretical item curves that match observed item responses can be found (Yen, 1981, as cited in FDOE, 2002). The $Q_l$ statistic is a ratio involving expected and observed item performance and is interpretable as a chi-square statistic. $Z$ transformations for the eighth grade FCAT reading assessment ranged from $-1.33$ to $8.81$. For the eighth grade FCAT reading assessment, no poorly fitting items were found according to $Q_l$ statistics.

Because the FCAT development used IRT, measurement error is not assumed to be constant, but varies to a greater extent at the tails of the distribution. However, multilog provides an estimate of “marginal” reliability, which is comparable to standard reliability statistics such as Cronbach’s alpha ($\alpha$) (FDOE, 2002). The IRT marginal reliability for eighth grade FCAT reading assessment is 0.91, with the Cronbach’s $\alpha$ for informational text equaling 0.82 and the overall Cronbach’s $\alpha$ equal to 0.89 (FDOE).

The five student achievement levels use accuracy, “the extent to which the actual classifications of the test takers...agree with those that would be made on the basis of their true score, if their true scores could somehow be known,” and consistency, “the agreement between classifications based on two non-overlapping, equally difficult forms of the test” (Livingston & Lewis, 1995, p. 180) to measure the error associated with
classification. For the eighth-grade FCAT reading assessment, accuracy was 0.73, consistency was 0.63, and Cohen’s kappa (κ) was 0.51, a measure of decision consistency.

**Textbook**

The textbook used by all classes was *Agriscience: Fundamentals & Applications*, by Cooper and Burton (2002), published by Delmar Publishers. The researcher ascertained text readability using the Fry Graph method (Fry, 1977) (see Table 3-1). The average number of sentences over three passages was 6.2 with 169.3 words; thus, the readability of the text was grade level 13, according to the Fry Readability Graph.

<table>
<thead>
<tr>
<th>Page</th>
<th>Number of Sentences</th>
<th>Number of Syllables</th>
</tr>
</thead>
<tbody>
<tr>
<td>158</td>
<td>7.0</td>
<td>182</td>
</tr>
<tr>
<td>435</td>
<td>4.2</td>
<td>151</td>
</tr>
<tr>
<td>654</td>
<td>7.4</td>
<td>175</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>6.2</strong></td>
<td><strong>169.3</strong></td>
</tr>
</tbody>
</table>

Chapters were selected to coincide with the individual lessons. Students were assigned the same readings, regardless of treatment or comparison group designation. All assigned readings were conducted at the same point in the lesson and completed in the same manner by students (in-class reading or reading assignments to take home) in order to account for differences in engagement.

Chapters were selected to coincide with the individual lessons. Students were assigned the same readings, however students in the comparison treatment only read, answered questions at the end of the chapter, and discussed the passages briefly in class. All assigned readings were conducted at the same point in the lesson and completed in
the same manner by students (in-class reading or reading assignments to take home) in order to account for differences in engagement.

**Lesson Plans and Agriscience Comprehension Assessments**

Florida Agriscience Foundations Lesson Plan Library (FDOE, 2003) (Appendix C for comparison group teachers and Appendix D for treatment group teachers) provided the content and lesson structure for the Foundations of Agriscience course. The researcher adapted the treatment group lessons by inserting CARS for systematic, planned, and thoughtful implementation of CARS. For example, strategies were used to activate background knowledge near the introduction of the lesson, and organizing strategies were used to develop relationships among key concepts in the lesson.

Comparison group teachers used their normal routine of instruction to teach the lessons. Additionally, the researcher developed identical handouts, transparencies, and student activities to reinforce both sets of lessons, with the exception of additional CARS materials for the treatment group teachers. The following lessons were taught:

**Animal Science**

- Lesson 06.07: Determining the Anatomy and Physiology of Animals
- Lesson 06.06: Meeting the Nutritional Needs of Animals
- Lesson 06.08: Understanding Animal Reproduction

The researcher selected lessons to be taught during the seven weeks of instruction from Monday, September 20, 2004 through Friday, December 17, 2004. The content of all lessons was consistent, unaltered from the original set of lessons, and in concordance with FDOE Student Performance Standards for the Agriscience Foundations I course (FDOE, 2004d). All students were taught all lessons in accordance with the lesson plans; however, the two treatments differed in their delivery methods—with and without
systematic, planned, and thoughtful implementation of CARS. Classes were randomly assigned to each of the two treatments.

Florida Agriscience Foundations Lesson Plan Library (FDOE, 2003) also provided assessments of student learning for each lesson plan used in the study. This corresponds to other research conducted on comprehension strategies where the researchers used researcher-derived instruments (Kim et al., 2004). The pre-test, post-test, and individual unit quizzes used a multiple-choice format.

In order to control for preexisting agricultural content knowledge, the researcher adapted an agricultural content knowledge pretest from existing assessments found in the Florida Agriscience Foundations Lesson Plan Library (FDOE, 2003). This test also served as the posttest at the conclusion of the treatment period. A panel of experts, consisting of teachers, faculty, and graduate students in agricultural education, evaluated the pretest and posttest to ensure face and content validity (see Appendix E for a list of the panel of experts).

**Motivation to Read Assessment**

Motivation to read was assessed with the Adapted Motivations for Reading Questionnaire (Wigfield & Guthrie, 1997, 2004). The Motivations for Reading Questionnaire was developed by John Guthrie, an expert in reading motivation, and adapted through pilot testing in this study. The instrument consists of 37 items to which students respond on a four-point, Likert-type scale, ranging from (1) *very different from me*, to (4) *a lot like me*. Validity was established with a panel of experts.

No reliability statistics were provided on the Adapted Motivations for Reading Questionnaire, thus this researcher established reliability through pilot testing of the instrument prior to initiating the dissertation study. Pilot testing was accomplished with
36 students enrolled in an agriscience course in a Florida high school not included in the study. The students represented the population in the study as those students enrolled in Agriscience Foundations in the state of Florida. The pilot test consisted of 37 items compiled from the Motivations for Reading Questionnaire (Wigfield & Guthrie, 1997, 2004). The researcher analyzed the pilot test of the motivation instrument using canonical discriminant cluster analysis via the SPSS Windows™ statistical package, version 12.0. Using discriminant and K-means cluster analyses, the 37 items condensed into three clusters. Fourteen questions described most of the variance and discriminated the clusters. Reliability was assessed on the final 14 items using the Cronbach’s α and yielded α = 0.90.

In the first part of the analysis, all 37 items were included in the K-means cluster analysis to determine groupings of students. The 37 items clustered students into three groups. Among the 37 items, canonical discriminant cluster analyses determined that nine items discriminated the clusters. These items were analyzed against the remaining items to find high correlations, which yielded an additional five items that highly correlated with one or more of the discriminating items. These 14 items were then analyzed to determine the number of factors underlying the discrimination and the canonical coefficients for each item.

Using factor analysis, a rotated portion matrix explained three latent factors, or three dimensions, underlying the 14 questions (see Table 3-2). Those dimensions roughly represented extrinsic motivation, intrinsic motivation, and effort toward reading tasks. Through canonical discriminant analysis, each item was determined to load
differentially on each of the three factors as indicated by the canonical coefficients in Table 3-2.

Table 3-2. Canonical discriminant coefficients for the Adapted Motivations for Reading Questionnaire ($n = 37$).

<table>
<thead>
<tr>
<th>Item</th>
<th>Portion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Extrinsic Factors</strong></td>
<td></td>
</tr>
<tr>
<td>I learn more from reading than most students in the class.</td>
<td>0.15</td>
</tr>
<tr>
<td>I like being the best at reading.</td>
<td>0.14</td>
</tr>
<tr>
<td>I read to improve my grades.</td>
<td>0.30</td>
</tr>
<tr>
<td>I talk to my friends about what I am reading.</td>
<td>0.09</td>
</tr>
<tr>
<td>If the teacher discusses something interesting I might read more about it.</td>
<td>0.17</td>
</tr>
<tr>
<td>My friends sometimes tell me I am a good reader.</td>
<td>0.30</td>
</tr>
<tr>
<td><strong>Intrinsic Factors</strong></td>
<td></td>
</tr>
<tr>
<td>I am a good reader.</td>
<td>-0.07</td>
</tr>
<tr>
<td>I am happy when someone recognizes my reading ability.</td>
<td>0.05</td>
</tr>
<tr>
<td>I am willing to work hard to read better than my friends.</td>
<td>0.05</td>
</tr>
<tr>
<td>I like it when the questions or topics in books make me think.</td>
<td>-0.03</td>
</tr>
<tr>
<td>If a book is interesting, I don’t care how hard it is to read.</td>
<td>-0.26</td>
</tr>
<tr>
<td><strong>Effort</strong></td>
<td></td>
</tr>
<tr>
<td>I do as little schoolwork as possible where reading is concerned.</td>
<td>-0.13</td>
</tr>
<tr>
<td>I try to find time each day to read something for pleasure.</td>
<td>-0.00</td>
</tr>
<tr>
<td>I usually learn difficult things by reading.</td>
<td>0.15</td>
</tr>
</tbody>
</table>
Reliability on each dimension was analyzed via Cronbach’s $\alpha$. The Cronbach’s $\alpha$ were as follows: extrinsic motivation component $\alpha = 0.76$, intrinsic component $\alpha = 0.63$, and effort $\alpha = 0.46$. Because of the low reliability on the effort scale, the researcher made the decision to treat the 14 items as one scale and represent the results with a summated score.

**Treatment Delivery Accountability**

In order to ensure that treatment was delivered appropriately and accurately, the researcher prepared prescriptive lesson plans for teachers in both the experimental and contrasting treatments. The researcher provided teachers with lesson plans, handouts, overheads, and student activities to ensure uniformity across treatments. At the conclusion of the study, each teacher reported the number and type of CARS used during the treatment period. Follow-up interviews also provided a measure of understanding the treatment and comparison group characteristics.

Student attendance records for the duration of the treatment period were gathered to ensure 80% attendance on days of treatment. These were reported on the reporting sheet provided by the cooperating teacher (Appendix B).

**Analysis of Data**

Data collected in this study were analyzed using SPSS© for Windows™ statistical package. Data pertaining to objectives describing the sample were analyzed using descriptive statistics, such as measures of central tendency and measures of variability (Gall et al, 2003). Bivariate correlation analysis was performed on the major variables in the study. The researcher determined a priori that statistical significance would be indicated for $\alpha \leq 0.05$. 
Variance in the sample was described using backward stepwise regression (Agresti & Finlay, 1997). This procedure begins by placing all predictors under consideration into the model and removes predictors until the remaining predictors make significant partial contribution to the overall model. While not every individual variable may be significant in and of itself, through the effects of multicollinearity, it may contribute to the overall significance and explanatory power of the model.

The data analysis plan for the experimental hypotheses included using a multivariate analysis of covariance (MANCOVA) procedure followed by univariate analysis of covariance (ANCOVA) to determine the source of variance, where appropriate. Agresti and Finlay (1997) recommended analysis of covariance for analyzing response variables (reading comprehension and agricultural content knowledge), while simultaneously controlling for other variables (FCAT scores, GPA, treatment group, gender). These other variables should be known to correlate with the dependent variable (Ary et al., 2002). Gall et al. (2003) noted that often pretest scores differ in quasi-experimental studies, because of the inability to randomly select subjects (Isaac & Michael, 1995); thus, ANCOVA should be used to control and adjust for initial differences in means. Using ANCOVA and MANCOVA, the researcher limits the likelihood of Type II error (Ary et al.).

Additional analysis on the experimental hypotheses associated with agricultural post-tests scores and motivation to read were analyzed using analysis of covariance (ANCOVA) procedures. ANCOVA is appropriate for determining the difference on mean scores (motivation to read) between two groups (reading strategies, gender, etc.) on one or more variables or factors while controlling for other factors (Agresti & Finlay,
1997; Gall et al., 2003; Vogt, 1999). However, due to the lack of correlation between the dependent variable, treatment with CARS, and the outcome variables, agriculture post-test scores and motivation to read scores, MANCOVA and ANCOVA were not conducted. Additional descriptive statistics, such as means, standard deviations, correlations, frequencies, and percentages were used to describe the results.

**Long Interviews**

Long interviews following McCracken’s (1988) four-step design were conducted with teachers participating in the study upon conclusion of the study. This section provides a detailed description of the methods used to conduct the interviews. This research methodology was chosen to gather information about teacher’s construction of reality regarding the use of content area reading strategies in secondary agriscience courses. As such, these interviews were respondent interviews (Lindlof & Taylor, 1998).

The interviews were conducted in order to gain deeper understanding into the motivations of teachers participating in the study, as well as to explain their use or non-use of content area reading strategies in secondary agriscience. The interviews provided a rhetorical construction of the teachers’ experiences with content area reading strategies (Lindlof & Taylor, 1998). Interviews are “often used to verify, validate, or comment on information obtained from other sources” (Lindlof & Taylor, 1998, p. 175). They are often used to validate test hypotheses in the field.

The four-step interview process involves the

1. Review of analytic categories and interview design
2. Review of cultural categories and interview design
3. Interview procedure and the discovery of cultural categories
4. Interview analysis and the discovery of analytical categories (McCracken, 1988, p. 29)

Reviewing analytic categories encompasses the literature review (McCracken, 1988). During the review of cultural categories, the researcher examines self as the measurement instrument and begins to assimilate ideas for constructing the interview questions. The third step involves constructing the interview questions, while the final step involves the analysis of the interview transcriptions and discovery of themes within the interviewee’s communicated ideas.

Interview questions were generated from two sources: a review of the literature on content area reading and data gathered from the first part of this study. Thus the interviews were explanatory in nature. Interviews were not triangulated with actual classroom observations or student interviews.

All interviews were conducted in the classroom setting at the teachers’ convenience upon completion of the study. They were conducted by the researcher. The interviews were audio taped and those tapes transcribed for further analysis (Creswell, 1998). Analysis of the transcriptions involved reviewing them for themes and explanatory purposes for the quantitative data.

Summary

This chapter outlined the methods by which the null and research hypotheses were tested. Topics included the research design, procedures for conducting research, the population, subject selection for teachers and students, sample size, instrumentation and data collection procedures (FCAT, textbook, lesson plans, agricultural content knowledge assessments, and motivation to read assessments), treatment delivery accountability, and the analysis of data.
The independent variables in this study were reading strategy instruction, specifically strategy use in the three microperiods of reading versus the teacher’s normal routine of instruction. The dependent variables in this study were motivation to read and agricultural concept knowledge. The antecedent variables were gender, grade level, ethnicity, and SES. In order to control for preexisting student conditions, eighth-grade FCAT reading levels, grade point averages, and pretest scores on motivation to read and agriculture knowledge were treated as covariates.

This study employed a quasi-experimental research design, specifically the nonequivalent control group design (Campbell & Stanley, 1963). The chapter discussed and accounted for threats to validity with this design. Data collected within this design included eighth-grade FCAT reading levels, middle school grade point averages, agriculture pretest and posttest scores, and the Adapted Motivations for Reading Questionnaire (Wigfield & Guthrie, 1997, 2004) pretest and posttest scores. Additionally, the researcher analyzed data on students’ gender, grade level, GPA, ethnicity, SES, and attendance records. The chapter discussed methods for data analysis, including analysis of variance, analysis of covariance, multivariate analysis of covariance, and descriptive statistics. Finally, the chapter outlined the procedures for conducting teacher interviews after concluding the study.
CHAPTER 4
FINDINGS

Introduction

Chapter 1 described the need for research in agriscience about the effect of reading strategies on students’ comprehension of agricultural concepts and motivation to read. Chapter 1 also provided background about secondary reading, content area reading, and agriscience. Definitions of key terms related to reading in agriscience and reading strategy instruction were provided. Chapter 1 also identified the purposes and explained the significance of the study. The primary purpose of this study was to determine the effects of implementing a package of content area reading strategies that focuses on the three micro-periods of reading on students’ knowledge of agricultural concepts and motivation to read.

Chapter 2 presented a discussion of theories of reading and research related to reading comprehension, motivation to read, strategy instruction, and variables influencing student reading. Variables discussed included the reading strategy instruction, reading ability, prior reading experiences, and gender.

Chapter 3 explains the methods employed to accomplish the objectives and test the hypotheses of this study. The objectives of this study were to include

1. Describe the grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students participating in this study.

2. Describe the variance in agriculture post-test score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.
3. Describe the variance in motivation to read score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.

4. Describe the variance in the comprehension portion of the agriculture post-test score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.

For this study, research hypotheses included:

$$H_a^1:$$ Comprehension of agricultural concepts will be significantly greater for secondary agriscience students using reading strategies versus those students using the teacher’s traditional routine in agriscience classes.

$$H_a^2:$$ Motivation to read will be significantly greater for secondary agriscience students using reading strategies versus those students using the teacher’s traditional routine in agriscience classes.

Questions leading the qualitative inquiry included:

1. How do agriculture teachers perceive their role in assisting students in developing reading comprehension skills in agriscience?

2. What are teacher’s reactions to implementing the content area reading strategies in agriscience? How effective are these efforts?

3. How do agriscience teachers model good literacy?

4. What strategies are effective in assisting agriscience teachers in implementing content area reading strategies?

5. What are the barriers to reading instruction in agriscience?

Chapter 3 specifically targets the research design, population, student sample, instrumentation, treatment, data collection procedures, and statistical analyses used in analyzing the data. The independent variables in this study were reading strategy instruction, specifically strategy use in the three microperiods of reading versus the teacher’s normal routine of instruction; total content area reading strategies employed; and instructional time. Outlining the status of reading comprehension instruction, Pressley (2001) supposed that if different types of instruction improve comprehension, “it just might be sensible to do all of them” (¶ 1). The dependent variables in this study were...
motivation to read and agricultural concept knowledge. The antecedent variables were gender, grade level, ethnicity, and SES. GPA, FCAT reading levels, agriculture pre-test scores, and motivation to read pre-test scores were treated as covariates.

Chapter 3 also addresses qualitative methods to answer the following questions about teachers’ instruction in content area reading strategies.

1. How do agriculture teachers perceive their role in assisting students in developing reading comprehension skills in agriscience?

2. What are teacher’s reactions to implementing the content area reading strategies in agriscience? How effective are these efforts?

3. How do agriscience teachers model good literacy?

4. What strategies are effective in assisting agriscience teachers in implementing content area reading strategies?

5. What are the barriers to reading instruction in agriscience?

Objective 1: Description of Participants

This study employed a purposive sample of students enrolled in Agriscience Foundations in Florida. Initially, six teachers each with two classes of Agriscience Foundations were selected to participate in the study. This selection was based upon the teacher’s projected ability to deliver the treatment effectively and provide usable data. The Florida hurricanes of 2005 caused one teacher to withdraw from the study, and another teacher provided limited usable data (n = 3). Thus, classes taught by those two teachers were dropped from the study. Therefore, four teachers, two randomly selected for the treatment and two for the comparison group, completed the study and provided usable data (see Table 4-1). Both teachers in the comparison group were female, while one of the teachers in the treatment group was female, and the other was male. Of the 95
students included in the study, 47 were assigned to the treatment group, while 48 were assigned to the comparison group (see Table 4-1).

Table 4-1. Schools participating in the study.

<table>
<thead>
<tr>
<th>Group</th>
<th>Treatment</th>
<th>Comparison</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schools (number)</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Students (number)</td>
<td>47</td>
<td>48</td>
<td>95</td>
</tr>
</tbody>
</table>

The study was initiated on October 4, 2004, when the researchers sent the packets of lessons and instructional materials to each teacher. The study concluded on January 20, 2005, when each teacher had returned all of the necessary data and all interviews were completed. Data were collected at two primary points in the study: demographic and pre-test data were collected within the first week if initiating the study, while post-test data were collected upon completion of the study. Teachers, often with the aid of the school’s guidance counselor, filled out the Demographic Reporting Sheet (see Appendix B) with student demographic data and data pertaining to the covariates. Each teacher administered the agriculture pre-test, the Adapted Motivations for Reading pretest, individual lesson quizzes, and the Adapted Motivations for Reading post-test.

One teacher in each the treatment and comparison group taught classes on a block schedule with 90 minutes of instruction on alternating days. The other teacher in each group taught on a traditional 50-minute schedule. Each teacher was provided identical lessons, with the exception of embedded reading strategies for the treatment group. Teachers taught the set of lessons for an overall average of 1,340 minutes (see Table 4-2). The treatment teachers taught their lessons for an average of 1,570 minutes, while the comparison group teachers taught their lessons for an average of 1,110 minutes.
Table 4-2. Instructional time on Agriscience Foundations lessons.

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Treatment</th>
<th></th>
<th></th>
<th>Comparison</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>days</td>
<td>minutes</td>
<td>days</td>
<td>minutes</td>
<td></td>
</tr>
<tr>
<td>06.07: Determining the Anatomy and Physiology of Animals</td>
<td>7.0</td>
<td>490</td>
<td>5.5</td>
<td>375</td>
<td></td>
</tr>
<tr>
<td>06.06: Meeting the Nutritional Needs of Animals</td>
<td>8.0</td>
<td>520</td>
<td>6.0</td>
<td>360</td>
<td></td>
</tr>
<tr>
<td>06.08: Understanding Animal Reproduction</td>
<td>8.0</td>
<td>560</td>
<td>5.5</td>
<td>375</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>23.0</td>
<td>1570</td>
<td>17.0</td>
<td>1110</td>
<td></td>
</tr>
</tbody>
</table>

Teachers in the study used a different number of total reading strategies depending upon their random group assignment. Treatment group teachers were instructed where to use strategies within their lessons, so that CARS were implemented in a systematic, planned, and thoughtful manner. In most cases they were instructed to choose between two complementary strategies when instructing students with reading. The comparison group teachers implemented CARS based upon their knowledge of the strategy and preference for using it.

Treatment group teachers were provided a choice of two or three systematic, planned, and intentional strategies for most objectives in the lesson. Teachers in the treatment group used an average of 16.5 content area reading strategies over the treatment period, which were embedded in the lessons according to the purpose of each strategy (see Table 4-3). The comparison group teachers used an average of 29.5 content area reading strategies.

The study included 95 students who agreed to participate and provided complete and usable data. These students met the additional criteria of complete data and school attendance for at least 80% of the days during the study. In a few instances where
individuals did not respond to individual questions, the missing data were completed by substituting the mean score of the participant’s remaining items (DeVaus, 1990).

Table 4-3. Number of strategies employed.

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Treatment</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>06.07: Determining the Anatomy and Physiology of Animals</td>
<td>5.0</td>
<td>9.0</td>
</tr>
<tr>
<td>06.06: Meeting the Nutritional Needs of Animals</td>
<td>5.0</td>
<td>9.0</td>
</tr>
<tr>
<td>06.08: Understanding Animal Reproduction</td>
<td>6.5</td>
<td>11.5</td>
</tr>
<tr>
<td>Total</td>
<td>16.5</td>
<td>29.5</td>
</tr>
</tbody>
</table>

Gender

Of the 95 students in the study, 58 (61.1%) were male, and 37 (38.9%) were female (see Table 4-4). The treatment group had a higher percentage of male students (70.2%) than the comparison group (52.1%), and a corresponding lower proportion of female students (29.8% in the treatment group and 47.9% in the comparison group).

Table 4-4. Student gender distribution.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Treatment</th>
<th>Comparison</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Male</td>
<td>33</td>
<td>70.2</td>
<td>25</td>
</tr>
<tr>
<td>Female</td>
<td>14</td>
<td>29.8</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>100.0</td>
<td>48</td>
</tr>
</tbody>
</table>

Grade level

Fifty-five students (57.9%) were ninth graders, 27 (28.4%) were tenth graders, seven (7.4%) were eleventh graders, and six (6.3%) were twelfth graders (see table 4-5). Agriscience Foundations is traditionally an introductory course for many of the agriscience courses of study in Florida secondary schools. Generally, ninth graders are
the predominant grade level classification of students enrolled in this course. In the treatment group, 70.2% of the students were ninth graders, while only 45.8% of the students in the comparison group were ninth graders. The combined proportion of underclassmen (ninth and tenth graders) was 91.5% in the treatment group and 81.2% in the comparison group.

Table 4-5. Student grade level distribution.

| Grade Level | Treatment | | | Comparison | | | | Total | | |
|-------------|-----------|---|---|-------------|---|---|---|---|
|             | n         | % | n | %           | n | % | n | % |
| 9           | 33        | 70.2 | 22 | 45.8       | 55 | 57.9 |
| 10          | 10        | 21.3 | 17 | 35.4       | 27 | 28.4 |
| 11          | 1         | 2.1  | 6  | 12.5       | 7  | 7.4  |
| 12          | 3         | 6.4  | 3  | 6.3        | 6  | 6.3  |
| Total       | 47        | 100.0 | 48 | 100.0      | 95 | 100.0 |

Ethnicity

The study used the conventions for ethnicity according to the University of Florida’s (2005) admissions form. Sixty-nine students (72.6%) were white, 14 (14.7%) were black, 11 (11.6%) were Hispanic, and one student was Asian (see Table 4-6). Most of the students (83.0%) in the treatment group were white. The treatment group also contained six Hispanic students (12.8%) and one each of Asian and Black (2.1% each). The comparison group contained 62.5% white students with five Hispanic students (10.4%) and 13 Black students (27.1%). There were no Asian students in the comparison group.
Table 4-6. Student ethnicity distribution.

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Treatment</th>
<th></th>
<th></th>
<th>Comparison</th>
<th></th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>1</td>
<td>2.1</td>
<td>0</td>
<td>---</td>
<td>1</td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>1</td>
<td>2.1</td>
<td>13</td>
<td>27.1</td>
<td>14</td>
<td>14.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>6</td>
<td>12.8</td>
<td>5</td>
<td>10.4</td>
<td>11</td>
<td>11.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>39</td>
<td>83.0</td>
<td>30</td>
<td>62.5</td>
<td>69</td>
<td>72.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>100.0</td>
<td>48</td>
<td>100.0</td>
<td>95</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SES

SES was determined using the free and reduced lunch counts for the student sample. Sixty students (63.8%) did not qualify for free or reduced lunches, while 28 (29.8%) qualified for free lunches and six (6.4%) qualified for reduced lunch pricing (see Table 4-7). In the treatment group, 32 students (68.1%) did not qualify for free or reduced lunches, while three students (6.4%) qualified for reduced lunch pricing and 12 students (25.5%) qualified for free lunches. In the comparison group, 60 students (59.6%) did not qualify for free or reduced lunches, while three students (6.4%) qualified for reduced lunch pricing and 16 students (34.0%) qualified for free lunches.

Table 4-7. Student SES distribution as determined by free and reduced lunch counts.

<table>
<thead>
<tr>
<th>Lunch program</th>
<th>Treatment</th>
<th></th>
<th></th>
<th>Comparison</th>
<th></th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free</td>
<td>12</td>
<td>25.5</td>
<td>16</td>
<td>34.0</td>
<td>28</td>
<td>29.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced</td>
<td>3</td>
<td>6.4</td>
<td>3</td>
<td>6.4</td>
<td>6</td>
<td>6.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full</td>
<td>32</td>
<td>68.1</td>
<td>28</td>
<td>59.6</td>
<td>60</td>
<td>63.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>100.0</td>
<td>47</td>
<td>100.0</td>
<td>94</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GPA

The mean GPA for the overall study was 2.62 out of four-points (see table 4-8).

Students were grouped by grade point averages into corresponding letter grade categories. The “A” range was from 4.00 to 3.50, the “B” range was from 3.49 to 2.50, the “C” range was from 2.49 to 1.50, the “D” range was from 1.49 to 0.50, and the “F” range was from .49 to 0.00.

Table 4-8. Student letter grade distribution.

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Treatment</th>
<th></th>
<th>Comparison</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>%</td>
<td>$n$</td>
<td>%</td>
<td>$n$</td>
<td>%</td>
</tr>
<tr>
<td>A</td>
<td>5</td>
<td>10.6</td>
<td>6</td>
<td>12.5</td>
<td>11</td>
<td>11.6</td>
</tr>
<tr>
<td>B</td>
<td>20</td>
<td>42.6</td>
<td>27</td>
<td>56.3</td>
<td>47</td>
<td>49.5</td>
</tr>
<tr>
<td>C</td>
<td>13</td>
<td>27.7</td>
<td>12</td>
<td>25.0</td>
<td>25</td>
<td>26.3</td>
</tr>
<tr>
<td>D</td>
<td>8</td>
<td>17.0</td>
<td>3</td>
<td>6.3</td>
<td>11</td>
<td>11.6</td>
</tr>
<tr>
<td>F</td>
<td>1</td>
<td>2.1</td>
<td>---</td>
<td>---</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>100.0</td>
<td>48</td>
<td>100.0</td>
<td>95</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Overall, 11 students (11.6%) earned an “A,” 47 students (49.5%) earned a “B,” 25 students (26.3%) earned a “C,” 11 students (11.6%) earned a “D,” and one student (1.1%) earned an “F.” Five students (10.6%) in the treatment group earned an “A,” while 20 students (42.6%) earned a “B,” 13 students (27.7%) earned a “C,” eight students (17.0%) earned a “D,” and one student (2.1%) earned an “F.” Six students (12.5%) in the comparison group earned an “A,” while 27 students (56.3%) earned between a “B,” 12 students (25.0%) earned a “C,” and three students (6.3%) earned a “D.”
FCAT reading level

The mean Sunshine State Standard reading score was 1773.5 and the mean corresponding FCAT Achievement Level was 2. Forty students (46.0%) read at the lowest FCAT reading level 1, 20 students (23.0%) read at level 2, 16 students (18.4%) read at level 3, nine students (10.3%) read at level 4, and two students (2.3%) read at level 5, the highest FCAT reading level (see Table 4-9). In the treatment group, 20 students (50.0%) read at the lowest FCAT reading level 1, eight students (20.0%) read at level 2, seven students (17.5%) read at level 3, five students (12.5%) read at level 4, and two students (2.1%) read at level 5, the highest FCAT reading level. In the comparison group, 20 students (42.6%) read at the lowest FCAT reading level 1, 12 students (25.5%) read at level 2, nine students (19.1%) read at level 3, four students (8.5%) read at level 4, and two students (4.3%) read at level 5, the highest FCAT reading level.

Table 4-9. Student FCAT reading level distribution.

<table>
<thead>
<tr>
<th>Reading Level</th>
<th>Treatment</th>
<th></th>
<th>Comparison</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>---</td>
<td>2</td>
<td>4.3</td>
<td>2</td>
<td>2.3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>12.5</td>
<td>4</td>
<td>8.5</td>
<td>9</td>
<td>10.3</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>17.5</td>
<td>9</td>
<td>19.1</td>
<td>16</td>
<td>18.4</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>20.0</td>
<td>12</td>
<td>25.5</td>
<td>20</td>
<td>23.0</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>50.0</td>
<td>20</td>
<td>42.6</td>
<td>40</td>
<td>46.0</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100.0</td>
<td>47</td>
<td>100.0</td>
<td>87</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Motivation to read

Motivation to read was assessed through pre-test and post-test assessments adapted from the Adapted Motivations for Reading Questionnaire (Wigfield & Guthrie, 1997,
2004). As noted in Table 4-10, the mean canonical discriminant score for the 14 items on the Adapted Motivations for Reading questionnaire (Wigfield & Guthrie, 1997, 2004) for the combined sample of students on the motivation pre-test was 5.93, and the mean canonical discriminant score on the post-test was 6.12. The difference between the pre-test and the post-test was significant at $\alpha = 0.05$ ($p < 0.05$). Overall canonical discriminant scores for student motivation to read on the pre-test ranged from 2.60 to 9.40 with a mean of 5.93. For the treatment group, student motivation had an overall mean canonical discriminant score of 5.89 on the pre-test. For the comparison group, student motivation had an overall mean canonical discriminant score of 5.98 on the pre-test.

Table 4-10. Motivation to read assessment scores ($n = 95$).

<table>
<thead>
<tr>
<th>Score</th>
<th>Treatment $^a$</th>
<th></th>
<th>Comparison $^b$</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Pre-test</td>
<td>5.89</td>
<td>1.61</td>
<td>5.98</td>
<td>1.38</td>
<td>5.93</td>
<td>1.49</td>
</tr>
<tr>
<td>Post-test</td>
<td>6.03</td>
<td>1.50</td>
<td>6.21</td>
<td>1.28</td>
<td>6.12</td>
<td>1.39</td>
</tr>
</tbody>
</table>

$^a n = 47$. $^b n = 48$.

Overall student motivation to read canonical discriminant scores on the post-test ranged from 2.60 to 9.00 with a mean of 6.12. For the treatment group, student motivation had an overall mean canonical discriminant score of 6.03 on the post-test. For the comparison group, student motivation had an overall mean canonical discriminant score of 6.21 on the post-test.

**Agriculture comprehension**

The reliability of the agriculture pre-test was assessed using Kuder-Richardson 20, which yielded $\alpha = 0.87$. Overall, students answered 37.6% of the pre-test questions
correctly and 60.4% of the post-test questions correctly (see Table 4-11). Students in the treatment group answered 37.9% of the questions correctly on the pre-test and 59.2% of the questions correctly on the post-test. Students in the comparison group answered 37.3% of the questions correctly on the pre-test and 61.5% of the questions correctly on the post-test.

Table 4-11. Students’ agriculture pre- and post-test performance (percent correct).

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Treatment</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Comparison</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Total</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>47</td>
<td>37.9</td>
<td>48</td>
<td>37.3</td>
<td>95</td>
<td>37.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06.07: Determining the Anatomy and Physiology of Animals</td>
<td>47</td>
<td>67.0</td>
<td>48</td>
<td>67.3</td>
<td>95</td>
<td>67.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06.06: Meeting the Nutritional Needs of Animals</td>
<td>47</td>
<td>51.2</td>
<td>48</td>
<td>55.9</td>
<td>95</td>
<td>53.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06.08: Understanding Animal Reproduction</td>
<td>47</td>
<td>58.8</td>
<td>48</td>
<td>61.3</td>
<td>94</td>
<td>60.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-test total</td>
<td>47</td>
<td>59.2</td>
<td>47</td>
<td>61.5</td>
<td>94</td>
<td>60.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reading habits of students

On the pre-test, 29 students (31.5%) indicated that they were currently reading a book, while 27 students (30.7%) indicated they were reading a book at the end of the study. In the treatment group, 12 students (26.7%) indicated they were reading a book during the pre-test period, while 16 students (36.4%) were reading a book during the post-test phase. In the comparison group, 17 students (36.2%) indicated that they were reading a book at the beginning of the study compared to 11 (25.0%) at the end of the study.
The motivation to read pre-test and post-test asked participants to report the number of books that they had read in the past month, the number of hours of reading per week for school and the number of hours of reading per week for pleasure (see Table 4-12). Overall, students read 1.74 books in the month prior to the study and read 3.44 hours per week for school and 1.94 hours per week for pleasure. Students in the treatment group read 1.40 books in the month prior to the study and read 3.42 hours per week for school and 1.33 hours per week for pleasure. Students in the comparison group read 2.07 books in the month prior to the study and read 3.45 hours per week for school and 2.52 hours per week for pleasure.

Table 4-12. Reading habits of students.

<table>
<thead>
<tr>
<th>Habit</th>
<th>Treatment</th>
<th></th>
<th></th>
<th>Comparison</th>
<th></th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>n</td>
<td>M</td>
<td>n</td>
<td>M</td>
</tr>
<tr>
<td>Pre-Test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Books per month</td>
<td>46</td>
<td>1.40</td>
<td>1.71</td>
<td>47</td>
<td>2.07</td>
<td>4.17</td>
<td>93</td>
<td>1.74</td>
</tr>
<tr>
<td>Weekly reading for school</td>
<td>43</td>
<td>3.42</td>
<td>4.17</td>
<td>47</td>
<td>3.45</td>
<td>5.49</td>
<td>90</td>
<td>3.44</td>
</tr>
<tr>
<td>Weekly reading for pleasure</td>
<td>44</td>
<td>1.33</td>
<td>2.47</td>
<td>47</td>
<td>2.52</td>
<td>5.61</td>
<td>91</td>
<td>1.94</td>
</tr>
<tr>
<td>Post-Test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Books per month</td>
<td>44</td>
<td>1.80</td>
<td>2.13</td>
<td>45</td>
<td>1.76</td>
<td>3.02</td>
<td>89</td>
<td>1.78</td>
</tr>
<tr>
<td>Weekly reading for school</td>
<td>43</td>
<td>3.74*</td>
<td>5.58</td>
<td>45</td>
<td>1.71*</td>
<td>2.42</td>
<td>88</td>
<td>2.70</td>
</tr>
<tr>
<td>Weekly reading for pleasure</td>
<td>44</td>
<td>2.57</td>
<td>5.05</td>
<td>47</td>
<td>1.47</td>
<td>3.23</td>
<td>91</td>
<td>2.01</td>
</tr>
</tbody>
</table>

*Difference in hours reading for school between the treatment and comparison groups is significant at α ≤ 0.05.
On the post-test, students read 1.78 books in the month prior to the study and read 2.70 hours per week for school and 2.01 hours per week for pleasure. Students in the treatment group read 1.80 books in the month prior to the study and read 3.74 hours per week for school and 2.57 hours per week for pleasure. Students in the comparison group read 1.76 books in the month prior to the study and read 1.71 hours per week for school and 1.47 hours per week for pleasure.

Looking at the change in reading habits of students, students in the treatment group significantly increased the time per week that they read for pleasure significantly more than the comparison group \((p < 0.05)\). The treatment group increased the hours per week reading for pleasure by 1.35 hours, while the comparison group decreased the time per week reading for pleasure by 1.14 hours (see Table 4-13).

<table>
<thead>
<tr>
<th>Habits</th>
<th>Treatment</th>
<th></th>
<th>Comparison</th>
<th></th>
<th>Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Books per month</td>
<td>43</td>
<td>0.56 1.69</td>
<td>44</td>
<td>-0.22 3.25</td>
<td>1.39 0.17 (-0.33, 1.88)</td>
</tr>
<tr>
<td>Weekly reading for school (hrs.)</td>
<td>40</td>
<td>0.60 6.87</td>
<td>44</td>
<td>-1.92 5.83</td>
<td>1.81 0.07 (-0.25, 5.27)</td>
</tr>
<tr>
<td>Weekly reading for pleasure (hrs.)</td>
<td>41</td>
<td>1.35 5.03</td>
<td>44</td>
<td>-1.14 4.67</td>
<td>2.36 0.02 (0.39, 4.57)</td>
</tr>
</tbody>
</table>

*Difference is significant at \(\alpha \leq 0.05\).

**Relationships between variables**

Before analysis of any of the variables through inferential methods, the researcher examined the variables for possible correlations (Miller, 1998). The conventions proposed by Davis (1971) were used to indicate the magnitude of the correlations. Correlations between 0.01 and 0.09 are *negligible*, correlations between 0.10 and 0.29 are *
low, correlations between 0.30 and 0.49 are moderate, correlations between 0.50 and 0.69 are substantial, and correlations between 0.70 and 0.99 are very high. For interpretation of the correlation table, comparison group, females, minorities, and students on free/reduced lunch programs were coded higher than the treatment group, males, whites, and high-SES. Thus, positive correlations would be indicated if the participant was in the comparison group, female, minority, and/or lower-SES.

As expected, a very high correlation was discovered between treatment group and total number of CARS \( (r = 0.99) \) and a very high negative correlation was observed between treatment group and instructional time \( (r = -0.75) \) (see Table 4-14 and 4-15). A very high negative correlation was discovered between instructional time and total number of CARS \( (r = -0.79) \). Further, a very high correlation \( (r = 0.89) \) was discovered between the agriculture post-test and the comprehension assessment portion of the test.

Substantial correlations were discovered between the FCAT reading level and the agriculture pre-test \( (r = 0.61) \), the agriculture post-test \( (r = 0.66) \), and the comprehension assessment portions of the post-tests \( (r = 0.53) \). Substantial correlations also existed between the agriculture pre-test and the agriculture post-test \( (r = 0.66) \) and the comprehension portion of the post-test \( (r = 0.50) \).

Moderate correlations were discovered between GPA and the agriculture post-test score \( (r = 0.49) \), the comprehension portion of the post-test \( (r = 0.44) \), FCAT reading levels \( (r = 0.42) \), and the agriculture pre-test \( (r = 0.38) \). A moderate correlation was observed between gender and the agriculture post-test \( (r = 0.33) \), GPA \( (r = 0.33) \), and the comprehension portion of the post-test \( (r = 0.34) \). Moderate correlations were also observed between grade level and ethnicity \( (r = 0.29) \).
Table 4-14. Correlations between continuous variables.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total CARS</td>
<td>---</td>
<td>-0.79*</td>
<td>0.13</td>
<td>0.23*</td>
<td>0.08</td>
<td>-0.01</td>
<td>0.09</td>
<td>0.03</td>
<td>0.04</td>
<td>-0.04</td>
</tr>
<tr>
<td>2. Instructional time</td>
<td>---</td>
<td>0.08</td>
<td>-0.21*</td>
<td>-0.11</td>
<td>-0.03</td>
<td>-0.02</td>
<td>0.11</td>
<td>-0.04</td>
<td>-0.13</td>
<td></td>
</tr>
<tr>
<td>3. Grade level</td>
<td>---</td>
<td>0.18</td>
<td>-0.07</td>
<td>0.03</td>
<td>0.04</td>
<td>0.00</td>
<td>0.05</td>
<td>-0.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. GPA</td>
<td>---</td>
<td>.42*</td>
<td>0.38*</td>
<td>0.4*</td>
<td>0.44*</td>
<td>0.11</td>
<td>0.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. FCAT reading level</td>
<td>---</td>
<td>0.61*</td>
<td>0.66*</td>
<td>0.53*</td>
<td>0.16</td>
<td>0.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Agriculture pre-test</td>
<td>---</td>
<td>0.66*</td>
<td>0.50*</td>
<td>0.14</td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Agriculture post-test</td>
<td>---</td>
<td>0.89*</td>
<td>0.13</td>
<td>0.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Comprehension Score</td>
<td>---</td>
<td>0.09</td>
<td>0.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Motivation to read pre-test</td>
<td>---</td>
<td>0.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Motivation to read post-test</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*\( p \leq 0.05 \).
Table 4-15. Point biserial correlations between categorical variables.

<table>
<thead>
<tr>
<th></th>
<th>Treatment Group</th>
<th>Gender</th>
<th>Ethnicity</th>
<th>SES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Total CARS</td>
<td>0.99*</td>
<td>0.20*</td>
<td>0.19</td>
<td>0.11</td>
</tr>
<tr>
<td>2. Instructional time</td>
<td>-0.75*</td>
<td>-0.20*</td>
<td>-0.09</td>
<td>-0.16</td>
</tr>
<tr>
<td>3. Grade level</td>
<td>0.20</td>
<td>-0.02</td>
<td>0.29*</td>
<td>-0.14</td>
</tr>
<tr>
<td>4. GPA</td>
<td>0.23*</td>
<td>0.33*</td>
<td>-0.08</td>
<td>-0.14</td>
</tr>
<tr>
<td>5. FCAT reading level</td>
<td>0.06</td>
<td>0.23*</td>
<td>-0.02</td>
<td>-0.04</td>
</tr>
<tr>
<td>6. Agriculture pre-test</td>
<td>-0.02</td>
<td>0.09</td>
<td>-0.09</td>
<td>-0.20</td>
</tr>
<tr>
<td>7. Agriculture post-test</td>
<td>0.06</td>
<td>0.33*</td>
<td>-0.26*</td>
<td>-0.14</td>
</tr>
<tr>
<td>8. Comprehension Score</td>
<td>-0.00</td>
<td>0.34*</td>
<td>-0.24*</td>
<td>-0.05</td>
</tr>
<tr>
<td>9. Motivation to read pre-test</td>
<td>0.03</td>
<td>0.17</td>
<td>0.09</td>
<td>0.13</td>
</tr>
<tr>
<td>10. Motivation to read post-test</td>
<td>-0.05</td>
<td>0.13</td>
<td>0.03</td>
<td>0.01</td>
</tr>
</tbody>
</table>

*p ≤ 0.05.

Low positive correlations were discovered between the treatment group and GPA (r = 0.23) and ethnicity (r = 0.23). They were also observed between ethnicity and SES (r = 0.25), between total CARS used and GPA (r = 0.24), and between gender and FCAT reading (r = 0.23). A low negative correlation was observed between ethnicity and the agriculture post-test (r = -0.26), between instructional time and GPA (r = -0.21), between ethnicity and the comprehension portion of the post-test (r = -0.23), and between instructional time and gender (r = -0.20).

**Objective 2: Variance in Agricultural Post-Test Scores**

Objective 2 described the variance in agricultural post-test scores explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students. Backward stepwise regression was used to select the most appropriate model for predicting agricultural content knowledge based
upon treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students (Agresti & Finlay, 1997). Backward regression was used because of its power to construct a model using only those factors that contribute significance to predicting the dependent variable (Gall et al, 2003; Licht, 2004). Variables initially included in the backward-stepwise regression were treatment group, gender, grade level, ethnicity, SES, GPA, FCAT reading level, and the agriculture pre-test score.

Variables needed a significance level of $\alpha = 0.05$ to enter the regression equation, while variables with $\alpha \geq 0.10$ were removed. Categorical variables were dummy-coded:

- Treatment group: 0 = treatment, 1 = comparison
- Gender: 0 = male, 1 = female
- Ethnicity: 0 = White, 1 = minority
- SES: 0 = unsubsidized lunch program, 1 = free or reduced lunch

The regression analysis produced a model consisting of the linear combination of agriculture pre-test, grade level, GPA, gender, ethnicity, and FCAT reading level to predict the overall agriculture post-test score, $F_{(85)} = 27.26, p < 0.05$. $R^2$ for the model was 0.67, and the adjusted $R^2$ was 0.65. Table 4-16 shows the variables and regression coefficients for this model. The agriculture pre-test score ($t = 3.41, p < 0.05$), FCAT reading levels ($t = 4.12, p < 0.05$), ethnicity ($t = -2.84, p < 0.05$), gender ($t = 2.16, p = 0.05$), GPA ($t = 2.99, p < 0.05$), and grade level ($t = 2.41, p = 0.05$) contributed significantly ($\alpha \leq .05$) to predicting agriculture post-test scores.

The linear combination of these variables explained 65.0% of the variance in agriculture post-test scores. Forward stepwise regression was used to determine $R^2$ change, or additional variance explained by each factor in the model. FCAT reading
level explained the most variance (44.0%). GPA explained 12.1% of the variance, the agriculture pre-test explained 4.9%, grade level explained 2.4%, ethnicity explained 2.1%, and gender explained 1.9%.

Table 4-16. Backward regression analysis to predict agriculture comprehension score.

<table>
<thead>
<tr>
<th>B</th>
<th>SE</th>
<th>β</th>
<th>t</th>
<th>R² change</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>-0.09</td>
<td>0.13</td>
<td>---</td>
<td>-.66</td>
</tr>
<tr>
<td>FCAT reading level*</td>
<td>0.06</td>
<td>0.01</td>
<td>0.36</td>
<td>4.12</td>
</tr>
<tr>
<td>GPA*</td>
<td>0.05</td>
<td>0.02</td>
<td>0.24</td>
<td>2.99</td>
</tr>
<tr>
<td>Agriculture pre-test*</td>
<td>0.36</td>
<td>0.11</td>
<td>0.29</td>
<td>3.41</td>
</tr>
<tr>
<td>Grade level*</td>
<td>0.04</td>
<td>0.01</td>
<td>0.17</td>
<td>2.41</td>
</tr>
<tr>
<td>Ethnicity*</td>
<td>-0.08</td>
<td>0.03</td>
<td>-0.19</td>
<td>-2.84</td>
</tr>
<tr>
<td>Gender*</td>
<td>0.06</td>
<td>0.03</td>
<td>0.15</td>
<td>2.16</td>
</tr>
</tbody>
</table>

*Adjusted $R^2 = 0.65$, $p \leq 0.05$.

**Objective 3: Variance in the Motivation to Read Post-Test**

Objective 3 attempted to describe the variance in the motivation to read post-test explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students. As none of the variables was significantly correlated with the motivation to read post-test, this analysis was not conducted.

**Objective 4: Variance in Comprehension Scores of the Agriculture Post-Test**

Objective 4 described the variance in comprehension scores of the agriculture post-test explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students. Backward stepwise regression was used to select the most appropriate model for predicting the
comprehension portion of the agriculture post-test based upon grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students. Variables initially included in the backward-stepwise regression were treatment group, gender, grade level, ethnicity, SES, GPA, FCAT reading level, and the agriculture pre-test score, coded in the same manner as in Objective 2. Variables needed a significance level of $\alpha = 0.05$ to enter the regression equation, while those with $\alpha \geq 0.10$ were removed.

The regression analysis produced a model consisting of the linear combination of agriculture pre-test, instructional time, GPA, gender, ethnicity, and FCAT reading level to predict the comprehension score, $F(86) = 19.67, p < 0.05$. $R^2$ for the model was 0.42, and the adjusted $R^2$ was 0.39. Table 4-17 shows the variables and regression coefficients for this model. GPA ($t = 3.88, p < 0.05$) and FCAT reading level ($t = 4.08, p < 0.05$) contributed significantly ($\alpha = 0.05$) to predicting the comprehension scores. Ethnicity ($t = -1.78, p < 0.08$) contributed to the model, but was not significant at $\alpha < 0.05$.

Table 4-17. Backward regression analysis to predict comprehension portion of the agriculture post-test\(^a\).  

<table>
<thead>
<tr>
<th></th>
<th>$B$</th>
<th>$SE$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>$R^2$ change</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>0.25</td>
<td>0.09</td>
<td>---</td>
<td>2.61</td>
<td>---</td>
</tr>
<tr>
<td>GPA(^*)</td>
<td>0.11</td>
<td>0.03</td>
<td>0.36</td>
<td>3.89</td>
<td>0.260</td>
</tr>
<tr>
<td>FCAT reading level(^*)</td>
<td>0.08</td>
<td>0.02</td>
<td>0.38</td>
<td>4.08</td>
<td>0.115</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>-0.08</td>
<td>0.05</td>
<td>-0.15</td>
<td>-1.78</td>
<td>---</td>
</tr>
</tbody>
</table>

\(^a\)Adjusted $R^2 = 0.39, p \leq 0.05$.  
\(^*\) $p \leq 0.05$.

The linear combination of these variables explained 39.4% of the variance in the comprehension scores. Forward stepwise regression was used to determine $R^2$ change, or additional variance explained by each factor in the model. GPA explained the most
variance (26.0%), FCAT reading level explained 11.5% of the variance, and ethnicity explained the remainder of the variance.

**Hypothesis Tests**

The dependent variables in this study were the agriculture post-test, the motivation to read post-test score, and the comprehension portion of the individual post-tests. All three of these variables were measured as interval data. The independent variables in the study were the treatment versus the comparison group, number of content area reading strategies, and instructional time. Group assignment was a categorical variable, while the remainder of the variables contained interval data. Constant variables were gender, grade level, ethnicity, and SES. The constant variables were categorical in nature. The covariates were GPA, FCAT reading level, the agriculture pre-test score, and the motivation to read pre-test score. All covariates were interval in nature.

No significant correlations were found between treatment group and the dependent variables, the score on the agriculture post-test and the Adapted Motivations for Reading post-test. Further, treatment group was not a significant factor in explaining the variance for either the agriculture post-test score or the Adapted Motivations for Reading post-test. Thus, no further analyses were conducted on the quantitative data.

**Teacher Interviews**

Upon completion of the treatment, the researcher interviewed the teachers participating in the study to ascertain their attitudes toward using content area reading strategies. The researcher also desired to determine what worked well, what strategies were less effective, and why both of these phenomena occurred in the agriscience classrooms. Teachers were asked a series of questions pertaining to their use of reading strategies during the study, their perceptions of students’ implementation of the reading
strategies, and the personal value that they placed on reading in agriscience. Upon analysis of the interview transcripts, several themes surfaced.

All names have been changed to protect the identity of the teachers and their schools. Charlie and Helen represented teachers in the treatment group, and Elizabeth and Norma represented teachers in the comparison group.

Attributes of Agriscience Teachers and Agriscience Students

Agriscience teachers indicated an interest in helping students learn

One of the first interview questions sought to ascertain why these teachers volunteered or agreed to participate in this reading study. The agriscience teachers in this study portrayed an interest in helping students learn as part of their motivation to participate in the study. Teachers possessed a genuine desire to help students learn about agriculture and improve their overall academic achievement. The teachers mentioned their desire to learn about new content area reading strategies and methods of active engagement with students.

These teachers also understood that some of their students failed to comprehend reading material. Teachers cited personal examples of incidents when student’s failed to comprehend reading:

I’ve noticed throughout when I’ve been teaching one of the things that they have a really difficult time with is summarizing and I think that goes back to the fact that when they read, they’re not getting the main points. They’re not comprehending the main points (Norma, comparison group).

Further, the teachers indicated a desire to demonstrate to their administrators that they were incorporating reading in agriscience and attempting to improve students’ overall academic achievement.
Agriscience teachers stated that content area reading was important

Part of agriscience teachers’ motivation to participate in this study stemmed from their beliefs about reading’s importance to lifelong learning. Teachers viewed agriscience as a content area where the teacher and students could blend reading into a practical context. Several of the teachers indicated that they understood and embraced the importance of content area reading in agriscience. Norma, a comparison group teacher, stated, “I think it’s important . . . , I feel like you need to be literate.” She continued later in the interview,

  Obviously I do feel like I have a role [in developing students’ reading skills], because I’m trying to learn different strategies, because I do see it is a problem with students. I do feel like I’m part of the team. I don’t think that because they’re in ag, they shouldn’t be doing English and math and history and social studies and all that kind of stuff, because really agriculture is a blend of all that . . . . And I feel like I’m really part of the team and even though sometimes the academic teachers don’t feel like ag is important, I understand how important education is and I’ve got a little bit of all of that in agriculture, . . . (Norma, comparison)

Teachers understood the relationship between reading and lifelong learning, especially in careers. Charlie, a treatment group teacher, asserted his perceptions of the importance of content area reading; “I think it’s important because when they get out in a job, it really doesn’t matter what they already know as much as what can they find out on their own when they need it.”

Helen, a treatment group teacher, summarized her feelings about the importance of content area reading and teaching students content. She felt that the use of content area reading strategies was a more efficient method of teaching both from a time and learning standpoint. In fact, the job of the teacher is

  To teach them and make them understand [content], and so if you can find a way that is 1) more efficient and 2) better for them to understand, then you need to do that. And, that’s what I found. I feel like that [reading strategy instruction] was probably the most efficient way that I had ever taught the reproduction part of those
lessons, using those reading strategies. I really did . . . And, I think they understood it better, I really do. I think my students understood [the content] better in that fashion, than the standard here-it-is-let-me-regurgitate-this-information-to-you-and-you-write-it-down (Helen, treatment group).

All of the teachers mentioned their personal role in helping students become better readers. They viewed themselves as part of a team to help students learn and excel. Helen, a treatment group teacher, related the importance of content area reading to the role of the teacher in ensuring that students can read and comprehend.

Number one, reading is important—you have to be able to read. You have to be able to understand the concepts, and you have to vary how those concepts are taught, so that you make sure that every child understands, and not just those geniuses that are sitting there. But that every child needs to be able to understand and I guess that’s . . . why it’s important to have all of those varying [reading strategies], so that you are touching on each student’s ability to absorb that material, ‘cause that’s what you’re supposed to be doing (Helen, treatment group).

**Agriscience teachers incorporated content area reading strategies**

Agriscience teachers desired to become better teachers by incorporating content area reading strategies. Teachers in this study were purposively selected for their ability to deliver the CARS, gather data, and teach. With these qualifications, the teachers acted as professional educators and viewed the study as an opportunity to learn new methods and become better teachers. Thus, teachers in this study were motivated by the opportunity to learn about new methods of engaging students with text and enhancing their comprehension. Charlie, a treatment group teacher, indicated his motivation to participate,

Anything that helps us as ag teachers become more aware of reading strategies and how we can help kids become better readers, we’re expected to do that anyway. So anything we can do to make ourselves better is an important thing and that’s why I chose to do it.

Treatment group teachers incorporated CARS as part of the normal course of teaching. They smoothly blended CARS in delivering content to students. Helen’s
students appeared to enjoy using the reading strategies. They even perceived them as part of the normal routine of instruction. She related an incident in one of her classes that epitomized her perceptions with content area instruction.

You know, the kids at first were real concerned, when you gave them [the informed consent] and they found out they were going to be participating in that study. And we were probably half if not three-quarters of the way through the lesson, and one of the kids raised their hand and asked, “Miss [Helen], remember that study thing you said we were going to be doing? When are we startin’ that?” And I thought that was really funny that here we are, three-quarters of the way through it right now, and oh, OK. The paper really threw them off; they didn’t really understand what they were going to do. You know, what type of guinea pigs they were going to be. It was really funny, I mean, if kids perceived what they were doing as everyday learning, then it must have be right. So, you know, it must have been good stuff (Helen, treatment group).

Teachers desired to participate in this study, because they wanted to learn additional instructional tools with which to teach students. Norma, a comparison group teacher, defined her motivation to participate in the study: “And that’s why I wanted to do this [the study], so I could have a few more tools in my bag, so I could try to get ‘em to do what they’re supposed to be doing.”

Charlie, a treatment group teacher, appreciated being part of the study to learn about new content area and active learning strategies to help his students and help with the study. He stated,

I appreciate being a part of the study and getting the opportunity to do that. I hope I was able to help in some way. I hope that something I was able to do made a difference. I know it’s made a difference in me, because I’ve implemented more science than ever before and now I’m going to implement more reading than ever before in my curriculum. And, I was glad to be a part of it, because it showed me how to implement some of these things [CAR strategies]. It was something I’d already learned from the school, but never learned how to implement them, and I think this has been a good study for that thing. At least it helped me, and from this I think we’ll be able to get some in-service to help teachers if nothing else (Charlie, treatment group).
Agriscience teachers were not avid readers themselves and/or were poor readers

Agriscience teachers were not avid readers and/or were poor readers in high school. While these teachers were motivated to participate in this study, they were not especially strong or motivated readers. Teachers involved in this study demonstrated an inclination to avoid reading in their agriscience courses prior to initiation of the study. The teachers indicated that they took little personal time to read, and suggested that their obligations with teaching agriscience and coordinating FFA activities precluded the time allocated to reading. Norma, a comparison group teacher, noted that she was “a reader, but not like an avid reader . . . a slow reader.” A treatment group teacher Charlie stated that he hated reading in school, yet he understood that reading is a skill, that the lack of reading ability will only be corrected through practice, and that poor readers struggle with reading, but will not engage in reading to improve.

Agriscience courses were populated with students possessing a wide range of reading abilities

During the interviews, teachers noted that their students possessed a wide range of reading abilities, ranging from students who read far below grade level to those with no apparent difficulty in comprehending text. Charlie’s students included “everything from nonreaders to honors students who read at a very high level.” Helen’s classes were no different. She summarized the reading levels of her students:

That class is the basic, basic SED student, this is the only time they are out [in regular classes] the entire day, to the academic honors student, who could probably be already in college, except they want to be in FFA so they haven’t left high school yet. So, there are so many different varying levels of academic ability in that class (Helen, treatment group).

This typified the range of students’ reading abilities in these agriscience courses.
Still, teachers felt that students should have had stronger reading skills prior to entering the secondary classroom. They realized that the range of reading levels in their agriscience courses presented a barrier to learning for many students. However, knowing that these skills were lacking in some students, teachers attempted to use the study and its strategies to improve their students’ reading abilities. A comparison group teacher, Helen, stated, “We have so many different reading levels, that if I could be a better teacher through teaching them a better strategy, then I always want to be a better teacher.”

**Approaches to Instruction in Agriscience**

The teachers used **lecture-discussion, teacher-centered approaches to instruction**

Even though the teachers in this study professed their understanding of and appreciation for the use of content area reading strategies, they indicated a preference for lecture-discussion and teacher-centered approaches to instruction. Elizabeth, a comparison group teacher, felt that students grew frustrated with attempts at active engagement in their learning; “sometimes they get to the point, where it’s like, ‘Just teach me, OK? Just teach me. Tell me a story that I can relate to this.’” Teachers felt that they could make learning more “real” for their students through teacher-centered approaches to learning.

With the treatment group students, Charlie provided an indication about his approach to teaching. He outlined his instruction, “If I read the material ahead and pick out what’s important to them and try to instruct them on what’s important, then when you do some reading, it kind of supports that and they can see that information.” In doing so, he took the lead in ascertaining the important points in the readings.

Yet, one of the treatment group teachers, Helen, felt that the use of reading strategies offered additional learning benefits to her students. She felt that as she
transitioned to a more student-centered approach to learning, the students took more ownership in their learning and thus benefited educationally. She attributed their learning gains to their active engagement and ownership in the lessons when using the content area reading strategies.

I felt like my students comprehended [content], and maybe it’s ‘cause they took a little bit more ownership through [reading strategy instruction]. Um, because they were a little bit more active in laying [content] out . . . I think that they used a lot of different ways to learn the same material, as opposed to me regurgitating the information to them. And, I think you always learn more when you’re more active in that learning (Helen, treatment group).

Though these teachers used activities in their classes, much of their instruction remained teacher-centered and teacher-controlled. Two of the agriscience teachers indicated that even though they had not consciously implemented content area reading strategies in their courses prior to initiation of this study, they had been instructing students using activities “all along” (Elizabeth, comparison group). Their instruction attempted to involve lower ability students in their in-class and out-of-class activities, such as FFA. The teachers used a combination of teacher-centered approaches to story-telling and novel activities to pique students’ interest in the agriscience topics. They believed that this benefited students as well as the school and community.

Norma, one of the comparison group teachers, noted that students could pass her agriscience course without reading much content, or even passing the tests. In her view, the hands-on aspects of her courses offset the aspects including reading, writing, and testing. She appreciated effort in participating, while not necessarily demanding accuracy in reading and writing, or even demonstration of knowledge gain through an assessment.
Reading was minimized in agriscience courses prior to initiating the study

Reading was minimized in agriscience courses prior to initiating the study. It was even a secondary or tertiary learning tool in agriscience courses. All four teachers indicated that prior to the study’s initiation, they did not, at least consciously, implement reading or reading strategies in their agriscience courses. As a treatment group teacher, Charlie’s response typified those of the other teachers, “Prior to this year, [reading has] been a very minimal part,” of his agriscience courses. Later in the interview when asked if he regularly employed CARS in his agriscience courses, he added, “Never; only when they tried to force me to [use CARS and reading]. I thought I would never do it.” When asked if she regularly employed CARS in her agriscience courses, Elizabeth, a comparison group teacher, answered, “Probably not as consciously as I did with that, the study.” Thus, participation in this study appeared to have an impact on teachers’ implementation of CARS in their agriscience courses.

For the agriscience teachers in this study, reading was clearly a secondary or even a tertiary learning activity. Teachers viewed reading as an activity for a substitute, an approach to providing baseline information, or a supplement to their lectures and discussions. Working with the treatment group, Helen suggested that reading was “a supplement or one of the tools for presenting the information.” When asked about the importance of content area reading in agriscience, in the comparison group, Elizabeth stated,

We’re able to provide real life examples having lived agriculture and been a part of agriculture, so there are some readings with certain lessons that are much, much more effective than others. And, with things like reproduction and those types of things, you know, I can give them examples or even show them examples rather than have them read it. Because, again, they’re going to retain that knowledge a whole lot better if they see it, if they see the reproductive tract of a chicken, or whatever. Or even me telling them about it, they’re going to retain that information
a lot better. So, even though I have readings for them or reading that relates to the content, I may or may not use it. Just because I can provide a different example or hands-on example of [the lesson]. Now, sometimes I’ll use [reading] as a unit introduction or something like that, or a part of lecture notes that I may give, but overall, you know, I don’t know that I do a whole lot of readings as far as my lessons go, and I probably should (Elizabeth, comparison group).

When reading was used, teachers indicated that the typical structure of the reading assignment included assigning a chapter to read in the text and questions to answer at the end of the chapter. Students may or may not have taken the book and questions home to complete, and the written answers were usually followed with a class discussion of the assignment on the following day. Charlie, a treatment group teacher, described his lessons,

From time to time we’ll find a unit in the textbook that kind of follows what we’re doing and I’ll assign them the reading and they’ll answer the questions at the back of the chapter or I’ll fix a worksheet that goes along with that unit and they’ll have to find the information in the reading of the paragraphs or whatever. But typically I instruct by discussion or by lecture and them asking questions and response and worksheets following that to make sure they understood what we went over (Charlie, treatment group).

Teachers cited use of reading only or predominantly for when a substitute was covering a teacher’s absence. While teachers felt that they could not trust a substitute to instruct students about a hands-on activity outside of the classroom, they did feel comfortable with leaving a reading assignment with the substitute to keep the students quiet and behaved. Norma, a comparison group teacher, delineated her approach to substitute lessons,

I know when I’m out, I always rely on my textbooks, almost always, because I’ve got a class of 25 kids, there’s very few things I can do with 25 kids outside doing the same thing and keep and eye on ‘em (Norma, comparison group).

She engaged in this teaching practice even though she understood its inherent ill effects on students’ motivation to read.
So I rely on using the textbook, and of course, a substitute is not going to get up there, and they’re not going to lecture, they’re just going to say, “Read this,” and give out a worksheet and do it. And I think that’s a problem, because then, I think the kids get the attitude that the reading’s not important. The reading’s not important, because this is just a busy-work assignment, and I think that’s a problem (Norma, comparison group).

Thus reading appeared to be a substitute for the instruction provided by the agriscience teacher.

Agriscience Teachers and Their Use of Content Area Reading in Agriscience

Agriscience teachers had limited understanding about implementing CARS

Teachers in this study possessed a fundamental knowledge of content area reading strategies. Collectively, they named 24 different CARS or active learning strategies, including boss-secretary, bubble charts, cell diagrams, concept maps, CRIS strategies, discussion, GIST, inside-out circles, Kagan Cooperative Learning structures, KWL, newspaper strategies, outlines, prediction guides, Question Answer Relationships, read-think-write, reading aloud, soap stones, summaries, sustained silent reading, textbook safari, think-aloud, think-pair-share, word walls, and Venn diagrams. This number of strategies equates to approximately six per teacher. While mentioning these strategies by name, teachers exhibited varying degrees of knowledge about how to use the strategies. They also possessed limited confidence in the implementation of CARS.

Through their answers, although not using accurate vocabulary, the teachers indicated limited general knowledge about how to use reading and CARS in agriscience. Several indicated stimulating interest in the reading, activating background knowledge, identifying main points, and summarizing information as key portions to helping students better comprehend what they read. Norma, a comparison group teacher, proposed that she was attempting to generate interest, activate background knowledge, and break
reading into chunks in order to facilitate students’ comprehension. In the treatment group, Charlie understood how he could help students comprehend: “I think that’s the worst part of students’ ability is being able to apply what they learned in the past to what they are reading at that moment that will help them to understand what they are reading.”

Further, teachers indicated that they knew that some learning situations were better suited to using reading as a learning tool than others. Charlie’s comments typified some of the teacher’s understanding of which learning situations and content supported content area reading. He stated,

It depends . . . the lesson will lend itself to certain . . . reading strategies…like a concept map lends itself well to lists of stuff. You know, collapsing those lists into organized charts so you can organize your thoughts on that, so you can understand where [learning] comes from. Think alouds work best if you’ve got some application questions and you’re reading information that’s going to answer those application questions. Then you can think aloud through the process (Charlie, treatment group).

**Agriscience teachers used a variety of other reading materials**

Teachers in the study used a variety of reading materials other than the course textbooks as a means of instructing students. Students read trade magazines, other textbooks, and trade books to supplement instruction. These materials included *A Child Called It* (Pelzer, 1993), *Across the Table*, *Ag Research* magazine, *Bleachers* (Grisham, 2003), *Farm Facts* (American Farm Bureau Federation, 2004), *Farm Press*, *The Foxfire Book* (Wigginton, 1972), *Let’s Roll* (Beamer & Abraham, 2003), *Progressive Farmer*, and *The Science of Agriculture* (Herren, 2002).

Some teachers used reading for a broader coverage of curriculum materials. For example, in the comparison group, Elizabeth instructed her students to read five articles from different locations each nine-week grading period. From these readings, the students summarized and related them to each other.
Teachers Participate in Professional Development Related to Content Area Reading

Agriscience teachers need assistance with implementing CARS

While teachers could name CARS and explain the gist of using them, they lacked a basic knowledge and confidence in using specific reading strategies in their agriscience courses. For example in the comparison group, Norma noted, “I’m not real comfortable with all of [the reading strategies] yet, because I just started using some of these.” She was not sure if she had been using the content area reading strategies in the correct manner, because she had not received feedback on her teaching with the strategies.

In the treatment group, Charlie indicated his deficiencies in using CARS:

I didn’t understand how to do the summaries to tell you the truth. And I think that’s part of what made it unbearable for them, ‘cause I didn’t know exactly how to do it, and I tried to follow the rubric and kind of get an idea of what was wanted and help the kids understand that, but it was difficult for them to do that (Charlie, treatment group).

Since this was the first time that many of these teachers had used CARS, their lack of knowledge and confidence may have been natural.

Part of the lack of confidence and knowledge in use of CARS may stem from a lack of preparation and in-service training in the use of CARS. Agriscience teachers may not be getting the help that they need to instruct students about content area reading strategies and how to improve their reading comprehension skills. Charlie also hinted at this problem:

You know, we’re academic up until the point that you expect them to help you just as much as they do somebody else, but then you’re not. You’re reading teachers right up until the point that they’re going to be required to help you, and then you’re not anymore. You’re important until then, then you’re not important anymore. But as an ag teacher, you get used to that (Charlie, treatment group).
Teachers in the study even defined what they desired in the way of professional development with content area reading strategies. The comparison group teacher Norma stated,

I would like to go to some kind of training where I actually get to sit down and I want them to use my subject matter and show me this is the strategy, here it is. This is what you do. This is how you do it (Norma, comparison group).

In the treatment group, Charlie continued,

What I’ve found from the workshops I’ve been to is that they throw a lot of information at you and don’t show you how to put it to use. And, any workshop that has to do with reading strategies needs to be about developing lessons so that you could see how it [CAR strategies] works. And so have people develop a lesson and teach it. ‘Cause if the teachers have to go through the process that these kids have to go through, I think they’d find out why the kids have trouble with it and why they don’t like it (Charlie, treatment group).

Nearly all of the teachers in this study had participated in intensive content area reading and/or active learning strategy workshops over the previous summer. Workshops included the Florida Reading Initiative training, Kagan Cooperative Learning structures, USA Today workshops, and workshops presented by other teachers within the school. Schools in this study were involved with several reading initiatives, such as the FCAT Connection, Florida Reading Initiative, or Literacy First. The teachers implemented some of the principles and practices from workshops in their classrooms. Helen indicated that part of her motivation to participate in the study stemmed from her school’s current emphasis on reading and the preparation she had received through workshops. Helen, a treatment group teacher, suggested that the strategies in the study “seemed to be some of the things we were trying to do with our students anyhow.”

Pressures to Teach Reading

Strong pressure from administrators and the state department of education motivated teachers to teach to accountability standards and prove that they are
contributing to students’ overall achievement. Each of the teachers in the study noted that part of their motivation to participate in the study stemmed from the pressure from administrators and the FDOE to incorporate reading into all courses, including agriscience. As Helen, one of the treatment group teachers stated, “FCAT drives this cart here and drives everyone’s cart.” Each of the four schools was undergoing intensive professional development and implementation of reading across the curriculum. Teachers in this study participated on school-wide committees to investigate appropriate means of incorporating reading instruction into content areas.

The pressure to use content area reading in agriscience courses was prevalent throughout the four interviews. Elizabeth, a comparison group teacher, stated, “[administrators] are putting the pressure on us to read as well as to implement strategies to help students read in our classroom as well as every academic classroom.” Norma continued this vein of thought: “in our county, reading is a big deal right now, because we did have low test scores.” Charlie’s school was committed to reading and even monitored the number of CARS that teachers used each week.

We have a committee at school that puts together reading assessments to assess the students throughout the year to make sure they’re learning their reading strategies and every teacher is teaching a certain amount of reading strategies . . . [E]very teacher in our school is expected to focus on that strategy that particular week. One week, it’s a certain benchmark and then at the end of each week we assess that particular benchmark in the text, the reading text. In addition to that, you supposed to implement that particular benchmark into your everyday curriculum. I find it very difficult to do that and get anything done . . . Basically, their comment is, ‘Every teacher is a reading teacher’ (Charlie, treatment group).

**Students’ Motivation to Read**

**Student motivation to read was lacking**

Teachers in the study indicated experiencing difficulty in motivating students to read and use content area reading strategies. In the comparison group, Norma noted,
“I’ve tried different things throughout the years, and um, it is like pulling teeth to get these kids to read these textbooks.” She continued,

Oh, it’s like pulling teeth and usually if I follow it up with a written assignment, whether it’s a worksheet, sometimes we’ll do a worksheet, sometimes I’ll do a cooperative activity, but if it’s written work afterwards, like answer the questions at the end of the unit, or if we’re going to discuss ‘em, they just won’t read. They just start immediately from the back. They’ll start answering the questions. They won’t have read it (Norma, comparison group).

With regard to the treatment group, Charlie noted that students appeared to enjoy reading strategies that involved little effort. He stated, “I think kids enjoy doing if they don’t have to do a pile of writing . . . I think a change from time to time and doing that is good. I think doing [reading] every day is ineffective.”

The teachers stated that their students were “inundated with strategies,” thus students preferred using strategies that were easy to use and understand. As such, the teachers felt that students did not like using reading strategies and were overwhelmed with their use in so many courses throughout the school day. One of the treatment teachers, Helen, also noted the variety of strategies in the treatment and the effects on students; “The fact that you alternated the types of reading strategies that you used hit a larger amount of the students in the class . . . I think they enjoyed them all. I didn’t have hardly anybody complain about any of them.”

Helen also provided anecdotal evidence of the impact of content area reading strategies on student achievement in agriscience. She felt that the reading strategies improved the performance of her lower ability students. She stated,

And, really and truthfully, I think that when you look at those test scores and those levels of those kids and the scores that they achieved, I think it helped them. I mean, yeah, some of our scores weren’t necessarily high, but for that particular child, that was a pretty high test score. And I think it was because of those strategies, if that makes sense. I think it helped them grasp the material instead of
saying, ‘Here’s the textbook, read it. Here [are] some notes. OK, now I’m going to test you on it’ (Helen, treatment group).

When teachers were interested in the reading and comfortable with using CARS, they were more effective with motivating students to read and use CARS

Teachers noted that when they were personally interested in reading and understood and adopted a particular content area reading strategy themselves, then their students tended to read and use CARS to a greater extent. The opposite was true as well. When the teacher was disinclined to use reading or reading strategies as learning tools, then their students were difficult to motivate to read or use strategies.

In a comparison group, Elizabeth noted, “I don’t enjoy a KWL chart a whole lot, and I don’t think [the students] do either . . . If I like it, then they like it. If I don’t like it, it’s goin’ to bleed over into them.” Helen also expressed a similar line of thought with the treatment group, “In situations where the teacher’s just give [the students] something so the administration doesn’t yell at them . . . , the kids hate it.” She attended workshops to glean new ideas for learning strategies, such as content area reading, and attempted to return to her classroom to implement those strategies. She knew her enthusiasm would carry over to students. The reason that she attended workshops was

So I take advantage of those things I go to, and I’m excited about ‘em, and I bring it back and make sure that I show my enthusiasm to my kids, and hopefully they’ll be excited about it. That’s what I hope for (Helen, treatment group).

Nearly all of the teachers indicated that for curriculum to be effective in their classrooms, they would need to spend time with a standardized curriculum to adapt it to their own particular style of teaching and preferences for instruction. They also suggested that adopting content area reading strategies followed a similar vein: they would need to adapt content area reading strategies to fit their profile for instruction. For agriscience teachers to adopt content area reading strategies, these teachers suggested that
those reading strategies may have to be renamed to reflect something new to the agriscience teacher community. Elizabeth, a comparison group teacher, stated, “I think if you adopt [a content area reading strategy], that you have to adapt it to you.”

**Teachers indicated that they would continue to implement CARS in agriscience courses**

All of the teachers indicated that they would continue to use some form of CARS in their agriscience courses following the conclusion of the study. Elizabeth, a comparison group teacher, indicated that she would adapt the strategies, but continue to use them with her instruction. Norma, another comparison group teacher, concluded, “Yeah, I’m definitely going to continue to use some of ‘em, ‘cause I do think it helps.” In the treatment group, Charlie understood that he was in a commonplace routine, or rut, with some of his teaching, but learned the value of reading strategies by participating in the study.

>You know, I tend to overuse lecture and discussion, because I’ve got it all organized and it’s easy for me to do, but I have to step out of my comfort zone and work on reading strategies now, and that’s what I plan to do (Charlie, treatment group).

**Summary**

Chapter 4 reported the quantitative and qualitative findings of the study. The findings followed the organizational pattern of the study’s objectives, hypotheses, and interview questions. The objectives were (1) to describe the grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students participating in this study, (2) to describe the variance in agriculture post-test scores explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students, (3) to describe the variance in motivation to read post-test score explained by the linear combination of treatment group, grade
level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students, and (4) to describe the variance in agricultural comprehension scores explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.

For this study, research hypotheses included (1) $H_a^1$: comprehension of agricultural concepts will be significantly greater for secondary agriscience students using reading strategies versus those students using the teacher’s traditional routine in agriscience classes, and (2) $H_a^2$: motivation to read will be significantly greater for secondary agriscience students using reading strategies versus those students using the teacher’s traditional routine in agriscience classes. The interview questions included (1) How do agriculture teachers perceive their role in assisting students in developing reading comprehension skills in agriscience?, (2) What are teacher’s reactions to implementing the content area reading strategies in agriscience?, (3) How do agriscience teachers model good literacy?, (4) What strategies are effective in assisting agriscience teachers in implementing content area reading strategies?, and (5) What are the barriers to reading instruction in agriscience? The findings presented in this chapter will be discussed in further detail in the next chapter. Additional conclusions, implications, and recommendations will also be presented in Chapter 5.
CHAPTER 5
SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

Chapter 1 described the need for research in agriscience about the effect of reading strategies on students’ comprehension of agricultural concepts and motivation to read. Chapter 1 also provided background about secondary reading, content area reading, and agriscience. Definitions of key terms related to reading in agriscience and reading strategy instruction were provided. Chapter 1 also identified the purposes and explained the significance of the study. The primary purpose of this study was to determine the effects of implementing a package of CARS that focuses on the three micro-periods of reading on students’ knowledge of agricultural concepts and motivation to read.

Chapter 2 presented a discussion of theories of reading and research related to reading comprehension, motivation to read, strategy instruction, and variables influencing student reading. Variables discussed included the reading strategy instruction, reading ability, prior reading experiences, and gender.

Chapter 3 explains the methods employed to accomplish the objectives and test the hypotheses of this study. The objectives of this study included:

1. Describe the grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students participating in this study.

2. Describe the variance in agriculture score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.
3. Describe the variance in motivation to read post-test score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.

4. Describe the variance in agricultural comprehension scores explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students.

For this study, research hypotheses included,

\( H_a^1: \) Comprehension of agricultural concepts will be significantly greater for secondary agriscience students using reading strategies versus those students using the teacher’s traditional routine in agriscience classes.

\( H_a^2: \) Motivation to read will be significantly greater for secondary agriscience students using reading strategies versus those students using the teacher’s traditional routine in agriscience classes.

Questions leading the qualitative inquiry include

1. How do agriculture teachers perceive their role in assisting students in developing reading comprehension skills in agriscience?

2. What are teacher’s reactions to implementing the CARS in agriscience? How effective are these efforts?

3. How do agriscience teachers model good literacy?

4. What strategies are effective in assisting agriscience teachers in implementing CARS?

5. What are the barriers to reading instruction in agriscience?

Chapter 3 specifically targets the research design, population, student sample, instrumentation, treatment, data collection procedures, and statistical analyses used in analyzing the data. The independent variables in this study were reading strategy instruction, specifically strategy use in the three microperiods of reading versus the teacher’s normal routine of instruction. The dependent variables in this study were motivation to read and agricultural concept knowledge. The antecedent variables were gender, grade level, ethnicity, and SES. GPA, FCAT reading levels, agriculture pre-test scores, and motivation to read pre-test scores were treated as covariates.
Chapter 4 presented the quantitative and qualitative findings obtained in this mixed-methods study. The results addressed the hypotheses in determining the effect of reading strategy instruction on secondary agriscience students’ comprehension of agricultural concepts and motivation to read. The results also pertained to answering the research questions about how and why secondary agriscience teachers implement CARS in their classrooms.

**Methods**

This study employed a mixed-methods approach to answering research questions. A variation of the nonequivalent control group design (Campbell & Stanley, 1963) was used with the quasi-experimental portion of the study. The independent variables in this study were reading strategy instruction, specifically strategy use in the three microperiods of reading versus the teacher’s normal routine of instruction. The dependent variables in this study were motivation to read and agricultural concept knowledge. The antecedent variables were gender, grade level, ethnicity, and SES. GPA, FCAT reading levels, agriculture pre-test scores, and motivation to read pre-test scores were treated as covariates.

All students enrolled in Agriscience Foundations served as the target population for the study, while the study used a purposively selected sample of students in four Florida high schools as the sample. Teachers were purposively selected for their ability to deliver the treatment, gather data, and teach agriscience content. Teachers, and thus their classes, were randomly assigned to either the treatment or the comparison group. The treatment taught a prescribed set of reading strategies within each of the three microperiods of reading, while the comparison group taught their normal routine of instruction.
Students were taught three lessons from the Florida Agriscience Foundations Lesson Plan Library (FDOE, 2003). The lessons pertained to animal science and included Lesson 06.07: Determining the Anatomy and Physiology of Animals, Lesson 06.06: Meeting the Nutritional Needs of Animals, and Lesson 06.08: Understanding Animal Reproduction. The text used during the lessons was *Agriscience: Fundamentals & Application* (Cooper & Burton, 2002) published by Delmar Publishers.

Measures of motivation to read and agriculture comprehension were gathered with pre-tests and post-tests of each. Data regarding motivation to read were gathered using the Adapted Motivations for Reading Questionnaire (Wigfield & Guthrie, 1997, 2004). The instrument consisted of 14 items and measured motivation along three constructs representing extrinsic motivation, intrinsic motivation, and effort toward reading. Reliability was assessed on the pilot test using the Cronbach’s α, and yielded $\alpha = 0.90$.

Comprehension of agricultural concepts was measured using a pre-test and individual unit quizzes developed for the Florida Agriscience Foundations Lesson Plan Library (FDOE, 2003). Post hoc reliability was assessed using the Kuder-Richardson 20 formula. Post-hoc reliability was $\alpha = 0.87$.

Data were analyzed with the SPSS© for Windows™ statistical package, version 12.0. Analysis of the first objective involved the use of descriptive and correlational statistics, including frequencies, means, standard deviations, and Pearson’s $r$. For objectives 2, 3, and 4, the researcher used backward stepwise regression to address the variance in the dependent variable attributed to the independent variables. Since analysis of correlations and variance procedures failed to yield significance regarding the test variable, no further analyses were conducted.
Summary of Findings

The findings of this study are delineated using the objectives, hypotheses, and research questions outlined in Chapter 1. A discussion of the findings follows.

Teachers in the treatment group used an average of 16.5 CARS and taught the three lessons for an average total of 1570 minutes. Teachers in the comparison group used an average of 29.5 CARS and taught the three lessons for an average total of 1110 minutes. The study used 95 students in total with 47 in the treatment group and 48 in the comparison group.

Research Objectives

Objective 1: Description of Students Participating in This Study

The first objective sought to describe demographic factors related to the students participating in this study. The majority of the students were current ninth grade students (57.9%). An additional 28.4% of the students were enrolled in the tenth grade, and juniors and seniors comprised the remainder of the student sample.

Overall, 61.1% of the students were male, while the remainder, 38.9% was female. The vast majority of the students was white (72.6%), with a substantial portion of Black and Hispanic students and a few Asian students. Most of the student (63.8%) did not qualify for free or reduced lunch programs, while 36.2% of the students did qualify for some form of meal support. This indicates that over one-third of the students were in a lower socioeconomic group.

The overall GPA for the 95 students was a 2.62 out of a possible four grade points, which falls into the “B-” range of grades. Eleven of the students would be considered “A” students, while an additional 47 students would be considered “B” students. One student in the test sample earned a failing GPA.
Over 42% of the students in this study read at the lowest FCAT reading level, Level 1, which is similar to the 43.3% of students who read at this level in the general school population of the schools tested (see Table 5-1). An additional 21% of the students in the study read at Level 2. However, this is much lower than the 29.6% of students reading at level 2 in the general population of those schools in the study. This means that less than 37% of the students in the study read at or above Level 3, compared to just over 27% in the general school population. As Level 3 represents the ability to read “at grade level,” a higher proportion of students enrolled in agriscience courses were reading above grade level than in the general population of those schools in the study.

Table 5-1. School district level FCAT reading levels (n = 1778)

<table>
<thead>
<tr>
<th>Reading Level</th>
<th>Treatment (n = 1119)</th>
<th>Comparison (n = 659)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4.6</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>4</td>
<td>6.0</td>
<td>6.3</td>
<td>6.1</td>
</tr>
<tr>
<td>3</td>
<td>18.0</td>
<td>15.3</td>
<td>17.0</td>
</tr>
<tr>
<td>2</td>
<td>30.4</td>
<td>28.2</td>
<td>29.6</td>
</tr>
<tr>
<td>1</td>
<td>41.0</td>
<td>47.1</td>
<td>43.3</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

aData from 2002-2003 academic school year.

Motivation to read was assessed using a canonical discriminant coefficient loadings score from a questionnaire involving 14 Likert-type items (1 = not like me, 4 = a lot like me). Motivation to read canonical discriminant summated scores could have ranged from 2.30 to 10.51. Overall student motivation to read on the pre-test ranged from 2.60 to 9.40 with a mean of 5.93. Overall student motivation to read on the post-test ranged from 2.60
to 9.00 with a mean of 6.12. This indicates that the motivation to read scores slightly improved over the treatment period. On the pre-test, 29 students (31.5%) indicated that they were currently reading a book, while 27 students (30.7%) indicated they were reading a book at the end of the study.

Researchers analyzed the reliability of the agriculture pre-test using Kuder-Richardson-20, which yielded $r = 0.87$. Overall, students answered 37.6% of the pre-test questions correctly. The three individual lesson quizzes served as the post-tests for agricultural comprehension. Students answered 60.4% of the post-test questions correctly, for a gain of 22.8 percentage points.

A very high correlation was discovered between treatment group and total number of CARS ($r = 0.99$) and a very high negative correlation was observed between treatment group and instructional time ($r = -0.75$). A second very high negative correlation was also discovered between instructional time and number of CARS ($r = -0.79$). These two high negative correlations indicate that teachers using more CARS took much less time to teach the lessons.

Further, a very high correlation ($r = 0.89$) was discovered between the agriculture post-tests and the comprehension assessment portions of those tests. Thus, the overall score on the agriculture post-test was highly correlated with the comprehension portion of the post-test. The comprehension portion of the post-test measured overall achievement nearly as accurately as the overall post-tests.

Substantial correlations were discovered between the FCAT reading level and the agriculture pre-test ($r = 0.61$), the agriculture post-test ($r = 0.66$), and the comprehension assessment portions of the post-test ($r = 0.53$). Students reading on a higher FCAT
reading level tended to score higher on the agriculture pre-test, the agriculture post-test, and the comprehension portion of the post-test. Substantial correlations also existed between the agriculture pre-test and the agriculture post-test ($r = 0.66$) and the comprehension portion of the post-test ($r = 0.50$). As would be expected, these correlations indicate that students scoring higher on the agriculture pre-test tended to score higher on the agriculture post-test and the comprehension portion of the post-test.

Students with higher grade point averages demonstrated a moderate tendency to score higher on the agriculture pre-test, the agriculture post-test, and the comprehension portion of the post-test. Those students also tended to read at higher FCAT reading levels. Moderate correlations were discovered between GPA and the post-test ($r = 0.49$), the comprehension portion of the post-test ($r = 0.44$), FCAT reading levels ($r = 0.42$), and the agriculture pre-test ($r = 0.38$).

Females showed a moderate tendency to score higher on the agriculture post-test and the comprehension portion of the post-test. They also tended to have higher grade point averages. A moderate correlation was observed between gender and the agriculture post-test ($r = 0.33$), GPA ($r = 0.33$), and the comprehension portion of the post-test ($r = 0.34$). Moderate correlations were also observed between grade level and ethnicity ($r = 0.29$).

Students in the comparison group tended to have higher grade point averages and were more likely to be a minority. Low positive correlations were discovered between the treatment group and GPA ($r = 0.23$) and ethnicity ($r = 0.23$). Further, students of minority status also tended to be of lower SES. Low positive correlations were also observed between ethnicity and SES ($r = 0.25$).
Low positive correlations were also observed between total number of CARS used and GPA ($r = 0.24$). This simply means that teachers who used more CARS, the comparison group teachers, tended to teach students with higher grade point averages. However, a low negative correlation was observed between instructional time and GPA ($r = -0.21$). This means that teachers who taught for longer periods of time, the treatment group teachers, tended to work with students of lower grade point averages. Further, a low negative correlation was observed between instructional time and gender ($r = -0.20$). Or, treatment group teachers tended to have more males in their agriscience courses than the comparison group teachers.

Low positive correlations were also observed between gender and FCAT reading ($r = 0.23$). In other words, females tended to read at higher FCAT reading levels. A low negative correlation was observed between ethnicity and the agriculture post-tests ($r = -0.26$) and the comprehension portion of the post-test ($r = -0.24$). Students of minority descent tended to score lower on the agriculture post-tests and the comprehension portions of the test.

**Objective 2: Description of the Variance in Agriculture Post-Test Scores**

Objective 2 sought to describe the variance in agriculture post-test score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading achievement levels of students. The regression analysis produced a model consisting of the linear combination of agriculture pre-test score ($t = 3.41, p < 0.05$), grade level ($t = 2.41, p < 0.05$), GPA ($t = 2.99, p < 0.05$), gender ($t = 2.16, p = 0.05$), ethnicity ($t = -2.84, p < 0.05$), and FCAT reading level ($t = 4.12, p < 0.05$) to predict the overall agriculture post-test score, ($F_{(85)} = 27.26, p < 0.05$), significant at the $\alpha \leq 0.05$ level. $R^2$ for the model was 0.67, and the adjusted $R^2$ was 0.65. The linear
combination of these variables explained for 65.0% of the variance in agriculture post-test score.

Sixty-five percent of the variance in the agriculture post-test score was explained by a combination of the student’s FCAT reading level, GPA, agriculture pre-test score, grade level, ethnicity, and gender. Comparatively, the student’s FCAT reading level and GPA produced the greatest $R^2$ change, 44.0% and 12.1%, respectively. The agriculture pre-test provided an additional 5.9% $R^2$ change, while the remaining factors provided near 2% each. Thus, by knowing a student’s FCAT reading level, GPA, and agriculture pre-test score, one could explain over 60% of the variance in the agriculture post-test score.

**Objective 3: Description of the Variance in the Motivation to Read Score**

Objective 3 sought to describe the variance in the motivation to read score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading levels of students. As none of the variables were significantly correlated with the motivation to read post-test, this analysis was not conducted.

**Objective 4: Description of the Variance in the Agricultural Comprehension Scores**

Objective 4 sought to describe the variance in the comprehension score explained by the linear combination of treatment group, grade level, gender, ethnicity, SES, GPA, and FCAT reading levels of students. Backward stepwise regression was used to select the most appropriate model for explaining the comprehension portion of the agriculture post-test. GPA ($t = 3.89$, $p < 0.05$) and FCAT reading level ($t = 4.08$, $p < 0.05$) contributed significantly ($\alpha \leq 0.05$) to explaining the comprehension portion of the agriculture post-test ($F_{(86)} = 19.67$, $p < .05$). $R^2$ for the model was 0.42, and the adjusted
$R^2$ was 0.39. The linear combination of these variables explained 39.4% of the variance in the comprehension portion of the agriculture post-test.

Thirty-nine percent of the variance in the comprehension portion of the agriculture post-test score was explained by a combination of the student’s GPA, FCAT reading level, and ethnicity. Comparatively, the student’s GPA and FCAT reading level produced the greatest $R^2$ change, 26.0% and 12.5%, respectively. Ethnicity contributed to the model, but was not significant by itself. Thus, by knowing a student’s GPA and FCAT reading level, one could explain over 38% of the variance in comprehension portion of the agriculture post-test score.

**Research Hypotheses**

No significant correlations were found between treatment group and the dependent variables, the score on the agriculture post-test and the Adapted Motivations for Reading post-test. Further, treatment group was not a significant factor in explaining the variance for either the agriculture post-test score or the Adapted Motivations for Reading post-test. Thus, no further analyses were conducted on the quantitative data.

**Research Questions**

Upon completion of the treatment, the researcher interviewed the teachers participating in the study to ascertain their attitudes toward using CARS. The researcher also desired to determine what worked well, what strategies were less effective, and why both of these phenomena occurred in the agriscience classrooms. Teachers were asked a series of questions pertaining to their use of reading strategies during the study, their perceptions of students’ implementation of the reading strategies, and the personal value that they placed on reading in agriscience.
**Question 1: How do agriculture teachers perceive their role in developing students’ reading comprehension skills?**

Teachers expressed their commitment to improve students’ reading achievement, but lacked demonstration of use of CARS in their agriscience courses prior to initiation of the study. During the study, teachers employed many CARS in both the treatment and comparison groups. Teachers attributed this increase in use of CARS to pressures from their school administration, pressures from standardized testing and the state department of education, and knowledge of their participation in a reading study. In essence, they responded as normal agriscience teachers would when pressured to implement a form of teaching for the betterment of student learning.

While these teachers valued reading, they also suggested that they possessed limited knowledge and confidence in the use of CARS in their agriscience courses. These teachers had not practiced teaching by using CARS, and thus were a bit tentative in their use during the study period. However, upon reflection of the efficacy of the CARS in their courses, all teachers stated that they would continue to use CARS in the future.

**Question 2: What are teacher’s reactions to implementing CARS in agriscience?**

Treatment group teachers employed an average of 16.5 CARS and used 1570 minutes of instructional time to teach the three animal science lessons. Comparison group teachers employed an average of 29.5 CARS and used 1110 minutes of instructional time to teach the three animal science lessons. The treatment group teachers appreciated that the CARS were embedded in the lessons, but still felt that they would need to adapt the use of CARS with their lessons in the future. Comparison group teachers felt the need to adapt CARS prior to implementing them in these lessons.
Reactions to the use of CARS by these agriscience teachers were mixed. Treatment group teachers generally felt more positive about the use of the CARS, but felt that perhaps too many were employed during the study. Comparison group teachers attempted many CARS, but developed preferences for those which were easiest to teach and easiest for students to use.

Again, teachers possessed limited knowledge and confidence in the use of CARS with their agriscience instruction. Still, they attempted to use the CARS as prescribed for the treatment group and adapt known CARS to instruction with the comparison group. Upon reflection on their use of CARS with student reading, teachers emphasized ways in which to better utilize and adapt CARS with future instruction.

**Question 3: How do agriscience teachers model good literacy?**

Teachers in this study professed being limited in their reading abilities and in their time available for reading. They were poor readers and/or did not read on a regular basis. Teachers indicated that they had not regularly used reading as a learning tool in their agriscience courses prior to initiation of the study. Still, they did utilize reading from various sources outside of the textbook in their agriscience courses. Due to the lack of observations of actual instruction, how teachers modeled good literacy is difficult to ascertain from this study.

**Question 4: What strategies are effective in assisting agriscience teachers in implementing CARS?**

Teachers in this study possessed limited knowledge of how, when, where, and why to use CARS with their instruction in agriscience. All of the teachers noted a need for further professional development in content area reading and CARS. They specifically focused on how to effectively implement CARS into their classes. Teachers wanted to
know where, how, and why to use CARS with their agriscience courses. Further, these teachers had previously engaged in professional development about active learning strategies involving content area reading. All of the teachers also participated in school-wide initiatives to integrate reading across the content areas.

**Question 5: What are the barriers to reading instruction in agriscience?**

The main barriers to integration of reading instruction in agriscience are the teachers’ limited knowledge and confidence in the use of CARS. Teachers indicated that professional development and time for adapting current curriculum to include CARS would be necessary for their commitment to using them with their agriscience courses. Further, teachers in this study cited few resources outside of the traditional textbook as alternative references for current agricultural reading.

**Conclusions**

The sample of students used in this study was not randomly drawn from the total population of Agriscience Foundations students in Florida. With this limitation in mind, the following conclusions were drawn from the multiple perspectives and data sources in this study.

1. Students enrolled in these Agriscience Foundations classes are generally ninth grade students who are White, male, and not of lower SES.

2. Students enrolled in the Agriscience Foundations course generally read below grade level.

3. At the conclusion of the study, students using CARS read significantly more hours per week for pleasure than students in the comparison group. Students using CARS increase the time per week of reading for pleasure, while students in the comparison group decrease their time for pleasure reading.

4. Students in both experimental groups are generally lacking in motivation to read.
5. White, female, upper grade level students who earn higher grade point averages, FCAT reading levels, and agriculture pre-test scores also score higher on agriculture post-tests.

6. Student characteristics do not significantly impact scores on the motivation to read post-test.

7. White students earning higher grade point averages and FCAT reading levels score higher on the comprehension portion of the agriculture post-test.

8. Prior to initiating the study, the agriscience teachers in this study implemented few or no CARS in their agriscience courses.

9. Agriscience teachers in this study possess limited knowledge of and confidence in using CARS with their agriscience courses.

10. Teachers in the comparison group implement twice as many strategies as teachers in the treatment group and their students arrive at nearly the same level of agricultural comprehension and motivation to read as students in the treatment group.

11. Teachers are under pressure to implement CARS in their agriscience courses.

12. Teachers in the comparison group are motivated to implement a large number of strategies because of their knowledge of and participation in a reading study and the pressures applied by the state and their administration to improve students’ FCAT reading levels.

Discussion and Implications

Objective 1: Description of the Students Participating in This Study

Conclusion 1A: students in Agriscience Foundations are generally ninth graders, White, male, and higher SES

Other researchers (Myers, 2004) have noted the prevalence of non-freshman students enrolled in course specifically designed as an introductory agriscience course, these students could be enrolled in this agriscience course for a variety of reasons. Perhaps these non-freshman students could not fit Agriscience Foundations into their course schedules due to core requirements as freshmen. Or, perhaps the upperclassmen found themselves in need of elective coursework and Agriscience Foundations appeared the best alternative for learning potential. Upper grade level students may have enrolled
in agriscience courses to earn science credit. In any respect, the prevalence of non-freshmen enrolled in Agriscience Foundations, while intriguing, is beyond the scope of this study.

However, the difference in proportions of underclass students, those in the ninth and tenth grades, between the treatment and comparison group is notable. Reading achievement is related to prior reading experiences as well as maturity of life experience. Thus older students should have more advanced reading abilities than younger students.

As a secondary agriscience teacher who uses reading as a method of instructing students, the prevalence of older students in an introductory level course causes problems with instruction. These students have more years of experience reading a variety of text, and thus may be able to comprehend more advanced texts (McKenna & Robinson, 2002). Further, these students may have more agriculture knowledge, making them better able to learn from text (Stanovich & Cunningham, 1993). Teachers need to be aware of these differences so that they can help their students read and comprehend text in agriscience.

**Conclusion 1B: Students read below grade level**

Notable in this study is the low FCAT reading levels of many students participating in the study. Over 60% of the students in this study read at the lowest two FCAT reading levels, while only 11.6% read at the highest two reading levels. This indicates that many students had “limited” or “little” success with Sunshine State Standards in reading (FDOE, 2004b).

Further, while students read below grade level, their earned grade point averages suggest that poor reading ability may not hinder earning high grades in high school courses. This may suggest that teachers do not regularly use reading in their content area courses or they do not assess students with tests that require reading. This finding
suggests that teachers are enabling students to learn without requiring them to read, and in doing so, fail to contribute to advancing their reading abilities.

Agriscience courses appear to disproportionately attract students who read below grade level, thus agriscience teachers must make modifications and use CARS when instructing students to read text. When instructed to read a chapter in an agriscience text, some students may be able to comprehend what they read, but many others (69% in this study) will most likely lack complete understanding of the text, even after reading it. While this study did not delve into particular reading comprehension deficiencies, possible problems for students could arise from a lack of relevant background knowledge, unfamiliar agriscience vocabulary, and the diversity of reading materials in agriscience. By implementing CARS, agriscience teachers may be able to help students activate relevant background knowledge, set purposes for reading, organize information, and summarize content in order to apply knowledge to problem solving in agriscience.

The combination of the large proportion of agriscience students reading below grade level and the grade level at which agriscience texts are written may challenge many readers. While the results of this study are not generalizable beyond the population of student in this research, the study indicates that students enrolled in Agriscience Foundations demonstrate low reading abilities. This is particularly interesting because of the diversity and complexity of reading material that students in agriscience encounter. For instance, the text selected for use in this study, *Agriscience: Fundamentals & Applications* (Cooper & Burton, 2002), had a readability of grade level 13 according to the Fry Readability Graph. This poses inherent challenges to teaching with this text and
could explain some of the frustrations that students and teachers feel when attempting to read, comprehend, and learn from the text.

**Conclusion 1C**: treatment group students read significantly more hours per week for pleasure and increased time per week of pleasure reading

At the conclusion of the study, students in the treatment group were reading significantly more hours per week for pleasure than students in the comparison group. Students in the treatment group increased the time per week of reading for pleasure, while the comparison group students decreased in reading for pleasure. Research (Morgan & Hosay, 1991) has indicated that when students are taught to use CARS, they tend to engage in reading and read a wider variety of texts. Students in this study appeared to reinforce these findings. Students in the treatment group, where CARS were implemented under circumstances that were logical from an instructional standpoint (Ryder & Graves, 1994), allocated more time for school reading and increased the time that they allocated for reading for pleasure.

Agriscience teachers should consider the impact that their actions have on students’ motivation to read. Throwing a large number of strategies at students may have a negative impact on students’ motivation to read and their actual reading behaviors. One possible explanation for the significantly more time reading for school in the treatment group could have been the more intensive focus on reading among treatment group teachers. They may have been implementing strategies more correctly than comparison group teachers, thus students were engaging with text for longer periods of time.

Further the strategic implementation of CARS versus attempting a large number of CARS may have had an impact on students’ motivation to read for pleasure. Students in the treatment group increased the amount of time reading for pleasure more than students
in the comparison group. Teachers in the comparison group may have inadvertently diminished students’ motivation to read by using too many CARS and/or implementing them inappropriately.

As an agriscience teacher, one must consider how students respond to learning from text. By modeling an appreciation for reading and appropriate use of CARS, teachers influence students in their approach to reading and use of strategies (Bintz, 1997; Moje, 1996; NRP, 2000; Readence et al., 1989; Sanchez, 2003; Stephens, 2002). Agriscience teachers are significant factors in the lives of their students, thus when they demonstrate that reading and use of CARS are important to learning, their students may adopt similar approaches to text.

Conclusion 1D: students are generally lacking in motivation to read

Students in both groups were lacking in motivation to read as assessed by the Adapted Motivations for Reading Questionnaire. With a potential range of 2.30 to 10.51 on the Adapted Motivations for Reading Questionnaire, students’ overall motivation to read score on the post-test averaged 6.12. This indicates a low motivation to read where the average student would have suggested that most of the motivation to read statements were “a little different from me,” or slightly unmotivated to read. However, students in the treatment group were reading more books and more hours per week for school and pleasure than the treatment group students.

This study also showed no significant correlation between FCAT reading level and motivation to read, between GPA and motivation to read, or between grade level and motivation to read. Even though a student could read at higher levels or earned higher grade point averages, he or she did not necessarily enjoy reading more than students reading at lower levels or earning lower grades. The lack of a correlation between
motivation and other measures (FCAT reading level, GPA, and grade level) is interesting and conflicts with other research (Choochom, 1995; Guthrie, 2001; Guthrie & Alao, 1997; Hurst, 2004; Knoll, 2000). Further, instruction and implementation of CARS appeared to have no impact on students’ motivation to read. Again, this contradicts other research (Choochom; Guthrie; Guthrie & Alao; Hurst; Knoll), but may be attributed to the duration of the study, the contamination of the comparison group, and/or the teacher’s ability to deliver the treatment.

Agriscience teachers should be aware that students are generally unmotivated to read. This may pose problems when teachers attempt to incorporate reading in their teaching routines. Teachers should be aware that when assigning students to read, they must have a relevant purpose, interest in the content, and appropriate applications for reading in order to attempt to motivate them to read.

The lack of motivation to read contributes to students’ downward spiral of poor reading comprehension episodes (Bean, 2001; Guthrie & Alao, 1997; McKenna et al., 1995). Research (Bean, 2001; Cibrowski, 1995; Readence et al., 1989) has indicated that students begin to struggle with reading and ultimately lose interest in reading as they progress through school. This study demonstrated no significant correlation between grade level and motivation to read, suggesting that these students were uniform in their motivation to read.

Perhaps students’ motivation to read had already declined through earlier grades or the duration of this study prohibited an accurate analysis of students’ motivation to read. Perhaps the hands-on nature of agriscience courses attracted students who were
struggling readers. These students may be seeking an escape from reading-intensive courses.

Research (Choochom, 1995; Guthrie, 2001; Guthrie & Alao, 1997; Hurst, 2004; Knoll, 2000) has indicated that using reading strategies helps students develop confidence and efficacy in reading, thus impacting motivation to engage in reading. This study did not reinforce this conclusion; however students in the treatment group reported reading more hours for school and increased the amount of time that they allocated reading for pleasure more than students in the comparison group. This indicates that the practices associated with reading may have been affected by the treatment of strategic use of CARS in agriscience.

When agriscience teachers help students overcome the barriers to reading and help motivate them to engage with text, they may be contributing to a reversal of reading fortunes for students. Because agriscience is an elective, agriscience teachers may be able to provide motivation to prompt students to read texts other than the textbook. They may also be able to motivate students to read in order to find specific information to solve problems in agriscience. Tying realistic outcomes to reading episodes may enhance students’ motivation to read in agriscience.

Objective 2: Description of the Variance in Agriculture Post-Test

Conclusion 2: demographic factors explain variance in agriculture post-test score

Consistent with previous research in reading, White, female (Donahue et al., 1999; NCES, 2000, 2001; Pomplun & Sundbye, 1999; Wirt et al., 2004), upper grade level (McKenna & Robinson, 2002; Stanovich & Cunningham, 1993; Stewart & Tei, 1983) students who earned higher grade point averages, higher FCAT reading levels, and higher agriculture pre-test scores (Alexander & Kulikowich, 1991) score higher on the
agriculture post-test. The treatment was not a significant factor in explaining variance.

Agriscience teachers should realize that when using text as a teaching tool, White, female, upper grade level students with higher grade point averages, FCAT reading levels, and agriculture pre-test scores will score higher on assessments of agriculture content comprehension.

Agriscience students tend to be a diverse population of students, both in their demographic composition and in their academic abilities. Agriscience teachers must be aware of this and use appropriate teaching methods to encourage learning with students who are not academically high-achievers. All students can benefit from CARS (Meltzer, 2001; Moore et al., 1999) and can learn from reading text.

Objective 3: Description of the Variance in Motivation to Read Score

Conclusion 3: student characteristics do not significantly impact motivation to read

While other research (Choochom, 1995; Guthrie, 2001; Guthrie & Alao, 1997; Hurst, 2004; Knoll, 2000; Morgan & Hosay, 1991) indicates that motivation could be impacted by knowledge and implementation of CARS, the findings of this study fail to generate this conclusion. Perhaps the duration of this study, less than 25 days of instruction in both the treatment and comparison groups, did not allow for a significant impact on students’ motivation to read. Motivation is not easily changed over a short duration, thus perhaps a longer treatment would have had an impact on students’ motivation to read. Agriscience teachers must also know that changing students’ motivation to read will not change quickly, but teachers may have an impact on that motivation if they work to demonstrate the importance of reading and use of CARS to students over a longer period of time.
Objective 4: Description of the Variance in Agricultural Comprehension Scores

Conclusion 4: white students earning higher GPA and FCAT reading levels score higher on comprehension

Students who earned higher grade point averages and higher FCAT reading levels tended to score higher on the comprehension portion of the agriculture post-test. Research (Alexander & Kulikowich, 1991) indicates that students with higher grade point averages and higher pre-test scores will score higher on post-test assessments of comprehension. Further, scores on the comprehension portion in this study were moderately correlated with GPA and substantially correlated with FCAT reading levels. The treatment was not a significant factor in explaining variance.

Because much of learning in the school setting involves reading, one would logically conclude that students with higher grade point averages and higher FCAT reading levels would generate higher scores of comprehension on content area tests. These students are able to discern important information in text, comprehend relationships among key concepts, and summarize information, thus leading them to excel with comprehension tasks involving graphic organizers and summaries of reading.

What is telling from the description of variance is that gender, grade level, and the agriculture pre-test, or background knowledge, did not significantly explain the variance in the comprehension portion scores of the post-test. The post-test was comprised of matching, multiple choice, and short answer questions, plus the comprehension portion. The comprehension portion involved reading a passage and then constructing a concept map or writing a summary. While the scores on the post-test were highly correlated with the scores on the comprehension portion ($r = .891$), scores on the comprehension portion were more equal across gender, grade level, and background knowledge. This means that
assessing student comprehension using more authentic means, such as concept maps or summaries, may provide a more level playing field for students to demonstrate their comprehension of agriculture concepts.

For agriscience teachers this means that they may be able to use more authentic forms of assessment to evaluate student learning. Using the matching, multiple choice, and short answer tests included in many curriculum packages may inadvertently bias grading with regard to gender, grade level, and background knowledge. Assessments of learning that incorporate concept maps and summaries may be relatively easy to create and grade when teachers or curriculum writers provide appropriate grading rubrics. They may also more accurately relate what students know about a given concept or topic.

**Conclusions Regarding the Hypotheses**

$H_a^1$: **Comprehension of Agricultural Concepts**

Several confounding factors arose during the study with regard to the treatment and comparison groups, leading to findings of *no significant difference* between the groups concerning the treatment. Based upon prior research about reading in agriscience (Park & Osborne, 2005), the researcher assumed that the agriscience teachers in the study would not be inclined to implement CARS when not specifically asked to do so in the lesson. Further, the research indicated that agriscience teachers had little knowledge, confidence, or even exposure to CARS, thus those teaches in the control (comparison) group should not have implemented a significant number of CARS during the study.

Because of the pressure to improve student reading from the state department of education, school administrators, and others, these teachers, including those in the comparison group, implemented a large number of CARS during the study. Even while all teachers cited not using reading or CARS prior to the study, the comparison group
teachers implemented nearly twice as many CARS during the study as the treatment
group teachers for whom the number of CARS was prescribed. For the comparison
group teachers, when motivated to implement CARS, they did so at a high rate. In light
of the miscalculation of the number of CARS that comparison group teachers would
implement, the finding of no significant difference between the groups with regard to the
treatment, still posed interesting conclusions.

Compared to students in the comparison group, students in the treatment group did
not score significantly different on measures of agricultural concept comprehension.
Reading is a skill that develops over time with much effort, thus perhaps the treatment
period for this study was too short in duration to warrant a significant difference. Or
perhaps, with the comparison group teachers implementing twice as many reading
strategies as the treatment group teachers, they offset their lack of knowledge and
confidence in using CARS with sheer numbers. Additional research is necessary to
determine the impact of CARS instruction over a longer duration and compared to
instruction that does not implement CARS.

What is interesting is that teachers in the comparison group reported using twice as
many CARS as teachers in the treatment group, yet their students performed equally. In
essence, the comparison group teaches attempted twice as many strategies and worked
twice as hard to accomplish the same learning levels as teachers using a more strategic
implementation of CARS. This raises questions about the efficacy of strategy instruction
by the comparison group teachers. How were strategies taught to students? How long
did teachers attempt to use CARS with each incidence of introduction of the strategy?
Did teachers model appropriate strategy use and provide students with adequate instruction in how and why to use the strategy?

The simple implementation of many CARS in the hopes that one or two help students learn appears to be no more valuable to student learning than using fewer CARS to accomplish the same end. During the interviews, teachers cited the considerable time and effort needed to incorporate CARS into their curriculum. If this is so, agriscience teachers would spend their time, and their students’ time, more wisely if they implemented fewer CARS, but more strategically. Classroom teachers should appraise how, where, and why they use CARS with their instruction to ensure that time and resources are well spent for learning.

$H_2$: Motivation to Read

Again, compared to students in the comparison group, those students in the treatment group reported similar levels of motivation on the Adapted Motivations to Read Questionnaire at the end of the study. For reasons associated with the duration of the study and the effectiveness of CARS instruction by comparison group teachers, motivation to read was not significantly impacted by CARS instruction. What is interesting to note is that students in the treatment group were reading significantly more hours per week for school and had increased their pleasure reading significantly more than students in the comparison group. Thus, while students reported little change in motivation to read, they did exhibit trends toward reading more for school and pleasure. This indicates that the impact of strategic use of CARS may have had an impact on reading behaviors.

This study attempted to ascertain the effects of CARS on students’ comprehension of agricultural concepts and their motivation to read. The use of a quasi-experimental
design necessitated the use of a treatment and a control group. While nothing suggested that the control (comparison) group teachers would have used twice as many strategies as the treatment group teachers, the short duration of this study would have warranted asking control (comparison) group teachers to withhold reading instruction from students. Ethical issues certainly arise, which preempted the use of a strict control in this study, but would have provided a more accurate assessment of CARS instruction in agriscience.

Secondly, the short duration of this study limited its ability to observe the effects of strategic CARS instruction. Reading is a skill that requires time and experience with different kinds of texts for different purposes to develop. Certainly additional time, even a year or more, would have enhanced outcomes and the contributions of this study.

Thirdly, while the researcher conducted a pilot study to analyze and develop quantifiable measure for motivation to read, the instrumentation may have been a limitation regarding its ability to accurately measure student motivation to read. The researcher obtained the instrument from a noted expert on reading motivation, but that expert could provide no evidence of reliability or validity for the instrument. After an exhaustive search of the literature on motivation to read, the researcher concluded that no other acceptable instruments were available. Thus, the researcher conducted the canonical discriminant analysis on the pilot test data.

**Interviews**

In hindsight, interviews with teachers prior to initiation of the study would have provided clues about their use of CARS during the study. Further, interviews would have allowed the researchers to attempt to triangulate why and how teachers used CARS with their instruction. Observations of actual incidents where teachers taught using CARS and focus groups of students who had used CARS would have aided this triangulation
process. The following are the conclusions based upon the interviews that were conducted in conjunction with this study.

**Conclusion 6A: agriscience teachers had implemented few or no CARS**

While the teachers involved in this study valued content area reading, they had implemented little reading and few or no CARS in their agriscience courses prior to initiation of this study. Research (Barry, 2002; Bean, 1997; Durkin, 1978; Irvin & Connors, 1989; Ivey, 2002; Menke & Davey, 1994; Morawski & Brunhuber, 1995) supports the notion that content area teachers generally avoid reinforcing reading as a means and an ends of instruction in their courses. Teachers in this study may have felt inadequate to help students with reading or in their knowledge of CARS, or they may have felt that content area reading infringed upon their instructional time (Barry; Bean; Cresson, 1999; Digisi, 1993; Durkin; Moore et al., 1999; Rhoder, 2002; Snow, 2002; Stewart & O’Brien, 1989). However, these teachers did not cite a lack of importance as one of the reasons that they failed to use reading strategies in their courses. In fact, all teachers in this study attested to the importance of reading for learning agriscience as well as lifelong learning.

The lack of implementation of reading in agriscience courses by these agriscience teachers follows other research regarding the use of reading in agriscience (Park & Osborne, 2005; Stewart & O’Brien, 1989). Teachers in this study instructed students from a teacher-centered approach, which inhibits the active engagement of students in their reading. Teachers also felt that their stories, activities, and ability to make learning about agriculture “real” contributed more to student learning than a student’s own engagement in reading.
Another possible explanation for the lack of reading in agriscience classes surfaced during the teacher interviews. Most of these teachers indicated that they were poor readers and/or did not take time to read. This may mean that, while teachers did report they felt that reading was important, in reality agriscience teachers do not value reading as from a personal or professional standpoint enough to actually read or demonstrate reading to their students. Agriscience teachers who only profess the importance of reading do not impact their students’ motivation to read or comprehension of reading. Reading is a skill that must be modeled in order for students to learn how to comprehend from text and value reading as a method of learning. Thus, the lack of reading habits could well manifest itself in the classroom with teachers’ lack of reading in approaches to instruction and failure to use reading as a learning tool.

Perhaps these teachers realized the wide range of reading abilities in their classrooms, and rather than fight difficult circumstances arising from the diversity of reading abilities, they chose other methods of instruction aside from reading. With such a range of reading abilities from the highest skill level to the lowest, teachers could feel more efficient methods of instruction were appropriate for their students than reading.

Further research is needed into what teachers believe about the foundations of learning. How do agriscience teachers approach learning? What are their notions about students’ active engagement with content? How do teachers make decisions about the methodology used to instruct students in agriscience? Why do they avoid reading?

**Conclusion 6B: limited knowledge of and confidence in using CARS**

Agriscience teachers in this study possess limited knowledge of and confidence in using CARS with their agriscience courses. While teachers named several reading strategies, they expressed only vague notions about how to effectively instruct students
about how to use those strategies. Instead, teachers in this study noted their lack of understanding of how, when, where, and why to use CARS with their agriscience courses.

The lack of knowledge and confidence in using CARS, even when presented in a prescribed and detailed manner in lesson plans, posed another possible confounding factor for this study. Teachers in the treatment group may not have been properly prepared to teach students to use and implement CARS so that they augmented learning and motivation. Teachers cited the notion that their hesitancy to use CARS affected their students’ reactions to the CARS. If this were the reality, then their lack of knowledge and confidence in teaching and implementing CARS may have had a confounding effect on the treatment.

The professed lack of knowledge of and confidence in use of CARS is consistent with other research regarding agriscience teachers’ use of CARS (Park & Osborne, 2005). It is also logical since teachers in this study reported using few or no readings and CARS in their agriscience courses prior to this study. The interviews support this conclusion, as teachers often reflected about ways to improve their instruction and use of CARS in the future. The lack of practice with teaching and using CARS could help explain their hesitation with using them during this study.

This lack of knowledge and confidence in use of CARS may help explain why agriscience teachers tend to avoid reading and using CARS in their courses (Stewart & O’Brien, 1989). Agriscience teachers use instructional strategies and methods that they are comfortable with and shy away from those with which they are less proficient. Thus, for teachers to incorporate additional CARS and use reading to a larger extent, teachers
must become more knowledgeable and confident in their use of CARS and reading as a learning tool. In order to become more knowledgeable and confident in the use of CARS, curriculum should include CARS as learning tools for teachers and students.

Completion of college reading courses may help explain the lack of confidence and knowledge of CARS. Teachers involved with this study may have lacked preparation in content area reading through a content area reading course in college. At least one teacher did not complete a content area reading course because she was not an education major, but had attained alternative certification through processes other than traditional teacher certification. The remainder of the teachers may not have completed a college reading course. They may not have valued the reading course while enrolled in it. Further, content area reading may have been neglected in their teacher education preparatory coursework.

The teachers in this study participated in part because of their interest in learning more about implementing CARS in their agriscience courses. This may be indicative of a need among agriscience teachers for professional development in using CARS. In fact, several of the teachers noted this need during their interviews. Agriscience teachers must learn how to implement reading effectively and use CARS with students in order to help them learn from text. Teacher educators and other education professionals may help fill this need by offering workshops and in-service about content area reading, especially with state and national focus on reading improvement in our students.

**Conclusion 6C: comparison group teachers implement many strategies**

One of the initial findings of this study was that teachers in the comparison group implemented twice as many strategies as teachers in the treatment group, and their students arrived at nearly the same level of agricultural comprehension and motivation to
read as students in the treatment group. Perhaps their own ideals of enhancing student achievement by implementing learning strategies, their participation in training and workshops about content area reading, their school administration’s pressure to focus on reading, and/or their participation in this study motivated these teaches to implement more CARS than the teaches in the treatment group. Regardless of the motivation, comparison group teachers may represent the reality of how agriscience teachers would behave when motivated to implement strategies to improve student learning, that being to implement more strategies than may be necessary in a shotgun approach.

Of interest is why these teachers felt compelled to approach reading enhancement by implementing twice the number of CARS of their own volition compared to the treatment group teaches. What does this say about agriscience teacher’s beliefs about learning? Does quantity of instruction necessarily correlate with quality of instruction?

**Conclusion 6b: pressure to implement reading and CARS in agriscience**

With the status of standardized testing across the country, one readily realizes the pressures that content area teachers, including agriscience teachers, feel to implement content area reading into their courses. Schools and teachers are being held accountable and must demonstrate their contribution to a student’s overall academic achievement.

The agriscience teachers in this study noted the pressures that they feel to implement content area reading and teach CARS in their agriscience courses. They had been asked by their schools to serve on school-wide initiatives to teach reading. Some were required to demonstrate in their daily lessons which CARS were being used and with what frequency. These standards of accountability reinforced the importance of reading, but also created additional pressures for agriscience teachers. How does an
agriscience teacher teach so that state standards in core academic areas are met while teaching their approved curriculum?

As one notes these additional pressures to teach subjects other than the teacher’s own content, one also wonders about the impact that these demands could have on the teacher’s longevity in the profession. How do teachers handle these added pressures? What are they doing to reinforce core academic areas within agriscience? What impact does the context of agriscience have on learning key math, science, and reading competencies? Further research is needed into these and other related questions.

In practice, agriscience teachers should also realize their dual teaching roles of teaching content as well as reinforcing reading concepts and skills. The axiom, *all teachers are teachers of reading*, really holds true for these agriscience teachers. If a teacher does not adopt this approach to instruction, then he or she may be in jeopardy of becoming inadequate in his or her teaching role. Further, to ensure the teacher’s viability, he or she may be required to read materials about teaching method, research effective content area reading strategies for their particular classes, and attend professional development about effective use of reading and CARS in agriscience.

**Conclusion 6F: motivation to implement CARS**

Comparison group teachers were motivated to implement a large number of strategies because of their participation in a reading study and the pressures applied by the state and their administration to improve students’ FCAT reading levels. They stated that part of their motivation to implement so many strategies, more strategies than the treatment group, stemmed from their knowledge of participation in a reading study. They were trying to be helpful and good teachers. One question that arises is if this behavior represents the natural reaction that these teachers would have if their administration asked
them to implement CARS to boost student achievement scores. Based upon the interviews, teachers cited their participation in the study plus the added pressures from their administrators and the state as reasons why they implemented CARS in their agriscience courses.

Evidently these teachers were not averse to implementing CARS in agriscience. Given the power to attempt implementation on their own, the comparison group teachers implemented nearly twice as many CARS as the treatment group teachers with the prescribed curriculum. This gives an indication that with proper motivation, agriscience teachers may be willing to alter their preferred teaching methods and adopt new CARS. As a teacher, though the effort may be great, one must adapt teaching methods to attempt to fulfill the learning needs of students.

**Recommendations for Practitioners**

Based upon the findings of this study, the researcher recommends the following suggestions for practitioners in secondary agriscience education:

1. Because agriscience courses are populated with students possessing a wide range of reading abilities, agriscience teachers must be aware of and address this wide array of reading abilities in their classes by implementing CARS to benefit all students. When using texts, teachers should implement appropriate CARS to assist students in comprehending the information found in the text and applying it to solve problems in agriscience. If agriscience teachers use reading as part of their instruction, they should adapt their approach to instruction to help all students, especially those who read below grade level, to learn from text. Agriscience teachers must adopt the perspective that when they use text, they are teachers of reading.

2. As the study found that implementing a large number of CARS had no significant effect on agriculture post-tests or motivation to read, teachers should take time to implement CARS in a systematic, thoughtful, and planned manner. Further, throwing a large number of strategies at students may have negative effects on students’ motivation to read, thus, teachers would be well-served to think about how and when they implement CARS in agriscience. CARS should be appropriate and pertinent to the reading situations that students encounter.
3. Because agriscience teachers appear to possess limited knowledge and confidence in implementing CARS, they must learn about and model CARS through their college preparation, teacher in-services, and professional development. Further, due to the pressures from the state department of education and local school administrators to teach reading to all students, agriscience teachers must realize that implementing CARS in agriscience may mean attending professional development and/or working with other teachers or reading coaches in the school to develop approaches that effectively incorporate reading and CARS in agriscience.

Based upon the findings of this study, the following recommendations were made for consideration of post-secondary teacher educators in agricultural education:

1. Because the current agriscience teacher population has limited knowledge and confidence in reading and the use of CARS, teacher educators in agricultural education must realize and reinforce the importance of reading and implementation of CARS in methods courses and other preparatory courses for pre-service teachers in order to circumvent the problem.

2. Additionally, teacher educators must work to reeducate current agriscience teachers and equip them with the CARS necessary to assist students in reading. Teacher educators should assess what professional development is currently being utilized by teachers with regard to content area reading. Teacher educators should develop in-service and other professional development that introduces agriscience teachers to three to five CARS on a yearly basis.

3. Professional development should include opportunities for teachers to use the CARS and develop ways to incorporate them into their curricula and instructional repertoires in order to build their confidence in the use of CARS.

4. Teacher educators should explore what and how they model reading behaviors and use of CARS to their students. Because many college courses rely heavily upon reading as a means of learning, college faculty could model appropriate uses of CARS and how to use text for learning in order to expose students to CARS, building their knowledge of how to use CARS.

5. Because CARS that are implemented in a systematic, planned, and thoughtful manner may save teachers time and produce the same effect as implementing a large number of CARS, agriscience curricula should include CARS. Curricula should be developed that incorporates CARS directly into lesson plans and student activities so that teachers are required to spend less time adapting strategies to the content and their own teaching styles.

6. To further assist with the implementation of CARS in a systematic, planned, and thoughtful manner, those teacher educators who author text should incorporate structure and other CARS within the text that help struggling readers comprehend that text.
Recommendations for Further Research

While this study provides conclusions regarding its objectives, hypotheses, and research questions, the study also triggers recommendations for further research, including:

1. How do agriscience teachers model and use reading and CARS in their agriscience courses?

2. What do agriscience teachers believe about content area reading in agriscience? How do those beliefs and attitudes manifest themselves in the secondary agriscience classroom?

3. In agriscience courses, what is the effect of systematic, planned, and thoughtful implementation of CARS on comprehension and motivation to read when compared to a defined control group?

4. What is the effect of CARS instruction on comprehension and motivation to read when students are exposed to the treatment over a longer duration, perhaps a year or more?

5. How does professional development in CARS impact changes in teachers’ knowledge of CARS, confidence in their use, and actual teaching methods in the classroom?

6. How effectively do agriscience teachers implement CARS and reading in agriscience before and after professional development?

7. What is the impact of the pressure to implement reading, math, and science in agriscience courses on teacher retention?
APPENDIX A
CORRESPONDENCE WITH TEACHERS

Letter to Treatment Group Teachers Outlining Responsibilities

October 1, 2004
Dear [Treatment Group Agriscience Teacher],

Thank you for volunteering to assist with my dissertation on reading in agriscience. Your professionalism and concern for bettering instruction for your students is simply tremendous. Agriscience teachers continually amaze me with their willingness to help, grow, and improve themselves on behalf of their students. Thank you for all that you do.

Enclosed you will find what I believe to be all of the necessary documents and/or information to complete your part of this study. After meeting with my doctoral committee, the dissertation experienced a few changes. Secondly, Frances, Ivan, and Jeanne played their part in delaying this process. I apologize for any inconveniences that these delays may have caused you. With this mailing you will find the following:

- Copies of the letters sent to your administrators,
- Institutional Review Board (IRB) informed consent to be completed by each student’s parent/guardian,
- Student assent language to be read to all students participating in the study,
- Descriptions of how to assign student identity codes,
- Demographic Reporting Sheet,
- Individual Lesson Quiz Score Reporting Sheet,
- Teaching calendar / timeline,
- 3 Foundations of Agriscience animal science lessons with curriculum, overheads, handouts, examples, and assessments,
- Agriculture knowledge pre-test,
- Examples of all reading strategies,
- Motivation for Reading questionnaire to be completed prior to starting the lessons and again after the lessons are concluded, and
- Strategy Use Recording Sheet

As the first item of business, it is vitally important that you collect the signed IRB informed consent forms from all students participating in the study. Ideally, this should be done prior to pre-testing students. Further, prior to testing students, you must read the assent script and obtain all students’ verbal willingness to cooperate with the study. Students and their parents are really consenting and assenting to our usage of the student’s data—you would not actually exclude them from instruction while teaching
these lessons. All students will participate in the assessments and quizzes, while you will withhold the data from students not willing to participate in the actual study. Please send me the informed consent forms once you have collected all of them. Further, you can fax or mail me the Demographic Reporting Sheet. The office fax is (352) 392-9585. If you would like, you can also email the Demographic Reporting Sheet, as I will be emailing these documents to you as well.

Also, please send the Scantron© sheets from the Motivations for Reading pre-assessment and the animal science pre-assessment once students have completed them. Make sure that students fill in the appropriate student ID code corresponding to the names and codes that you have assigned to them.

I have enclosed copies of the informed consent forms and the Motivations for Reading assessment. For the individual unit quizzes and other handouts, I have provided copy masters within the lessons.

When teaching these three lessons, you should select one or more of the reading strategies provided within the lessons to teach to students. If, in your normal routine of teaching, you conduct labs, demonstrations, or other teaching methods to help students learn about animal science, please continue to implement those methods while working with this study. I will ask you to document what additional strategies you added to each lesson at the end of the study. As a matter of fact, you may want to mark which reading strategies you use right on the lesson as well as track what additional teaching strategies you used.

Please record each student’s individual quiz scores from the three individual lessons, as broken down on the Individual Lesson Quiz Score Reporting Sheet. I will collect these sheets at the end of the study.

The Motivations for Reading assessment must be completed prior to starting the lessons and again at the end of teaching the final lesson. I will compare each individual student’s scores from the beginning and the end of the study to determine how their motivation to read changed.

We will try to complete all three lessons by Friday, November 18. If you need additional time, please let me know and we will make arrangements. At the end of the study, I will collect the Individual Lesson Quiz Score Reporting Sheet.

You will probably have seen some, if not all of these reading strategies, and know how to implement them. If you have any questions, please feel free to call me at school, (352) 392-0502, extension 223; home, (352) 375-3253; or on my cell phone, (352) 514-3582. You may also email me at tpark@ufl.edu. Thank you once again for your help.

Sincerely,
Travis Park
CALS Alumni Doctoral Fellow
Letter to Comparison group Teachers Outlining Responsibilities

October 1, 2004

Dear [Comparison group Agriscience Teacher],

Thank you for volunteering to assist with my dissertation on reading in agriscience. Your professionalism and concern for bettering instruction for your students is simply tremendous. Agriscience teachers continually amaze me with their willingness to help, grow, and improve themselves on behalf of their students. Thank you for all that you do.

Enclosed you will find what I believe to be all of the necessary documents and/or information to complete your part of this study. After meeting with my doctoral committee, the dissertation experienced a few changes. Secondly, Frances, Ivan, and Jeanne played their part in delaying this process. I apologize for any inconveniences that these delays may have caused you. With this mailing you will find the following:

- Copies of the letters sent to your administrators,
- Institutional Review Board (IRB) informed consent to be completed by each student’s parent/guardian,
- Student assent language to be read to all students participating in the study,
- Descriptions of how to assign student identity codes,
- Demographic Reporting Sheet,
- Individual Lesson Quiz Score Reporting Sheet,
- Teaching calendar / timeline,
- 3 Foundations of Agriscience animal science lessons with curriculum, overheads, handouts, and assessments,
- Agriscience content pre-test, and
- Motivation for Reading questionnaire to be completed prior to starting the lessons and again after the lessons are concluded

As the first item of business, it is vitally important that you collect the signed IRB informed consent forms from all students participating in the study. Ideally, this should be done prior to pre-testing students. Further, prior to testing students, you must read the assent script and obtain all students’ verbal willingness to cooperate with the study. Students and their parents are really consenting and assenting to our usage of the student’s data—you would not actually exclude them from instruction while teaching these lessons. All students will participate in the assessments and quizzes, while you will withhold the data from students not willing to participate in the actual study.

Please send me the informed consent forms once you have collected all of them. Further, you can fax or mail me the Demographic Reporting Sheet. The office fax is (352) 392-9585. If you would like, you can also email the Demographic Reporting Sheet, as I will be emailing these documents to you as well.

Also, please send the Scantron© sheets from the Motivations for Reading pre-assessment and the animal science pre-assessment once students have completed them. Make sure
that students fill in the appropriate student ID code corresponding to the names and codes that you have assigned to them.

I have enclosed copies of the informed consent forms and the Motivations for Reading assessment. For the individual unit quizzes and other handouts, I have provided copy masters within the lessons.

Part of the dissertation that changed a bit was the desire to determine what reading strategies our Florida agriscience teachers traditionally implement in their instruction without prompting. Please teach the enclosed lessons as you would normally teach them.

If, in your normal routine of teaching, you conduct labs, demonstrations, or other teaching methods to help students learn about animal science, please continue to implement those methods while working with this study. I will ask you to document what additional strategies you added to each lesson at the end of the study.

Please record each student’s individual quiz scores from the three individual lessons, as broken down on the Individual Lesson Quiz Score Reporting Sheet. I will collect these sheets at the end of the study.

The Motivations for Reading assessment must be completed prior to starting the lessons and again at the end of teaching the final lesson. I will compare each individual student’s scores from the beginning and the end of the study to determine how their motivation to read changed.

We will try to complete all three lessons by Friday, November 18. If you need additional time, please let me know and we will make arrangements. At the end of the study, I will collect the Individual Lesson Quiz Score Reporting Sheet.

If you have any questions, please feel free to call me at school, (352) 392-0502, extension 223; home, (352) 375-3253; or on my cell phone, (352) 514-3582. You may also email me at tpark@ufl.edu. Thank you once again for your help.

Sincerely,

Travis Park
CALS Alumni Doctoral Fellow
October 1, 2004

Travis Park
University of Florida
P.O. Box 110540, 310 Rolfs Hall
Gainesville, FL 32611-0540

[First Name] [Last Name]
[Title], [School Name]
[Address]
[City], [State] [Zip Code]

Dear [First Name] [Last Name]:

As you know, your agriscience department is one of the best in Florida and the nation. Your students are fortunate to learn from teachers who care about students, who seek out better methods of teaching, and who engage in professional development opportunities to enhance the learning of all students. Consequently, [Agriscience Teacher Name] at [High School] has volunteered to assist with my dissertation study in the Agricultural Education and Communication Department at the University of Florida dealing with reading in secondary agriscience.

The dissertation focuses on implementing content area reading strategies to improve student reading achievement in secondary agriscience. [Agriscience Teacher Name] will be using reading strategies to enhance learning from text in agriscience classes. With feedback from students and teachers, we will be better equipped to prepare teachers with reading strategies that most effectively enhance learning in agriscience.

If you have any questions regarding this study, please feel free to contact me at the University of Florida. I can be reached by telephone at (352) 392-0502, extension 223, or by email at tpark@ufl.edu. Thank you for your support of agricultural education.

Sincerely,

Travis Park
Doctoral Candidate
Letter of Informed Consent

October 1, 2004

Dear Parent / Student,

The purpose of this study is to assess the effectiveness of content area reading strategies in secondary agriscience courses in improving student reading comprehension, motivation to read, and agricultural content knowledge. Your student’s motivation to read and agricultural content knowledge will be assessed at the beginning and the end of the study. These tests will provide you and your student with information about his/her strengths in reading and learning, but will not affect their grade or placement in any classes. We estimate that the assessments will take approximately two class periods to complete.

Your student’s participation is voluntary, however we sincerely hope that he/she will help us with this project. Your student does not have to answer any questions that he/she does not wish to answer, and he/she will not be penalized in any way for not participating in the study. We believe that there are no risks to your student from participating in this study, nor a monetary incentive. Possible benefits of participation in the study include improved content area reading skills and subject matter comprehension. If you have questions about your rights concerning this study, please contact the UFIRB office, P.O. Box 112250, University of Florida, Gainesville, FL, 32611-2250.

Please be assured that all individual responses will be kept strictly confidential to the extent provided by law, and we will not release information that could identify individuals who participate in the study.

You and your child have the right to withdraw consent for your child's participation at any time without consequence. If you have any questions about this research study or the survey, please contact Travis Park by telephone (352) 392-0502, email (tpark@ufl.edu), or Dr. Ed Osborne by email (ewo@ufl.edu). Thank you for your help in this educational endeavor. If you agree to participate in the study, please sign and return this document to your student’s agriscience teacher. Also, please keep a copy of this document for your records.

Sincerely,

Travis Park  Dr. Ed Osborne
Doctoral Fellow  Professor & Department Chair
I have read the procedure described above. I voluntarily give my consent for my child, _______________________, to participate in this study of reading comprehension, motivation to read, and agricultural content knowledge. I have received a copy of this description.

Parent / Guardian  Date  
2nd Parent / Witness  Date 

Student Assent

Effective Reading Strategies for Secondary Agriscience

Good morning, I am agriscience teacher.

We would like to assess your motivation to read and agricultural content knowledge. This assessment will not affect your agriscience grade in any way, nor will it affect any other class grades. We would like for you to take a test, so that we can measure your performance in these areas. You can stop at any time and do not have to answer any questions that you do not want to. Whether you choose to participate in this activity will not affect your grade in any way.

Do you want to participate?
Informed Consent for Agriscience Teacher Interviews

Dear Agriscience Teacher,

The purpose of the study is to determine your attitudes toward reading strategy interventions in secondary agriscience. We estimate that the interview will take approximately one hour to complete.

Your participation is voluntary, however we sincerely hope that you will help us with this project. You do not have to answer any questions that you do not wish to answer, and you will not be penalized in any way for not participating in the study. We believe that there are no risks or benefits to you from participating in this study, nor a monetary incentive. If you have questions about your rights concerning this study, please contact the UFIRB office, P.O. Box 112250, University of Florida, Gainesville, FL, 32611-2250.

Please be assured that all individual responses will be kept strictly confidential to the extent provided by law, and we will not release information that could identify individuals who participate in the study.

You have the right to withdraw consent for your participation at any time without consequence. If you have any questions about this research study, please contact Travis Park by telephone (352) 392-0502, email (tpark@ufl.edu), or Dr. Ed Osborne by email (ewo@ufl.edu). Thank you for your help in this educational endeavor. If you agree to participate in the study, please sign and return this document. Also, please keep a copy of this document for your records.

Sincerely,

Travis Park     Dr. Ed Osborne
Doctoral Fellow     Chair, Professor

I have read the procedure described above. I voluntarily consent to participate in this study of influences on the decision to teach secondary agriscience. I have received a copy of this description.

________________________    ______________________
Participant       Date
Procedures for Collecting Data

Effect of Reading Strategy Instruction on Achievement in Secondary Agriscience

Travis Park  
Agricultural Education and Communication  
P.O. Box 110540  
Room 310 Rolfs Hall  
Gainesville, FL 32611  
352.392.0502 x223  
tpark@ufl.edu  
October 1, 2004

Adolescents entering the adult world in the 21st century will read and write more than any other time in human history. (Moore, Bean, Birdyshaw, & Rycik, p. 3, 1999) The responsibility for teaching reading is a shared one, belonging to all teachers in all subjects (Vacca, p. 187, 2002) and includes promoting active, mindful reading and teaching students to use strategies. (Rhoder, p. 498, 2002)

What’s in it for you, the agriscience teacher?
- Assist students with FCAT reading performance
- Model implementation of reading strategies for your school
- Develop accountability for teaching reading strategies
- Demonstrate leadership among agriscience teachers in Florida
- Help your students learn reading comprehension ➔ a lifelong success skill

Cooperating Teacher Responsibilities
- Assign student identity codes.
- Collect and submit all data (data submission sheet provided).
- IRB informed consent letters.
- 8th grade, or previous year, FCAT reading levels.
- Middle school, or current high school, grade point averages.
- Demographic information (gender, ethnicity, etc.).
- Agriscience Foundations lesson quiz scores.
- Motivation for Reading pre-assessment and post-assessment.
- Teach Agriscience Foundations lessons.
- Return the Individual Lesson Quiz Score Reporting Sheet and the demographic information sheet.
Coding Students:  Cubs High School

<table>
<thead>
<tr>
<th>Agriscience Foundations</th>
<th>Student Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alou, M.</td>
<td>A-1</td>
</tr>
<tr>
<td>Barrett, M.</td>
<td>A-2</td>
</tr>
<tr>
<td>Garciaparra, N.</td>
<td>A-3</td>
</tr>
<tr>
<td>Grudzielanek, M.</td>
<td>A-4</td>
</tr>
<tr>
<td>Lee, D.</td>
<td>A-5</td>
</tr>
<tr>
<td>Maddux, G.</td>
<td>A-6</td>
</tr>
<tr>
<td>Patterson, C.</td>
<td>A-7</td>
</tr>
<tr>
<td>Prior, M.</td>
<td>A-8</td>
</tr>
<tr>
<td>Ramirez, A.</td>
<td>A-9</td>
</tr>
<tr>
<td>Sosa, S.</td>
<td>A-10</td>
</tr>
<tr>
<td>Walker, T.</td>
<td>A-11</td>
</tr>
<tr>
<td>Zambrano, C.</td>
<td>A-12</td>
</tr>
</tbody>
</table>

Agriscience teacher sees the names and code numbers.

Travis Park only sees the code numbers. All data submitted with code numbers only, no names.
# Lesson Plan Calendar

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/1</td>
<td>Letter to administration documenting voluntary participating in reading study</td>
<td>Letter from Travis Park</td>
</tr>
<tr>
<td>10/4</td>
<td>Secure informed consent paperwork Collect background data Assign student identity codes Pre-testing Send scantrons to Travis at UF (Motivations for Reading &amp; Agriculture knowledge pre-test)</td>
<td>IRB informed consent documentation Grade level, GPA, gender, ethnicity, 8th Grade FCAT reading levels, socioeconomic status, documented reading disability Motivations for Reading pre-assessment Agricultural knowledge pre-test</td>
</tr>
<tr>
<td>10/5</td>
<td>Begin teaching Agriscience Foundations curriculum Record lesson quiz scores with student codes assigned on the Individual Lesson Quiz Score Reporting Sheet Teach Lesson 06.07: Determining the Anatomy and Physiology of Animals</td>
<td>Individual Lesson Quiz Score Reporting Sheet Lesson 06.07: Determining the Anatomy and Physiology of Animals</td>
</tr>
<tr>
<td>10/18</td>
<td>Teach Lesson 06.06: Meeting the Nutritional Needs of Animals Record lesson quiz scores with student codes assigned on the Individual Lesson Quiz Score Reporting Sheet</td>
<td>Individual Lesson Quiz Score Reporting Sheet Lesson 06.06: Meeting the Nutritional Needs of Animals</td>
</tr>
<tr>
<td>11/1</td>
<td>Teach Lesson 06.08: Understanding Animal Reproduction Record lesson quiz scores with student codes assigned on the Individual Lesson Quiz Score Reporting Sheet</td>
<td>Individual Lesson Quiz Score Reporting Sheet Lesson 06.06: Understanding Animal Reproduction</td>
</tr>
<tr>
<td>11/19</td>
<td>Post-testing</td>
<td>Motivations for Reading post-assessment</td>
</tr>
<tr>
<td>11/22-24</td>
<td>Travis will pick up final data</td>
<td>All IRB consent forms Individual Lesson Quiz Score Reporting Sheet Motivations for Reading post-assessment</td>
</tr>
</tbody>
</table>

* Instruction can and should include methods other than entirely text-based approaches to learning.

** You may teach for a shorter period of time, but please teach all three lessons by November 19, 2004.

Thank you. ☺
### APPENDIX B
#### DATA REPORTING FORMS

**Demographic Reporting Sheet**

**READING IN AGRICIENCE DISSERTATION: Demographic Reporting Sheet**

<table>
<thead>
<tr>
<th>School:</th>
<th>Sunshine State Standard</th>
<th>Norm Referenced Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student ID</td>
<td>Grade Level: (9 - 12)</td>
<td>GPA</td>
</tr>
<tr>
<td>---------</td>
<td>-------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Individual Lesson Quiz Score Reporting Sheet

School: _____________________________________________________

Instructions: Please write the number of points earned by each student under the appropriate column.

<table>
<thead>
<tr>
<th>Student ID</th>
<th>Lesson 06.07: Determining the Anatomy and Physiology of Animals</th>
<th>Lesson 06.06: Meeting the Nutritional Needs of Animals</th>
<th>Lesson 06.08: Understanding Animal Reproduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Matching</td>
<td>Completion</td>
<td>Short answer</td>
</tr>
<tr>
<td>Poss.</td>
<td>10</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Strategy Use Recording Sheet

Name: ______________________________
School:  ____________________________________

Instructions: Please indicate strategies used during each lesson by placing a check mark in the appropriate box under each column.

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Lesson 06.07: Determining the Anatomy and Physiology of Animals</th>
<th>Lesson 06.06: Meeting the Nutritional Needs of Animals</th>
<th>Lesson 06.08: Understanding Animal Reproduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Interest Approach</td>
<td>Objective 1</td>
<td>Objective 2</td>
</tr>
<tr>
<td>K-W-L</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Making Predictions A-Z</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Anticipation Guide</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Think-Aloud</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Graphic Organizers</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Bubble Cluster / Concept Map</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Classification Map</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Concept of Definition Map</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Frayer Model</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Sequence Map</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Matrices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discussion Web</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cube It!</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lesson 06.07

Determining the Anatomy and Physiology of Animals

Intended Outcome: 06.0: Describe the principles of plant and/or animal nutrient growth and reproduction.
SPS: 06.07: Identify and describe the anatomical systems of animals and the functions of each including major portions.
Sunshine State Standard(s): LAA 1.4, 2.4; LAB 1.4, 2.4; LAC 1.4, 2.4, 3.4; LAD 1.4, 2.4; LAE 1.4, 2.4; SCA 1.4, 2.4; SCB 1.4, 2.4; SCF 1.4, 2.4

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Explain the meaning of anatomy and physiology.
2. Explain the role of cell specialization in organisms.
3. Describe the importance of anatomy and physiology in animal production.
4. List the organ systems of mammals and describe the functions, major parts, and locations of each.
5. Identify the external parts of selected animals.

List of Resources. The following resources may be useful in teaching this lesson:
Recommended Resources. One of the following resources should be selected to accompany the lesson:

Other Resources. The following resources will be useful to students and teachers:

List of Equipment, Tools, Supplies, and Facilities
- Textbook for student use
- Writing surface
- Overhead projector
- Transparencies from attached masters
- Copies of student lab sheets

Terms. The following terms are presented in this lesson (shown in bold italics):
- Anatomy
- Gross anatomy
- Nervous system
- Animal well-being
- Integumentary system
- Organ
- Cell
- Lymph
- Organ system
- Cell specialization
- Lymphatic system
- Physiology
- Circulatory system
- Mammal
- Respiratory system
- Digestion
- Mammary system
- Reproductive system
- Digestive system
- Microscopic anatomy
- Skeletal system
- Excretion
- Muscular system
- Tissue
- Excretory system

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here:

Ask students to describe what functions an animal organism must perform to carry out life processes. List these on the writing surface. Examples include respiration, digestion, and elimination. Next, ask students how organisms are able to carry out these functions—they have body parts or organ systems that make it possible for these functions to occur. Have students name and discuss specific examples, such as the mammary system of a dairy cow secretes milk used as food for her calf as well as for human food. Move from this interest approach into the lesson. Have students read appropriate sections or chapters in the textbooks as homework or during supervised study. Students will also need to refer to the figures with line drawings of anatomical features.

Summary of Content and Teaching Strategies

Objective 1: Explain the meaning of anatomy and physiology.

Anticipated Problem: What is the meaning of anatomy and physiology?

Reading:
- Agriscience … 294
- Agriscience fundamentals & applications … 505-511
- Introduction to livestock and companion animals … 36-39
I. Animals are complex organisms with systems and processes that allow them to carry out activities to remain in the living condition.

A. Anatomy is the study of the form, shape, and appearance of an animal. Since mammals are among the most common animals, most of the information on anatomy will focus on these animals.
   1. Gross anatomy deals with the features that can be seen with the unaided eye. Examples include feet, horns, tails, tongues, and teeth.
   2. Microscopic anatomy deals with the features that can only be seen with magnification. Examples include cells and sperm.

B. Physiology is the study of the functions of the cells, tissues, organs, and organ systems of the living organism.
   1. Physiology includes relationships among functions by different systems of an organism, such as secretion to digestion.
   2. Diseases can cause the systems to fail to work properly.

Have students read sections in the textbook related to this objective. Organize information on the writing surface using student input. Have students keep notes on important issues covered in class. Use TM: 06.07.A or the writing surface to present a definition of the key terms. Have students give examples of anatomy and physiology in animals that they have as companions or for production.

Objective 2: Explain the role of cell specialization in organisms.

Anticipated Problem: What is cell specialization? Why is it important?
Reading:
- Introduction to livestock and companion animals … 33-35
- The science of agriculture: A biological approach … 56-68

II. Cells are the building blocks of organisms. A cell is the basic structure of life. Cells have important structures that allow them to function. Protoplasm within a cell carries out important chemical activities. Multi-cellular organisms have many cells. These cells form specialized systems to carry out life processes.

A. Cell specialization is different in each cell in order to perform unique activities for an organism. Organisms could not exist if all cells were alike.
   1. A tissue is a group of cells that is alike in activity and structure. The functions tend to be specialized such as those in muscles or bones.
   2. An organ is a group of tissues that work together to perform specific functions. Each tissue’s job varies, but by working together the organ carries out its function. Examples of organs include the heart, lungs, and liver.
   3. An organ system is a collection of several organs that work together to perform an activity. Two examples are the respiratory system and digestive system.

B. Cell specialization is important because it makes multi-cellular organisms possible. Without specialization, all cells would be alike. Tissues, organs, and organ systems would not exist. Life processes in multi-cellular organisms would not occur.
Objective 3: Describe the importance of anatomy and physiology in animal production.

Anticipated Problem: What is the importance of anatomy and physiology in animal production?

Reading:
- Agriscience fundamentals & applications … 505-511

III. People who care for animals need to understand the fundamentals of anatomy and physiology.
   A. Practicing the correct nature of anatomy and physiology of an organism promotes animal well-being. Animal well-being is caring for animals so that their needs are met and they do not suffer. Conditions for raising and keeping animals must be considered for their well-being.
      1. Species have different environmental requirements. Animal producers are more effective in meeting these requirements when they know the unique anatomy and physiology of a species. For example, some breeds of cattle are more resistant to extreme temperatures than others. Producing a breed outside its preferred temperature range means that steps need to be taken to provide shade to protect from the heat or housing to protect from the cold.
      2. The design of facilities can accommodate the unique anatomy needs of organisms. The size, shape, and form influences facility arrangement and design. For example, keeping dairy cattle housing clean requires a way to handle animal wastes, including feces and urine. Facility design can help collect and remove wastes from the area.
      3. Young animals require different care than older animals. Feed for young animals should be appropriate to its digestive system and nutrient needs. For example, young animals typically require feed with a higher percentage of protein than older animals.
   B. Animal productivity is based on animal capacity.
      1. Meat animals are required to have muscling in areas that are used to make the higher-priced cuts. Examples include the loin and hams of hogs.
      2. Dairy animals need to have the capacity for high milk production. For example, a dairy cow needs a well-developed mammary system.
      3. Animals used for other products are required to have the capacity to produce those products, including egg-laying capacity of chickens and wool quality of sheep.
      4. Knowing how animals reproduce helps a producer provide conditions that promote reproduction.

Ask students to indicate why they feel knowledge of anatomy and physiology is important to animal producers. Have students tell the importance for the production of
farm animals as well as the keeping of companion animals in the home. Have students relate animal well-being to having a knowledge of the needs of an animal. Students can name examples in the local area where animal well-being is practiced properly and where it is ignored so that the animals are not in a good situation. Outline the major areas on the writing surface or use TM: 06.07.C.

Objective 4: List the organ systems of mammals and describe the functions, major parts, and locations of each.

Anticipated Problem: What are the organ systems of mammals? What are the functions, major parts, and locations of each?

Reading:
- Agriscience … 297-312
- Agriscience fundamentals & applications … 505-511
- Introduction to livestock and companion animals … 185-216
- The science of agriculture: A biological approach … 40-54

IV. A mammal is a vertebrate animal that is usually covered with hair. The females give birth to live young and secrete milk as food for their babies. Cattle, hogs, sheep, horses, dogs, cats, and many other common animals are mammals. Each mammal species has unique organ systems that promote the life processes of the species.

A. Mammal species are said to have eleven organ systems. Some variation may exist, with the greatest being the presence of mammary glands on females.
  1. The skeletal system is the framework that gives shape to the body. The skeleton is comprised of bones and cartilage. The skeletal system protects the delicate internal organs and makes locomotion possible.
  2. The muscular system is the system that makes movement and locomotion possible. Muscles form nearly half the weight of many animals such as hogs and cattle. Without muscles, other organ systems would not function such as the respiratory and circulatory systems. Locomotion would not be possible.
  3. The nervous system is the system that coordinates body activity. It receives and responds to stimuli. It controls activity, learning, and memory.
  4. The circulatory system is the system that moves blood, digested food, oxygen, wastes, and other materials around the body of an organism. It includes the organs that move the blood. The heart moves the blood throughout the body. It goes by the lungs to gain oxygen and give off carbon dioxide acquired from cell respiration.
  5. The respiratory system is the system that moves gases to and from the circulatory system. The purpose is to provide the blood with oxygen and remove carbon dioxide from the blood.
  6. The excretory system is the system that rids the body of wastes from cell activity (known as metabolic wastes). The process of ridding the body of these wastes is known as excretion. Though associated with the elimination of undigested food, the excretory system is not the digestive system. The major products excreted are carbon dioxide, water, and nitrogen compounds.
7. The digestive system is the system that prepares food for use by the body. Digestion is the process of breaking down food materials into molecules that the body can absorb. The system varies depending on the species of organism. Some organisms, such as cattle, have digestive systems that will handle considerable roughage. Other organisms have simple stomachs that require food with higher percentages of protein and digestible materials.

8. The lymphatic system is the system that produces and circulates lymph throughout the body. Lymph is a clear fluid that aids in circulation, excretion, and other body functions. It also helps protect the body from disease.

9. The integumentary system is the skin and outer covering of the body of an organism. It protects the internal organs, helps regulate temperature, and gives shape to the body. The integumentary system keeps disease pathogens away from the internal organs.

10. The reproductive system is the system that produces offspring and continues the existence of a species. The system varies by gender—male and female.

11. The mammary system is the system in female mammals that secretes milk as food for their babies. Male mammals have undeveloped mammary systems.

B. Most animals tend to have the same organ systems except that mammals have mammary systems that are not found in non-mammals. The reproductive system varies by the gender of the animal.

1. The parts of the organ systems have been identified and studied by scientists in anatomy and physiology.

2. Drawings have been made that show the location and structure of the major parts of organ systems. These were prepared by scientists who have studied the anatomy of animals in great detail.

Have students read appropriate sections in the textbooks. Use their input to develop a list of the organ systems, their functions, and a summary of the major parts of each organ system on the writing surface. Refer students to information in the textbook as this objective is developed in class. Use TM: 06.07.D to list the major organ systems and their functions. TM: 06.07.E provides a listing of the major parts for each system. Refer students to line drawings of animals that show the layout and correctly name the different parts of systems. Indicate that the systems tend to be similar from one species to the other. Use sketches on writing surface, line drawings in the textbook, and transparencies to show various anatomical features. TM: 06.07.F is an example that shows the circulatory system of a horse.

Objective 5: Identify the major external parts of selected animals

Anticipated Problem: What are the major external parts of animals?

V. Animal producers must be able to describe animals and use the information in selecting, examining, and providing health care. The descriptions are based on the external parts of the animals.

A. The presence of various qualities in the external parts indicates the value, health, and condition of an animal. This means that animal producers not only know the
names of the parts but they also know the qualities that should be evident upon visual examination of the parts. Animal scientists have prepared line drawings that show the location and name of the external parts of common animals. Samples are included in TM: 06.07.G and LS: 06.07.A.

B. Qualities vary with the species and the way the species is used. For example, cattle raised for beef have qualities that vary from those raised for dairy production. Considerable study is needed to learn the qualities that indicate the desired characteristics of animals.

Have students read appropriate sections in the textbook and study the figures with line drawings that show the locations and names of the major external parts. Sketches on the writing surface or transparencies may be used to illustrate the external parts (an example is TM: 06.07.G). Practice locating and naming the parts is essential for student mastery. Having students observe animal specimens and name the parts is an important strategy in assuring student mastery of the objectives. (Note: More in-depth instruction will be provided when the various species are studied from a production perspective.)

Review/Summary. The review and summary should be organized around the objectives for the lesson. Students should be called upon to orally demonstrate their mastery of the objectives. Review will also be a part of future instruction in the production and care of various species. Questions at the end of the chapter in the textbook will also serve a useful role in the review process. Use observations of student performance as a basis for reteaching areas where students appear not to have achieved satisfactorily.

Application. Application will be achieved throughout the class and other classes as students study animal production. The content of this lesson is fundamental in those classes. Use LS: 06.07.A to provide students with practice in identifying the external parts of an animal. Students will need a textbook or reference that lists the major external parts of a pig for this activity.

Evaluation. Evaluation should be based on student achievement of the objectives. Observe student performance during the instruction as well as later in application opportunities. Review of each student’s notebook will also be useful in evaluation. A written test may be given. A sample test is attached.

Answers to Assessment:
Part One: Matching
1=i, 2=e, 3=a, 4=f, 5=c, 6=d, 7=b, 8=h, 9=j, 10=g

Part Two: Completion
1=integumentary, 2= muscular, 3=skeletal, 4=digestive, and 5=circulatory

Part Three: Short Answer
1. The answer should address the ability of a producer to provide for the well-being of the animal. The answer should also include animal selection for a particular use.
2. The sketch should be compared to that in a textbook or reference and depends upon the species or breed that is drawn. (Students may be instructed to sketch a pig, bovine, horse, or sheep since those sketches are provided in the textbook.)

Part Four: Multiple Choice
1 = d, 2 = b, 3 = a, 4 = c, 5 = b, 6 = d, 7 = a, 8 = a, 9 = d, 10 = b, 11 = b, 12 = a, 13 = b, 14 = c, 15 = d

Part Five: Comprehension
Grading rubric.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>5 pts.</th>
<th>3 pts.</th>
<th>0 pts.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic sentence</td>
<td>Clear, concise topic sentence.</td>
<td>Topic sentences, but does not describe summary.</td>
<td>No topic sentence.</td>
</tr>
<tr>
<td>Organization</td>
<td>Organized. States relationships among cells, tissues, organs, &amp; organ systems.</td>
<td>Some organization. Does not relate all four key concepts.</td>
<td>Little or no organization. No mention of relationships among ideas.</td>
</tr>
<tr>
<td>Collapsed lists and paragraphs</td>
<td>Collapsed information into concise sentences. No mention of examples.</td>
<td>Lack of concise sentences. One or two examples provided.</td>
<td>Failed to collapse information. Three or more examples provided.</td>
</tr>
<tr>
<td>Eliminated unnecessary detail</td>
<td>Unnecessary detail eliminated.</td>
<td>Some unnecessary detail remaining.</td>
<td>Excess unnecessary detail remaining.</td>
</tr>
<tr>
<td>Key points</td>
<td>Key points (cells, tissues, organs, organ systems) clearly delineated.</td>
<td>Mentions key points, but does not delineate.</td>
<td>No key points identified.</td>
</tr>
<tr>
<td>Total Points</td>
<td>25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Assessment

Name_____________________________________

Lesson 06.07: Determining the Anatomy and Physiology of Animals

Part One: Matching
Instructions. Match the term with the correct response. Write the letter of the term by the definition. (1 point/question).

a. animal well-being     f. organ system
b. anatomy      g. excretion
c. physiology      h. digestion
d. tissue     i. lymph
e. organ      j. mammal

_______ 1. A clear fluid that aids circulation, excretion, and other body functions.
_______ 2. A group of tissues that work together to perform specific functions.
_______ 3. Caring for animals so that their needs are met and they do not suffer.
_______ 4. A collection of organs that work together to perform a function for an organism.
_______ 5. The study of the functions of cells, tissues, organs, and organ systems of a living organism.
_______ 6. A group of cells that is alike in activity and structure.
_______ 7. The study of the form, shape, and appearance of an animal.
_______ 8. Breaking down food into molecules that the body can absorb.
_______ 9. A group of animals that are covered with hair, and in which the females give birth to live young and secrete milk as food for their babies.
_______ 10. The process of the body ridding itself of wastes.

Part Two: Completion
Instructions. Provide the word(s) to complete the following statements. (1 point/question).

1. The __________________ system consists of skin and other body covering.
2. The __________________ system makes body movement possible.
3. The __________________ system provides a framework to give the body shape.
4. The __________________ system prepares food for use by the body.
5. The __________________ system moves blood and other materials throughout the body of an animal.

Part Three: Short Answer
Instructions. Provide information to answer the following questions. (5 points/question).

1. Why is knowledge of anatomy and physiology important to animal producers?

2. Sketch the external features of an animal and label the major parts.
Part Four: Multiple Choice

Instructions. Select the best answer for the following questions. (1 point/question).

1. What is the difference between anatomy and physiology?
   a. Anatomy refers to the functions of cells, tissues, organs, and organ systems, while physiology refers to the study of form, shape, and appearance of an animal.
   b. Anatomy is the same as physiology.
   c. Physiology refers to an animal’s physical health, while anatomy refers to the animal’s anatomical features.
   d. Physiology refers to the functions of cells, tissues, organs, and organ systems, while anatomy refers to the study of form, shape, and appearance of an animal.

2. Producers who raise livestock for meat attempt to maximize which organ system?
   a. Circulatory.
   b. Muscular.
   c. Respiratory.
   d. None of the above.

3. Which two organ systems would work together in producing a fast racehorse?
   a. Skeletal and muscular.
   b. Circulatory and reproductive.
   c. Nervous and muscular.
   d. Skeletal and circulatory.

4. When an animal is breathing, which organ systems are primarily involved?
   a. Circulatory.
   b. Skeletal.
   c. Respiratory.
   d. Lymphatic.

5. A barrow that goes lame during transportation to market experiences damage to which organ systems?
   a. Lymphatic and/or muscular.
   b. Muscular and/or skeletal.
   c. Nervous and/or reproductive.
   d. Skeletal and/or excretory.

6. A large volume of blood is necessary for high milk production in dairy cows. Which organ system provides this blood to the udder?
   a. Reproductive.
   b. Circulatory.
   c. Muscular.
   d. Excretory.
7. Ruminants and nonruminants differ in primarily which organ system?
   a. Integumentary.
   b. Reproductive.
   c. Circulatory.
   d. Digestive.

8. Ruminants can digest what kind of feedstuffs because of the specialized organ system from question 7?
   a. Roughages.
   b. Supplements.
   c. Concentrates.
   d. None of the above.

9. In meat livestock, muscle definition is a characteristic of which organ system?
   a. Skeletal.
   b. Digestive.
   c. Integumentary.
   d. Muscular.

10. Body conformation is essential for locomotion and enabling an animal to feed and reproduce. Which two organ systems does conformation primarily refer?
    a. Lymphatic and/or muscular.
    b. Muscular and/or skeletal.
    c. Nervous and/or reproductive.
    d. Skeletal and/or excretory.

11. Animals in confined feeding that live on concrete flooring may have difficulty with which two organ systems due to the stress of the concrete?
    a. Lymphatic and/or muscular.
    b. Muscular and/or skeletal.
    c. Nervous and/or reproductive.
    d. Skeletal and/or excretory.

12. Which of the following represents a tissue?
    a. Muscle.
    b. Heart.
    c. Circulatory.
    d. Blood.

13. Which of the following represents an organ?
    a. Muscle.
    b. Heart.
    c. Circulatory.
    d. Blood.
14. Which of the following represents an organ system?
   a. Muscle.
   b. Heart.
   c. Circulatory.
   d. Blood.

15. Which of the following represents a cell?
   a. Muscle.
   b. Heart.
   c. Circulatory.
   d. Blood.

Part Five: Comprehension
Instructions. Read the following passage about animal nutrition. After reading the passage, create a summary for the passage. (25 points possible). You may use the back of this page for writing your summary.

ANIMAL STRUCTURE AND FUNCTIONS

Knowing body structures and functions helps in raising animals. Whether the animal is large or small, similar conditions are needed. All need a good environment for living.

All animals have similarities. The structure begins with cells—the smallest building blocks in an animal. Groups of similar cells form tissues. Tissues form organs. Organs with similar functions form organ systems. The organ systems form the organism.

CELLS

The cell is the basic building block of life. All living things are made up of cells. Plant cells have walls; animal cells have only membranes. The cell provides information and uses energy.

Probably the most important part of the cell is the nucleus. Within the nucleus are genes that contain complete instructions for the organism. These genes are important in reproduction and in biotechnology uses.

TISSUES
Animals have four kinds of tissue. The four tissues are protective, connective, muscular, and nervous. Tissue is a group of cells that do a specific job. Tissues may be protective, like skin. They may be connective, joining various body parts. Another tissue is muscular and aids in movement. The nervous tissue responds to outside factors and transmits information.

ORGANS

Organs are groups of similar tissues that work together to form a specific function. Animals have many organs, which typically do not work alone, Examples of organs are the heart, liver, and kidney.

Organs form organ systems. The organs work together as a system to do certain activities. Most animals have ten organ systems. Without the systems, the animal could not survive. For example, the circulatory system consists of a heart, veins, arteries, and capillaries. Another example is the digestive system. It consists of the mouth, stomach, intestines, and other parts.
Anatomy and Physiology of Animals

Anatomy—study of the form, shape, and appearance of animals

• Gross anatomy—study of the anatomy features that can be seen with the unaided eye
• Microscopic anatomy—study of the anatomy features that require magnification

Physiology—study of the functions of cells, tissues, organs, and organ systems of a living organism
Building Blocks

Cell—basic structure of a living organism; contains protoplasm which carries out important chemical activities

Cell specialization—differences in cells so that they can perform unique activities

Tissue—a group of cells that are alike in structure and activity

Organ—a group of tissues that work together to perform a specific function

Organ system—a collection of organs that work together to perform a function essential for the living condition
Why Know Anatomy and Physiology?

• promotes animal well-being
• Animal well-being—caring for animals so that their needs are met; animals do not suffer
• consider environmental needs of animals
• provide facilities to meet needs
• provide care based on age and condition
• consider animal production capacity in selection
Organ Systems and Functions

- skeletal—framework for body
- muscular—makes movement and locomotion possible
- nervous—coordinates body activities and respond to stimuli
- circulatory—moves blood and its contents in body
- respiratory—moves gases to and from the circulatory system
- excretory—rids body of metabolic wastes
- digestive—prepares food for digestion and eliminates undigested food materials
- lymphatic—produces and circulates lymph
- integumentary—protects and shapes the body exterior
- reproductive—produces offspring; varies by gender
- mammary—present in female mammals; secretes milk
Major Organ System Parts

• skeletal—bones and cartilage
• muscular—muscles and connective tissues
• nervous—brain, spinal cord, and nerves
• circulatory—heart, arteries, and veins
• respiratory—lungs
• excretory—kidneys, bladder, urethra, and skin
• digestive—mouth, stomach, and intestines
• lymphatic—lymph nodes and lymph vessels
• integumentary—skin, hooves, claws, and other exterior parts
• reproductive—varies by gender—testes in males; ovaries in females
• mammary—milk glands and udder
Circulatory System of a Horse
Major External Parts of a Bovine (Beef Animal)

Artwork supplied with permission of Interstate Publishers, Inc.
Lab Sheet

External Parts of a Pig

Purpose:
The purpose of this activity is to help students master the external anatomy of a pig.

Supplies/Equipment:
You will need a textbook or reference book that identifies the major external parts of a pig.

Safety:
No safety hazards should be involved with this activity.

Procedure:
Correctly label the twelve numbered external parts of the pig shown below. Write the common name of the part in the space provided that matches the number of the part.

1. ___________________  2. ____________________  3. ____________________
4. ___________________  5. ____________________  6. ____________________
7. ___________________  8. ____________________  9. ____________________
10. ___________________ 11. ____________________ 12. ____________________

[Diagram of a pig with labels for external parts]
Lesson 06.06

Meeting the Nutritional Needs of Animals

Intended Outcome: 06.0: Describe the principles of plant and/or animal nutrient growth and reproduction.

SPS: 06.06: Identify the nutrients required for animal growth and development and role of each.

Sunshine State Standard(s): LAA 1.4, 2.4; LAB 1.4, 2.4; LAC 1.4, 2.4, 3.4; LAD 1.4, 2.4; LAE 1.4, 2.4; SCA 1.4, 2.4; SCB 1.4, 2.4; SCF 1.4, 2.4

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Explain the functions of feed.
2. Identify the various feed types and their characteristics.
3. Explain how animals are fed.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:


Other Resources. The following resources will be useful to students and teachers:


List of Equipment, Tools, Supplies, and Facilities

- Writing surface
- Overhead projector
- Transparencies from attached masters
- Copies of student lab sheets

Terms. The following terms are presented in this lesson (shown in bold italics):

Animal proteins Free access Nodules
Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Have samples of corn, soybean meal, and hay placed in front of the class. Ask the students to make a list of the similarities and differences between the three types of feed. Make a class list of similarities and differences on the board. Tell the students to keep their lists and to refer back to it as the lesson progresses.

**Summary of Content and Teaching Strategies**

Objective 1: Explain the functions of feed.

Anticipated Problem: What are the functions of feed?

Reading:
- Agriscience … 317-320
- Agriscience fundamentals & applications … 511-518
- Introduction to livestock and companion animals … 57-58, 68-70
- The science of agriculture: A biological approach … 243-245

I. The nutritional needs of animals change throughout the animal’s life. The amount and type of feed depends on the stage of life and use of the animal. The feed consumed by the animal is used for various purposes. These uses or functions can be categorized into the following groups.

A. Maintenance—Maintenance is keeping the body at a constant state. There is no loss or gain of weight. Every second an animal is alive it requires energy. The amount of energy needed by an animal for maintenance is known as the basal maintenance requirement. A maintenance diet is usually high in carbohydrates and fats. It should contain a small amount of protein, minerals, and vitamins. On average, about 50 percent of an animal’s diet is used for maintenance.

B. Growth—Growth is defined as the increase in size of the muscles, bones, internal organs, and other parts of the body. Animal growth requires mostly energy and smaller amounts of other nutrients. Very high levels of carbohydrates and fats in the animal’s diet provide this energy.

C. Reproduction—Proper nutrition is the key to successful and efficient reproduction in animals. Most reproductive failures are caused by poor nutrition in the female. A proper reproduction ration typically includes
higher levels of protein, minerals, and vitamins. This is especially needed in the last three months of gestation (pregnancy) because this is when the fetus or unborn offspring experiences the most growth. Poor nutrition also affects males. A lack of proper nutrients can lower sperm production and fertility rates.

D. Lactation—Lactation is the production of milk. The nutrient requirements for moderate to heavy milk production are greater that the requirements during gestation. A lactation ration requires even higher levels of protein, calcium, and phosphorus.

E. Work—A work ration is needed by animals that are expected to conduct all types of work and activity for the operation. Examples could include draft animals, racehorses, and hunting dogs. These animals require increased carbohydrates and fats.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the functions of feed. Chapter 3 in Introduction to Livestock and Companion Animals is recommended. Use TM: 06.06.A to aid in discussion.

Objective 2: Identify the various feed types and their characteristics.

Anticipated Problem: What are the various feed types?

Reading:
- Agriscience … 321-339
- Agriscience fundamentals and applications … 516-518
- Introduction to livestock and companion animals … 70-72

II. A feedstuff is an ingredient used in making the feed for animals. Feed is what animals eat to get nutrients. Feedstuffs can be added to feed to provide flavor, color, or texture to increase palatability. Palatability is how well an animal likes a feed. A feed high in nutrients is of no benefit if the animal refuses to eat it. Feeds can be placed into three basic categories. They are:

A. Roughages—Livestock feeds that contain more than 18 percent crude fiber when dry are called roughages. The type of feed is mostly leaves and tender stems of plants. These plants are also known as forages. Forages can be grouped into two general classes: legume roughages and nonlegume roughages.

1. A legume is a plant that can take nitrogen from the air. These plants specialized root parts called nodules, contain bacteria that aid in this process. All of the clovers, as well as alfalfa, soybeans, trefoil, lespedeza, peas, and beans are legumes.

2. Nonlegume roughages cannot use the nitrogen from the air. They are usually lower in protein than the legume roughages. Some examples of this type of roughage are: corn silage, fodders, bluegrass, timothy, redtop, bromegrass, orchard grass, fescue, and prairie grasses.
B. Concentrates—Livestock feeds that contain less than 18 percent crude fiber when dry are called concentrates. This type of feedstuff is high in energy. Concentrates have more energy per pound than roughages. Higher producing animals need more nutrients from concentrates.
   1. High-energy concentrates are feeds that contain less than 20 percent crude protein. Some common sources of high-energy concentrates are corn, wheat, sorghum, barley, rye, and oats.
   2. High-protein concentrates are feeds that contain 20 percent or more protein. Examples of high-protein concentrates are soybean meal, cottonseed meal, and sunflower meal.

C. Supplements—A supplement is a feed material high in a specific nutrient. Supplements are often added to feeds to increase protein content. Protein supplements can be divided into two groups based on the source of the protein.
   1. Protein supplements that come from animals or animal by-products are called animal proteins. Common animal proteins are tankage, meat scraps, meat and bone meal, fish meal, and blood meal. Tankage is animal tissues and bones from animal slaughterhouses and rendering plants that are cooked, dried, and ground. Most animal proteins contain more that 47 percent crude protein. Animal proteins contain a more balanced amount of the essential amino acids than do the other type of protein supplements.
   2. Protein supplements that come from plants are called vegetable proteins. Common vegetable proteins are soybean oil meal, peanut oil meal, and corn gluten feed. Most vegetable proteins contain less than 47 percent crude protein.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the various feed types. Chapter 3 in Introduction to Livestock and Companion Animals is recommended.

Objective 3: Explain how animals are fed.

Anticipated Problem: What are some ways to feed animals?

Reading:
- Agriscience … 342-343
- Introduction to livestock and companion animals … 74-75

III. How and when animals are fed is an important portion of animal production. This affects the growth and development of the animal. Animals need to consume the correct amount of the ration without overeating, which can cause health problems as well. There are two basic methods in which feed can be provided to animals: free access and scheduled feeding.

A. Free access or free choice is allowing animals to eat feed when they want feed. The feed is available to the animal at all times. This method is good
for some species and with some feedstuffs but not others. For example, swine can be fed concentrates free access because they will not overeat. However, cattle should not be fed concentrates free access because they will overeat and could possibly founder and die.

B. Scheduled feeding is providing feed at certain times of the day. Feeding times and regularity should be based on the needs of the animal or management practices.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding how animals are fed. Chapter 3 in Introduction to Livestock and Companion Animals is recommended.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at end of chapters in the textbook may also be used in the review/summary.

Evaluation. Focus the evaluation of student achievement on mastery of the objectives stated in the lesson. Measure student performance on classroom participation, laboratory assignments, and written tests or quizzes.

Answers to Assessment:
Part One: Matching
1 = e, 2 = a, 3 = b, 4 = f, 5 = g, 6 = j, 7 = h, 8 = i, 9 = d, 10 = c

Part Two: Completion
1. 47 percent
2. greater
3. energy
4. source
5. overeat

Part Three: Short Answer
See Objective 2 in lesson for scoring.

Part Four: Multiple Choice
1 = a, 2 = c, 3 = c, 4 = b, 5 = d, 6 = d, 7 = c, 8 = a, 9 = b, 10 = a, 11 = b
Part Five: Comprehension
Grading rubric. Total points possible = 28 points. For any missing element (title or bulleted information), subtract 1 point.

**Nutrients**
- Substance required for life
- Needs vary based on type and size of animal, life span

**Water**
- Obtained from drinking or feed
- Helps transport other nutrients

**Fats, or lipids**
- Provide energy
- Carry vitamins
- Form chemicals in the body

**Protein**
- Building material
- Growth of muscles, tissues, bones
- Repair damage to cells
- Weight gain, growth & preproduction

**Carbohydrates**
- Simple or complex
- Provide energy
- 75% of diet
- Fiber

**Vitamins**
- Very small amounts for specific functions
- 16 vitamins are required
- Vitamin A, D, E, K, & B-complex vitamins
- Ruminants produce some vitamins in the rumen

**Minerals**
- Required by skeletal system
- Largest amounts = calcium & phosphorus
Assessment

Name_____________________________________

Lesson 06.06: Meeting the Nutritional Need of Animals

Part One: Matching
Instructions. Match the term with the correct response. Write the letter of the term by the definition. (1 point/question).

a. Basal maintenance requirement  f. Roughages
b. Feedstuff  g. Tankage
c. Growth  h. Free access
d. Palatability  i. Feed
e. High-energy concentrates  j. Maintenance

_____ 1. Feeds that contain less than 20 percent crude protein.
_____ 2. The amount of energy needed by an animal for maintenance.
_____ 3. An ingredient used in making the feed for animals.
_____ 4. Livestock feeds that contain more than 18 percent crude fiber when dry.
_____ 5. Animal tissues and bones from animal slaughterhouses and rendering plants that are cooked, dried, and ground.
_____ 6. Keeping the body at a constant state.
_____ 7. Allowing animals to eat feed when they want.
_____ 8. What animals eat to get nutrients.
_____ 9. How well an animal likes a feed.
_____ 10. The increase in size of the muscles, bones, internal organs, and other parts of the body.

Part Two: Completion
Instructions. Provide the word(s) to complete the following statements. (1 point/question).

1. Most vegetable proteins contain less than ________________ crude protein.
2. The nutrient requirements for moderate to heavy milk production are ________________ than the requirements during gestation.
3. Animal growth requires mostly ________________ and smaller amounts of other nutrients.
4. Protein supplements can be divided into two groups based on the ________________ of the protein.
5. Swine can be fed concentrates free access because they will not ________________. 
Part Three: Short Answer
Instructions. Provide information to answer the following question. (5 points/question).

1. Compare and contrast roughages and concentrates.

Part Four: Multiple Choice
Instructions. Select the best answer for the following questions. (1 point/question).

1. If a producer were feeding steers for weight gain, which of the following functions would the feed perform?
   a. Maintenance and growth.
   b. Growth and work.
   c. Reproduction.
   d. None of the above.

2. If a different producer were feeding replacement gilts that were soon to be bred, which of the following function(s) would the feed perform?
   a. Reproduction.
   b. Growth and reproduction.
   c. Growth and lactation.
   d. All of the above.

3. How is a feedstuff selected for maintenance the same as a feedstuff for growth? Both contain high amounts of ________________.
   a. Carbohydrates.
   b. Fats.
   c. Carbohydrates and fats.
   d. Calcium and phosphorus.

4. How is a feedstuff selected for work different from a feedstuff for lactation?
   a. A feedstuff for work is high in carbohydrates and fats, while a feedstuff for lactation is high in fats only.
   b. A feedstuff for work is high in carbohydrates and fats, while a feedstuff for lactation is high in protein, calcium, and phosphorus.
   c. A feedstuff for work contains a lot of energy, while a feedstuff for lactation contains a lot of carbohydrates.
   d. There is no difference.

5. Why would a high-protein concentrate be fed to livestock?
   a. Maintenance.
   b. Growth.
   c. Work.
   d. Lactation.
6. Which of the following animals would a producer feed high-energy concentrates?
   a. Milking cows.
   b. Replacement heifers.
   c. Laying hens.
   d. Feeder pigs.

7. In the above question, why would the producer feed the high-energy concentrate?
   a. Lactation.
   b. Work.
   c. Growth.
   d. Reproduction.

8. For a riding mare (female horse) that is in gestation, which of the following would be an appropriate mix of feedstuffs?
   a. Roughages, protein concentrate, vitamin supplements, and energy concentrate.
   b. Roughages only.
   c. Concentrates only.
   d. Roughages, vitamin supplements, and fiber.

9. Which of the following feedstuffs would contain the highest energy content?
   a. Nonlegume roughages.
   b. Concentrates.
   c. Supplements.

10. Why would a producer feed dairy cows a ration containing roughages, concentrates, and supplements?
    a. Roughages for fiber, concentrates for lactation, and supplements for calcium and phosphorus.
    b. Roughages for nitrogen, concentrates for work, and supplements for protein.
    c. Roughages for energy, concentrates for protein, and supplements for nitrogen.
    d. Roughages for lactation, concentrates for reproduction, and protein supplements.

11. Which of the following types of livestock should be feed free-choice?
    a. Draft horses.
    b. Feeder steers.
    c. Over-weight heifers.
    d. None of the above.

Part Five: Comprehension
Instructions. Read the following passage about animal nutrition. After reading the passage, create a concept map. (28 points possible). Use a piece of notebook paper upon which to construct your concept map.
NUTRIENT REQUIREMENTS

A nutrient is any substance required for life. Animals need six types of nutrients: water, protein, carbohydrates, fats, vitamins, and minerals. Some scientists include a seventh—air. Nutrient needs vary based on the type and size of animal, as well as the life stage they are in. For example, a lactating cow (producing milk to feed her young) requires more feed.

Water may be obtained from drinking and from the feed given animals. Water is the major portion in cells and helps transport other nutrients.

Protein is the building material. It is needed for the growth of muscles, tissues, and bones, Protein also helps repair damage or injury to cells. Protein is important for weight gain, growth, and reproduction.

Carbohydrates may be simple or complex. They provide energy for all animals. Carbohydrates should make up about 75 percent of an animal’s diet. Carbohydrates also provide fiber, which helps the digestive system run more smoothly. Ruminants can digest this fiber; non-ruminants cannot.

Fats, also called lipids, are part of animal cells. They provide energy and carry some vitamins. They also help form certain chemicals used in body functions.

Vitamins are nutrients required in very small amounts for specific functions. Sixteen known vitamins are required. These include vitamins A, D, E, K and the B-complex. Ruminants can produce some vitamins within the rumen.

Minerals are chemical elements required by the skeletal system. Other systems also require minerals. The minerals needed in the largest amounts are calcium and phosphorus.
Functions of Feed

Lactation
Work
Reproduction
Growth
Maintenance
Lesson 06.08

Understanding Animal Reproduction

Intended Outcome: 06.0: Describe the principles of plant and/or animal nutrient growth and reproduction.
SPS: 06.08: Describe the process of animal reproduction.
Sunshine State Standard(s): LAA 1.4, 2.4; LAB 1.4, 2.4; LAC 1.4, 2.4, 3.4; LAD 1.4, 2.4; LAE 1.4, 2.4; MAA 1.4, 2.4, 3.4, 4.4; MAB 1.4; MAE 1.4, 2.4, 3.4; SCF 1.4, 2.4; SCH 1.4, 3.4

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:
1. Describe the importance and process of animal reproduction.
2. List the sexual classification of animals for major species.
3. List the parts and explain the functions of female and male reproductive systems.
4. List and describe the phases of the estrous cycle.
5. Explain the reproductive development of animals.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Other Resources. The following resources will be useful to students and teachers:

List of Equipment, Tools, Supplies, and Facilities
- Textbook for each student
- Writing surface
- Overhead projector
- Transparencies from attached masters
Terms. The following terms are presented in this lesson (shown in bold italics):

- Anestrus
- Artificial insemination
- Castration
- Cervix
- Copulation
- Diestrus
- Egg
- Ejaculation
- Estrous cycle
- Estrus
- Fertilization
- Gestation
- Heat
- Insemination
- Lactation
- Libido
- Metestrus
- Natural insemination
- Neutering
- Ovary
- Oviduct
- Parturition
- Penis
- Proestrus
- Prostate gland
- Puberty
- Reproduction
- Scrotum
- Semen
- Seminal glands
- Seminal vesicles
- Sexual classification
- Sexual reproduction
- Sperm
- Sperm ducts
- Steer
- Testicles
- Uterus
- Urethra
- Vagina
- Vulva

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Ask students to explain how a cattle producer increases the size of the herd. Students may name methods such as buying cattle from someone else or breeding the cattle that are owned. Have students assess which alternative would be used if money was not available to buy animals. Ask students to relate examples of animal reproduction on farms, with companion animals, or with laboratory or exotic species. Move from the interest approach into the objectives of the lesson and its content.

**Summary of Content and Teaching Strategies**

Objective 1: Describe the importance and process of animal reproduction.

Anticipated Problem: Why is reproduction important? What is the process of animal reproduction?

Reading:
- Agriscience … 368-371
- Agriscience fundamentals & applications … 539-540, 547-550
- Introduction to livestock and companion animals … 113-117
- The science of agriculture: A biological approach … 219-222

I. Reproduction is the process by which animals produce offspring.
   A. Offspring are the same species and have traits of their parents.
      a. Parents are selected and mated to achieve certain goals with offspring. Examples of goals include producing offspring with high milk productivity or meaty carcasses.
      b. Reproduction results in new animals that are raised for the products they produce. Examples of products include meat, eggs, milk, and wool.
Most animals are produced with sexual reproduction. Sexual reproduction is the union of a sperm and an egg. Two parents are required.

1. Sperm is the sex cell of male animals. They are produced in the testes.
2. The egg or ovum is the sex cell of female animals. They are produced in the ovaries.

Fertilization is the process by which the union of a sperm and an egg occurs. It is also known as conception.

1. The union of the sperm with the egg occurs in the reproductive tract of the female. The process of placing sperm in reproductive tract of the female is known as insemination.
2. Natural insemination occurs when a male of a species mates with a female of the same species. Sperm are placed in the female reproductive tract by the male during copulation. Copulation is the mating process in which sperm are ejaculated from the penis of the male in the vagina of the female. Females must be receptive to males at a time in the estrus cycle known as heat.
3. Artificial insemination is used in some situations, such as with dairy cows. Artificial insemination is placing semen collected from a male in the female reproductive tract using equipment designed for the purpose. Artificial insemination must be done when the cow is in heat.

Once an egg has been fertilized, it becomes an embryo that attaches itself to the uterus for nourishment. The female is pregnant. The embryo goes through a time of development and becomes a fetus. The fetus develops to a stage where it is born and can live outside the uterus.

Have students read appropriate sections in textbooks as homework or during supervised study in class. Use student input to outline the content of the objective on the writing surface or use TM: 06.08.A. Have students keep notes on the major terms and concepts covered in class. Ask students to provide examples of animals that have recently given birth and the number of offspring produced.

Objective 2: List the sexual classification of animals for major species.

Anticipated Problem: What sexual classifications are used for animals?

Reading:
• Agriscience … 364

Sexual classification is the condition of an animal based on its age and sexual condition. It includes animals that are capable of reproduction as well as those that are not capable of reproduction.

A. An animal can be made incapable of reproduction by removing the ovaries or testes or altering the condition of the reproductive organs so that they are no longer fertile. The animals are not capable of conception.
   1. Castration is the process of removing the testes from a male. It is a management practice used on young male animals. Castration eliminates unwanted breeding. It also promotes growth and development of young animals in more desirable ways with food animal production. Castration may
be done surgically or with other methods. (Note: Castration is also known as emasculation and gelding.)

2. Neutering is the process of making a female incapable of reproduction. It is also known as spaying. The ovaries of the female are removed or other procedures are used to render the female incapable of conception. (Note: Neutering can also refer to the castration of males but often refers specifically to females.)

B. A number of terms are used to describe the sexual classification of animals. These terms vary by species, age, and gender. For example, a steer is a male bovine castrated at a young age and before sexual maturity was reached. Textbooks and references usually have lists of terms for the sexual classification of common species.

Have students read appropriate sections in the textbook. Use their input to outline the content of the objective on the writing surface or use TM: 06.08.B. Students can be referred to tables that list sexual classification in textbooks and TM: 06.08.C can be used to list a few examples of sexual classification. Have students name examples of animals that are in the different sexual classifications.

Objective 3: List the parts and explain the functions of female and male reproductive systems.

Anticipated Problem: What are the major parts of female and male reproductive systems? What are the functions of the parts?

Reading:
- Agriscience fundamentals & applications … 544-545
- Introduction to livestock and companion animals … 117-123
- The science of agriculture: A biological approach … 522-527

III. The reproductive system is the only organ system that varies among males and females of the same species.

A. The reproductive system of the female is designed to produce eggs, make conception possible, and promote development of embryo and fetus until birth. The major parts of the system are:

1. The vulva is the external part of the female reproductive tract.
2. The vagina is the mating organ of the female. It receives semen (sperm cells) from the male and serves as the canal through which the fetus moves during birth.
3. The cervix is the entrance to the uterus.
4. The uterus is the organ in which the embryo and fetus develop.
5. The oviduct (also known fallopian tube) is a tube from the ovaries to the uterus. Fertilization usually takes place near the upper end of oviduct. There are two oviducts—one for each ovary.
6. The ovary is the organ that produces the eggs or ova. Eggs pass from the ovary into the oviduct.
B. The reproductive system of the male is designed to produce and store sperm, and to deposit them in the reproductive tract of the female of the species. The major parts are:

1. The penis is the male reproductive organ that deposits semen in the reproductive tract of the female. Semen is a fluid containing sperm secreted by the seminal and prostate glands. Semen is expelled by a process known as ejaculation. Sexual stimulation during the mating process is needed for ejaculation to occur.
2. The urethra is the tube that extends through the penis from the urinary bladder.
3. The seminal glands produce fluids that promote the production of viable sperm.
4. The seminal vesicles are organs attached to the urethra and produce a fluid that nourishes sperm.
5. The prostate gland is an organ located around a section of the urethra and produces a fluid that becomes part of the semen.
6. The sperm ducts are tubes that connect the urethra with the testicles. They carry sperm from the testicles and mix with fluids to form semen.
7. The testicles are the male organs that produce sperm. They are outside the body cavity and carried in the scrotum.
8. The scrotum is a pouch-like skin structure that holds the testicles outside the body. The temperature in the scrotum is slightly lower than that of the body. This promotes sperm production.

C. The female and male reproductive systems are designed to assure efficient reproduction processes. This is needed in animal production systems where animals are produced and used for specific purposes.

Have students read appropriate sections in the textbook as homework or during supervised study. Involve students in developing a summary of the content for the objective on the writing surface. Another approach is to sketch and label the parts of the female and male reproductive systems on the writing surface or use TM: 06.08.D and TM: 06.08.E. In some cases, reproductive tracts may be obtained from slaughter houses for student examination. Caution: Be sure to follow all safety rules with any animal tissues used in the classroom.

Objective 4: List and describe the phases of the estrous cycle.

Anticipated Problem: What are the phases of the estrous cycle? How are these related to reproduction?

Reading:
- Agriscience … 370-372
- Agriscience fundamentals & applications … 544-545
- Introduction to livestock and companion animals … 124-125

IV. The estrous cycle is the phases in the reproductive cycle between periods of estrus. These are the phases of reproductive readiness in the reproductive system of a mature
female. The cycle does not occur during pregnancy nor when a female is in anestrus. Anestrus is the absence of cycling. It may occur due to disease, not being of reproductive age, or other conditions.

A. The estrous cycle is comprised of four phases. The phases occur in a definite sequence unless the female is pregnant. (The sequence listed here is the sequence of occurrence.)

1. Estrus is the phase when a female is in heat. The animal is receptive to mating and will stand for copulation with a male. Females exhibit signs of heat. An enlarged vulva and a discharge from it are signs. Some females exhibit behaviors indicating readiness for mating such as when a cow mounts another cow in the mating position.

2. Metestrus is the phase following heat. Ovulation occurs during metestrus as do other processes that help maintain a pregnancy should conception occur.

3. Diestrus is the phase in the estrous cycle when the reproductive system assumes that conception has occurred, even if it has not. Diestrus is several days long depending on the species of animal.

4. Proestrus is the period following diestrus in which preparation is being made by the reproductive system for the next heat period and ovulation. If conception has occurred, the estrous cycle ceases until it is renewed after gestation and parturition.

B. Animal producers can be more efficient in animal reproductive management if they know the phases of estrous. Careful observation by a trained producer and records on reproductive cycles will promote breeding to assure the production of young animals at the best time. For example, cattle producers often breed cows to assure calving in the spring when pasture grasses are beginning to grow. This allows a cow to produce maximum milk for the nutrition and growth of the calf.

Have students read appropriate sections in the textbook. Develop the information on the writing surface using student input. TM: 06.08.F can be used to present a summary of the information. If appropriate, have students observe a female hog (or other species that exhibits visible signs) that is in heat and compare the signs with those of a female that is not in heat. Have an artificial insemination technician serve as a resource person in class and describe the signs used to know the time to artificially inseminate a female.

Objective 5: Explain the reproductive development of animals.

Anticipated Problem: What are the phases in the reproductive development of animals?

Reading:
- Agriscience … 372-373
- Agriscience fundamentals & applications … 544-545
- Introduction to livestock and companion animals … 125-128

V. Animals of a species begin life as either a male or female. Their development as a member of their species includes reproductive development for their gender.

A. Reproductive development follows fairly definite stages and processes.
1. Prepuberty is the stage of life of a young animal before it is capable of reproduction. Sufficient development has not been reached for an animal to reproduce.

2. Puberty is the stage when an animal reaches a level of sexual development where it is capable of reproduction. Puberty occurs in both males and females. With females, the estrous cycle results in the release of mature eggs that can support the mating, conception, and gestation processes. With males, the animal is capable of producing viable sperm. Age of puberty varies with animal species and other conditions such as nutrition and health condition. Examples of when puberty is reached are: cattle 8–12 months, sheep 5–7 months, swine 4–7 months, and horses 12–15 months.

3. Gestation is the period when a female is pregnant. The length of gestation varies with species though it tends to be consistent among members of the same species. For example, the gestation period is 114 days for sows and 337 days for a mare. The animal gives birth at the end of gestation.

4. Parturition is the process of giving birth. Hormones are produced to support the birth process and prepare for lactation.

5. Lactation is the secretion of milk by the mammary glands of a female. It is initiated by hormone activity. Lactation lasts for several months following parturition.

B. Mating behavior is a part of reproductive development. Both males and females of a species exhibit mating behavior. With males, this includes libido (desire to mate) and social status within a herd. With females, receptivity to mating occurs during heat.

Have students read appropriate sections in the textbook. Follow reading by having students participate in summarizing the content on the writing surface. TM: 06.08.G can be used to present a summary of the information.

Review/Summary. Use the objectives for the lesson as the structure for reviewing and summarizing the content of the lesson. Have students orally explain the content associated with each objective. Assess adequacy of their responses and reteach the content of any objective as needed. Activities that may support summary and review include making a field trip to observe the artificial insemination of an animal, observing the birth of an animal, and assessing the quality of semen used in artificial insemination.

Application. Application can occur as students produce animals in their supervised experience or later in their careers. In some cases, school laboratories may have animals where students can apply information on animal reproduction.

Evaluation. Evaluation should be based on mastery of the objectives by the students. This can occur during instruction, review, or later as students apply the information. A written test can also be used. A sample written test is attached to the lesson plan.
Answers to Assessment:
Part One: Matching
1=i, 2=f, 3=a, 4=b, 5=d, 6=c, 7=e, 8=j, 9=h, 10=g

Part Two: Completion
1=Gestation, 2=Lactation, 3=Estrus, 4=steer, 5=Semen

Part Three: Short Answer
1. The paragraph should include mating and the process of fertilization. The major organs of males and females that produce sex cells can be included. The pregnancy, gestation, and parturition should be included.
2. Efficient reproduction is important because animal producers want more animals.

Part Four: Multiple Choice
1 = c, 2 = a, 3 = b, 4 = b, 5 = d, 6 = a, 7 = b, 8 = c, 9 = c, 10 = d, 11 = b, 12 = a, 13 = d, 14 = b, 15 = b

Part Five: Comprehension
Grading rubric.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>5 pts.</th>
<th>3 pts.</th>
<th>0 pts.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic sentence</td>
<td>Clear, concise topic sentence.</td>
<td>Topic sentences, but does not describe summary.</td>
<td>No topic sentence.</td>
</tr>
<tr>
<td>Organization</td>
<td>Organized. Encompasses key concepts (breeding, artificial insemination, purebred, hybrid)</td>
<td>Some organization. Does not relate all four key concepts.</td>
<td>Little or no organization. No mention of key concepts.</td>
</tr>
<tr>
<td>Collapsed lists and paragraphs</td>
<td>Collapsed information into concise sentences. No mention of examples.</td>
<td>Lack of concise sentences. One or two examples provided.</td>
<td>Failed to collapse information. Three or more examples provided.</td>
</tr>
<tr>
<td>Eliminated unnecessary detail</td>
<td>Unnecessary detail eliminated.</td>
<td>Some unnecessary detail remaining.</td>
<td>Excess unnecessary detail remaining.</td>
</tr>
<tr>
<td>Key points</td>
<td>Key points clearly delineated.</td>
<td>Mentions key points, but does not delineate.</td>
<td>No key points identified.</td>
</tr>
<tr>
<td>Total Points</td>
<td>25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Assessment

Name_____________________________________

Lesson 06.08: Understanding Animal Reproduction

Part One: Matching
Instructions. Match the term with the correct response. Write the letter of the term by the definition. (1 point/question).

a. sexual reproduction   f. estrous cycle
b. fertilization     g. ovary
c. sperm     h. testicle
d. egg      i. puberty
e. castrate     j. parturition

_____ 1. The stage at which an animal becomes capable of reproduction.
_____ 2. The time between the periods of estrus.
_____ 3. Reproduction that involves the union of an egg and sperm.
_____ 4. The process by which union of an egg and sperm occurs.
_____ 5. The female sex cell.
_____ 6. The male sex cell.
_____ 7. To remove the testicles from a male.
_____ 8. The process of giving birth.
_____ 9. The male organ that produces sperm.
_____ 10. The female organ that produces eggs.

Part Two: Completion
Instructions. Provide the word or words to complete the following statements. (1 point/question).

1. _________________________ is the period when a female is pregnant.
2. _________________________ is the secretion of milk by the mammary glands of a female mammal.
3. _________________________ is the period when a female is in heat and receptive to breeding.
4. A _________________________ is a male bovine that has been castrated at a young age.
5. _________________________ is the fluid produced by males that contains sperm.

Part Three: Short Answer
Instructions. Provide information to answer the following questions. (5 points/question).

1. Write a paragraph that describes the reproductive process in mammals.

2. Why is efficient reproduction important to animal producers?
Part Four: Multiple Choice
Instructions. Select the best answer for the following questions. (1 point/question).

1. What is the difference between reproduction and fertilization?
   a. Reproduction is the union of the sperm and egg, while fertilization refers to producing offspring.
   b. Reproduction is the process of a male mating with a female of the same species, while fertilization is the when a producer places the semen from the male in the female reproductive tract with specialized equipment.
   c. Fertilization is the union of the sperm and egg, while reproduction refers to producing offspring.
   d. Fertilization is the process of a male mating with a female of the same species, while reproduction is the when a producer places the semen from the male in the female reproductive tract with specialized equipment.

2. For livestock, fertilization can be broken down into which two different methods?
   a. Natural insemination and artificial insemination.
   b. Reproduction and breeding.
   c. Fertilization and circulation.
   d. Heat and copulation.

3. Both of the methods of livestock fertilization mentioned in question #2 involve which of the following female characteristics?
   b. Heat.
   c. Semen production.
   d. None of the above.

4. What happens once an egg has been fertilized?
   a. The egg moves through the oviduct where the embryo and fetus develop.
   b. The egg moves through the oviduct to the uterus where the embryo and fetus develop.
   c. The egg moves through the ovary where the embryo and fetus develop.
   d. None of the above.

5. Which of the following organs is part of the female reproductive system?
   a. Urethra.
   b. Seminal glands.
   c. Testicles.
   d. Cervix.

6. Which of the following organs is not part of the male reproductive system?
   a. Vulva.
   b. Prostrate gland.
   c. Sperm ducts.
   d. Seminal glands.
7. When a producer uses artificial insemination to breed livestock, where does he or she insert the sperm?
   a. Oviduct.
   b. Vagina.
   c. Fallopian tubes.
   d. None of the above.

8. After fertilization, an embryo develops in the _________________.
   a. Vulva.
   b. Cervix.
   c. Uterus.
   d. Oviduct.

9. The vulva, vagina, and uterus are all parts of the _________________.
   a. Circulatory system.
   b. Male reproductive system.
   c. Female reproductive system.
   d. None of the above.

10. Why are the testicles held outside of the body cavity?
    a. There is not enough room in the body cavity.
    b. Sperm have less distance to travel to the penis.
    c. To ease castration.
    d. To lower the temperature of the testicles.

11. For which of the following animal would the reproductive system be made irrelevant?
    a. Heifers.
    b. Barrows.
    c. Roosters.
    d. Mares.

12. An unbred heifer is in which reproductive period in her life?
    a. Puberty.
    b. Gestation.
    c. Parturition.
    d. Lactation.

13. A dairy cow that is being milked daily is in what reproductive period of her life?
    a. Puberty.
    b. Gestation.
    c. Parturition.
    d. Lactation.
14. A pregnant sow is in what reproductive period of her life?
   a. Puberty.
   b. Gestation.
   c. Parturition.
   d. Lactation.

15. Which of the following reproductive periods have a definite length of time, depending upon the species?
   a. Puberty.
   b. Gestation.
   c. Parturition.
   d. Lactation.

Part Five: Comprehension
Instructions. Read the following passage about animal nutrition. After reading the passage, develop a summary of the following information. (25 points possible). You may use the back of this page to write your summary.

BREEDING

Breeding is helping animals reproduce. Animal scientists do this by controlling male and female animals. They may be kept in separate pens or pastures. Hormones are sometimes used to enhance fertility.

Animal producers may use artificial insemination. This is using implements to place sperms in the female mechanically. In this case, the sperms are collected from the male beforehand as semen. The semen may be frozen if it is to be kept for an extended period. One advantage to artificial insemination is that an animal can be bred to a high-quality mate from anywhere in the world without moving the animals. In addition, more offspring may be obtained from each male.

Over time, animal species have been bred for specific qualities. This has led to breeds, which are groups of animals with consistent and distinctive traits. Breed names often come from the region of the world where the breed was developed.
A purebred animal has two parents with the same set of distinctive characteristics. The animal has a documented pedigree, which is a certificate proving its parentage. The pedigree is obtained from a registering agency for a fee.

A hybrid animal has parents with different characteristics. In some cases, this results in hybrid vigor. This means that offspring have the best qualities of both parents.
Animal Reproduction

- Reproduction—the process by which offspring are produced
- Sexual reproduction—the union of a sperm and egg
- Sperm—male sex cell
- Egg—female sex cell (also known as ovum)
- Fertilization—process by which sexual reproduction occurs
- Natural insemination—male of species deposits semen in the reproductive tract of a female
Animal Sexual Classification

- Sexual classification—condition of an animal based on its age and sexual condition
- Castrate—remove testes (testicles) from a male
- Neuter—remove ovaries from a female
Sexual Classification of Selected Animals

<table>
<thead>
<tr>
<th>Species</th>
<th>Young Animal</th>
<th>Mature Female</th>
<th>Male</th>
<th>Castrated Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>Calf</td>
<td>Cow</td>
<td>Bull</td>
<td>Steer</td>
</tr>
<tr>
<td>Hog</td>
<td>Pig</td>
<td>Sow</td>
<td>Boar</td>
<td>Barrow</td>
</tr>
<tr>
<td>Sheep</td>
<td>Lamb</td>
<td>Ewe</td>
<td>Ram</td>
<td>Wether</td>
</tr>
<tr>
<td>Goat</td>
<td>Kid</td>
<td>Doe</td>
<td>Buck</td>
<td>Wether</td>
</tr>
<tr>
<td>Chicken</td>
<td>Chick</td>
<td>Hen</td>
<td>Rooster</td>
<td>Capon</td>
</tr>
<tr>
<td>Horse</td>
<td>Foal</td>
<td>Mare</td>
<td>Stallion</td>
<td>Gelding</td>
</tr>
<tr>
<td></td>
<td>Colt Filly</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1Young animal of either sex, except horses as indicated.
Reproductive System of a Cow

Artwork supplied with permission of Interstate Publishers, Inc.
Reproductive System of a Bull

Artwork supplied with permission of Interstate Publishers, Inc.
The Estrous Cycle

- Estrous cycle—the phases in the reproductive cycle from one estrus period (heat) to the next
- Estrus—the phase when a female is receptive to mating—heat
- Metestrus—the phase following heat when ovulation occurs and uterus is prepared for a pregnancy should conception occur
- Diestrus—estrous cycle phase between metestrus and proestrus
- Proestrus—phase following diestrus in which reproductive system is prepared for next estrus
Reproductive Development of Animals

- Prepuberty—stage of life of a young animal before it is capable of reproduction
- Puberty—stage when an animal is capable of reproduction
- Gestation—period when a female is pregnant
- Parturition—process of giving birth
- Lactation—secretion of milk by mammary glands
Lesson 06.07

Determining the Anatomy and Physiology of Animals

Intended Outcome: 06.0: Describe the principles of plant and/or animal nutrient growth and reproduction.
SPS: 06.07: Identify and describe the anatomical systems of animals and the functions of each including major portions.
Sunshine State Standard(s): LAA 1.4, 2.4; LAB 1.4, 2.4; LAC 1.4, 2.4, 3.4; LAD 1.4, 2.4; LAE 1.4, 2.4; SCA 1.4, 2.4; SCB 1.4, 2.4; SCF 1.4, 2.4

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:
1. Explain the meaning of anatomy and physiology.
2. Explain the role of cell specialization in organisms.
3. Describe the importance of anatomy and physiology in animal production.
4. List the organ systems of mammals and describe the functions, major parts, and locations of each.
5. Identify the external parts of selected animals.

List of Resources. The following resources may be useful in teaching this lesson:
Recommended Resources. One of the following resources should be selected to accompany the lesson:

Other Resources. The following resources will be useful to students and teachers:
Terms. The following terms are presented in this lesson (shown in bold italics):

<table>
<thead>
<tr>
<th>Anatomy</th>
<th>Gross anatomy</th>
<th>Nervous system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal well-being</td>
<td>Integumentary system</td>
<td>Organ</td>
</tr>
<tr>
<td>Cell</td>
<td>Lymph</td>
<td>Organ system</td>
</tr>
<tr>
<td>Cell specialization</td>
<td>Lymphatic system</td>
<td>Physiology</td>
</tr>
<tr>
<td>Circulatory system</td>
<td>Mammal</td>
<td>Respiratory system</td>
</tr>
<tr>
<td>Digestion</td>
<td>Mammary system</td>
<td>Reproductive system</td>
</tr>
<tr>
<td>Digestive system</td>
<td>Microscopic anatomy</td>
<td>Skeletal system</td>
</tr>
<tr>
<td>Excretion</td>
<td>Muscular system</td>
<td>Tissue</td>
</tr>
<tr>
<td>Excretory system</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Interest Approach. Use an interest approach that will prepare the students for the lesson.

Teachers often develop approaches for their unique class and student situations. A possible approach is included here:

Ask students to describe what functions an animal organism must perform to carry out life processes. List these on the writing surface. Examples include respiration, digestion, and elimination. Next, ask students how organisms are able to carry out these functions—they have body parts or organ systems that make it possible for these functions to occur. Have students name and discuss specific examples, such as the mammary system of a dairy cow secretes milk used as food for her calf as well as for human food. Move from this interest approach into the lesson. Have students read appropriate sections or chapters in the textbooks as homework or during supervised study. Students will also need to refer to the figures with line drawings of anatomical features.

Pre-Reading Strategies
Please select one of the following Pre-Reading strategies to use to activate student background knowledge prior to reading.

K-W-L
Procedure:
1. Create three columns on the chalkboard, labeling the columns with what we know, what we want to know, and what we learned, or utilize an overhead with the K-W-L chart.
   a. Students should individually fill out a K-W-L chart on their own.
   b. Use RS: 06.07.A for the handout.
2. Ask/Brainstorm with students about what they know related to animal anatomy and physiology or the text that you are about to study. You may need to prompt students with pictures, questions, or ideas.
3. Ask students what they want to know about animal anatomy and physiology. Again, students may need prompting. For example, you may want to phrase questions in a problem-solving approach.
4. Instruct students to read the assigned text.
   a. As students read the text, they should fill in the third column, what we learned.
   b. Students can add questions to the “what we want to learn” column as they read.
   c. A further development of K-W-L would be to assign and name categories for the information that students generated in the what we learned column. From the categories, students can create a concept map of animal anatomy and physiology.
5. As a summary, you can conduct a class discussion to generate consensus about what was learned.
   a. Students can also categorize the information that they learned into a graphic organizer to further their engagement with the material and learning.
   b. Students could create a summary of the passage.

Making Predictions A-Z
Procedure:
1. The teacher selects the text passage and 3-7 letters for which students will make word predictions.
   a. Letters chosen should be the first letters of key words that will likely be found in the text
   b. Recommended letter choices for this lesson are D-E-F, M-N-O, and P-Q-R.
   c. Use RS: 06.07.B for the handout.
2. The teacher should read aloud the title of the passage and/or relevant sub-headings and conduct a brief discussion about the content of the passage.
   a. Write the pre-selected letters for predictions on the chalkboard. (These are the letters for which students will generate words related to the topic and make predictions about the reading).
4. Students list words beginning with the pre-selected letters and form predictions about what they will encounter in the text passage.
   a. Students may be paired with a partner to share their predicted words.
   b. After sharing the words, student pairs should generate predictions about the text.
5. From the words and predictions, conduct a whole-class discussion about the topic.
6. Instruct the students to read the text.
   a. While reading students should continue to add relevant words to their Making Predictions A-Z worksheet.
   b. These words may be used to create a graphic organizer and/or summary of what they learned.
Summary of Content and Teaching Strategies

Objective 1: Explain the meaning of anatomy and physiology.

Anticipated Problem: What is the meaning of anatomy and physiology?

Reading:
- Agriscience … 294
- Agriscience fundamentals & applications … 505-511
- Introduction to livestock and companion animals … 36-39

I. Animals are complex organisms with systems and processes that allow them to carry out activities to remain in the living condition.

A. Anatomy is the study of the form, shape, and appearance of an animal. Since mammals are among the most common animals, most of the information on anatomy will focus on these animals.
   1. Gross anatomy deals with the features that can be seen with the unaided eye. Examples include feet, horns, tails, tongues, and teeth.
   2. Microscopic anatomy deals with the features that can only be seen with magnification. Examples include cells and sperm.

B. Physiology is the study of the functions of the cells, tissues, organs, and organ systems of the living organism.
   1. Physiology includes relationships among functions by different systems of an organism, such as secretion to digestion.
   2. Diseases can cause the systems to fail to work properly.

Have students read sections in the textbook related to this objective. Organize information on the writing surface using student input. Have students keep notes on important issues covered in class. Use TM: 06.07.A or the writing surface to present a definition of the key terms. Have students give examples of anatomy and physiology in animals that they have as companions or for production.

Objective 2: Explain the role of cell specialization in organisms.

Anticipated Problem: What is cell specialization? Why is it important?

Reading:
- Introduction to livestock and companion animals … 33-35
- The science of agriculture: A biological approach … 56-68

During Reading Strategies
Classification Map
Procedure:
1. Introduce the concept of cell specialization to students.
2. Ask students to brainstorm words related to cell specialization. Record the words on the chalkboard.
   a. Use RS: 06.07.C for the handout.
b. Extend the discussion around words that suggest larger related categories.
c. Allow students a few minutes to categorize the words under more general headings.
3. Instruct students to survey the passage, looking for textual hints in the headings and titles that suggest key concepts.
4. Instruct students to read the assigned passage.
   a. As students read they should refine their categories by adding information and strengthening concept lines.
   b. Students may use their maps during classroom discussion or for creating a summary of information.

II. Cells are the building blocks of organisms. A cell is the basic structure of life. Cells have important structures that allow them to function. Protoplasm within a cell carries out important chemical activities. Multi-cellular organisms have many cells. These cells form specialized systems to carry out life processes.
   
A. Cell specialization is different in each cell in order to perform unique activities for an organism. Organisms could not exist if all cells were alike.
   1. A tissue is a group of cells that is alike in activity and structure. The functions tend to be specialized such as those in muscles or bones.
   2. An organ is a group of tissues that work together to perform specific functions. Each tissue’s job varies, but by working together the organ carries out its function. Examples of organs include the heart, lungs, and liver.
   3. An organ system is a collection of several organs that work together to perform an activity. Two examples are the respiratory system and digestive system.

B. Cell specialization is important because it makes multi-cellular organisms possible. Without specialization, all cells would be alike. Tissues, organs, and organ systems would not exist. Life processes in multi-cellular organisms would not occur.

Have students read the appropriate sections in the textbook. Use student input to outline the major content on the writing surface or use TM: 06.07.B. Ask students to name examples of tissues, organs, and organ systems.

Objective 3: Describe the importance of anatomy and physiology in animal production.

Anticipated Problem: What is the importance of anatomy and physiology in animal production?

Reading:
- Agriscience fundamentals & applications … 505-511

During Reading Strategies
Think-Aloud
Procedure:
1. Select a passage that contains points of difficulty, ambiguities, or unknown words.
2. Preview the passage and imagine that you are reading it for the first time as a good reader would.
   a. Make notes and comments of your thoughts for the students.
   b. Use RS: 06.07.D for a guide.
3. Read the passage aloud, telling students to follow along silently and listen to how you construct meaning and think through trouble spots.
   a. Develop hypotheses.
   b. Make predictions.
   c. Describe any pictures forming in your head.
   d. Link new information with prior knowledge.
   e. Share an analogy.
   f. Verbalize confusing points.
   g. Demonstrate fix-up strategies (rereading, thinking about a word, etc.).
4. Select a logical stopping point and have students use your model to continue reading.
5. Have students practice thinking aloud with partners.

III. People who care for animals need to understand the fundamentals of anatomy and physiology.
   A. Practicing the correct nature of anatomy and physiology of an organism promotes animal well-being. Animal well-being is caring for animals so that their needs are met and they do not suffer. Conditions for raising and keeping animals must be considered for their well-being.
      1. Species have different environmental requirements. Animal producers are more effective in meeting these requirements when they know the unique anatomy and physiology of a species. For example, some breeds of cattle are more resistant to extreme temperatures than others. Producing a breed outside its preferred temperature range means that steps need to be taken to provide shade to protect from the heat or housing to protect from the cold.
      2. The design of facilities can accommodate the unique anatomy needs of organisms. The size, shape, and form influences facility arrangement and design. For example, keeping dairy cattle housing clean requires a way to handle animal wastes, including feces and urine. Facility design can help collect and remove wastes from the area.
      3. Young animals require different care than older animals. Feed for young animals should be appropriate to its digestive system and nutrient needs. For example, young animals typically require feed with a higher percentage of protein than older animals.
   B. Animal productivity is based on animal capacity.
      1. Meat animals are required to have muscling in areas that are used to make the higher-priced cuts. Examples include the loin and hams of hogs.
      2. Dairy animals need to have the capacity for high milk production. For example, a dairy cow needs a well-developed mammary system.
      3. Animals used for other products are required to have the capacity to produce those products, including egg-laying capacity of chickens and wool quality of sheep.
4. Knowing how animals reproduce helps a producer provide conditions that promote reproduction.

Ask students to indicate why they feel knowledge of anatomy and physiology is important to animal producers. Have students tell the importance for the production of farm animals as well as the keeping of companion animals in the home. Have students relate animal well-being to having a knowledge of the needs of an animal. Students can name examples in the local area where animal well-being is practiced properly and where it is ignored so that the animals are not in a good situation. Outline the major areas on the writing surface or use TM: 06.07.C.

Objective 4: List the organ systems of mammals and describe the functions, major parts, and locations of each.

Anticipated Problem: What are the organ systems of mammals? What are the functions, major parts, and locations of each?

Reading:
- Agriscience … 297-312
- Agriscience fundamentals & applications … 505-511
- Introduction to livestock and companion animals … 185-216
- The science of agriculture: A biological approach … 40-54

During Reading Strategies
Please select one of the following During Reading strategies to use with this objective.

Concept Map
Procedure:
1. Display a blank concept/definition map on the overhead or PowerPoint (use RS: 06.07.E).
   a. Point out the questions that complete a definition of the concept: what is it like?, what are some examples/nonexamples?, what are characteristics?, and what is it?.
   b. Model the strategy by using a concept for which students are familiar, for example, you may use cheese.
2. Present a key term or concept (organ systems) from the text.
3. Student may work individually or in pairs to complete the concept/definition map for the new concept.
   a. When students have finished their map, they should develop their own definition of the concept using their maps.
   b. The definition may include several sentences to encompass the scope of the concept.
4. You may want to develop a “class” definition of the concept for assessment purposes.
Matrices

Procedure:
1. Examine text to determine categories for the left-hand column and variables for the top row.
2. Fill in some cells as a model for students as you read aloud.
   a. Use RS: 06.07.F for the handout.
   b. Find evidence in the text or course to support your entries.
3. Instruct students to finish the matrix on their own or in pairs.
4. Ask students to analyze their matrix to determine trends, patterns, or conclusions.
   a. This may generate discussion among the class.
   b. Instruct students to write a concise conclusion based on their matrix.

III. A mammal is a vertebrate animal that is usually covered with hair. The females give birth to live young and secrete milk as food for their babies. Cattle, hogs, sheep, horses, dogs, cats, and many other common animals are mammals. Each mammal species has unique organ systems that promote the life processes of the species.

A. Mammal species are said to have eleven organ systems. Some variation may exist, with the greatest being the presence of mammary glands on females.
   1. The skeletal system is the framework that gives shape to the body. The skeleton is comprised of bones and cartilage. The skeletal system protects the delicate internal organs and makes locomotion possible.
   2. The muscular system is the system that makes movement and locomotion possible. Muscles form nearly half the weight of many animals such as hogs and cattle. Without muscles, other organ systems would not function such as the respiratory and circulatory systems. Locomotion would not be possible.
   3. The nervous system is the system that coordinates body activity. It receives and responds to stimuli. It controls activity, learning, and memory.
   4. The circulatory system is the system that moves blood, digested food, oxygen, wastes, and other materials around the body of an organism. It includes the organs that move the blood. The heart moves the blood throughout the body. It goes by the lungs to gain oxygen and give off carbon dioxide acquired from cell respiration.
   5. The respiratory system is the system that moves gases to and from the circulatory system. The purpose is to provide the blood with oxygen and remove carbon dioxide from the blood.
   6. The excretory system is the system that rids the body of wastes from cell activity (known as metabolic wastes). The process of ridding the body of these wastes is known as excretion. Though associated with the elimination of undigested food, the excretory system is not the digestive system. The major products excreted are carbon dioxide, water, and nitrogen compounds.
   7. The digestive system is the system that prepares food for use by the body. Digestion is the process of breaking down food materials into molecules that the body can absorb. The system varies depending on the species of organism. Some organisms, such as cattle, have digestive systems that will handle considerable roughage. Other organisms have simple stomachs that require food with higher percentages of protein and digestible materials.
8. The lymphatic system is the system that produces and circulates lymph throughout the body. Lymph is a clear fluid that aids in circulation, excretion, and other body functions. It also helps protect the body from disease.

9. The integumentary system is the skin and outer covering of the body of an organism. It protects the internal organs, helps regulate temperature, and gives shape to the body. The integumentary system keeps disease pathogens away from the internal organs.

10. The reproductive system is the system that produces offspring and continues the existence of a species. The system varies by gender—male and female.

11. The mammary system is the system in female mammals that secretes milk as food for their babies. Male mammals have undeveloped mammary systems.

B. Most animals tend to have the same organ systems except that mammals have mammary systems that are not found in non-mammals. The reproductive system varies by the gender of the animal.

1. The parts of the organ systems have been identified and studied by scientists in anatomy and physiology.

2. Drawings have been made that show the location and structure of the major parts of organ systems. These were prepared by scientists who have studied the anatomy of animals in great detail.

Have students read appropriate sections in the textbooks. Use their input to develop a list of the organ systems, their functions, and a summary of the major parts of each organ system on the writing surface. Refer students to information in the textbook as this objective is developed in class. Use TM: 06.07.D to list the major organ systems and their functions. TM: 06.07.E provides a listing of the major parts for each system. Refer students to line drawings of animals that show the layout and correctly name the different parts of systems. Indicate that the systems tend to be similar from one species to the other. Use sketches on writing surface, line drawings in the textbook, and transparencies to show various anatomical features. TM: 06.07.F is an example that shows the circulatory system of a horse.

Objective 5: Identify the major external parts of selected animals

Anticipated Problem: What are the major external parts of animals?

IV. Animal producers must be able to describe animals and use the information in selecting, examining, and providing health care. The descriptions are based on the external parts of the animals.

A. The presence of various qualities in the external parts indicates the value, health, and condition of an animal. This means that animal producers not only know the names of the parts but they also know the qualities that should be evident upon visual examination of the parts. Animal scientists have prepared line drawings that show the location and name of the external parts of common animals. Samples are included in TM: 06.07.G and LS: 06.07.A.

B. Qualities vary with the species and the way the species is used. For example, cattle raised for beef have qualities that vary from those raised for dairy
production. Considerable study is needed to learn the qualities that indicate the desired characteristics of animals.

Have students read appropriate sections in the textbook and study the figures with line drawings that show the locations and names of the major external parts. Sketches on the writing surface or transparencies may be used to illustrate the external parts (an example is TM: 06.07.G). Practice locating and naming the parts is essential for student mastery. Having students observe animal specimens and name the parts is an important strategy in assuring student mastery of the objectives. (Note: More in-depth instruction will be provided when the various species are studied from a production perspective.)

Post-Reading Strategies
Please select one of the following Post-Reading strategies to use as a conclusion to the lesson.

Cube It!
Procedure:
1. The teacher should select the text passage to be read.
   a. Divide the students into teams of no more than 6 students.
   b. You will need a die with the six questions (describe it, compare it, associate it, analyze it, apply it, and argue for or against it) listed on the sides.
2. Students should number a sheet of notebook paper 1-6, skipping 6-8 lines in between each number.
   a. By each number, students should write a team member’s name (some team members might have their name listed twice, depending on the size of the teams).
3. The person whose name is written after number 1 will roll the die first (use RS: 06.07.G as the dice pattern).
   a. Whatever question it lands on, that person must answer it on notebook paper.
   b. Be sure to write the die question by your number (example – 1. Travis – Describe it – the answer).
4. Each member will roll the die until all of the six questions have been answered. Remember: each member is responsible for one side of the die, and the answer must be in his/her own words and writing.

Die Questions and How to Answer:
- Describe it: What is animal anatomy and physiology about? What is the importance, color, size, shape, etc.?
- Compare it: What is animal anatomy and physiology similar to or different from?
- Associate it: What does animal anatomy and physiology make you think of?
- Analyze it: Tell how animal anatomy and physiology is made or what it is composed of.
- Apply it: What can you do with it? How is it used?
- Argue for or against it: Take a stand and list reasons supporting its importance.
Summary
Use RS: 06.07.H as a guide for writing summaries.

Four General Steps to Help with the Four+ Specific Rules for Writing a Summary

1. Make sure you understand the text. Ask yourself, “What was this text about?”
   “What did the writer say?” Try to say the general theme to yourself.
2. Look back. Reread the text to make sure you got the theme right. Also read to
   make sure that you really understand what the important parts of the text are. Star
   the important points.

Now Use the Four Rules for Writing a Summary

3. Rethink. Reread a paragraph of the text. Try to say the theme of that paragraph to
   yourself. Is the theme a topic sentence? Have you underlined it? Or is the topic
   sentence missing: If it is missing, have you written one in the margin?
4. Check and double-check. Did you leave in any lists? Make sure you don’t list
   things out in your summary. Did you repeat yourself? Make sure you didn’t.
   Did you skip anything? Is all the important information in the summary?

Four Rules for Writing a Summary

5. Collapse lists. If you see a list of things, try to think of a word or phrase name for
   the whole list. For example, if you saw a list like eyes, ears, neck, arms, and legs,
   you could say “body parts.” Or, if you saw a list like ice skating, skiing, or
   sledding, you could say “winter sports.”
6. Use topic sentences. Often authors write a sentence that summarizes a whole
   paragraph. It is called a topic sentence. If the author gives you one, you can use
   it in your summary. Unfortunately, not all paragraphs contain topic sentences.
   That means you may have to make up one for yourself. If you don’t see a topic
   sentence, make up one of your own.
7. Get rid of unnecessary detail. Some text information can be repeated in a
   passage. In other words, the same thing can be said in a number of different
   ways, all in one passage. Other text information can be unimportant, or trivial.
   Since summaries are meant to be short, get rid of repetitive or trivial information.
8. Collapse paragraphs. Paragraphs are often related to one another. Some
   paragraphs explain one or more other paragraphs. Some paragraphs just expand
   on the information presented in other paragraphs. Some paragraphs are more
   necessary than other paragraphs. Decide which paragraphs should be kept or
   gotten rid of, and which might be joined together.

A Final Suggestion

9. Polish the summary. When a lot of information is reduced from an original
   passage, the resulting concentrated information often sounds very unnatural. Fix
   this problem and create a more natural-sounding summary. Adjustments may
   include but are not limited to: paraphrasing, the insertion of connecting words
   like “and” or “because,” and the insertion of introductory or closing statements.
   Paraphrasing is especially useful here, for two reasons: one, because it improves
   your ability to remember the material, and two, it avoids using the author’s words,
   otherwise known as plagiarism. (Hare & Borchardt, p. 66, 1984)
Review/Summary. The review and summary should be organized around the objectives for the lesson. Students should be called upon to orally demonstrate their mastery of the objectives. Review will also be a part of future instruction in the production and care of various species. Questions at the end of the chapter in the textbook will also serve a useful role in the review process. Use observations of student performance as a basis for reteaching areas where students appear not to have achieved satisfactorily.

Application. Application will be achieved throughout the class and other classes as students study animal production. The content of this lesson is fundamental in those classes. Use LS: 06.07.A to provide students with practice in identifying the external parts of an animal. Students will need a textbook or reference that lists the major external parts of a pig for this activity.

Evaluation. Evaluation should be based on student achievement of the objectives. Observe student performance during the instruction as well as later in application opportunities. Review of each student’s notebook will also be useful in evaluation. A written test may be given. A sample test is attached.

Answers to Assessment:
Part One: Matching
1=i, 2=e, 3=a, 4=f, 5=c, 6=d, 7=b, 8=h, 9=j, 10=g

Part Two: Completion
1=integumentary, 2= muscular, 3=skeletal, 4=digestive, and 5=circulatory

Part Three: Short Answer
1. The answer should address the ability of a producer to provide for the well-being of the animal. The answer should also include animal selection for a particular use.
2. The sketch should be compared to that in a textbook or reference and depends upon the species or breed that is drawn. (Students may be instructed to sketch a pig, bovine, horse, or sheep since those sketches are provided in the textbook.)

Part Four: Multiple Choice
1 = d, 2 = b, 3 = a, 4 = c, 5 = b, 6 = b, 7 = d, 8 = a, 9 = d, 10 = b, 11 = b, 12 = a, 13 = b, 14 = c, 15 = d
Part Five: Comprehension
Grading rubric.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>5 pts.</th>
<th>3 pts.</th>
<th>0 pts.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic sentence</td>
<td>Clear, concise topic sentence.</td>
<td>Topic sentences, but does not describe summary.</td>
<td>No topic sentence.</td>
</tr>
<tr>
<td>Organization</td>
<td>Organized. States relationships among cells, tissues, organs, &amp; organ systems.</td>
<td>Some organization. Does not relate all four key concepts.</td>
<td>Little or no organization. No mention of relationships among ideas.</td>
</tr>
<tr>
<td>Collapsed lists and paragraphs</td>
<td>Collapsed information into concise sentences. No mention of examples.</td>
<td>Lack of concise sentences. One or two examples provided.</td>
<td>Failed to collapse information. Three or more examples provided.</td>
</tr>
<tr>
<td>Eliminated unnecessary detail</td>
<td>Unnecessary detail eliminated.</td>
<td>Some unnecessary detail remaining.</td>
<td>Excess unnecessary detail remaining.</td>
</tr>
<tr>
<td>Key points</td>
<td>Key points (cells, tissues, organs, organ systems) clearly delineated.</td>
<td>Mentions key points, but does not delineate.</td>
<td>No key points identified.</td>
</tr>
<tr>
<td>Total Points</td>
<td>25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Assessment

Name_____________________________________

Lesson 06.07: Determining the Anatomy and Physiology of Animals

Part One: Matching
Instructions. Match the term with the correct response. Write the letter of the term by the definition. (1 point/question).

a. animal well-being     f. organ system
b. anatomy      g. excretion
c. physiology      h. digestion
d. tissue     i. lymph
e. organ      j. mammal

_______ 1. A clear fluid that aids circulation, excretion, and other body functions.
_______ 2. A group of tissues that work together to perform specific functions.
_______ 3. Caring for animals so that their needs are met and they do not suffer.
_______ 4. A collection of organs that work together to perform a function for an organism.
_______ 5. The study of the functions of cells, tissues, organs, and organ systems of a living organism.
_______ 6. A group of cells that is alike in activity and structure.
_______ 7. The study of the form, shape, and appearance of an animal.
_______ 8. Breaking down food into molecules that the body can absorb.
_______ 9. A group of animals that are covered with hair, and in which the females give birth to live young and secrete milk as food for their babies.
_______ 10. The process of the body ridding itself of wastes.

Part Two: Completion
Instructions. Provide the word(s) to complete the following statements. (1 point/question).

1. The __________________ system consists of skin and other body covering.
2. The __________________ system makes body movement possible.
3. The __________________ system provides a framework to give the body shape.
4. The __________________ system prepares food for use by the body.
5. The __________________ system moves blood and other materials throughout the body of an animal.

Part Three: Short Answer
Instructions. Provide information to answer the following questions. (5 points/question).

1. Why is knowledge of anatomy and physiology important to animal producers?

2. Sketch the external features of an animal and label the major parts.
Part Four: Multiple Choice
Instructions. Select the best answer for the following questions. (1 point/question).

1. What is the difference between anatomy and physiology?
   a. Anatomy refers to the functions of cells, tissues, organs, and organ systems, while physiology refers to the study of form, shape, and appearance of an animal.
   b. Anatomy is the same as physiology.
   c. Physiology refers to an animal’s physical health, while anatomy refers to the animal’s anatomical features.
   d. Physiology refers to the functions of cells, tissues, organs, and organ systems, while anatomy refers to the study of form, shape, and appearance of an animal.

2. Producers who raise livestock for meat attempt to maximize which organ system?
   a. Circulatory.
   b. Muscular.
   c. Respiratory.
   d. None of the above.

3. Which two organ systems would work together in producing a fast racehorse?
   a. Skeletal and muscular.
   b. Circulatory and reproductive.
   c. Nervous and muscular.
   d. Skeletal and circulatory.

4. When an animal is breathing, which organ systems are primarily involved?
   a. Circulatory.
   b. Skeletal.
   c. Respiratory.
   d. Lymphatic.

5. A barrow that goes lame during transportation to market experiences damage to which organ systems?
   a. Lymphatic and/or muscular.
   b. Muscular and/or skeletal.
   c. Nervous and/or reproductive.
   d. Skeletal and/or excretory.

6. A large volume of blood is necessary for high milk production in dairy cows. Which organ system provides this blood to the udder?
   a. Reproductive.
   b. Circulatory.
   c. Muscular.
   d. Excretory.
7. Ruminants and nonruminants differ in primarily which organ system?
   a. Integumentary.
   b. Reproductive.
   c. Circulatory.
   d. Digestive.

8. Ruminants can digest what kind of feedstuffs because of the specialized organ system from question 7?
   a. Roughages.
   b. Supplements.
   c. Concentrates.
   d. None of the above.

9. In meat livestock, muscle definition is a characteristic of which organ system?
   a. Skeletal.
   b. Digestive.
   c. Integumentary.
   d. Muscular.

10. Body conformation is essential for locomotion and enabling an animal to feed and reproduce. Which two organ systems does conformation primarily refer to?
    a. Lymphatic and/or muscular.
    b. Muscular and/or skeletal.
    c. Nervous and/or reproductive.
    d. Skeletal and/or excretory.

11. Animals in confined feeding that live on concrete flooring may have difficulty with which two organ systems due to the stress of the concrete?
    a. Lymphatic and/or muscular.
    b. Muscular and/or skeletal.
    c. Nervous and/or reproductive.
    d. Skeletal and/or excretory.

12. Which of the following represents a tissue?
    a. Muscle.
    b. Heart.
    c. Circulatory.
    d. Blood.

13. Which of the following represents an organ?
    a. Muscle.
    b. Heart.
    c. Circulatory.
    d. Blood.
14. Which of the following represents an organ system?
   a. Muscle.
   b. Heart.
   c. Circulatory.
   d. Blood.

15. Which of the following represents a cell?
   a. Muscle.
   b. Heart.
   c. Circulatory.
   d. Blood.

Part Five: Comprehension
Instructions. Read the following passage about animal nutrition. After reading the passage, create a summary for the passage. (25 points possible). You may use the back of this page for writing your summary.

ANIMAL STRUCTURE AND FUNCTIONS

Knowing body structures and functions helps in raising animals. Whether the animal is large or small, similar conditions are needed. All need a good environment for living.

All animals have similarities. The structure begins with cells—the smallest building blocks in an animal. Groups of similar cells form tissues. Tissues form organs. Organs with similar functions form organ systems. The organ systems form the organism.

CELLS

The cell is the basic building block of life. All living things are made up of cells. Plant cells have walls; animal cells have only membranes. The cell provides information and uses energy.

Probably the most important part of the cell is the nucleus. Within the nucleus are genes that contain complete instructions for the organism. These genes are important in reproduction and in biotechnology uses.

TISSUES
Animals have four kinds of tissue. The four tissues are protective, connective, muscular, and nervous. Tissue is a group of cells that do a specific job. Tissues may be protective, like skin. They may be connective, joining various body parts. Another tissue is muscular and aids in movement. The nervous tissue responds to outside factors and transmits information.

ORGANS

Organs are groups of similar tissues that work together to form a specific function. Animals have many organs, which typically do not work alone. Examples of organs are the heart, liver, and kidney.

Organs form organ systems. The organs work together as a system to do certain activities. Most animals have ten organ systems. Without the systems, the animal could not survive. For example, the circulatory system consists of a heart, veins, arteries, and capillaries. Another example is the digestive system. It consists of the mouth, stomach, intestines, and other parts.
Anatomy and Physiology of Animals

Anatomy—study of the form, shape, and appearance of animals

- Gross anatomy—study of the anatomy features that can be seen with the unaided eye
- Microscopic anatomy—study of the anatomy features that require magnification

Physiology—study of the functions of cells, tissues, organs, and organ systems of a living organism
TM: 06.07.B

Building Blocks

Cell—basic structure of a living organism; contains protoplasm which carries out important chemical activities

Cell specialization—differences in cells so that they can perform unique activities

Tissue—a group of cells that are alike in structure and activity

Organ—a group of tissues that work together to perform a specific function

Organ system—a collection of organs that work together to perform a function essential for the living condition
Why Know Anatomy and Physiology?

• promotes animal well-being
• Animal well-being—caring for animals so that their needs are met; animals do not suffer

• consider environmental needs of animals

• provide facilities to meet needs

• provide care based on age and condition

• consider animal production capacity in selection
Organ Systems and Functions

• skeletal—framework for body
• muscular—makes movement and locomotion possible
• nervous—coordinates body activities and respond to stimuli
• circulatory—moves blood and its contents in body
• respiratory—moves gases to and from the circulatory system
• excretory—rids body of metabolic wastes
• digestive—prepares food for digestion and eliminates undigested food materials
• lymphatic—produces and circulates lymph
• integumentary—protects and shapes the body exterior
• reproductive—produces offspring; varies by gender
• mammary—present in female mammals; secretes milk
Major Organ System Parts

- skeletal—bones and cartilage
- muscular—muscles and connective tissues
- nervous—brain, spinal cord, and nerves
- circulatory—heart, arteries, and veins
- respiratory—lungs
- excretory—kidneys, bladder, urethra, and skin
- digestive—mouth, stomach, and intestines
- lymphatic—lymph nodes and lymph vessels
- integumentary—skin, hooves, claws, and other exterior parts
- reproductive—varies by gender—testes in males; ovaries in females
- mammary—milk glands and udder
Circulatory System of a Horse
Major External Parts of a Bovine (Beef Animal)

Artwork supplied with permission of Interstate Publishers, Inc.
External Parts of a Pig

Purpose:
The purpose of this activity is to help students master the external anatomy of a pig.

Supplies/Equipment:
You will need a textbook or reference book that identifies the major external parts of a pig.

Safety:
No safety hazards should be involved with this activity.

Procedure:
Correctly label the twelve numbered external parts of the pig shown below. Write the common name of the part in the space provided that matches the number of the part.

1. ___________________  2. ____________________  3. ____________________
4. ___________________  5. ____________________  6. ____________________
7. ___________________  8. ____________________  9. ____________________
10. ___________________ 11. ____________________ 12. ____________________
RS: 06.07.A
Name_____________________________________

Animal Physiology K-W-L

<table>
<thead>
<tr>
<th>Know</th>
<th>Want to know</th>
<th>Learned</th>
</tr>
</thead>
</table>
RS: 06.07.B

Name_____________________________________

Making Predictions A-Z: Animal Physiology

<table>
<thead>
<tr>
<th>A – B – C</th>
<th>D – E – F</th>
<th>G – H – I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I predict that…
RS: 06.07.B key

Name ____________________________

Making Predictions A-Z: Animal Physiology

<table>
<thead>
<tr>
<th>A – B – C</th>
<th>D – E – F</th>
<th>G – H – I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatomy</td>
<td>Digestion</td>
<td>Gross anatomy</td>
</tr>
<tr>
<td>Animal well-being</td>
<td>Digestive system</td>
<td>Integumentary system</td>
</tr>
<tr>
<td>Cell</td>
<td>Excretion</td>
<td></td>
</tr>
<tr>
<td>Cell specialization</td>
<td>Excretory system</td>
<td></td>
</tr>
<tr>
<td>Circulatory system</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lymph</td>
<td>Mammal</td>
<td>Physiology</td>
</tr>
<tr>
<td>Lymphatic system</td>
<td>Mammary system</td>
<td>Respiratory system</td>
</tr>
<tr>
<td></td>
<td>Microscopic anatomy</td>
<td>Reproductive system</td>
</tr>
<tr>
<td></td>
<td>Muscular system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nervous system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organ system</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Skeletal system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tissue</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I predict that...
RS: 06.07.C

Name_____________________________________

Cell Specialization Classification Map
Cell Specialization Classification Map

Cell Specialization

Cell – basic structure of life

Tissue – group of cells that is alike in activity and structure
- Muscle
- Bone
- Nervous

Organ – group of tissues that work together to perform specific functions
- Heart
- Lungs
- Brain
- Liver

Organ System – collection of several organs that work together to perform an activity
- Circulatory system
- Skeletal system
- Nervous system
- Digestive system
The relationship between proper nutrition and health has long been recognized.

Early sailors stocked their sailing vessels with limes when going to sea for long periods. This was to prevent the dreaded disease, scurvy. Scurvy is a disease of the gums and skin caused by a deficiency of vitamin C in the diet. Even today, the effects of poor nutrition are seen in the human problems of anorexia and obesity. In simple terms, anorexia is a result of too little nutrition, and obesity the result of too much or improper types of foods being eaten.

In animals, proper nutrition is just as important as it is in humans. Feed efficiency, rate of gain, and days to market weight are all uppermost in the minds of those people who raise livestock for meat. Proper nutrition is just as important for animals
being grown for milk, wool, or fur production. Slow growth, poor reproduction, lowered
production, and poor health are generally the result of less-than-adequate animal rations.

The amount and content of food eaten by an animal in one day is referred to as the
animal’s ration. When the amount of feed consumed by an animal in 24 hours contains
all of the needed nutrients in the proper proportions and amounts, the ration is referred to
as a balanced ration.

Numerous diseases may result from improper amounts or balances of vitamins
and minerals. Such diseases are called deficiency diseases. Vitamins are complex
chemicals and minerals are elements essential for normal body functioning of humans
and animals alike. Not all types of animals require the same vitamins and minerals to
maintain good health.

Animals producing milk and wool probably require more and different vitamins and minerals.
RS: 06.07.E

Name_____________________________________

Organ Systems Concept Map
Organ Systems Concept Map

**Muscular System**
- Makes movement
- Nearly ½ weight of hogs & cattle

**Skeletal System**
- Framework, gives shape to the body
- Bones & cartilage
- Protects internal organs
- Locomotion

**Respiratory System**
- Moves gases to & from the circulatory system
- Provides blood with oxygen & removes carbon dioxide

**Circulatory System**
- Moves blood, digested food, oxygen, wastes, & other materials
- Heart, arteries, veins

**Nervous System**
- Coordinates body activity
- Receives & responds to stimuli
- Controls activity

**Digestive System**
- Prepares food for use by body
- Varies by species
- Compound and simple stomachs

**Lymphatic System**
- Produces & circulates lymph
- Protects body from disease

**Integumentary System**
- Skin & outer covering of the body
- Protects internal organs, regulates temperature, & gives body shape
- Keeps disease away from internal organs

**Excretory System**
- Rids the body of waste from cell activity
- Excretes carbon dioxide, water, nitrogen

**Reproductive System**
- Produces offspring
- Varies by gender

**Reproductive System**
- Produces offspring
- Varies by gender

**Mammary System**
- Produces offspring
- Varies by gender
RS: 06.07.F
Name______________________________

Organ Systems Matrix

<table>
<thead>
<tr>
<th>Categories</th>
<th>Variables</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Organ Systems</td>
<td>Function(s)</td>
<td>Organs Included</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RS: 06.07.F key

Name_____________________________________

Organ Systems Matrix

<table>
<thead>
<tr>
<th>Categories</th>
<th>Variables</th>
<th>Organs Included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organ Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skeletal system</td>
<td>Framework that gives shape to the body</td>
<td>Bones</td>
</tr>
<tr>
<td></td>
<td>Protects delicate internal organs</td>
<td>Cartilage</td>
</tr>
<tr>
<td></td>
<td>Makes locomotion possible</td>
<td></td>
</tr>
<tr>
<td>Muscular system</td>
<td>Makes movement and locomotion possible</td>
<td>Muscles</td>
</tr>
<tr>
<td></td>
<td>Nearly ½ weight of hogs &amp; cattle</td>
<td></td>
</tr>
<tr>
<td>Nervous system</td>
<td>Coordinates body activity</td>
<td>Brain</td>
</tr>
<tr>
<td></td>
<td>Controls learning &amp; memory</td>
<td>Spinal cord</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nerve cells</td>
</tr>
<tr>
<td>Circulatory</td>
<td>Moves blood, digested food, oxygen, waste, and other</td>
<td>Heart</td>
</tr>
<tr>
<td>system</td>
<td>materials in the body</td>
<td>Arteries</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Veins</td>
</tr>
<tr>
<td>Respiratory</td>
<td>Moves gases to and from the circulatory system</td>
<td>Lungs</td>
</tr>
<tr>
<td>system</td>
<td>Provides blood w/ oxygen and removes carbon dioxide</td>
<td></td>
</tr>
<tr>
<td>Excretory system</td>
<td>Rids body of wastes from cell activity</td>
<td>Stomach</td>
</tr>
<tr>
<td></td>
<td>Excretes carbon dioxide, water, &amp; nitrogen compounds</td>
<td>Intestines</td>
</tr>
<tr>
<td>Digestive system</td>
<td>Prepares food for use by the body</td>
<td>Liver</td>
</tr>
<tr>
<td></td>
<td>Monogastric and ruminant systems</td>
<td>Pancreas</td>
</tr>
<tr>
<td>Lymphatic system</td>
<td>Produces &amp; circulates lymph</td>
<td>Lymph glands</td>
</tr>
<tr>
<td></td>
<td>Protects the body from disease</td>
<td></td>
</tr>
<tr>
<td>Integumentary</td>
<td>Protects internal organs</td>
<td>Skin</td>
</tr>
<tr>
<td>system</td>
<td>Helps regulate temperature</td>
<td>Mucous tissues</td>
</tr>
<tr>
<td></td>
<td>Gives shape to the body</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Keeps disease pathogens away from internal organs</td>
<td></td>
</tr>
<tr>
<td>Reproductive</td>
<td>Produces offspring</td>
<td>Ovaries</td>
</tr>
<tr>
<td>system</td>
<td>Varies by gender</td>
<td>Testes</td>
</tr>
<tr>
<td>Mammary system</td>
<td>In females only</td>
<td>Teats</td>
</tr>
<tr>
<td></td>
<td>Secretes milk as food for young</td>
<td>Udder</td>
</tr>
</tbody>
</table>
RS: 06.07.G
Cube It! Dice Pattern

Describe it

Analyze it

Compare it

Associate it

Apply it

Argue for/against it
RS: 06.07.H

Summary Rules

1. Make sure you understand the text. What was this text about? What did the writer say? Try to say the general theme to yourself.

2. Look back. Reread the text to make sure you got the theme right.

3. Rethink. Reread a paragraph of the text. Try to say the theme of that paragraph to yourself. Is the theme a topic sentence? Have you underlined it? Or is the topic sentence missing: If it is missing, have you written one in the margin?

4. Check and double-check. Did you leave in any lists? Make sure you don’t list things out in your summary. Did you repeat yourself? Make sure you didn’t. Did you skip anything? Is all the important information in the summary?

5. Collapse lists. If you see a list of things, try to think of a word or phrase name for the whole list.

6. Use topic sentences. Often authors write a sentence that summarizes a whole paragraph. It is called a topic sentence. If the author gives you one, you can use it in your summary. If you don’t see a topic sentence, make up one of your own.

7. Get rid of unnecessary detail. Some text information can be repeated in a passage. Since summaries are meant to be short, get rid of repetitive or trivial information.

8. Collapse paragraphs. Paragraphs are often related to one another. Some paragraphs explain one or more other paragraphs. Some paragraphs just expand on the information presented in other paragraphs. Some paragraphs are more necessary than other paragraphs. Decide which paragraphs should be kept or gotten rid of, and which might be joined together.

9. Polish the summary. When a lot of information is reduced from an original passage, the resulting concentrated information often sounds very unnatural. Fix this problem and create a more natural-sounding summary. Adjustments may include but are not limited to: paraphrasing, the insertion of connecting words like “and” or “because,” and the insertion of introductory or closing statements. Paraphrasing is especially useful here, for two reasons: one, because it improves your ability to remember the material, and two, it avoids using the author’s words, otherwise known as plagiarism.

(Hare & Borchardt, p. 66, 1984)
Meeting the Nutritional Needs of Animals

Intended Outcome: 06.0: Describe the principles of plant and/or animal nutrient growth and reproduction.
SPS: 06.06: Identify the nutrients required for animal growth and development and role of each.
Sunshine State Standard(s): LAA 1.4, 2.4; LAB 1.4, 2.4; LAC 1.4, 2.4, 3.4; LAD 1.4, 2.4; LAE 1.4, 2.4; SCA 1.4, 2.4; SCB 1.4, 2.4; SCF 1.4, 2.4

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:
1. Explain the functions of feed.
2. Identify the various feed types and their characteristics.
3. Explain how animals are fed.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:


Other Resources. The following resources will be useful to students and teachers:


List of Equipment, Tools, Supplies, and Facilities

- Writing surface
- Overhead projector
- Transparencies from attached masters
- Copies of student lab sheets

Terms. The following terms are presented in this lesson (shown in bold italics):
Animal proteins   Free access   Nodules
Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Have samples of corn, soybean meal, and hay placed in front of the class. Ask the students to make a list of the similarities and differences between the three types of feed. Make a class list of similarities and differences on the board. Tell the students to keep their lists and to refer back to it as the lesson progresses.

Pre-Reading Strategies
Please select one of the following Pre-Reading strategies to use to activate student background knowledge prior to reading.

K-W-L
Procedure:
1. Create three columns on the chalkboard, labeling the columns with what we know, what we want to know, and what we learned, or utilize an overhead with the K-W-L chart.
   a. Students should individually fill out a K-W-L chart on their own. Use RS: 06.06.A as a handout to guide students.
2. Ask/Brainstorm with students about what they know related to animal nutrition. You may need to prompt students with pictures, questions, or ideas.
   a. Ask students what they want to know about animal nutrition. Again, students may need prompting. For example, you may want to phrase questions in a problem-solving approach.
3. Instruct students to read the assigned text.
   a. As students read the text, they should fill in the third column, what we learned.
   b. Students can add questions to the “what we want to learn” column as they read.
   c. A further development of K-W-L would be to assign and name categories for the information that students generated in the what we learned column. From the categories, students can create a concept map of the general topic.
4. As a summary, you can conduct a class discussion to generate consensus about what was learned about animal nutrition.
a. Students can also categorize the information that they learned into a graphic organizer to further their engagement with the material and learning.
b. Students could create a summary of the passage.

Anticipation Guide
Procedure:
1. Identify major concepts in the lesson.
2. Create statements that question notions, beliefs, or opinions that challenge what students already know about animal nutrition.
   a. In creating the statements, you may develop them in such a way as to challenge students to think deeply about animal nutrition.
   b. Statements should help identify the major concepts in the lesson.
   c. Statements should also be general rather than specific.
3. Hand out the guide prior to reading and instruction (RS: 06.06.B).
   a. Students should mark their responses of agreement/true (✓) or disagreement/false (✗) in the “Before Reading” column.
   b. Students should provide their reasons for agreeing/disagreeing in the “Why?” area.
4. Instruct students to read the text. During reading, students can refer to the guide and make notes.
5. After reading, students should mark the “After Reading” column.
   a. Conduct a discussion comparing before- and after-reading results.
   b. Discussion should refer to evidence in the text.

Summary of Content and Teaching Strategies

Objective 1: Explain the functions of feed.

Anticipated Problem: What are the functions of feed?

Reading:
- Agriscience … 317-320
- Agriscience fundamentals & applications … 511-518
- Introduction to livestock and companion animals … 57-58, 68-70
- The science of agriculture: A biological approach … 243-245

During Reading Strategies
Please select one of the following During Reading strategies to use with this objective.

Bubble Cluster
Procedure:
1. Introduce the general topic, types of feeds, to students. Ask students to think of words associated with feeds.
2. Students list words associated with feeds, cluster the words according to some characteristics, and draw a bubble around each cluster (see RS: 06.06.C and RS: 06.06.C key for examples).
Think-Aloud

Procedure:

1. Select a passage that contains points of difficulty, ambiguities, or unknown words.
   a. Preview the passage and imagine that you are reading it for the first time as a good reader would.
   b. Make notes and comments of your thoughts for the students. You may use RS: 06.06.D as a guide to the think-aloud.

2. Read the passage aloud, telling students to follow along silently and listen to how you construct meaning and think through trouble spots.
   a. Develop hypotheses.
   b. Make predictions.
   c. Describe any pictures forming in your head.
   d. Link new information with prior knowledge.
   e. Share an analogy.
   f. Verbalize confusing points.
   g. Demonstrate fix-up strategies (rereading, thinking about a word, etc.).

3. Select a logical stopping point and have students use your model to continue reading.

4. Have students practice thinking aloud with partners.

I. The nutritional needs of animals change throughout the animal’s life. The amount and type of feed depends on the stage of life and use of the animal. The feed consumed by the animal is used for various purposes. These uses or functions can be categorized into the following groups.

A. Maintenance—Maintenance is keeping the body at a constant state. There is no loss or gain of weight. Every second an animal is alive it requires energy. The amount of energy needed by an animal for maintenance is known as the basal maintenance requirement. A maintenance diet is usually high in carbohydrates and fats. It should contain a small amount of protein, minerals, and vitamins. On average, about 50% of an animal’s diet is used for maintenance.

B. Growth—Growth is defined as the increase in size of the muscles, bones, internal organs, and other parts of the body. Animal growth requires mostly energy and smaller amounts of other nutrients. Very high levels of carbohydrates and fats in the animal’s diet provide this energy.

C. Reproduction—Proper nutrition is the key to successful and efficient reproduction in animals. Most reproductive failures are caused by poor nutrition in the female. A proper reproduction ration typically includes higher levels of protein, minerals, and vitamins. This is especially needed in the last three months of gestation (pregnancy) because this is when the fetus or unborn offspring experiences the most growth. Poor nutrition also affects males. A lack of proper nutrients can lower sperm production and fertility rates.

D. Lactation—Lactation is the production of milk. The nutrient requirements for moderate to heavy milk production are greater than the requirements during gestation. A lactation ration requires even higher levels of protein, calcium, and phosphorus.
E. Work—A work ration is needed by animals that are expected to conduct all types of work and activity for the operation. Examples could include draft animals, racehorses, and hunting dogs. These animals require increased carbohydrates and fats.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the functions of feed. Chapter 3 in Introduction to Livestock and Companion Animals is recommended. Use TM: 06.06.A to aid in discussion.

Objective 2: Identify the various feed types and their characteristics.

Anticipated Problem: What are the various feed types?
Reading:
- Agriscience … 321-339
- Agriscience fundamentals & applications … 516-518
- Introduction to livestock and companion animals … 70-72

During Reading Strategies
Please select one of the following During Reading strategies to use with this objective.

Concept Map
Procedure:
1. Display a blank concept/definition map on the overhead or PowerPoint.
   a. Point out the questions that complete a definition of the concept: what is it like?, what are some examples/nonexamples?, what are characteristics?, and what is it?.
   b. Model the strategy by using a concept for which students are familiar, for example, you may use cheese.
   c. You may use RS: 06.06.E and RS: 06.06.E key as a guide to the concept map.
2. Present a key term or concept from the text.
3. Student may work individually or in pairs to complete the concept/definition map for the new concept.
   a. When students have finished their map, they should develop their own definition of the concept using their maps.
   b. The definition may include several sentences to encompass the scope of the concept.
4. You may want to develop a “class” definition of the concept for assessment purposes.

Matrices
Procedure:
1. Examine text to determine categories for the left-hand column and variables for the top row.
   a. Use RS: 06.06.F for the handout and RS: 06.06.F key as the guide.
b. Fill in some cells as a model for students as you read aloud.
c. Find evidence in the text or course to support your entries.

2. Instruct students to finish the matrix on their own or in pairs.
3. Ask students to analyze their matrix to determine trends, patterns, or conclusions.
   This may generate discussion among the class.
4. Instruct students to write a concise conclusion based on their matrix.

II. A feedstuff is an ingredient used in making the feed for animals. Feed is what animals eat to get nutrients. Feedstuffs can be added to feed to provide flavor, color, or texture to increase palatability. Palatability is how well an animal likes a feed. A feed high in nutrients is of no benefit if the animal refuses to eat it. Feeds can be placed into three basic categories. They are:

A. Roughages—Livestock feeds that contain more than 18 percent crude fiber when dry are called roughages. The type of feed is mostly leaves and tender stems of plants. These plants are also known as forages. Forages can be grouped into two general classes: legume roughages and nonlegume roughages.
   1. A legume is a plant that can take nitrogen from the air. These plants specialized root parts called nodules, contain bacteria that aid in this process. All of the clovers, as well as alfalfa, soybeans, trefoil, lespedeza, peas, and beans are legumes.
   2. Nonlegume roughages cannot use the nitrogen from the air. They are usually lower in protein than the legume roughages. Some examples of this type of roughage are: corn silage, fodders, bluegrass, timothy, redtop, bromegrass, orchard grass, fescue, and prairie grasses.

B. Concentrates—Livestock feeds that contain less than 18 percent crude fiber when dry are called concentrates. This type of feedstuff is high in energy. Concentrates have more energy per pound than roughages. Higher producing animals need more nutrients from concentrates.
   1. High-energy concentrates are feeds that contain less than 20 percent crude protein. Some common sources of high-energy concentrates are corn, wheat, sorghum, barley, rye, and oats.
   2. High-protein concentrates are feeds that contain 20 percent or more protein. Examples of high-protein concentrates are soybean meal, cottonseed meal, and sunflower meal.

C. Supplements—A supplement is a feed material high in a specific nutrient. Supplements are often added to feeds to increase protein content. Protein supplements can be divided into two groups based on the source of the protein.
   1. Protein supplements that come from animals or animal by-products are called animal proteins. Common animal proteins are tankage, meat scraps, meat and bone meal, fish meal, and blood meal. Tankage is animal tissues and bones from animal slaughterhouses and rendering plants that are cooked, dried, and ground. Most animal proteins contain more than 47 percent crude protein. Animal proteins contain a more balanced amount of the essential amino acids than do the other type of protein supplements.
   2. Protein supplements that come from plants are called vegetable proteins. Common vegetable proteins are soybean oil meal, peanut oil meal, and corn
During Reading Strategies
Frayer Model
Procedure:
1. Review categories of feedstuffs and create a list of essential and nonessential characteristics, as well as examples and nonexamples.
2. Display a blank Frayer model on the overhead or PowerPoint (use RS: 06.06.G1, RS: 06.06.G2, and RS: 06.06.G3).
   a. Point out the categories of information that complete the Frayer model: essential characteristics, nonessential characteristics, examples, and nonexamples.
   b. Model the strategy by using a concept for which students are familiar, for example, you may use vegetable (see example).
3. Distribute blank Frayer models (use RS: 06.06.G1, RS: 06.06.G2, and RS: 06.06.G3) to students and instruct them to read the selected passage, filling out the Frayer model as they read.
4. Once students have read the passage and completed their own Frayer model, generate one composite model with the entire class.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the various feed types. Chapter 3 in Introduction to Livestock and Companion Animals is recommended.

Objective 3: Explain how animals are fed.

Anticipated Problem: What are some ways to feed animals?
Reading:
- Agriscience … 342-343
- Introduction to livestock and companion animals … 74-75

III. How and when animals are fed is an important portion of animal production. This affects the growth and development of the animal. Animals need to consume the correct amount of the ration without overeating, which can cause health problems as well. There are two basic methods in which feed can be provided to animals: free access and scheduled feeding.
A. Free access or free choice is allowing animals to eat feed when they want feed. The feed is available to the animal at all times. This method is good for some species and with some feedstuffs but not others. For example, swine can be fed concentrates free access because they will not overeat. However, cattle should not be fed concentrates free access because they will overeat and could possibly founder and die.
B. Scheduled feeding is providing feed at certain times of the day. Feeding times and regularity should be based on the needs of the animal or management practices.
There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding how animals are fed. Chapter 3 in Introduction to Livestock and Companion Animals is recommended.

Post-Reading Strategies
Please select one of the following Post-Reading strategies to use as a conclusion to the lesson.

Cube It!
Procedure:
1. The teacher should select the text passage to be read.
   a. Divide the students into teams of no more than 6 students.
   b. You will need a die with the six questions (describe it, compare it, associate it, analyze it, apply it, and argue for or against it) listed on the sides.
2. Students should number a sheet of notebook paper 1-6, skipping 6-8 lines in between each number.
   a. By each number, students should write a team member’s name (some team members might have their name listed twice, depending on the size of the teams).
3. The person whose name is written after number 1 will roll the die first. Whatever question it lands on, that person must answer it on notebook paper.
   a. Use RS: 06.06.H for the dice pattern.
   b. Be sure to write the die question by your number (example – 1. Travis – Describe it – the answer).
4. Each member will roll the die until all of the six questions have been answered. Remember: each member is responsible for one side of the die, and the answer must be in his/her own words and writing.

Die Questions and How to Answer:
• Describe it: What is animal nutrition about? What is the importance, color, size, shape, etc.?
• Compare it: What is animal nutrition similar to or different from?
• Associate it: What does animal nutrition make you think of?
• Analyze it: Tell how is a balanced ration made or what it is composed of.
• Apply it: What can you do with animal nutrition? How is it used?
• Argue for or against it: Take a stand and list reasons supporting its importance.

Summary
Use RS: 06.06.I as a guide for writing summaries.
Four General Steps to Help with the Four+ Specific Rules for Writing a Summary
1. Make sure you understand the text. Ask yourself, “What was this text about?” “What did the writer say?” Try to say the general theme to yourself.
2. Look back. Reread the text to make sure you got the theme right. Also read to make sure that you really understand what the important parts of the text are. Star the important points.

Now Use the Four Rules for Writing a Summary
3. Rethink. Reread a paragraph of the text. Try to say the theme of that paragraph to yourself. Is the theme a topic sentence? Have you underlined it? Or is the topic sentence missing: If it is missing, have you written one in the margin?

4. Check and double-check. Did you leave in any lists? Make sure you don’t list things out in your summary. Did you repeat yourself? Make sure you didn’t. Did you skip anything? Is all the important information in the summary?

Four Rules for Writing a Summary

5. Collapse lists. If you see a list of things, try to think of a word or phrase name for the whole list. For example, if you saw a list like eyes, ears, neck, arms, and legs, you could say “body parts.” Or, if you saw a list like ice skating, skiing, or sledding, you could say “winter sports.”

6. Use topic sentences. Often authors write a sentence that summarizes a whole paragraph. It is called a topic sentence. If the author gives you one, you can use it in your summary. Unfortunately, not all paragraphs contain topic sentences. That means you may have to make up one for yourself. If you don’t see a topic sentence, make up one of your own.

7. Get rid of unnecessary detail. Some text information can be repeated in a passage. In other words, the same thing can be said in a number of different ways, all in one passage. Other text information can be unimportant, or trivial. Since summaries are meant to be short, get rid of repetitive or trivial information.

8. Collapse paragraphs. Paragraphs are often related to one another. Some paragraphs explain one or more other paragraphs. Some paragraphs just expand on the information presented in other paragraphs. Some paragraphs are more necessary than other paragraphs. Decide which paragraphs should be kept or gotten rid of, and which might be joined together.

A Final Suggestion

9. Polish the summary. When a lot of information is reduced from an original passage, the resulting concentrated information often sounds very unnatural. Fix this problem and create a more natural-sounding summary. Adjustments may include but are not limited to: paraphrasing, the insertion of connecting words like “and” or “because,” and the insertion of introductory or closing statements. Paraphrasing is especially useful here, for two reasons: one, because it improves your ability to remember the material, and two, it avoids using the author’s words, otherwise known as plagiarism. (Hare & Borchardt, p. 66, 1984)

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at end of chapters in the textbook may also be used in the review/summary.

Evaluation. Focus the evaluation of student achievement on mastery of the objectives stated in the lesson. Measure student performance on classroom participation, laboratory assignments, and written tests or quizzes.
Answers to Assessment:
Part One: Matching
1 = e, 2 = a, 3 = b, 4 = f, 5 = g, 6 = j, 7 = h, 8 = i, 9 = d, 10 = c

Part Two: Completion
1. 47 percent
2. greater
3. energy
4. source
5. overeat

Part Three: Short Answer
See Objective 2 in lesson for scoring.

Part Four: Multiple Choice
1 = a, 2 = c, 3 = c, 4 = b, 5 = d, 6 = d, 7 = c, 8 = a, 9 = b, 10 = a, 11 = b

Part Five: Comprehension
Grading rubric. Total points possible = 28 points. For any missing element (title or bulleted information), subtract 1 point.
Assessment

Name_____________________________________

Lesson 06.06: Meeting the Nutritional Need of Animals

Part One: Matching
Instructions. Match the term with the correct response. Write the letter of the term by the definition. (1 point/question).

a. Basal maintenance requirement  f. Roughages
b. Feedstuff  g. Tankage
c. Growth  h. Free access
d. Palatability  i. Feed
e. High-energy concentrates  j. Maintenance

_______ 1. Feeds that contain less than 20 percent crude protein.
_______ 2. The amount of energy needed by an animal for maintenance.
_______ 3. An ingredient used in making the feed for animals.
_______ 4. Livestock feeds that contain more than 18 percent crude fiber when dry.
_______ 5. Animal tissues and bones from animal slaughterhouses and rendering plants that are cooked, dried, and ground.
_______ 6. Keeping the body at a constant state.
_______ 7. Allowing animals to eat feed when they want.
_______ 8. What animals eat to get nutrients.
_______ 9. How well an animal likes a feed.
_______ 10. The increase in size of the muscles, bones, internal organs, and other parts of the body.

Part Two: Completion
Instructions. Provide the word(s) to complete the following statements. (1 point/question).

1. Most vegetable proteins contain less than ________________ crude protein.
2. The nutrient requirements for moderate to heavy milk production are ________________ than the requirements during gestation.
3. Animal growth requires mostly ________________ and smaller amounts of other nutrients.
4. Protein supplements can be divided into two groups based on the ________________ of the protein.
5. Swine can be fed concentrates free access because they will not ________________.

Part Three: Short Answer
Instructions. Provide information to answer the following question. (5 points/question).

1. Compare and contrast roughages and concentrates.
Part Four: Multiple Choice
Instructions. Select the best answer for the following questions. (1 point/question).

1. If a producer were feeding steers for weight gain, which of the following functions would the feed perform?
   a. Maintenance and growth.
   b. Growth and work.
   c. Reproduction.
   d. None of the above.

2. If a different producer were feeding replacement gilts that were soon to be bred, which of the following function(s) would the feed perform?
   a. Reproduction.
   b. Growth and reproduction.
   c. Growth and lactation.
   d. All of the above.

3. How is a feedstuff selected for maintenance the same as a feedstuff for growth? Both contain high amounts of ________________.
   a. Carbohydrates.
   b. Fats.
   c. Carbohydrates and fats.
   d. Calcium and phosphorus.

4. How is a feedstuff selected for work different from a feedstuff for lactation?
   a. A feedstuff for work is high in carbohydrates and fats, while a feedstuff for lactation is high in fats only.
   b. A feedstuff for work is high in carbohydrates and fats, while a feedstuff for lactation is high in protein, calcium, and phosphorus.
   c. A feedstuff for work contains a lot of energy, while a feedstuff for lactation contains a lot of carbohydrates.
   d. There is no difference.

5. Why would a high-protein concentrate be fed to livestock?
   a. Maintenance.
   b. Growth.
   c. Work.
   d. Lactation.

6. Which of the following animals would a producer feed high-energy concentrates?
   a. Milking cows.
   b. Replacement heifers.
   c. Laying hens.
   d. Feeder pigs.
7. In the above question, why would the producer feed the high-energy concentrate?
   a. Lactation.
   b. Work.
   c. Growth.
   d. Reproduction.

8. For a riding mare (female horse) that is in gestation, which of the following would be an appropriate mix of feedstuffs?
   a. Roughages, protein concentrate, vitamin supplements, and energy concentrate.
   b. Roughages only.
   c. Concentrates only.
   d. Roughages, vitamin supplements, and fiber.

9. Which of the following feedstuffs would contain the highest energy content?
   a. Nonlegume roughages.
   b. Concentrates.
   c. Supplements.

10. Why would a producer feed dairy cows a ration containing roughages, concentrates, and supplements?
    a. Roughages for fiber, concentrates for lactation, and supplements for calcium and phosphorus.
    b. Roughages for nitrogen, concentrates for work, and supplements for protein.
    c. Roughages for energy, concentrates for protein, and supplements for nitrogen.
    d. Roughages for lactation, concentrates for reproduction, and protein supplements.

11. Which of the following types of livestock should be feed free-choice?
    a. Draft horses.
    b. Feeder steers.
    c. Over-weight heifers.
    d. None of the above.

Part Five: Comprehension
Instructions. Read the following passage about animal nutrition. After reading the passage, create a concept map. (28 points possible). Use a piece of notebook paper upon which to construct your concept map.

NUTRIENT REQUIREMENTS

A nutrient is any substance required for life. Animals need six types of nutrients: water, protein, carbohydrates, fats, vitamins, and minerals. Some scientists include a
seventh—air. Nutrient needs vary based on the type and size of animal, as well as the life stage they are in. For example, a lactating cow (producing milk to feed her young) requires more feed.

Water may be obtained from drinking and from the feed given animals. Water is the major portion in cells and helps transport other nutrients.

Protein is the building material. It is needed for the growth of muscles, tissues, and bones. Protein also helps repair damage or injury to cells. Protein is important for weight gain, growth, and reproduction.

Carbohydrates may be simple or complex. They provide energy for all animals. Carbohydrates should make up about 75 percent of an animal’s diet. Carbohydrates also provide fiber, which helps the digestive system run more smoothly. Ruminants can digest this fiber; non-ruminants cannot.

Fats, also called lipids, are part of animal cells. They provide energy and carry some vitamins. They also help form certain chemicals used in body functions.

Vitamins are nutrients required in very small amounts for specific functions. Sixteen known vitamins are required. These include vitamins A, D, E, K and the B-complex. Ruminants can produce some vitamins within the rumen.

Minerals are chemical elements required by the skeletal system. Other systems also require minerals. The minerals needed in the largest amounts are calcium and phosphorus.
Functions of Feed

Lactation
Work
Reproduction
Growth
Maintenance
RS: 06.06.A

Name_____________________________________

Animal Nutrition K-W-L

<table>
<thead>
<tr>
<th>Know</th>
<th>Want to know</th>
<th>Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Animal Nutrition Anticipation Guide

<table>
<thead>
<tr>
<th>Before Reading: Yes/No</th>
<th>Statement</th>
<th>After Reading: Yes/No</th>
<th>Evidence/Support</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nutritional needs remain relatively the same throughout an animal’s life. Why?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female and male livestock require different feed rations. Why?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Livestock need a balanced ration, including roughages, protein, concentrates, vitamins, and minerals in order to lead productive lives. Why?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Proteins are the most important nutrient for livestock. Why?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water is an important, but often overlooked nutrient necessary for high productivity in livestock. Why?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RS: 06.06.C

Name_____________________________________

Animal Nutrition Bubble Cluster
Animal Nutrition Bubble Cluster

Functions of Feed(s)

**Maintenance** – keeps the body at a constant state
- Carbohydrates & fats
- 50% of diet

**Growth** – increase in size
- Requires energy
- High levels of fats and carbohydrates

**Reproduction** – most reproductive failures result from poor nutrition
- Higher levels of protein, minerals, & vitamins
- Last 3 months of gestation

**Lactation** – production of milk
- Greater nutrient requirements than during lactation
- Higher protein, calcium, & phosphorus

**Work**
- Draft horses, race horses, hunting dogs
- Increased fats and carbohydrates
Functions of Feed Think Aloud
From Agriscience, pg. 317.

Animals must have the right feed to live, grow rapidly, and be productive. Animals that do not get what they need may be stunted, get sick, or die.

This must cost producers a lot of money

What kinds of animals need different kinds of feed?  We studied this...organ systems are groups of organs working together.

Feed needs vary with the kind of animal. An animal’s body structure and organ systems are important. Ruminants can eat large amounts of roughage because they have stomachs that convert low-quality feedstuffs into higher-quality nutrients. They are fed differently than other animals. Nonruminants usually have stomachs with one compartment and this affects what they are fed. Of course, poultry are different from hogs, horses, sheep, cattle, and fish.

What is a ruminant?  What is a roughage?  Their stomachs must be different than ours.

What are low-quality feedstuffs?

What is a nonruminant?

How so? They eat basically the same things, don’t they? Maybe worms have something to do with it.

If they have favorite foods, why do they eat so much corn?

Animals have preferences about feed just as people have their favorite foods.

Is this the same kind of molasses that we eat?

These need to be considered. Cattle will eat about anything if it has molasses added to it!
RS: 06.06.E

Name_____________________________________

Feed Types Concept Map
Feed Types Concept Map

**Legume** — plant that takes nitrogen from the air
- Contains nodules
- Clover, alfalfa, soybeans, trefoil, lespedeza, peas

**non-Legume** — plant that cannot use nitrogen from the air
- Lower in protein
- Corn silage, fodders, bluegrass, timothy, redtop, bromegrass, orchard grass, fescue

**Roughages** — feeds containing more than 18% crude fiber

**Feedstuffs** — ingredient used in making the feed for animals

**Concentrates** — feeds containing less than 18% crude fiber

**Supplements** — feed high in a specific nutrient (protein)

**Animal protein** — come from animals
- Tankage, meat scraps, meat and bone meal, fish meal, blood meal
- > 47% crude protein
- Balanced amino acids

**Vegetable protein** — come from plants
- Soybean oil meal, peanut oil meal, corn gluten meal
- < 47% crude protein

**High-energy** — feed containing less than 20% crude protein
- Corn, wheat, sorghum, barley, rye, oats

**High-protein** — feed containing 20% or more crude protein
- Soybean meal, cottonseed meal, sunflower meal
Name_____________________________________

### Types of Feeds Matrix

<table>
<thead>
<tr>
<th>Categories</th>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of Feeds</td>
<td>Definition</td>
</tr>
<tr>
<td>Roughages</td>
<td></td>
</tr>
<tr>
<td>Roughages:</td>
<td></td>
</tr>
<tr>
<td>Legumes</td>
<td></td>
</tr>
<tr>
<td>Roughages:</td>
<td></td>
</tr>
<tr>
<td>Nonlegumes</td>
<td></td>
</tr>
<tr>
<td>Concentrates</td>
<td></td>
</tr>
<tr>
<td>Concentrates:</td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td></td>
</tr>
<tr>
<td>Concentrates:</td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td></td>
</tr>
<tr>
<td>Supplements</td>
<td></td>
</tr>
<tr>
<td>Supplements:</td>
<td></td>
</tr>
<tr>
<td>Animal Protein</td>
<td></td>
</tr>
<tr>
<td>Supplements:</td>
<td></td>
</tr>
<tr>
<td>Vegetable</td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td></td>
</tr>
</tbody>
</table>
## Types of Feeds Matrix

<table>
<thead>
<tr>
<th>Categories</th>
<th>Variables</th>
<th>Contents</th>
<th>Use/Functions</th>
<th>Found in…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roughages</td>
<td>Leaves &amp; tender stems of plants Forages</td>
<td>Fiber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roughages: Legumes</td>
<td>Plant that takes in nitrogen from the air</td>
<td></td>
<td></td>
<td>Clover, Alfalfa, Soybeans, Trefoil, Beans, Lespedeza, Peas</td>
</tr>
<tr>
<td>Roughages: Nonlegumes</td>
<td>Plants that cannot use nitrogen from the air</td>
<td></td>
<td></td>
<td>Corn silage, Fodders, Fescue, Bluegrass, Timothy, Redtop Bromegrass, Orchard grass, Prairie grasses</td>
</tr>
<tr>
<td>Concentrates</td>
<td>Feeds that contain less than 18% crude fiber</td>
<td>Energy More energy than roughages</td>
<td>Add muscle, fat</td>
<td></td>
</tr>
<tr>
<td>Concentrates: Energy</td>
<td>Feeds that contain less than 20% crude protein</td>
<td></td>
<td></td>
<td>Corn, Wheat, Sorghum, Barley Rye, Oats</td>
</tr>
<tr>
<td>Concentrates: Protein</td>
<td>Feeds that contain 20% or more protein</td>
<td></td>
<td></td>
<td>Soybean meal Cottonseed meal Sunflower meal</td>
</tr>
<tr>
<td>Supplements</td>
<td>Feed that is high in a specific nutrient</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplements: Animal Protein</td>
<td>Protein supplements that come from animals or animal by-products</td>
<td>Contain more than 47% crude protein More balanced amino acids</td>
<td></td>
<td>Tankage Meat scraps Meat &amp; bone meal Fish meal Blood meal</td>
</tr>
<tr>
<td>Supplements: Vegetable Protein</td>
<td>Protein supplements that come from plants</td>
<td>Contains less than 47% crude protein</td>
<td></td>
<td>Soybean oil meal Peanut oil meal Corn gluten meal</td>
</tr>
</tbody>
</table>
Roughages Frayer Model

**Essential Characteristics:**

**Non-Essential Characteristics:**

**Examples:**

Roughages
Concentrates Frayer Model

<table>
<thead>
<tr>
<th>Essential Characteristics:</th>
<th>Non-Essential Characteristics:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Examples:

Concentrates
RS: 06.06.G3

Name_____________________________________

Supplements Frayer Model

<table>
<thead>
<tr>
<th>Essential Characteristics:</th>
<th>Non-Essential Characteristics:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Examples:

Supplements
RS: 06.06.H
Cube It! Dice Pattern

Describe it

Analyze it

Compare it

Associate it

Apply it

Argue for/against it
RS: 06.06.I

Summary Rules

1. Make sure you understand the text. What was this text about? What did the writer say? Try to say the general theme to yourself.
2. Look back. Reread the text to make sure you got the theme right.
3. Rethink. Reread a paragraph of the text. Try to say the theme of that paragraph to yourself. Is the theme a topic sentence? Have you underlined it? Or is the topic sentence missing: If it is missing, have you written one in the margin?
4. Check and double-check. Did you leave in any lists? Make sure you don’t list things out in your summary. Did you repeat yourself? Make sure you didn’t. Did you skip anything? Is all the important information in the summary?
5. Collapse lists. If you see a list of things, try to think of a word or phrase name for the whole list.
6. Use topic sentences. Often authors write a sentence that summarizes a whole paragraph. It is called a topic sentence. If the author gives you one, you can use it in your summary. If you don’t see a topic sentence, make up one of your own.
7. Get rid of unnecessary detail. Some text information can be repeated in a passage. Since summaries are meant to be short, get rid of repetitive or trivial information.
8. Collapse paragraphs. Paragraphs are often related to one another. Some paragraphs explain one or more other paragraphs. Some paragraphs just expand on the information presented in other paragraphs. Some paragraphs are more necessary than other paragraphs. Decide which paragraphs should be kept or gotten rid of, and which might be joined together.
9. Polish the summary. When a lot of information is reduced from an original passage, the resulting concentrated information often sounds very unnatural. Fix this problem and create a more natural-sounding summary. Adjustments may include but are not limited to: paraphrasing, the insertion of connecting words like “and” or “because,” and the insertion of introductory or closing statements. Paraphrasing is especially useful here, for two reasons: one, because it improves your ability to remember the material, and two, it avoids using the author’s words, otherwise known as plagiarism.

(Hare & Borchardt, p. 66, 1984)
Lesson 06.08

Understanding Animal Reproduction

Intended Outcome: 06.0: Describe the principles of plant and/or animal nutrient growth and reproduction.
SPS: 06.08: Describe the process of animal reproduction.
Sunshine State Standard(s): LAA 1.4, 2.4; LAB 1.4, 2.4; LAC 1.4, 2.4, 3.4; LAD 1.4, 2.4; LAE 1.4, 2.4; MAA 1.4, 2.4, 3.4, 4.4; MAB 1.4; MAE 1.4, 2.4, 3.4; SCF 1.4, 2.4; SCH 1.4, 3.4

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:
1. Describe the importance and process of animal reproduction.
2. List the sexual classification of animals for major species.
3. List the parts and explain the functions of female and male reproductive systems.
4. List and describe the phases of the estrous cycle.
5. Explain the reproductive development of animals.

List of Resources. The following resources may be useful in teaching this lesson:
Recommended Resources. One of the following resources should be selected to accompany the lesson:

Other Resources. The following resources will be useful to students and teachers:

List of Equipment, Tools, Supplies, and Facilities
• Textbook for each student
• Writing surface
• Overhead projector
• Transparencies from attached masters
Terms. The following terms are presented in this lesson (shown in bold italics):

- Anestrus
- Artificial insemination
- Castration
- Cervix
- Copulation
- Diestrus
- Egg
- Ejaculation
- Estrous cycle
- Estrus
- Fertilization
- Gestation
- Heat
- Insemination
- Lactation
- Libido
- Metestrus
- Natural insemination
- Neutering
- Ovary
- Oviduct
- Parturition
- Penis
- Proestrus
- Prostate gland
- Puberty
- Reproduction
- Scrotum
- Semen
- Seminal glands
- Seminal vesicles
- Sexual classification
- Sexual reproduction
- Sperm
- Sperm ducts
- Steer
- Testicles
- Uterus
- Urethra
- Vagina
- Vulva

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Ask students to explain how a cattle producer increases the size of the herd. Students may name methods such as buying cattle from someone else or breeding the cattle that are owned. Have students assess which alternative would be used if money was not available to buy animals. Ask students to relate examples of animal reproduction on farms, with companion animals, or with laboratory or exotic species. Move from the interest approach into the objectives of the lesson and its content.

Pre-Reading Strategies
Please select one of the following Pre-Reading strategies to use to activate student background knowledge prior to reading.

K-W-L
Procedure:
1. Create three columns on the chalkboard, labeling the columns with what we know, what we want to know, and what we learned, or utilize an overhead with the K-W-L chart.
   a. Students should individually fill out a K-W-L chart on their own.
   b. Use RS: 06.08.A for the K-W-L chart.
2. Ask questions or brainstorm with students about what they know related to animal reproduction. You may need to prompt students with pictures, questions, or ideas related to increasing herd size and quality, improving breeds, and genetics.
3. Ask students what they want to know about animal reproduction. Again, students may need prompting. For example, you may want to phrase questions in a problem-solving approach, such as how would you increase muscling in your beef herd?
   a. Instruct students to read the assigned text.
b. As students read the text, they should fill in the third column, what we learned.
c. Students can add questions to the “what we want to learn” column as they read.
d. A further development of K-W-L would be to assign and name categories for the information that students generated in the what we learned column. From the categories, students can create a concept map of the general topic.

4. As a summary, you can conduct a class discussion to generate consensus about what was learned about animal reproduction.
   a. Students can also categorize the information that they learned into a graphic organizer to further their engagement with the material and learning.
   b. Students could create a summary of the passage.

Making Predictions A-Z

Procedure:

1. The teacher selects the text passage and 3-7 letters for which students will make word predictions.
   a. Letters chosen should be the first letters of key words that will likely be found in the text
   b. Suggested letters for animal reproduction include A-B-C, P-Q-R, and S-T-U.
   c. Use RS: 06.08.B for making predictions.

   2. The teacher should read aloud the title of the passage and/or relevant subheadings and conduct a brief discussion about the content of the passage.
      b. Write the pre-selected letters for predictions on the chalkboard. (These are the letters for which students will generate words related to the topic and make predictions about the reading).

   3. Students list words beginning with the pre-selected letters and form predictions about what they will encounter in the text passage.
      a. Students may be paired with a partner to share their predicted words.
      b. After sharing the words, student pairs should generate predictions about the text.
      c. Use RS: 06.08.B key as a guide to the vocabulary that will be encountered in this lesson.

4. From the words and predictions, conduct a whole-class discussion about the topic.

5. Instruct the students to read the text.
   a. While reading students should continue to add relevant words to their Making Predictions A-Z worksheet.
   b. These words may be used to create a graphic organizer and/or summary of what they learned.
Anticipation Guide

Procedure:

1. Identify major concepts in the lesson.
   a. Create statements that question notions, beliefs, or opinions that challenge what students already know (see RS: 06.08.C).
   b. In creating the statements, you may develop them in such a way as to challenge students to think deeply about the topic.
   c. Statements should help identify the major concepts in the lesson.
   d. Statements should also be general rather than specific.

2. Hand out the guide prior to reading and instruction.
   a. Students should mark their responses of agreement/true (✓) or disagreement/false (✗) in the “Before Reading” column.
   b. Students should provide their reasons for agreeing/disagreeing in the “Why?” area.

5. Instruct students to read the text.
   a. During reading, students can refer to the guide and make notes.
   b. After reading, students should mark the “After Reading” column.
   c. Conduct a discussion comparing before- and after-reading results.
   d. Discussion should refer to evidence in the text.

Summary of Content and Teaching Strategies

Objective 1: Describe the importance and process of animal reproduction.

Anticipated Problem: Why is reproduction important? What is the process of animal reproduction?

Reading:
- Agriscience ... 368-371
- Agriscience fundamentals & applications ... 539-540, 547-550
- Introduction to livestock and companion animals ... 113-117
- The science of agriculture: A biological approach ... 219-222

During Reading Strategies
Please select one of the following During Reading strategies to use with this objective.

Concept Map

Procedure:

1. Introduce the concept of animal reproduction to students.
   a. Ask students to brainstorm words related to animal reproduction. Record the words on the chalkboard. Words could include sexual, sperm, egg, insemination, embryo transfer, and/or artificial insemination.
   b. Extend the discussion around words that suggest larger related categories.

2. Pass out RS: 06.08.D to help students classify the information.
   a. Use RS: 06.08D key as an example.
   b. Allow students a few minutes to categorize the words under more general headings.
3. Instruct students to survey the passage, looking for textual hints in the headings and titles that suggest key concepts.
4. Instruct students to read the assigned passage.
   a. As students read they should refine their categories by adding information and strengthening concept lines.
   b. Students may use their maps during classroom discussion or for creating a summary of information.

Concept of Definition Map
Procedure:
1. Display a blank concept/definition map (RS: 06.08.E) on the overhead or PowerPoint.
   a. Point out the questions that complete a definition of animal reproduction: what is it like?, what are some examples/nonexamples?, what are characteristics?, and what is it?.
   b. Model the strategy by using a concept for which students are familiar, for example, you may use cheese.
2. Present the key term, animal reproduction.
3. Students may work individually or in pairs to complete the concept/definition map for animal reproduction.
   a. When students have finished their map, they should develop their own definition of animal reproduction using their maps.
   b. The definition may include several sentences to encompass the scope of the concept.
   c. Use RS: 06.08.E key as a guide to what a concept of definition map may look like.
4. You may want to develop a “class” definition of animal reproduction for assessment purposes.

I. Reproduction is the process by which animals produce offspring.
   A. Offspring are the same species and have traits of their parents.
      1. Parents are selected and mated to achieve certain goals with offspring. Examples of goals include producing offspring with high milk productivity or meaty carcasses.
      2. Reproduction results in new animals that are raised for the products they produce. Examples of products include meat, eggs, milk, and wool.
   B. Most animals are produced with sexual reproduction. Sexual reproduction is the union of a sperm and an egg. Two parents are required.
      1. Sperm is the sex cell of male animals. They are produced in the testes.
      2. The egg or ovum is the sex cell of female animals. They are produced in the ovaries.
   C. Fertilization is the process by which the union of a sperm and an egg occurs. It is also known as conception.
      1. The union of the sperm with the egg occurs in the reproductive tract of the female. The process of placing sperm in reproductive tract of the female is known as insemination.
2. Natural insemination occurs when a male of a species mates with a female of the same species. Sperm are placed in the female reproductive tract by the male during copulation. Copulation is the mating process in which sperm are ejaculated from the penis of the male in the vagina of the female. Females must be receptive to males at a time in the estrus cycle known as heat.

3. Artificial insemination is used in some situations, such as with dairy cows. Artificial insemination is placing semen collected from a male in the female reproductive tract using equipment designed for the purpose. Artificial insemination must be done when the cow is in heat.

D. Once an egg has been fertilized, it becomes an embryo that attaches itself to the uterus for nourishment. The female is pregnant. The embryo goes through a time of development and becomes a fetus. The fetus develops to a stage where it is born and can live outside the uterus.

Have students read appropriate sections in textbooks as homework or during supervised study in class. Use student input to outline the content of the objective on the writing surface or use TM: 06.08.A. Have students keep notes on the major terms and concepts covered in class. Ask students to provide examples of animals that have recently given birth and the number of offspring produced.

Objective 2: List the sexual classification of animals for major species.

Anticipated Problem: What sexual classifications are used for animals?
Reading:
- Agriscience … 364

II. Sexual classification is the condition of an animal based on its age and sexual condition. It includes animals that are capable of reproduction as well as those that are not capable of reproduction.

A. An animal can be made incapable of reproduction by removing the ovaries or testes or altering the condition of the reproductive organs so that they are no longer fertile. The animals are not capable of conception.

1. Castration is the process of removing the testes from a male. It is a management practice used on young male animals. Castration eliminates unwanted breeding. It also promotes growth and development of young animals in more desirable ways with food animal production. Castration may be done surgically or with other methods. (Note: Castration is also known as emasculation and gelding.)

2. Neutering is the process of making a female incapable of reproduction. It is also known as spaying. The ovaries of the female are removed or other procedures are used to render the female incapable of conception. (Note: Neutering can also refer to the castration of males but often refers specifically to females.)

B. A number of terms are used to describe the sexual classification of animals. These terms vary by species, age, and gender. For example, a steer is a male bovine castrated at a young age and before sexual maturity was reached. Textbooks and
references usually have lists of terms for the sexual classification of common species.

Have students read appropriate sections in the textbook. Use their input to outline the content of the objective on the writing surface or use TM: 06.08.B. Students can be referred to tables that list sexual classification in textbooks and TM: 06.08.C can be used to list a few examples of sexual classification. Have students name examples of animals that are in the different sexual classifications.

Objective 3: List the parts and explain the functions of female and male reproductive systems.

Anticipated Problem: What are the major parts of female and male reproductive systems? What are the functions of the parts?

During Reading Strategies
Matrices
Procedure:
1. Examine text to determine categories for the left-hand column and variables for the top row.
2. Fill in some cells as a model for students as you read aloud.
3. Find evidence in the text or course to support your entries.
4. Instruct students to finish the matrix (RS: 06.08.F and RS: 06.08.F key) on their own or in pairs.
5. Ask students to analyze their matrix to determine trends, patterns, or conclusions.
a. This may generate discussion among the class.
6. Instruct students to write a concise conclusion based on their matrix.

Reading:
- Agriscience fundamentals & applications … 544-545
- Introduction to livestock and companion animals … 117-123
- The science of agriculture: A biological approach … 522-527

III. The reproductive system is the only organ system that varies among males and females of the same species.
A. The reproductive system of the female is designed to produce eggs, make conception possible, and promote development of embryo and fetus until birth. The major parts of the system are:
1. The vulva is the external part of the female reproductive tract.
2. The vagina is the mating organ of the female. It receives semen (sperm cells) from the male and serves as the canal through which the fetus moves during birth.
3. The cervix is the entrance to the uterus.
4. The uterus is the organ in which the embryo and fetus develop.
5. The oviduct (also known fallopian tube) is a tube from the ovaries to the uterus. Fertilization usually takes place near the upper end of oviduct. There are two oviducts—one for each ovary.
6. The ovary is the organ that produces the eggs or ova. Eggs pass from the ovary into the oviduct.

B. The reproductive system of the male is designed to produce and store sperm, and to deposit them in the reproductive tract of the female of the species. The major parts are:
1. The penis is the male reproductive organ that deposits semen in the reproductive tract of the female. Semen is a fluid containing sperm secreted by the seminal and prostate glands. Semen is expelled by a process known as ejaculation. Sexual stimulation during the mating process is needed for ejaculation to occur.
2. The urethra is the tube that extends through the penis from the urinary bladder.
3. The seminal glands produce fluids that promote the production of viable sperm.
4. The seminal vesicles are organs attached to the urethra and produce a fluid that nourishes sperm.
5. The prostate gland is an organ located around a section of the urethra and produces a fluid that becomes part of the semen.
6. The sperm ducts are tubes that connect the urethra with the testicles. They carry sperm from the testicles and mix with fluids to form semen.
7. The testicles are the male organs that produce sperm. They are outside the body cavity and carried in the scrotum.
8. The scrotum is a pouch-like skin structure that holds the testicles outside the body. The temperature in the scrotum is slightly lower than that of the body. This promotes sperm production.

C. The female and male reproductive systems are designed to assure efficient reproduction processes. This is needed in animal production systems where animals are produced and used for specific purposes.

Have students read appropriate sections in the textbook as homework or during supervised study. Involve students in developing a summary of the content for the objective on the writing surface. Another approach is to sketch and label the parts of the female and male reproductive systems on the writing surface or use TM: 06.08.D and TM: 06.08.E. In some cases, reproductive tracts may be obtained from slaughter houses for student examination. Caution: Be sure to follow all safety rules with any animal tissues used in the classroom.

Objective 4: List and describe the phases of the estrous cycle.

Anticipated Problem: What are the phases of the estrous cycle? How are these related to reproduction?
Reading:
- Agriscience … 370-372
• Agriscience fundamentals & applications … 544-545
• Introduction to livestock and companion animals … 124-125

During Reading Strategies
Sequence Map / Timeline
Procedure:
1. Instruct students to survey the passage, looking for textual hints in the headings and titles that suggest key concepts.
2. Instruct students to read the assigned passage.
3. As students read the passage, they should fill in the appropriate information in the sequence map, timeline, or flow chart.
4. Use RS: 06.08.G for the handout and RS: 06.08.G key for a guide.
5. The cause and effect map, sequence map, timeline, or flow chart may be used to create a summary of the process or series.

IV. The estrous cycle is the phases in the reproductive cycle between periods of estrus. These are the phases of reproductive readiness in the reproductive system of a mature female. The cycle does not occur during pregnancy nor when a female is in anestrus. Anestrus is the absence of cycling. It may occur due to disease, not being of reproductive age, or other conditions.

A. The estrous cycle is comprised of four phases. The phases occur in a definite sequence unless the female is pregnant. (The sequence listed here is the sequence of occurrence.)
   1. Estrus is the phase when a female is in heat. The animal is receptive to mating and will stand for copulation with a male. Females exhibit signs of heat. An enlarged vulva and a discharge from it are signs. Some females exhibit behaviors indicating readiness for mating such as when a cow mounts another cow in the mating position.
   2. Metestrus is the phase following heat. Ovulation occurs during metestrus as do other processes that help maintain a pregnancy should conception occur.
   3. Diestrus is the phase in the estrous cycle when the reproductive system assumes that conception has occurred, even if it has not. Diestrus is several days long depending on the species of animal.
   4. Proestrus is the period following diestrus in which preparation is being made by the reproductive system for the next heat period and ovulation. If conception has occurred, the estrous cycle ceases until it is renewed after gestation and parturition.

B. Animal producers can be more efficient in animal reproductive management if they know the phases of estrous. Careful observation by a trained producer and records on reproductive cycles will promote breeding to assure the production of young animals at the best time. For example, cattle producers often breed cows to assure calving in the spring when pasture grasses are beginning to grow. This allows a cow to produce maximum milk for the nutrition and growth of the calf.

Have students read appropriate sections in the textbook. Develop the information on the writing surface using student input. TM: 06.08.F can be used to present a summary of the
information. If appropriate, have students observe a female hog (or other species that exhibits visible signs) that is in heat and compare the signs with those of a female that is not in heat. Have an artificial insemination technician serve as a resource person in class and describe the signs used to know the time to artificially inseminate a female.

Objective 5: Explain the reproductive development of animals.

Anticipated Problem: What are the phases in the reproductive development of animals?

Reading:
- Agriscience … 372-373
- Agriscience fundamentals & applications … 544-545
- Introduction to livestock and companion animals … 125-128

During Reading Strategies
Sequence Map / Timeline
Procedure:
1. Instruct students to survey the passage, looking for textual hints in the headings and titles that suggest key concepts.
2. Instruct students to read the assigned passage.
3. As students read the passage, they should fill in the appropriate information in the sequence map, timeline, or flow chart.
4. Use RS: 06.08.H for the handout and RS: 06.08.H key for a guide.
5. The cause and effect map, sequence map, timeline, or flow chart may be used to create a summary of the process or series.

V. Animals of a species begin life as either a male or female. Their development as a member of their species includes reproductive development for their gender.
A. Reproductive development follows fairly definite stages and processes.
1. Prepuberty is the stage of life of a young animal before it is capable of reproduction. Sufficient development has not been reached for an animal to reproduce.
2. Puberty is the stage when an animal reaches a level of sexual development where it is capable of reproduction. Puberty occurs in both males and females. With females, the estrous cycle results in the release of mature eggs that can support the mating, conception, and gestation processes. With males, the animal is capable of producing viable sperm. Age of puberty varies with animal species and other conditions such as nutrition and health condition. Examples of when puberty is reached are: cattle 8–12 months, sheep 5–7 months, swine 4–7 months, and horses 12–15 months.
3. Gestation is the period when a female is pregnant. The length of gestation varies with species though it tends to be consistent among members of the same species. For example, the gestation period is 114 days for sows and 337 days for a mare. The animal gives birth at the end of gestation.
4. Parturition is the process of giving birth. Hormones are produced to support the birth process and prepare for lactation.
5. Lactation is the secretion of milk by the mammary glands of a female. It is initiated by hormone activity. Lactation lasts for several months following parturition.

B. Mating behavior is a part of reproductive development. Both males and females of a species exhibit mating behavior. With males, this includes libido (desire to mate) and social status within a herd. With females, receptivity to mating occurs during heat.

Have students read appropriate sections in the textbook. Follow reading by having students participate in summarizing the content on the writing surface. TM: 06.08.G can be used to present a summary of the information.

Post-Reading Strategies
Please select one of the following Post-Reading strategies to use as a conclusion to the lesson.

Cube It!
Procedure:
1. The teacher should select the text passage to be read.
   a. Divide the students into teams of no more than 6 students.
   b. You will need a die with the six questions (describe it, compare it, associate it, analyze it, apply it, and argue for or against it) listed on the sides.
2. Students should number a sheet of notebook paper 1-6, skipping 6-8 lines in between each number.
   a. By each number, students should write a team member’s name (some team members might have their name listed twice, depending on the size of the teams).
   b. The person whose name is written after number 1 will roll the die first. Whatever question it lands on, that person must answer it on notebook paper.
3. Be sure to write the die question by your number (example – 1. Travis – Describe it – the answer).
   a. Use RS: 06.08.I for the dice pattern.
4. Each member will roll the die until all of the six questions have been answered. Remember: each member is responsible for one side of the die, and the answer must be in his/her own words and writing.

Die Questions and How to Answer:
- Describe it: What is animal reproduction about? What is the importance of animal reproduction?
- Compare it: What is animal reproduction similar to or different from?
- Associate it: What does animal reproduction make you think of?
- Analyze it: Tell the steps of animal reproduction.
- Apply it: What can you do with animal reproduction? How is animal reproduction used to improve herd productivity?
• Argue for or against it: Take a stand and list reasons supporting animal reproduction’s importance.

Summary
(see RS: 06.08.J for condensed rules)

Four General Steps to Help with the Four+ Specific Rules for Writing a Summary
1. Make sure you understand the text. Ask yourself, “What was this text about?” “What did the writer say?” Try to say the general theme to yourself.
2. Look back. Reread the text to make sure you got the theme right. Also read to make sure that you really understand what the important parts of the text are. Star the important points.

Now Use the Four Rules for Writing a Summary
3. Rethink. Reread a paragraph of the text. Try to say the theme of that paragraph to yourself. Is the theme a topic sentence? Have you underlined it? Or is the topic sentence missing: If it is missing, have you written one in the margin?
4. Check and double-check. Did you leave in any lists? Make sure you don’t list things out in your summary. Did you repeat yourself? Make sure you didn’t. Did you skip anything? Is all the important information in the summary?

Four Rules for Writing a Summary
5. Collapse lists. If you see a list of things, try to think of a word or phrase name for the whole list. For example, if you saw a list like eyes, ears, neck, arms, and legs, you could say “body parts.” Or, if you saw a list like ice skating, skiing, or sledding, you could say “winter sports.”
6. Use topic sentences. Often authors write a sentence that summarizes a whole paragraph. It is called a topic sentence. If the author gives you one, you can use it in your summary. Unfortunately, not all paragraphs contain topic sentences. That means you may have to make up one for yourself. If you don’t see a topic sentence, make up one of your own.
7. Get rid of unnecessary detail. Some text information can be repeated in a passage. In other words, the same thing can be said in a number of different ways, all in one passage. Other text information can be unimportant, or trivial. Since summaries are meant to be short, get rid of repetitive or trivial information.
8. Collapse paragraphs. Paragraphs are often related to one another. Some paragraphs explain one or more other paragraphs. Some paragraphs just expand on the information presented in other paragraphs. Some paragraphs are more necessary than other paragraphs. Decide which paragraphs should be kept or gotten rid of, and which might be joined together.

A Final Suggestion
9. Polish the summary. When a lot of information is reduced from an original passage, the resulting concentrated information often sounds very unnatural. Fix this problem and create a more natural-sounding summary. Adjustments may include but are not limited to: paraphrasing, the insertion of connecting words like “and” or “because,” and the insertion of introductory or closing statements. Paraphrasing is especially useful here, for two reasons: one, because it improves your ability to remember the material, and two, it avoids using the author’s words, otherwise known as plagiarism. (Hare & Borchardt, p. 66, 1984)
Discussion Web

Procedure:
1. Select a passage of text for students to read that contains potentially opposing viewpoints about artificial insemination versus natural breeding.
   a. You may want to prepare students by activating their background knowledge about artificial insemination and natural breeding through brainstorming.
2. Instruct students to read the assigned passage.
3. Introduce students to the discussion web (RS: 06.08.K) by asking a focusing question for discussion.
4. Assign students into pairs to develop opposing sides of the question. As they work the students should flesh out the arguments on both sides of the blank discussion web.
   a. Emphasis should be on making the strongest possible arguments for both sides of the question.
   b. Students should temporarily postpone their personal beliefs about the topic so that they can generate arguments for both sides of the issue.
5. Students should share their points of view and capture them on the discussion web.
   a. You may combine pairs into larger groups to share ideas and develop consensus on the topic.
   b. The group’s conclusion should be written at the bottom of the discussion web.
6. The larger groups should present their conclusions to the entire class.
   a. Groups should select a spokesperson who will present the group’s consensus to the entire class.
   b. Group presentations should be limited to 2-3 minutes to eliminate the possibility of repeating information.
   c. Spokespersons should be encouraged to mention opposing views from within their group or strong arguments from the opposing position.
7. Students may be instructed to create a summary position resulting from their personal discussion web as well as the entire class discussion.

Review/Summary. Use the objectives for the lesson as the structure for reviewing and summarizing the content of the lesson. Have students orally explain the content associated with each objective. Assess adequacy of their responses and reteach the content of any objective as needed. Activities that may support summary and review include making a field trip to observe the artificial insemination of an animal, observing the birth of an animal, and assessing the quality of semen used in artificial insemination.

Application. Application can occur as students produce animals in their supervised experience or later in their careers. In some cases, school laboratories may have animals where students can apply information on animal reproduction.
Evaluation. Evaluation should be based on mastery of the objectives by the students. This can occur during instruction, review, or later as students apply the information. A written test can also be used. A sample written test is attached to the lesson plan.

Answers to Assessment:
Part One: Matching
1=i, 2=f, 3=a, 4=b, 5=d, 6=c, 7=e, 8=j, 9=h, 10=g

Part Two: Completion
1=Gestation, 2=Lactation, 3=Estrus, 4=steer, 5=Semen

Part Three: Short Answer
1. The paragraph should include mating and the process of fertilization. The major organs of males and females that produce sex cells can be included. The pregnancy, gestation, and parturition should be included.
2. Efficient reproduction is important because animal producers want more animals.

Part Four: Multiple Choice
1 = c, 2 = a, 3 = b, 4 = b, 5 = d, 6 = c, 7 = b, 8 = c, 9 = c, 10 = d, 11 = b, 12 = a, 13 = d, 14 = b, 15 = b

Part Five: Comprehension
Grading rubric.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>5 pts.</th>
<th>3 pts.</th>
<th>0 pts.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic sentence</td>
<td>Clear, concise topic sentence.</td>
<td>Topic sentences, but does not describe summary.</td>
<td>No topic sentence.</td>
</tr>
<tr>
<td>Organization</td>
<td>Organized. Encompasses key concepts (breeding, artificial insemination, purebred, hybrid)</td>
<td>Some organization. Does not relate all four key concepts.</td>
<td>Little or no organization. No mention of key concepts.</td>
</tr>
<tr>
<td>Collapsed lists and paragraphs</td>
<td>Collapsed information into concise sentences. No mention of examples.</td>
<td>Lack of concise sentences. One or two examples provided.</td>
<td>Failed to collapse information. Three or more examples provided.</td>
</tr>
<tr>
<td>Eliminated unnecessary detail</td>
<td>Unnecessary detail eliminated.</td>
<td>Some unnecessary detail remaining.</td>
<td>Excess unnecessary detail remaining.</td>
</tr>
<tr>
<td>Key points</td>
<td>Key points clearly delineated.</td>
<td>Mentions key points, but does not delineate.</td>
<td>No key points identified.</td>
</tr>
<tr>
<td>Total Points</td>
<td>25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Assessment

Name_______________________________

Lesson 06.08: Understanding Animal Reproduction

Part One: Matching
Instructions. Match the term with the correct response. Write the letter of the term by the definition. (1 point/question).

a. sexual reproduction    f. estrous cycle
b. fertilization      g. ovary
c. sperm      h. testicle
d. egg       i. puberty
e. castrate      j. parturition

_______ 1. The stage at which an animal becomes capable of reproduction.
_______ 2. The time between the periods of estrus.
_______ 3. Reproduction that involves the union of an egg and sperm.
_______ 4. The process by which union of an egg and sperm occurs.
_______ 5. The female sex cell.
_______ 6. The male sex cell.
_______ 7. To remove the testicles from a male.
_______ 8. The process of giving birth.
_______ 9. The male organ that produces sperm.
_______ 10. The female organ that produces eggs.

Part Two: Completion
Instructions. Provide the word or words to complete the following statements. (1 point/question).

1. _______________ is the period when a female is pregnant.
2. _______________ is the secretion of milk by the mammary glands of a female mammal.
3. _______________ is the period when a female is in heat and receptive to breeding.
4. A _______________ is a male bovine that has been castrated at a young age.
5. _______________ is the fluid produced by males that contains sperm.

Part Three: Short Answer
Instructions. Provide information to answer the following questions. (5 points/question).

1. Write a paragraph that describes the reproductive process in mammals.

2. Why is efficient reproduction important to animal producers?
Part Four: Multiple Choice
Instructions. Select the best answer for the following questions. (1 point/question).

1. What is the difference between reproduction and fertilization?
   a. Reproduction is the union of the sperm and egg, while fertilization refers to producing offspring.
   b. Reproduction is the process of a male mating with a female of the same species, while fertilization is the when a producer places the semen from the male in the female reproductive tract with specialized equipment.
   c. Fertilization is the union of the sperm and egg, while reproduction refers to producing offspring.
   d. Fertilization is the process of a male mating with a female of the same species, while reproduction is the when a producer places the semen from the male in the female reproductive tract with specialized equipment.

2. For livestock, fertilization can be broken down into which two different methods?
   c. Natural insemination and artificial insemination.
   d. Reproduction and breeding.
   e. Fertilization and circulation.
   f. Heat and copulation.

3. Both of the methods of livestock fertilization mentioned in question #2 involve which of the following female characteristics?
   b. Heat.
   c. Semen production.
   d. None of the above.

4. What happens once an egg has been fertilized?
   a. The egg moves through the oviduct where the embryo and fetus develop.
   b. The egg moves through the oviduct to the uterus where the embryo and fetus develop.
   c. The egg moves through the ovary where the embryo and fetus develop.
   d. None of the above.

5. Which of the following organs is part of the female reproductive system?
   a. Urethra.
   b. Seminal glands.
   c. Testicles.
   d. Cervix.

6. Which of the following organs is not part of the male reproductive system?
   a. Vulva.
   b. Prostrate gland.
   c. Sperm ducts.
   d. Seminal glands.
7. When a producer uses artificial insemination, where does he or she insert the sperm?
   a. Oviduct.
   b. Vagina.
   c. Fallopian tubes.
   d. None of the above.

8. After fertilization, an embryo develops in the _________________.
   a. Vulva.
   b. Cervix.
   c. Uterus.
   d. Oviduct.

9. The vulva, vagina, and uterus are all parts of the _________________.
   a. Circulatory system.
   b. Male reproductive system.
   c. Female reproductive system.
   d. None of the above.

10. Why are the testicles held outside of the body cavity?
    a. There is not enough room in the body cavity.
    b. Sperm have less distance to travel to the penis.
    c. To ease castration.
    d. To lower the temperature of the testicles.

11. For which of the following animals would the reproductive system be irrelevant?
    a. Heifers.
    b. Barrows.
    c. Roosters.
    d. Mares.

12. An unbred heifer is in which reproductive period in her life?
    a. Puberty.
    b. Gestation.
    c. Parturition.
    d. Lactation.

13. A dairy cow that is being milked daily is in what reproductive period of her life?
    a. Puberty.
    b. Gestation.
    c. Parturition.
    d. Lactation.
14. A pregnant sow is in what reproductive period of her life?
   a. Puberty.
   b. Gestation.
   c. Parturition.
   d. Lactation.

15. Which of the following reproductive periods have a definite length of time, depending upon the species?
   a. Puberty.
   b. Gestation.
   c. Parturition.
   d. Lactation.

Part Five: Comprehension
Instructions. Read the following passage about animal nutrition. After reading the passage, develop a summary of the following information. (25 points possible). You may use the back of this page to write your summary.

BREEDING

Breeding is helping animals reproduce. Animal scientists do this by controlling male and female animals. They may be kept in separate pens or pastures. Hormones are sometimes used to enhance fertility.

Animal producers may use artificial insemination. This is using implements to place sperms in the female mechanically. In this case, the sperms are collected from the male beforehand as semen. The semen may be frozen if it is to be kept for an extended period. One advantage to artificial insemination is that an animal can be bred to a high-quality mate from anywhere in the world without moving the animals. In addition, more offspring may be obtained from each male.

Over time, animal species have been bred for specific qualities. This has led to breeds, which are groups of animals with consistent and distinctive traits. Breed names often come from the region of the world where the breed was developed.
A purebred animal has two parents with the same set of distinctive characteristics. The animal has a documented pedigree, which is a certificate proving its parentage. The pedigree is obtained from a registering agency for a fee.

A hybrid animal has parents with different characteristics. In some cases, this results in hybrid vigor. This means that offspring have the best qualities of both parents.
Animal Reproduction

- Reproduction—the process by which offspring are produced
- Sexual reproduction—the union of a sperm and egg
- Sperm—male sex cell
- Egg—female sex cell (also know as ovum)
- Fertilization—process by which sexual reproduction occurs
- Natural insemination—male of species deposits semen in the reproductive tract of a female
Animal Sexual Classification

- Sexual classification—condition of an animal based on its age and sexual condition
- Castrate—remove testes (testicles) from a male
- Neuter—remove ovaries from a female
### Sexual Classification of Selected Animals

<table>
<thead>
<tr>
<th>Species</th>
<th>Young Animal</th>
<th>Mature Female</th>
<th>Male</th>
<th>Castrated Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>Calf</td>
<td>Cow</td>
<td>Bull</td>
<td>Steer</td>
</tr>
<tr>
<td>Hog</td>
<td>Pig</td>
<td>Sow</td>
<td>Boar</td>
<td>Barrow</td>
</tr>
<tr>
<td>Sheep</td>
<td>Lamb</td>
<td>Ewe</td>
<td>Ram</td>
<td>Wether</td>
</tr>
<tr>
<td>Goat</td>
<td>Kid</td>
<td>Doe</td>
<td>Buck</td>
<td>Wether</td>
</tr>
<tr>
<td>Chicken</td>
<td>Chick</td>
<td>Hen</td>
<td>Rooster</td>
<td>Capon</td>
</tr>
<tr>
<td>Horse</td>
<td>Foal</td>
<td>Colt Filly</td>
<td>Mare</td>
<td>Stallion</td>
</tr>
<tr>
<td>Male</td>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1Young animal of either sex, except horses as indicated.
Reproductive System of a Cow

Artwork supplied with permission of Interstate Publishers, Inc.
Reproductive System of a Bull

Artwork supplied with permission of Interstate Publishers, Inc.
The Estrous Cycle

• Estrous cycle—the phases in the reproductive cycle from one estrus period (heat) to the next

• Estrus—the phase when a female is receptive to mating—heat

• Metestrus—the phase following heat when ovulation occurs and uterus is prepared for a pregnancy should conception occur

• Diestrus—estrous cycle phase between metestrus and proestrus

• Proestrus—phase following diestrus in which reproductive system is prepared for next estrus
Reproductive Development of Animals

- Prepuberty—stage of life of a young animal before it is capable of reproduction
- Puberty—stage when an animal is capable of reproduction
- Gestation—period when a female is pregnant
- Parturition—process of giving birth
- Lactation—secretion of milk by mammary glands
RS: 06.08.A

Name______________________________________

Animal Reproduction K-W-L

<table>
<thead>
<tr>
<th>Know</th>
<th>Want to know</th>
<th>Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RS: 06.06.B

Name_____________________________________

Making Predictions A-Z: Animal Reproduction

<table>
<thead>
<tr>
<th>A – B – C</th>
<th>D – E – F</th>
<th>G – H – I</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I predict that...
RS: 06.06.B key
Making Predictions A-Z: Animal Reproduction

<table>
<thead>
<tr>
<th>A – B – C</th>
<th>D – E – F</th>
<th>G – H – I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anestrus</td>
<td>Egg</td>
<td>Gestation</td>
</tr>
<tr>
<td>Artificial insemination</td>
<td>Ejaculation</td>
<td>Heat</td>
</tr>
<tr>
<td>Castration</td>
<td>Estrous cycle</td>
<td>Insemination</td>
</tr>
<tr>
<td>Cervix</td>
<td>Estrus</td>
<td></td>
</tr>
<tr>
<td>Copulation</td>
<td>Fertilization</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactation</td>
<td>Metestrus</td>
<td>Parturition</td>
</tr>
<tr>
<td></td>
<td>Natural insemination</td>
<td>Penis</td>
</tr>
<tr>
<td></td>
<td>Neutering</td>
<td>Proestrus</td>
</tr>
<tr>
<td></td>
<td>Ovary</td>
<td>Prostate gland</td>
</tr>
<tr>
<td></td>
<td>Oviduct</td>
<td>Puberty</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reproduction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrotum</td>
<td>Vagina</td>
<td></td>
</tr>
<tr>
<td>Semen</td>
<td>Vulva</td>
<td></td>
</tr>
<tr>
<td>Seminal glands</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sexual classification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sexual reproduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sperm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sperm ducts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testicles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urethra</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uterus</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I predict that…
RS: 06.08.C

Name_____________________________________

Animal Reproduction Anticipation Guide

<table>
<thead>
<tr>
<th>Before Reading: Yes/No</th>
<th>Statement</th>
<th>After Reading: Yes/No</th>
<th>Evidence/Support</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Livestock producers generally improve herd quality by purchasing muscular, lean, and soundly conformed animals. Why?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Livestock are sexually classified in order to improve productivity (i.e.: feeding heifers, steers, and cows differently) Why?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>In order for high productivity, reproductive animals must possess sound reproductive organs. Why?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Estrus is a feeding cycle that is influenced by the moon. Why?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>All livestock progress through reproductive stages. Why?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RS: 06.08.D

Name_____________________________________

Reproduction Concept Map
Reproduction Concept Map

Sexual Reproduction

Fertilization

Natural insemination

Artificial insemination

Sperm

Egg

Growth after Fertilization

Embryo

Fetus

Copulation

Heat

Primarily dairy cows

Human aided

Collect semen
Reproduction Concept of Definition Map

**Definition:**

**What are examples?**

**What are characteristics?**

**Concept**

**What is it like? What is the purpose?**

**What are non-examples?**

**What are examples?**
Reproduction Concept of Definition Map

**Definition:**
Process by which animals produce offspring

sexual reproduction – union of sperm and egg

**What are characteristics?**
- Involves sperm & egg
- Involves copulation
- Females must be in heat
- Insemination
- Once fertilization occurs, embryo develops into fetus

**What are examples?**
- Breeding
- Natural insemination
- Artificial insemination
- Sexual reproduction
- Embryo transfer

**What is it like?  What is the purpose?**
- To produce new offspring
- To improve the quality of the herd
- To improve milk production or meat quality
- It is like producing seeds in plants
- Insemination

**What are non-examples?**
- Cuttings of plants
- Division in plants
- Cloning
- Castrated males (wethers, steers, barrows, geldings, etc.)
Reproductive Systems Matrix

<table>
<thead>
<tr>
<th>Categories</th>
<th>Variables</th>
<th>Location</th>
<th>Male/Female</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vulva</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vagina</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cervix</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uterus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oviduct</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Fallopian tubes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ovary</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urethra</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seminal glands</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seminal vesicles</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prostrate gland</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sperm ducts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testicles</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scrotum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RS: 06.06.F key
Reproductive Systems Matrix

<table>
<thead>
<tr>
<th>Categories</th>
<th>Variables</th>
<th>Male / Female</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reproductive Organs</td>
<td>Location</td>
<td>Male / Female</td>
<td>Function</td>
</tr>
<tr>
<td>Vulva</td>
<td>External part of female reproductive tract</td>
<td>Female</td>
<td>Keeps foreign material out of reproductive tract</td>
</tr>
<tr>
<td>Vagina</td>
<td>Mating organ of the female</td>
<td>Female</td>
<td>Receives semen from male &amp; serves as the canal through which the fetus moves at birth</td>
</tr>
<tr>
<td>Cervix</td>
<td>Entrance to uterus</td>
<td>Female</td>
<td></td>
</tr>
<tr>
<td>Uterus</td>
<td>Organ in which the embryo and fetus develop</td>
<td>Female</td>
<td>House the embryo and fetus</td>
</tr>
<tr>
<td>Oviduct (Fallopian tubes)</td>
<td>Tube from the ovaries to the uterus</td>
<td>Female</td>
<td>Fertilization takes place near upper end of oviduct</td>
</tr>
<tr>
<td>Ovary</td>
<td>Organ that produces the eggs or ova</td>
<td>Female</td>
<td>Produce eggs</td>
</tr>
<tr>
<td>Penis</td>
<td>Male reproductive organ</td>
<td>Male</td>
<td>Deposits semen in the reproductive tract of female</td>
</tr>
<tr>
<td>Urethra</td>
<td>Tube that extends through the penis from the urinary bladder</td>
<td>Male</td>
<td>Conducts urine and semen</td>
</tr>
<tr>
<td>Seminal glands</td>
<td>Glands that produce fluids that promote viable sperm</td>
<td>Male</td>
<td>Produce fluids that promote the production of viable sperm</td>
</tr>
<tr>
<td>Seminal vesicles</td>
<td>Organs attached to the urethra</td>
<td>Male</td>
<td>Produce a fluid that nourishes sperm</td>
</tr>
<tr>
<td>Prostrate gland</td>
<td>Organ located around a section of the urethra</td>
<td>Male</td>
<td>Produces a fluid that becomes part of semen</td>
</tr>
<tr>
<td>Sperm ducts</td>
<td>Tubs that connect the urethra with the testicles</td>
<td>Male</td>
<td>Carry sperm from the testicles and mix with fluids to form semen</td>
</tr>
<tr>
<td>Testicles</td>
<td>Male sex organs</td>
<td>Male</td>
<td>Produce sperm</td>
</tr>
<tr>
<td>Scrotum</td>
<td>Pouch-like skin structure</td>
<td>Male</td>
<td>Holds testicles outside the body</td>
</tr>
</tbody>
</table>
RS: 06.08.G

Name: _____________________________

Estrous Cycle Sequence Map

Estrous Cycle

______________________ –

·

·

·

______________________ –

______________________ –

______________________ –

______________________ –

·

·
**Estrous Cycle Sequence Map**

**Estrous Cycle — phases of the reproductive cycle between periods of estrus**

**Estrus** — female is in heat
- Female is receptive to mating
- Enlarged vulva
- Discharge from vulva
- Females may mount other females

**Metestrus** — phase following heat
- Ovulation occurs

**Diestrus** — reproductive system assumes conception has occurred
- Occurs even if conception has not occurred
- Several days long

**Proestrus** — preparation is being made for next period of heat and ovulation
- If conception has occurred, estrous cycle ceases until it is renewed after gestation and parturition
RS: 06.08.H

Name: ____________________________

Phases of Reproductive Development Sequence Map

Reproductive Development

•

•

•

•

•

•
Phases of Reproductive Development Sequence Map

**Reproductive Development** — definite stages and processes

**Puberty** — animal is capable of reproduction
- Males & females
- Release of eggs in females
- Production of sperm in males
- Varies w/ species, nutrition, & health
- Cattle = 8-12 mos., sheep = 5-7 mos., swine = 4-7 mos., horses = 12-15 mos.

**Gestation** — period when female is pregnant
- Varies w/ species
- Cows = 11 months, ewes = 150 days, sows = 114 days, mares = 337 days,

**Parturition** — process of giving birth
- Hormones produced
- Body prepares for lactation

**Lactation** — secretion of milk by mammary glands of female
- Initiated by hormone activity
- Lasts for several months after parturition
RS: 06.08.I
Cube It! Dice Pattern

Describe it

Analyze it

Compare it

Associate it

Apply it

Argue for/against it
Summary Rules

1. Make sure you understand the text. What was this text about? What did the writer say? Try to say the general theme to yourself.
2. Look back. Reread the text to make sure you got the theme right.
3. Rethink. Reread a paragraph of the text. Try to say the theme of that paragraph to yourself. Is the theme a topic sentence? Have you underlined it? Or is the topic sentence missing: If it is missing, have you written one in the margin?
4. Check and double-check. Did you leave in any lists? Make sure you don’t list things out in your summary. Did you repeat yourself? Make sure you didn’t. Did you skip anything? Is all the important information in the summary?
5. Collapse lists. If you see a list of things, try to think of a word or phrase name for the whole list.
6. Use topic sentences. Often authors write a sentence that summarizes a whole paragraph. It is called a topic sentence. If the author gives you one, you can use it in your summary. If you don’t see a topic sentence, make up one of your own.
7. Get rid of unnecessary detail. Some text information can be repeated in a passage. Since summaries are meant to be short, get rid of repetitive or trivial information.
8. Collapse paragraphs. Paragraphs are often related to one another. Some paragraphs explain one or more other paragraphs. Some paragraphs just expand on the information presented in other paragraphs. Some paragraphs are more necessary than other paragraphs. Decide which paragraphs should be kept or gotten rid of, and which might be joined together.
9. Polish the summary. When a lot of information is reduced from an original passage, the resulting concentrated information often sounds very unnatural. Fix this problem and create a more natural-sounding summary. Adjustments may include but are not limited to: paraphrasing, the insertion of connecting words like “and” or “because,” and the insertion of introductory or closing statements. Paraphrasing is especially useful here, for two reasons: one, because it improves your ability to remember the material, and two, it avoids using the author’s words, otherwise known as plagiarism.

(Hare & Borchardt, p. 66, 1984)
Animal Reproduction Discussion Web

Instructions:
Think about the positive and negative aspects of artificial insemination. List these in the appropriate columns and develop a conclusion about artificial insemination versus natural breeding.

<table>
<thead>
<tr>
<th>Positive Impacts / Pros</th>
<th>Negative Impacts / Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Is artificial insemination the best method of improving beef herd productivity?</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conclusion


APPENDIX E
PANEL OF EXPERTS

The following are a list of panel of experts for this dissertation.

<table>
<thead>
<tr>
<th>Portion</th>
<th>Faculty</th>
<th>Graduate Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural comprehension pre-test</td>
<td>Dyer, Jim</td>
<td>Bellah, Kimberly</td>
</tr>
<tr>
<td></td>
<td>Myers, Brian</td>
<td>Friedel, Curt</td>
</tr>
<tr>
<td></td>
<td>Osborne, Ed</td>
<td>Fuhrman, Nick</td>
</tr>
<tr>
<td></td>
<td>Rudd, Rick</td>
<td>Jones, David</td>
</tr>
<tr>
<td></td>
<td>Washburn, Shannon</td>
<td>Kaufman, Eric</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rocca, Steve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Warner, Wendy</td>
</tr>
</tbody>
</table>
APPENDIX F
INSTRUMENTS

Agriculture Pre-test

Pre-Test  Student ID# __________________

Part One: Matching
Instructions. Match the term with the correct response. Write the letter of the term by the
definition. (1 point/question).

a. anatomy  f. high-energy concentrates  k. sperm
b. digestion  g. organ  m. tissue
c. egg  h. parturition
d. feedstuff  i. puberty
e. fertilization  j. roughages

_____ 1. Feeds that contain less than 20% crude protein.
_____ 2. A group of tissues that work together to perform specific functions.
_____ 3. The stage at which an animal becomes capable of reproduction.
_____ 4. An ingredient used in making the feed for animals.
_____ 5. The study of the functions of cells, tissues, organs, and organ systems of a
   living organism.
_____ 6. A group of cells that is alike in activity and structure.
_____ 7. Livestock feeds that contain more than 18% crude fiber when dry.
_____ 8. Breaking down food into molecules that the body can absorb.
_____ 9. The process by which union of an egg and sperm occurs.
_____ 10. The female sex cell.
_____ 11. The male sex cell.
_____ 12. The process of giving birth.

Part Two: Completion
Instructions. Provide the word(s) to complete the following statements. (1 pt/question).

1. The __________________ system consists of skin and other body covering.
2. The __________________ system provides a framework to give the body shape.
3. The __________________ system moves blood and other materials throughout
   the body of an animal.
4. Most vegetable proteins contain less than ________________ crude protein.
5. Animal growth requires mostly ________________ and smaller amounts of
   other nutrients.
6. ________________ is the period when a female is pregnant.
7. _____________ is the period when a female is in heat and receptive to breeding.

Part Four: Multiple Choice
Instructions. Select the best answer for the following questions. (1 point/question).

1. What is the difference between anatomy and physiology?
   a. Anatomy refers to the functions of cells, tissues, organs, and organ systems, while physiology refers to the study of form, shape, and appearance of an animal.
   b. Anatomy is the same as physiology.
   c. Physiology refers to an animal’s physical health, while anatomy refers to the animal’s anatomical features.
   d. Physiology refers to the functions of cells, tissues, organs, and organ systems, while anatomy refers to the study of form, shape, and appearance of an animal.

2. Producers who raise livestock for meat attempt to maximize which organ system?
   a. Circulatory.
   b. Muscular.
   c. Respiratory.
   d. None of the above.

3. Which two organ systems would work together in producing a fast racehorse?
   a. Skeletal and muscular.
   b. Circulatory and reproductive.
   c. Nervous and muscular.
   d. Skeletal and circulatory.

4. A barrow that goes lame during transportation to market experiences damage to which organ systems?
   a. Lymphatic and/or muscular.
   b. Muscular and/or skeletal.
   c. Nervous and/or reproductive.
   d. Skeletal and/or excretory.

5. A large volume of blood is necessary for high milk production in dairy cows. Which organ system provides this blood to the udder?
   a. Reproductive.
   b. Circulatory.
   c. Muscular.
   d. Excretory.
6. Ruminants and nonruminants differ in primarily which organ system?
   a. Integumentary.
   b. Reproductive.
   c. Circulatory.
   d. Digestive.

7. Body conformation is essential for locomotion and enabling an animal to feed and reproduce. Which two organ systems does conformation primarily refer to?
   a. Lymphatic and/or muscular.
   b. Muscular and/or skeletal.
   c. Nervous and/or reproductive.
   d. Skeletal and/or excretory.

8. Animals in confined feeding that live on concrete flooring may have difficulty with which two organ systems due to the stress of the concrete?
   a. Lymphatic and/or muscular.
   b. Muscular and/or skeletal.
   c. Nervous and/or reproductive.
   d. Skeletal and/or excretory.

9. Which of the following represents an organ?
   a. Muscle.
   b. Heart.
   c. Circulatory.
   d. Blood.

10. Which of the following represents an organ system?
    a. Muscle.
    b. Heart.
    c. Circulatory.
    d. Blood.

11. If a different producer were feeding replacement gilts that were soon to be bred, which of the following functions would the feed perform?
    a. Reproduction.
    b. Growth and reproduction.
    c. Growth and lactation.
    d. All of the above.

12. How is a feedstuff selected for maintenance the same as a feedstuff for growth? Both contain high amounts of ________________________.
    a. Carbohydrates.
    b. Fats.
    c. Carbohydrates and fats.
    d. Calcium and phosphorus.
13. Why would a high-protein concentrate be fed to livestock?
   a. Maintenance.
   b. Growth.
   c. Work.
   d. Lactation.

14. Which of the following animals would a producer feed high-energy concentrates?
   a. Milking cows.
   b. Replacement heifers.
   c. Laying hens.
   d. Feeder pigs.

15. In the above question, why would the producer feed the high-energy concentrate?
   a. Lactation.
   b. Work.
   c. Growth.
   d. Reproduction.

16. Which of the following feedstuffs would contain the highest energy content?
   a. Nonlegume roughages.
   b. Concentrates.
   c. Supplements.

17. Why would a producer feed dairy cows a ration containing roughages, concentrates, and supplements?
   a. Roughages for fiber, concentrates for lactation, and supplements for calcium and phosphorus.
   b. Roughages for nitrogen, concentrates for work, and supplements for protein.
   c. Roughages for energy, concentrates for protein, and supplements for nitrogen.
   d. Roughages for lactation, concentrates for reproduction, and protein supplements.

18. For livestock, fertilization can be broken down into which two different methods?
   a. Natural insemination and artificial insemination.
   b. Reproduction and breeding.
   c. Fertilization and circulation.
   d. Heat and copulation.
19. What happens once an egg has been fertilized?
   a. The egg moves through the oviduct where the embryo and fetus develop.
   b. The egg moves through the oviduct to the uterus where the embryo and fetus develop.
   c. The egg moves through the ovary where the embryo and fetus develop.
   d. None of the above.

20. Which of the following organs is part of the female reproductive system?
   a. Urethra.
   b. Seminal glands.
   c. Testicles.
   d. Cervix.

21. Which of the following organs is not part of the male reproductive system?
   a. Vulva.
   b. Prostrate gland.
   c. Sperm ducts.
   d. Seminal glands.

22. After fertilization, an embryo develops in the _________________.
   a. Vulva.
   b. Cervix.
   c. Uterus.
   d. Oviduct.

23. For which of the following animal would the reproductive system be made irrelevant?
   a. Heifers.
   b. Barrows.
   c. Roosters.
   d. Mares.

24. An unbred heifer is in which reproductive period in her life?
   a. Puberty.
   b. Gestation.
   c. Parturition.
   d. Lactation.

25. A pregnant sow is in what reproductive period of her life?
   a. Puberty.
   b. Gestation.
   c. Parturition.
   d. Lactation.
26. Which of the following reproductive periods have a definite length of time, depending upon the species?
   a. Puberty.
   b. Gestation.
   c. Parturition.
   d. Lactation.

Agriculture Pre-Test Key

Part One: Matching

___F___ 1. Feeds that contain less than 20% crude protein.
___G___ 2. A group of tissues that work together to perform specific functions.
___I___ 3. The stage at which an animal becomes capable of reproduction.
___D___ 4. An ingredient used in making the feed for animals.
___A___ 5. The study of the functions of cells, tissues, organs, and organ systems of a living organism.
___M___ 6. A group of cells that is alike in activity and structure.
___J___ 7. Livestock feeds that contain more than 18% crude fiber when dry.
___B___ 8. Breaking down food into molecules that the body can absorb.
___E___ 9. The process by which union of an egg and sperm occurs.
___C___ 10. The female sex cell.
___K___ 11. The male sex cell.
___H___ 12. The process of giving birth.

Part Two: Completion

1. integumentary
2. skeletal
3. circulatory
4. 47%
5. energy
6. Gestation
7. Estrus

Part Four: Multiple Choice

1. d. Physiology refers to the functions of cells, tissues, organs, and organ systems, while anatomy refers to the study of form, shape, and appearance of an animal.
2. b. Muscular.
3. a. Skeletal and muscular.
4. b. Muscular and/or skeletal.
5. b. Circulatory.
7. b. Muscular and/or skeletal.
8. b. Muscular and/or skeletal.
10. c. Circulatory.
11. b. Growth and reproduction.
12. c. Carbohydrates and fats.
15. c. Growth.
17. a. Roughages for fiber, concentrates for lactation, and supplements for calcium and phosphorus.
18. a. Natural insemination and artificial insemination.
19. b. The egg moves through the oviduct to the uterus where the embryo and fetus develop.
22. c. Uterus.
23. b. Barrows.
24. a. Puberty.
25. b. Gestation.
Adapted Motivations for Reading Pre- and Post-Test

Student ID code: ______________

School: ______________

Please fill in the circle that most accurately describes your motivation and/or attitude toward reading.

<table>
<thead>
<tr>
<th>A lot like me.</th>
<th>A little like me.</th>
<th>A little different from me.</th>
<th>Very different from me.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

- I like it when the questions or topics in books make me think. [1] [2] [3] [4]
- I am willing to work hard to read better than my friends. [1] [2] [3] [4]
- If a book is interesting, I don’t care how hard it is to read. [1] [2] [3] [4]
- I try to find time each day to read something for pleasure. [1] [2] [3] [4]
- If the teacher discusses something interesting I might read more about it. [1] [2] [3] [4]
- I am a good reader. [1] [2] [3] [4]
- I like being the best at reading. [1] [2] [3] [4]
- I do as little schoolwork as possible where reading is concerned. [1] [2] [3] [4]
- I talk to my friends about what I am reading. [1] [2] [3] [4]
- I am happy when someone recognizes my reading ability. [1] [2] [3] [4]
- I usually learn difficult things by reading. [1] [2] [3] [4]
- I learn more from reading than most students in the class. [1] [2] [3] [4]
- I read to improve my grades. [1] [2] [3] [4]
- My friends sometimes tell me I am a good reader. [1] [2] [3] [4]

Please answer the following questions to the best of your ability.

Are you currently reading a book for pleasure? [ ] Yes [ ] No

How many books did you read in the past month? ___________________

How many hours do you read each week for school? ___________________

How many hours do you read each week for pleasure? ___________________

Approximately how many books do you own? ___________________

How many magazines does your household subscribe to? ___________________
LIST OF REFERENCES


Hurst, B. (2001). ABCs of content area lesson planning: Attention, basics, and comprehension. *Journal of Adolescent & Adult Literacy, 44*(8), 692-693.


Travis Park earned his bachelor’s degree in agricultural education from Purdue University in 1996. While at Purdue, Travis was an active member of FarmHouse International Fraternity, vice-president of Mortar Board, and an agriculture ambassador. Upon graduation he received the G. A. Ross Award recognizing the outstanding male senior for the university.

Travis taught secondary agriscience and business at Tri-County High School in Wolcott, Indiana. Travis helped the agriculture program grow from 75 students to 165, add a second teacher, build a greenhouse, and remodel the facility. Tri-County FFA was recognized as the top FFA chapter and several students served as state FFA officers.

Travis earned his master’s degree in agricultural education from Purdue University in 2002. He completed the degree while teaching at Tri-County, using the educational experiences in his graduate program to enhance the learning of his high school students. In 2002, Travis and his wife Lacy made the decision to pursue a doctoral degree in agricultural education and leadership at the University of Florida.

While completing a doctoral degree, Travis has taught several courses, including AEE 3030: Effective Oral Communication, which draws 250 students each semester from across campus, and departmental courses that included mentoring student teachers in their field experiences. In June, Travis will take a faculty position at Cornell University in the Department of Education, teaching agricultural education. He is excited about continuing to make a difference and promote agricultural education in New York.