BIOLOGY, LITERACY, AND THE AFRICAN AMERICAN VOICE: A CASE STUDY OF MEANINGFUL LEARNING IN THE BIOLOGY CLASSROOM

by

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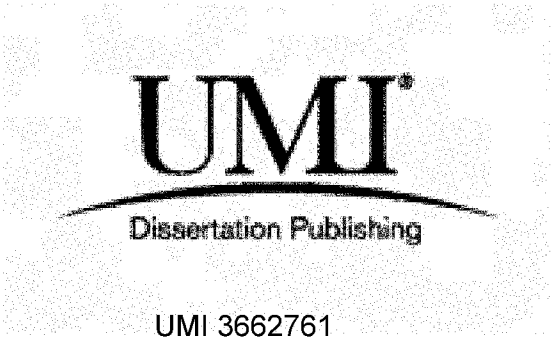

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DEDICATION

MY PAST

Mr. Matthews Landers Jr. and Mrs. Mildred Landers, my grandparents, instilled in me the power of prayer and the unction to never give up. May they continue to rest in God's everlasting arms. My mother and father, Kuturah Davis and Anthony Morris Sr. Thank you for creating me and having the foresight to place me in an environment in which I flourished. Mommy, thanks for ALWAYS telling me to never give up and reach for the stars. Dad thanks for always telling me that you were proud of me. I LOVE YOU BOTH!

MY PRESENT

Kawain Martez Reese, you are awesome! God blessed me with the love of my dreams. Throughout this entire process, you NEVER wavered. You encouraged me to be who I have become. You are my backbone, without you, I could not stand. Thank you for all of your love, support, constructive criticism, good times, and bad times. You are my inspiration. God made you just for me. I LOVE YOU!!

MY FUTURE

God truly made our children just for us. This book is dedicated lastly to Kaylee Moriah Reese and Khyla Madison Reese. Our daughters have been a refreshing breeze in such a stressful time. Mommy wants you two to reach for whatever you want. Speak things as though they were. Knock and the door shall be opened, seek and you shall find, ask and it shall be given. I LOVE YOU TWO WITH ALL MY HEART. When I look at you two, I know that this work has not been in vain. You are truly mommy's reason for wanting more.

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ABSTRACT

KETURAH M. REESE
BIOLOGY, LITERACY, AND THE AFRICAN AMERICAN VOICE:

A CASE STUDY OF MEANINGFUL LEARNING IN THE BIOLOGY CLASSROOM

Under the direction of Sharon Murphy Augustine, Ph.D./Ph.D Curriculum and Instruction

There was a substantial performance gap among African Americans and other ethnic groups. Additionally, African American students in a Title I school were at a significantly high risk of not meeting or exceeding on performance tests in science. Past reports have shown average gains in some subject areas, and declines in others (NCES, 2011; GADOE, 2012). Current instructional strategies and the lack of literacy within the biology classroom created a problem for African American high school students on national and state assessments. The purpose of this study was to examine the perceptions of African American students and teachers in the context of literacy and biology through the incorporation of an interactive notebook and other literacy strategies. The data was collected three ways: field notes for a two week observation period within the biology classroom, student and teacher interviews, and student work samples. During the observations, student work collection, and interviews, I looked for the following codes: active learning, constructive learning, collaborative learning, authentic learning, and intentional learning. In the process of coding for the pre-determined codes, three more codes emerged. The three codes that emerged were organization, studying/student

ownership, and student teacher relationships. Students and teachers both solidified the notion that literacy and biology worked well together. The implemented literacy strategies were something that both teachers and students appreciated in their learning of biology. Overall students and teachers perceived that the interactive notebook along Cornell notes, Thinking maps, close reads, writing, lab experiments, and group work created meaningful learning experiences within the biology classroom.

CHAPTER 1

INTRODUCTION TO THE STUDY

Even though I excelled in science, many of my African American classmates were not as fortunate. Excelling in science as a gifted African American female at the school, district, and national levels was a rarity. I often noticed how my African American peers struggled to grasp science. Even if they made B's and C's in other courses, they would typically make D's and F's in science. Science was a subject that was often taught to us through lecture, notes, and vocabulary. Facts were given and students were expected to memorize and regurgitate pieces of information. There were rarely moments where science was taught for deep understanding. With educators as my grandparental support, I could not imagine having to go to a home of drama, despair, low income, and be expected to do well in science. Teaching science to African American students in the South, I still see the underachievement among African Americans in science. Comparing 1996, my year of high school graduation, to 2015, science is still a struggle for all students, especially the African American population located in high poverty areas. The purpose of this qualitative study was to investigate African American teachers and African American students' perceptions of the effect of the utilization of literacy strategies as tools that influenced success in literacy within a biology classroom.

Background of the Problem

Brief History of African Americans and Science Education

The problem with African Americans, biology, and literacy struggles stem from years of legal and social practices uncommon to other ethnicities of people within the United States. For the majority of American history, education of African Americans was designed to ensure the political, social, economic, and intellectual inferiority of African Americans (Franklin, 1947; Pearson & Bechtel, 1989; Woodson, 1919). During Reconstruction, it was decided that if African Americans were to be educated, they were educated in separate and equal schools for African Americans. Southern states began enacting separate but equal status related to public accommodations, including schools in 1887. This was 10 years after reconstruction and 9 years before Plessy vs. Ferguson. The Plessy decision upheld the constitutionality of these laws, which remained unchanged for nearly 60 years (Plessy v. Ferguson, 1896). There were many forms of discrimination when it came to African Americans being equally educated. Three areas were identified in which segregation laws were compromised.

One of the identified areas of compromise was the unequal apportionment of school funds in which African Americans paid taxes. The second identified area of compromise was the differences in African American and white teachers' salaries as well as a failure to give African Americans the access to publicly funded graduate and professional schools (Stakeman & Stakeman, 2012). In addition to the aforementioned direct discrimination in funding, African Americans were discriminated against in the

opportunity to get an adequate education. African American school attendance remained low because assigned schools were often too remotely located, making it infeasible to go to school without transportation (Pearson & Bechtel, 1989). There would usually be only one African American teacher for a large class. In addition to distance, large class sizes, and lack of funding, African American students had to learn the same information in a shorter amount of time due to the length of the school terms.

These improper practices were supposed to be obviated with the monumental case of *Brown v. Board of Education* in 1954. This case ruled that separate but equal was unconstitutional. The new law stated that education for African Americans and Whites was separate but clearly unequal. Segregation was deemed a violation of the Equal Protection Clause of the 14th amendment (Spring, 2005). This ruling ended desegregation in public schools. *Brown v. Board of Education* helped spark a civil rights movement that sparked many African Americans' interests in organized political and social action on their own behalf (Rebell & Wolff, 2008; Urban & Wagoner, 2009). In 1964 the Civil Rights Act was passed. This act contained several facets that required mandatory enforcement of civil rights pertaining to African Americans in different areas (Rebell & Wolff, 2008; Urban & Wagoner, 2009). Title VI of this act affected segregation in education. This title also allowed federal money to be withheld from the districts that allowed segregation. The Civil Rights Act led to certain responses that questioned the reliability of the act.

In 1964, James Coleman, a professor at Johns Hopkins, was hired by the US government to conduct a massive study known as the Coleman Report. The Coleman Report was written in response to the Civil Rights Act (Jackson, 1992; Urban & Wagoner, 2009). Coleman's report communicated an investigation conducted about the lack of educational opportunities provided for the underprivileged. This report provided insights about things such as social class and the educational achievements of students in the minority and the majority. Coleman's report communicated two conclusions. First, Coleman noticed that the differences in resources were slightly related to educational achievement. Second, Coleman noted that differences in achievement were strongly related to educational backgrounds and visions of students. Poorer students performed much better when they were put in classes with privileged students who were higher-achieving. This report addressed the underachievement of poor students which brought to light the possible relationships among economic class, race, and school achievement (Jackson, 1992; Urban & Wagoner, 2009). Even though the Coleman Report caused people to question the Elementary and Secondary Education Act/Title I in its first stages of implementation, Title I still existed today. Around the same time African American students were in turmoil, science education was too.

Brief History of Science Education

In 1957, science educators first questioned the effectiveness of science instruction when Russia sent Sputnik outside the earth into space (Spring, 2005). America was supposed to be ahead in everything, but the failure to venture into outer space first

became problematic for science preparation among all Americans. Over the years, science education researchers had examined the reasons for the low performance in science. In response, the American Congress mandated major spending increases for science education. In addition to this, some of the finest scientists turned their attention to the problem in science education (Spring, 2005).

According to the Engleman & Bybee (2001), shortly following the Sputnik launch, critics began blaming the United States for lagging behind Russia in science and technology education. One year later, the National Aeronautics and Space Administration (NASA) was created. Simultaneously, Congress passed the National Defense Education Act (NDEA), which was signed into law in September 1958. The NDEA provided funding to develop state-of-the-art science textbooks. The National Science Foundation (NSF) was coaxed by Congress to fund the development of the materials (Engleman & Bybee 2001).

After these goals and programs were created, science still was a subject that students struggled with especially African Americans. Due to reports such as A Nation at Risk and curriculum reforms such as GOALS 2000, No Child Left Behind, and the American Recovery and Reinvestment Act of 2009, America showed great inconsistency in how they wanted anything, especially science, to be conveyed to students (National Commission on Excellence, 1983; Spring, 2005; Urban & Wagoner, 2009; U.S. Department of Education, 2009).

According to A Nation at Risk (National Commission on Excellence, 1983), even though the nation went through a scientific shift during the Sputnik era, the average performance of high school students on most standardized tests was lower in 1983 than the NAEP scores of science students in 1969. The result of this report was the beginning of a new paradigm during the Reagan administration which focused on additional laws to mandate teaching and instruction as a means to return to traditional instruction and discipline, and also an increased emphasis on testing. In 1992, during the Clinton administration, America 2000 education program was implemented as a foundation for *Goals 2000*. One major change in educational policy in the two administrations of Bill Clinton caused the public criticism of schools and teachers to decrease (Urban & Wagoner, 2009). Clinton only continued that of the Reagan-Bush years where education focused on school reform led by politicians intertwined with a lack of meaningful amounts of federal funding for education.

No Child Left Behind entered the scene in 2001 and was signed into law on January 8, 2002 by President George H.W. Bush (Urban & Wagoner, 2009). *No Child Left Behind* was the driving force behind the district, state, and national changes made in education. *No Child Left Behind* (NCLB) was written under the guise of closing the achievement gap among minorities, so that quality supplies would be produced equally in all backgrounds. However, NCLB was not able to help the minority children that it was supposed to be written for (Spring, 2005). In 2009, because of the complaints and ineffectiveness of NCLB, President Barack Obama passed a new educational reform

initiative. The American Recovery and Reinvestment Act of 2009 (ARRA) was historic legislation designed to rouse the economy, fund job creation, and invest in education. The ARRA provided $4.35 billion for the Race to the Top Fund which was a grant program created to encourage and reward the states that were creating the conditions that foster innovation and change, significant improvement in achievement, and the implementation of creative plans in the education reform facets in the areas of math and science.

From state to state, classroom teachers felt the overly involved presence of the state government in the forms of academic standards and statewide exams as they began to become enforced. All states went through the changes, including Georgia who began revising its curriculum during this time. Georgia transitioned from the quality core curriculum in 2002 to the Georgia Performance Standards (GPS). According to the Georgia Department of Education (2005), the standards movement allowed them to adopt the research-based 'less was more' philosophy. These standards were based on abstract ideas that required higher levels of thought such as analysis, synthesis, and evaluation. With GPS, African Americans were still unsuccessful. Eventually in 2013, Georgia joined that nation in the adoption of the Common Core curriculum (GADOE, 2014).

National and State Assessment Data

According to the National Center for Education Statistics (2005, 2009), science proficiency among American 4th graders, 8th graders, and 12th graders varied among different ethnicities of students. Figures 1 and 2 shows the largest gap in

science proficiency exists between African Americans and their White counterparts. African Americans scored the lowest on both NAEP science assessments for 2005 and 2009. African Americans' scores on the NAEP science assessment increased for 8th and 12th graders between 2005 and 2009. The fourth grade scores for African Americans decreased between the years of 2005 and 2009. Although there was an increase in the NAEP scores of African Americans, the increase still proved not to be substantial enough to close the African American-White achievement gap. These data reflect that there still remains a need for African American students to perform scientifically on a level with their counterparts.

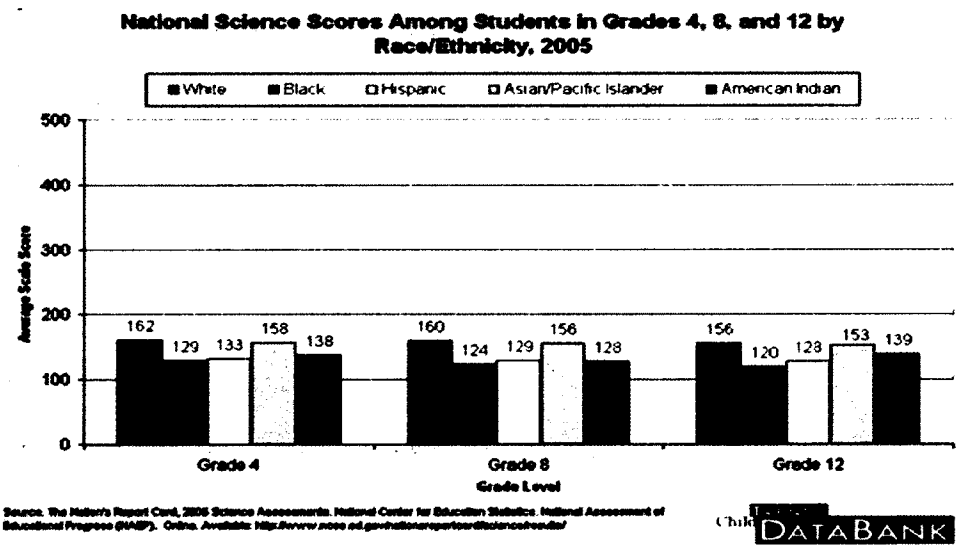

Figure 1. National Science Scores. This figure shows the comparison NAEP scores among different ethnic/racial student groups in 2005 (NCES, 2005).

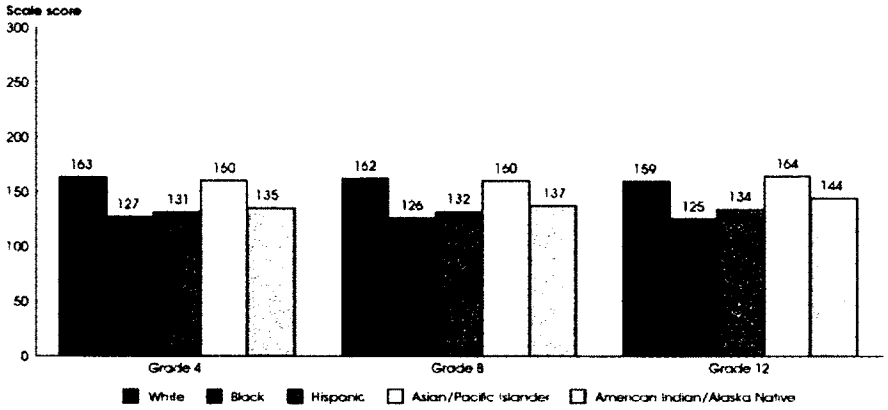

Figure 2: National Science Scores. This figure shows the comparison of NAEP scores among the different ethnic/racial student groups in 2009 (NCES, 2009).

According to Figure 2 (US Department of Education, 2009), grade 4 African Americans scored an average of 127 on the Science NAEP in comparison with their White counterparts who scored an average score of 163. African Americans in grades 8 and 12 scored an average score of 126 and 125 respectively in comparison with their White counterparts who scored 162 and 159 respectively on the Science NAEP test. There was shown to be at least a 30 or higher point gap between the science scores of African Americans in comparison with the average scores of their White counterparts (US Department of Education, 2009). In grade 4, 54% of children in low poverty were at or above proficiency on the science NAEP whereas only 11% of children in high poverty performed at or above proficient. The trend was repeated in grades 8 and 12 with the 46 % and 32 % of the low poverty students performing at or above proficiency in comparison to 8% and 4% of the high poverty students performing at or above proficiency.

After analyzing these NAEP scores of African American students and White students, I saw that there were major problems in African Americans' performances on standardized tests such as the NAEP test. African Americans consistently scored the lowest on the NAEP in reading, math, and science. If these African American students live in high poverty areas, according to the National Center for Education Statistics data (2009), the chance of performing at or above proficiency decreased even more. The trend from 2005 to 2009 shows that African American students' scores have increased by no more than five points with the exception of the fourth grade students who showed a decrease. The trend also shows that their White counterparts' scores consistently increased across all three grade levels. Even though the White students' scores only increased by an average of three points, the trend shows that the gap will never close if Whites and African Americans keep increasing at the same rate. There had to be an intervention implemented that would help drastically improve the science performance scores of African American students in order for performance gap to decrease because this was not only a nationwide problem but statewide problem as well.

On the state level assessments, African American students in Georgia have fared even worse. According to the Georgia Governor's Office of Student Achievement (2011) with the release of the Georgia Report Card, African American students that took the biology End of Course Test (EOCT) in 2010-2011, had a failure rate of 55 % compared to their White counterparts who had a 6% failure rate. This large discrepancy proves to be a monumental imbalance in the performance of African Americans in comparison with

Whites. In addition to this, the economically disadvantaged had a 55% failure rate on the biology EOCT in comparison to the non-economically disadvantaged students who had a failure rate of 31%. The aforementioned gaps proved to be very substantial when trying to reach and instruct every child and ensure that every child receives a quality education. This task of reaching every child has been significantly difficult for all educators, but especially challenging at the high school level where I teach.

There is a substantial performance gap among African Americans and other ethnic groups. Additionally, African American students in a Title I school are at a significantly high risk of not meeting or exceeding on performance tests in science. Past reports have shown average gains in some subject areas, and declines in others (NCES, 2011; GADOE, 2012). Generally, the trend in science was characterized by declines in the 1970s, followed by increases during the 1980s and early 1990s, and mostly stable performance since that time; however, one thing that has remained unchanged was the gap that persists between African American students and their White counterparts. There was a problem when performance becomes stagnant. Even if African American move up a point or two, the gaps are still quite significant between them and their White counterparts.

The problem was not that there was no decrease in the gap between African American and Whites, but it was that the rate of decrease was very slow and minimal. Even though achievement gaps were decreasing on the science NAEP, African American students still failed to conquer the elusive skill of performing on science tests. The lack

of creativity, innovation, science literacy, and technology led to the problem of African American students' poor performance (Spring, 2005). If African American students cannot turn around the dismal performance, they may never be able to attribute to the scientific community in the U.S. and abroad. Current instructional strategies and the lack of literacy within the biology classroom had created a problem for African American high school students on national and state assessments.

Purpose of the Study

The purpose of this qualitative study was to investigate African American teachers and African American students' perceptions of the effect of the utilization of literacy strategies as tools that influenced success in literacy within a biology classroom.

Statement of the Problem

This study utilizes Ausubel's theory of meaningful learning to investigate the perceptions of African American high school students and teachers in the area of literacy within a biology classroom. The problem investigated stemmed from the continual poor performance of African American student on national and state assessments.

Research Questions

The following research questions guided my data collection and analysis:

1. How did literacy strategies affect the performance of African American students within the biology classroom of a Title I school?

a. How did African American teachers perceive the effect of the incorporation of literacy strategies on the science performance of African American students and their meaningful learning experiences within a biology classroom?
b. How did African American students perceive the effect of the incorporation of literacy strategies on their meaningful learning experiences and science performance within a biology classroom?

Theoretical Framework

The theories of constructivism and meaningful learning guided this study. Constructivism lay at the root of many learning principles and had a major influence on educational thinking about curriculum and instruction. This thinking led to the notion that children investigated topics from a variety of multiple perspectives (Schunk, 2012). Within the classroom, teachers acted as facilitators instead of disseminators of knowledge. There are two main branches of constructivism, social and cognitive because of the theorists' universal belief that children constructed their own knowledge.

David Ausubel (1965) extended the cognitive constructivism approach with the addition of placing the mental images or thoughts into a concrete form in which the learner could experience meaningful learning. This criterion for meaningful learning was met if differentiated cognitive content was thought of as having a model relative to concrete concepts and a combination of conceptualized meaning (Ivie, 1998; Odom & Kelly, 1998). According to Ausubel (1965), new meanings were acquired when meaningful symbols, concepts, or propositions were related to and incorporated within an

individual's cognitive structures (Schunck, 2012). Meaningful learning happened when students constructed the knowledge and utilized the cognitive procedures required for successful problem solving.

Conceptual Underpinnings for the Study

This study focuses on the utilization of various literacy strategies such as Thinking maps, Cornell notes, writing, and collaboration to facilitate the learning within the population of African American students in poverty. Because of the focus on African American students using various literacy strategies to construct knowledge, the study incorporates two theories: constructivism, primarily the cognitive elements of constructivism and Ausubel's (1965) theory of meaningful learning.

Definition of Key Terms

- *Close reading* is a literacy strategy in which students read the text at least three times. Students must also be able to answer questions about the article that increase in complexity. Students are also encouraged to annotate the text while doing their close reads (Fisher & Frey, 2013)
- A *concept* is any word we say (Martinez, 2010). According to Carey (2009), a concept is a unit of thought and the constituents of beliefs and theories. According to Schunk (2012), concepts are labeled sets of objects, symbols, or events that share common characteristics. A concept is a mental representation of a category that allows a person to identify examples and non-examples of a particular category.

- *Concept learning* happens in two ways, concept formation and concept assimilation. A concept was a mechanism which enables categorization of different things into the same class. A concept exists whenever two or more distinguishable objects or events are classified together a set apart from other objects or events(Schunk, 2012)
- *Constructivism* is a psychological and philosophical perspective stating that individuals construct much of what was learned and understood. The learning in constructivism was conceived to be holistic, bottom-up process carried out by an active learner (Dimitriadis & Kamberelis, 2006; Martinez, 2010; Schunk, 2012).
- *Cornell notes* are notes that were created by Walter Pauk. Cornell notes are divided into a left and right side. The right side was utilized for the notes given by the teacher. The left side was utilized for questions, topics, or themes pertaining to the newly collected information. A summary was written at the bottom as a reflection tool for what has been learned (Pauk, 2001).
- *KIM Vocabulary* is a vocabulary method in which the information was broken down into four or five categories. The Keyword, Information, and Memory Cue, sometimes Sentence, are utilized to help students learn new words. It can be done before or after reading a text (Cohen & Johnson, 2011).
- *Literacy* is not simple to define. According to Harris, Hodges, & International Reading Association (1995), literacy is the ability to read and write across a continuum. Literacy provides people with the ability to be competent in whatever

field of study they may pursue. Literacy also allows people to interact effectively within the community in order to be successful.

- *Meaningful learning* happens when new information relates to relevant concepts stored in an individual's long term memory. It depends on certain variables such as age, experience, socioeconomic status, and education (Schunk, 2012, Ausubel, 1965).
- According to the American Psychological Association (2011), *socioeconomic status* (SES) is commonly conceptualized as the social standing or class of an individual or group. It is often measured as a combination of education, income and occupation. Examinations of socioeconomic status often reveal inequities in access to resources, plus issues related to privilege, power and control.
- *Visual tools* are divided into three categories, each with subcategories: (a) brainstorming webs, which include mind mapping, clustering, and webbing, (b) task-specific organizers, which include life cycles, text structures, flow maps, and decision trees, and (c) thinking process maps, which include concept maps, thinking maps, and Vee maps. They support strategies that enable students to process information through building conceptual links, discern patterns among concepts, develop the capacity for viewing situations from multiple perspectives, and reflect on and modify understandings in response to feedback from others (Caviglioli & Harris, 2003; Hyerle, 1996).

Summary

Chapter one provided information about the disconnect between African American student achievement and science education through the descriptions of social, legal, and educational changes in America over time. The chapter focused on the purpose of the study as well as the problem being investigated. The theoretical framework and conceptual underpinnings for this research study will be explored in chapter two.

CHAPTER 2:

REVIEW OF THE LITERATURE

In America, science performance had always been an elusive part of our history. From the era of Sputnik in 1957 to the present, the lack of performance in science for all students had puzzled researchers, teachers, students, parents, and communities. Scientific thinking was a primary source of understanding of the physical, biological, behavioral, and social world. Over the years, the NAEP scores for science have shown deficiencies especially among different ethnic groups. According to the National Center for Education Statistics (2010), trends were documented in the academic performance of America's students for over 30 years. Documenting trends in the academic performance of American students over time was one of the primary goals of the National Assessment of Educational Progress (NAEP). The reading, mathematics, and science long-term trend assessments were administered and reported multiple times during the last three decades (NAEP, 2011). In addition to NAEP scores, the Georgia Department of Education (2014) had seen a consistent lack of performance among African American students on the science CRCT scores and the biology and physical science EOCT scores.

As a science educator, I have noticed that students come to high school with a lack of preparation and organization skills. Students do not know how to put their thoughts on paper. Major gaps have appeared between the abstract and concrete thinking when students attempt to articulate these ideas on paper. Students also have critic

thinking and processing problems, especially in science (GADOE, 2014; NCES, 2012; NCES, 2009). According to Hyerle (1996) students' use of graphic organizers opened new avenues into the mindscapes of the students' thinking patterns. Students externalized and showed their interrelated thinking patterns on paper. So, why do African Americans struggle so much scientifically in education?

This literature review addressed the following areas: the historical perspective on African American education in science, the theoretical framework of constructivism, Ausubel's theory of meaningful learning, science literacy, and literacy strategies in science. After reviewing the literature in these areas, gaps were noted in the research that focused on how African American students' scientific performance had been improved by using any type of visual tools to support literacy in science. There were limited amounts of studies done in the area of literacy, visual tools, and African American students. This literature review identified the need for increased support for African American students that supported more avenues of literacy learning in science classes.

Science Education for African American Students: A Lack of Meaningful Learning

In 2009, because of the complaints and ineffectiveness of NCLB, President Barack Obama passed a new educational reform initiative. On February 17, 2009, President Obama signed into law the American Recovery and Reinvestment Act of 2009 (ARRA). This historic legislation laid the foundation for education reform by investing in innovative strategies that were projected to lead to improved student results and long term school/district gains (US Department of Education, 2009). The ARRA also provided $4.35 billion for the *Race to the Top Fund. Race to the Top* was a grant

program created to encourage and reward the states that were creating the conditions that fostered innovation and change, showed significant improvement in achievement, and implemented creative plans for the reform of education. One of the key improvements that this act highlighted was the increase in students' achievement scores on the National Assessment of Progress (NAEP) test in reading and math as well as the decrease in the reading and math NAEP achievement gaps among the different subgroups (National Center for Education Statistics [NCES], 2009). There were several subgroups that fell below the majority on the NAEP in reading and math; however, the African American subgroup was at the lowest part of the gap.

The National Assessment of Educational Progress (NAEP) was the only nationally representative and ongoing assessment that showed what America's students knew and applied in various subject areas. Assessments were given periodically in mathematics, reading, science, writing, the arts, civics, economics, geography, and U.S. history (National Center for Education Statistics [NCES], 2012). Even though African Americans had improved since 1973, the improvement was not enough to equal the scores of their White counterparts. In 1973, there was a 46-point gap on the math NAEP between 13 year old African Americans and Whites with African Americans scoring an average of 228 compared to Whites scoring an average of 274 (NCES, 2009). In 2008, there was a 28-point gap on the Math NAEP between 13 year old African Americans and Whites with African Americans scoring an average of 268 in comparison to an average of 290 scored by Whites (NCES, 2009). In reading, there were similar results. In 1971, 13 year old African Americans scored an average of 222 in comparison with an average

score of 261 scored by Whites. In 2008, 13 year old African Americans scored an average of 247 in comparison with an average score of 268 scored by Whites (NCES, 2008). On the 1973 science NAEP, 13 year old African Americans scored on average 205 in comparison with the average score of 259 scored by Whites (NCES, 2000). On the 2011 science NAEP, 13 year old African Americans scored an average of 129 in comparison with the average score of 163 for Whites (NCES, 2011). After analyzing the NAEP scores of African American students and White students, the gaps still existed today. African Americans scored the lowest on the NAEP in reading, math, and science over time. Many tried to figure out what was done because African American students did not perform well on national science tests or statewide science tests.

In Georgia, African American students lagged behind their white counterparts on the End Course Test (EOCT). The Georgia Office of Student Achievement (GOSA) reported in 2010-2011, 2011-2012, 2012-2013, and 2013-2014, that African American students scored poorer than any other ethnic group on every EOCT given (GADOE, 2014). The A+ Educational Reform Act of 2000, mandated that the State Board of Education adopted end-of-course assessments for core courses. With input from various educators, along with state board approval, end-of-course assessments were created. The EOCT's for Georgia assessed twelve content areas which include biology (GADOE, 2014). The purpose of the EOCT was to improve teaching and learning throughout Georgia's education system by aligning with Georgia's mandatory content standards to assess specific content knowledge and skills. The EOCT's also gave diagnostic information to facilitate the identification of students' strengths and weaknesses.

Improved teaching and learning were the main focus of Georgia's education system. These tests also provided data to judge the quality of classroom instruction on all levels of the GA education system. In 2011-2012, the EOCT became Georgia's high school accountability assessment as part of the college and career readiness performance (GADOE, 2014).

According to HB2722 Advisory Committee (2008), African American students needed rigor, relevance and relationships in order to experience meaningful learning. The instruction needed to be engaging and rigorous. The teachers and school leaders needed to consistently express high expectations for students. The curriculum connected the instruction to the assessment and the real world. More math and science needed to be correctly taught. There also needed to be more access to advanced placement and gifted classes for African American students. They needed teachers and leaders to connect them with the necessary skills to help them be successful. Ladson-Billings stated that African Americans students needed an environment in which they flourished to create experiences of meaningful learning. The environment had to be relevant to the world the students were used to. She called this theory cultural relevance (Ladson-Billings, 1995a).

According to Ladson-Billings (1995a) in order for African Americans to be successful there had to be a cultural relevance to what they were learning. She termed the phrase culturally relevant pedagogy. The notion of culturally-relevant pedagogy derived from Ladson-Billings (1995a), who provided the criteria of academic success, social competence, and critical consciousness as the foundations of a culturally-relevant pedagogy. Academic success had to be developed by the student. There were various

methods by which these skills were developed. All students needed numeracy, literacy, social, political, and technological skills in order to be an active participator within a democracy (Ladson-Billings, 1995b). Even though students struggled with other issues such as poverty, self-esteem, lack of motivation, students had to have a foundation that was rooted in academic capability. A student's academic capabilities stemmed from their abilities to think effectively and with a certain level of complexity. In order for African American students to excel academically in science, these students had to become a scientifically literate group of people.

African Americans made up less than 2% of practicing, PhD-holding scientists. This statistic had changed little since it was first reported by the National Science Board in 1977 (Maton, Hrabowski, & Greif, 1998). The focus that the science education community had placed on equity in science education suggested that there was a common interest in addressing this long-standing problem with the science courses taken (Mutegi, 2013). One of the main reasons for African American students' lack of involvement in engineering, math, and science was the lack of academic preparedness in grades K-12. As a result of this, African American college students failed to enter college with competitive grades or standardized test scores. This aforementioned problem led to missed opportunities for majoring in harder sciences such as physics, biology, and chemistry. Because African American students performed poorly in science, engineering and math, they usually encountered science instruction that was lackluster in comparison to those students who performed well in science, which in turn led to the low science preparation (Russell, 2005). Since African American students performed so poorly in

science, it compounded the problem of African American students constructing knowledge, having meaningful learning experiences, and effectively utilizing scientific literacy to perform better in the science field. The theoretical framework that guided this study addressed how this daunting task could be tackled through the theories of constructivism and meaningful learning.

Constructivism

The theory of constructivism, primarily cognitive constructivism, originated with Jean Piaget (Martinez, 2010). Constructivism lay at the root of many learning principles and had a major influence on educational thinking about curriculum and instruction. This thinking led to the notion that children investigate topics from a variety of multiple perspectives (Schunk, 2012). Within the classroom, teachers acted as facilitators instead of the traditional model as a disseminator of knowledge. There were two main branches of constructivism, social and cognitive. Both fell under constructivism because of the theorists' universal belief that children constructed their own knowledge. Piaget was the creator of cognitive constructivism, while Vygotsky was the creator of social constructivism. These two theorists laid a foundation for many other researchers within the constructivist field.

Different theories of constructivism changed over time. All of the theories, however, had something in common. The foundational characteristics of constructivism were the same. Knowledge was constructed rather than transmitted or obtained. Knowledge construction happened through the reflection. The learning process was aided by the mental capacities of the learner. The learners' mental capacities continue to

develop. Finally, construction of knowledge craves methods and pedagogies rooted in the theory of constructivism (Ahmad, 2011). Ahmad stated that regardless of the type of constructivism noted, in order to even be included as a type of constructivism, the aforementioned four major characteristics had to be present. Constructivism meant constructing knowledge or ideas. Students constructed these ideas by adding to what they already had mentally. In order to do this efficiently, a teacher had to use teaching methods that built a bridge between existing knowledge and new knowledge so that the constructivist thinking was fostered. The challenge in being a constructivist teacher in any content area was the content being taught was difficult if they did not already have some idea of the topic. Whatever topic was presented had to cause a student to see the relevance in their mind so that they fully understood what was being taught. Often times, many students had nothing to put forth. That was why being a constructive teacher led to creating a constructivist environment of learning for students to become constructive thinkers.

In order to increase students' abilities to construct meaningful knowledge, something had to be done to bridge the gap of the unknown to what was perceived. Literacy, because it focused on a multifaceted approach of reading, writing, and speaking provided the best way in which to teach biology and create constructive individuals. Piaget in his creation of this cognitive constructivism theory focused on the mental ability of a person and how that mental capacity developed in stages. The mental ability of an individual according to Piaget's actual theory of cognitive development occurred in four distinct stages. Because the four stages focused more on the developmental stages

guiding abstract thinking, Vygotsky proved to be the most influential theorist for my study. Vygotsky believed that abstract learning could happen at any age as long as a foundation was there along with an ability to socialize and learn more, thus making learning meaningful and relevant (Dimitriadis & Kamberelis, 2006).

For Vygotsky, the ability of humans to think critically was increased by the utilization of language. Vygotsky observed and researched children in order to obtain a deeper understanding of the critical thinking ability within humans. According to Vygotsky (1978), constructivism afforded humans with the ability to use language to provide supporting strategies in the solution of difficult tasks, plan a solution to a problem, overcome impulsivity, and master their own behavior. The cognitive and communicative functions of language then became the basis of a new and superior form of activity in children.

Vygotsky (1978) stated that when children were confronted with a problem that was slightly too hard for them, they exhibited a complex variety of responses. A series of related observations revealed that labeling was the primary function of speech used by young children. Labeling allowed the child to choose a specific object and separate it from the perceived situation. Research had shown that even the very young had links between language and perception (Vygotsky, 1978). Concepts in children were based on memories. This meant that a child's thinking depended on his memory. Very young children developed visual concepts. Children's thinking when they were required to reorder a relationship showed Vygotsky that the transfer of knowledge was nothing more than remembering isolated incidents and combining them.

According to Vygotsky (1978), "The most significant moment in the course of intellectual development which gives birth to purely human forms of practical and abstract intelligence occurred when speech and practical activity, two previously independent lines of development converge." (p. 24). This meant that higher order thinking occurred at its best when the child/student knew how to combine abstract images into speech that connected with doing a real world activity. Vygotsky spoke consistently of children's learning being based on mental maturity, not physical maturity as Piaget suggested. Vygotsky explained this mental maturity of children in his theory known as the zone of proximal development. According to Vygotsky (1978), the zone of proximal development characterized the mental place where instruction was most advantageous. This wealth of knowledge and theory explained by Vygotsky, piqued the interest of many.

Ausubel's Theory of Meaningful Learning

David Ausubel (1965) used Vygotsky's notion that children critically thought better when there was a combination of speaking as well as doing. Ausubel was a cognitive theorist who was greatly influenced by Vygotsky's work. Ausubel was one of the few cognitive theorists who provided a bridge between educational theory and practice. He was one of the few theorists who concurrently addressed curriculum, teaching, and learning issues (Biser, 2003; Mintzes & Wandersee, 1998; Novak, 2005). This research on meaningful learning was a subset of Ausubel's overall theory of assimilation.

Ausubel favored the teachings of Vygotsky as opposed to Piaget to support his theory of meaningful learning. Piaget neither regarded verbal symbols, after they evolved as internalized imitations, nor considered operational thought, after its developmental emergence as internalized action (Ausubel, 1965). In other words, Piaget focused on how the mental processes of children developed in stages. Piaget was not a proponent of critical thinking before the appropriate age. Because of this aforementioned belief, Ausubel aligned with Vygotsky because he did not believe in a set stage for abstract or critical learning. David Ausubel extended the cognitive constructivism approach with the addition of placing the mental images or thoughts into a concrete form in which the learner experienced meaningful learning. According to Ausubel (1965), new meanings were acquired when meaningful symbols, concepts, or propositions were related to and incorporated within an individual's cognitive structures (Schunck, 2012). How did this happen?

Meaningful learning happened when students constructed the knowledge and cognitive procedures required for successful problem solving. The focus on meaningful learning was aligned with the view of learning being the construction of knowledge which allows students to make sense of their learning experiences. In constructivist learning, students took part in active mental processing, such as focusing on new information relevant to them. Students also had to mentally organize the new information into a form that represented what they had learned. Finally students had to be able to connect the new information to the old by creating bridges of learning mentally and in concrete form through advanced organizers (Mayer, 1999).

According to Jonassen (2003), meaningful learning had several characteristics within a classroom environment. In order for the learning to be meaningful, students interacted within an environment where objects were manipulated. Students had to be exposed to activities that were constructive and reflective. Students did not only do an activity, but had to be allowed to write or talk about what went on in the activity to solidify learning. The activities or learning had to be intentional. This meant that there had to be a goal or reason for the students to learn the information. Not only was there a goal stated, but students had to be able to talk about their own learning goals and monitor their progress. Meaningful learning was authentic. Students' thoughts relied on contextual and real world problems. Finally meaningful learning had to be collaborative and conversational. Students had the opportunity to discuss problems and solutions with others (Ashburn & Floden, 2006). The combination of these criteria were essential for meaningful learning to occur.

According to Mintzes & Wandersee (1998), Ausubel's, a cognitive constructivist who favored Vygotsky over Piaget, theory of meaningful learning offered a number of concepts, when linked together that provided a framework for explaining a wide variety of unrelated events about teaching and learning. The most pivotal of Ausubel's concepts included the distinction between meaningful learning and rote learning. For Ausubel, meaningful learning was the spontaneous, substantive integration of new ideas into a learner's framework of knowledge. For this integration of concepts to happen, three criteria had to be met. The presented material had to have potential meaning. Secondly, the learner had to already possess relevant concepts to anchor the new ideas. Finally, the

learner had to choose to incorporate the new knowledge. If any one of these criteria was missed, then the possibility for rote learning to happen increased greatly (Mintzes &Wandersee, 1998). Ausubel made the clear distinction between rote learning in which the learner made little or no effort to integrate new concepts and propositions with preconceived relevant concepts and propositions, and meaningful learning where the learner sought to integrate new knowledge with relevant existing knowledge (Ausubel, 1965; 1968; Novak, 1998; Schunk, 2012). Learning was meaningful when new information aligned with relevant concepts in the long-term memory of the brain (Schunk, 2012). Meaningful learning also was dependent on the age, prior knowledge, socioeconomic status, and experiences of the individual.

According to Novak (1998) meaningful learning focused on more than the learner's thinking. Feelings and actions were also important. All three forms of learning—thinking, feeling, and action—had to be addressed. A positive educational experience enhanced a person's capacity for thinking, feeling, and/or acting. A negative educational experience lowered the human capacity. Humans engaged in thinking, feeling, and acting and it was these that combined to form the meaning of experience (Novak, 1998). According to Novak (1998) meaningful learning was a key concept that was both simple and universally known, but also very complex and never fully understood. What may be meaningful to one, may not be meaningful to another. So how did students become influenced to view the content we taught as meaningful? We knew that learning truly occurred to some people if it was meaningful or relevant to them. It

seemed as if it was a simple task to make learning meaningful. Often times it was not as easy as it seemed due to the different barriers or factors involved in teaching students.

Shared meanings of this concept of meaningful learning were facilitated by the active intervention of well-prepared teacher (Mintzes &Wandersee, 1998). As far as teaching and learning were concerned, teachers had to demand active participation, intensive interaction, and thoughtful reflection. These approaches may took the form of small, cooperative grouping, debate teams, one-on-one dialogue, demonstrations, or labs that introduced and attempted to resolve conceptual conflict, interactive technologies, and whole-class activities that gave context and encouraged meaning-making. Successful science was quality over quantity, meaning over memorizing, and understanding over awareness (Mintzes & Wandersee, 1998).

Constructivism and meaningful learning seem to have had a distinct connection that had not always been applied in the facilitation of learning. In order for learning to be constructed, students had to be able to mentally make connections and transfer them to concrete ideas. Utilizing constructivism and meaningful learning to aid in the instructional process of teaching biology easily appeared to be the right mix that African American students needed to perform scientifically. Since science was such a conceptual and abstract content, students had to be taught how to create mentally constructed ideas on paper from actual experiences to create meaningful learning. This process facilitated African American students in understanding the all so abstract and complex scientific content.

Ausubel stated that the sequential organization of subject matter, combined with the use of appropriate advanced organization, was very effective in the classroom (Novak, 2005). Advanced graphic organizers, such as Thinking maps, built a foundation for meaningful learning. Each new step of knowledge served as a foundation for future learning. Advanced organizers either were expository or comparative. The purpose of the advanced organizer was to trigger students' prior knowledge and connect the new information to the stored information by providing optimal support through the process of making learning meaningful and relevant. The advanced organizers, such as Thinking maps, were quite beneficial for students who had relatively poor verbal ability and less than average general or immediate background knowledge in the learning task (Ausubel, 1965). Evidence suggested that advanced organizers provided a conducive environment for learning and transfer (Ausubel, 1978; Faw & Waller, 1976; Mautone & Mayer, 2007). Advanced organizers belonged to a larger group of instructional strategies that existed under the auspices of literacy. Literacy strategies had the potential to operationalize Ausubel's theory of meaningful learning in the biology classroom.

Science Literacy as Meaningful Learning

What did it really mean to be considered scientifically literate? According to the American Association for the Advancement of Science (1989), a scientifically literate person was aware that science, mathematics, and technology were co-dependent human projects with strengths and weaknesses; understood key concepts and principles of science; was familiar with the natural world and recognized both its diversity and uniformity; and utilized scientific knowledge and scientific ways of thinking for

individual and social purposes (see also Bybee, Fensham, & Laurie, 2009). For several years educators were worried about the inadequate ability of children to read, comprehend, and critically judge scientific information. This reading comprehension deficit was emphasized by the American Association for the Advancement of Science Project 2061 (1989), which articulated an obligation for all students to gain knowledge of science, mathematics, and technology (International Literacy Association, 1994).

According to International Literacy Association (1994), scientific learning was improved through distinguishing what students knew about reading and writing. Teachers needed to focus more on the literacy parts of science so that students related the content better. Literacy was to be incorporated daily into the science instruction. Students that were struggling readers and writers had a hard time even reading science nevertheless understanding it. In order for students to be deemed scientifically literate, reading, writing, thinking, listening, and speaking literacy skills needed to be integrated daily within the science content. According to International Literacy Association (1994) comprehending science procedures, gaining science information, and conducting scientific experiments mandated the correct application of a plethora of literacy skills. Literacy-based instruction had maintained students' attention in science and expanded their knowledge through integrating science process skills with literature and literary process skills.

The National Science Education Standards (National Research Council, 1996) stressed the need for scientifically literate students who engaged in inquiry. Strategies for scientific literacy and inquiry were developed in a mutualistic way. Inquiry was not just

about doing hands-on investigations. It also included analyzing books and other pieces of information, planning investigations, formulating hypotheses and explanations, and communicating results. Scientific literacy was more than reading about science. According to Ebbers (2002), scientific literacy meant that a person asked, found, or established answers to questions that developed from curiosity about everyday experiences. It meant that a person had the ability to describe, explain, and predict natural phenomena. Scientific literacy involved being able to comprehend articles about science, the real world, and the engagement of the topics in everyday conversations.

Literacy posed as a major foundation of growth in scientific knowledge. Composed of facts, concepts, laws, and theories, the knowledge of science content was conveyed best through written and oral language. If there was no understanding of the language or literacy of science, then science remained a content area that was poorly taught, comprehended, and achieved. When students learned about science, they were not just learning science; they were learning the language of science (International Literacy Association, 1994). The more that students were able to apply to scientific processes that led to critical thinking and effective communication, the better they wrote, thought, and problem-solved.

Being literate produced effective comprehension and the effortless communication of ideas manifested through reading, writing, listening, speaking, and thinking. This literacy subsequently provided support for the development of the science process skills essential for obtaining knowledge and understanding the world. Learning in literacy and science then became give-and-take. Each area nurtured the other.

Integrating literacy activities within the teaching of science helped elucidate content concepts and offered a guiding formation for the application of science processes. Ultimately, the merger strengthened both science knowledge and literacy development (International Literacy Association, 1994). In order to integrate science and literacy, there had to be an effective tool utilized to make this possible. The literature reviewed spoke of trade books (Ebbers, 2002), increased reading variety and building vocabulary (Adams & Pegg, 2012; Ebbers, 2002; Fang & Wei, 2010; Fisher, Grant, & Frey, 2009; Hairrell, Rupley, & Simmons, 2011); incorporated literature circles (Devick-Fry & Lesage, 2010); increased writing in science (Adams & Pegg, 2012; Shelley, Rochwerger, Brigman, & Wood, 2006); and the utilization of science interactive notebooks (Chesbro, 2006; Waldman & Crippen, 2009; Young, 2003).

Science Literacy Strategies: Tools of Meaningful Learning

Herber (1970) did work that refreshed the view of the relationship between literacy and learning in the content areas of science, math, and social studies. After his work, many effective instructional literacy strategies were developed. Content literacy strategies were divided into three groups. The first group of content strategies was anticipatory tasks, which engaged the student, aroused curiosity, and activated prior knowledge. Examples of these strategies included any tasks such as Thinking maps or other visual tools and close reads that elicited students to build and apply background knowledge. The second group of content strategies belonged to those that were utilized for making vocabulary and conceptual connections. Examples of these strategies such as Cornell notes, interactive notebooks, Thinking maps and the KIM method for vocabulary

helped students organize information by generating questions and making connections through images, words, phrases, or sentences in order to link vocabulary to the actual concept. The final groups consisted of content strategies that included teaching methods used to transition their learning with others and on paper. Examples of this in science would include working in groups to do lab experiments, collaborating about different topics, and writing summaries/essays to solidify the knowledge learned within that group. Several studies were noted in which these content literacy strategies used effectively led to positive changes in student performance in reading and on standardized tests (Alfassi, 2004; Calweti, 2004; Fisher & Frye, 2008). For this study, all three groups of content strategies mentioned above were utilized to support meaningful learning.

Visual Tools and Thinking Maps

Visual tools offered an intrinsic view of patterns, interconnectedness, and interdependencies. Unlike physical models used for smaller or larger representations of abstract concepts, visual tools/models generate and unmask mental models of interrelationships developed by learners, along with the capacity of learners to create patterns (Hyerle, 1996). Concept mapping (Novak & Gowin, 1984) and Thinking Maps (Buzan, 2012; Hyerle, 1996) were directly supported by the concept of visual tools because these approaches offer common languages for all students in thinking about, interpreting, and displaying knowledge that was created mentally and then transferred to concrete forms. In order for students to be successful in any discipline, especially science, they had to learn how to think and make connections. Based on the research on the use of certain visual tools (Buzan, 2012; Hyerle, 1996; Keown, 2008; Novak, 1998;

Novak & Gowin, 1984; Ruiz-Primo and Shavelson, 1996), the visual tools provided a way to improve student understanding of difficult science concepts.

According to Hyerle (1996), the most familiar name utilized for visual tools had been either semantic maps or graphic organizers. A concise definition for graphic organizers was organized visual tools under three categories, each with subcategories: (a) brainstorming webs, which included mind mapping, clustering, and webbing, (b) task-specific organizers, which included life cycles, text structures, flow maps, and decision trees, and (c) thinking process maps, which included concept maps, thinking maps, and Vee maps. Visual tools, as their proponents argue, were deeply rooted in constructivist theory and concept learning (Novak & Gowin, 1984).

Concept learning happened in two ways, concept formation and concept assimilation. A concept was a mechanism which enables categorization of different things into the same class (Anglin, 1977). A concept exists whenever two or more distinguishable objects or events were classified together a set apart from other objects or events. A concept was a hypothetical construct which consists of all the knowledge an individual possesses about a category of objects or events (Schunk, 2012; Anglin, 1977). Concepts were units of thought that constitute belief, theories, and mental representation (Carey, 2009). Novak (1998) defined a concept as a perceived regularity in events or objects, or records of events or objects, designated by a label. Children's conceptual abilities were quite similar to those of adults. The differences seemed to be largely related to differences in experience, domain knowledge, and processing ability (Murphy 2002).

According to Nelson (1974) children formed concepts in four steps. First, the child identified an object. Second, the child identified the important connection of an object, assigning individuals based on their functionality to synthesize the concept. The third step involved the identification of new concept examples by observing the important characteristics of members included in the concept (Nelson, 1974). This was the step where children moved from concept formation to concept attainment (Anglin, 1977). The fourth and final step happened when the child attached a name to the formed concept (Nelson, 1974). In order to form a concept, an idea had to be created. The idea was not a simple creation, but a journey of complex steps. Once these concepts were created, then children needed a way to formulate these thoughts on paper. In order to visually facilitate concept learning, students utilized different graphic representations intermingled with organizations of thought. The best example of this was the Thinking map.

According to Hyerle and Piercy (2004), Thinking Maps were based on the eight foundational thinking skills identified by early psychologists such as Piaget, within many generations of tests of cognitive skills, and present cognitive scientists as basic cognitive structures for thinking, language development and learning. Each of the maps had user-friendly names, but similar definitions drawn from original definitions. From the viewpoint of language use, the cognitive roots were exposed: the eight parts of speech were the pieces for generating "language" that were co-dependent with cognitive patterning such as categorization, comparatives, causality, attributes, etc. The eight Thinking Maps were the links connecting the language use to the deeper, complex, overlapping patterns of thinking that existed in students' minds.

The eight maps were listed as follows: Circle Map, Bubble Map, Double Bubble Map, Tree Map, Flow Map, Multi-Flow Map, Brace Map, and Bridge Map. The circle map was utilized for defining in context. The bubble map was utilized for descriptions using adjectives. The tree map was used for classifying information. The flow map was used for sequencing information. The multi-flow was used to show cause and effect relationships. The brace map shows part to whole relationships. The bridge map shows relationships using analogies. These maps always had a frame of reference where the students placed the source of their information. These maps were combined or used alone (Hyerle & Pierce, 2004). Thinking maps were unique in that they transcended more than one group of content strategies. Thinking maps embodied the mutual visual language teachers and students utilized to generate and consolidate prior and new knowledge, reflected on one or multiple series of events, characterized and contrasted story elements, as well as recognized cause and effect (Spiegel, 1999).

Close Reads

Reading was necessary for all to be successful. If you could not read, it was very hard to function in society. Reading was a foundational form of your mind at work (Paul & Elder, 2006). Close reading was the process of removing and adopting the essential meaning that was implied in a text. It was a constructive task and a reflective thought process that delved into the author's purpose (Cummins, 2012; Feaman & Geldermann, 2014; Fisher & Frey, 2008; Paul & Elder, 2006). When teachers taught close reading, there was a focus on reading the text at least three times. Students were taught how to

annotate or mark the text with lines and symbols to increase the analysis of the article (Fisher & Frey, 2008).

There were five levels of close reading. Level 1 referred to paraphrasing sentences which then connected to explicating paragraphs or level 2. In paragraph explication, the main idea was stated, the paraphrased sentences were elaborated, examples of the meanings were given, and metaphors or ideas were generated. Level 3 focused on the analysis of the text in which specific text dependent questions were answered. Level 4 was the level in which the reading was assessed by answering questions about the author's purpose. Finally roles were played to further solidify the understanding of the text (Paul & Elder, 2006).

Science Interactive Notebook

The interactive science notebook was a perfect opportunity for science educators to encapsulate and promote the most cutting edge constructivist teaching strategies while simultaneously addressing standards, differentiation of instruction, literacy development, and maintenance of an organized notebook (Chesbro, 2006). The interactive notebooks were such a fantastic tool for science because they gave students an opportunity to create a portfolio of their work. The notebooks were home to various activities, and were teacher and student directed. At its best, an interactive notebook provided a diverse set of approaches to produce a personal, structured, and documented learning record (Waldman & Crippen, 2009).

Science interactive notebooks were a tool utilized to solidify students learning through more student participation. The notebooks were used daily in class to help

students think deeper. This tool utilized both the right and left hemispheres of the brain to facilitate sorting, classifying, and implementing new knowledge in a creative manner. The notebook was divided into right and left pages of information. On the right side of the notebook, students placed information only given to them by the teacher. Examples of this information ranged from Cornell notes to vocabulary. The left side was the side that students put their thoughts. Examples of the information that would go on the left ranges from visual tools to self-reflections. The notebook not only offered advantages to the student, but was beneficial to the teacher as well.

The interactive notebook deemed to be important because of various reasons. It provided constant communication between the student and the teacher; allowed students to model actual scientists' behavior of writing down information, figures; and became a reference for every unit of study (Young, 2003). According to Gilbert & Kotelman (2005), there were five good reasons to utilize science notebooks. The interactive notebooks served as thinking tools, guided teacher instruction, enhanced literacy skills, supported differentiated instruction, and fostered teacher collaboration. The power of an interactive notebook dwelt within students through the processes of engagement, common sense, and metacognitive behaviors.

Working with the interactive notebook, students began to value instruction that made sense. The students also began to become attentive to the knowledge and skills essential for managing their learning. This in turn allowed students to become confident and focused, thereby improving their achievement. Students valued their interactive notebooks because they became personal self-reflective journals. Teachers loved them

because the notebooks were representative of a method used to help students become scientifically literate (Waldman & Crippen, 2009).

Cornell Notes

Cornell notes were developed by Walter Pauk at Cornell University. Pauk originally created these notes as a study tool because he noticed that his students were not retaining and learning information as they should (Pauk, 2001). Cornell notes had to be a conversation between the student and the information given by the instructor. According to English (2014), Cornell notes appealed to both the visual and the auditory learner because the notes work with both text and space on the page. The learner that benefitted the most; however, was the kinesthetic learner because the notes allowed a hands-on process through the manipulation of space on the paper. The notes actively engaged the student in a process centered learning pattern. With the Cornell notes system, the paper had to be divided into three sections. There was a vertical line that separates the paper into right and left sections with more space available on the right side. There was a horizontal line drawn to separate the bottom section from the top leaving about three to four lines in the bottom section. The keywords, topics, generated questions belonged on the left side. The lecture notes given were placed in the right section. Underneath the right and left sections was the summary section. The Cornell note taking method consisted of the six R's which were record, reduce, recite, reflect, review and recapitulate.

While the lecture was being given, the student was to record the information that they thought was beneficial. Once the information was reduced, the student was to

reduce the notes by placing generated questions, key words, or topics in the left column. After information had been recorded and reduced, the student was then to recite the information by studying and talking through the notes. The reflection part of this took place after the aforementioned r's had been covered. The student was to write their own thoughts and how they connected to the facts. The student was then to review at least 10 minutes daily to maintain what had been learned. Finally in order for all to be solidified, the student had to recapitulate or summarize their notes in paragraph form at the bottom of the notes (Dole & Taggart, 2012; Kruse, 2011; Pauk, 2001; Pearse & Walton, 2011).

One benefit of Cornell notes was the motivation given to students to understand why the collected information was important. Another benefit pertained to the opportunity for students to engage in critical reflection which allowed them to make connections, meaning, and sense of what they were learning. Basically Cornell notes placed students' learning at the forefront of the construction of knowledge process (Burns & Sinfield, 2012).

KIM Vocabulary

Teaching vocabulary had never been just for English teachers. All teachers have had to teach vocabulary in one form or another. Vocabulary was the critical piece of students' comprehension of concepts within all content areas especially biology. Biology had always been full of thousands of strange words. In order for biology to be understood, the language of biology had to be understood. Science texts had become more and more difficult to read. According to Young (2005) vocabulary needed to be connected to inquiry based strategies that when given to students increased their

understanding of the content. Engaged vocabulary strategies were utilized to facilitate the connection between language and prior knowledge within that content. Without vocabulary comprehension, science remained misunderstood by students.

According to Cohen & Johnson (2012), the enhancement of vocabulary was linked to imagery. When students created or found images that connected to vocabulary, they remembered the words because they had something tangible to connect to the word. As students created images, the depth of understanding and processing was increased because drawing required careful observations of objects in detail. The KIM method of vocabulary aligned with the combination of text and imagery. KIM stood for keyword, information, and memory cue. The keyword was the vocabulary word while the information was the definition from the text, notes, or student created based on information. The memory cue was a picture or image that helped the students remember the vocabulary word being used. Research from various studies have solidified the benefits of vocabulary strategies to promote text comprehension and content understanding (Cohen & Johnson, 2012; Fisher & Frey, 2008; Fisher and Frey, 2009; Nixon, Saunders, & Fishback, 2012; Young, 2005).

Writing and Collaboration

Literacy strategies had never excluded writing. Writing pulled everything such as Cornell notes summaries, vocabulary comprehension, close reading, Thinking maps, and collaboration, together. If students had not displayed the ability to write about the concept, they probably have not grasped the concept of what had been taught. In science writing was always included. The writing focused on not only essays, but lab reports,

notes, vocabulary, and reflections. The push from Common Core had caused another shift in the science curriculum. Expository essays, persuasive essays, and close reading summaries had now been included in the science curriculum. The goal of the Common Core and Next Generation Science Standards was to incorporate more technical writing in addition to more reading, speaking, and writing within the science classroom (Kendell, 2011; National Research Council, 2013).

According to Moogalian (2012), writing had to be done in order for students to enhance their learning within the science classroom. Vocabulary improvement, comprehension increase, connections between concepts, improvement of the comprehension of lab investigations and development of processing were all things that the writing helped. Ediger (2012) claimed that writing was an essential skill in the science classroom. Lab reports, essays, summaries, notebooks, were all things mentioned utilized to continue to build writing skills and enhance learning.

In a study done by Merten (2015), she and a group of her colleagues worked together to align writing and reading in science and other content areas. The study that they did, incorporated different literacy strategies collaborated together to achieve the expository essay as the end product. First students were taught how to annotate text. Next teachers introduced students to the Cornell notes. They taught the students how to correctly take Cornell notes in order to guide them to think deeper. The next phase of this afforded teachers the opportunity to teach students about the Thinking map and how to utilize the maps to organize ideas for their essay. All of these literacy strategies were kept in the students' notebooks. Once the teachers had completed the unit integrated with

different strategies to help children write, the students produced the expository essay as a culminating project. Writing was infused throughout every literacy strategy in order to solidify what students knew or not.

Summary

This literature review gave an overview of the history of African American students' achievement in science and described how the theoretical framework of constructivism informed the use of Ausubel's theory of meaningful learning. Furthermore, the chapter detailed how meaningful learning could be operationalized through the use of content area literacy strategies. The next chapter describes the case study methodology used to conduct the study and gives an inside look into how Ausubel's meaningful learning theory and literacy strategies were investigated in the setting of a high school biology classroom.

CHAPTER 3:

METHODOLOGY

Although the gaps between African American and Whites have decreased, the rates at which the gaps have decreased proved to be minimal. There was not enough closure between African American and other ethnic groups that proved that African Americans were becoming more scientifically advanced. The purpose of this qualitative study was to investigate African American teachers and African American students' perceptions of the effect of the utilization of literacy strategies as tools that influenced success in literacy within a biology classroom. Science literacy strategies were used to create a learning method or tool that educators could use to engage the minds of African American children. The methodology section addressed the following areas: (a) statement of the problem, (b) research questions, (c) setting, (d) population sample/participants (teacher participants; student participants), (e) data collection (interviews, participant observations, field notes, document analysis), and (f) data analysis (coding, emerging themes across participants), validity, and limitations

Statement of the Problem

This study utilized Ausubel's (1965) theory of meaningful learning to investigate the perceptions of African American high school students and teachers in the area of literacy within a biology classroom. The problem investigated stemmed from the

continual poor performance of African American student on national and state assessments.

Research Questions

The following research questions guided my data collection and analysis:

1. How did literacy strategies affect the performance of African American students within the biology classroom of a Title I school?
    a. How did African American teachers perceive the effect of the incorporation of literacy strategies on the science performance of African American students and their meaningful learning experiences within a biology classroom?
    b. How did African American students perceive the effect of the incorporation of literacy strategies on their meaningful learning experiences and science performance within a biology classroom?

Case Study Design

According to Mertens (2010), Lincoln and Guba recommended that qualitative methods be utilized for the research studies done within the paradigm of constructivism. This qualitative study was done to broaden my understandings of students' and teachers' perceptions of the interactive notebook and its effect on the learning of African American students in biology. In this qualitative study, the sample of participants were recruited from a class that was already intact. Because of this type of nonrandom sampling, the study consisted of participants pulled from a convenience sample (Lodico, Spaulding, & Voegetle, 2006). This study highlighted two African American teachers' and eight African American students' perceptions of the effects of the incorporation of science

interactive notebooks on the science performance of African American students in biology. The type of qualitative research that was employed was a case study.

According to different researchers of the case study method (Creswell, 2007; Yin, 2009; Mertens, 2010), case study research included the study of an issue explored through one or more cases within a bounded system. A case study was a qualitative design study that also provided inquiry into the problem. Generally, case studies were the preferred method used when posing research questions that began with why or how; the researcher has limited control over what happens, and the focus was on a contemporary problem within the real world (Yin, 2009). An effective case was built by collecting multiple sources of data on the individuals being studied. A case study design was most appropriate for this research because the environment in which students' learned and their academic performance in the science classroom were undividable (Yin, 2009). According to Mertens (2010), a case study method allowed the investigator to explore a single case, recounting specific details, in order to understand the experiences of these high school science students. Each experience was described in a way that showed how the context influenced student performance.

In my case study the problem being investigated centered on the perceptions of students and teachers pertaining to the incorporation of literacy within a biology classroom. The investigation of this problem led to the determination of the literacy strategies and its connection to meaningful learning experiences. A case study design proved to be the best because my research question asked "how." I also had little control over how the classes were put together, the operational run of the day, or the content that

I taught. Finally, the case study method proved to be the best fit for my study because I had to observe in the real world setting of my classroom. This case study method allowed me to build a substantial case to answer the posed research question with the triangulation of data through interviews, class observations, and student work samples. I felt that in order for me to truly understand students' perceptions, I had to immerse more in their world. Even though I did this daily, building a case with deliberate data afforded me the opportunity to really comprehend and observe meaningful learning that took place.

Setting

District and School Setting

This qualitative study took place in a high poverty, urban district in the Southeastern United States. According to the US Census Bureau (2015), the population of the city where the study took place was estimated at 154,721 in 2013. Forty-three percent of the population consisted of Whites whereas 53.4% of the population consisted of African Americans. Eighty-two percent of this population earned a high school degree while only 22.5% of the population has a bachelor's degree or higher. The median income in 2013 was $37, 550 which connected to the poverty rate of 24.9%. Even though it seemed to be a small percentage living in poverty, it exceeded the state and national percentage. One of the groups in poverty was children below the age of 18.

This city consisted of 25.3% of children below the age of 18 which equated to about 39,144. Out of this youth population of 39,144, 13,735 or about 35% of youth existed in poverty in 2011. In 2012, the population of children in poverty increased to

15,891 or 39.7% in comparison with the state percentage of 14.3% (US Census Bureau, 2015). These percentages of children under the age of 18 affected the effectiveness of the school district greatly.

The school district in which the investigated school existed had a great history muddled with some recent downfalls due to inconsistencies in leadership, high discipline rates, low graduation rates, and a looming perception of being an inadequate school district with a high rate of qualified teacher attrition, and a transient student population. The school district consisted of 28 elementary schools, 6 middle schools, and 7 high schools. Out of the 41 schools, all 41 received Title I funding which served as the funding for the economically disadvantaged students. If every school in the district was Title I that meant that this district was full of students who were economically disadvantaged or below poverty (Department of Education (GADOE, 2015). This picture was very much indicative of what most of the schools mirrored in the county.

As of 2015, the school under investigation consisted of 1154 students of which 13 were Asian/Pacific Islanders, 3 were American Indian/Alaskan, 1022 were African American, 27 were Hispanic, 13 were multiracial, and 76 were White (National Center of Statistics, 2015). One hundred percent of the students were listed on free/reduced lunch partially because of the Federal Community Eligibility Provision (FCEP). Under this provision, schools that served low income students were allowed to offer free, nutritious meals to all (USDA, 2015). Before this provision was enacted, the school under investigation still had 86% of the population eligible for free and reduced lunch.

The school that I investigated was the same school in which I had been teaching since 2012 This school was in a state of emergency when I entered in 2012-2013, There had been a mass exodus of staff which included the principal, both assistant principals, and 42 teachers. The graduation rate had dropped to 46%. With the school being taken over by a new administration and new teachers, there was quite a bit of work to be done. The school, at the time of my entrance, was filled with over-aged students who were not really interested in school. Several of the students were 18 years of age with only one credit hour. There was a culture and climate that was non-conducive to learning.

After one year of new leadership, the school began to transform. We applied for a SIG grant and received it in 2013. This was the beginning of something special; however, there was still much work that needed to be done from pumping up the graduation rate to increasing passage rates on end of course tests. In the science department, biology was the only course, at the time I got there, that was attached to an end of course test. We only had one advanced placement science class which was advanced placement environmental science. Even though most of the school suffered from a culture of high rates of discipline, the science hall represented the eye of the storm because it was very peaceful. By 2015, the school had implemented PBIS (Positive Behavior Intervention System), Thinking maps, AVID, consistent rules for discipline and a fully staffed building. We were also in the process of becoming a STEM certified school of excellence. We had been in SIG for 2 years and it has caused our culture and climate to begin a transformation. We were given a fearless leader, who took chances for

the betterment of the children and staff. Even though the school's culture was changing, some classrooms were still in limbo.

Classroom Setting

As a science educator and current researcher, I dealt with performance gaps on a daily basis. Teaching in a county that had a high poverty rate had forced me to notice that students came with a lack of preparation in science, literacy, critical thinking, and organization skills. Students did not know how to represent their thoughts on paper. Major gaps appeared between abstract and concrete thinking when students attempt to articulate their ideas on paper. As a science teacher, I observed that students also came with critical thinking and processing problems in science. According to Hyerle (1996) students' use of graphic organizers opened new avenues into the mindscapes of the students' thinking patterns. Students externalized their thinking and showed their interrelated thinking patterns on paper. This process allowed the teacher to see the thinking patterns of students including what was understood and not understood. When I investigated the actual foundation of graphic organizers, I found that graphic organizers were tools used to increase literacy in different content areas (Fisher & Frey, 2012; Hyerle, 1996; Manoli & Papadopoulou, 2012).

Literacy encompassed reading, writing, and communicating (Fisher & Frey, 2012). Literacy had become increasingly important with the introduction of the Common Core Standards as well as the Next Generation Science Standards. There was a necessity to make sure that educators were equipped with the best research, reflective on their practice, and dedicated to teaching and knowing and reaching their community of

learners. In 46 states, teachers had been given the task to correctly implement the Common Core Standards. With the task of implementing Common Core, teachers, including myself had been asked to increase the rigor in instruction, the use of resources and assessment, and the promotion of higher order thinking in all classrooms daily (Herrera, Perez, Kavimandan, & Wessels, 2013). The Common Core Standards required that all students be able to comprehend texts of steadily increasing complexity as the students went through school (National Governors Association Center for Best Practices [NGA & CCSSO], 2009). In order for this to happen, more reading, writing, and speaking in the content areas took place. More reading, writing, and speaking within the science classrooms eventually led to a class that was literate in science or any content.

At the beginning of the Common Core implementation until now, still many questions remained unanswered. According to Fisher and Frey (2008) by the time students reach the age of 17, only one in seventeen could read and understand specialized information such as the type found in the science section of a local periodical. This was quite alarming to see in writing; however, I knew that students were not graduating scientifically literate. In order to aid my students in the process of becoming literate in science I incorporated the utilization of a science interactive notebook.

I was first introduced to the interactive notebook at conference that I attended as a middle school teacher. This idea seemed interesting, so I tried it with my middle school classes. The notebooks were beautifully done, but still there were no significant results on the local or state assessments. Students were doing what I asked them to do in the notebook; however, they were not thinking, I was. I toyed with the idea of not doing the

notebook anymore. I took a step back from the notebook and reevaluated my choices for students. Leaving middle school and becoming a high school teacher changed my thoughts about the incorporation of an interactive notebook. These students needed help maintaining all of the information given to them as well as a place to store and maintain the information. So, the journey again began.

I wanted to incorporate the notebook with my high school students, but I knew that I had to do several things differently. After attending an Advancement Via Individual Determination (AVID) conference, the mystery of the interactive notebook began to unravel. I now, after 7 years of incorporating the notebook, had figured out how to make the notebook become a literacy strategy which included other literacy strategies and connected deeply to student understanding. AVID for science enhanced my thought processes not only about the notebook, but about other content literacy strategies as well.

AVID brought research-based strategies and curriculum to educational institutions in elementary, secondary, and higher education (AVID, 2015). AVID convinced me because of the best practices that were implemented through their program. Interactive notebooks existed as a part of their best practices. AVID supported the idea that every student needed not just a notebook, but an interactive one. The interactive notebooks looked a lot like the ones I implemented earlier in my career; however there were some fundamental differences. One of AVID's, main focuses derived from writing, inquiry, collaboration, organization, and reading (WICOR). This made all the difference in the world. The notebook now took a meaning because the WICOR strategies were in combination not in isolation. This was literacy. AVID also provided activities to align

with WICOR and methods for getting them done within a science classroom setting. It was here that I finally learned how to correctly implement Cornell notes, reflective writing, close reading, Thinking maps, lab experiments, and collaboration. I now zoned in on what my focus needed to be for this study and due to the requirements of Common Core for science, what I had just learned aligned with Common Core's requirements for students to participate in reading texts by varying levels of complexity, writing persuasively and informatively, and communicating with evidence (National Governor's Association, 2010).

Now I realized the power behind correctly implementing the interactive notebook. The interactive science notebook provided an ideal opportunity for science educators to summarize and uphold the most cutting edge constructivist teaching strategies while at the same time addressing standards, differentiation of instruction, literacy development, and preservation of an organized notebook as scientists do. Students then had an enclosed notebook encompassing all of their learning during the year (Chesbro, 2006). The interactive notebook included literacy strategies such as KIM method vocabulary which included the keyword, information, memory clue and sentence as well as Cornell notes, scientific articles, written responses, and visual tools also known as advanced graphic organizers which offered the opportunity to increase literacy in science and any other content.

Because I was new to this school, when I first arrived, I had to quickly set up a culture of high expectations for all. After the first semester, students knew who I was and what I was about. In my classroom, students were actively learning through different

researched best practices such as labs, group work, writing, and reading. Daily when students walked in, the date, biology performance standards, the opening, the work session, and closing were posted on the board. This ensured that the students knew what they did for the day. One of the best methods of classroom management depended on structure. This structure became a habit and if there was a day that I didn't post the schedule for the day, the students asked about the schedule not being posted. Students always expected different activities on a daily basis because I believed in utilizing various methods to teach biology.

Population Sample/Participants

This qualitative study consisted of two African American teachers, one of which was me, and 12 African American students chosen from the representative sample. Of the 12 African American students chosen, only 7 students participated in the interviews. The other students did not bring back permission slips, had a high absenteeism, or refused to do the interview. The high school studied closely resembled the demographics of the district which was a good indicator that it was a representative sample in which to be researched. The study investigated my perception as well as another African American teacher's perception of the impact of incorporated literacy strategies. My classes ranged from AP biology, gifted/honors to regular biology. The students chosen to be interviewed for this study were chosen because of their initial responses to an introduction activity in biology, their placement in a regular biology class, as well as their data from prior science state assessments. I also chose these students because quite a few of them had been written up by others due to behavior and academics. The additional

teacher chosen to participate in the study was chosen due to her extensive knowledge concerning literacy and teaching African American students.

When researching my new classes, I discovered that most of my students within my two regular biology classes with the exception of about 5 had consistently failed the science CRCT in 6th, 7th, and 8th grade as well as different End of Course Tests (EOCT) that they had taken. I discovered analyzing a chart that I created to determine which students were going to put in the study. The first thing that I noticed was that all of the students had met or exceeded on the reading CRCT, but all of the same students failed the 8th grade CRCT in science. This was shocking to see on paper. Other educators were quick to say if students could read, they could pass the science CRCT. Well I now had the evidence that proved otherwise. I had to find something that I thought would facilitate the learning of science through literacy. While I researched different topics, I ran across a few such as the interactive notebook and other literacy strategies that I recently had been re-exposed to at the AVID conference. I finally decided to incorporate the use of science interactive notebooks again, only this time it was with high school students, and I had a better grasp of what and how to do things more effectively.

While observing these students at work, I noticed that they lacked organization of information physically and mentally. This problem led to the idea about the effect of the incorporation of interactive notebooks with literacy strategies on the understanding of biology concepts. These classes were already created by the district and I had no control over the class selections. Because the high school utilized seven period scheduling, each class received 50 minutes of science instruction daily. The IRB for Mercer, the principal

of the high school investigated, and the school district in which the high school existed had approved this research to occur with these students in the allotted amount of time.

Participant Vignettes

Researcher Qualifications

For this study, I was the researcher and a teacher participant. Not only had I observed, interviewed, and analyzed student work, but I also was the teacher and allowed my perceptions to be refined throughout this process. My students as well as their parents received verbal and written communication that their participation or lack of participation in my study would not affect their grade. Parents and students were also informed that their participation was strictly voluntary and was going to be used for the enrichment of African American students just like them. I interviewed students one on one so that I could have rich conversations with them. Each interview was recorded to make sure that was no bias. I also incorporated various methods of data collection to strengthen the validity of my study.

The implementation of science literacy strategies, especially the interactive notebook, proved to be an essential part of my biology class. During the two week observation period, students were observed using their notebooks religiously. Out of the 8 students that I observed for two weeks 7 of them used the notebook every day. One of the 8 students usually did nothing until I prompted him to do so. When the students walked in, all of them honed in on the opening part of the lesson. All 8 knew that the opening belonged on the left side of the notebook behind the unit that we were covering at that time. Students wrote vigorously about the topic addressed on the smart board. I

then, allowed them to read what their thoughts were from their notebook. I really saw the notebook transform into a journal of meaningful learning and literacy within my biology class.

The Literacy Guru Teacher, Mrs. Lindsey

Mrs. Lindsey had been a teacher for 28 years. She was certified in reading and special education. She understood what it took for students to learn and sometimes struggles with the low achievement of African Americans within a science classroom. Although she was not science certified, she learned a lot by teaching alongside me for two years within the science classroom. Although we no longer collaborated together, she still offered me a variety of literacy strategies that sought to improve the literacy of African American students in science. She was certified as a teacher support specialist for the county and knows what good instruction was and how to get students to be successful. Good instruction took place when a teacher used a variety of methods to make learning meaningful to students. Not only did the teacher direct instruction, but the teacher created an environment that allowed students to construct their own knowledge and deepen critical thinking.

We first met in 2005. She was a special education teacher, and I was a beginning teacher to a new school. She had been there for a while. We did not interact much because we were in two separate buildings. Fast-forwarding to 2011, we met again. This time she was my collaboration teacher in my biology classroom. Even though I was in a new environment, we remembered each other from previous settings. She became my collaboration teacher the second semester at the high school where the study took place.

It was then that I finally got to see, first-hand, her desire for literacy and helping students be successful. She always broke down reading passages with the students as well as encouraged them to write and do vocabulary activities. She would consistently sit with special education and regular education students alike to ensure that the harder concepts in biology were understood. When the results came back, she and I had been successful in making sure that at least half of the special education students in the class passed the EOCT. The next year that I was favored to have her, allowed the next biology class to be graced with her literacy knowledge. Her presence and working knowledge in literacy helped to improve the students' attitudes and skills pertaining to the literacy in science.

Angel, Miss Fashionista

Angel was a 16 year old young lady who with the exception of the 8th grade science CRCT, passed science CRCT consistently. She was very vocal in the classroom and loves to participate. She was very goal-oriented. She described herself as classy, ambitious, and outgoing. Her best experience in science was passing her science final exams and doing group projects instead of book work. Her goal for biology this year was to pass the class and learn new things.

On the first day of school, I remembered looking at this class in particular. I remembered every students' expression and demeanor. Angel always had a smile on her face and an eager look in her eyes. She was a picture of neatness, style, and finesse. Unknown to her, I saw her as a perfectionist because of the effort and money she spent in all of her projects and work. Everything she did had been the best. This young lady for the most part had proven to be a cooperative member of the class, but as with any

teenager, life as a student sometimes became secondary to the social drama. Angel wanted to be seen because she always entered in a pageant or some type of superlative because she craved the attention. Because she always craved the positive, this attitude carried over in biology. She was the one that immediately told me to get my retest ready because she stayed in tune with the idea that studying sometimes did not work out the way she wanted it to.

Kris, Undercover Achiever

Kris was 16 years old. He seemed to have a zest for learning. With the exception of the 8th grade CRCT, he had consistently passed the science CRCT. He described himself as eager, a learner, and an epic dreamer. His best experience in science was in middle school. His goal for biology was to exceed in the class and receive his credit.

While researching my students for the 2014-2015, my first impression of this student was one of a thug who wanted to cause nothing but trouble within my classroom. Boy was I wrong! This young man, although he didn't want anyone to know he had ability, was quite intelligent. Did he apply himself daily? No, but he did just enough to get by. In several conversations with him, I expressed to him the needed to speak up more in class and to get rid of the persona of being an unintelligent trouble maker. In the following weeks, he began to speak up, with the right answers of course. He did not do all of his assignments for biology. I didn't believe that it was because he couldn't, it was just because he was satisfied with just enough to get by. On certain days depending on what activities were going on, I recalled him slyly leading a group or helping others that

didn't understand. Ironically one of his favorite places to go when I allowed them time to work on things, was the library. Go figure!

Michael, Grandmother's Grace

Michael was a 17 year old male student who suffered from a chronic disorder that affected the way he thought. He had consistently failed all of his science CRCT's. He liked to do just enough to get by or nothing at all. He was used to laying his head down and not working or being silly. He only came to life when he was doing group work because he loved to socialize.

Michael often times just sat in class doing nothing. He tended to connect better when labs or other hands-on activities were taking place. He barely did any work, and if he did, it took him all period to complete half of a task. Because he had a chronic disorder, he was on a special plan that had been followed in order to ensure his success. All of this aside, Michael's saving grace was his grandmother. One of the first parent conferences of the year that took place was with Michael's grandmother who stated that she had gotten him this far by meeting all of his teachers and showing herself as a concerned parent. Even though Michael did not live with his grandmother, she played a substantial part in his life and his education. Many times Michael expressed disdain for his grandmother because he once told me that he could do things himself.

In all actuality, after being around him for about 3 months, I knew that to not be the case. He needed all the help he could get. If it were not for her, he would not be passing at this point. We emailed constantly about his work and his notebook. She stated to me that his notebook provided a way of keeping her informed about biology. She

sometimes got very frustrated with Michael, but she stated that she would not give up until he walked across that stage.

In conversation with Michael, I told him that at some point he had to want this education for himself. He candidly stated that he wished that we would all let him be him. After that I asked him, just who was that and what was he going to look like? He smiled and said, you will see. From that conversation, Michael tried desperately to do things in class, but just could not stay focused for more than 3 minutes. I had to set time limits for him in order to get any work from him. It had become a habit for me to continuously call his name about every three minutes. I had to frequently check his work. Whatever he failed to complete, his grandmother caught on our gradebook database and emailed me for help. I explained what he needed to do, sent the activity and extended the deadline. This was a continuous cycle that we used for Michael.

Briana, Miss All About Me

Briana was a 16 year old female who failed the science CRCT in 2012, 2011, and 2010. She described herself as intelligent, loving, and hard working. Her best experience in science was in elementary school. Her main goals for biology were to stay focused, listen, and take lots of notes.

Because I had already researched my students, I knew what I was getting with Briana. Mind you, I believed in fresh starts, but I also believed in knowing the students you were serving. This young lady had a history of defiance and disrespect that spanned over 6 years and 3 schools. She was highly misunderstood or so I thought. After meeting her for the first time, I quickly figured out that this young lady was much smarter

than what the data showed. However, I also figured out that her behavior hindered a lot of opportunities that she had to be successful.

Our relationship was a rocky one simply because every day was a different day with Briana. Some days she was the sweetest student in the class and other days, I just wanted to avoid her altogether. I noticed that when I didn't engage her behavior by arguing back with her or getting on her level, she lashed out. She cringed when I just looked at her and said the words high expectations. She was one that wanted all of the attention and wanted me to immediately be at her beck and call. She felt that it was all about her, and that she was the most important. Any deviation from this script for her meant rejection and disrespect and that led to her outbursts and spurts of defiance and disrespect. In order to combat this, I took things with Briana day by day. I praised her when she did well and ignored her when she was in her ranting spells. We have an understanding that has pretty much become a way of life. A mutual respect slowly began to form, and the ranting spells and disrespect slowly began to dissipate.

Cara, Intellectual Mother of Two

Cara was a 17 year old female who was on her second pregnancy. She failed the CRCT in science in 2011, yet she passed the test in 2010. She described herself as intelligent, silly, and acknowledging. Her best experience in science was passing conceptual physics with an A. Her goal was to pass the class in order to graduate.

I first met this young lady a year ago prior to this study. At the time I met her, she already had one child and had several failed attempted suicides. She was very depressed about all the things that were going on around her. I said something to her about her

attitude. I also told her I would see her again in biology. She then proceeded to tell me about all of the misfortunes she had been through. I stopped her before she had gone too far with her information, and just simply stated to her that she was still here for a reason.

The next year when I received my roll, the first thing that I noticed was her name. I said to myself, oh boy. Our second encounter, with me as her biology teacher, was much different than the first. Although pregnant again, her disposition was much more positive than before. Even though she missed quite a bit of school, when she was present, she was deeply engaged in the class and the biology conversation. Whenever I posed a question, she was the first to answer. Her answers were almost always right whether she was there to take the notes or not. I quickly noticed that I might be dealing with a child who was gifted and unidentified. She was so smart that she could miss two weeks and still return and make A's on my tests. Not to brag on myself, but I prided myself in challenging students and making them work for their education. I loved to make my work rigorous so that students had to think.

I slowly realized that she was a diamond in the ruff. The last conversation that we had before she went out to have her second baby centered on her desires and dreams to become a biochemical engineer. With the right support, this young lady had the potential to explode in any area she desires.

Julie, Miss Facilitator

Julie was a 16 year old female who loved learning. This young lady loved basketball, dancing, and school. She described herself as an intelligent young lady who loved learning. She has consistently failed science CRCT in 2010, 2011, and 2012. She

did pass her EOCT in 9th grade literature as well as her Georgia high school writing test this year. Her goal was to learn as much about life as possible and pass the class.

In my first encounter with this young lady, I immediately picked up on her willingness to work. She proved to be very serious about her work and graduating on time. Although she had a violent streak, it was all channeled into staying on the path of positivity. She seemed quiet at first, but now I eventually discovered that that was not the case. She completed her work and was not afraid to speak up about things that bothered her or misconceptions that she possessed. Julie did all that I asked her to and more. She had even adopted a mentality of confidence that enhanced her no nonsense attitude. She was very proud of her work and made sure that I knew she had done everything that I asked of her.

A lot of times in class, she would take over and make sure that everyone understood what I was teaching. She made it a point to help me out in any way possible. She was the one that wanted to help me with my desk, pass out papers, and run errands if necessary. She was quite intelligent, but struggled with word pronunciations and some reading. She comprehended well, but did not vocally express herself as well. She was one of those students that recognized her deficiencies and craved the opportunity to turn those deficiencies into strengths.

LaShae, The Workaholic

LaShae was a young mother who had an 8 month old little baby. She struggled with attendance because she would rather not be in school. She was a very intelligent and articulate young lady whose main focus was on working and being a mother. School

was now a second thought to her. Her initial goal was to complete this course with an A, but eventually her goal changed to just coming to school and being able to graduate on time. She passed CRCT in 2011. She failed CRCT in 2010 and 2012.

As intelligent as this young lady was, school was not the focus of her life. Her main focus was to go to work to provide for her daughter. Although she was very bright, her life choices now guided her down a path that might have led her towards a GED. This young lady barely came to school. When she did, however, she worked and for the most part passed every assignment given to her. Unfortunately, she transferred to another school after she interviewed with me. I no longer know how she was doing or where she was.

Kasondra, Miss Nonchalant

Kasondra described herself as shy and quiet. She was 16 years old at the time of the study. She talked to those who she felt the most comfortable. She did not particularly like science. She had consistently failed science in 2010, 2011, and 2012. She failed the 9th grade literature EOCT with a 67. She was not a repeater, but struggled to understand the concepts of biology.

On our first encounter, this young lady appeared to be very quiet and shy. She did not say one word for about the first six weeks of school. Her grades were nothing to brag on and she was just one of those kids that just drifted along and blended into the normal crowd of high school. One day, I asked her to work on speaking up and contributing to the class. She shyly smiled and gave me that yeah right look. As time progressed,

Kasondra started to become more vocal and more demanding of me within the biology classroom.

Her work began to progress from average to good. She began to ask more questions about the things she did not understand. Now the one thing about Kasondra was that she moved like a turtle in everything. She was the child that it took the entire period to complete anything. It was not that she was not intelligent, but her brain processed a little different from the other students that I had. Other students in the class would make comments about her eluding to her academic potential. She would just shrug it off as the students being playful. This young lady was not a multi-tasker by far and had to remain focused on getting her work up to the standards of excellence that were exuded in my room.

Data Collection

My data collection included students' and teachers' reflections, 7 student interviews, and 2 teacher interviews. I chose to solidify my case by including two weeks of field notes/observations and student work samples. Day one of the study began after receiving approval from IRB and parent and participant informed consent forms and student assent forms (See Appendix A, B, C).

In order to build an effective case, there had been a substantial amount of evidence. According to Yin (2009) case study inquiry relied on many different sources of evidence with the data converging into a triangulation form. My case was built utilizing the evidence of teacher and student perceptions about the effectiveness of science interactive notebooks, KIM vocabulary, Cornell notes, group work, lab

experiments, writing, close reads, and Thinking maps on the comprehension of biology concepts as well as student work and two weeks of observations within the biology classroom.

At the beginning of school, students knew nothing about what an interactive notebook was or how to use it. So, in order to help students utilize this tool, I had to show them how to use the notebook and why it was important. The incorporation of the science interactive notebook had been a step by step process. In order to get students acclimated to using the interactive notebooks, I presented a PowerPoint presentation on how to setup an interactive notebook. This PowerPoint included step by step instructions on how to setup the notebook, what it would be used for, and information about the utilization of the left and right sides of the notebook. The PowerPoint also included what other literacy strategies would go in the notebook. Examples of the types of information that were listed in the PowerPoint included Cornell notes, Thinking maps, science close read articles, graphic organizers, labs, summaries, and essay writings. Once the students were shown this presentation, I walked through every step with them in setting up the notebook. This notebook would be their life for the next year in biology. The notebooks were to include all of the assignments that were given to them. Once the notebooks were set up, we began to utilize them on a daily basis.

The first step involved surveying all of my new students for 2014-2015. The following questions were asked:

- What has been your best science experience in elementary, middle or high school?

- What has been your worst science experience in elementary, middle, or high school?
- Describe yourself using a diamante poem (See Appendix H).

From analyzing the three question survey and their student assessment data, I determined who I needed to interview for the study. I chose 12 students from my regular biology classes and two teachers, one of which included me. I chose the other teacher based on her experiences teaching reading/literacy and collaborating with me as a special education teacher in a collaborative biology classroom. Once the 12 students were chosen, I sent them home with a parent consent form to sign.

On day two, I explained to the students in the study that I would be observing them for two weeks in my class. On days three-thirteen, I observed 8 of 12 students in the class for 20 minutes a day because only 8 of the students returned their parent consent form. The observations included how they were using their notebooks, using other literacy strategies, interacting in class, and interacting with me and other students. During these two weeks, I renewed their thoughts and practices on the literacy strategies that were already implemented. Each day within the observation period, students entered my classroom and followed the protocol that had been in place since August. The protocol included an opener, work session, and closing. For example, on day 3, students began a new unit on cells. As soon as the students walked in the projector screen projected the question/statement, "Create a circle map on cells. Include as much information about it as possible. Then be sure to include a frame of reference." After I called roll, we discussed this task. We then proceeded to break down the standard and set

goals for the unit. I then asked them to explain the importance of cells to living things. Once this was discussed, students began their Cornell notes on cells. Once we completed this, questions were created to accompany the notes. Students were given a template to help them create questions and write questions to go along with the notes. Once this was done, students partnered up to peer check questions. Then, as a class we discussed it. After this we closed with the students writing three things they learned about cell.

The students had already been introduced to most of the literacy strategies; however, there needed to be a more consistent implementation of the strategies to evaluate the usefulness of each. All of the observations were recorded in a notebook that was locked and secured. After day 13, I asked the students and the literacy teacher to sign up for an interview day and time. I also called each parent of the student involved to ensure that they understood what was going on and to inform them of when their child needed to stay after school. The single interviews were conducted between the hours of 3:15-5:15 on Tuesday, Wednesday, and Thursday. The interviews lasted no more than 15 minutes with the exception of Ms. Lindsey's, which lasted about an hour. Each student and teacher were first read the student assent form and adult informed consent form (See Appendices C & D). This was done to ensure that each student and teacher understood the interview process. Once this was read, discussed, and signed, I proceeded to follow the interview protocol that I created based on the predetermined codes of meaningful learning.

Students were chosen to interview based on the science and reading CRCT scores, number of course repeats, EOCT for 9th grade literature, and science experiences

(See Appendix E). I noticed that once I put all of the chosen students' data in the chart I created, all of them had met or exceeded on the reading 7th and 8th grade CRCT. Ironically, none of them passed the 8th grade CRCT in science. If I were naïve, I would have believed other educators when they said that if children could read they could excel at science. I knew different and this data solidified that notion of the disconnect between the ability to read and the ability to read science.

Seven of the eight students were interviewed because one student refused to do the interview. The seven students were interviewed after school using a seven question focused interview protocol (See Appendix G). As the interviews were taking place, I wrote down notes in addition to using the recording device. Once the student interviews were completed, the teacher interviewee was interviewed using a nine question focused interview protocol (See Appendix I). This interview protocol was designed to give an in depth view of the perceptions of teachers. The teacher was interviewed after school as. The interviews were recorded on my cell phone which was password protected and recorded on a program called "Recorder Pro" an audio recorder app. Once all interviews were completed, I played the interviews back and transcribed the information on paper. Once I wrote it out, I then proceeded to type the transcription. I saved it on my computer which was also password protected.

These interviews allowed for students and teachers to be represented in this particular case study. Both sets of interview questions were aligned to the research questions for this study to ensure consistency (See Appendix F & H). The focused interview was an overall evaluation of the perceptions of the students and the

collaboration teacher during the observation period in which literacy strategies were implemented effectively and consistently. According to Yin (2009) a focused interview was one in which the interviewer interviews the interviewee for about short amount of time which was usually no longer than one hour. A set of questions was followed by the interviewer in order to stay on track. The interview questions utilized allowed room for some open ended answers, but for the most part was guided by the pre-developed questions.

Data Analysis

Once the interviews were completed, the data was analyzed by coding the interviews and looking for the common themes of meaningful learning and construction of knowledge. The interviews led to a better understanding of the learning that was happening within my biology classroom. Once the interviews were completed, they were analyzed for common themes by listening to the interview and further analyzing the notes that I wrote during the data collection process. The main themes or codes that I looked for were pre-determined based on the relevance and alignment to five characteristics of meaningful learning: active, constructive, intentional, utilizing authentic context, and collaborative (Olfosson & Lindberg, 2012). In research utilizing predetermined codes was referred to as a priori coding because they were codes developed before examining data (Stemler, 2001).

After I collected all of the data from the interviews, observation notes, student work samples, I began to analyze the collaboration of data.

> The process of data analysis involved making sense of text and image data. It involved preparing the data for analysis, conducting different analyses, moving deeper and deeper into understanding the data, representing the data, and making an interpretation of the larger meaning of the data (Creswell, 2009).

Once I completed the interviews, the reflections, two weeks of observations, the interviews, and the student samples were placed side by side. It was at this time that I realized after comparing the three forms of data, that I had to go back and reorganize the data I had written up in chapter four by the codes instead of by the participants.

According to Creswell (2009) data analysis begins with a coding method. Coding was the process of classifying bits and pieces of information into categories before beginning to actually make meaning of it. For my study I chose to use predetermined/ priori codes that were based on the theoretical framework of meaningful learning (See Table 1). I placed the analyzed data into these predetermined codes based on the meaning of the categories and how the pieces of information aligned with the categories.

Table 1. Alignment of Characteristics of Meaningful Learning

Characteristics of Meaningful Learning	Definitions of Characteristics	Evidence from Observations	Evidence from Interviews	Evidence from Student Work
1. Active	Learners were engaged by the learning process. Students ask questions, acquire information, evaluate information, and express new ideas.	Students were observed engaging in learning. Students were creating questions for Cornell notes, discussing content related to cells, and engaging in labs and other class activities.	Participants mentioned engaging in labs, taking graphic notes, and working in groups.	Products were created by students, which enabled me to see the growth between pretest and posttest. Example: Cornell notes with student generated questions and summary.
2. Constructive	Learners attach new ideas to prior knowledge.	Yes, observed this in our close reads about new topics and making connections to real world ideals. Also observed in building on prior knowledge with discussions and openings.	Yes, participants spoke of new information being observed through labs and how they were able to understand what the notes stated through the visual, hands-on connection.	Yes, the cell booklet students created allowed them to link new knowledge, cell organelles and function, to old knowledge by relating functions of real world items to functions of the organelles. Ex. Nucleus controls the cell like the brain controls the body.
3. Intentional	Learners were goal-driven, self-directed, and understand the learning targets for the course of study. Self-assessment was a big part of this.	Yes, this was observed in students' conferences with me when they were able to tell me what they understood and did not understand. This was also observed in our increased learning time in which students were in group based on assessment data.	Yes, participants stated that the interactive notebook allowed them to keep up with where they were supposed to be. It allows them to write what they do and don't understand.	Yes, standards were written on almost everything that students were given. Students also have the opportunity to self-assess projects, tests, etc. This provides immediate feedback and lets students know where they stand.
4. Authentic	Learners were exposed to real-world situations as well as learn in context.	Yes, students were observed taking part in a lab experiment that involved a gummy bears and different solutions of water. It also allowed them to see how cells transport fluids in their bodies.	Yes, participants stated that biology was meaningful to them because it was about them. It's life. Also, students stated that they know what gummy bears were, but did not know their biological significance. .	Yes, students utilized this in several readings, projects, and notes. Everything was linked to a real world connection.

Table 1 Continued

5.	Collaboration	Learners were in conversation with each other about the concepts. Learners exploit each other's skills to provide social support	Yes, this was observed almost on a daily basis. Everyday students were given the freedom to consult with each other about biology. This helps them become more confident in the subject area.	Participants stated that group work was fundamental. They love discussing	Students collaborated on a daily basis in the classroom. Whether it was by helping each other with activities, lab experiments, or group discussion.

After I placed all of my data that I collected into the chart above, I realized that I had information that did not fit into any of the categories listed above and that surfaced more than once. I had to add three more codes that emerged from the data. The three emerging codes were student ownership/responsibility, organization, and student-teacher relationships.

Table 2. Emergent Codes from the Data

Emergent Code	Meaning	Evidence
Organization	According to Merriam-Webster Online (2015), organization involved the act or process of placing different parts of something in a particular order so that they were easily located.	All participants referred to the interactive notebook, Cornell notes, and Thinking maps as providing means of organization.
Student Ownership	Students ownership equated to a student investing in their learning (O'Neill & Barton, 2005)	All participants took ownership for not studying enough, keeping up with their notebook, and acknowledging that writing helped them to make meaningful learning connections.
Student-Teacher Relationships	According to Merriam-Webster Online (2015), relationships focused on the way two or more people behave towards one another.	During the time of the study, grades increased, behavior decreased, and students, mostly 100%, came to class willing to learn.

Limitations and Assumptions

There were several limitations to this study. Further studies had to be done to begin to make judgments about what worked and what didn't. This study was limited to the students in my classroom. I collected other artifacts such as copies of students' Thinking maps, Cornell notes, close read responses, KIM vocabulary maps, and

notebooks in order to minimize bias. Students were randomly placed in classes by a central group of registrars outside of the school. Because consent had to be obtained, there was no guarantee of student participation. The study was limited to African American students in one particular Title I school within a large school district. Because this study was focusing on the perceptions of me, another African American teacher, and African American students in an impoverished environment, generalizability did not occur for all African American students in all public schools throughout the US.

One of the first threats to validity was that I was the researcher and the teacher. Another threat to the internal validity of this study was that the students were conveniently sampled. In order to minimize bias, I utilized member checking with the interviewees, triangulation of data sources, and a clarification of researcher bias through self-reflection (Creswell, 2009). According to Vogt (2007) validity threats were categorized as design, measurement, or analysis issues. Threats to internal validity and threats about external validity came from not paying attention to research design. I combated this by ensuring that my data was triangulated by analyzing several different forms of data. I did student and teacher interviews, classroom observation, and analyzed student work. This allowed me to see things through a multi-faceted perspective in order to increase validity to my study.

Summary

The methodology section addressed the following areas: statement of the problem, research questions, setting, population sample/participants (teacher participants; student participants), data collection (interviews, participant observations, field notes,

document analysis), data analysis (coding, emerging themes across participants, validity, and limitations). This chapter explained the context and steps taken to complete a case study of meaningful literacy learning in a biology classroom. The next chapter describes the results of the case study.

CHAPTER 4:

RESULTS

Students and teachers had different perceptions of literacy within the science classroom; however, the goal was the same, biology needed to be meaningful in order for students to be successful and teachers to see growth. According to Ebbers (2002) scientific literacy was more than reading about science:

> It means that a person can ask, find, or determine answers to questions that derive from curiosity about everyday experiences. It means that a person has the ability to describe, explain, and predict natural phenomena. Scientific literacy entails being able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions. (p. 22)

In this study, literacy was infused in the biology classroom in order to create meaningful and successful learning experiences. Biology does not focus on just cells, animals, plants, or other living things; instead, biology was also about learning the language and discourse of those living things that were studied. As learners became more skilled in applying the literacy strategies, significant comprehension and effective communication increased, so they were better able to read, write, think, and express themselves in ways that successfully engaged them in scientific study and problem solving (International

Literacy Association, 1994). Students and teachers were observed in the classroom setting, interviewed, and had work samples analyzed. Evidence of the perceptions of two teachers and 8 students was collected from a biology classroom using literacy strategies on a daily basis. As an African American science teacher who had consistently seen African American students struggle in the area of science, I wanted to know if incorporating these literacy strategies would make learning biology content more meaningful.

The research questions were as follows:

1. How did literacy strategies affect the performance of African American students within the biology classroom of a Title I school?
    a. How did African American teachers perceive the effect of the incorporation of literacy strategies on the science performance of African American students and their meaningful learning experiences within a biology classroom?
    b. How did African American students perceive the effect of the incorporation of literacy strategies on their meaningful learning experiences and science performance within a biology classroom?

In order for this task to be completed, I observed students for two weeks within my biology classroom, collected student work, and interviewed students and teachers about their perceptions regarding literacy in the science classroom. The results proved to be very interesting and eye-opening. There were several categories that were pre-determined based on the characteristics of Ausubel's theory of meaningful learning. These categories helped to code the interviews for meaningful learning, which was rooted

in constructivism, the theoretical framework that guided this study. During the observations, student work collection, and interviews, I looked for the following codes which were the five characteristics of Ausubel's theory of meaningful learning: active learning, constructive learning, collaborative learning, authentic learning, and intentional learning. In the process of coding for the pre-determined codes, I developed three more codes that the theory did not seem to fit. The three codes that emerged were organization, studying/student ownership, and student-teacher relationships.

Often times, I questioned the various methods used in science. I was continuously researching best practices and trying them out within my classroom. Over 14 years, I had utilized a lot of strategies such as cooperative grouping, music incorporation, differentiation, graphic organizers, and frequent assessments that worked effectively with my students. However, the research never quite prepared me for the population of students that I currently served. African American students, from high poverty areas, were rarely mentioned in articles regarding best practices in a science classroom (Crippen & Walden, 2009; Fang & Wei, 2012; Fisher & Frey, 2009; Shelley, Rochwerger, Brigman, & Wood, 2006). There were a few instances where African Americans were mentioned (Brand, Glasson, Green, 2006; Mutegi, 2012; Russell, 2005; Stewart, 2008; White, 2009), but none of the resources could answer the question that haunted me: Why were my students not showing gains in science? The state, district, and my classroom science test results were consistently marked with failing scores which failed to meet the state average.

I wondered, just how I could bring this problem to its knees, and put African American students on the path to succeeding on local and state assessments. I began

researching interactive notebooks. I found the information interesting, but too daunting of a task for me to attempt. Two years later, I attended a conference for science educators and had the pleasure of attending a session on interactive notebooks. The conference I attended seemed to refocus my attention on the interactive notebook in science. Seeing how students reacted to the notebook, as well as the growth that each student experienced, led me to conduct this research study to assess whether the use of interactive notebooks would impact the performance of all of my students.

The goal of chapter 4 was to explain my results of the student and teacher interviews, the observations within my biology classroom, and the analysis of student work. Chapter 4 focused on the information that surfaced after an in depth analysis of all three types of data that were collected. Additionally, chapter 4 showed the connection between the research questions posed and the analyzed data that was collected from the 9 participants as well as my overall perception and reflections about the triangulated information that I collected.

My Perceptions

During this research study I learned and reflected on things that I observed, analyzed, and listened to. My perceptions changed during this process because this was the first time I really had had an opportunity to hear, observe, and analyze my students all at once. My research made me sit and really begin to see the learning process for what it was. For so long, I thought that if I worked hard, students would be overjoyed and willing to learn something that I loved. Although teaching has been a part of me for a long time, I never had the opportunity to see it from the stance as a researcher. I thought that just by giving students work, that they would learn it just because they were students

and wanted to graduate. I thought that learning was meaningful to every student when they walked through the doors of the school. Even though I wanted and believed this to be the case, my dreams were shattered, and reality set in. These students were not going to make teaching easy. I was going to have to become one with them, in order for me to even stand a chance at teaching them. I discovered that through this process, literacy strategies were wonderful, but building relationships was the key to it all. The results below told it all.

Biology Class Snapshot

On day one of the observations, I showed my 6th period students a picture of a prokaryotic cell (Appendix K). Students were asked to predict what type of cell it was. They were asked to write down and share their results with their partners. Angel and Kris were in an intense conversation about what they thought they saw. Angel told Kris that the picture had to be a picture of a germ because it was ugly and had a tail on it. Kris told Angel that she was wrong because the question was about the type of cell. Kris and Angel continued to go back and forth until eventually Briana hollered across the room, "Would ya'll please shut up and get a book or your notebook, dang." Once the students got a book, they asked me for the page number where the information was located. Having very high expectations of my students, I told them to look in the index or ask three before me.

While Angel and Kris were researching, Julie chose to work independently because she really did not fit in with the others in the class. She quickly got her book out and her notebook and began immediately answering the question. She predicted that the picture was a prokaryotic cell because it looked just like the one in the book. Because

this was a new unit, notes had not been taken on the topic of prokaryotic and eukaryotic cells. Her prediction was made solely on the evidence collected from the book. LaShae and Kasondra worked together to find the answer. They used the book to help them find the answer as well. I did notice them asking Julie what she had gotten on her paper. I proceeded to listen as Julie told them that "the page number was 77, you two needed to tell me what you find. I'll let you know what I have after you look for it like I did." This did not surprise me because Julie was the student that worked for hers and believed that others should do the same. She helped others, but did not just give answers. After I observed these interactions, I proceeded to move on to the work session for the lesson.

In order to transition to the work session from the opener, the students returned to their seats. I called on several students to discuss their prediction about the picture of the cell. Several students did not know what the picture was and did not bother to try to investigate the matter. Some students, however, turned to page 77 in their biology book and discovered that the picture was a picture of the prokaryotic cell. We then went into the literacy activity for the day. Students engaged in a close read literacy activity on comparing and contrasting prokaryotic and eukaryotic cell.

Students had to read one article entitled, "Morphing Mitochondria" by Dr. Yaffe (NIH, 2005). From the reading, each student was to extract answers to the leveled questions, which were questions characterized by difficulty. Once the leveled questions were answered, the students had to write a summary about the article read (See Appendix L). The students did answer the leveled questions about the article. Because this article referred directly to a part of the living cell, it created a link to the upcoming cell

comparison booklet project, which was a booklet that included thinking maps, a summary, and illustrations.

During the 2 week observation period, students also took Cornell notes, read more articles utilizing the close read method, engaged in collaborative learning in the forms of group projects and labs. The two week observation period offered different insights for me because as the researcher and observer, I took notes about what was going on in my class. Although I reflected daily on my instruction, my written collection of data added another layer of depth to my instruction.

These observations led me to believe that students' learning experiences became more meaningful through discussion, collaborative learning, and writing. So as I continued to analyze the observations, I prepared myself for the interviews by reviewing the pre-determined codes that I had derived from Ausubel's theory of meaningful learning.

Code Analysis

Code 1: Active learning

Active learning occurred when learners were engaged in the learning process. Students asked questions, acquired information, evaluated information, and expressed new ideas. This code was exhibited throughout the two weeks of observations, in the interviews, and in the student work. Students constantly created their own questions in their interactive notebook to enhance their understanding of biology. Students were almost always engaged in the lesson. There were some days that students had to be prompted or reminded of the expectations; however, for the majority of the time, the students worked.

One activity that I vividly remembered and wrote about in my field notes was the day that students took notes on cellular transport. Students were able to create questions about the cells in their Cornell notes within their notebook. Some of the questions that were created ranged from compare and contrast active and passive transport all the way to how a red blood cell would look in pure water. The summaries that were written were precise, and included information about cell transport as well as deep thought about the differences between them (Appendix P).

According to Kris, "The interactive notebook affected my understanding because the notes taken were graphic and the notebook allowed me to be able to add the extra information provided. The Cornell notes allowed me to go through different thought processes in biology. Cornell notes made it easier to learn different things in class because we wrote our own questions and answered them in addition to what you gave us." Julie stated that the Cornell notes were divided into different levels of questions which helped with her thinking. She then went on to state that Cornell notes allowed her to create her own questions which were more beneficial to her than me giving her questions. "If you gave me everything, I would not be learning," stated Julie. Kasondra agreed with Julie and Kris because she stated that Cornell notes allowed her to be able to create her own questions from the notes. Not only were Cornell notes noted by student because of student generated questions and summaries, but close reads were noted because they gave my students new information.

Kris stated that he liked close reads because the article gave him different information about processes that he did not know before. Julie agreed by stating, "Close reads of articles have helped me to understand what we were getting ready to learn by

giving me new information. Finally Kasondra stated that close reads were good for her because she learned things that she did not know. As the observer, I recognized that my students did better with close reads because I read aloud the first time. A student was then chosen to read the article for the second time. The student then chose another student to read the article for the third time. The questions I had chosen to accompany these close reads increased in complexity as we read each time. Students struggled with the close reading method because they did not like reading. Additionally, science terminology was hard for them to pronounce and understand. I found that I had to ensure that students marked the text. I walked them through this process every time we did a close read. This process that should not have taken all period, ended up taking all period; however, students were engaged in the learning process.

Code 2: Constructive

A constructive learning environment took place when learners attached new ideas to prior knowledge. According to Mayer (1999), meaningful learning focused on the alignment of the view of learning where knowledge was constructed, and students were allowed to make sense of their learning. During the two week observation period, I observed and guided students in the direction of linking prior knowledge to new knowledge. One activity that the students did helped them to link the functions of cell organelles to the function of real world object. Julie was able to construct knowledge through the bridge thinking map which was used to show analogies in the cell booklet. In one of her analogies she said that the lysosome digests things in the cell just as the stomach digest things in the body. This activity allowed Julie to construct knowledge by connecting the organelle function to a real life function (See Appendix I). Other

Thinking maps as well as the KIM method for vocabulary allowed students to construct knowledge.

"The graphic organizer for vocabulary helped my special education students as well as the regular education students to grasp the key vocabulary. When students comprehended and retained vocabulary, the doors were opened for a better student understanding," stated Mrs. Lindsey. The students seemed to have found the vocabulary method beneficial as well. Angel stated that the KIM vocabulary (Appendix M) helped her learn her vocabulary because the graphic organizer displayed the word, information, memory cue or picture, and maybe a sentence. Michael added that he liked the KIM method because he was able to remember the picture and connect it to the word the next time he saw it. This advanced organizer utilized images to help students construct knowledge.

Vocabulary was very important because students had to know the meanings of words in order to have a proper understanding of the content. The way that my students did vocabulary gave them the opportunity to have multiple modes of representation. My students did the vocabulary KIM method style. Students wrote the Keyword, Information about the word, a Memory clue, usually an image, that reminded them of the word, and a sentence that allowed them to summarize the new information. The students tried to take shortcuts with this, so I had to set deadlines for them to do the work. The students felt that vocabulary was very important. Michael stated that biology would be more meaningful to him if he studied more and learned his definitions. "Definitions were very important. I especially like the KIM method because the pictures helped me better than just the words on paper," stated Michael. Not only did KIM method help students learn

vocabulary, but Thinking maps solidified critical learning and construction of knowledge even more by creating new avenues of learning.

"The Thinking maps helped me because they allowed me to see patterns and think harder," stated Cara. Michael continued to explain how the double bubble Thinking map (Appendix N) helped him to compare and contrast. Additionally, Kasondra stated that Thinking maps helped her to do things such as compare and contrast information. The Thinking maps provided me with insight into what my students knew and did not know. They afforded students the opportunity to connect old to new knowledge and think deeper about the topic of discussion.

Code 3: Intentional

Everything that my students and I did in biology class was intentional. The class was guided by standards which were given to us by the state department of education. Intentional learning happened when students were goal-driven, self-directed, and understood the learning targets for the course of study. At the beginning of the year, I had my students to set goals for this class. These goals were made based on what the student wanted in the class. Angel set a goal to pass the class with an A. Briana made a goal to take a lot of notes, stay focused, and listen. Cara stated that she wanted to pass the class and graduate. All of the goals ranged from staying focused and listening, to studying and passing. I used these goals in class to remind them of what they stated.

I also ensured that students knew where they were in the content. Before every lesson, we deconstructed the standard and discussed it. On one particular day, when I introduced cellular transport, I read through the standard and asked my students what the verbs meant in the standard. One verb was analyze. I asked LaShae what analyzed

meant and she stated that it meant to break down. As a class we continued to discuss the standard, and I explained to them what the learning targets were for the standard. Each student wrote the standard and essential questions for the unit on their unit page in the interactive notebook. This helped them to remember what we were going to do for the content of the particular unit. Not only were the standards and student goals intentional, but Mrs. Lindsey's goals for the students aligned with mine.

When Mrs. Lindsey was my collaboration teacher, she and I always had goals for our students on the end of course test. We always set goals for the special education and the regular education students. Our goals were intentionally set 5-10% higher than the end of test scores from the previous year. "It was always good when students saw their growth and received feedback about their work. Because this biology class was attached to an end of course test, I intentionally set a goal with Mrs. Reese for our special education students to either pass or make between a 60-69, so that they could retest," stated Mrs. Lindsey. Everything we did was intentional from setting goals with students to setting goals as teachers.

Code 4: Authentic

For authentic learning, learners were exposed to real-world situations as well as contextual learning. A good example of this was the lab experiments that we did in biology. According to Cara, "I liked lab experiments because of the hands-on experiences. It helped me learn concepts that I did not know such as osmosis. When we put the gummy bears in the water and the bear sucked up all the water, it provided me with a real connection between something we read about and now were able to see. We had been learning about osmosis and this helped me to see what it really looked like in

real life." Angel stated that labs showed her things that she didn't know. "I learned that gelatin, what we eat as Jell-O, really comes from something living and can, through the form of gummy bears, show us what happens to cell membranes in pure water and salt water." All of the other students agreed that lab experiments produced a real world, hands on experience that was necessary for biology.

As I observed them participating in a lab, I always saw them come to life. On lab day, they literally ran to class. The struggle was not in getting them to do the lab, but in getting them to understand the analysis that accompanied the lab. The same sentiments were echoed throughout about labs. My students were hands on students who would much rather do a lab than other work. "Lab experiments helped me a whole lot because I learned stuff when I did hands on experiments. It was easier and a more complex way of learning than just reading a book. I have always been a hands-on learner. I needed to see it for myself," stated Julie.

Code 5: Collaboration

Students not only had to do an activity, but had to be allowed to write or talk about what went on in the activity to solidify learning (Jonassen & Henning, 1999). Collaboration constantly took place when students were allowed to talk to each other about the topic being taught. In my classroom this was a consistent process, because everything students had done involved discussion. Students were allowed to discuss questions for Cornell notes, summaries for Cornell notes, lab questions and analysis, close read/articles read, and any other activity that took place in my class. My classroom was always full of collaboration. According to Mrs. Lindsey, collaboration was one of

the most effective ways students benefited from learning because students were able to attack problems together and learn from one another.

In one situation, I distinctly remembered how Mrs. Lindsey and I were able to get students to learn through collaboration. The students had to complete a Punnett square activity lab in which they were in groups of three to four. This helped these students talk through the problem and solve it based on the knowledge of everyone. "Working in groups helped me to see other people and their solutions and how to get the work done. If I had a group of people and our minds were put together, the work became easier. In a group I may not have known something that my group member did. It made it easier to learn from each other," stated Julie. Michael stated that he liked group work because it allowed him to socialize. "Instead of me running back and forth to the teacher, I asked my group members for help. In groups, I thought better," stated Michael.

Mrs. Lindsey stated that collaboration was one of the most effective ways students benefit from learning. "Students were able to solve problems together and share different experiences. Collaboration served as a perfect tool to use in inquiry learning because students worked through the issues," stated Mrs. Lindsey. She continued to state, "Students had many different experiences, while some had few experiences. In a collaboration group when students asked questions, they were able to get responses from other students with different levels of learning, experiences and viewpoint, thus making the learning experience meaningful."

Code 6: Organization

All of the students and teachers interviewed in this study agreed with the evidence of organization. The interactive notebook in addition to the Cornell notes, and Thinking

maps helped to organize abstract mental thoughts as well as concrete facts on paper. The thinking maps, according to LaShae helped with comparing and contrasting and seeing patterns in information. She also discussed the importance of Cornell notes because they helped her stay organized. Julie stated that the interactive notebook helped her sort out all of her information given and gave her a clear understanding of where she was in the class. Mrs. Lindsey stated that the interactive notebook was just another tool that helped students to organize their thoughts. "All materials were kept in one place," stated Mrs. Lindsey.

Other students, such as Kasondra, went into more detail about the organization benefit of certain literacy strategies. "The interactive notebook that I used in this class affected my learning greatly because of the openings, notes and vocabulary." She went on to describe in detail what she was referring to. "The notes were different because they were Cornell notes. With these notes we wrote the answers first and then created our own questions. The questions went on the left and the answers on the right followed by a summary underneath. These notes helped me to understand more because they were organized." Angel stated that the notebook helped her to organize the KIM vocabulary, Cornell notes, labs, and Thinking maps and keep her information in one place.

Michael and Julie described in detail how the double bubble map helped them in organizing their thoughts on paper. According to Michael, "Double bubble maps have helped me because I placed the words that were alike in the middle and the differences on the outside. This made it easier for me to see how these two cells were alike and different." Julie talked about how Thinking maps helped with organization too because her thoughts were organized on paper. "Recently we did a double bubble map on

prokaryotic and eukaryotic cells. The Thinking map helped me to figure out what was different. We wrote what the cells had in common in the middle and the differences on the outside. Without this map, I would not have been able to see that both cells consisted DNA."

Code 7: Student Ownership/Responsibility

According to O'Neill and Barton (2005), student ownership had been characterized through four elements: control over the learning environment, connections with the learning process, expressions of territorial possession, and investments in one's learning. The students in this study always had opportunities to own their own learning. Writing summaries and reflections were key to this code that emerged through the process. Students agreed that writing helped to put things in the language that they could understand. Kasondra stated that writing helped her because everything had to have a summary. She further stated that writing helped her to remember things that we have learned. Mrs. Lindsey summarized it best: "Writing reflections helped students to write about key concepts and put it into their own words, which helped them own the concepts and helped them make those special connections that helped them understand and retained what they learned."

"By keeping what I have done in my interactive notebook, I could use it in the future. I needed to come to school more, so that I took part in more lab experiments. All of this combined made biology more meaningful to me," stated LaShae. Ownership was always aligned to the personal pronouns such as me, my, and I. Every time that those personal pronouns were utilized, ownership took place. Another indicator that this code was evident throughout was that every student mentioned that they needed to study more.

When students started spending time with their work, it had become a personal goal to be successful. All of the students mentioned that the work would be better understood it they took more time to study their notebooks. Angel said it best, "By taking up the time to read my notebook more, I made my learning in biology more meaningful. A lot of times I just tried to get work done if it was a lot of work instead of trying to understand it."

Code 8: Teacher-Student Relationships

Every year I taught different students and every year I was compelled to create positive relationships with each of them. Teaching over the years had provided me the opportunity to learn that positive relationships with students was key to a successful year. The participants that were interviewed for this study thought that relationships were important as well. Until this study, I did not realize how important and influential positive relationships were to students.

The last code that emerged was a connection between me and my students. "My experiences in science were bad and good. Biology class turned out good because of my teacher Mrs. Reese. In the past my science teachers had shown no interest in me neither were they interesting teachers. In your class, you made it a point to always motivate us to do better," stated Julie. Julie had profoundly stated because of me, biology was good. I realized that my students' growth and willingness to work was not just luck, it was due in part to my aggressive want for them to be successful.

When Briana told me she did not want to interview, I was devastated because I knew that she had something to say. Her next statement to me proved monumental. "Mrs. Reese, I did not want to interview because I didn't want to say anything wrong that

might mess up your study." I told her that she was not going to mess up my study. I explained to her that her classwork/grades were not affected by what she said; however, she still declined the interview. I wondered why this child did this, but after I got to know her better, I found out what she did was a sign of respect for me. She often had those days where she was not focused or where she exhibited low expectations. The day of the interview had been one of those days where her behavior had not been the best. So as I thought back, I appreciated the relationship we had and realized she liked me more than she cared to admit.

Often times my students in this class asked me if I was going to teach them again. Because most of them were on the regular tract, the next class in their sequence was a class that I did not teach. Angel stated, "Why the rest of these teachers not like you?" Michael interjected, "I was glad they not like her because she always have us doing the most, no disrespect Mrs. Reese, but I want to have a stress-free senior year." Angel rebutted, "It wasn't like you have done anything anyway. You better be glad you had Mrs. Reese, cause some of these other teachers have already given up on you. I liked that she had high expectations for us because she always pushed me to do more." These conversations went on in some form daily in my classroom. They had given me a pass to cross over into their world. I realized that these conversations did not happen everywhere with everyone. Usually these types of conversations took place in environments where students felt comfortable. Even though the students were comfortable with me, there was a mutual understanding that failure was not an option and success was what was taught in biology class.

At the beginning of the school year I had consistently motivated my students with the phrase, "high expectations." On one of the days I observed my biology class, the students were engaged in self-assessing and peer assessing each other's cell comparison booklet. I constantly heard students tell each other that the work they had done was not aligned to 'high expectations.' They imitated me often in the classroom. This imitation allowed me to see how positive student-teacher relationships played a major role in how students reacted within my classroom. I now realized that a lot of what my students did was not just because of the incorporated strategies/activities; it was in some part about the positive student-teacher relationship that had been fostered. Positive teacher-student relationships grounded in expressed concern for students overall growth and success proved to be a necessity for students development of knowledge, strong personal and interpersonal skills, and the ability to globally compete in the 21st century (Mulkerrin & Hill, 2013).

Students began making their study of biology meaningful by transforming their learning from teacher directed to student centered. I began to see students take pride in their work and in the beauty of learning. Also, I consistently overheard comments from students stating that science never really piqued their interest. Students continually told me that they hated all the work, but having the interactive notebook led them to learning in a way they were not familiar with. They made comments about not having to look for everything because the notebook kept all of their work in one place. The students also bragged on the idea of the notebook allowing them to be creative and make learning their own. I always knew that learning had to be relative and meaningful, but this study's findings solidified the importance of literacy strategies in making learning in biology

meaningful (See Table 3). The total number of people in Table 3 included students and teachers.

Table 3. Percentages of Perceived Meaningful and Non-meaningful Literacy Strategies among Students

Literacy Strategy	Meaningful	Non-Meaningful
Interactive Notebook	9/9 or 100% **All students and teachers stated that the notebook helped them keep everything organized and in one place	0%
Cornell Notes	7/9 or 78% **The students' main reasons were due to organization and creation of own questions. Teachers believed that Cornell notes allowed for more reflective thought and organization.	2/9 or 22% **Either the students would rather take bulleted notes or just did not like the way the notes were set up.
Thinking maps	8/9 or 89% **Students bragged on the graphic organization of the maps and the level of thinking that the maps lead to. Teachers felt that Thinking maps led to a better understand through utilizing critical thinking skills.	1/9 or 11% **Student did not like the maps because he stated that he doesn't needed to do all of that.
Close Reads of Articles	6/9 or 67% **Students and teachers eluded to the fact that the articles provided them with information they did not know. Teachers also agreed that close reading was necessary for reading comprehension.	3/9 or 33% **Students do not like reading.
Working in Groups	8/9 or 89% **Students and teachers agreed that working in groups helped them to be able to toss ideas and collaborate with their peers.	1/9 or 11% ** Student would rather work alone because she gets distracted.
Lab Experiments	9/9 or 100% **All students and teachers agreed with the notion of doing hands on activities to bring the information read to life	0/7 or 0%
Writing	9/9 or 100% **All students and teachers agreed that writing helps them because it leads to knowledge being remembered.	0/7 or 0%

Analysis of Results

The perceptions of teachers and students within this study both pointed to the importance and usefulness of the interactive notebook in making meaning in the biology classroom. Before the study began, ten out of fifteen students in this class were failing. After the incorporation of literacy strategies and a classroom environment conducive to learning, the number of failing students went from ten to five. The results led me to believe that literacy was a very necessary portion of content that needed to be added within the biology classroom. The students' voices spoke loudly about all of the strategies that we used in class. Each strategy had its own way of making learning meaningful to students. All students in this study cried out for help in the areas of organization, ownership of their learning, and positive student teacher relationships. So in addition to the five characteristics of meaningful learning that I used as pre-determined codes, three more codes emerged: organization, studying or ownership of learning, and student-teacher relationships.

Students felt that biology was meaningful because of the use of the interactive notebook and other strategies such as Thinking maps and Cornell notes. These things made learning more meaningful because it helped students to organize their learning in different ways. Students mentioned that biology would be more meaningful if they studied more and took more ownership of their learning. Angel said it best, "I needed to read and study more in biology instead of just trying to get work done. This would make biology more meaningful to me." Students and teachers both talked about the importance of vocabulary. Teacher 2 stated, "When students can comprehend and retain the vocabulary then that opens the door for students to better understand the text." Students

mentioned the use of the KIM method for learning vocabulary as well as Thinking maps for comparing and contrasting vocabulary. I also feel that knowing vocabulary was important because it helps build prior knowledge of content.

Mrs. Lindsey really advocated for literacy within the biology classroom to make learning meaningful. "Literacy gave students an opportunity to learn more about what they were studying. By encouraging and implementing reading articles pertaining to biology, the students' understanding of concepts were enhanced. Because of the level of difficulty of text in biology, various literacy strategies helped them digest the text." Mrs. Lindsey went on to state that literacy needed to be in the biology curriculum so that the prior knowledge of students was tapped and topics were connected. According to Mrs. Lindsey, literacy not only can led to students' independent growth, but it also led to the development of higher order thinking skills and relevancy within the biology classroom. This in itself made learning more meaningful for students.

Summary

The students and teachers in this study agreed that literacy in all of its various forms helped to make the biology content meaningful. In talking with students and teachers, I found that not only was it going to take the teacher being innovative, but the students had to at some point take ownership of their learning. All of these literacy strategies worked for me, but at the end of the day, students did better when they utilized what I gave them and enhanced it by studying, questioning, and collaborating about the information learned. Not only did I discover that students needed to own their learning and organize their learning, but my relationship with my students had to be positive. The largest factor that affected students the most depended on my ability to create an

environment of high expectations. Biology and literacy were interwoven partners that did not need to be separated if meaningful learning were to take place within the biology classroom. Chapter five will highlight the summary of findings, implications for teaching, and further studies.

CHAPTER 5

CONCLUSION

Can literacy and biology be merged together to exhibit a mutualistic relationship that builds a path of meaningful learning among African American students? According to Herman and Wardrip (2012), even though students have read in elementary and middle grade classrooms, few students really knew how to read to learn science. Teachers had to incorporate successful tools to aid students in learning more science and increase the significant reading to learn skills that literacy research categorized as essential for academic success. In this qualitative study, I investigated the perception of meaningful learning of African American students in a biology classroom. The research questions were rooted in the theoretical framework of meaningful learning, which fell under the larger umbrella of constructivism. In order to adequately address the questions, I observed my biology class for 2 weeks, interviewed 7 students and 2 teachers, one being me, and collected student work. After analyzing my data, I quickly came to the realization that the participants viewed the literacy strategies essential for making biology meaningful. Data was analyzed through the process of coding. Five codes were predetermined based on the characteristics of meaningful learning and three more codes emerged in the areas of organization, student-teacher relationships, and student

ownership. The results spoke volumes about how to make learning meaningful for African American students in a high school biology classroom.

Summary of Findings

The goal of this study was to investigate whether students and teachers perceived learning to be meaningful in biology. After the investigation of literacy and meaningful learning, I concluded that meaningful learning was operationalized through the implemented literacy strategies. Every participant felt that the implemented literacy strategies created an environment of meaningful learning (See Table 3). Cornell notes made learning meaningful because they allowed students to create their own questions and write their own summaries. Close reads allowed the students to learn new information and use the learned information with the prior knowledge they already possessed. Writing helped students to express their ideas within the area of biology. Collaboration allowed students to put ideas together to create new ways of thinking. Thinking maps allowed students to place the abstract ideas they had on paper in an organized manner. Lab experiments allowed students to actively engage in authentic experiences that related to real life.

These findings supported the research because the literacy strategies used in the biology class were aligned to the characteristics of meaningful learning which included active learning, constructive learning, intentional learning, collaborative learning, and

authentic learning. The findings also suggested that meaningful learning is best conveyed through literacy strategies that operationalized the theory. The findings also suggested that the incorporation of these literacy strategies helped students become more organized, responsible, and positive in their biology class.

It was very insightful to have heard the voices of students and teachers state what was meaningful to them. All of the students stated that learning would be more meaningful if they studied more, paid attention more, attended school regularly, took better notes, reviewed their notebook frequently, learned their vocabulary, read more, and tried to get a better understanding of the work. The teachers agreed that the literacy strategies helped but students needed to take more responsibility for their work. The students spoke volumes when they revealed all of the things that they needed to do. It was surprising to me that none of the students said anything about the needing to do more. This study also highlighted the importance of positive student, teacher relationships.

At the beginning of the year the class consisted of 15 students. Out of the 15, at least 10 were failing tests, assignments, and the class. After relationships were fostered, literacy strategies were implemented, organization was put in place, and students began to take ownership for their learning, the data flipped. Ten students were now passing and five were failing. So, the investigation I did proved that meaningful learning occurred and the literacy strategies that were used facilitated this process.

Implications for Practice

Several implications arose from this study. According to my study (Appendix E) students' ability to read had no correlation with their ability to do science. All of the students met or exceeded on the reading CRCT test in opposition to all failures on the science CRCT. This study implied that there is more to understanding science than just reading. My study also implied that science needed to be the focus of all grade levels. Literacy needs to be disciplinary specific meaning that literacy in science looks different from literacy in social studies. Students must be taught how to critically read in the science classroom. Students must be taught how to take notes within a classroom. Students must basically be taught how to effectively use any literacy strategy in the biology classroom.

If students are taking Cornell notes, teachers must spend at least one class period teaching students how to set up the page for Cornell notes, create leveled questions for the Cornell notes from the provided question stems, and write summaries based on the protocol provided by AVID. If students are doing a close read, students must be taught how to mark or annotate the text, answer text dependent questions, and write a response to the reading. If students are participating in a collaborative lab, students must be taught how to work in groups, follow the role they are given, listen to other group members, and work together to come to a compromise. When students are using Thinking maps, they must be taught what thinking map is used for what process of thinking, how to create the

proper frame of reference, and how to use Thinking maps as a thoughts organizer to lead into writing essays.

Finally this study implies that students must be taught how to be organized by keeping everything in an interactive notebook. The notebook setup must be taught on day one of the science class. The notebook must be checked weekly for assigned activities and monitored heavily to ensure that students are using their notebooks in the right way. Positive behavior and taking ownership of their work are the last two qualities that foster meaningful learning. Based on my study, these aforementioned qualities came from a classroom in which the teacher had positive relationships with students. The positive relationships fostered an environment where students were comfortable with active, constructive, intentional, authentic, and collaborative learning experiences.

Further Research

There were many other factors that could be studied. This study was not able to track the data on how these strategies aided in performance on statewide assessment. Neither does this study focus on other literacy strategies specifically reading or writing strategies such as S3QR, actual comprehension of text, or other proven strategies. This study also failed to address the sole impact of motivation, cultures of high expectations, or self-efficacy and how they impacted the literacy in a biology classroom. Other research that could be done pertains to the implementation of AVID strategies within a biology classroom and how it positively affects student performance in science. Finally

longitudinal research could be done to show the effect of a cohort of students that have effectively been taught science literacy from kindergarten to 12th grade.

Summary

This study's goal was to ascertain perceptions of African American students and teachers in the area of literacy within a biology classroom. Students and teachers both solidified the notion that literacy and biology work well together. The literacy strategies investigated such as the Cornell notes and Thinking maps proved to be strategies that both teachers and students appreciated in their learning of biology. The notebook allowed students to be creative in their learning while collecting information provided by me and created by them. It was a perfect mix of both worlds. This allowed students to begin take ownership of their learning as well as build their prior knowledge base. Biology and literacy was a partnership that needed to exist more in classrooms nationwide. Scientific literacy was the new push according to the Next Generation Science Standards (National Academies of Science, 2012). African American students needed to own their learning especially in a field that needed them the most. In addition to this, chapter 5 provided implications for learning for other teachers as well as further areas of research for those who choose to follow this path of research. According to my study, literacy helped build bridges among meaningful learning, science, African American students, and the real world.

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APPENDICES

APPENDIX A

MERCER IRB APPROVAL LETTER

MERCER
UNIVERSITY
Institutional Review Board

15-Oct-2014

Mrs. Keturah Reese
Tift College of Education
Macon, GA 31207-0001

RE: Biology, Literacy, and the African American Voice: Perceptions of African American Teachers and Students (H1410262)

Dear Mrs. Reese:

Your application entitled: Biology, Literacy, and the African American Voice: Perceptions of African American Teachers and Students (H1410262) was reviewed by this Institutional Review Board for Human Subjects Research in accordance with Federal Regulations 21 CFR 56.110(b) and 45 CFR 46.110(b) (for expedited review) and was approved under Category 6, 7 per 63 FR 60364.

Your application was approved for one year of study on 15-Oct-2014. The protocol expires 14-Oct-2015. If the study continues beyond one year, it must be re-evaluated by the IRB Committee.

Item(s) Approved:
New Application

Please complete the survey for the IRB and the Office of Research Compliance. To access the survey, click on the following link: https://www.surveymonkey.com/s/K7CTTBR

Respectfully,

Ava Chandalia-Richardson, M.ED., CIP, CIM
Member
Institutional Review Board
Mercer University IRB & Office of Research Compliance
Phone (478) 301-4101
Fax (478) 301-2329
ORC_Mercer@Mercer.Edu

APPENDIX B.

MERCER INFORMED CONSENT FORM

MERCER UNIVERSITY

Tift College of Education

Informed Consent

"Biology, Literacy, and the African American Voice: Perceptions of African American Teachers and Students"

You are being asked to participate in a research study. Before you give your consent to volunteer, it is important that you read the following information and ask as many questions as necessary to be sure you understand what you will be asked to do.

Investigators

The investigator's name is Keturah M. Reese. She has a Bachelor's degree in biology education, a Master's degree in Curriculum and Instruction, and a Specialist's in Curriculum and Instruction. She is receiving a doctoral degree in Curriculum and Instruction from the department of teacher education within the Tift College of Education at Mercer University. The investigator can be contacted by phone at 478-737-2517. The investigator's doctoral chair is Dr. Sharon Augustine. Dr. Augustine's number is 478-301-2677.

Purpose of the Research

This research study is designed to utilize case studies to investigate how twelve African American students and two African American teachers at a Southeastern high school perceive the utilization of science interactive notebooks in terms of meaningful learning. This dissertation is being done to give African American students another chance to perform scientifically with a new set of literacy strategies to aid them in the process. This study will allow science educators to utilize the stories of African American students to better help teach other students like them. This study will also help to make biology more meaningful to future African American students.

Procedures

If you volunteer to participate in this study, you will be asked to write a short reflection about how you think science interactive notebooks help African American biology students use literacy to understand biology. You will be asked to take part in a face to face interview with the investigator. This interview will focus on your perceptions of science interactive notebooks, literacy in science, learning experiences in science as well as your teaching experiences in science.

Your participation will take approximately 30 to 45 minutes for the interview with the possibility of an additional 30-45 minute follow up interview.

10/13/2014

10/14/2015

APPENDIX C

MERCER PARENT/GUARDIAN INFORMED CONSENT FORM

MERCER UNIVERSITY

Tift College of Education
Parent or Guardian Informed Consent Form

"Biology, Literacy, and the African American Voice: Perceptions of African American Teachers and Students"

Your child has been asked to participate in a research study entitled.
"Biology, Literacy, and the African American Voice: Perceptions of African American Teachers and Students"

The study is being conducted by Keturah M Reese, 478-737-2517, keturah.m.reese@live.mercer.edu. Keturah is supervised by Dr. Sharon Augustine, 478 301-2677; Augustine_SM@mercer.edu. The results will be used to further understand what African American students need academically in order to be successful in biology. Your son's/daughter's participation is voluntary. A decision to participate in the research will not affect his/her relationship with Westside High School, his/her relationship with other teachers, or his/her academic standing.

I. The purpose of my study is to explore:
This research study is designed to see your child's viewpoint about learning in the biology classroom. The study is designed to provide information about the effective use of science interactive notebooks in biology as well as the amount of reading and writing within the biology classroom. The data from this research will be used to help science educators understand how African American students learn biology best. These results will help contribute to the collection of information needed to build a solid case for literacy in science

II. Procedures:
If you allow your child to volunteer for this study, any work generated by your child during the 2014-2015 school year may be utilized for this study. Also, your child will be asked to write a short reflection about using their interactive notebook in biology and take part in an interview about their perceptions of the interactive notebook, literacy, and their biology class. Their participation will take approximately 30-45 minutes on a Tuesday or Thursday after school. This time will be used to interview your child. If needed an additional 30-45 minute interview will be conducted on a Tuesday or Thursday after school. Your child will be asked to assent to participate in this research. (Assent means that your child will be asked to voluntarily participate in this research.) Your child will tell the teacher they want to participate by answering yes or no after the teacher verbally reads to your child what the research is about and what he/she will be asked to do. The child will be told the following:
"You will be asked to write a short reflection about using your interactive notebook in biology, participate in a two week observation, and take part in an interview(additional

8/26/2014

10/13/2014
10/14/2015

APPENDIX D.

MERCER INFORMED ASSENT FOR PARTICIPANTS AGES 14-21

Tift College of Education

(Qualitative Case Study)
Informed Assent for Participants Ages 14-21
"Biology, Literacy, and the African American Voice"

You are being asked to participate in a research study. Before you give your consent to volunteer, it is important that you read the following information and ask as many questions as necessary to be sure you understand what you will be asked to do.

Your biology teacher, an investigator at Mercer University, is doing a research study where she is trying to learn about how using science interactive notebooks help you in your high school biology class. She is also trying to learn how reading and writing help make your biology class meaningful.

Procedures

Any work that you have done in biology for the 2014-2015 school year may be included in this study. You will be asked to write a short reflection about using your interactive notebook in biology, participate in a two week observation period, and take part in one 30-45 minute afterschool interview (Tuesday/Thursday) about your perceptions of the interactive notebook, literacy, and your biology class. If needed an additional 30-45 minute interview (Tuesday/Thursday) will be conducted after school. You have the right to refuse to have your information included in the research. Refusing to include your information will not jeopardize you receiving any services related to your grade, class work, or tests in your biology class.

Interviews

An interview will be conducted after school on a Tuesday or Thursday in September for about 30 minutes. You will be asked six questions about your experiences in biology class, certain learning strategies used in biology class such as Thinking maps or Cornell notes, and how the overall interactive notebook /literacy strategies have affected your learning experiences in biology. Your interview will be recorded on my phone which is a password protected device. Once the interview is completed, I will transfer the file to my password protected computer. If necessary, an additional interview will be conducted afterschool (Tuesday/Thursday) for 30-45 minutes.

Potential Risk and Discomforts

There may be a potential discomfort for you. You may not be comfortable in being completely honest in your interview about your biology class because your interviewer is your teacher. Your answers will not negatively affect your working relationship with me, the teacher/investigator. If at any time, you want to discontinue the study, do so.

Potential Benefits of the Research

The benefits of participation in the research may not directly assist you but the study will assist your teacher and other science educators in understanding the perceptions of African American students in biology class. This study will allow science educators to utilize your stories to better help teach other students like you. This study will also help to make biology more meaningful to future African American students. Confidentiality and Data Storage

10/13/2014
10/14/2015

APPENDIX E.

CHARACTERISTICS USED FOR STUDENT PARTICIPANTS

Student	7th & 8th Grade Science CRCT Data		7th & 8th Grade Reading CRCT Data		9th Literature EOCT	Repeater	Experiences in Science
1	M	DNM	M	M	M	No	Good
2	M	DNM	M	M	M	No	Good
3	DNM	DNM	M	M	DNM	No	Bad
4	DNM	DNM	M	M	M	No	**
5	M	DNM	M	M	M	Yes	Good
6	DNM	DNM	M	M	M	No	Ok
7	M	DNM	M	E	M	No	Good
8	DNM	DNM	M	M	DNM	No	Good

Key:
DNM: Did Not Meet Standards
M: Meets Standards
E: Exceeds Standards
**: Did not Interview

APPENDIX F.

STUDENT INTERVIEW ALIGNMENT

	Student Interview Q1	Student Interview Q2	Student Interview Q3	Student Interview Q4	Student Interview Q5	Student Interview Q6	Student Interview Q7
RQ1:				**X**	**X**	**X**	**X**
How does the science interactive notebook create meaningful learning experiences for African American students within the high school biology classroom of a Title I school?							
RSQb	**X**	**X**	**X**				
How do African American students perceive the effect of the incorporation of science interactive notebooks with other literacy strategies on their science performance within a biology classroom?							

APPENDIX G.

STUDENT INTERVIEW PROTOCOL

1. Tell me about your experiences in science.
2. Describe the best experience you have ever had in science (elementary, middle, or high school)?
3. Describe the worst experience you have ever had in science (elementary, middle, or high school)?
4. How does using science interactive notebooks affect your understanding of biology?
5. Describe how each of the following things affect your learning in biology.
    a. Cornell notes
    b. Thinking maps
    c. Close reads of articles
    d. Working in groups
    e. Lab Experiments
    f. Writing
6. How could you make your learning experiences in biology more meaningful to you?

APPENDIX H.

TEACHER INTERVIEW ALIGNMENT

	Teacher Interview Q1	Teacher Interview Q2	Teacher Interview Q3	Teacher Interview Q4	Teacher Interview Q5	Teacher Interview Q6	Teacher Interview Q7	Teacher Interview Q8	Teacher Interview Q9
RQ1:					X	X	X	X	X
How does the science interactive notebook create meaningful learning experiences for African American students within the high school biology classroom of a Title I school?									
RSQa	X	X	X	X					
	How do African American teachers perceive the effect of the incorporation of science interactive notebooks with other literacy strategies on the science performance of African American students?								

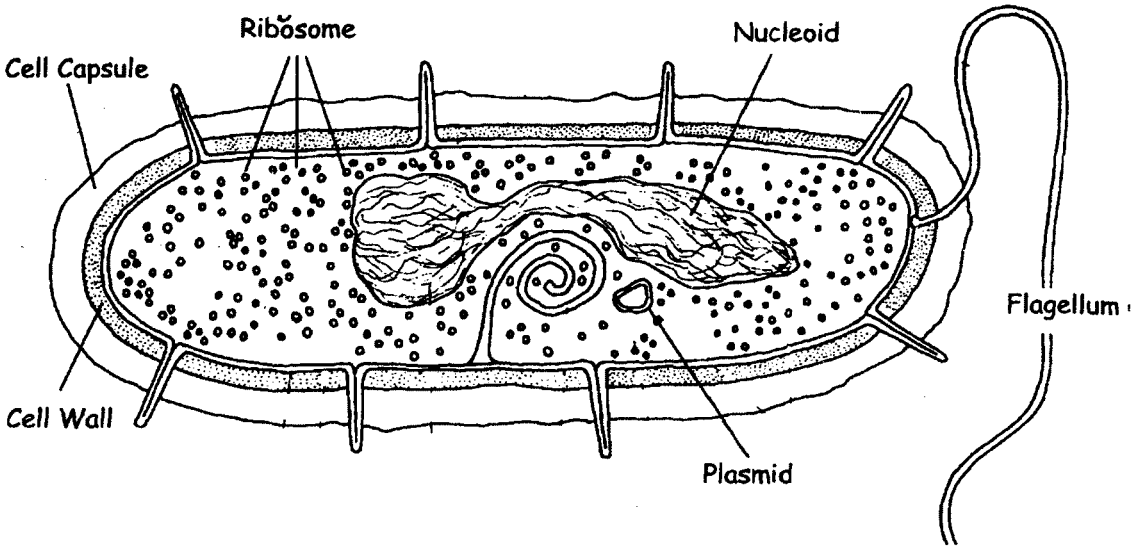
APPENDIX I.

TEACHER INTERVIEW PROTOCOL

1. Tell me a little bit about yourself.
    a. Years of teaching
    b. Subject areas taught
    c. Certifications and endorsements
2. Tell me about your experiences as a science educator.
3. Describe the best experience you have ever had teaching in a collaboration science class?
4. Describe the most challenging experience you have ever had teaching in a collaboration science class?
5. How does your knowledge of literacy impact students' performance in the biology classroom?
6. How does using science interactive notebooks help your students understand the biology concepts?
7. What specific strategies/activities have you used with your students to help you understand biology concepts better? (i.e. concept mapping, Thinking maps, Cornell notes, self-reflection, reading informational texts, and writing).
8. How does writing a reflection help your students demonstrate an understanding of the biology concepts they have learned?
9. How could you use literacy to help students learning experiences in biology become more meaningful?

APPENDIX J.

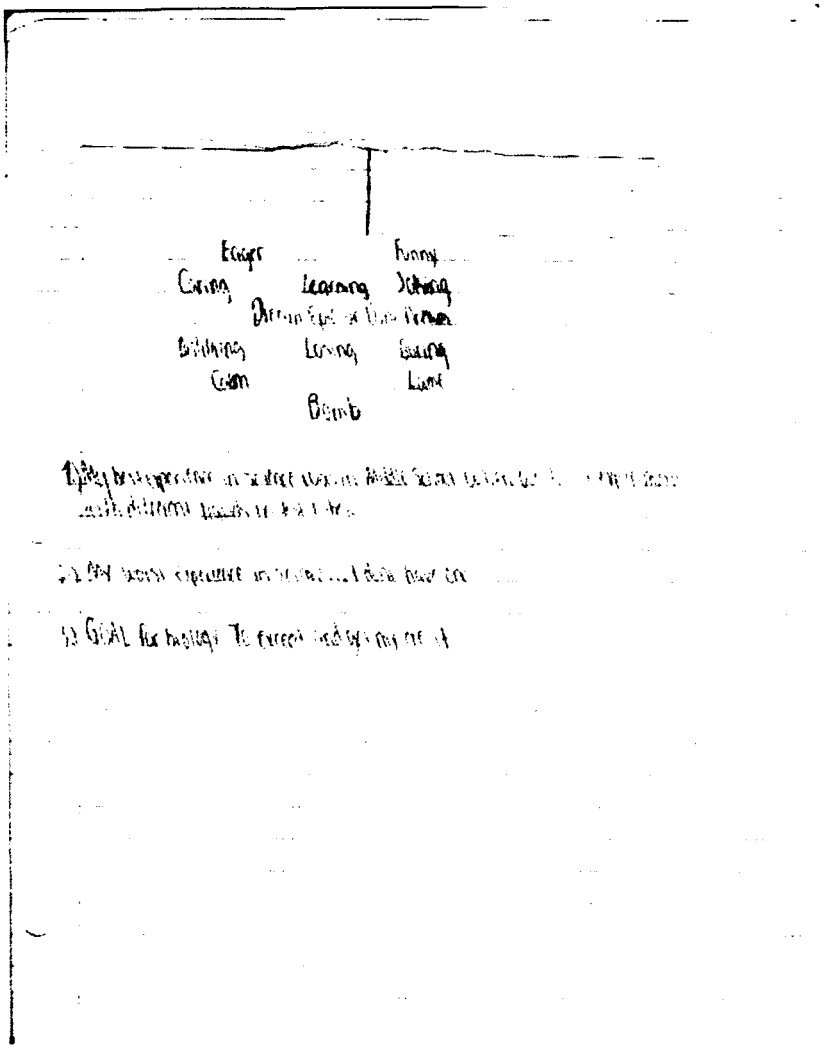
PICTURE OF PROKARYOTIC CELL



http://chsweb.lr.k12.nj.us/mstanley/outlines/cellap/APcell5.gif

APPENDIX K.

KRIS: DIAMANTE POEM


Eager
Funny
Learning
Bomb

APPENDIX L.

KASONDRA: MORPHING MITOCHONDRIA CLOSE READ ACTIVITY: ANSWERS TO TEXT DEPENDENT QUESTIONS AND QUICK WRITE SUMMARY

Morphing Mitochondria

11/4/14.

The cells Dr. Yaffe has used to see mitochondria morphing such as yeast or fruit fly cells.

Scientists believe that Mitochondria divide on their own and have their own genome and protein-making machinery and Resemble prokaryotes in many ways.

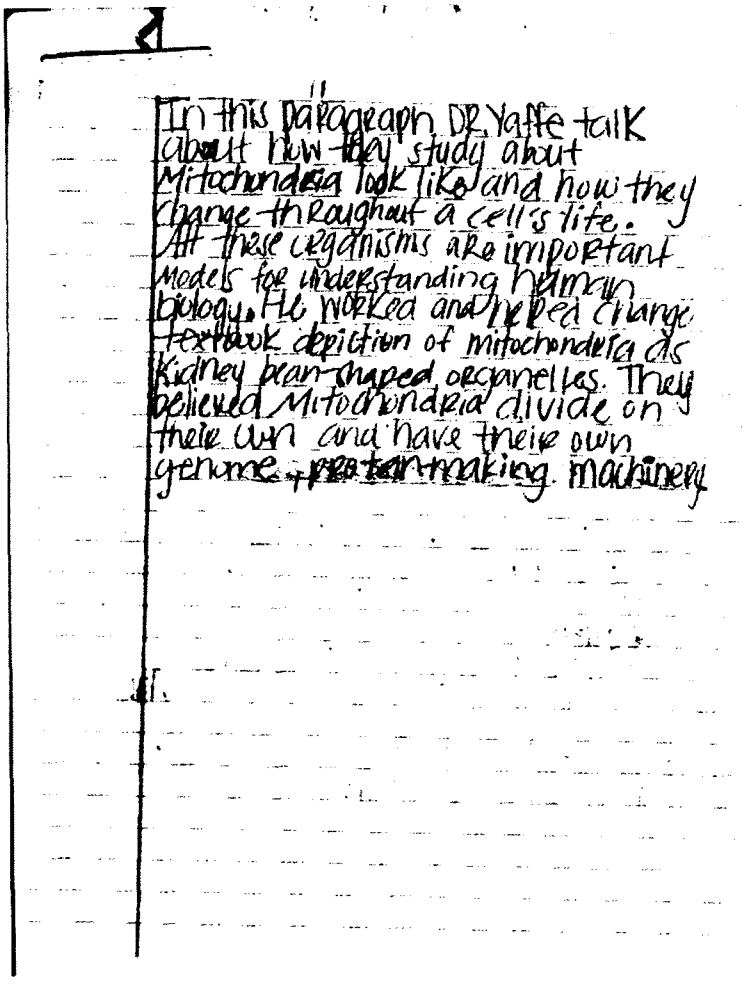
[redacted]

I would describe mitochondria as a oxygen-loving microorganisms.

[redacted]

The macromolecule the genome would be connected to is Nucleic Acids.

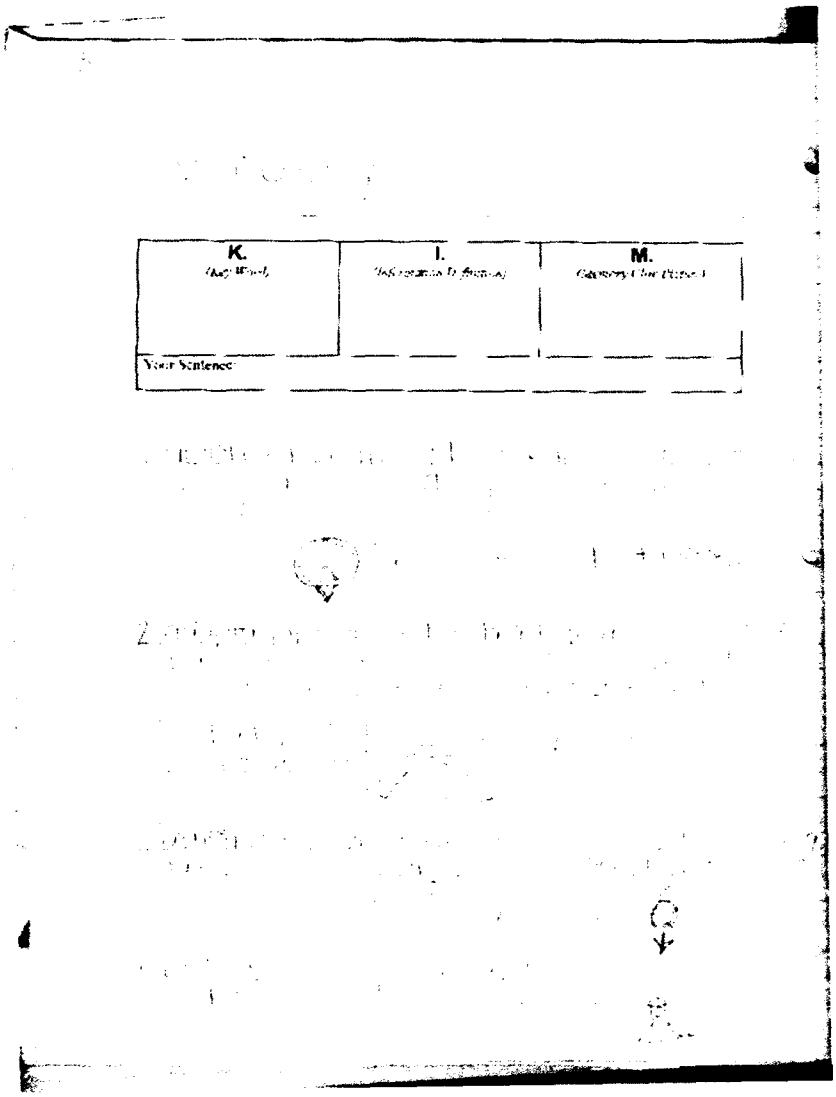
Reading this made me learn more about what they believed in.



In this paragraph DR.Yaffe talk about how they study about Mitochondria look like and how they change throughout a cell's life. All these organisms are important models for understanding human biology. He worked and helped change textbook depiction of mitochondria as kidney bean-shaped organelles. They believed Mitochondria divide on their own and have their own genome protein-making machinery

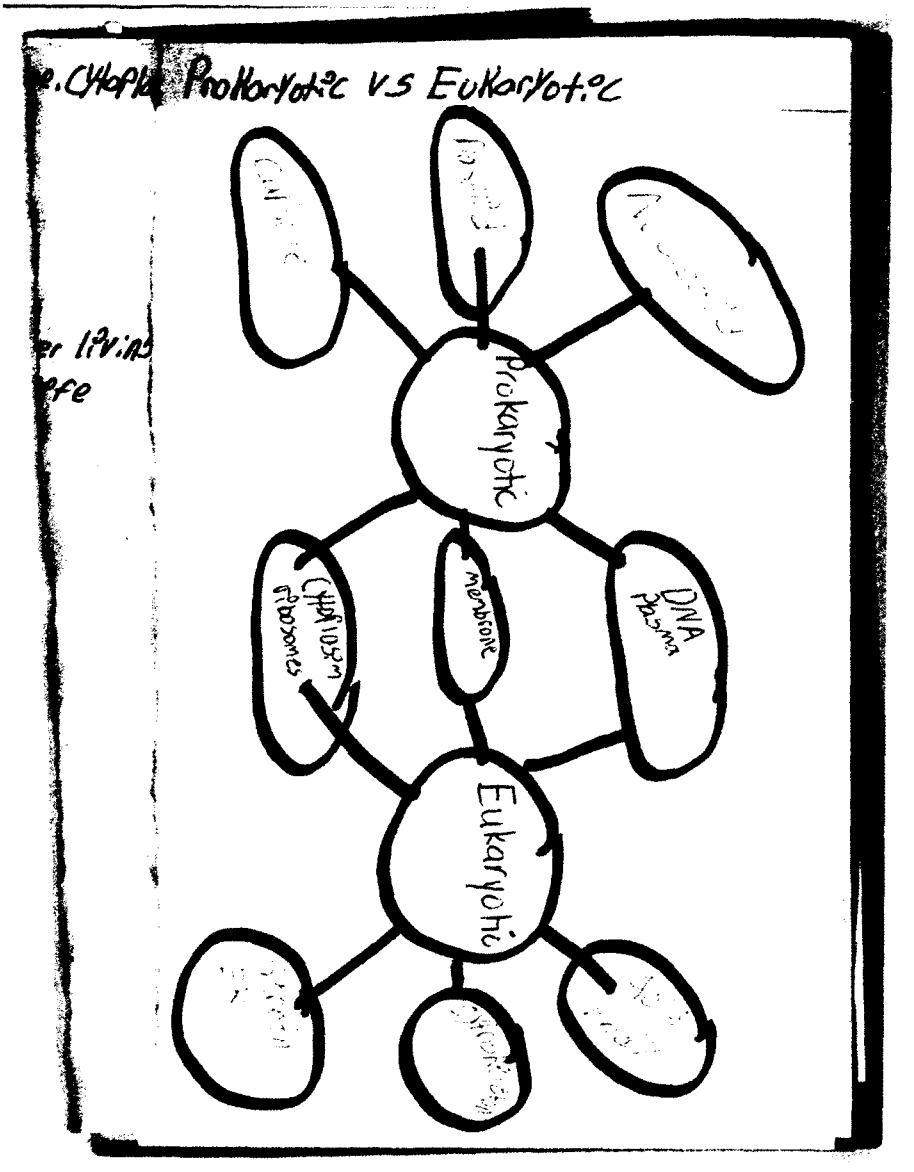
APPENDIX M.

ANGEL: KIM VOCABULARY


K.
I.
M.
Your Sentence:

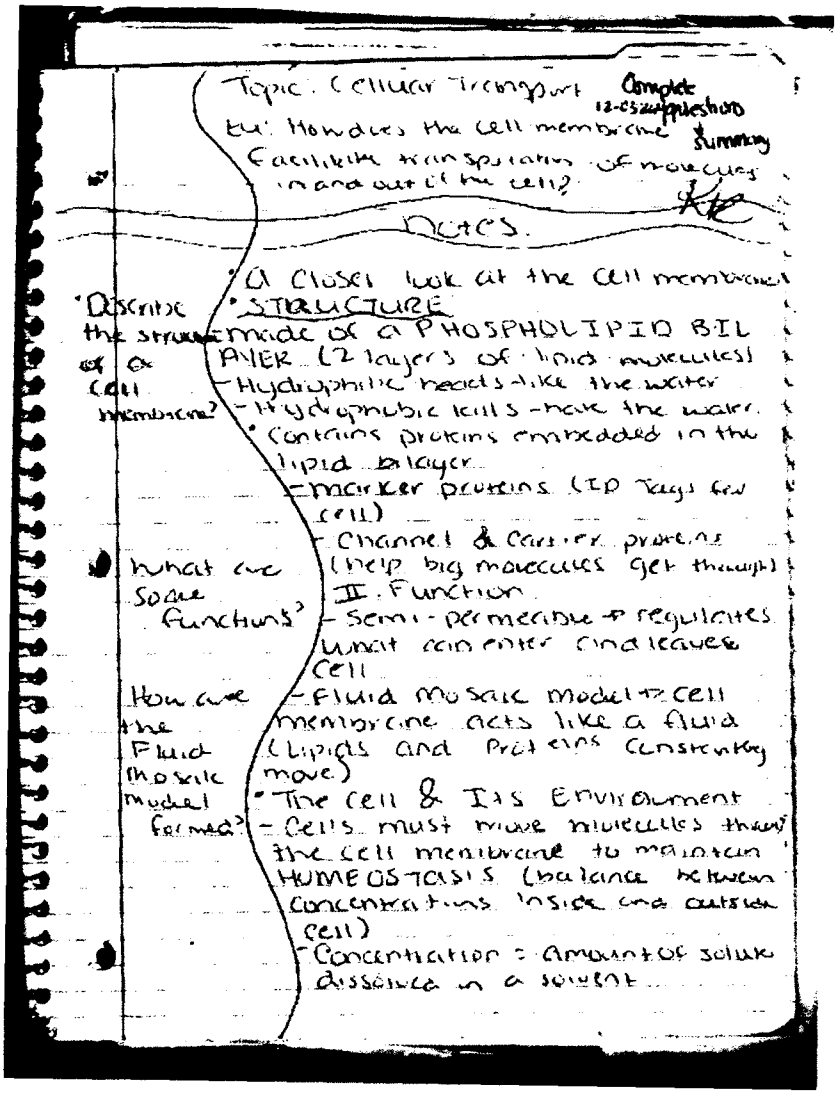
APPENDIX N

MICHEAL: THINKING MAP


Prokaryotic
Eukaryotic
DNA
Membrane

APPENDIX O.

JULIE: CORNELL NOTES



Topic: Cellular Transport Complete 12-03 Application Summary

EU: How does the cell membrane facilitate transportation of molecules in and out of the cell?

KE

NOTES.

*A closer look at the cell membrane

*Describe the structure of a cell membrane?

*STRUCTURE

- made of a PHOSPHOLIPID BILAYER (2 layers of lipid molecules)
- Hydrophilic heads-like the water
- Hydrophobic tails-hate the water
- *Contains proteins embedded in the lipid bilayer
  - marker proteins (ID tags for cell)
  - Channel & Carrier proteins (help big molecules get through)

II. Function

What are some functions?

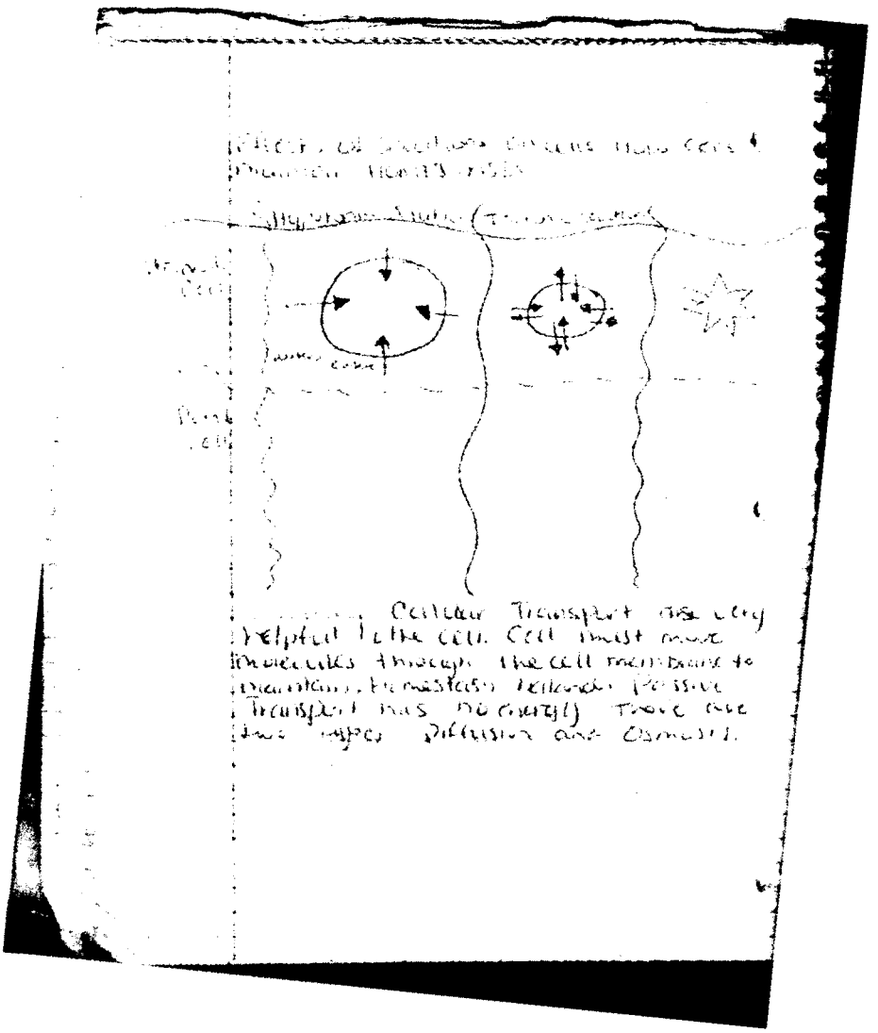
- Semi-permeable → regulates what can enter and leave cell

How are the Fluid Mosaic model formed?

- Fluid Mosaic Model → cell membrane acts like a fluid (Lipids and Proteins constantly move)

*The Cell & Its Environment

- Cells must move molecules through the cell membrane to maintain HOMEOSTASIS (balance between concentrations inside and outside cell)
- Concentration = Amount of solute dissolved in a solvent



APPENDIX P.

DISSERTATION TIMELINE

Keturah M. Reese 11/26/2014

Doctoral Student Signature date Doctoral Committee Chair
Signature date

Activity	**Target Date**
Admission to Candidacy	
Complete proposal (Chapter 1, 2, & 3)	March 1, 2014
Defend proposal	March 18, 2014
Mercer IRB application submitted	August 25, 2014
Formally apply to graduate	Completed
Complete data collection	November 24, 2014
Complete data analysis (chapters 4-5)	January 15, 2015
Schedule final defense	March 1, 2015
Submit final dissertation to Committee *(must be submitted 2 weeks prior to final defense date)*	March 1, 2015
Final Defense	March 17, 2015
Final Format Check Doctoral Committee Chair will: A. Check for final revisions	March 17, 2015

B. Proofread for grammar and punctuation errors C. Check for APA 6 accuracy	
Final copies for signatures submitted to PhD Program Director, Department Chair, Dean of Tift College *(Important: check ahead of time for availability for signatures.)*	March 18, 2014
For Posting of Degree in Spring:	
Copies for binding submitted to Provost's Office	**April 1, 2015**
Commencement	**May, 2015**
For Posting of Degree in Summer:	
Copies for binding submitted to Provost's Office Summer Enrollment in EDCI 881 required	
Commencement	
For Posting of Degree in Fall:	
Copies for binding submitted to Provost's Office Summer and Fall Enrollment in EDCI 881 required	
Commencement	