Exploring Effective Methods to Build Literacy, Critical Thinking Skills, and Confidence in Middle School Science Classrooms

Jennifer W. Butler
St. John Fisher College

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In most science classrooms, one of the most challenging aspects of teaching science is getting students to understand and apply scientific concepts. Most students have simple, generalized knowledge of the concepts, but they lack in the ability to articulate their knowledge and to comprehend questions that use scientific terminology. As a result, many of these students do poorly on standardized tests. The objective of this study was to increase middle school students’ skills in reading, comprehension, and oratory articulation in science by implementing the following literacy strategies: Read-Alouds, graphic organizers, K-W-L (Know, Want to know, and Learned) charts, and writing to learn assignments. In addition to these strategies, inquiry-based activities were developed to increase students’ learning, understanding, and confidence in a science classroom. At the conclusion of this study, it was found that most students’ achievement levels significantly increased as a result of these literary and critical thinking tools. Additionally, students’ understanding and confidence levels increased the most when the activities and literacy methods within the lessons were closely related to the students’ learning styles and the researcher’s ability to create hands-on learning experiences.
Dedication

This work is dedicated to Leah Grace Peterson. I do this so that you may have best future that I can offer. I pray that your teachers are as reflective and concerned with improving education as I am. Lastly, I would like to express my gratitude of support to my grandparents (Roosevelt and Lula Walton) in Mississippi.
Acknowledgements

Steven Hurt, a friend and a brother, thanks for being that thorn in my side, encouraging me to get the work done. Jay Costanza, my mentor and father-like figure, thanks for helping me to organize my ideas in the classroom when I was all over the place. And last but not least, Melody Levert, thanks for being understanding and helpful throughout this process.
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Exploring Effective Methods to Build Literacy, Critical Thinking Skills, and Confidence in Middle School Science Classrooms

Assisting students in the development of skills that allow them to read, write, and question scientific text is one of the most challenging academic responsibilities for any middle school science teacher. Due to this difficult challenge, students often do not understand the content, do not score well on assessments, or do not appropriately participate in class. Most middle school science teachers fail to properly equip students with the tools to be successful academically because students often arrive at middle school ill-prepared due to below level reading skills and lack in the ability to think critically. Furthermore, science teachers are not able to equip the students because they are not equipped to handle these problems. Teachers have been caught up in the cycle of teaching content only with the main focus of preparing students to pass a standardized test by teaching the content as it is presented on the test. As a result of this poor approach to teaching and learning, students are continuously left with the problems of not being able to read, comprehend, evaluate, synthesize, write, and speak the science content presented to them in other settings, including on the standardized exams, next level science classes, and everyday life (Martin, 2005; Vacca, 2002; Williams, 2004). When it comes to incorporating a multi-facet of literacy tools into lessons, some science teachers are simply ineffective in their approach to teaching to the general interest and strengths of all learners (Radeliffe, Caverly, Peterson, & Emmons, 2004; Worth, Moriarty, & Winokur, 2004).
For most students, middle school marks the beginning of their exposure to expository text. This may come in the form of textbooks, articles, or trade books about a particular subject area (Finch, 2003). Therefore, it is crucial that teachers introduce strategies to students that will help them understand what they are reading. Educators, especially science educators, should recognize that content area literacy is important because students in the 21st century are being asked to read and write more than any other generation (Vacca, 2002). Scientific literacy is likely the key to increasing students' standardized test scores, social awareness, and generations of scientifically literate individuals.

In this study, various literacy strategies and their effectiveness were examined. The strategies that were implemented in the students' daily lessons are the following: Read-Alouds, graphic organizers, K-W-L (Know, Want to know, and Learned) charts, and writing to learn assignments. These strategies were selected because each of them independently strengthens learning and thinking differently. Additionally, students' performance were measured using informal and formal assessments, such as anonymous warm-ups and ticket-out the door quizzes, thumbs-up and thumbs-down activities, Vocabulary-bingo, unit test, and the game of hang-man. All of these activities proved that students' knowledge and understanding has increased because students were more active in classroom discussions, wrote better lab write-ups, performed better on assessments.
Incorporating literacy in a science classroom is a daunting task for most teachers. Some teachers lack confidence in their own understanding of the concepts and rely heavily on textbooks that have little or no alignment with the standard-based principles for concept learning (Kragler, Walker, & Martin, 2005; Radcliff, Caverly, Peterson & Emmons, 2004; Finch, 2003). The process of implementing literacy into middle school science classes may pose as a challenge to most because it may be time consuming, overwhelming, and frustrating; but it is worth the extra effort, because it may actually help save time and frustration for the teacher in the long-term (Gilbert & Kotelman, 2005). When students are able to read and comprehend text themselves, they are more apt to read the science text that is provided to them independently, question the text and topic, and actively participate in class discussions (Fisher, Frey, & Williams, 2002; Allington, 2002; Corkery, 2005).

When a teacher is confident in his or her own knowledge and understanding of a science concept, it is easier to incorporate various types of literacy strategies into the classroom, no matter what type of strategy is being executed. When studies (Fisher, Frey, & Williams, 2002; Hurd & Musso, 2005; Hapgood & Palincsar, 2007; Klentschy, 2005; Martin, 2005) discussed effective science literacy strategies, they often revealed the benefits and definitions of the literacy strategy strategies. However, the actual methods for effective implementation of these literacy strategies in middle school science classrooms, based upon the students' abilities and learning styles, were not the focus of many studies. Therefore, it was assumed that these authors completely forgot to focus on
the individual learner and the learning styles and abilities of students when they recommended these strategies to use in the classroom. Thus, this study revealed how effective literacy strategies coupled with inquiry-based science learning, oral presentations, and reports are in a middle school classroom can build student confidence and understanding. The results of this study will further reveal how one can properly implement these literacy strategies. To assist in this research, it is pertinent to evaluate science literacy, literacy levels, and literacy strategies. It is also important to find out why all teachers are not using these methods in their science classrooms, and the benefits that both educators and students stand to gain from effective literacy strategy implementation.

*Scientific literacy*

Reading is an essential part of science literacy, but the question of how, what, and when to incorporate reading in the classroom is a mystery to most educators (Martin, 2002). The existence of a literacy-based classroom is important in educating the whole student. According to Vacca (2002), "As students move into the middle grades and high school, they often receive little or no instruction on how to use reading and writing strategies to learn with text" (p. 8). As a result of the students lacking in these skills, and the mandates from national, state and district educational governing offices, there is an enormous need for educators to fervently work at incorporating meaningful literacy strategies into their daily curriculum.

Many people have debated about whether or not the educational system is giving students the appropriate tools required to become literate in the processes around them.
(Vacca, 2002; Michell, 2006; Williams 2005). Worth et al. (2004) argued that in addition to there being so many new literacy strategies, there are also many concepts and topics to cover in middle school science, and little time to plan lessons that are engaging, require critical thinking skills, and incorporate the appropriate literacy strategies that will meet the needs of all or most learners in the classroom. No matter what teachers are aiming for in the classroom, the main goal of scientific literacy should be to teach students to read and write in their world so that they can be critically aware of the content, intent, and context of the texts students encounter and compose (Michell, 2006; Williams, 2005).

Hapgood and Palincsar (2007) wrote that learning about the world and sharing one’s own discoveries can be powerful motivators for learning to read, write, and speak effectively. That is scientific literacy at its best. Creech and Hale (2006) went on to say that literacy and science is a natural fit because, without it, students are not able to make the connection from the classroom to the things they witness each day. Berger (2002) went on to say that it important for everyone, whether they are a scientist or not, to understand the origin of science and the source, rather than having the knowledge of isolated facts and trivia, because this is what leads to misconceptions.

When scientific literacy is discussed amongst educators and researchers, many adequately define the dimensions of scientific literacy (Bybee, 1995). Educators should be clear on which dimensions of scientific literacy that he or she desires for their students so that the lessons can flow more efficiently and students are not confused on what they should know (Martin, 2002).
Dimensions of literacy

There are many domains and dimensions of literacy. Bybee (1995) pointed out three main dimensions of scientific literacy: functional, conceptual and procedural, and multidimensional. Thus, individuals such as Kragler, Walker, and Martin (2005) and Meichtry (1992) have observed classrooms and teachers who have made the case for favoring one dimension over the others because educators feared that all students were not capable of learning all three main dimensions of scientific literacy. However, Hamm (1992) agreed with Bybee (1995) on the idea that there should be a balance between the three dimensions. This balance provides achievement in scientific literacy that is positive for all students. To aid in this research, it is important to discuss these levels of scientific literacy, as well as what other subject areas encompass scientific literacy.

Functional Literacy. Functional literacy is defined by having the knowledge of scientific terms and vocabulary. According to Bybee (1995), the expectation is that learners, given their age, stage of development, and educational level, should meet minimum standards of literacy. The minimum standard in this category is for learners to be able to read and write passages that include scientific and technological vocabulary (Bybee, 1995; Martin, 2002). It is this thread of knowledge that opens the door to the other two science literacy dimensions of science. There have been a few educators who viewed functional literacy as a thing of the past (Bybee, 1995; Loranger, 1999; Vacca, 2002). According to Bybee (1995), “Scientific literacy includes more than vocabulary, information, and facts about science and technology” (p.29). Gillis and MacDougall (2007) discussed that science teachers often think of reading as passive activity, and
science as a hands-on, active process. This way of thinking is often evident in teachers’ lesson planning. Michell (2006) and Bybee (2005) felt that functional literacy deserved little focus, and that teachers must spend their time on developing conceptual, procedural and multidimensional literacy, because this is the level of knowledge that prepares students to critically read and write about events and processes around them.

*Conceptual and Procedural Literacy.* Conceptual and procedural literacy is a dimension of literacy that allows students to unify many of the concepts that they learned into a unified model. This type of literacy assists students in becoming life-long learners of science (Gillis & MacDougall, 2007). Students should be able to see the connections among concepts in and out of the classroom, because it has been reported that students, especially African Americans and Latinos, responded positively to knowledge that is represented in a humanized or story format (Worth et al., 2004; Hart et. al 2004).

One effective way to meet the demand of teaching scientific concepts is through integrated, interdisciplinary instruction, simultaneously addressing content from several different subjects (Hart, Liggit, & Daisey, 2004). In addition, they advised that teachers should make effective use of classroom time and address content in more depth, by removing artificial divisions among subjects. Concurrently, students would be able to see connections within different content areas and understand important concepts and ideas more easily (Duke, Gates, Hall, and Tower, 2005). These claims by Duke et al. (2005) and Hart et al. (2004) refute the claim of not having enough time to promote literacy strategies and higher level of thinking in the classroom.
Multidimensional Literacy. Educators must help learners to develop perspectives of science and technology that include the history of scientific ideas, the nature of science and technology, and the role of the person in life and society (Michell, 2006; Hamm, 1992). In other words, educators must equip all students with effective scientific literacy strategies which will help students to develop a way of thinking, writing, and reading that extends beyond functional and conceptual and procedure scientific literacy. This can occur when teachers challenge students in spite of their abilities, because all students can master this dimension of literacy (Corkery, 2000). This area of literacy is the focus of much debate, because many feel that this is a challenge for both the student and teacher.

Literacy Strategies

After reviewing the research of the various literacy strategies and their meaning, the following strategies were implemented into my lessons: Read-Alouds, graphic organizers, K-W-L (Know, Want to know, and Learned) charts, and writing to learn assignments. These strategies were selected based upon the needs of the students and the objectives of the curriculum. Literacy strategies have been around for some time, providing a wide variety of literacy strategies to stimulate students to become better readers and writers (Martin, 2002). According to Fisher, Frey, and Williams (2002), there is a strong link between strategic teaching and student learning. This section of this paper gives an overview on what each of these strategies and discusses their effectiveness in other studies.

Strategy one: Read-alouds. A Read-Aloud is one of the most effective ways for young adults to hear fluent reading and it should be done each day (Fisher, Frey, and
Williams, 2002; Hansen, 2003). They further go on to state this approach to increasing literacy can be as a whole class, in small groups, and with a partner. Hansen (2003), Fisher et al. (2002), and Loranger (1999) encourage teachers select other materials that build students' background knowledge and connects with them rather than the traditional textbook. In addition, they believe that this activity lowers the anxiety of reading in front of large groups, and assists in managing the classroom because students are presented with their opportunity to read much sooner. There is also an opportunity for more one on one time for students, who have problems reading and comprehending, and teachers, who can assist them in reading and questioning the text. (Hansen, 2003).

Strategy two: Graphic organizers. Graphic organizers provide students with visual information that complements the class discussion or text. Organizers come in many forms and offer students the opportunity to organize ideas and thoughts. (Fisher et al., 2002; Kragler, et al. 2005). According to Gilbert and Kotelman (2005), most teachers observed that students' ideas were clearer when they communicated through and combination of written and visual text—in an organized manner. Most students appreciate this strategy because it allows them to systematically arrange words that are closely associated with each other in a manner that can assist students in understanding how concepts and terms are connected (Martin, 2002).

Strategy three: K-W-L (know, want to know, and learned) charts. K-W-L (know, want to know, and learned) charts are a great way to engage students and assess their prior knowledge, so that they could successfully begin generating questions and designing scientific experiments (Schmidt, 1999; Fisher et al., 2002). K-W-L charts can
help students to organize their inquiries and question a specific text or concept (Schmidt, 1999). Additionally, having students complete K-W-L charts can provide an opportunity for students to discover their own knowledge.

*Strategy four: Writing to learn assignments.* Writing to learn assignments can be used effectively at any time during the class to help students inquire, clarify, or reflect on the content. Some of the most popular writing activities to learn assignments are RAFTs (Role, Audience, Format, and Topic) activities, warm-up writing, daily notebook reflections, and Point of View (POV) guides (Fisher et al., 2002; Gilbert et al., 2005). They allow students to put themselves in something or someone else's shoes. Regardless of how teachers implement this strategy, writing helps students think about the content, reflect on their knowledge of the content, and share their thoughts with the teacher and others (Fisher et al., 2002). In addition, this strategy allows students to be creative and make a connection with the concept (Fisher et al., 2002).

*Benefits of Incorporating Literacy in Science Classes*

Both science and literacy should be viewed as an active process (Gillis & MacDougall, 2007). Gillis et al. (2007) see reading as an “on your own” activity, whereas science is a hands-on learning adventure. According to Fredericks (2003), using a literature-based science curriculum naturally promoted hands-on, minds-on science learning. Michell (2006) reported that people sometimes contrast reading with science inquiry though they are exact opposite of each other. Teachers may believe that students should engage in inquiry by exploring questions through their own activities and thinking, rather than by turning to books for answers (Hapgood & Palincsar, 2007).
Students must be given the opportunity to be engaged and challenged. Finch (2003) realized that incorporating a few challenging hands-on activities can greatly help students in their understandings of scientific concepts. Lastly, Michell (2006) and Hapgood et al. (2007) viewed that promoting literacy in a science class is a timely process, when indeed it is not. According to Byee (1995), when the two are properly implemented it could save a teacher more time in the long run, with planning, because it condenses the curriculum.

**Students’ benefits.** Students come to class with a wide range of reading abilities, as well as knowledge of, and experience with different science concepts (Moore-Hart et al, 2004; Williams, 2005). It is an educators’ job to cultivate those different experiences and abilities and to show the students the value that their individuality holds. When students take advantage of these literacy strategies they develop an appreciation for life and a lift in their confidence in writing (Corkey, 2005). According to Vacca (2002), when teachers expose student to the various literacy strategies, they are capable of constructing meaning through self-monitoring, connecting previous knowledge to new knowledge, and applying this knowledge to new ways. This is especially important as we head into the 21st century, where the ability to construct meaning and understanding of abstract concepts becomes crucial to participation in a literate society (Vacca, 2002; Williams 2004).

**Teachers’ benefits.** Effective teachers know students need variety in their learning, and teachers work diligently to find those activities that they can use to increase student involvement in learning from text (Pearman, Camp, & Hurst, 2004). In addition, teachers found that sharing strategies provided a wider repertoire for each other as they
grappled with what worked best for increasing students' understanding of science concepts (Gilbert & Kotelman, 2005). Unlike popular conceptions, teaching literacy is not time consuming; it is natural in a science classroom. Teachers must be willing to put in the time and effort and it will pay off (Hansen, 2003).

**Connecting science literacy and science inquiry**

Engaging in hands-on, inquiry activities lead to a better understanding of science because students are allowed to explore the nature of science and write about what and why something is occurring (Meichtry, 1992). Science and Literacy have several inquiry skills in common. According to Schmidt (1999) and Martin (2002), as students learn to apply these inquiry skills, they will move toward becoming proficient scientists and readers. The inquiry skills are questioning, predicting, observing or noting details, inferring, fact verses opinion, comparing and contrasting, cause and effect, sequencing events, and questioning (Schmidt, 1999). These are skills that will improve both students' reading comprehension and science content understanding. However, teachers must models these reading and inquiry skills in order for students can be successful (Hamm, 1992).

**Summary**

The purpose of this literature review was to take a look at how others have tackled the integration of science and literacy in the classroom and the benefits that have come from implementing these reading strategies properly. Most researchers (Vacca, 2002; Pearman, Camp, & Hurst, 2004; Williams, 2004) agreed that implementing literacy strategies into lessons can be taken one strategy at a time. As for the students, studies
(Martin, 2002; Coskie, 2005; Gillis-Ridgeway and MacDougall, 2007) also suggested that students' confidence in class and achievements increased in science as well as in other content areas when they were exposed to tools that enabled them to understand the content. Their studies even revealed that even the smallest implementations of a literacy strategy can be helpful in students' achievement, understanding, and societal awareness.

Even with the knowledge of the benefits that students, teachers, and society obtain from having literacy taught in the content area of science, there are still teachers who are not teaching reading skills in the science classroom. Thus, there should be more professional development in this area to motivate the teachers to take that challenge of increasing literacy by meaningful literacy lessons in the classroom.
Methodology

This study was conducted at Wilson Magnet High School’s Foundation Academy. Each lesson students were introduced one or a combination of the following literacy strategy in their daily lesson: Read-Alouds, graphic organizers, K-W-L (Know, Want to know, and Learned) charts and writing to learn assignments (see appendices for Unit Plan Outline). Students’ performance was measured using informal and formal assessments.

Participants

The participants in this study are 130 seventh grade students. The average age of this group is Twelve (12) years old. The student population was made up ninety (90) percent of African Americans, six (6) percent were Hispanic American, three (3) percent are European Americans, and one (1) percent of the student population is made up of Vietnamese Americans. Fifty (50) of the students are male and Eighty-five (85) of students are female. Eighty-five (85) percent of the students in this study receive free or reduced lunches. The school that the students in this study attend is Wilson Magnet High School (Foundation Academy). Students were selected because they are enrolled in the researcher’s seventh (7th) grade science classroom. The students’ reading levels are as followed: fifty-five (55) percent of the students read at a seventh (7th) grade reading level, fifteen (15) percent of the students read at an eighth (8th) grade reading level, and thirty (30) percent of the students read in the range of a fourth (4th) to sixth (6th) grade reading level.
Materials

The materials needed to complete this study were marble notebooks, pre, during, and post reading/learning questions for each topic of exploration, understanding by design template (UBD), and reading passages for the Read-Aloud activities, concept map template, lesson handout to reinforce learning, and project agenda. The marble notebooks were used by the students to assist them in being organized, recognizing their own misconceptions, addressing those misconceptions, and to reflect daily upon the pre, during, and post questions that were giving by the teacher. These questions helped guide students in their learning process and helped assess them throughout the duration of the lesson. The Read-Aloud passages were given to the students and completed as in groups, followed by questions. The purpose of the Read-Aloud passages was to build and extend the students’ background knowledge.

Procedures

As a part of the researcher’s usual classroom activities, I implemented from start to finish one of the following literacy strategies in each of my daily lesson: Read-Alouds, graphic organizers, K-W-L (Know, Want to know, and Learned) charts and writing to learn assignments (see appendices for Unit Plan Outline). The three data sources of this study were collected from the students’ daily assessments, notes and observations from an observing outside teacher and reflections and observations made by the researcher of this study. For this study, the students’ assessments used will be used to collect data. At the end and the start of each lesson the class was asked a question, they were required to respond to the question by answering a ticket out the door question anonymously on a
half sheet of paper or using their notebooks. Students placed their responses in a box. The observing teacher came into the classroom to observe the students’ behavior and receptiveness towards the lesson being presented by the researcher. In addition, the observing teacher shared those reflections and notes with the researching teacher after each lesson. The researcher made observations on how well the students received the lessons. At the end of each lesson, the researcher took into account the informal assessment results and reflected on which literacy strategies were effective.
Results

The average number of students who got ticket-out the door and warm-up question prompts correctly went from a forty-five (45) percent correct rate to a seventy-five (75) percent correction rate. Students’ report of their first through fourth marking period letter grades is represented in the chart below. These numbers in this chart are reported in percentage. The number of students that participated in this data sample was 130.

Figure 1. Grade Distribution for Marking Periods 1-4.

M.P.=Marking Period
Total Students=130
Discussion and Conclusion

The sole objective of this study was to assist educators on how to effectively plan and implement inquiry-based lessons that are effective, so that students' achievement in writing, reading, and comprehension in science would improve. Moreover, this study improved the researcher's ability to reach the students of various learning styles. Furthermore, this will further help students to develop positive attitudes toward both reading and science.

From this study three areas of growth were observed by the researcher. First, the students were more engaged in the lesson, and this trend supports Hapgood et al.'s (2007) and Michell (2006) idea that learning about the world and sharing one's own discoveries can be powerful motivators for learning to read, write, and speak effectively. It was noted that students were on task and interested in the topic. Second, as suggested by Lorranger (1999) and Martin (2002), the students' success on informal assessments increased. Thirdly, students' ability and enthusiasm to write about science increased as the activities related to their worlds. This observation supports Hurd et al.'s (2005) and Worth et al.'s (2004) ideas of effective literacy strategies. The researcher noticed that students were more actively involved in class and eager to read and share their writings with the class.

Students' confidence level increased, and this was observed from students' increased participation in class and their ability to articulate their lab work through oral presentation. Moreover, most students' vocabulary increased because they were getting better assessment scores in both English and science classes where the science vocabulary was being assessed. Lastly, students were writing better science lab write-
ups. The students were using science vocabulary appropriately and questioning the causes and effects of their laboratory work. All of these observations confirm what researchers such as, Vacca’s (2002), Radcliffe et al.’s (2004), and Williams’ (2004), discussed in their writings.

As these literatures suggest (Allington, 2002; Berger 2002; Finch, 2003), integrating reading and science hold promise for improved student achievement. However, more training program may be implemented for science teacher to become better at teaching students how to relate to a particular text. Educators need to be aware of what literacy strategies work best in science, and how to effectively implement them in the classroom. With this knowledge, students are able to benefit not only in the present, but also in the future.

One aspect of science and literacy in middle school classrooms that was not addressed by the literature and the researcher adequately was the consideration of a students’ learning style and abilities. Educators can learn which methods and strategies work best by doing research that will enable them to understand the strategies’ function, attending meaningful professional development workshops that will help them in better assisting students learning, implementing one or two literacy strategies at a time in their lessons, designing inquiry-based learning, and being cognizant of the learning abilities and styles of their students.
References


Appendix A:  
THE UNDERSTANDING BY DESIGN (UBD) TEMPLATE

Stage 1: Identify Desired Results  
A > Essential Questions  
B > Knowledge and Skills  
C > Enduring Understandings

Stage 2: Determine Acceptable Evidence  
D > Performance Tasks  
E > Essential Questions  
F > Performance Task Blueprint (D)

Stage 3: Plan Learning Experiences and Instruction  
G > Unprompted Evidence  
H > Blueprint for Other Evidence (E, F, G)

Unit Title: Animal Diversity  
Grade Level: 7th

Organizing Concepts: 1. Classify organisms according to a classification scheme 2. Classify various organisms according to similarities 3. Compare and contrast the variations of similar organisms. 4. Environments and Ecosystems

Subject/Topic Areas: Biological Science

Key Words: Exoskeleton, variation, endoskeleton, genus, classification, species, kingdom, mammal, binomial nomenclature, mimicry, camouflage, dichotomous keys, behavior, organism

Unit Designer: Jennifer Butler  
Time Frame: 2.5 weeks

School District: RCSD  
School: Wilson Magnet High School—Foundation Academy

Link to Content Standards

Standard 4: The Living Environment  
Key Idea 1: Living things are both similar to and different from each other and from nonliving things.

Performance Indicator 1.1 Compare and contrast the parts of plants, animals, and one-celled organisms.

Key Idea 4: The continuity of life is sustained through reproduction and development.

Performance Indicator 4.3 Observe and describe developmental patterns in selected plants and animals (e.g., insects, frogs, humans, seed-bearing plants).

Brief Summary of Unit (including curriculum and unit goals)

At the end of the unit, student will be able to classify organisms according to their observable characteristics and behavior, design and use a dichotomous key, compare and contrast organisms. In addition, students will understand how and why scientist must have system to classify organisms.
What enduring understandings are desired?

Classifying objects and organisms are important in establishing order in a system.
Understanding how animal behavior helps us understanding our own behaviors.
How and where we live can impact our survival.
Life is a cyclic process.

What essential questions will guide this unit and focus teaching and learning?

Why do scientists classify animals?
Why do animals behave a certain way?
How do animals live in their natural habitats?
How does an organism's structure enable it to survive in its habitat?

What key knowledge and skills will students acquire as a result of this unit?

Knowledge: Students will be able to classify organisms and objects, understand how animals are able to thrive in their habitats, use key terms/vocabulary when describing animals, their behaviors, and habitats, relate or differentiate in the various types of animals.

Skills: Students will be able to create a dichotomous key to organize organisms and objects, create an animal that is able to survive in any given habitat, dissect small organisms to locate their organs, and exhibit proper use laboratory equipment.
What evidence will show that students understand?

Performance Tasks (summarized) □  (Complete a Performance Task Blueprint for each task.)

Student will be given a performance task where they will pretend to be scientists who are able to genetically engineer animals and environments. They will need to pick one of the following environments of already created planets and create an animal which is going to be strong and resilient enough to survive in that environment. They need to consider how this animal is going to stay warm or cool, what it is going to eat, how it is going to get its food and water, and how it is going to care for its young to make sure they survive. Their animal must FIT INTO the existing food chain - it cannot be the ultimate predator (the one which can eat everything else and nothing can eat it). Animals must fit into one or two of the current animal classification systems. When students are designing your animal consider the following: size, what does it eat, how will it catch/get food and water, how will it keep warm/cool, where will it shelter, how will it protect/defend itself from attackers, and which class of animal does your animal fit.

OTHER EVIDENCE □  (Use the Blueprint for Other Evidence to describe assessments other than performance tasks.)

Quizzes, Tests, Prompts, and Work Samples (summarized)

Quizzes will be used to assess students' ability to use and know vocabulary and application of the notes and text. Quizzes will given on the following five animal diversity subtopics: animals classification, characteristics of an animals, animal habitats, types of animals, and types of animal behaviors.

Unprompted Evidence (e.g., observations and dialogues)

Unprompted evidence will involve teacher observations of students completing in and out of class assignments. Teacher will have mini discussions with students where questions and situations are posed and the students will be required to respond either as a class or as an individual.

Student Self-Assessment

Students will self-assess themselves with "ticket out" the door statements. Where students will describe what they learned that day what they are unclear about, concerning the daily lesson.
What desired understandings/content standards will be assessed through this task?

- Students will be able to think critically when trying to solve problems.
- Student will understand how an animal's characteristics are important for survival in an environment.
- Students will be able to classify their animals according to their characteristics.

What is the purpose of this assessment task?  
☐ Formative  ☐ Summative

Through what authentic performance task will students demonstrate understanding?

**Task Overview** (including GRASPS: goal, role, audience, situation, product or performance, and standards)

G-The goal of this task is to allow students to think critically and understand how an animal's characteristics are important for its survival.

R- You are one of the scientists working on the animals, and it is your job to design and create an animal which will be perfectly suited to its environment on this new planet.

A-The audience is the scientific community and the human race.

S- It is the future, the year 3000, and it is now possible for humans to build planets, and genetically engineer or create plants and animals to live on that planet.

P-The product of this task will be a newly created creature that is able to live in its selected habitat.

S-Students are covering the state and district standards of inquiry, scientific processes, and how animals are diverse.

What student products/performances will provide evidence of desired understandings?

- Students' ability to articulate their animal and how it is able to survive in a given habitat.
- Students' ability to apply what they know about animal characteristics and behaviors in their final write-ups and animal designs.
- Students' ability to use terminology properly.

By what criteria will student products/performances be evaluated?

- Has the student fulfilled all parts of the task?
- Has the student chosen features which allow the animal to survive in this environment?
- Is it neatly presented and labeled?

What type of scoring tools will be used for evaluation? (Use a separate sheet for scoring tools.)

☐ Analytic rubric  ☐ Holistic rubric  ☐ Criterion (performance) list  ☐ Checklist

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What other assessment evidence will be collected during this unit?

**What will be assessed?**
- Knowledge
- Skill
- Understanding

**How will evidence be collected?**
- Quiz/Test
- Assignment
- Teacher notes
- Other: Discussions

**What type of assessment will be used?**
- Selected response
- Observation
- Academic Prompt
- Work sample
- Brief constructed
- Other: 

**What is the assessments purpose?**
- Diagnostic
- Formative
- Summative

**Describe the assessment and state the prompt (if applicable).**
Students will have to complete a summative test on animal classification, characteristics, behaviors, habitats, and animal types. This assessment will include short answers, multiple choice, true and false, and matching questions.

**By what criteria will student responses be evaluated? (Complete if applicable)**
- Using an answer key

**What type of scoring tools will be used for evaluation? (Check if applicable)**
- Analytic rubric
- Checklist
- Holistic rubric
- Answer key
- Criterion list

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**What will be assessed?**
- Knowledge
- List:
- Skill
- Understanding

**How will evidence be collected?**
- Quiz/Test
- Assignment
- Teacher notes
- Other: Discussions

**What type of assessment will be used?**
- Selected response
- Observation
- Academic Prompt
- Work sample
- Brief constructed
- Other: 

**What is the assessments purpose?**
- Diagnostic
- Formative
- Summative

**Describe the assessment and state the prompt (if applicable).**
Students will be evaluated using ticket-out the door, thumbs up and down, and warm-up questions.

**By what criteria will student responses be evaluated? (Complete if applicable)**
- Student responses from these activities will be collected and evaluated

**What type of scoring tools will be used for evaluation? (Check if applicable)**
- Analytic rubric
- Checklist
- Holistic rubric
- Answer key
- Criterion list
What sequence of teaching and learning experiences will equip students to develop and demonstrate the desired understanding?

Consider the WHERE elements from the student's perspective.

1. Introduction: What are animals?
   - Lesson 1: Video with questions on what are animals will be presented.
     - Develop a K-W-L chart in animals
     - Power point Presentation and note taking activity on animals
     - National Geographic Article on the animal and their classification
     - Literacy strategies: Read-Aloud in small groups, K-W-L chart

2. Types of Animals and their general characteristics.
   - Lesson 2: Teacher will fill in a graphic organizer on animals with the students using an overhead projector.
     - Teacher will set up stations that have various types of animals. It is the students' job to follow the directions of the station and make observations on the animals and form a hypothesis on why the animal is behaving in that manner.
     - DI strategy: Stations
     - Literacy strategies: Graphic organizers/writing to learn

3. Animal classification system
   - Lesson 3: Teacher will introduce classification using cars.
     - Students will be assigned various “made up” animals and students will have to create a classification system for these animals based upon their characteristics.
     - DI strategy: Independent project
     - Literacy strategy: writing to learn

4. Where do animals live and how do they survive?
   - Lesson 4: Students have a choice to choose different environments from the choice boards to create their own environment and animals. Some environments will have more details than others. Students will create a diorama and a detailed summary to go along with their animal and environment describing how that animal is able to survive in that environment.
     - DI strategy: Choice Boards
     - Literacy strategy: writing to learn

5. Types of Animal behaviors
   - Lesson 5: Video and handout activity on animal behaviors.
   - Station

6. Life Cycle of Animals
   Lesson 6: Students will have to research an organism that goes through metamorphosis (complete or incomplete). Their job is to recreate that cycle with factual information, but from their perspective. This recreation must be done in the form of a story. Students will have agendas to help them in accomplishing this task and develop graphic organizers.
     - DI strategies: Agendas/Problem-based learning
     - Literacy strategies: graphic organizers, RAFT
Appendix B
Unit Concept Map on Animal Diversity

Animal
Diversity

Animal Classification

Types of Animal Behavior

Animal Characteristics
Appendix C
Sample Animal Observations Lab

Station 1

**Directions:** Write down your observations of the gold fish. After you have visited all stations, complete each post station questions at your desk.

**Observations:**

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Post-Stations Questions:

Why do you think that the animal is behaving the way it does?

What type of animal is this (what group of animals does it belong and why)?

Could this animal survive in another environment beside the one it currently resides? Why or why not?
Appendix D
Metamorphosis Writing to Learn Assignment

Life Cycle Agenda
**Directions:** Read the task below and complete them thoroughly. Before going on to the next task, please get the signature of the teacher.

<table>
<thead>
<tr>
<th>Teacher's Signature</th>
<th>Student's Signature and Role</th>
<th>Original task</th>
<th>State any modifications to original plans?</th>
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<tbody>
<tr>
<td></td>
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<td>Select an animal that goes through metamorphosis</td>
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<td>Gather enough research using books and the internet</td>
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<td>Draw or obtain a picture of your animal</td>
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<td>Develop/Write a story that explains the metamorphosis (complete or incomplete) process.</td>
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<td></td>
<td>Completed the assignment neatly</td>
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<td></td>
<td></td>
<td>Present your final product</td>
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Appendix E
K-W-L Chart and Questions

Animal Life in Action: Animal Classification Video Quest

Pre/Post Video Activity: Generate a list on everything we think we know about animal classification. After viewing the video, mark each entry with a “+” if the entry is correct and a “-” if the entry is incorrect. Please use the chart below to generate the list.

<table>
<thead>
<tr>
<th>Know</th>
<th>What to Learn</th>
<th>Learned</th>
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During-Video Activity: Answer the following questions during the video and today’s lesson in your notebooks.

1. Why is a scientific classification system necessary?
2. How do we group animals into categories?
3. What is the current seven-step system (in order) of classifying animal all living organisms?
4. Is the current taxonomic system accepted completely in scientific circles?
5. Why aren’t common names useful in describing creatures?
6. How did Aristotle contribute to animal classification?
7. Who was Carolus Linnaeus and how did he change the classification system?
Appendix F

Students’ Writing Sample from Lab Notebook (student with a 5th grade reading level)

**Essential Question to lab on respiration:** Do all living organisms experience respiration?

**Student’s Response:** Respiration is a combination of oxygen and sugar in the presence of energy yields water, carbon dioxide, and energy. Living things such as fungi, bacteria, viruses, humans, plants and animals respire, to obtain energy to carry out life functions. The purpose of this lab is to see if yeast is a living substance/organism and if it is what sweetens such as equal, white sugar and sweet-n-low.

**Student’s Response:** Prediction- When the yeast and water mixes with sugar, I think it will fill the balloon up with carbon dioxide.

**Student’s Response:** Hypothesis- I think this will happen because yeast grows when it is exposed to moisture and food.

**Student’s Response:** Procedures-First we mixed 200ml of warm water and three packets of sugar in a water bottle. Then we added a bag of yeast to each of the mixtures, then gently swirled the mix. Next I capped each bottle with a balloon. Then I used a piece of string and ruler to measure each of the balloons circumferences every 5 minutes (or each group came up with their own method to measure the balloons. Then I created a data table and recorded the all of the information. After I had to measure the balloon for the amount of time and plot the results on a graph.

**Student’s Response:** Conclusion-My Hypothesis and prediction were some what right. Adding the sugar with the water and yeast was the best to do in this case. The mixture of yeast and water was not so successful but the mixture of yeast, water, and sweet-n-low was the most successful out of all the sugars. This experiment was a great experience it could have been improved. We should have recorded the time better and been more careful when we put the balloons on the tubes. In this lab my group had a few errors. For example measuring the diameter was hard and recording the information was hard two because some times when we were measuring the balloon we would stop the clock but some times we would keep it going. Next time I do this lab I plan to be more careful and try to make as few errors as possible.