DOES SCIENCE VOCABULARY INSTRUCTION INCREASE STUDENT COMPREHENSION WITH 7TH GRADE STUDENTS IN MIDDLE SCHOOL

by

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ABSTRACT

This project was conducted to examine how science vocabulary instructional strategies might increase science literacy and comprehension in science. In the literature review, a combination of direct instruction and vocabulary strategies were suggested to improve understanding. During this project, the students spent a lot of time learning vocabulary words for each unit. The summative assessment indicated the students had shown improvement in comprehension and science literacy. Additionally, the students started to use more of the vocabulary terms in their Science Interactive Notebook.
INTRODUCTION AND BACKGROUND

Based on numerous studies, vocabulary instruction is crucial for comprehending science texts and vital in interpreting the simplest text to the most complex text (Beck, McKeown, and Kucan, 2002; Braswell and Flood, 2004; Nagy and Anderson, 1985; and Lapp, Flood, Brock, and Fisher, 2005). In fact, studies have shown that the average student should gain at least 3000 words each year (Johnson, C. & Johnson, D, 2004). This means a student has to learn six to eight words every day; a significant amount of these words can be taught through direct instruction. Traditionally, as part of the science vocabulary instruction, teachers present students with a list of vocabulary words to look up in the dictionary. Students are then instructed to write them down and use them in sentences. However, this method is not an effective way to improve students’ reading comprehension. Nagy (1988) said, “neither method taken by itself, however, is an especially effective way to improve reading comprehension” (p. 12). This topic of study was selected because disaggregated data implied that vocabulary instruction is deficient in an urban setting science classroom, and, as Blachowiez, Fisher, Olge, and Watts-Taffe (2006) said, “what is needed is a comprehensive, integrated, schoolwide approach to vocabulary in reading and learning” (p.526).

With this in mind, the Georgia Milestone Assessment results from Crawford W. Long Middle School were carefully analyzed and revealed that students are deficient in vocabulary usage across all content areas. This was supported by in-class observations during which I did not see students using strategies to decode or recognize vocabulary for comprehension and mastery. As a result of these findings, a schoolwide action plan in
vocabulary instruction was integrated across all content areas. All teachers had to use the first 20 minutes of class incorporating vocabulary strategies in the lesson, such as showing students how to recognize word parts (decoding), use context to figure out new words through reading a caption or paragraph, write sentences, or analyze a picture in writing. The students were introduced to a large number of unfamiliar words over a short period. The goal of this project was to discover if this intense, purposeful vocabulary instruction would be enough to increase student comprehension and science literacy at Crawford Long Middle School.

Crawford W. Long Middle School is located in Atlanta, Georgia. The Atlanta metro area is the home of an estimated 456,002 residents in the city (U.S. Census Bureau, 2014) and borders three counties: Fulton, Dekalb, and Clayton County. This particular middle school sits in the demographic of low economic families (less than $25,000 a year). The school serves a population of 545 students.

I chose to conduct my study with the entire seventh-grade class which consists of 189 students. Of those, some 13 students are tagged gifted; nine had an Individualized Educational Plan (IEP), and four were English to Speakers of Other Languages (ESOL) students. In the 7th grade, 56% were girls, and 44% were boys. The demographics of our 7th-grade student population for 2015-2016 were African-American 90%, Caucasian 1%, and Hispanic-Latino 9%. All of the students received free and reduced lunch. As the only science teacher in the seventh grade, I taught the whole seventh-grade class Life Science. There were three sessions a day, and each of the students was put on either an
“A” and “B” day schedule, meaning that instead of the students receiving science every day, it was every other day. Each class had an average of thirty-two children.

The primary question for my capstone project was, ”Does vocabulary instruction increase student comprehension with 7th-grade students in middle school?” To answer this question, I focused on (1) strategies teachers are using to reinforce vocabulary, (2) the impacts of using methods that are considered best practice to teach science vocabulary on science literacy skills, (3) how the methods that are considered best practices to learn science vocabulary impact student attitudes, and (4) the effects of vocabulary instruction on the classroom teacher.

CONCEPTUAL FRAMEWORK

Armbuster, Lehr, & Osborn (2001) stated that vocabulary is critical “in learning to read and reading comprehension” (p. 29). Children learn vocabulary words daily through conversation with other people, listening when adults are reading to them, and reading on their own. For example, how can a child determine a meaning of a word when reading if they can not understand what they are reading. Direct instruction of vocabulary words tends to lead to better reading comprehension. Direct instruction includes providing students with specific word instruction, and teaching students word-learning strategies (Armbuster, B., Lehr, F. & Osborn, J., 2001). Specific word instruction includes giving students words before reading, extending the period for students to work with vocabulary words, and using these vocabulary words repeatedly through the various contexts (Armbuster, B., Lehr, F. & Osborn, J., 2001). Word-learning strategies include students using the dictionary or other references to define a
word, utilizing word parts to figure out the meaning of the word, and using context clues (Armbuster, B., Lehr, F. & Osborn, J., 2001). Therefore, teachers should use prior knowledge and visual images to increase student comprehension.

Numerous studies have indicated a connection between vocabulary and reading comprehension (Blachowicz, Fisher, Olge, & Watts-Taffe, 2006; Monroe & Orme, 2002; Nagy, 1988; National Panel, 2006; Stahl & Fairbanks, 1986). Although individual teachers are using different strategies for vocabulary instruction, Blachowicz, Fisher, Olge, & Watts-Taffe, 2006 said, “what is needed is a comprehensive, integrated, schoolwide approach to vocabulary in reading and learning” (p. 526). In reading comprehension, vocabulary is a prerequisite. However, in grades three and above teachers had noticed the reading materials starts to get more complex especially in vocabulary, which begins to impact students reading comprehension (Biemiller, 2003).

Bromely (2007) stated that struggling readers and English language learners should “use context to help drive appropriate meanings for words” (p. 581). Armbuster, Lehr, & Osborn (2001) reveal vocabulary instruction must be “learned indirectly and must be taught directly” (p. 29).

To build the gap in vocabulary instruction and comprehension, every content-area teacher must teach vocabulary. Students have to understand the science language and the teacher instruction in which it is presented. Science is loaded with terminology, and “the meanings are more restrictive and carry the concepts represented in the text” (Rubley & Slough, p. 100). To increase student vocabulary, Young (2005) recommend teachers “contextualize word meanings, establish a relationship, and provide multiple exposures
and usage of words” (p. 12). In fact, if we look at vocabulary development, it is linked to background experiences, which broadens the conceptual representation of vocabulary words in science textbooks (Rupley and Slough, 2005).

Vocabulary knowledge is necessary to reading comprehension; how can children understand the science text or science language without knowing what the word means. Nagy (1998) mentions” the obviousness of the need and strong relationship between vocabulary and comprehension invite a simplistic response: if we simply teach students more words, they will understand the text better” (p. 9). The vision of science education is to implement scientific literacy in the classroom for the 21st century that allows students to use scientific skills in making a personal decision and discussing the scientific issue in real life situations (National Science Education Standards, 1996). Young (2005) reported, “when students understand the language of their science subjects, they are well on their way to content literacy mastery (i.e., being able to read, write, speak, listen, and effectively communicate content knowledge with a high degree of competency and expertise)” (p. 15). However, students must understand the meaning of vocabulary words, process this information, and use new concepts to achieve literacy mastery.

Reading comprehension is a link to scholars’ academic achievement including science achievement (Cromley, Snyder-Hogan & Luciw-Dubas, 2010). Science achievement is based on students’ performance in the classroom, tests in the classroom, and state standardized tests. To measure vocabulary instruction for reading comprehension Cromley, Snyder-Hogan & Luciw-Dubas (2010) used two types of comprehension measurements: “(a) global comprehension measures and (b) word
specific measures” (p. 79). Also, a teaching method for vocabulary was measured by global vocabulary measures, definitional word-specific measures, and contextual words specific measures (Cromley, Snyder-Hogan & Luciw-Dubas, 2010).

One traditional method teachers use in the classroom for vocabulary instruction is giving students vocabulary words and asking the student to look up the meaning and then write this meaning down. However, this traditional vocabulary method does not measure nor increase students’ reading comprehension. Unfortunately, this strategy does not meet the requirements for effective vocabulary teaching outlined by Blachowitz, Fisher, and Ogle (2006). Teachers have failed in improving reading comprehension by not teaching in depth vocabulary instruction. Teachers have to get the student to use prior knowledge, to use context information, and to decode new words. However, traditional vocabulary instruction still fails to increase reading comprehension even though the students are being exposed to vocabulary words (Mckeown, Beck, Omanson, & Pople, 1985).

Not only do teachers have to build up background knowledge for the children, but they must then connect the vocabulary word to that knowledge (Allen, 1999; Rubley & Slough, 2010; Taylor, Mraz, Nichols, Rickelman & Wood, 2009). “Word study should be integrated with prior knowledge and with learning in the content areas in order to assist pupils in vocabulary development” (Glowacki, Lanucha, & Pietrus, 2001, pp. 34-35). Teachers should teach children how to associate words they already know with new words. (Taylor et al., 2009).

Vocabulary instruction is critical when you want to improve students’ reading comprehension and science literacy. Today, educators have moved past the traditional
methods and focus on prior background knowledge of word meaning to improve reading comprehension. Vocabulary instruction should be student centered, use different strategies, and must continue to elicit prior knowledge.

**METHODOLOGY**

The primary reason for my project was to determine how science vocabulary instruction, including using semantic mapping of unit vocabulary words, biological morphology, and textbook reading strategy lessons increased student comprehension in seventh-grade life science.

**Treatment**

The research was implemented during a twelve week period on two units, Genetics and Ecology. The invention was given to the entire seventh-grade life science classes for both units. The content of the first unit included awareness of the importance of genes and chromosomes in the process of inheriting traits and the mechanisms of reproduction. I met with the principal, science instructional coach, ELA instructional coach, and all content teachers to determine how to began my treatment. It was decided to begin my treatment by assessing each chapter to determine which words should be taught to achieve the largest increase in comprehension instead of simply using the vocabulary lists at the beginning of each chapter (Appendix A). Finally, I determined which words I was going to teach, and I designed the vocabulary enrichment activities described below for each unit.

The genetics unit began with an exercise called *List-Group-Label* (Taba, 1967; Blachowicz & Fisher, 2002). Students were put into groups of four and asked them to
generate a list of words related to the topic of genetics. Each group was responsible for arranging their list of words according to similarities, and then, finally, to create a title for each of the word groupings they came up with. This activity not only integrates prior knowledge, but it also allows the student to develop their vocabulary without using a dictionary. The next activity the students completed was called Genetics Frayer Model as shown in Figure 1 which is designed to help to build student vocabulary. The students had to define the vocabulary word, create examples and non-examples, give characteristics of the term, and draw a picture that represents the term.

*Figure 1.* A student example of a Genetics Frayer Model.

The next vocabulary activity for this unit was called *Possible Sentences* (Stahl & Kapinus, 1991). Students were given a list of vocabulary terms for the genetic unit and asked to write five sentences they expect to see in the text as they are reading. After reading the text, students compared their possible sentences with the text shown in
Figure 2. If the possible sentence is inaccurate, the student had to rewrite the sentence to make it accurate.

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**Figure 2.** Student example of Genetics Possible Sentences.

Students were then introduced to the semantic map after the reading activity shown in Figure 3. I described the semantic map as a graphic organizer where my students can identify, better understand, and recall the meaning of vocabulary words that they read in the science textbook. After reading about genetics, the students shared their definitions and comments with the class and created a semantic map.
The second unit of treatment included the independence of life, the Earth’s major biomes and environmental influences that affect both individuals and populations.

During all treatments units, an interactive word wall was maintained in the classroom. The interactive word wall created to resemble semantic maps which support vocabulary development and literacy in the classroom. Jackson, Tripp, and Cox (2011) said that interactive word walls, “provides visual aids that assist in illustrating word meanings and conceptually organize words to deepen understanding” (p. 45). Also, each unit ended with a vocabulary relay game that focused on the new vocabulary terms to encourage students to enjoy studying words, their relationship, and meanings.
Before and after the treatment, students were given the Science Vocabulary Questionnaire which examine the student’s perception of the importance of science literacy (Appendix B). The Science Vocabulary Questionnaire was mainly to measure how students felt toward science literacy and their confidence in science literacy skills. Four items on the questionnaire related to students having a good knowledge of scientific vocabulary. Also related to science literacy, some questions on the questionnaire that asked the students what skills they used to find the meaning of a word that they did not know. Additionally, students were given a Student Focus Group Vocabulary Survey (Appendix C) asking students if they like to read, how often their content teacher exposes them to vocabulary and what various strategies they used during reading.

As a result of the student responses, three strategies were implemented and assessed throughout this unit (Appendix D). These strategies were word morphological, text-dependent analysis questions, and vocabulary relay. The first strategy was introducing a range of biological terminology, with emphasis on commonly used prefixes, root words, or suffixes within the unit vocabulary. At the beginning of each class period, students would enter the classroom, and write down three prefixes, root words, or suffixes in their Science Interactive Notebook and guess their meanings and write an example of a word containing the specific morpheme. After every student had guessed, I used the Promethean board to show the prefixes, suffixes, or root words, their meanings, and an example of the word that incorporated the new morpheme. Students were taught a total of 32 morphemes. They were quizzed on the meanings of the word parts with a formative assessment at the each of unit.
The second strategy was text-dependent analysis reading response. The students were given a passage or passage set which they had to read completely. Also, the students must use the information in the passage to answer the text-dependent questions. Students had to highlight any significant information that would help them to answer the question. Finally, they must use complete sentences and evidence from the passage to support their responses.

The third strategy that was implemented was vocabulary relay which summarized the vocabulary terms students learned in each unit. Each student had to write one definition on an index card. All of the cards were turned into me. I then placed a vocabulary word on the opposite side of the index card that did not match the definition. The cards were passed out to each student to begin the vocabulary relay. The game started when a student read the definition from the card they have been given. If the student has that vocabulary word, they would stand and say the word. If the answer is incorrect, I waited until the correct vocabulary word was given.

**Instrument**

The research methodology for my project received an exemption by Montana State University’s Institutional Review Board and compliance with human subjects was maintained (Appendix E). Crawford W. Long Middle School Principal Lisa Hill approved the research project without the need for parent consent.

Numerous sources were used to collect data that include qualitative and quantitative data collection techniques. The first sub-question asked what strategies are teachers using to reinforce vocabulary (Table 1). A variety of strategies were found to be
in use. The students were given Biological Vocabulary Terms and Words Parts before and after treatment (Appendix D). Also, Unit Vocabulary Tests were given before and after both units (Appendices F & G). These data were analyzed to determine if there was an increase from pre and post assessment using a box and whisker plot. The students were given the Science Vocabulary Questionnaire before the treatment to determine the student perception of science literacy (Appendix B). This questionnaire was analyzed by using the Likert scale choices of agree, tend to agree, tend to disagree, disagree, often, sometimes, rarely, and never. The data was mainly used for measuring how students felt about science literacy. Additionally, there were several items on the survey that related to the importance of having a sound knowledge of scientific vocabulary. Several questions on the Science Vocabulary Questionnaire asked students what strategies they used to find the meaning of a word if they did not know.

The second sub-question enquired about the impacts of methods that are practice to teach science vocabulary on science literacy skills. Additionally, students were given the Student Focus Questionnaire to relate strategies they used when reading and encountering new words they could not read or do not know (Appendix C). These responses from the questionnaire were analyzed for common themes. The primary focus was on students’ knowledge and the strategies used for figuring out unknown words. Additionally, Teacher Questionnaire (Appendix H) was given to all science teachers to determine what strategies they used and when science vocabulary instruction occurred in the classroom. Students were given reading comprehension test and formative
assessments to measure comprehension and mastery toward unit objectives. After each unit, students were given teacher made tests measure their understanding.

The third sub-question asked how using methods that are considered best practices to teach science vocabulary impact student attitudes. Students were given formative and summative assessments to measure comprehension and progress toward unit objectives. I scored each assessment on a scale of zero, being not adequate to three, which represented more than adequate, using the Formative Assessment Scoring Rubric. The summative unit tests and the pre- vocabulary assessment were given to serve as a comparison for growth at the end of the treatment unit. Student Focus Group Questionnaire items were grouped based on vocabulary strategies the students would use the most. The student responses were tallied, and percentages were calculated. The percentages were used to identify any trends.

Lastly, the fourth sub-question asked about the impacts of vocabulary instruction on the classroom teacher. Throughout my studies, the students and I maintained Science Interactive Notebooks. The Interactive Notebook Rubric (Appendix I) was used to look for improvements in student writing in the journaling prompts. The journaling prompts were designed to collect data on science literacy skills by reflecting on the lesson for that day. These entries were graded and scored using the Interactive Notebook Rubrics to show in-depth reflection and detailed comprehension in science literacy (Appendix I). The Teacher Journal was used to evaluate how the science vocabulary instruction impacted the students attitudes in science literacy. Additionally, notes were made of the vocabulary words that were used in their Science Interactive Notebook.
Table 1  
**Data Triangulation Matrix**

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Data Source #1</th>
<th>Data Source #2</th>
<th>Data Source #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Pre and Post Vocabulary Assessment Summative/Formative Assessments Possible Sentence</td>
<td>Student Focus Group Survey Science vocabulary questionnaire Venn Diagram</td>
<td>Teacher Journals Teacher Questionnaire Vocabulary Strategies</td>
</tr>
<tr>
<td>#2</td>
<td>Summative/Formative Assessments Wordstorming</td>
<td>Teacher Questionnaire Teacher Journals Possible Sentences</td>
<td>Science vocabulary questionnaire Semantic mapping</td>
</tr>
<tr>
<td>#3</td>
<td>Summative/Formative Assessments Semantic Mapping</td>
<td>Teacher Journals Student Journals</td>
<td>Vocabulary Strategies List-Group-Label</td>
</tr>
<tr>
<td>#4</td>
<td>Teacher Questionnaire Teacher Journals Semantic Mapping</td>
<td>Science vocabulary questionnaire Vocabulary Strategies</td>
<td>Student Focus Group Survey List-Group-Label</td>
</tr>
</tbody>
</table>

**DATA AND ANALYSIS**

All students received the same treatment and completed the same methods of assessment. After collecting data, I analyzed the data to find similarities and differences across all the instruments. The first analysis consisted of the students’ Pre-Test and Post-Test on Genetics using Prentice Hall Science Explorer Georgia Life Science summative assessment. The data provided information about the students’ test scores on genetics.
As shown in Figure 4, the students took a pre-test on genetics with maximum questions of 35. The minimum scores the students had correct range from 3 to 5 but the maximum ranged from 16 to 21. However, the median for all the classes ranges from 10 to 11. The percentage of the students scoring proficiency averaged 15% in the pre-test unit on Genetics. However, 85% of the students scored below proficiency. The low pre-test genetics assessment scores were a surprise since the students learned about genetics in the 5th grade. After students had learned the vocabulary and content in the unit genetics, they were given a post-test. The students showed significant growth in the post-test unit on genetics as shown in Figure 5 below.
The minimum range increased by 12% and the maximum range increased by 33%. The range from the median was from 20 to 25. Therefore, the proficiency increased by 80% while 20% remained below proficiency. Based on the Pre-test and Post-test on Genetics students showed more growth as evidenced by increased means and higher median scores. Additionally, the range increased as well in the pre- to post-test scores on Genetics. This could mean that, although the treatment worked for the majority of students, some remained low and experienced no positive impact from the vocabulary strategies.

Analyzing the data from the pre-test on ecology, I noticed the range of the
minimum scores was the same as the pre-test for genetics as shown in Figure 6.

![Pre-Test on Ecology](image)

*Figure 6: Summative scores for the pre-test on ecology, (N=189).*

This was not a surprise to me since it is the first time the students are learning about ecology. The maximum range for the pre-test on ecology ranges from 7 to 8, which is lower than the pre-test on genetics. The median range from the pre-test on ecology was 7 to 11. However, I noticed an increase on the post-test on the ecology as shown in Figure 7.
The minimum range was increased by 13% and maximum range increase by 33% which was almost the same on the post-test of genetics. However, the median range increase by 23% which was higher than pre-genetics test. In conclusion, I would teach the ecology unit first since that is the bulk of the Georgia Milestone Assessment. Also, I would give the students a formative assessment to enhance their reading comprehension. The students would read an article on genetics. After reading, the students will answer multiple choice questions and then refer back to text to answer the text dependent questions.

Figure 7: Summative scores for post-test on ecology, (N=189).
Comparing the pre-test summative assessments for both units showed students were below proficiency more on the ecology unit than the genetics unit. Since students were exposed to genetics in the 5th grade, it would make sense that their scores were a bit higher. However, it was the first time that they learned about ecology. Therefore, it followed that after learning about the content and using various vocabulary strategies the students showed an increase in the post-test summative ecology assessment.

From the teacher questionnaire, student survey, and the focus group questions, I began to search for common themes. The primary focus was to uncover which strategies teacher uses during instruction, and which strategies the students used to learn vocabulary. I developed theses focal points from the literature review and the focus on the research question to assist me to gain a better understanding of how science vocabulary instruction increases student’s comprehension.

All 7th-grade students took a focus group vocabulary survey on November 11, 2015. I combined the data into the following figure below and began to look for common patterns among the survey. The focus group vocabulary survey was related to strategies the students use when reading and encountering words they could not understand or do not know. The responses from the discussion were coded and analyzed for common patterns among the discussion. To elicit feedback concerning the strategies students used when encountering words they could not read or do not know, student
filled out a survey in class, which I combined the data into Figure 8.

*Figure 8:* Science Vocabulary Questionnaire response to survey items related to figure out words and how to spell new words, *(N=189).*

I hoped that by focusing on what strategies the students use to learn vocabulary I would gain a better understanding of how vocabulary instruction and strategies promoted comprehension for struggling readers in content areas. About 58% of students agreed they use the dictionary to look up words to find their meanings, and 50% use the strategy chunk its method to locate the meaning of words. One pattern addresses the students’ knowledge and usage of the vocabulary strategies when reading to aid in comprehension. Only one student said they didn’t use any strategies when they didn’t know a word. Some students used more than one strategy. Based on the data collected, I noticed that
most of the students used a dictionary to look up a word, or they chunk it. In particular, I focused on what strategies the students use to learn vocabulary. In conclusion hopefully, I gained a better understanding of how vocabulary instruction and strategies promoted comprehension for struggling readers in content areas.

The Student Vocabulary Survey was analyzed and coded according to categories and then put into themes.

![Reading Is Interesting](image)

*Figure 9: Reading is interesting, (N=189).*

I began to look for common patterns among the responses. I hoped to find out if students like to read, and the amount of time they spent reading outside the classroom vocabulary instruction given in each content area. The figure above shows the total number of students who reported liking to read versus not liking to read. Additionally, I was looking for strategies students used to figure out the meaning of a word, and how to spell new words. All of the students shared their feelings about reading, whether positive or negative. When asked about reading 154 students indicated they like to read, and 35
of them said they didn’t like to read. About 21% of the students like to read because it helped built vocabulary and improved their reading skills. One student said, “he likes to read because he pictures(sic) actual story in his head.” Another student said, “reading takes her on an adventure.” However, the majority of the students like to read things that were funny, fiction, biographies, and mysteries.

When asked why he didn’t like reading, one student said it hurts his head, and sixteen students said it is boring. Eight students just stated that they don’t like to read. In additional three students indicated that they got sleepy when they read. Even though these students didn’t like to read, they still maintained a “C’ or above in the class. The majority of the students who reported that they liked to read indicated it was because it was fun, educational, entertaining, and could be used to build their vocabulary. A majority of the students like to read did so when they have nothing else to do. Another pattern I noticed is 62% of my gifted students didn’t like to read, however, 67% of my students with IEP’s did like to read. After further investigation, my gifted and talented students said, “reading is boring”, and they only read things that caught their interest, but that the school textbooks were boring.

In order to see if teachers were teaching vocabulary to the students in all content areas, students were asked to score how much vocabulary they received in Science, Mathematics, Language Arts, and South Studies (Figure 10). The response from the discussion was coded and analyzed for common patterns among the discussion.
Figure 10. Vocabulary in content areas, (N=189).

I noticed that science, math, and social studies classes provided between 23%-25% consistently in vocabulary instruction and between 50%-59% frequently. However, English Language Arts teaches vocabulary to the students 57% of the time on a weekly basis. Contents teachers realized that they had to implement vocabulary instruction into the classroom to increase student reading comprehension. One student said that “The teacher gives them all the words we need to know for the unit ahead time in Language Arts,” and the Language Arts teacher implemented vocabulary instruction every day in the classroom. This means that the Language Arts teacher is passionate about vocabulary and encourages her students to read.
This figure was created to see how often students practice spelling new vocabulary words. The responses from the discussion were coded and analyzed for common patterns among the discussion.

![Practice Spelling](chart.png)

*Figure 11.* Science Vocabulary Survey responses to survey item “How often do you practice spelling new vocabulary words?”, (N=189).

About 33% of the students practice spelling new vocabulary words on a weekly basis. One pattern I noticed is that about 19% of students practice spelling new words and the same number of students who don’t. When asked why not, three of my students said they forgot to practice, and there wasn’t enough time. However, 22 students stated that they practice spelling to learn new vocabulary words.

As a result, students can not learn new vocabulary just by looking it up in the dictionary or writing down the definition. This sort of work is not engaging for students and therefore will not promote learning. Beck, McKeown, and Kucan (2002) stated for students to learn new vocabulary they must be excited about learning new vocabulary.

Beck, McKeown, and Kucan (2002) say “students need to develop an interest and
awareness in words beyond vocabulary school assignments in order to adequately build their vocabulary repertoires” (p.13). Therefore, as teachers, we need to encourage the students to play with and use the vocabulary which will help create an interest in learning new vocabulary. Thus, this can become a strategy for independent vocabulary learning.

All science teachers in my building were asked to complete a Teacher Questionnaire (Appendix H). The purpose of the survey was to gain a better understanding of how science teachers promote vocabulary development of their students. Close examination of these results revealed several things. One, teachers said students are unable to decode words without the assistance of a teacher, and they had a hard time applying new vocabulary words to real-world applications. Two, some of the students were using cloze statement, prefixes, suffixes, and identifying written words. Third, teachers can speak knowledgeably about the vocabulary instructional strategies such as thinking maps, bingo games, Frayer models, flash cards, and context clues to shape understanding of vocabulary. One teacher said, “I used a lesson called pyramid where the students pair up and try to get their partner to say the word they are describing without saying certain words.” The eighth-grade science teacher said, “the most useful vocabulary strategy in her class is flash cards and collaborative group work.” Lastly, all teachers used vocabulary strategies at the beginning of every unit to introduce new vocabulary. Based on these results from the Teacher Questionnaire, it indicated that teachers were providing vocabulary instruction to students the first fifteen minutes of class time.
INTERPRETATION AND CONCLUSION

This action research provides evidence that teaching science vocabulary strategies increase student comprehension in middle school science. In my response to my first research question regarding what strategies teachers are using to reinforce vocabulary, a significant impact was observed on the Genetics and Ecology Pre and Post Tests showed a gained of about 80% proficiency. Little difference was noted on the Genetics and Ecology Pre-Test, however, there was a marked increase on both Genetics and Ecology Post-Test. The increase in both units was most likely the result of the different vocabulary strategies being implemented during this treatment after observing the students work. In the future, I will implement a more efficient pre-test, in which the questions aligned to the instruction to allow an assessment of initial student comprehension. However, the scores increased on the vocabulary terms and vocabulary parts used in the treatment to examine and compare the growth in their comprehension. It was evident in the summative assessment for the treatment of both units.

In my response to my second action research question, the impacts of using methods that are considered best practice to teach science vocabulary on science literacy skills, the students gained an understanding of the different vocabulary strategies based on the results Pre and Post-Vocabulary Assessment. The Student Focus Group, Science Vocabulary Questionnaire, and Teacher Questionnaire verified that the different strategies were more effective in the classroom. The student focus group was used to provide insight into which vocabulary strategies they use the most. The two major
strategies students used to figure out the meaning of an unfamiliar word were looking it up in the dictionary and chunk it.

In my response to my third action research question, does using methods that are practice to teach science vocabulary science on science literacy skills, I used the Student Vocabulary Questionnaire to measure comprehension and science literacy. Also, the students were assessed to determine the students’ knowledge of vocabulary words they used to encounter new words during reading. The majority of the students were familiar with using the vocabulary words which showed in their Science Interactive Notebook in writing their reflections for both units.

My fourth action research question was addressing the impacts of vocabulary instruction on the classroom teacher. All 7th-grade teachers had to complete a questionnaire (Appendix H) regarding the methods they use to teach vocabulary instruction. One of the questions from the survey was for a teacher to list a weakness they noticed in students. All of the teachers said the students are reading below grade level. Therefore, students were given an article to read and then to answer text-dependent questions to improve their reading comprehension (Appendix D). This exercise taught the student how to refer back to the text for answers. The majority of the student started using the science vocabulary in their sentences and using the vocabulary in their conversations.

Even though I used surveys, interviews, and focus groups, it was obvious vocabulary strategies being used in the classroom made a positive impact on students’ comprehension. It showed that student’s utilized strategies that were taught to them. The
vocabulary strategies were effective in students learning that related to the particular unit and aided in their comprehension of the unit. Implementing an interactive word wall along with vocabulary games and different vocabulary strategies seem to be more fun to the students. However, I was left with the following question. When it comes to implementing vocabulary instruction into the science content area, how much time should teachers spend of teaching vocabulary strategies?

In conclusion, we must be knowledgeable of vocabulary instruction and strategies, and implement them into our classroom. I believe prefixes, suffixes, and root words provided for the students help increase students awareness of how to break down a word and find the word meaning. When students incorporate these vocabulary strategies into their everyday lives, their knowledge in vocabulary will increase, and their comprehension will improve as well.

VALUE

Vocabulary instruction plays a very critical role in reading comprehension. Completing my studies on science vocabulary instruction and increasing understanding, changed my teaching style in many ways. First, I am more aware that students understood prefixes, root words, and suffixes which would help them learn a vocabulary word better. If it were not for my colleagues looking at the Georgia Milestones results and my research on vocabulary instruction, I would have never known how important vocabulary instruction which impacts students reading, writing, and talking about science. From my literature review, studies have shown how a combination of direct instruction, indirect instruction, and vocabulary strategies will improve students’ reading
comprehension. Therefore, giving students’ vocabulary terms on the board and asking them to look up the definition has gone out the door.

Even though I have improved on my vocabulary instruction, I would like to focus on providing many opportunities to interact with new words on a regular basis so meaning can be automatically used during reading. For example, students need to be exposed to scientific terminology and different images that they will encounter throughout life. It will help the students to gain familiarity and fluency with science vocabulary, rather than overwhelming the students with a new vocabulary for every new unit. I believe my student’s vocabulary would increase even more when using scientific terms in real conversation instead of limiting them to the textbook. Additionally, I would implement real world applications that my students can use science vocabulary in school, at work, conferences, and in their conversation every day. For example, students will use the vocabulary words in real conversations and their writing. I will continue to use the Interactive Word Wall, Possible sentences, and vocabulary relay in my teaching next year. The students showed lots of improvement in their science literacy and reading comprehension.

In conclusion, it is evident that vocabulary plays a significant role in reading. My project has made me fully aware how to evaluate the big picture in my teaching practices. As a teacher, I used to simply talk about the problems in the classroom, but now I can help fix the problem by changing the way I see and approach things in my teaching situations. The next two action research projects I would like to study include how
student’s behavior is impacting their academics and why the student does not respond to learning with a substitute teacher versus a regular teacher when being taught.
REFERENCES CITED


Taba, H. (1967). Teacher’s handbook for elementary social studies. Reading, MA: Addison-Wesley


APPENDICES
APPENDIX A

GENETICS AND ECOLOGY VOCABULARY WORDS
<table>
<thead>
<tr>
<th><strong>Genetics Unit</strong></th>
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<tr>
<td>Gregory Mendel</td>
<td>Inherited trait</td>
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<td>Trait</td>
<td>Gene</td>
</tr>
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<td>Genetics</td>
<td>Heredity</td>
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<td>DNA</td>
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<td>Allele</td>
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<td>Gamete</td>
<td>Dominant allele</td>
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<td>Recessive allele</td>
<td>Expression</td>
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<tr>
<td>Desirable trait</td>
<td>Selective breeding</td>
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<td>asexual reproduction</td>
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<td>Mesois</td>
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<td>Punnett Square</td>
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<td>Phenotype</td>
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<td>Purebred</td>
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<td>Ratio</td>
<td>Probability</td>
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<td>Cloning</td>
<td>Variations</td>
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<td>Geneticist</td>
<td>Phenotype</td>
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<table>
<thead>
<tr>
<th><strong>Ecosystems and Biomes</strong></th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Desert</td>
<td>Grassland</td>
</tr>
<tr>
<td>Savanna</td>
<td>Deciduous</td>
</tr>
<tr>
<td>Tropical Rain Forest</td>
<td>Taiga</td>
</tr>
<tr>
<td>Tundra</td>
<td>Biome</td>
</tr>
<tr>
<td>Term</td>
<td>Term</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Neritic zone</td>
<td>Intertidal zone</td>
</tr>
<tr>
<td>Coniferous tree</td>
<td>Permafrost</td>
</tr>
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<td>Mutualism</td>
<td>Parasitism</td>
</tr>
<tr>
<td>Symbiosis</td>
<td>Commensalism</td>
</tr>
<tr>
<td>Competition</td>
<td>Natural selection</td>
</tr>
<tr>
<td>Adaptations</td>
<td>Biotic factor</td>
</tr>
<tr>
<td>Abiotic factor</td>
<td>Ecosystem</td>
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</tbody>
</table>
APPENDIX B

SCIENCE VOCABULARY QUESTIONNAIRE
Participation in this research is voluntary, and participation or non-participation will not affect a student’s grades or class standing in any way.

Circle the answer that best describes your feeling toward the following statements.

There is no right or wrong answer, but your honest answers are most helpful.

1. Building vocabulary in science is essential.

   Agree   Tend to agree   Tend to disagree   Disagree

   Why did you answer the above question the way you did?

2. There are issues in the real world that require science vocabulary.

   Agree   Tend to agree   Tend to disagree   Disagree

   Can you give an example?

3. The vocabulary words I learned in science can be used in current topics.

   Agree   Tend to agree   Tend to disagree   Disagree

4. The vocabulary words that I learned in science will help me to explain or defend an idea

   Agree   Tend to agree   Tend to disagree   Disagree

   Can you give an example?

5. Sometimes I struggle with reading science textbooks or scientific information because of the vocabulary.

   Agree   Tend to agree   Tend to disagree   Disagree

6. If I don’t know a word, I tend to use the dictionary or glossary in the back of the science textbook.

   Agree   Tend to agree   Tend to disagree   Disagree
7. I use vocabulary words from the unit to explain or summarize main ideas from science class.
   Agree  Tend to agree  Tend to disagree  Disagree

8. Reading or writing the definition of a vocabulary word from the text is helpful.
   Agree  Tend to agree  Tend to disagree  Disagree
   Why did you answer the above question the way you did?

   Agree  Tend to agree  Tend to disagree  Disagree
   Why did you answer the question the way you did?

10. My reading comprehension suffers when I don’t understand the science vocabulary.
    Agree  Tend to agree  Tend to disagree  Disagree

These questions listed below are a bit different; they are asking you how often do you use a particular strategy for learning vocabulary.

11. When I have to figure out a word meaning, I use prefixes and suffixes to help me.
    Often  Sometimes  Rarely  Never

12. When I have to figure out a word meaning, I use root words to help me.
    Often  Sometimes  Rarely  Never

13. When I have to figure out a word meaning, I use context clues to help me.
    Often  Sometimes  Rarely  Never
14. When I have to figure out a word meaning I try to break it down in syllables and chunk it to help me.

Often		Sometimes		Rarely		Never
APPENDIX C

STUDENT FOCUS GROUP VOCABULARY SURVEY
Participation in this research is voluntary, and participation or non-participation will not affect a student’s grades or class standing in any way.

1. Do you like to read? **Circle Yes or No**  Explain why or why not?

2. How do you figure words out you cannot read? **Please put a check on the line.**
   - _____ Skip it
   - _____ chunk it
   - ____ call it what you think makes sense
   - _____ Ask someone to tell you the word
   - _____ Put it in a sentence

3. How often does your teacher give you vocabulary words? **Please put a check on the line.**
   - Science  ___ Every week ______ Often ______ Never
   - Math ___ Every week _____ Often ______ Never
   - ELA ___ Every week ______ Often ______ Never
   - Social Studies ___ Every week ______ Often ______ Never

4. How often do you practice spelling new vocabulary words? **Explain why or why not? Please put a check on the line.**
   - _______ Daily ___________ Weekly _____________ Monthly ________Never

5. What strategy do you use to learn how to spell new words? **Please put a check on the line.**
   - _______ Rewrite several times
   - _______ Through games
   - _______ Looking words up in the dictionary
   - _______ Interactive notebooks (images)
APPENDIX D

VOCABULARY STRATEGIES
Vocabulary Strategy #1

Name: Morphology in prefix, suffix, and roots words

-ab  an-
ad-  anti-
bi-  bio-
chloro-  chromo-
com-  con-
contra-  decid-
di-  diplo-
eco-  exo-
geo-  heter-
homo-  inter-
intra-  -itis
-logy  mono-
multi-  muta-
non-  ortho-
para-  semi-
trans-  uni-
Vocabulary Strategy #2

Name: Text-Dependent Analysis Response
Cooperative Grouping: Individual or pairs (teacher preferences)

The Father of Genetics

In 1822 Gregor Mendel was born on a farm in Austria. His father encouraged Mendel’s fascination with plants. He knew that his son was intelligent, and he wanted him to have a good education. So he sent Mendel to high school. At that time few people attended high school, and those who did lived there. However, since his father could not pay the full tuition, Mendel received no food. He always felt hungry, but he survived because the other students gave him the scraps from their plates.

As an adult Mendel became a monk and continued his studies. He tended the gardens at the monastery where he and the other monks lived. He did experiments with pea plants for eight years. He wanted to prove that parents passed characteristics to their offspring. Over time he found that plants have genes. Genes carry codes for features from one generation to the next. Around 1860 Mendel discovered recessive and dominant genes. Dominant genes showed up the most often in offspring. Recessive genes only showed up occasionally and only when both parents carried the gene for the trait.

How did he figure this out? He bred a tall pea plant with a short pea plant. Every one of the first generation of four pea plants was tall. This meant that tall was the dominant gene. Yet in the next generation of four pea plants, one plant was very short. The recessive short genes it received from both of its parent plants had made it short.

Eager to share his finding with others, he wrote a paper. No one paid any attention to it. During his lifetime no one cared about what he had discovered. At the time of his death, he still felt frustrated because his knowledge went unrecognized.

Finally, his important discovery was recognized in 1990. We now know that both plants and animals have genes and that genes play a major role in how we look, how we act, and whether or not we are apt to get certain diseases. Today, Gregor Mendel is called the “Father of Genetics.”
The Father of Genetics (cont.)

Comprehension Questions

1. Scientists acknowledged Mendel's discovery about genetics worldwide
   (a) before his death.
   (b) more than 100 years after he figured it out.
   (c) during the 19th century.
   (d) just last year.

2. On a historical timeline, what happened second?
   (a) Mendel learned how parents pass genes to offspring.
   (b) Mendel became a monk.
   (c) Mendel conducted extensive plant experiments.
   (d) Mendel wrote a paper to share his discoveries.

3. Mendel found out that when both parents carry a recessive gene,
   (a) there is a strong chance that their child will inherit the trait.
   (b) there is some chance that their child will inherit the trait.
   (c) there is no chance that their child will inherit the trait.
   (d) their child will definitely inherit the trait.

4. Which is an example of tuition?
   (a) finishing a school project on time
   (b) knowing something is going to happen before it happens
   (c) buying food in a restaurant
   (d) spending money on school courses

5. How do you think Mendel felt about the students who gave him their scraps?
   (a) overjoyed
   (b) annoyed
   (c) grateful
   (d) disgusted

6. Picture Mendel writing the paper about his findings. What is he using?
   (a) a quill pen
   (b) a word processor
   (c) a ball-point pen
   (d) a marker

7. Should scientists continue to study genetics? Explain.
**Article Title:** The Father of Genetics

**Lexile Level:** 810L

**Additional Text Dependent Questions:**
1. Explain the difference between a dominant and a recessive gene.

2. Using your context clues, what does the word “characteristics” mean?

3. Explain how genes determine the way we look.
Vocabulary Strategy #3

Name: Vocabulary Relay
Cooperative Grouping: Entire Class

1. Have students write one definition and one definition only on an index card (the word itself should not be included).

2. The cards are then turned in to the teacher.

3. Take the cards and write one vocabulary word on the back of each card making sure that the word does not match the definition. (It helps to put the words on post it notes first to make sure that no two cards directly cancel each other out.)

4. Hand out the cards so that each student has one card. If there are more cards than students, you may give more than one card to each student. If there are fewer cards than students, then repeat the process as often as needed to make sure that everyone has had a turn.

5. Begin by reading a definition and then the student who has that word on their index card should stand and say their word. If they are correct, then they should read the definition on the other side of their card. If they are incorrect, wait until the correct answer is read.

This can be used as a competition among classes or teams within the same classroom.
APPENDIX E

IRB EXEMPTION FORM AND EXEMPTION FOR IMPLIED CONSENT
INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

MONTANA STATE UNIVERSITY

MEMORANDUM
TO: Leslie LaShaun Moncur and Walter Woolbaugh
FROM: Mark Quinn, Chair
DATE: December 2, 2015
RE: "How Does the Implementation of Improving Vocabulary Instruction Increase Student Comprehension and Science Literacy with 7th-Grade Students in Middle School?" [LM120215-EX]

The above research, described in your submission of December 2, 2015, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

X (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

X (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

(b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

(b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

(b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

(b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.
Administrator Exemption Regarding Informed Consent

1. Lisa Hill, Principal of Crawford W. Long Middle School, verify that the classroom research conducted by Leslie Moran is in accordance with established or commonly accepted education settings involving normal educational practices and that I approve the project. To maintain the established culture of our school and not cause disruption to our school climate, I have granted an exemption to Leslie Moran regarding informed.

(Signed Name, Title of Position)

Lisa Hill
(Printed Name)

11/17/15
(Date)
APPENDIX F

GENETICS VOCABULARY TEST
### Genetics Vocabulary Test

**Name:** __________________________  **Date:**_______________________

Match the vocabulary word with the correct definition.

<table>
<thead>
<tr>
<th>Match</th>
<th>Word</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____</td>
<td>1. Heredity</td>
<td>a. The scientific study of heredity</td>
</tr>
<tr>
<td>_____</td>
<td>2. Genetics</td>
<td>b. Physical characteristics</td>
</tr>
<tr>
<td>_____</td>
<td>3. Traits</td>
<td>c. The passing of traits from parents to offspring</td>
</tr>
<tr>
<td>_____</td>
<td>4. Alleles</td>
<td>d. an organism with two different alleles for a trait</td>
</tr>
<tr>
<td>_____</td>
<td>5. Recessive allele</td>
<td>e. factors that control traits</td>
</tr>
<tr>
<td>_____</td>
<td>6. Genes</td>
<td>f. an allele whose traits always show up in the organism</td>
</tr>
<tr>
<td>_____</td>
<td>7. Hybrid</td>
<td>g. the different forms of genes</td>
</tr>
<tr>
<td>_____</td>
<td>8. Dominant allele</td>
<td>h. an allele whose trait is masked in the presence of dominant allele</td>
</tr>
<tr>
<td>_____</td>
<td>9. Phenotype</td>
<td>i. describes an organism with two identical alleles for a trait</td>
</tr>
<tr>
<td>_____</td>
<td>10. Genotype</td>
<td>j. an organism’s physical appearance, or visible traits</td>
</tr>
<tr>
<td>_____</td>
<td>11. Homozygous</td>
<td>k. an organism’s genetic makeup, or allele combination</td>
</tr>
<tr>
<td>_____</td>
<td>12. Heterozygous</td>
<td>l. describes an organism that has two different alleles for a trait</td>
</tr>
<tr>
<td>_____</td>
<td>13. Punnett Square</td>
<td>m. a number that describes how likely it is that an event will occur</td>
</tr>
<tr>
<td>_____</td>
<td>14. Probability</td>
<td>n. a chart that shows all the possible combination of alleles that can result from a genetic cross.</td>
</tr>
<tr>
<td>_____</td>
<td>15. DNA</td>
<td>o. hereditary materials in humans</td>
</tr>
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</table>
APPENDIX G

ECOSYSTEMS VOCABULARY TEST
Ecosystems Vocabulary Test

ecosystems, estuaries, salt marshes, oceans, lakes, ponds, terrestrial ecosystem, aquatic ecosystem, deciduous forest, rainforest, grasslands, continental shelf, freshwater, saltwater, shoreline, producers, consumers, decomposers, biotic factors, abiotic factors, food chain, food web, nutrients, energy, population, community, organism

1. ___________ Nonliving.
2. ___________ A living thing that gets energy by eating other living things.
3. ___________ A model that shows the path of energy as it flows from one living thing to another.
4. ___________ A living thing that gets energy by breaking down wastes, dead plants, and dead animals.
5. ___________ A living component of a community.
6. ___________ A living thing that makes its own food.
7. ___________ A body of water in which freshwater from a river meets and mixes with salt water from the ocean.
8. ___________ All of the living and nonliving things in an area.
9. ___________ A biome that occurs where there are moderate temperatures and the dominate plants are deciduous.
10. ___________ A land-based ecosystem.
11. ___________ A water-based ecosystem.
12. ___________ A living thing.
13. ___________ A biome found near the equator where about half of all of the different kinds of plants on earth can be found.
14. ________ A model that shows how several food chains connect together.
15. ________ All individuals of the same kind living in the same environment.
16. ________ The ability to cause change in matter.
17. ________ All the populations of organisms living together in an environment.
18. ________ A small body of fresh water surrounded by land.
19. ________ A large body of fresh water surrounded by land.
20. ________ An ecosystem that has fertile soil covered with tall grass.
21. ________ A large body of salt water.
22. ________ A flat area of land where salt water overflows.
23. ____________ The part of a continent that lies under the ocean and slopes down to the ocean floor.
24. ________ Components in foods that an organism utilizes to survive and grow.
APPENDIX H

TEACHER QUESTIONNAIRE
Participation in this research is voluntary, and participation or non-participation will not affect a student’s grades or class standing in any way.

1. What vocabulary strategies do you use for students to learn science vocabulary? Which ones are helpful to you? How often do you use them?
2. What strengths and weakness have you noticed in your students when using science vocabulary? Strengths- Weakness-
3. When you give your students an assessment, to what degree does science vocabulary play?
4. What are some of the strengths you notice in your students when they are reading or comprehending science textbooks in your class?
5. Can you describe a lesson that you use to teach science?
6. How might you use vocabulary in the above example?
7. Has your school or district offered professional development on vocabulary instruction (can you tell me about this)? If so, have you used any of the strategies and were they successful?
APPENDIX I

SCIENCE INTERACTIVE NOTEBOOK RUBRIC
## Interactive Notebook Rubric

<table>
<thead>
<tr>
<th>Assessment Level</th>
<th>Description</th>
</tr>
</thead>
</table>
| **“Totally Awesome!” (Almost Gross)** | - The writing goes beyond the basic requirements and shows in-depth understanding of concepts.  
- The work shows in-depth reflection throughout the learning process.  
- Your notebook has all the components expected, including dates and labels on each page.  
- All pages are numbered properly with odd numbers on the right and even numbers on the left.  
- Right- and left-side work is correctly organized with all criteria.  
- The use of color and labeled diagrams enhance understanding.  
- The notebook is so tidy it’s almost “gross!” |
| 10 | |
| **“Awesome!”** | - The writing follows the basic requirements, shows understanding of concepts, but does not go beyond.  
- The work shows in-depth reflection.  
- Your notebook has all the components expected, including dates and labels on each page.  
- All pages are numbered properly with odd numbers on the right and even numbers on the left.  
- Right- and left-side work is correctly organized with all criteria.  
- The notebook has color, and the student uses labeled diagrams.  
- A “9” looks much like a “10,” but it lacks the “totally” in “awesome.” |
| 9 | |
| **“Pretty Damn Good!”** | - The written work shows a basic understanding of concepts.  
- An honest reflection, but limited.  
- Your notebook has about 90% of the components expected, with dates and labels.  
- All pages are numbered properly with odd numbers on the right and even numbers on the left.  
- Right- and left-side work is correctly organized.  
- The notebook has some color and diagrams, with a few labels.  
- Some requirements are met, but your notebook lacks criteria in all areas. |
| 8 | |
| **“Kick It Up a Notch!”** | - The written work shows a limited understanding of concepts.  
- Limited reflection overall.  
- Your notebook has about 80% of the components expected, with dates and labels.  
- Most pages are numbered.  
- Right- and left-side work is fairly organized, “just so-so.”  
- The notebook has very little color and hardly any diagrams.  
- Notebook requirements are rarely met. |
| 7 | |
| **“Better Get Movin’!”** | - The written work shows misconceptions and a lack of understanding.  
- “Reflection, what reflection?”  
- The pages in your notebook are unfinished.  
- You tried, but the dates and labels did not make it to the page.  
- There are inconsistencies in your right- and left-side entries.  
- The notebook is unorganized, and “the dog ate your pages.” |
| 6 | |
| **“What Were You Thinking!”** | - Hey, you turned in a notebook, but the pages are blank, or they include the class template only. “Maybe you wrote with invisible ink!” |
| 5 | |

Reproducible I

APPENDIX J

GENETICS TEST
*Review Test Genetics S7L3*

Multiple Choice
Identify the choice that best completes the statement or answers the question.

1. What did Gregor Mendel do to study different characteristics in his genetics experiments?
   a. He studied only asexual plants.
   b. He studied only tall and short pea plants.
   c. He cross-pollinated plants.
   d. He cross-pollinated both plants and animals.

2. In Mendel’s experiments, what proportion of the plants in the F2 generation had a trait that had been absent in the F1 generation?
   a. none
   b. one fourth
   c. half
   d. three fourths

3. Factors that control traits are called
   a. genes.
   b. purebreds.
   c. recessives.
   d. parents.

4. Scientists call an organism that has two different alleles for a trait a
   a. hybrid.
   b. trait.
   c. purebred.
   d. factor.

5. What does the notation TT mean to geneticists?
   a. two dominant alleles
   b. heterozygous alleles
   c. at least one dominant allele
   d. one dominant and one recessive allele

6. What does the notation Tt mean to geneticists?
   a. two dominant alleles
   b. two recessive alleles
   c. homozygous alleles
   d. one dominant allele and one recessive allele

7. What is probability?
   a. the actual results from a series of events
   b. a number that describes how likely it is that an event will occur
   c. the way the results of one event affect the next event
   d. the number of times a coin lands heads up
8. What is the probability of producing a tall pea plant from a genetic cross between two hybrid tall pea plants?
   a. one in four
   b. two in four
   c. three in four
   d. four in four

9. What does a Punnett square show?
   a. all the possible outcomes of a genetic cross
   b. only the dominant alleles in a genetic cross
   c. only the recessive alleles in a genetic cross
   d. all of Mendel’s discoveries about genetic crosses

10. If a homozygous black guinea pig (BB) is crossed with a homozygous white guinea pig (bb), what is the probability that an offspring will have black fur?
    a. 25 percent
    b. 50 percent
    c. 75 percent
    d. 100 percent

11. An organism’s physical appearance is its
    a. genotype.
    b. phenotype.
    c. codominance.
    d. heterozygous.

12. A purebred chicken with white feathers is crossed with a purebred chicken that has black feathers. Each of their offspring has both black and white feathers. Why does this happen?
    a. Both alleles for feather color are dominant.
    b. Both alleles for feather color are recessive.
    c. The alleles for feather color are neither dominant nor recessive.
    d. Several alleles work together to determine the trait.

13. What is the chromosome theory of inheritance?
    a. Chromosomes are carried from parents to offspring on hybrids.
    b. Genes are carried from parents to offspring on chromosomes.
    c. Hybrid pairs of chromosomes combine to form offspring.
    d. Codominant genes combine to form new hybrids.

14. Walter Sutton discovered that the sex cells of grasshoppers have
    a. 12 times the number of chromosomes found in the body cells.
    b. twice the number of chromosomes found in the body cells.
    c. the same number of chromosomes found in the body cells.
    d. half the number of chromosomes found in the body cells.

15. What happens during meiosis?
    a. Two sex cells combine.
    b. Chromosome pairs separate and are distributed into new sex cells.
    c. Each sex cell copies itself to form four new chromosomes.
    d. Chromosome pairs remain together when new sex cells are formed.
16. When sex cells combine to produce offspring, each sex cell will contribute
   a. one fourth the number of chromosomes in body cells.
   b. half the number of chromosomes in body cells.
   c. the normal number of chromosomes in body cells.
   d. twice the number of chromosomes in body cells.

17. What determines the genetic code?
   a. the order of nitrogen bases along a gene
   b. the number of nitrogen bases in a DNA molecule
   c. the order of amino acids in a protein
   d. the number of guanine and cytosine bases in a chromosome

18. The order of the bases along a gene determines the order in which
   a. sugars are put together to form a carbohydrate.
   b. phosphates are arranged in DNA.
   c. amino acids are put together to form a protein.
   d. chromosomes are arranged in the nucleus.

19. What does messenger RNA do during protein synthesis?
   a. copies the coded message from the DNA and carries it into the cytoplasm
   b. copies the coded message from the DNA and carries it into the nucleus
   c. carries amino acids and adds them to the growing protein
   d. copies the coded message from the protein and carries it into the nucleus

20. What do transfer RNA molecules do during protein synthesis?
   a. copy the coded message from the protein and carry it into the nucleus
   b. copy the coded message from the DNA and carry it into the nucleus
   c. carry amino acids and add them to the growing protein
   d. copy the coded message from the DNA and carry it into the cytoplasm

21. What is a mutation?
   a. any change that is harmful to an organism
   b. any change in a gene or chromosome
   c. any change that is helpful to an organism
   d. any change in the phenotype of a cell

22. A mutation is harmful to an organism if it
   a. changes the DNA of the organism.
   b. changes the phenotype of the organism.
   c. reduces the organism's chances for survival and reproduction.
   d. makes the organism better able to avoid predators.

23. Which term refers to physical characteristics that are studied in genetics?
   a. traits
   b. offspring
   c. generations
   d. hybrids
24. The different forms of a gene are called
   a. alleles.
   b. factors.
   c. masks.
   d. traits.

25. Where does protein synthesis take place?
   a. in the ribosomes in the nucleus of the cell
   b. on the ribosomes in the cytoplasm of the cell
   c. in the chromosomes in the nucleus of the cell
   d. on the chromosomes in the cytoplasm of the cell

26. An organism’s genotype is its
   a. genetic makeup.
   b. feather color.
   c. physical appearance.
   d. stem height.

27. Which nitrogen base in RNA is NOT part of DNA?
   a. adenine
   b. guanine
   c. cytosine
   d. uracil

28. An organism that has two identical alleles for a trait is
   a. codominant.
   b. tall.
   c. homozygous.
   d. heterozygous.

29. A heterozygous organism has
   a. three different alleles for a trait.
   b. two identical alleles for a trait.
   c. only one allele for a trait.
   d. two different alleles for a trait.

30. Chromosomes are made up of
   a. one pair of alleles.
   b. many traits joined together.
   c. transfer RNA.
   d. many genes joined together.
31. Which of these traits is controlled by a gene with multiple alleles?
   a. straight hairline
   b. smile dimples
   c. widow's peak
   d. blood type

32. Which combination of sex chromosomes results in a male human being?
   a. XX
   b. YY
   c. XY
   d. either XX or YY

33. Genetic disorders are caused by
   a. pedigrees.
   b. DNA mutations or changes in chromosomes.
   c. dominant alleles only.
   d. recessive alleles only.

34. In an attempt to produce a potato that tastes good and also resists disease, plant breeders crossed a potato variety that tastes good with a variety that resists disease. This technique is an example of
   a. genetic engineering.
   b. inbreeding.
   c. hybridization.
   d. cloning.

35. Which form of selective breeding crosses parents with the same or similar sets of alleles?
   a. fertilization
   b. inbreeding
   c. hybridization
   d. cloning
APPENDIX K

ECOSYSTEM TEST
### Ecosystems and Biomes

**Multiple Choice**
*Identify the choice that best completes the statement or answers the question.*

1. Consumers that eat both plants and animals are called
   a. omnivores.
   b. herbivores.
   c. carnivores.
   d. scavengers.

2. Georgia is in the __________ biome.
   a. taiga
   b. temperate deciduous
   c. tundra
   d. tropical rainforest

3. The many overlapping food chains in an ecosystem make up a(an)
   a. food web.
   b. niche.
   c. energy pyramid.
   d. feeding level.

4. A diagram that shows the amount of energy that moves from one feeding level to another in a food web is called a(an)
   a. food chain.
   b. energy pyramid.
   c. ecosystem.
   d. niche.

5. In an energy pyramid, which level has the most available energy?
   a. producer level
   b. first-level consumer level
   c. second-level consumer level
   d. third-level consumer level

6. The six major biomes are:
   a. tropical rainforest, desert, mountain, taiga, temperate deciduous, grassland
   b. desert, taiga, grassland, tropical rainforest, mountain, valley, temperate deciduous
   c. rainforest, desert, grassland, temperate deciduous, tundra, taiga
   d. taiga, desert, grassland, valley, temperate deciduous forest, tundra

7. Which of the following habitats probably has the greatest number of plant and animal species
   a. an African savanna
   b. a rainforest in Brazil
   c. a temperate forest in China
   d. a temperate forest in Kansas
Name: ___________________________________________  ID: A

8. The typical weather pattern in an area over a long period of time is called
   a. climate.
   b. precipitation.
   c. the water cycle.
   d. weather.

9. A group of land ecosystems with similar climates and organisms is called a(an)
   a. energy pyramid.
   b. climate.
   c. biome.
   d. food web.

10. Which biome is extremely cold and dry?
    a. desert
    b. tundra
    c. grassland
    d. mountains

11. Ponds and rivers are two types of
    a. marine ecosystems.
    b. rain forest biomes.
    c. freshwater ecosystems.
    d. estuary ecosystems.

12. Karl describes an ecosystem that he visits frequently. The plant life in the ecosystem is mostly grass, about 3
    feet tall. The grass is in a muddy area that floods each afternoon with a mix of freshwater and saltwater.
    There is a small river present. Karl likes to catch crabs there and often sees baby fish. What type of
    ecosystem is Karl describing?
    a. estuary ecosystem
    b. shoreline ocean ecosystem
    c. freshwater river ecosystem
    d. coral reef ocean ecosystem

13. An organism that can make its own food is called a
    a. consumer.
    b. decomposer.
    c. producer.
    d. scavenger.

14. Vultures, which feed on the bodies of dead organisms, are
    a. first-level consumers.
    b. scavengers.
    c. producers.
    d. herbivores.

15. Which biome receives less than 25 centimeters of rain per year?
    a. desert
    b. grassland
    c. temperate rain forest
    d. tropical rain forest
16. The first organism in a food chain is always a
   a. consumer.
   b. herbivore.
   c. carnivore.
   d. producer.

17. What do producers release as a result of photosynthesis?
   a. hydrogen
   b. nitrogen
   c. oxygen
   d. carbon dioxide

18. What area(s) are not part of any major biome?
   a. tundras
   b. deserts
   c. grasslands
   d. mountains and ice

19. A large variety of plants grows in tropical rain forest because
   a. many insects live there.
   b. the forest floor is very dark.
   c. it has very good soil.
   d. it is warm, humid, and rainy.

20. If a kestrel eats a mouse that eats grass, the kestrel is a
    a. producer.
    b. second-level consumer.
    c. first-level consumer.
    d. decomposer.

21. The study of where organisms live is called
    a. dispersal.
    b. biogeography.
    c. ecology.
    d. climatology.

22. Which of these is NOT an example of precipitation?
    a. rain
    b. snow
    c. groundwater
    d. hail