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COMPREHENSION OF SCIENCE TEXT BY AFRICAN AMERICAN FIFTH AND SIXTH
GRADE STUDENTS: THE EFFECTS OF A METALINGUISTIC APPROACH

by

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A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
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ABSTRACT

Scientific literacy has been at the forefront of science education reform for the past 20 years, particularly for students from culturally and linguistically diverse (CLD) backgrounds (Lee et. al., 2005; Pearson, Moje & Greenleaf, 2010). The ability to extract meaning from text is an important skill. Yet many students struggle with effectively comprehending what they read, particularly in content areas of science, math and history. According to the National Assessment Educational Progress (NAEP, 2013) report, adolescents are not acquiring advanced literacy skills needed to succeed in the workplace and academic setting. Literacy experts have called for the use of disciplinary literacy approaches to engage learners with the content in ways that mirror what scientists, historians and mathematicians do to gain understanding in their disciplines (Moje, 2006; Shanahan & Shanahan, 2008).

Although disciplinary literacy instruction is promising, there is limited empirical research on the effectiveness of discipline-specific literacy approaches. The present study examined the effects of a metalinguistic approach on the comprehension of science text among African American 5 and 6th grade students. The focus of the instructional protocol was to explicitly teach adverbial clauses and assist students to unpack adverbial clauses through the use of a graphic organizer. The process of unpacking complex sentences aimed to facilitate comprehension of science text by engaging the participants in analysis and discussion of the meaning obtained from the adverbial clauses.

This study employed an experimental single-case multiple-probe across participants design. Visual Analysis (VA) and the Improvement Rate Difference (IRD) were used to analyze

the data. The results of VA and IRD indicated that all participants demonstrated progress between baseline and treatment phases. Overall, the results of the investigation suggest that it is possible for 5th and 6th grade African American students to benefit from instruction that closely analyzes language. Clinical implications and future research directions are discussed.

To my family: Mom, Dad, Sharon, Charlita, Joelle, and my soon to be hubby, Khary.

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CHAPTER I: INTRODUCTION

This study examined the impact of a metalinguistic approach to facilitate the comprehension of the text found in the discipline of science. Specifically, the study determined whether such an instructional approach, consisting of explicit instruction in adverbial clauses, would have a positive effect on the comprehension of science text among three African American females in fifth and sixth grades. This chapter presents the current problem, purpose of the study, specific research questions, hypotheses, study limitations, delimitations, assumptions, and operational definitions.

Statement of the Problem

Upper elementary, middle school, and high school students are not reading and writing above basic level or gaining the literacy skills they need to perform at their full potential in school and the workforce (Cook & Ball, 2009; NAEP, 2011; NAEP, 2013). Adolescents need to demonstrate advance literacy skills, which require the ability to understand and analyze a variety of texts, write, and verbally communicate persuasively (Heller & Greenleaf, 2007). Adolescents' ability to acquire advance literacy skills is important to the United States' standing in the global economy. Our nation is concerned about preparing and increasing the numbers of scientists, engineers, and mathematicians to keep the U.S. in the forefront of research, innovation, and technology (Lantz, 2009). However, the National Assessment Educational Progress (NAEP, 2013) reported that adolescents continue to perform below proficient levels in reading and writing, suggesting that the nation's position as a leader in the economy may be in jeopardy

because adolescents are not acquiring the advance literacy skills to become successful in the aforementioned professions.

More concerning is the persistent achievement gap between the literacy expectations in reading and science and the achievement among African American students and White students in those academic areas. Seventeen percent of fourth grade African American students and 16% of African American eighth graders performed at proficient levels in reading. In comparison, 43% of White fourth graders and 40% of White eighth graders performed at proficient levels in reading. Thirty-four percent of fourth grade African Americans and 39% of eighth grade African Americans performed below basic levels in reading; while 9% of White fourth graders and 14% of White eighth graders performed below basic levels in reading (NAEP, 2013). On the 2011 NAEP science assessment, White and African American eighth grade students performed below proficient levels. An achievement level of 141 indicates basic level skills and a score of 170 represents proficient level (NAEP, 2011). However, there was a great disparity in the percentage of African American eighth grade students performing below basic levels. The average score among African American eighth graders was 129 in comparison to the average score of 163 among White eighth graders (NAEP, 2011).

These alarming data have translated into research examining various factors impacting academic achievement among African American students in literacy and content-area education, such as science education. Research has identified the limited number of African Americans pursuing science careers, as well as their negative attitudes towards science and difficult experiences within science classrooms (Brown, 2005; Lee & Fradd, 1996; Lee, Deaktor, Hart, Cuevas, & Enders, 2005). Researchers in the field of linguistics and communication sciences

and disorders often opined that the oral language of African American students has been one of the many contributors to the low performance observed in their reading and writing (Charity, Hollis, Scarborough, & Griffin, 2004; Craig, Washington, Thompson-Porter, 1998; Green, 2002; Terry, 2010; Washington & Craig, 1994; Wolfram, 1997).

In science education research, scholars (e.g., Brown, 2005; Fang 2004; Wellington & Osborne, 2001) have noted that a major challenge for students in learning science is understanding the language of science itself. The language of science is characterized by specialized grammar. Fang (2004) described the language of science as very dense, abstract, technical, and authoritative. Some scholars suggest that because the discipline of science has its own language there is a need to teach science explicitly as a second language (Brown & Spang, 2007; Otero et al., 2005). Particularly, for African American students, science discourse may conflict with the student's use of everyday ways of describing phenomena and experiences if they are unfamiliar with the language of schooling (Brown, 2005; Schellepegrell, 2007).

Traditionally, a content-literacy approach has been utilized to teach literacy within subjects of science, math, history and literature. This approach is characterized by the use of general literacy strategies (e.g., predicting, summarizing, paraphrasing) across content-area subjects to teach reading (Snow & Moje, 2010). Shanahan (2008; 2012) highlighted that the content literacy approach emphasizes the use of techniques to help student make sense of disciplinary text, such as how to study for a science exam. Although this approach has been helpful for students, literacy experts (e.g., O'Brien, Moje, & Stewart, 2001; Shanahan & Shanahan 2008; Snow & Moje, 2010) have been advocating for a disciplinary literacy approach in recent years.

A disciplinary literacy approach focuses on teaching content-area subjects by emphasizing the language and literacy demands of the subject. However, there are limited data to support the effectiveness of disciplinary literacy strategies and approaches among various populations. These populations would include students from culturally and linguistically diverse (CLD) backgrounds (Almanza de Schonewise & Klinger, 2012; Lee, Deaktor, Hart, Cuevas, & Enders, 2005). Thus, this study focused on examining possible correlations between African American students' linguistic abilities and their comprehension of the language of science.

Purpose of the Study

The purpose of the present study was to examine the impact of an approach to facilitate the comprehension of the text found in the discipline of science. The primary goal was to determine whether such an instructional approach, consisting of explicit instruction of adverbial clauses, would have a positive effect on the African American students' comprehension of science text.

Research Questions

1. What are the effects of a metalinguistic approach using a graphic organizer on the unpacking of complex sentences with adverbial clauses by African American fifth and sixth grade students?
2. What are the effects of a metalinguistic approach used to unpack complex sentences on the comprehension of science text among African American fifth and sixth grade students?

Hypotheses

1. Two African American fifth grade students and one sixth grade student taught about adverbial clauses using a metalinguistic approach with a graphic organizer, will demonstrate the ability to unpack complex sentences.
2. Two African American fifth grade students and one sixth grade student taught about adverbial clauses using a metalinguistic approach will demonstrate improved comprehension of science text.

Significance of the Study

According to Ehren, Murza, and Malani (2012), language growth in syntax and semantics has important implications for the academic language used during adolescence. Adolescents have to comprehend and produce increasingly complex sentences (Nippold, Hesketh, Duthie, & Mansfield; 2005; Nippold, Mansfield, Billow, & Tomblin, 2008; Scarborough, 1990). Specifically, the language demands found in the content areas of science and history call for students to attend to vocabulary, clause structures, and syntax structures (Fang & Schleppegrell, 2008).

Disciplinary literacy requires professionals who work with adolescents in the area of literacy to be familiar with the language demands that students will encounter in the academic setting. Generally in the research literature, literacy instruction for adolescents has often been associated with middle and high school grades (Alvermann, Swafford, & Montero, 2004; Brown, 2005; Wood, 2003). However, providing early exposure to discipline specific text can lay the foundation for student understanding of the text that dominates in later grades (Duke & Bennett-

Armistead, 2003). With the recent adoption of more rigorous learning standards by many states, educators cannot wait until the complexity of middle and high school academic standards increases to address the literacy skills needed to be successful in post-secondary education and beyond to address the literacy skills needed to be successful. Therefore, it is essential to prepare students as early on as fifth and sixth grades.

This requirement provides the opportunity for speech-language pathologists (SLPs) to showcase their added value to students' academic success. SLPs' knowledge about language places them in a position to impact reading and writing instruction (Ehren, Murza, & Malani, 2012). Therefore, conducting research on the effectiveness of an instructional approach can highlight SLPs' stake in disciplinary literacy.

Theoretical Framework

This research is grounded in Halliday's systemic functional linguistics (SFL), the meaning-based theory of language (Halliday & Matthiessen, 2004), which views language as a resource for making meaning. It explores how language is used in social contexts to achieve particular goals, therefore placing more emphasis on language function than on language structure.

Language function is referred to as functional grammar and is different from traditional school grammar. Functional grammar does not view language as just a set of rules (e.g., subject-verb agreement, placement of adjectives); it emphasizes the link between the linguistic choices of speakers and writers to convey information of a specific discipline (Schleppegrell, 2004). SFL allows for clauses in sentences to be separated into manageable chunks. This is in contrast to traditional grammar which isolates grammatical features (Schleppegrell & Go, 2007). In other

words, linguistic structures (e.g., adverb clauses, nominalization, noun clauses) are selected to communicate specific information for a particular purpose.

In describing systemic functional linguistics, Halliday (1994) supported the examination of lexical and grammatical choices that create clauses to understand the meaning of registers of text. Registers are configurations of certain lexical and grammatical resources that are appropriate for particular language use within a particular discourse context (Schleppegrell, 2004). Halliday (1994) identified three kinds of semantic components of register that he referred to as meta-functions: ideational, interpersonal, and textual.

Ideational meaning refers to language being able to construe experience in terms of what is going on around us or inside us. In reference to literacy, this would refer to what the text is about. The second meta-function, interpersonal, refers to language interacting with the world by negotiating social roles and attitudes. In literacy, interpersonal would refer to interaction, attitudes, and judgments found in text. Lastly, textual function refers to how messages are organized to convey meaning. In literacy, this refers to how clauses, phrases, and conjunctions are used to organize text in a cohesive manner.

SFL has expanded in the last two decades through the work of many scholars in North America (Fang & Schleppegrell, 2008; Lemke 1998; Schleppegrell, 2007), in Australia (Christie, 2002; Hasan & Martin, 1989; Painter, 1989) and Latin America (Bolivar 1994; Ghio & Fernandez, 2005). According to Schleppegrell (2007), it is through a systemic functional linguistics approach that we can analyze lexico-grammatical choices for crafting texts, show how meaning is created, and present the options linked to meaning, all of which give the students some control over their academic success. In other words, “literacy research that incorporates a

focus on language itself through a systemic functional linguistic perspective on grammar can recognize the role of language in literacy development and offer new ways of talking about language that can enrich teaching and learning” (Schleppegrell, 2007, p.127).

Fang and Schleppegrell (2008, 2010) highlighted the use of SFL in their development of Functional Language Analysis (FLA), an approach developed to improve literacy in secondary content areas. Specifically, this system aims to develop students’ understanding of how language works in different subjects by enabling students to read clauses closely and talk about the language choices used by the author to convey meaning. FLA is further described as an approach that makes content accessible to students and should be embedded in a sequence of activities in which students speak, interact, and do project work in a coherent unit of instruction. This approach consists of various activities that allow students to analyze text closely, such as vocabulary building, noun expansion, paraphrasing, contrastive analysis, sentence combining, and sentence deconstruction (Fang, 2006).

Halliday’s theory of systemic functional linguistics (1978, 1994) combined with Schleppegrell’s (2008, 2010) interpretation influenced the theoretical framework for the metalinguistic approach developed for this particular study. This study aims to gain more understanding of the challenges that African American students may face in comprehending written academic discourse of a particular discipline. Therefore, unlike FLA, the metalinguistic approach used in this study focuses specifically on sentence deconstruction to examine the meaning provided by adverbial clauses. The findings from this study have the potential to help students who struggle with the linguistic skills of the academic setting and support speech-

language pathologists, teachers, and reading specialists who strive to help them acquire these skills.

Limitations of the Study

There are several possible limitations that were considered in conducting this design. This study had the following limitations:

1. The investigator could not control for the absences of the participants.
2. There was a possibility that the intervention may have produced inconsistent effects on the participants. For instance, the data of the participants' current reading comprehension level and ability to unpack complex sentences might demonstrate varied trends during baseline prior to the introduction of the intervention.
3. Generalization of this study may be limited to African American, female fifth and sixth grade students enrolled in private schools in Durham, North Carolina.

Delimitations

Given the contributions of this study, there were boundaries that had been specifically set to conduct this study. This study had the following delimitations:

1. The study used a single-case experimental design, therefore, a relatively small number of students were included in the investigation.

2. The intervention was developed to explicitly instruct student participants how to unpack complex sentences consisting of adverbial clauses as opposed to unpacking other kinds of clauses, such as adjective and noun clauses.
3. Science text was selected because science text is characterized by frequent usage of adverbial clauses.
4. The participants were required to meet the following inclusionary criteria:
 - a. African American
 - b. Enrolled in the summer enrichment program
 - c. Previously enrolled in the private school during the school year
5. The intervention was provided four days a week.
6. Student participants completed all assessments across phases.

Assumptions

This study makes the following assumptions:

1. Students will be purposeful in learning about adverbial clauses and the use of graphic organizer to unpack complex sentences.
2. Decoding, vocabulary, and reading fluency skills may be the basis of the reading comprehension difficulties for the students enrolled in the summer enrichment program.
3. Improving reading skills will continue to be important in the school curriculum as evidenced by the implementation of summer enrichment program and reading enrichment programs utilized during the school year.

Operational Definitions

The following terms are operationally defined for the purpose of this study:

1. *Achievement gap*: A statistically significant difference in scores in reading and science between White and minority students (NAEP, 2011).
2. *Adolescent literacy* refers to “the set of skills and abilities that students need in grades 4-12 to read, write, and think about the text materials they encounter” (Berman & Biancarosa, 2005, p. 6). Adolescent literacy incorporates multiple literacies, including workforce literacy, content literacy, disciplinary literacy, and digital literacy (Langer, 2001).
3. *Adverbial clause*: A dependent clause that provides information about time, place, manner, condition, and reason. These clauses begin with subordinating conjunctions, such as after, before, since, when, while (Justice & Ezell, 2008).
4. *African American English*: A rule governed variety of English that contributes in part to the cultural identity of individuals in the African American community (Green 2002). This dialect is characterized by at least 40 morpho-syntactical features that differ from other varieties of English (Oetting & McDonald, 2002; Washington & Craig, 1994).
5. *Clause*: A syntactic structure or a group of words that contains a subject and a verb. The clause can be complete (independent/main) or incomplete (dependent/subordinate) (Justice & Ezell, 2008).
6. *Complex sentence*: A sentence consisting of one independent clause and one or more dependent clauses (Justice & Ezell, 2008).

7. *Content literacy*: instructional support that teaches reading using subject areas. There is emphasis on techniques that a novice might use to make sense of a disciplinary text, such as how to study a history book for an examination (Shanahan & Shanahan, 2012).
8. *Dependent clause*: A clause that contains a subject and a verb but must be combined with an independent clause to form a sentence. It is typically introduced by a subordinating conjunction (Justice & Ezell, 2008).
9. *Disciplinary literacy*: Specialized ways of sharing information, getting people's attention, debating, responding to criticism, reporting facts, and establishing authority in a given subject area (Shanahan & Shanahan, 2008).
10. *Explicit instruction*: A systematic instructional approach that includes a set of delivery and design procedures derived from effective schools' research merged with behavior analysis. It is characterized by a series of scaffolds whereby students are guided through the learning process. It includes clear statements about the purpose for learning the new concept or skill (Archer & Hughes, 2011; Hall, 2002).
11. *Functional Language Analysis*: An instructional approach developed for secondary content area reading. This approach offers a set of practical tools for engaging students in systematically analyzing the language patterns and discussing the meanings of these language patterns in disciplinary texts (Fang, 2012; Fang & Schleppegrell, 2008; 2010).
12. *Independent clause*: A clause that contains a subject and a verb. This clause expresses the main idea of a sentence, can stand alone, and maintain full meaning (Justice & Ezell, 2008).

13. *Metalinguistic approach*: An instructional model that deliberately makes language system the object of thought and discussion among students. Students consciously consider the nature and function of the language at the word, form, and meaning levels and give thought to the patterns of language (Francis, 2006; Turner & Cole, 1985).
14. *Systemic Functional Linguistic*: a theory of language developed by Michael Alexander Kirkwood Halliday during the 1960s that provides a framework for demonstrating how meaning is constructed in text (Halliday, 1994).
15. *Subordinating conjunction*: A word used to connect a dependent clause with an independent clause. The subordinating conjunction is positioned at the beginning of the dependent clause (e.g., after, although, when) (Justice & Ezell, 2008)
16. *Unpack*: refers to the actions of study participants in identifying adverbial clause components within complex sentences. In this study, unpacking was achieved through the use of a graphic organizer. The graphic organizer guided the participants in their analysis of grammatical features in order to comprehend complex sentences.

CHAPTER II: REVIEW OF THE LITERATURE

This study investigated the effectiveness of a metalinguistic approach used to facilitate the comprehension of text found in the discipline of science among two African American fifth students and one sixth grade student. The following is a review of literature pertinent to this study. First, this literature review will discuss adolescent literacy and the existing literacy achievement gap. Secondly, this review will focus on the underperformance of African American students in literacy and the content area of science. This review will then address the importance of disciplinary literacy and the language demands found in the content area of science. Next, this review will discuss the theoretical frameworks adopted to develop the metalinguistic approach used in the study. Since the purpose of this research study is to investigate the effects of a metalinguistic approach to improve comprehension when reading science text, the review will highlight the current teaching practices in science education to improve student reading comprehension.

Adolescent Literacy and the Achievement Gap

Literacy Features and Student Performance

Literacy has been defined as the ability to read, write, speak in English, compute, and solve problems at levels of proficiency necessary to function on the job and in society, to achieve one's goals and to develop ones knowledge and potential (National Literacy Act of 1991). Researchers recognize that literacy development is a complex, multi-layered, and ongoing process that does not end in the elementary grades (Berman & Biancarosa, 2005). The term 'adolescent literacy' refers to readers in grades four through 12 and their ability to read, write,

use language, reason, and analyze information for various situations and disciplines (Berman & Biancarosa, 2005; Kamil et al., 2008; Langer, 2001; Marchand-Martella et al., 2013). Moje, Overby, Tysvaer, and Morris (2008) stated that ‘adolescent literacy’ includes the needs of adolescents who have been labeled as struggling or striving readers as well as students that are successful readers.

After grade three, reading in subject areas becomes longer, more complex, and content dense. It also becomes increasingly more varied in vocabulary, text structure, purpose, and style (Heller & Greenleaf, 2007). The demands of these changes require adolescents to possess high literacy skills to comprehend this text. However, millions of adolescents do not possess the proficient literacy skills to be successful at the secondary and post-secondary level (Biancarosa & Snow, 2006).

The acquisition of literacy among older students is at a crisis, as evidenced by the percentage of students that continue to struggle with reading comprehension and writing past the fourth grade. According to NAEP (2009, 2011), reading comprehension scores indicated minimal change from 2009 to 2011 for fourth and eighth graders. Sixty-seven percent of fourth graders performed below proficient level, while 76% of eighth graders performed below proficient levels. Only 3% of fourth and eighth graders performed at advance levels in reading. NAEP (2011) provided examples of advanced level literacy skill for fourth and eighth graders. Eighth graders are expected to be able to form an opinion about a central issue in an argumentative text and support it with references. Fourth graders are expected to demonstrate the ability to use story events to support an opinion about a story type. These higher order literacy skills are imperative in the literacy demands of the workforce and post-secondary

settings. Internationally, six countries had higher scores than U.S. in reading literacy. Eighteen percent of U.S. students scored below basic literacy levels (OECD, 2013). This is especially concerning as the demand for a literate workforce in today's global economy is increasing, and is only expected to grow (Partnership for 21st Century Skills, 2003; RAND Reading Study Group [RRSG], 2002).

Much attention has been placed on the literacy needs of students in grades kindergarten through third grade, following the results of the publication of the *Report of the National Panel Reading* (2000). Equally alarming was achievement data reported by NAEP (2009) on the reading performance of adolescents, making it apparent that literacy skills among this group needed just as much attention. In response to consistently low NAEP scores among America's adolescent students, Biancarosa, & Snow (2006) developed guidelines for effective adolescent literacy instruction entitled, *Reading Next*. This position paper described in detail 15 elements imperative to improving middle and high school literacy achievement. The 15 elements included: (a) Direct, explicit comprehension instruction; (b) effective instructional principles embedded in content; (c) motivation and self-directed learning; (d) text-based collaborative learning; (e) strategic tutoring; (f) diverse texts; (g) intensive writing; (h) a technology component; (i) ongoing formative assessment of students; (j) extended time for literacy; (k) professional development; (l) ongoing summative assessment of students and programs; (m) teacher teams; (n) leadership; and, (o) a comprehensive and coordinated literacy program.

Following *Reading Next*, meta-analysis and research reviews were published regarding effective literacy strategies and instruction for adolescents. Soon, more funding streams for adolescent literacy emerged. The Striving Readers Program, for example, was established to

focus on literacy support for students from birth to grade 12. With this progress, one would hope to see major gains in adolescents' reading and writing. However, adolescents continue to demonstrate challenges in reading and writing, particularly reading comprehension (NAEP, 2011; 2013). Although NAEP provides data regarding reading comprehension in general, other literature on academic achievement among adolescents support that adolescents are struggling to comprehend text in specific disciplines such as science, history, math and literature (Fang, 2012).

The Literacy Achievement Gap

Another concern within adolescent literacy is the achievement gap. The National Assessment of Educational Progress (NAEP, 2013) reported that African American students are performing below proficient levels in reading, while their White counterparts continue to perform at or above grade level in reading. This gap has persisted since 2005, when African American students scored 26 points below their Caucasian peers in reading. This performance discrepancy has been called the "Black-White" achievement gap, and has been evident for nearly a century (Fishback & Baskin, 1991).

Research has identified various factors impacting the achievement gap. The National Education Association (NEA) published a report that grouped these factors into seven categories: (a) *school wide factors*; such as curriculum rigor, low expectations for student achievement, poor instructional leadership, culturally unfriendly environment; (b) *teacher and teaching-related factors*, such as uncertified and inexperienced teachers, inadequate instructional materials, poor teacher preparation, and low expectation for students; (c) *students' background*, such as families socioeconomic status, primary language, low birth weight, diet and nutrition, and mobility; (d)

local community, such as access to health and social services, access to libraries, museums, after-school programs, and community safety; (e) *student-related factors*, such as motivation, self-efficacy, interest in school; (f) *education funding shortfalls*, such as state budget deficits, and inequities in funding among school districts, and (g) *families' support of student learning*, such as students' at-home reading behavior and TV watching, families participation in school activities, and families' literacy skills.

The Equity and Excellence Commission (2013) published a five-part framework to guide policies addressing the aforementioned factors in order to close the achievement gap. The framework consisted of recommendations addressing: (a) equitable school finance; (b) teachers, principals, and curricula; (c) early childhood education; (d) mitigating poverty's effect, and (e) accountability and governance.

The push for closing the achievement gap is not a new phenomenon. For the past ten years, policy makers at the national, state, and local district levels examined and implemented several policies, regulations, and practices designed to assist underrepresented students in U.S. classrooms. For instance, The No Child Left Behind Act of 2002 (NCLB) reauthorized and reformed the Elementary and Secondary Act (ESEA) of 1965. Under this legislation, former president George Bush proposed a deadline that all students are expected to meet or exceed minimum proficiency standards, as defined by each state by the 2013-2014 school year. Obama's administration adopted "The Race to the Top" (2009) which posits that states must make realistic plans to conduct school reform to improve literacy for all students. The race to the top legislation also emphasizes literacy in the area of science, technology, engineering and mathematic (STEM). In addition to Race to the Top, the Obama administration implemented

efforts such as Educate to Innovate (2009) which called on federal government, foundations, leading companies, non-profit organizations, science and engineering societies to build partnerships with communities and schools to strengthen STEM education for underrepresented populations. These efforts aimed to improve instruction for underrepresented students, with an emphasis on students who are English learners (ELs).

Although these initiatives have good intentions, two issues arise. One issue is that early literacy has received more attention than adolescent literacy. The Department of Education's funding for states and media interest have focused in recent years on early literacy – improving reading instruction in kindergarten through third grade (Snow & Biancarosa, 2003). With federal and state support, early literacy research has been able to conduct empirical studies to inform instruction and address concerns regarding the achievement gap. For instance, research has found that home literacy practices and the nature of early reading instruction impact the achievement gap (Scarborough & Dobrich, 1994; Whitehurst & Lonigan, 2001). Researchers have also examined the relationship between literacy and factors such as educational levels of caregivers and socioeconomic status (National Reading Panel, 2000; National Research Council, 1998; Senechal & LeFevre, 2002; Sirin, 2005). Such findings led to early literacy initiatives such as Reading First (2002). However, adolescent literacy began to receive more attention following the NAEP (2005) results that indicated that 70% of students entering fifth and ninth grade were reading below grade level (Biancarosa & Snow, 2006).

The second issue is that ELs are usually characterized as students who are not yet proficient in English and who typically require specialized or modified instructional support in order to fully access academic content (Rosa-Lugo, Mihai & Nutta, 2012). The term “ELs”

typically does not refer to students whose primary language is English but continue to struggle with acquisition of Standard American English (SAE); such as speakers of a dialect (Freeman & Freeman, 2009). Okoye-Johnson (2011) indicated that federal and state-funded programs do not consider Standard English Learners (SEL) under the EL category. SEL refers to ethnic native speakers of English whose mastery of the Standard American English (SAE) used in schools is limited due to their use of non-academic language (LeMoine, 1999). For example, an African American student that speaks African American English (AAE) would fall under the category of SEL, but not be characterized as an EL student

Okoye-Johnson (2011) stated that SEL students have specific needs to achieve academic success, however, speakers of a dialect often do not qualify for programs that provide instructional services to students that have been identified as ELs. Although researchers have confirmed that AAE is a linguistic system, many school programs do not view it as a linguistic system that varies enough from English in the way that Spanish, Chinese, and French may vary. Also, AAE continues to be viewed as a substandard linguistic system (Cooks & Ball, 2009; Kraemer, Rivers, & Ratusnik, 2000; Washington & Craig, 2001; Wolfram, 2007). According to Adger (1998), *English for speakers of other languages* (ESOL) programs have not come to a consensus on how to serve speakers of various English dialects. LeMoine (1999) suggested the need for culturally responsive pedagogical strategies for minority students, particularly African American students that present with AAE dialect.

African American English and the achievement gap. African American English (AAE) is a distinct dialect of American English, reaching well back to the early eighteenth century and beyond and is a by-product of the slave trade (Dillard, 1972). There are several

hypothesis of the origin of AAE. Green (2002) offered the Creolist theory which indicates the possibility that slaves from African and those imported from the West Indies developed a first language among themselves, which is referred to as a “creole.” The Anglicist hypothesis posits that AAE is derived simply from the language contact situation of African descendants in the U.S., therefore AAE is more closely related to English than to Creoles (Green, 2002; Mufwene, 1998).

AAE is spoken throughout the U.S. mono- or bidialectally by at least 80% of continental African Americans, as well as by a number of southern Whites and urban Hispanics (Amberg & Vause, 2009; Smitherman, 1986). This vernacular has been known by terms such as Black English (BE), Black English Vernacular (BEV), and the highly politicized Ebonics (Craig & Washington, 2006). Historically, AAE has been viewed as an inferior form of dialect of English. AAE is often associated with unemployment, oppression, and limited education (Washington, 1998). The dialect continues to be seen as an inferior language that is stigmatized and a barrier to the acquisition of literacy (Cook & Ball, 2009).

In the field of speech-language pathology and linguistics, researchers have examined the characteristics of African American English and have determined that there are far more similarities than differences between AAE and SAE. However, the difference described in the literature is significant and has shown to have a decidedly strong impact on educational achievement (Baugh, 1983; Craig & Washington, 2004; Green, 2002; Wolfram & Fasold, 1974).

Earlier research on AAE was centered on the difference versus deficit debate (Seymour, Bland-Stewart, & Green, 1998). In the 1960s and 1970s, large-scale examinations of speech communities were conducted in Detroit by Wolfram (1969), and in Harlem by Labov (1972).

The data from these studies provided evidence for establishing AAE as a full linguistic system and not a cognitive or language impairment (Charity, Scarborough, & Griffin, 2004). However, most of the data regarding AAE focused on adults and little was known about AAE spoken by African American children (Craig & Washington, 2006). The following tables are descriptions of some of the phonological and morphological features of the AAE dialect:

Table 1: Phonological Features (Thompson et al., 2004)

Phonological Types	African American English	Standard American English
Postvocalic consonants reduction	mou_	mouth
Substitutions of /n/ for /ng/ in final word positions	waitin	waiting
Substitution of /d/ for /th/	dis, dat	this, that
/f, t/ and /v/ substitute for /th/ in intervocalic positions	bof wit	both with
Syllable addition	forestsiz likeded	forests liked
Syllable reduction	_came	became
/t/ and /d/ substitute for /th/ in prevocalic positions	birtday	birthday

Table 2: Morphosyntactic Features (Thompson et al., 2004)

Morphological Types	African American English	Standard American English
Completive <i>done</i>	“He done set the fire”	“He has set the fire”
Ain’t	“You ain’t know that?”	“You did not know that?”
Preterite <i>had</i>	“What had happened”	“What happened”
Multiple negation	“It <i>not</i> raining <i>no</i> more”	“It’s not raining”
Subject-verb agreement	“Our cat Mimi like_ to sleep”	“Our cat Mimi likes to sleep”
Zero copula/auxiliary	“When it time to eat?”	“When is it time to eat?”
Zero possessive	“The boy hat was stolen”	“The boy’s hat was stolen”

Clause structures and AAE. Most literature describing AAE list features of phonology, discourse (e.g., signifying, call and response), and morphosyntactic structures. However, information regarding the development of complex syntax of African American children is lacking (Craig & Washington, 1994). According to Martin and Wolfram (1998), speakers of other English dialect sometimes view sentence structure of AAE as distinct from other varieties. However, the uniqueness of AAE does not particularly reside in the structures of its sentences (Martin & Wolfram, 1998). Green (2002) pointed that words in sentences in AAE are arranged in the same order as words in sentences in other varieties of English, but have different syntactical property (e.g., negation, relative clause, preterit *had*).

This study focuses on the impact of clauses, with a particular emphasis on adverbial clauses and its' impact on students' comprehension of science text. In AAE, adverbial and adjective clauses exist, however, some of the words used in the clauses take on a different meaning than they would if spoken in SAE and in the same format. For example, below are lines extracted from two songs sung in African American churches:

(a) "When I rose this morning, I didn't have no doubt."

(b) "Can't nobody do me like Jesus cause he's my friend."

In the examples above, the adverbial clause is produced appropriately in the complex sentence, however, the double negation (i.e., "didn't have no..."), is the feature that contrasts with the Standard English system.

There have been a few studies that attempted to analyze complex syntax skills among African American children. Craig and Washington (1994) analyzed the syntactic skills in preschoolers. The authors concluded that children who spoke AAE used more complex sentence structures than children who spoke SAE. The complex syntax widely used among AAE speakers in this study were the following: (a) infinitives marked with 'to;' (b) the conjunction 'and' to link two independent clauses; (c) noun phrase complement; and, (d) non-infinitive wh-clauses. Smith, Lee, and McDade (2001) investigated the T-Units among African American fourth graders that were speakers of AAE and speakers of SAE. Their study indicated that AAE and SAE fourth-grade children may not use all types of complex syntax in a similar manner. Specifically, AAE speakers used a higher percentage of simple infinitives, relative clauses, double embedding's, and coordinating conjunctions. The authors concluded that it is

“reasonable to assume that dialect may have contributed to the differences in usage of complex sentence types” (p. 156).

Although there is limited discussion regarding clause structures among speakers of AAE, researchers have hypothesized that there is a relationship between AAE and academic achievement (Adler, 1992; Manning & Baruth, 2000). Specifically, failure of African American students to learn SAE grammatical rules has been attributed to delayed development in SAE reading and writing (Thompson, Craig, & Washington, 2004). Many African American students enter school with a home language different from the mainstream English found in the school setting (Cook & Ball, 2009; Green 2002; Rickford, 1999). The fact that many African-American students speak a vernacular that is distinct from standard academic English may contribute to problems in school performance (Ball, 1992). There is a continued need to research AAE to build on the knowledge of specific social groups and African American communities as well as the educational implications for AAE use on language and literacy skills (Charity et al., 2004; Stockman, 2010).

African American Students’ Underperformance in Science

African American students are performing below their White peers in the discipline of science (NAEP, 2011). Although the 2011 NAEP report in science indicated that the achievement score gap narrowed from 2009 to 2011 (NCES, 2012), the fact still remains that African American students are performing poorly in science. According to the 2011 national report card, 63% of African American students are performing below basic level; 37% are performing at or above basic level; 10% at or above proficient and 0% at advance level. The

average science score for African American students is 129 although 141 is the Basic Level score for 8th grade students. Teachers, administrators, and researchers have found it challenging to find effective ways to address the academic achievement gap between African Americans and Caucasian students in science education (Bacharach, Baumeister, & Furr, 2003; Obed, Ault, Bentz, & Meskimen, 2001). Literacy and linguistic experts (e.g. Brown, 2005; Craig, Zhang, Hensel, & Quinn, 2009; Green 2010) have often suggested that the use of AAE does have an impact on African Americans' academic performance in reading and in science.

There have been efforts in educational reform to address the needs of underrepresented students and their success in science. Lee and Fradd (1996) developed a conceptual framework for instructional congruence in literacy and science that was described as an effective ideal to assist science teachers in making science literacy attainable for all EL students. This ideal is referred to as "Science for All." The authors' proposed the notion of instructional congruence to reflect the process of mediating the nature of academic content with students' language and cultural experiences to make a content area meaningful and relevant. They noted the following requirements for teachers to establish instructional congruence. Teachers should know: (a) who the students are from culturally and linguistically diverse background, (b) how the students acquire literacy and English-language proficiency, (c) what the nature of science is and what kinds of language and cultural experiences the students bring to the learning process, and, (d) how to guide and enable the students to understand science.

While it is clear that the aim of this framework is to support underrepresented students, not all agree with this agenda. Mutegi (2011) argued that the "Science for All" is a political mantra that has failed underrepresented students, particularly African American students.

Mutegi (2011) further states that science curriculum does not provide African American students with the knowledge to better themselves and/or their communities and therefore does not meet their social needs. The author calls attention to the pedagogical work of Paulo Freire (1985), whose work identified educational goals focused on empowering oppressed people. Mutegi (2011) proposed five specific goals to assist African American students in science. The first is content mastery, which refers to the standards recommended by the National Science Education Standards (NSES). The remaining goals are the following: (a) critical awareness, (b) racial awareness, (c) conscientization, and (d) praxis.

Brown (2005) conducted a systematic review of twenty years of research on African American students in science education. This review identified three types of research on African American students: (a) status reports of African American students' performance in science; (b) studies on cultural differences existing between African American students' home culture and the classroom culture; and, (c) studies identifying cultural continuities that exist between African-American students' culture and science. Brown (2005) concluded that the systematic review of the research failed to thoroughly explore the relationship between students' language, identity, and their influence on science learning. Therefore, much of his research has focused on teaching students scientific concepts in everyday language prior to using scientific language (Brown, 2006; Brown & Ryoo, 2008; Brown & Spang, 2007).

In a specific study, Brown, Ryoo, and Rodriguez (2010) examined the effects of disaggregate instruction, which is instruction that allows the teacher to present scientific ideas by using the language and cultures of their minority students before introducing the ideas utilizing the language of science. The students in the experimental group outscored the students in the

control group. The students in the experimental group, also demonstrated improved ability to write using scientific language as well as improved ability to produce oral explanations using scientific language.

While Brown et al. (2010) had an interest in using the language of minority students to access science content, it appears the focus in this study is on technical vocabulary. The everyday language described in his studies does not address specific dialect features of minority students. For example, the general term ‘sugar’ was used before using the scientific term, ‘glucose’ and “light” was presented before the term, ‘Photon,’ when discussing the process of photosynthesis. Brown et al. (2010) highlighted the importance of language, to minority students’ identity in the science classroom and calls for more research to better understand why African American students who are SEL struggle to appropriately use science discourse. Although there are different views on how African American students should be educated in science, the common focal point is content mastery and examining effective ways to assist students in acquiring the literacy skills to be successful.

Disciplinary Literacy

Although disciplinary and content-area literacy are considered to be of high interest on the International Reading Association’s Literacy Hot Topics in Literacy Education List (Cassidy & Ortlieb, 2013), these areas are not new topics in literacy education. For several decades literature has focused on the importance of literacy instruction at the secondary level. In the 1970s authorities on adolescent literacy recommended that content area teachers should incorporate literacy-related instruction and activities into their curricula (Phelps, 2005). As

content area teachers began incorporating popular reading strategies within their instruction, this practice became known as content literacy (Moss, 2005).

In 2002, the RAND Reading Study Group (RRSG) was charged with the task of examining the state of research on adolescent literacy and establish a long-term effort aimed at improving the literacy skills of adolescents (Morsy, Kiefe, & Snow, 2010). The efforts of RRSG resulted in the distribution of reports and white papers about adolescent literacy. One of the widely distributed report was the Reading Next report (Biancarosa & Snow, 2006). This document provided guidelines for effective adolescent literacy instruction and emphasized the urgency to address adolescent literacy. However, with the growing knowledge base regarding adolescent literacy, adolescent students continued to struggle in various subject areas (NAEP, 2009). Literacy scholars (e.g. Alvermann, 2004, Moje, 2008; Shanahan, 2009) suggested the need to approach content-area reading differently.

Shanahan and Shanahan (2008) recommended that teachers implement disciplinary literacy practices, which differs from content literacy. “Disciplinary literacy involves the use of reading, reasoning, investigating, speaking, and writing required to learn and form content knowledge appropriate to a particular discipline” (McConachie & Petrosky, 2010, p.16). In contrast, content literacy focuses on teaching reading strategies and study skills (e.g. note-taking, highlighting, prediction, compare/contrast, and inferencing) that may help students understand and remember whatever they read within a content-area (Shanahan & Shanahan, 2012). Thus, disciplinary literacy moves beyond just providing general strategies to improve reading and writing in the content areas. For instance, the language patterns of history text differs from science text. Therefore, it is likely that some strategies used for understanding history text,

would not be applicable to science text. History text is characterized by language patterns that serves various purposes, such as retelling events, and/or presenting debates or explanations, from the authors' perspective. Strategies that focus on helping the student understand the author's perspective is important to History text, however, understanding the author's perspective may not be as critical in comprehending Science text (e.g., a chemistry text book).

Although science text does present with language patterns similar to history text, such as explanations and arguments, science text is highly technical and dense (Fang, 2006). Science text is characterized by various clause structures, technical vocabulary, graphs and diagrams. Therefore, students would benefit more from learning how to unpack dense sentences found in science text more so than identifying the author's voice. For instance, take the sentence, "*Once the DNA's structure is known, scientist are able to figure out how it provides a library of instructions that control the cells that make up our bodies and those of all other living things*" (Walker, 2003, p. 25, reprinted in Fang, 2006). According to Fang and Schleppegrell (2008) reading dense texts takes a lot of time for students to process and comprehend. Fang (2006) posits that if students are taught to unpack complex sentences, they would be better able to process the information. The process of unpacking complex sentences would require identifying the clause type (e.g. adverbial, adjective, or noun) and engaging the student in discussions about the information he/she is gaining from the clauses.

Moje, Overby, Tysvaer, and Morris (2008) advocated for the creation of disciplinary literacy instructional programs instead of encouraging content teachers to employ general literacy teaching practices and strategies. While several scholars support the aforementioned suggestion, there are others that are concerned about its effectiveness for all students, particularly

students with language-learning difficulties (Brozo, Moorman, Meyer & Stewart, 2013; Flaggella-Luby, Graner, Deshler & Drew, 2012). Flaggella-Luby, et al., (2012) argued that disciplinary literacy is not enough to replace general strategies for adolescent learners who struggle. Brozo, et al., (2013) contended that there is a ‘false dichotomy’ developing between content area literacy and disciplinary literacy requiring educators to choose either disciplinary literacy or content literacy approaches to effectively teach literacy in the content area classroom. Choosing sides can lead to a misunderstanding about the importance of each approach. For instance, Shanahan and Shanahan (2012) has emphasized the importance of differentiating between content literacy and disciplinary literacy. He stated that disciplinary literacy does not replace content literacy but provides added support to develop the skills needed to prepare all students’ advance literacy skills. Brozo et. al. (2013) concluded that a blend of both perspectives could be utilized to support adolescents in mastering the literacy demands of specific disciplines

The limited research regarding the effectiveness of discipline literacy strategies and approaches may be a contributing factor to the misunderstanding of the importance of its use. Flagella-Luby et. al. (2012) examined several meta-analyses on discipline-specific strategies. Their meta-analysis identified five studies that focused specifically on reading comprehension within English Language Arts content. One writing study (De La Paz, 2005) examined the use of a historical reasoning strategy in the content area of social studies. A qualitative study conducted by Schleppegrell and Oliveira (2006) described the use of various FLA strategies to increase student understanding of history text. In this study, the teachers utilized strategies specific to the discipline of history with students that were ELs and students with learning disabilities (LD). The authors provided a detailed description of what the teachers did to assist

the students in analyzing history text and described the positive gain among the participating students following the implementation of the discipline-specific strategies. However, the study did not provide quantitative data about the effectiveness of the disciplinary-specific strategies on the students' outcome in history.

Disciplinary literacy and Standard English Learners (SELs). The increase in racial, ethnic, and cultural diversity in American schools is reflected in many classrooms. ELs and SELs students speak various languages and dialects and come to school with varied experiences and linguistic skills that differ from what is expected in the academic setting (Craig & Washington, 2006; Freeman & Freeman, 2009; Horton-Ikard & Miller, 2004; Washington & Thomas-Tate, 2009). Often, many of the language-related issues in the education of ELs also appear to be present in African American students who use non-standard English. According to August and Shanahan (2006), oral language proficiency is highly correlated with measures of reading comprehension. As these students progress to advanced grade levels, the need for oral language proficiency increases to meet the demands of the complex text (Almanza de Schonewise & Klinger, 2012). There is also a need for students to perfect oral and written language skills, such as grammatical structures, to be successful in the classroom (Washington & Thomas-Tate, 2009). Therefore, the linguistic demands placed on these students require intense attention when developing disciplinary literacy (Almanza de Schonewise & Klinger, 2012).

There is a small body of research that acknowledge that discipline specific strategies, when used intensively and purposefully, support adolescent literacy in tremendous ways (Meltzer, Cook-Smith, & Clark, 2006). When these strategies are combined with problem-solving approaches to reading comprehension and used in context, EL and SELs literacy skills

are significantly influenced (Langer, 1999, Mohan, 1990; Schoenbach, Greenleaf, Cziko, & Hurwitz, 1999). Langer & Flihan (2000) indicated that explicit teaching of the discourse features of specific disciplines is especially helpful to students coming from limited literacy backgrounds. However, there is limited empirical data to support these conclusions.

Language Demands in Science

Science is a form of culture with its own language and is one of the reasons students find science text difficult to read and comprehend (Gee, 2004; Fang & Schleppegrell, 2008). Science text is described as technical, abstract, dense, impersonal, authoritative, and metaphorical, all of which present unique comprehension challenges for students (Fang, Lamme, & Pringle, 2010). This discipline represents particular ways of thinking, and communicating scientific ideas as realized by particular linguistic registers (Halliday & Martin, 1993; Lemke, 1990; Pappas, Kiefer, & Levstik, 2006). Schleppegrell (2004) supports the notion that every science lesson is a language lesson and that attending to language is one of the most important acts that can be done to improve the quality of science education

This study takes an interest in the lexical density of science text; particularly its use of complex sentences. Fang (2006) defines complex sentences as sentences with multiple dependent clauses. Scientific text employs complex sentences using both subordinate and embedded clauses. Lexical density measures the effect of informational density on the readability of a text. More specifically, lexical density measures how much information is packed into clauses by calculating the number of lexical items (e.g. nouns, verbs, adverbs) by the number of non-embedded clauses. According to Halliday and Martin (1993), the number of

lexical items per non-embedded clause is about two for everyday spontaneous speech and four to six for written language. In science, the number of lexical items can exceed 10. This shows that children are being exposed to text with a high degree of informational density than they can produce on their own (Fang & Schleppegrell, 2008).

There have been a few studies that have examined the lexical features found in expository text, particularly science text. The National Center for Research in Evaluation, Standards, and Student Teaching (CRESST) conducted a series of studies to develop specifications and create tasks of academic English Language Proficiency (AELP). The tasks were designed to help determine whether students have sufficient knowledge of English language features to be able to comprehend the content of a text (Bailey, Butler, & Sato, 2007). Instead of focusing on subject matter and overall meaning, studies focused on analyzing classroom discourse and textbooks. Butler, Bailey, Stevens, Huang, and Lord (2004) examined fifth grades science, math and history textbooks to record the presence of specific linguistic features. The researchers found unique adverbial clause connectors (e.g. 'if', 'after'), that indicated that semantic relationships between clauses, were more frequent in science and social studies text. They observed more complex clausal structures (i.e., main clause and dependent-embedded clause) in the science text than social studies. Finally, the authors observed that the science selections consisted of more adverbial dependent clauses far more often than found in other subjects.

DeFrancesco and Perkins (2012) investigated proposition density, clause type usage, and non-infinite verbal usage in two sports psychology college textbooks. The authors randomly selected and analyzed 52 sentences from the two textbooks. Both text consisted of a high frequency of simple sentences followed by compound sentences. The authors reported that both

science texts used adjective, noun and adverbial clauses with similar frequency; however, adjective and adverbial clauses had higher frequency than noun clauses.

The aforementioned studies support Fang and Schleppegrell's (2010) confirmation about the density of science text and particularly the presence of adverbial clauses. Although there are limited empirical studies regarding the presence of various clause structures, the literature has indicated that these structures can be challenging for some students (Nippold, Mansfield, Billow & Tomblin, 2008; Scott, 2009; Westby, 2012)

Theoretical Framework to Address Reading Comprehension with the Discipline of Science

This study focuses on the reading comprehension challenges faced by African American fifth and sixth grade students. Therefore, this section will discuss the theoretical frameworks adopted to develop the metalinguistic approach used in the study.

Reading comprehension difficulties are complex. According to the RAND Reading Study Group (2002) reading comprehension is an interactive process involving the reader, the text, and the context. There are a number of reasons why adolescents struggle to comprehend what they are reading, such as their own vocabulary, conceptual knowledge, weak reasoning, or inability to apply active comprehension strategies (Roberts, Torgesen, Boardman, & Scammacca, 2008). Robinson and McKenna (2008) stated that these difficulties most likely stem from the lack of progression through the literacy development stages. Kame'enui and Simmons (1990) noted that inadequate instruction, insufficient practice, deficient memory capacity and functioning and unfamiliarity of text features and task demands contribute to students' difficulty in reading comprehension. To assist readers understand the meaning of content, Halliday (1994)

proposed a theory known as Systemic Functional Linguistics (SFL). This theory states that the understanding of language forms (grammar) assist readers in understanding the meaning of content. Thus Halliday's (1994) theory and RRSF's (2002) model of reading comprehension were considered in the development of the metalinguistic approach used in this study.

Systemic Functional Linguistics

This research is grounded in Halliday's systemic functional linguistics (SFL) theory, the meaning-based theory of language (Halliday & Matthiessen, 2004). This theory views language as a resource for constructing meaning. It explores how language is used in social contexts to achieve particular goals, therefore placing more emphasis on language function than on language structure.

Language function is referred to as functional grammar and is different from traditional school grammar. Functional grammar does not view language as just a set of rules (i.e., subject, verb, adjectives), but emphasizes the link between the linguistic choices of speakers and writers to convey information of a specific discipline (Schleppegrell, 2004). SFL allows for clauses to be separated into manageable chunks. This is in contrast to traditional grammar, which isolates grammatical features (Schleppegrell & Go, 2007). In other words, linguistic structures (e.g. adverb clauses, nominalization, noun clauses) are selected to communicate specific information for a particular purpose.

In describing systemic functional linguistics, Halliday (1994) supports the examination of lexical and grammatical choices that create clauses to understand the meaning of registers of text. Registers are configurations of certain lexical and grammatical resources that are

appropriate for particular language use within a particular discourse context (Schleppegrell, 2004). Halliday (1994) identifies three kinds of semantic components of register that he refers to as meta-functions: ideational, interpersonal and textual. Ideational meaning refers to people using language to construe experience in terms of what is going on around us or inside us. In reference to literacy, this would refer to what the text is about. The second meta-function, interpersonal, refers to language interacting with the world by negotiating social roles and attitudes. In literacy, interpersonal would refer to interaction, attitudes, and judgments found in text. Lastly, textual function refers to how messages are organized to convey meaning. In literacy, this refers to how clauses, phrases and conjunctions are used to organize text in a cohesive manner.

SFL has expanded in the last two decades through the work of many scholars in North America (Fang and Schleppegrell 2008; Lemke 1998; Schleppegrell, 2007), in Australia (Christie, 2002; Hasan and Martin; 1989; Painter, 1989) and Latin America (Bolivar 1994; Ghio & Fernandez, 2005). According to Schleppegrell (2007), it is through a systemic functional linguistics approach that we can analyze lexico-grammatical choices for crafting texts, show how meaning is created, and present the options linked to meaning; all of which give the students some control over their academic success. In other words, “literacy research that incorporates a focus on language itself through a systemic functional linguistic perspective on grammar can recognize the role of language in literacy development and offer new ways of talking about language that can enrich teaching and learning” (Schleppegrell, 2007, p.127).

This present study was also influenced by Fang and Schleppegrell’s (2010) functional language analysis (FLA) approach. FLA is an approach developed to improve literacy in

secondary content areas. Specifically, this approach aims to develop students' understanding of how language works in different subjects by enabling students to read clauses closely and talk about the language choices used by the author to convey meaning. FLA is further described as an approach that makes content accessible to students and should be embedded in a sequence of activities in which students speak, interact, and do project work in a coherent unit of instruction, Fang and Schleppegrell, 2010). This approach consists of various activities that allow students to analyze text closely; such as vocabulary building, noun expansion, paraphrasing, contrastive analysis, sentence combining and sentence deconstruction (Fang, 2006). Unlike FLA, the metalinguistic approach in this study focuses specifically on sentence deconstruction to examine the meaning provided by adverbial clauses.

Reading Comprehension

Reading comprehension has been a part of classroom performance as long as there have been schools, texts, and individuals who desired or were required to read them (Pearson, 2009). Several literacy experts agree that reading comprehension is hard to define due to its many facets (Kamhi and Catts, 2012; Paris & Hamilton, 2009; RAND Reading Study Group, 2002). The Research and Development (RAND) Reading Study Group (RRSG, 2002) defines comprehension as the process of simultaneously constructing and extracting meaning through interaction and engagement with print. The NAEP (2009) Reading Framework Committee defines reading comprehension as an active and complex process that involves understanding written text, developing and interpreting meaning, and using meaning as appropriate to type of text, purpose and situation. According to Snow (2010), successful comprehension is determined

by a reader's ability to decode words and understand spoken language; text factors (e.g., clarity of writing, readability, font size, genre, and graphics), and a reader's ability to understand word meaning, phrases, and clauses in order to interpret sentences.

Syntax as a Foundation of Reading Comprehension. Since 1925, many educators and researchers believed that vocabulary played a central role in reading comprehension (Pearson, Hiebert, & Kamil, 2007). The strong link between vocabulary and reading has been well documented. Previous studies have found that vocabulary is a significant predictor of decoding and reading comprehension for typically developing children as well as children with language impairment (Botting, Simzkin, & Conti-Ramsen, 2006; Catts, Adolf, & Weismer, 2006; Catts, Fey, Tomblin, & Zhang, 2002; Muter, Hulme, Snowling, & Stevenson, 2004; Ouelette, 2006; Roth et al., 2002; Seigneuric & Ehrlich, 2005). However a growing number of studies have established a relationship between higher-level language abilities, such as syntax, and reading (Carlisle & Rice, 2004; Demont & Gombert, 1996; Gottardo, Stanovich, & Siegel, 1996; Leikin, 2002; Mahony, Singson, & Mann, 2000; Nation & Snowling, 2000; Nation, Clarke, Marshall, & Durand, 2004; Stothard & Hulme, 1992).

Syntax is one of the foundational skills of reading and speaking. In English, word order is important for establishing the relationships of meaning between and across propositions (Carroll, 2008). Phrases can extend the information associated with a noun or verb phrase using elements such as prepositions, adverbs, or infinitive verbs. Two complete propositions can be placed in coordinating, correlative, or subordinate relationships through use of conjunctions, or one proposition can be embedded within another using relative or adverbial clause structures.

The acquisition of these complex grammatical structures, forms, and strategies allows for more sophisticated and precise ways of using language. With each grade level, students must become more proficient at using these “literate” forms of language for reading and writing (Fillmore & Snow, 2000).

Syntax is the study and understanding of grammar – the system and arrangement of words, phrases, and clauses that make up a sentence. In order to comprehend a sentence, the reader must process, store (in working memory), and integrate a variety of syntactic and word meaning information (Paris & Hamilton, 2009). One by one, sentences communicate ideas that combine to create meaning. Efficient processing of sentence structure is necessary for overall comprehension (Scott, 2009). Syntax can be seen as the “vehicle” or “workhorse of meaning” (Scott, 2009, p. 185) when it comes to reading comprehension. One of the major difficulties of reading comprehension among school-age children is knowing the difference between oral and written language that becomes more apparent by third or fourth grade. At this level, the syntactic and semantic complexity of written language surpasses oral language (Kamhi & Catts, 2012). Subsequently, reading problems may become apparent for readers who have good word recognition skills but lack the language skills to comprehend the text at this level of complexity (Catts, Adlof, Hogan, & Ellis-Weismer, 2005; Scarborough, 2005; Scott, 2004).

For more than twenty years, reading research focused on syntax and comprehension (Bowey, 1986; Dowhower, 1987; Perera, 1984; Schreiber, 1991). These studies found that good readers are more sensitive to syntactic units than poor readers. Strong readers are able to decode text with more ease in spite of complex sentences consisting of embedded clauses, such as adverbial clauses. These studies also highlighted that certain structures present particular

difficulties for children, such as inflectional morphology (e.g., verb tense and agreement), reflexive pronouns, relative clauses, adverbial clauses, and passive sentences. Long separations between subjects and verbs that occur as a result of embedded clauses have also shown to be difficult for struggling readers (Thompson & Shapiro, 2007). Mastering the more complex structures of English is important for children entering school. With each grade level, the number and types of clauses included in one sentence increases, placing greater language demands on reading with successive grades (Fry, 1963; Loban, 1976). Snow and Kim (2010) suggest that students need to develop sentence-level grammatical processing in earlier grades to become successful readers in middle grades and beyond. This is a powerful suggestion in light of the fact that most of the literacy research has focused on vocabulary, prior knowledge, and decoding skills. This focus most likely germinated from The National Reading Panel (NRP, 2000) report, which listed the aforementioned areas as important to reading comprehension and did not mention syntax structures as an important contributor to the literacy crisis or an area of instruction (Scott, 2009). More recent studies on syntax and comprehension (e.g. Leikin, 2002; Martohardjono, et. al., 2005; Mokhtari & Thompson, 2006; Snow & Kim, 2010; Wiseheart et. al., 2009) have established the association between syntactic ability and reading. However, the difficulty in the research regarding syntax and reading comprehension is the true nature of the relationship (Scott, 2009).

Syntax and high academic standards. The National Governors Association and the Council of Chief State School Officers' release of the Common Core State Standards (2010), contributed to the focus on academic language. They concluded that syntax awareness is important in the comprehension of academic language. Academic language is not the

conversation of everyday communication. It involves a specialized set of words, grammar and organizational strategies that are used for higher-order thinking processes and to describe complex concepts and abstract relationships (Zwiers, 2008).

In contrast, conversational language is used to meet functional needs for daily tasks and to share personal information; such as requesting and commanding. According to Westby (2012),

Academic discourse makes use of complex syntactic patterns more than conversational discourse, and particularly greater use of all types of dependent clauses. The following dependent clauses: adverbial, adjectival, and noun are used increasingly in academic texts from the middle elementary school years (pp. 166-167).

Readers and writers in the upper elementary grades will be required to understand new syntactic structures and expected to use these structures when writing and reading informational text. Sentences that are complex, contain a large number of ideas, or have unusual word order can make it difficult for students to comprehend what they are reading, particularly students who enter school with limited oral language exposure or for whom English is a second language. However, effective readers have knowledge of phrase structures, clause structures, parts of sentences, and are more successful in understanding complex sentences (Scott, 2004).

Difficulties with syntax. Although research has made it quite clear that syntax is important for reading comprehension, students in upper grades continue to struggle in this area (Scott, 2009). There are two hypothesis in the research literature that explain the difficulties students face in comprehending syntactic information. One theory is the Processing Deficit Hypothesis (PDH) and the other is the Structural Deficit Hypothesis (SDH).

The PDH supports the claim that unskilled readers do not experience deficits in processing syntactic information but do experience difficulty in processing and retaining phonological information. In contrast, the SDH supports the notion that difficulties in processing syntactic information contributes to reading difficulties (Martohardjono et al., 2005). The metalinguistic approach in this dissertation supports the SDH theory. Presumed in the SDH theory is that the acquisition of syntactic structures are staged and gradual with simpler structures preceding more complex structures in language development. Adolescent literacy researchers discuss the use of complex sentences in text found in the upper and secondary grades and note that poor readers and beginning readers tend to struggle most with complex structures (Fang & Schleppegrell, 2008; Kamhi, 2012; Moje, 2007; Scott, 2004; Westby, 2012).

Current Teaching Practices in Science Education to Improve Literacy

In recent years, science is one of the content areas that has received increased attention (Silliman & Scott, 2009). Science education has emphasized performance-based activities to engage students and stimulate their interest in science. Reform initiatives called for science curriculum to employ an inquiry-oriented approach; which has been referred to as the “doing of science”. According to Wignell (1994) common discourses of science include: (a) procedure, (b) procedural recount, (c) science report and (4) science explanation. Therefore, inquiry-based approaches involved observation, posing questions, examining sources of information, gathering data, analyzing and interpreting data; and communicating results (Fang, Lamme, & Pringle, 2010). Although the approach of ‘doing science’ yielded positive outcomes, Kamil and Bernhardt (2004) argue that reading and writing science texts should be an integral part of a

science curriculum in order to emphasize the importance of understanding the language of science. Not only do students need to be able to hypothesize and draw conclusions, but they need to understand how language is used to communicate procedures and inquiries; and enhance reading competence (Norris & Phillips, 2003).

According to Shanahan (2012), teachers often choose to explain the information found in text orally to compensate for the difficulty students have in understanding the language used in science text books. Another common practice among teachers is focused instruction of technical vocabulary. However, the difficulty of understanding science text lies not just in deciphering its technical vocabulary, but more broadly in understanding its usage of grammar (words and structure) found in science text. Wellington and Osbourne (2001) argue that students need more than just exposure to science. Students must have a conscious understanding of the unique grammar of science that scientist use when writing reports or explaining a phenomenon. If students do not obtain the language of science, they will continue to be disadvantaged in a society that has become increasingly reliant on science and technology (Martin, 1998).

There has been some research examining the grammar found in science texts. According to Shanahan (2009), research on instruction about science text structure has primarily focused on: (1) research on facilitative text structures for learning science and overcoming misconception, and, (2) research in helping students use existing text structures to comprehend science texts (e.g., Hand, 1999; Hand & Prain, 2002; Rossi, 1990; Veel, 1997). More specifically, reading comprehension instruction in science has focused on two sets of strategies: (1) fluency-oriented strategies, such as repeated reading, chunking, and prosody monitoring (e.g., Hudson, Lane, & Pullen, 2005; Rasinski, 2003); and cognitive and metacognitive strategies, such

as predicting, inferencing, visualizing and think-aloud (e.g., Scammaca et. al., 2007; Topping & McManus, 2002). These strategies are definitely important to the development of engaged and reflective readers, however, they alone are not sufficient enough to ensure successful comprehension of science text at the upper elementary and secondary level (Fang, 2012; Shanahan & Shanahan, 2012; Zygouris-Coe, 2012).

Fang (2006) described the language demands of science and suggested strategies to assist students in overcoming the barriers faced when manipulating science text. In his report he described strategies for promoting students understanding and use of language of school science (LSS). These included: (a) robust vocabulary building, (b) noun expansion, (c) sentence completion, (d) paraphrasing, (e) sentence stripping, and (f) developing awareness of signposts. These strategies are grounded in functional linguistics and therefore have the potential to develop linguistic insights among students that can facilitate their transaction and engagement with text (Halliday & Matthiessan, 2004; Schleppegrell, 2004).

Metalinguistic approach to reading comprehension in Science

Due to the unique linguistic features of science, researchers (e.g. Fang, 2004; 2010; Schleppegrell, 2007) call for an instructional approach grounded in systemic functional linguistic (SFL) theory (Halliday, 1994). In literacy, consciously manipulating linguistic forms and structures are referred to as metalinguistic or metalinguistic awareness. The term ‘metalinguistic’ is defined as an acquired awareness of language structure and function that allows one to reflect on and consciously manipulate the language (Fielding-Barnsley & Purdie,

2005). It includes an awareness of phonemes, syllables, rhyme, morphology, and syntax (Zipke, 2007).

Studies have shown that metalinguistic awareness is strongly related to beginning reading skills for instance, phonemic awareness and decoding skills (Apel, & Thomas-Tate, 2009; Goswami, 2001; Rivers & Lombardino, 1998). However, fewer studies have examined the role of metalinguistic understanding in reading comprehension. Zipke (2007) investigated the role of metalinguistic awareness in reading comprehension among one hundred and five sixth and seventh graders. She tested the participants on 25 structural riddles and 40 ambiguous sentences. The results indicated that the tasks correlated significantly with reading comprehension, therefore suggesting that metalinguistic awareness contributes to reading comprehension. Zipke's (2007) study was grounded in Tunmer and Bowey's (1984) model of metalinguistic awareness. In their model, higher and lower levels of metalinguistic awareness are distinguished by the size of the linguistic units. For instance, phonemic and morphemic awareness are lower level and contribute to decoding. Lexical and superlexical skills, such as syntax, are higher level and contribute to comprehension. Although the results of Zipke's (2007) study supported the idea that metalinguistic awareness plays an important role in reading comprehension just as much as it does for decoding, it did not examine the syntactical structures in context. The tasks in her study were decontextualized and did not consider the language demands of specific disciplines. Furthermore, the participants were not provided with the opportunity to engage in discussions about the ambiguous language presented in the tasks. For instance, the participants did not converse with the instructor about what they read and what meaning they gained from the riddles or ambiguous sentences.

Syntax intervention. There is a body of research that specifically supports the metalinguistic skill of syntactic awareness. The increasing evidence of the importance of syntactic awareness to reading comprehension for students identified as struggling readers has researchers calling for effective instruction aimed at syntactic awareness (Demont & Gombert, 1996; Lesaux, Lipka, & Siegel, 2006; Mokhtari & Thomson, 2006; Siegel, 2008). If poor levels of syntactic awareness correspond to poor reading fluency and poor comprehension, then increasing syntactic awareness should have a positive effect on reading.

Scott (2009) indicated that there is notable evidence for treatment for sentence-level grammar in speech-language pathology literature, but primarily for preschool children. Hirschman (2000) found that explicit teaching of sentence complexity yielded positive outcomes for 9 to 10 year old children with specific language impairment. The participants were taught to identify complex sentences in fables and then to identify constituent clauses and subordinate conjunctions.

The best researched technique for helping students in producing and understanding complex sentences has been sentence combining. In sentence combining, students are given the opportunity to manipulate the structure of sentences, therefore exposing them to varieties of sentence structures, such as adverbial, relative, and independent clauses. Andrews et al. (2006) conducted a systematic review in which findings supported sentence combining over traditional grammar teaching methods. Eisenberg (2006) described sentence combining as an effective technique for the direct teaching of complex sentences. Eisenberg and other researchers recommended that students be engaged in activities that are contextualized, rather than engaged in isolated exercises (Scott & Balthazar, 2008; Ukrainetz, 2006).

Fang and Schleppegrell's (2010) metalinguistic approach, the FLA, highlights the importance of understanding syntactical structures. This approach offers secondary teachers new language-based strategies for helping students read advanced texts with greater understanding and engagement. More specifically, FLA is designed to guide teachers in engaging students in dialogue and activities to recognize and understand the language patterns of a particular discipline and the meaning of the discipline-specific language. There has not been empirical research addressing the effectiveness of FLA, however, the early work of Schleppegrell and Oliveira (2006) reported on a project that used this instructional approach with history teachers in California. Although the author's research provides readers with qualitative data about this approach, there continues to be a need for quantitative data about the effectiveness of this approach to increase adolescents' reading skills in disciplinary literacy.

In conclusion, this study on the comprehension of science text by African American students recognizes the importance of syntactical structures and guiding students to closely analyze these structures to obtain meaning conveyed by the text of specific disciplines, particularly the discipline of science. This study adopts the SFL theory by focusing on the syntactical structure of adverbial clauses. A metalinguistic approach is used to teach students to think about what information the clause structure provides in order to enhance their understanding of the text. This study has as one of its' major goals to contribute to the literature on adolescent literacy by examining the effectiveness of an instructional approach that addresses disciplinary literacy. Specifically, the participants in this study will be required to unpack complex sentences that contain adverbial clauses. They will then engage in activities that require them to analyze sentences by talking about the clause and discussing the information obtained

through their analysis. The goal of using this approach is to increase their understanding of the science text.

The subsequent chapter will detail the methodology that was used in this study to investigate the effectiveness of a metalinguistic approach used to facilitate the comprehension of text found in the discipline of science among two African American fifth students and one sixth grade student.

CHAPTER III: METHOD

This chapter details the method that was used in the investigation. First, the chapter presents the research design. Next, the setting and participants, data collection, and instrumentation are detailed. The chapter culminates with a description of the study procedures and data analyses.

Research Design

This study examined the effects of a newly developed multi-component intervention plan, among a heterogeneous group of African American students. These students presented with similar socioeconomic backgrounds, but differed in their language variation characteristics and grade level. Two of the students were fifth graders and one was a sixth grader. A single case multiple-probe design was chosen because such designs are widely recognized as appropriate in providing experimental documentation of unequivocal relationships between manipulation of independent variables and change in dependent variables within heterogeneous populations (e.g., Horner et al., 2005). The multiple-probe design is a variation of the multiple baseline design in which intermittent probes replace continuous baseline assessment (Byiers, Reichle, & Symons, 2012; Kucera & Axelrod, 1995). This design allows each participant to serve as his/her own control.

During the baseline, the assessment procedure consisted of reading 400- word science passages and completing sentence deconstruction maps and comprehension assessments. These activities were not feasible to implement for long periods of times for students that were identified as readers who struggle. Additionally, all of the participants did not attend the summer

program consistently. For instance one participant attended daily, while the third participant came only on Monday and Thursday. Therefore, the multiple-probe design was judged to be the best design to account for the aforementioned conditions, instead of the multiple baseline design. According to Byiers, Reiche, Symons (2012), the use of intermittent probes reduces the need for continuous data collection in all phases simultaneously and thus reduces ethical concerns relating to repeatedly probing unchanged low performance levels without offering relevant interventions. Finally, this design was selected as an initial evaluative step to provide detailed information on the efficacy of a novel intervention program.

Setting

The study took place in a private school during a summer enrichment program in Durham, NC. The participants were two fifth graders and one sixth grader. Each participant in the study received intervention during summer program hours on the school campus. All treatment and assessment was conducted individually and in a quiet workroom, during the regular program hours. No intervention took place outside of the school day or off school campus.

School Demographics

This study was conducted within the context of a summer enrichment camp program offered by an urban private school in Durham, NC. The private school is described as a college-preparatory, non-denominational, co-educational day school serving grades K-12 and boarding school grades 9-12. This private school is accredited by the International Christian Accrediting

Association (ICAA) and the Southern Association of Colleges and Schools Council on Accreditation and School Improvement (SACS CASI).

The mission of the school is to promote academic excellence through Jesus Christ. One of the key educational aims of their program is to equip students with the ability to communicate effectively through reading, writing, listening, and speaking. The goal of the school's summer enrichment camp was to reinforce concepts taught in the areas of reading, comprehension, and mathematics. The school has a population of approximately 175 students in grades kindergarten through 12. A total of 50 students ranging from grades 3-6 were enrolled in the summer enrichment program at the time of the current investigation.

Participants

A total of three female students participated in this investigation. The participants were enrolled in the summer enrichment program and had been enrolled in the private school during the 2012-2013 school year. They all resided in Durham, NC and parent self-report indicated that they fell within lower- to lower-middle class socioeconomic groups. Two of the three participants completed the entire study. One participant was unable to complete all components of the investigation due to a family crisis. However, data were collected for this participant during the baseline and intervention phase. Pseudonyms are used to label the participants.

Assessment of Participant Skills

Assessment measures utilized during this study to assess language variation and academic performance skills included the Diagnostic Evaluation of Language Variation (DELV)-

Screening Test, and the Stanford Achievement Test-Tenth Edition (SAT-10). These measures were utilized to determine if the participation criterion.

The Diagnostic Evaluation of Language Variation (DELV)-Screening Test (Seymour, Roeper, & de Villiers, 2002). The DELV-Screening Test is a norm-referenced assessment that identifies children who are speaking a variation from Mainstream American English (MAE). The screening test consists of two parts, both of which are designed to assist clinicians in distinguishing normal developmental language changes and patterns of variation from true markers of language disorder or delay. The first part entitled Language Variation Status was used for this study to identify the language patterns of the participants. This portion of the screening test is appropriate for children four to 12 years of age. The second portion of the screening test is appropriate for children age four to nine. Since the participants of this study are older than nine, this portion of the screening test was not administered.

The reliability of the DELV-Screening Test was evaluated by examining the decision consistency obtained from repeated test administrations. The decision consistency was evaluated by administering the screening test to one group of 25 children typically developing language on two separate occasions and by five pairs of different examiners; one White examiner and one Black examiner. The results indicated that, in most cases, the race/ethnicity of an examiner will have a fairly small effect, if any, on the overall classification of a child as speaking Mainstream American English (MAE) or a variation from MAE. The validity for the DELV-Screening Test included evidence based on content, response processes, the relationship of one to another variable, and on clinical studies.

The DELV-Screening test was used in this study to provide the investigator with additional descriptive information about the participant's oral language. Specifically, this screener provided information about the participant's degree of language variation, if any, from MAE. Although the focus of this study does not investigate the impact of dialect on unpacking complex sentences and comprehending science text, this information was judged to be important when working with students from culturally and linguistically diverse backgrounds.

The Standard Achievement Test-Tenth Edition (SAT-10). The SAT-10 is a norm-referenced standardized, achievement test measuring how a student's performance compares to a reference group. This assessment is typically implemented by school districts to determine how the local educational system prepares students as compared to a larger system, such as the state or nation (Carney, 2005). The contents of the measure consist of reading, lexile measure, mathematics, language, spelling, listening, science, and social science. The score reliability of the SAT-10 was evaluated resulting in coefficient range of .80-.90. This range indicates a high degree of internal consistency reliability. No test-retest reliability data were reported (Carney, 2005). The validity of the SAT-10 was evaluated resulting in coefficient range of .70 to .80. This range indicates a moderate to high degree of validity (Carney, 2005).

Criteria for Participation

The participants for this study were recruited from the above-described Durham private school. The investigator obtained administrative support from the school to recruit participants. The investigator met with the school principal and presented the purpose and rationale for the proposed study, which the school principal subsequently identified as being consistent with the

school mission and needs of some students within the school. Once permission was obtained to conduct the study, the school principal identified potential participants for the study. Parental consent was obtained for students to participate in the study.

The selection criteria used to identify potential participants required that each participant: (a) be African American; (b) speak English as the primary language; (c) attend the private school; (d) achieve a below average score in the area of reading comprehension on the Stanford Achievement Test-Tenth Edition (SAT-10); (f) be between the ages of 11-12; (g) have no history of a language-learning disability, and (h) return the consent form signed by a parent/guardian. Given that the term “Black” in school demographic reports may be used to refer to students of more than African American ethnicities (e.g., Haitian or Haitian American students who do not speak English as a primary language), parent(s) or guardian(s) of potential participants were interviewed and demographic information, such as ethnicity, age, and native language was collected by the PI. To ensure that the participants were African American, the PI met with the respective participants and obtained demographic information provided by the school’s administrative office.

In accordance with the participation criteria, each of the participating students was of African American heritage, attended the summer enrichment program at the private school identified for the current investigation, had a score on the SAT-10 that fell within the 40th percentile, were between the ages of 11 and 12, and had written parental consent to participate in the investigation. The students were screened using the Diagnostic Evaluation of Language Variation™—Screening Test (DELV). The DELV-Screening test is designed to identify students that present with language characteristics that differ from the Mainstream American

English (MAE) often used in the academic setting. The results of the screening fall into three categories of degree of language variation: (a) Strong Variation from MAE; (b) Some Variation from MAE; (c) Mainstream American English (MAE). Table 3 provides a summary of participant demographic information.

Table 3: Participant Characteristics

Participants	Degree of Language Variation	Age	SAT-10 Percentile
Lynn	MAE	11-11	40 th
Dana	Strong Variation from MAE	11-5	40 th
Pam	Strong Variation from MAE	12-2	40 th

Lynn

Lynn, an 11-year, 11-month-old African American female had just completed sixth grade at the beginning of the current investigation. Lynn’s reading comprehension scores fell within the 40th percentile on the SAT-10, indicating that her skills fell within the low average range. Language variation screening, conducted prior to the beginning of the baseline phase, revealed that Lynn presented with minimal variation from Mainstream American English, therefore deemed a speaker of MAE. The school principal reported that Lynn had received services from a reading specialist the previous school year and that she did not have a history of language-learning disabilities. Lynn was described as a hard worker and highly motivated. However, it

was also reported that Lynn could be hard on herself at times and seemed to periodically lose confidence in her ability to learn new information and skills.

Dana

Dana, an 11-year, 5-month-old African American female, had just completed fifth grade at the beginning of this investigation. Dana's reading comprehension scores fell within the 40th percentile on the SAT-10, indicating her reading comprehension skills fell within the low average range of functioning. Based on her scores, she was referred for the study. Language variation screening, conducted prior to the beginning of the baseline phase, revealed that Dana presented with a strong variation from Mainstream American English. The principal reported that Dana had not received any supplemental services and that Dana did not present with any language-learning disability. Dana was described as a bright student who lacked motivation.

Pam

Pam, an African American female, was a 12-year, 2-month-old African American female who had just completed fifth grade at the beginning of this investigation. Her reading comprehension skills fell within the tenth percentile on the SAT-10, indicating that she was performing in the low range of functioning. Language variation screening, conducted prior to the beginning of the baseline phase, revealed that Pam presented with strong variation from Mainstream American English. The principal reported that Pam was retained in third grade. Pam was described as a hard worker who struggled with reading and writing. It was also reported that Pam could become easily frustrated and needed encouragement to remain motivated. Although Pam had been retained in third grade, she did not have a history of additional education services, such as reading recovery or exceptional education.

Instructional Materials

A novel instructional program was developed by the investigator for implementation in this study. The participants in this investigation were repeatedly engaged in tasks that required knowledge about clause structures (e.g., independent clauses, dependent clauses, adverbial clauses.) The investigator taught the participants about adverbial clauses and how to identify these clauses within complex sentences. Reigeluth and Keller (2009) indicated that explicit instruction is an instructional approach that consists of various instructional components, such as advance organizers, guided practice, and coaching. Each instructional lesson in this study employed those components. What makes the approach in this study metalinguistic was the process of closely analyzing adverbial clauses and discussing the meaning provided by these clauses. The graphic organizer that was developed for this study served as a tool to aid the investigator in guiding the students through this process of thinking about the language within the sentence, that is, engage in a metalinguistic process. By engaging the participants in these discussions, the expectation was that the participants were able to comprehend complex text found in science texts. The instructional materials utilized in this study included:

- Seventeen, 400 word passages from *Jamestown Education: Timed Readings Plus in Science- Book 2 and Book 3* (Glencoe, 2003).
- A 10-question quiz per 400-word passage. The first five questions were multiple-choice questions that were taken from the quiz located in the *Jamestown Education: Timed Reading Plus in Science Books*. The investigator developed the second set of five questions, which were open-ended questions. The open-ended questions were developed based on the adverbial clauses found in the text. For example, the complex sentence may

read, “As a person moves into quiet sleep, the body moves from stages one to four and back to one again.” The questions develop based on the underlined adverbial clause would be the following: “When does a person’s body move to stage four of sleep?”

- Practice worksheets (adverbs, independent clauses, dependent and adverbial clauses, subordinate conjunctions) developed by the investigator.
- Sentence Deconstruction Map (Graphic Organizer), designed by the investigator.
- Word Walls. The word walls were large post-it chart paper. The investigator wrote key terms with definitions that were introduced in each instructional lesson. The chart paper was then posted on the wall for the participants to view. An additional word wall, was posted on the wall for participants to view, that consisted of the common types of subordinate conjunctions.
- Concept Maps/Bubble Maps. The bubble map was not a mandatory tool for this study, however, the investigator developed a handwritten bubble map. This map served to remind students of the focus on a specific dependent clause, which was the adverbial clause.

Two tasks developed by Killgallon and Killgallon (2000, 1997) to improve students’ ability to compose sentences were incorporated in the instructional program. Specifically, matching and identifying were used to increase participants’ understanding of adverbial clauses.

The science passages that were used in the baseline and instructional phase were obtained from the *Jamestown Readers-Time Reading Plus in Science* series (Glencoe, 2003). These are supplemental workbooks that consist of 25,400-word reading passages. The passages were analyzed by the primary investigator to determine if the selected passages consisted of enough

adverbial clauses to provide practice for the students. Analysis of the reading passages yielded an average of 7 adverbial clauses per passage. The reading passages that consisted of fewer than 7 adverbial clauses were not utilized in the study.

The reading passages served as supplemental text to the content area of science. The reading passages did not refer to prior material in the text or to any charts, pictures, or graphs in the students' classroom textbook. To determine text complexity of the reading passages, lexile measures were calculated through an online lexile measure (<http://lexile.com>). According to White and Clement (2001), the U. S. Department of Education Institute of Education Statistics recognizes lexile measures as acceptable measures of reading level. Therefore, a lexile measure was used in this study to determine if the text complexity of the reading passages was appropriate for the participants. The Council of Chief State School Officers (2012) has provided an updated text complexity grade band. Fourth and fifth grade students are expected to read and comprehend text with a lexile range of 740-1010. Students in grades six through eight are expected to read text with a lexile range of 925-1185. The passages utilized in this study fell within the lexile range of 740-925.

Procedures

There were three phases in the present investigation: baseline, instruction, and maintenance. Instruction took place within individual sessions with the investigator during the above-described summer program. The sessions were conducted up to four times a week based on the participant attendance. Each participant received a minimum of six instructional lessons utilizing explicit instruction. Explicit instruction was characterized by the investigator providing

advance organizers to introduce the purpose and expectation of each session, modeling key concepts, providing guided practice, providing independent practice, and assessment.

Since the participants were identified as readers who struggle, the investigator implemented the read aloud technique, which was characterized by reading the passages aloud as the student followed the text visually while listening to the investigator. Read alouds have been supported by research (e.g., Albright & Arial, 2005; Duffy-Hester, 1999; Lesene, 2006; Trelease, 2006; Wadsworth, 2008,) as an effective way to support older readers who struggle. According to Burkins and Croft (2010), read alouds motivate and encourage readers, build background knowledge and develop comprehension. The read aloud technique was used throughout all phases of this study to circumvent possible word recognition difficulties. The sessions were video-recorded for fidelity checking. Details describing procedures for each of the three instructional phases, as well as the fidelity check, follow.

Baseline Phase

What Works Clearinghouse (WWC) set forth clear standards to identify research as meeting evidence based standards (Kratochwill et al., 2010). In order to determine initial performance levels and variability, baseline measures for the two dependent variables were gathered prior to initiation of the instructional program. In accordance with WWC standards, a minimum of five data points must be obtained from each participant in order to provide an appropriate basis for comparison of progress between all phases. Five data points are also required to establish dependent measure stability (Kazdin, 2010; Kratochwill et al., 2010).

During individual baseline sessions, each student was given a blank sentence deconstruction map. The investigator provided a brief overview of the map and an explanation of what each component of the map required. For example, the student was told that the adverbial clause should be written in the box labeled ‘adverbial clause.’ However, the investigator did not provide any explanation or definitions for terms such as, ‘adverbial clause’ or ‘subordinate conjunction.’ After the brief overview, the participants were asked to complete the sentence deconstruction map. The investigator did not provide feedback whether the response was correct or incorrect. Following the completion of the sentence deconstruction map, the participant received a print copy of a science passage. After the passage was read, the student was provided with a print quiz consisting of five multiple choice questions and five open-ended questions. The student was instructed to answer the five multiple choice questions and five open ended questions about the text within 10 minutes. Upon completion of the quiz, the investigator collected the answer sheets and the story passage. Individual files were maintained for each participant.

Before implementing the intervention to participant one, the researcher and committee advisor visually inspected baseline trends for all participants and determined if the data were stable and predictable. An acceptable level of variability between data points was required. In general, a stable and predictable data trend is established when 80% of the data points reside on or within the stability envelope (Gast & Spriggs, 2010). WWC recommends five data points to be obtained to observe stability or variance. Five data points were obtained for each participant and no more than 30% variance was set for baseline measurements in order to define stability of the baseline measurements between data points and rising trends. The changes in mean level,

trend slopes, and variability were considered as well in determining the stability and predictability.

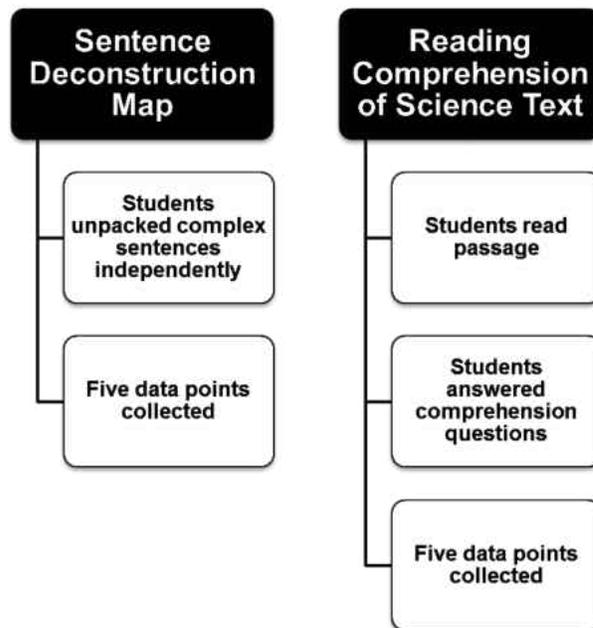


Figure 1: Baseline Phase

Intervention Phase

During the intervention phase, each participant engaged in six instructional lessons before intervention probes were collected. One participant required additional instruction which resulted in seven instructional lessons instead of six instructional lessons. Once a stable baseline was established, the intervention was implemented sequentially with each of the students. Instruction began with the first student while the others remained in baseline (McReynolds & Kearns, 1983; Richards, Taylor, Ramasamy, & Richards, 1999). When the first student demonstrated a treatment effect, the instructional phase was introduced to the second student, and so forth. Treatment effect in the instructional phase was characterized by the participant's

ability to achieve a score of 70% or above on the quizzes and completed a sentence deconstruction map with 70% or above accuracy.

Instructional lessons. The participants were engaged in six instructional lessons. The summer program took place four days out of the week, Monday through Thursday. Instructional lessons were implemented, based on participant attendance. The goal of the instructional lessons was to provide the students with opportunities to develop their understanding of adverbial clause structures.

Each lesson began with a presentation of an advance organizer introducing the lesson topic, the rationale, and the expectations of the lesson activities. Each of the six lessons had specific mastery criteria that had to be met in order to move to the subsequent lesson. For example, the instructor did not introduce the student to Lesson Two, until the student demonstrated that she could define the term, ‘adverb’ and identify an adverb within a sentence. The sixth lesson provided the participants with the opportunity to further develop their skills by demonstrating their understanding of adverbial clauses in contextualized tasks by reading a complete 400-word science passage rich with adverbial clauses and demonstrating understanding of the text. Figure 2 provides the instructional lesson sequence and the lesson topic. The subsequent section provides a summary of each lesson, however a complete description of each lesson, along with a guided script, can be found in the instructional protocol located in Appendix A (see page 111).

Lesson One	• Adverbs
Lesson Two	• Simple and Complex Sentences
Lesson Three	• Independent and Dependent Clauses
Lesson Four	• Adverbial Clauses and Subordinate Conjunctions
Lesson Five	• Subordinate Conjunctions
Lesson Six	• Complete Passage Practice

Figure 2: Instructional Lesson Sequence

Lesson one. The purpose of Lesson One was to review adverbs with each participant. The lesson began with the presentation of an advance organizer that presented the purpose, rationale, and expectation of the lesson. The participants received a review of the different types of adverbs: when, where, why, how, and under what condition. The participants were provided with examples of each adverb and the opportunity to identify the specific adverb in a sentence. Then the participant was engaged in guided practice in which the student was provided with the opportunity to produce a sentence using the adverb, written or orally. If the participant provided an incorrect answer, the instructor noted the correct response and offered the participant another opportunity to practice generating more sentences using the target adverb.

Following the practice of producing sentences using the adverb types, the participant was given five sentences and asked to identify the adverbs by circling or underlining the adverb. The investigator then asked the participant to express the type of question that the adverb answered (e.g., Does it tell you when something happened? Does it tell you where?). After the participant

completed this task, the investigator presented the participant with a four to five sentence paragraph consisting of adverbs. The investigator read the paragraph aloud, while the participant read silently. The investigator then modeled the expectation of this task and identified the first adverb in the paragraph and expressed what the information provided. Then the participant was required to analyze the remaining paragraph and independently identify the adverbs. Once the participant identified the adverbs, the investigator engaged the participant in a discussion about the responses and the key information provided by the adverbs. Finally, the lesson concluded with an assessment to measure the participants' ability to identify adverbs. The participant was required to have an understanding of adverbs before being introduced to adverbial clauses in a later lesson. Prior to advancing to the second lesson the participant had to meet the set mastery criterion level: identification of adverbs in five sentences with 100% accuracy.

Lesson two. The purpose of Lesson Two was to teach the participant the difference between complex and simple sentences. This knowledge was judged to be important to understanding the type of sentences typically found in expository text, particularly science text.

The lesson began with the presentation of an advance organizer that presented the purpose, rationale, and expectation of the lesson. Following the presentation of the advance organizer, a review of the previous lesson about adverbs was conducted. After the review, the participant was provided with definitions of each sentence type followed by example sentences. The participant was then provided with the opportunity to identify the simple and complex sentences from a list of eight sentences developed by the investigator. Following the identification exercise, the participant was required to practice developing a simple and complex sentence with feedback provided by the investigator. The participant was then provided with a

four- to five-sentence paragraph. The student was asked to independently identify simple and complex sentences within the paragraph. After the student identified the sentence types, the investigator engaged the participant in discussion about the responses. The investigator then explained to the participant that the complex sentence is the type of sentence that they would be working on throughout the study. The lesson concluded with an assessment to measure the participant's understanding of simple and complex sentences. In order to advance to the third lesson the participant had to meet the set mastery criterion level: Identification of simple and complex sentences, given a worksheet of five sentences with 100% accuracy.

Lesson three. The purpose of Lesson Three was to define the term 'clause' and to teach the difference between independent and dependent clauses. This knowledge was judged to be important before teaching the student about adverbial clauses.

The lesson began with the presentation of an advance organizer that presented the purpose, rationale, and expectation of the lesson. Following the presentation of the advance organizer, a review of the previous lessons about adverbs and simple and complex sentences was conducted. After the review, the participant provided the definition for the term, 'clause.' The investigator explained the role of clauses in complex sentences. The student was taught the key characteristic of clauses, specifically, that clauses consist of a subject and a verb.

The investigator then presented the two types of clauses, independent and dependent. The term 'independent clause' was presented first along with the definition. The investigator provided a sample clause for the participant to view. Next, the investigator introduced the term 'dependent clause' and its definition. A sample dependent clause was presented for the participant to view. The investigator engaged the participant in a discussion about both clause

types and noted that they each consist of a subject and verb. However, the dependent clause does not communicate a complete thought and has to be attached to an independent clause. The investigator also explained the various locations that dependent clauses appear within a sentence. Dependent clauses can appear as openers within a sentence (e.g., “If the temperature is very cold, the water vapor freezes on the crystals.”), as closers of a sentence (e.g., “Layers of ice continue to form on the ice particles until balls of ice form.”) and between the subject and verbs of a sentence (e.g., “Dr. Sockwell, before he mixed the two chemicals, turned on the burner.”).

Following the presentation of the terms and examples, the participant was presented with sentences from science texts and required to practice identifying dependent clauses and independent clauses. During this practice, the primary investigator asked the participant to label the subject and verb within each identified clause. For the dependent clauses, the investigator asked the students to label the location of the clause. Next, the participant was provided a four-to five-word paragraph to practice identifying the independent and dependent clauses. The investigator emphasized that the remaining lessons would focus on the dependent clause, and specifically, the adverbial clause.

The lesson concluded with an assessment to measure the participant’s understanding of dependent and independent clauses. In order to advance to the fourth lesson, the participant had to meet the following mastery criterion level: Label a mix of eight independent and dependent clauses sentences with 100% accuracy. Once the criterion level was met, the participant proceeded to Lesson Four.

Lesson four. The purpose of Lesson Four was to teach about the adverbial clause and subordinate conjunction. Following the presentation of the advance organizer, the lesson began

with a review of independent and dependent clauses with extended discussion about dependent clauses. The investigator then reviewed the term ‘adverb’ and asked the participant to recall the function of the adverb. The investigator and the participant reviewed that an adverb answers when, where, why, how, and under what condition? The investigator then introduced the term “adverbial clause” and informed the participant that the adverbial clause is used in the same way that adverbs are used. Following the review, the term “adverbial clause” and its definition was presented to the student. The student was reminded that an adverb clause is a dependent clause, and that the key feature of the clause was that it has a subject and verb. The investigator discussed the types of questions that adverb clauses assisted in answering (i.e., when, where, why, how, and under what condition). The investigator also discussed the positions in which adverbial clauses are found within sentences. The investigator then provided examples of two sentences with adverb clauses located in different positions (opener and closer).

After the discussion of adverbial clauses, the investigator presented the term, ‘subordinate conjunction.’ The investigator indicated that in addition to the adverbial clause having a subject and verb, the clauses have signal words, often referred to as subordinate conjunctions. The words are typically found at the beginning of the clause, followed by the subject and verb. The investigator then provided a list of subordinate conjunctions that were categorized in the following groups: (a) time (e.g., after, before, since, when), (b) cause and effect (e.g., because, in order that, now that, so), (c) opposition/contrast (e.g., although, even if, whenever, even though), and (d) condition (e.g., provided that, while, as long as, unless, if). This list was placed on a large post-it chart paper and placed on the wall of the room for the

participant to view. The investigator discussed a list of the common subordinate conjunction words and provided an example for each.

The investigator informed the participant she was not expected to initially remember all of this information. The investigator indicated that a tool would be provided to help with identifying adverbial clauses within a complex sentence. The investigator presented the participant with a sentence deconstruction map (found in Appendix B, see p. 146), and explained that this graphic organizer would help her analyze the sentence and talk about the information that would be learned from the complex sentence.

The first step in using the sentence deconstruction map required that the sentence be written in the sentence box of the map (e.g., “A plant can release water through the stomata if it soaks in too much water.”). Next, the sentence was read aloud to the participant. Then the investigator demonstrated a “think aloud” strategy to the participant by commenting on the characteristics of an independent clause and dependent clause. Once the investigator identified the dependent clause, the investigator asked the participant to confirm the answer by recalling the key characteristics of a dependent clause. The investigator re-emphasized that a dependent clause does not provide a complete thought. Now that the dependent clause has been identified, this clause would be the adverbial clause. The investigator then explained to the participant that if she was not sure if she had identified the adverbial clause, the next step is to look for the subordinate conjunction.

The investigator directed the participant’s attention to the word wall consisting of subordinate conjunctions. Following a brief review, the investigator identified the subordinate conjunction within the clause which was ‘if.’ The investigator wrote the word, ‘if’ in the box

labeled ‘subordinate conjunction.’ The investigator then posed the question, “Does a subject and verb follow the subordinate conjunction?” The investigator read the group of words including the subordinate conjunction, “if it soaks in too much water.” The subject that follows the subordinate conjunction ‘if,’ is ‘it’ and the verb is ‘soak.’ The investigator wrote the subject and verb in the corresponding boxes of the sentence deconstruction map. The investigator then indicated to the participant that now once the subordinate conjunction, subject, and verb have been identified, we have our adverbial clause. This clause is then in the designated box within the sentence deconstruction map labeled, “adverbial clause.”

Then the investigator moved to a subsequent box within the sentence deconstruction map that contained a list of the types of questions the clause would answer (i.e., why, when, where, how and under what conditions). The investigator asked the participant about the type of question that the adverbial clause would answer. The participant determined the question type and then the entire sentence was read again aloud. Finally, the investigator completed the last component of the sentence deconstruction map that required a paraphrase about the information learned from the complex sentence. The paraphrase was written in the final box.

Following this demonstration, the investigator and student practiced the process of unpacking and utilized the graphic organizer two more times. Additional practice (i.e., 2-3 more practices with the use of the graphic organizer) was provided to the participants that demonstrated difficulty with the task. After the guided practice, the investigator provided the opportunity for the participant to unpack a complex sentence independently using the graphic organizer. The investigator provided feedback after the participant worked independently.

The lesson concluded with an assessment to measure the participant's understanding of unpacking the complex sentence. In order to advance to Lesson Five, the participant had to meet the following mastery criterion level: The identification of adverbial clauses in four complex sentences using the sentence deconstruction map with 100% accuracy.

Lesson five. The purpose of Lesson Five was to provide more practice with subordinate conjunctions. The lesson began with the presentation of an advance organizer that presented the purpose, rationale, and expectation of the lesson. Following the presentation of the advance organizer, a review of the previous lessons about adverbial clauses and subordinate conjunctions was conducted. Following the presentation of the advance organizer, the investigator displayed the chart paper consisting of the categories of subordinate conjunctions. The investigator and participants reviewed the types of subordinate conjunctions found in adverbial clauses, such as time, cause and effect, opposition, and condition. The participant was provided with examples and was able to practice identifying the subordinating conjunction within the adverbial clause. The sentence deconstruction map was utilized to demonstrate how to identify the subordinate conjunction and adverbial clause within a complex sentence.

The participant was then provided with a four- to five-sentence science paragraph to practice identifying the subordinate conjunction word and adverbial clause. The participant engaged in discussion regarding how the subordinate conjunction assisted in identifying the adverbial clause. The discussion also involved the information learned from the adverbial clause, such as when an event happen, how or why something occurred. The lesson concluded with an assessment to measure the participant's understanding of subordinate conjunctions. In order to advance to Lesson Six, the participant had to meet the following mastery criterion level:

The identification of subordinate conjunction words in five adverbial clauses within a four- to five-sentence paragraph with 100% accuracy.

Lesson six. The purpose of Lesson Six was to provide practice with a complete 400-word passage. The lesson began with the presentation of an advance organizer that presented the purpose, rationale, and expectation of the lesson. Following the presentation of the advance organizer, a review of the previous lessons about adverbial clauses and subordinate conjunctions was implemented.

The participant was provided practice with a complete 400-word passage that was presented during baseline. The investigator provided the participants the opportunity to see the difference in their initial responses as well as how they had initially analyzed the passages. The passages consisted of underlined complex sentences with adverbial clauses. The investigator read the passage aloud as the participant followed along. After each paragraph, the student was provided with an opportunity to analyze complex sentences within the paragraph. The sentence deconstruction map was used. Upon completion of reading the passage, the investigator and student worked collaboratively to answer the questions. Feedback was provided as necessary. After completing Lesson Six, each participant independently read a 400-word science passage and completed an accompanying quiz. The passages consisted of topics that were different from the passages used during the baseline phase and in the instructional lessons. If the students scored 70%, additional booster intervention sessions were not provided.

Maintenance Phase

Maintenance probes were conducted two weeks, four weeks, and six weeks following the completion of the instruction to determine if the positive changes were maintained over time. Probes were conducted to measure the two dependent variables: (a) the student's ability to unpack complex sentences; and (b) the student's ability to comprehend science text. If the student's performance had decreased by more than 30%, the participant would have been provided with a review lesson until criterion was reached again (i.e., 70% and above accurate implementation). However, two of the participants did not require any review sessions. The third participant was unable to complete the study; therefore maintenance data was not collected.

Intervention Fidelity

A procedural checklist was developed and utilized to ensure intervention fidelity (see Appendix B - Intervention Fidelity Checklist; see p. 146). The investigator trained the fidelity coder on the instructional procedures. The fidelity coder was an undergraduate student with a history of working with professors on various research projects. The investigator trained the fidelity coder as to how to analyze the videos and complete the checklist.

To ensure procedural fidelity, approximately 20% of videotaped sessions of each student were randomly selected and reviewed by the investigator and the fidelity coder. Procedural fidelity was calculated by the number of steps correctly implemented divided by the number of steps correct, incorrect, or omitted (Neuman & McCormick, 2000). The mean procedural fidelity across intervention sessions was 96% (91% to 100%), suggesting that the procedures were followed consistently.

Measures

The Jamestown Time Reading Plus in Science Comprehension Test (Glencoe, 2003), and researcher developed assessments, to include (a) open-ended questions, (b) sentence deconstruction map, were used as the dependent measures for this study.

Dependent Measures

Two types of dependent measures were taken throughout this study: (a) measures of the students' comprehension of science passage rich with adverbial clauses; and (b) measures of the student's ability to unpack the complex sentence using the sentence deconstruction map.

Instrumentation and Coding. To measure the students' comprehension of science passages rich with adverbial clauses, objective multiple-choice and open-ended question quizzes were administered. The quiz consisted of five multiple-choice questions and five open-ended questions. The five multiple-choice questions were extracted from the quiz found in the Jamestown Readers-Time Reading Plus in Science (Glencoe, 2003). The multiple-choice questions consisted of questions calling for the following information: (a) main ideas, (b) details, (c) inference, (d) drawing conclusions. Reliability, validity, and evidence of technical adequacy were not available for the Jamestown Readers-Time Reading Plus in Science. The researcher requested these data from the publisher; however, the publisher indicated that there is no information available for public distribution regarding reliability and validity. Additionally, an electronic search was conducted to locate reviews of content validity, but no such information was located.

The investigator developed five open-ended questions using the adverbial clauses found within the selected reading passages. The open-ended questions answered the following questions: when, why, where, how, and under what condition. Based on Webb's (1997) Depth of Knowledge, these questions tap into Level 1 knowledge (i.e., recalling information, answering, who, what, where and why questions) and Level 2 (i.e., cause and effect, and inference). Therefore, the questions that were developed for the quizzes required students to recall information, express cause and effect and make a few inferences. Since the questions were developed from the adverbial clauses within the selected reading passages, the question types were not parallel for each reading passage.

A rubric was developed to evaluate the participant's answer to the five open-ended questions of the quiz. Rubrics are a set of guidelines for giving scores and outlines all of the dimensions being assessed and contains a scale (Arter & McTighe, 2001; Jandris, 2001; Jonsson & Svingby, 2007; Whittaker, Salend, & Duhanney, 2001). The investigator scored the rubrics. The rubric and rubric score criterion can be found in Appendix E (see p. 160).

To measure the students' ability to unpack complex sentences, the Sentence Deconstruction Map was utilized. The map which consist of six boxes, have an assigned point system in which the student could obtain a total of eight points. The first box is designated for entering the complex sentence. The second box required the participant to identify the subordinate conjunction in the complex sentence and equated to 1 point. The third box required the participant to identify the subject that followed the subordinate conjunction and equated to 1 point. The third box required the participant to identify the verb that followed the subordinate conjunction and equated to 1 point. The fourth box required the participant to identify the

adverbial clause and equated to 1 point. The fifth box required the participant to identify the question type that the adverbial clause would answer. The correct response equated to 1 point. The final box requires the student to communicate in her own words the information she had learned from the complex sentence. A complete paraphrase totaled three points. A paraphrase was deemed appropriate if they had the following components: (a) a complete thought with a subject and verb (1 point); (b) the response must make sense (1 point); (c) must consist of three to four new words to communicate own idea (1 point). A copy of the sentence deconstruction map and the scoring criterion can be found in Appendix C (see p. 148).

Intervention Probes. Following the instructional lessons, intervention probes were conducted to assess change, if any, in the participant's ability to unpack complex sentences and comprehend science text. Intervention probes consisted of the use of the sentence deconstruction maps to assess the participant's ability to unpack complex sentences and the completion of a comprehension quiz. The dependent measures used during the baseline phase was used for the intervention probes. The mastery criterion was 70% and above for both measures. The number of probe sessions varied between participants because stability had to be determined by investigator.

During the intervention probes, the participants received supplemental lessons after they had completed the sentence deconstruction map and reading comprehension quiz. The supplemental lesson was administered if the investigator decided that the participant needed a review on key concepts. For example, if the investigator observed the participant making careless mistakes or not thinking about key definitions, the investigator provided a 5-10 minute review at the end of the session. The supplemental lessons took place after the probe to avoid

influencing the participant's results. The supplemental lessons served as reviews of previously learned topics. Once the participant met the criterion of 70% or above on the assessments, supplemental probes were not provided in later probe sessions. The probe sessions for each participant are described in detail and can be found in Appendix D (see pp. 150-159). Figure 3 outlines the tasks implemented during the intervention probe.

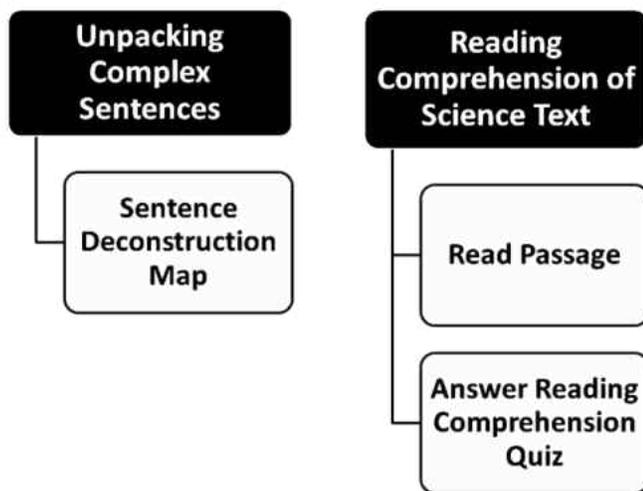


Figure 3: Intervention Probe

Videotaping. Intervention sessions were videotaped across the span of the study for fidelity checks. All videos were stored in a locked cabinet in the investigator's home office. Only the investigator had access to the video recordings. Upon completion of the study all videos were erased.

Interventionist. The investigator, a licensed speech-language pathologist (SLP), provided the instruction.

Data Analysis

According to Kratochwill et al. (2010), single case design studies typically employ visual analysis to determine if the predicted and replicated changes in a dependent variable are associated with active manipulation of an independent variable. Visual analysis is commonly used among researchers in the field of single subject research (Gast & Spriggs, 2010; Tankersly, Harjusola-Webb, & Landrum, 2008). Visual analysis examines trends, levels, and data variability among baseline and treatment conditions (Horner et al., 2005). Trends refer to the directional path of the data and level refers to the change in data points once the intervention has been implemented (Kratowill et al., 2010; Tankersly et al., 2008). Kratochwill and colleagues (2010) described variability as the “fluctuation of the data around the mean” (p. 5). Tankersly, Harjusola-Webb, and Landrum (2008) discussed the mean as the average of each phase. Further, visual analysis calls for frequent analysis of data, which assists in making data driven decisions during a study (Gast & Spriggs, 2010). When data were graphed in an Excel spreadsheet and analyzed for each participant, the risks of overestimation and underestimation were reduced.

Visual analysis was used in this study to determine when participants moved between phases. During the baseline phase, a participant moved into the treatment phase when 80% of that participant’s baseline data fell within a 20% range of the baseline mean. Visual analysis was also used in this study to compare the data between baseline and treatment phases and in determining if there were a functional relationship between the two phases (Tankersly et al., 2008). Kratochwill et al. (2010) described four steps in conducting visual analyses. The first step includes documenting a predictable baseline data path. The second step includes finding the within-phase patterns among each phase. A comparison among adjacent phases for

demonstrated effects is the third step. The final step in visual analysis is an overall analysis of the study in search of at least three illustrations of an effect. A functional relationship was demonstrated if data displayed stable trends, levels, and variability in each condition.

Improvement Rate Difference

The Improvement Rate Difference (IRD), a new effect size for summarizing single-case research data, was utilized for this study. According to Parker, Vannest, and Brown (2009), the IRD is a nonparametric measure of nonoverlap for comparing two phases, typically baseline and treatment phases. IRD was modeled after the “Risk Difference” concept used in group medical research. The IRD is calculated as the difference between two Improvement Rates (IRs) of intervention phase and baseline phase. The IR of each phase is calculated by the number of improved data points divided by the total data points in that phase. The maximum IRD score is 100% or 1.00, which indicates a large effect size. The range of effect sizes for IRD are as follows: (a) small (.2-.3), (b) medium (.5-.7), (c) large (.8-1.0) (Cochrane Collaboration, 2006). The IRD scores supplement the visual analysis by presenting the effect size of the instructional approach on the dependent measures between the phases. Combining effect sizes with visual analysis offers the advantage of certainty that the results of the study is not by chance (Parker, Vannest, & Brown, 2009).

Summary

This chapter presented and reviewed the methodology for the current study. The study employed an experimental single-case multiple-probe across participants design to answer the two research questions in this study. The setting and participants were discussed. The measures

utilized in the study were presented and the data analytic procedures for each research questions were described. The subsequent chapter will discuss the results of this study.

CHAPTER IV: RESULTS

This chapter describes the results of this study conducted to address the following questions: (1) What are the effects of a metalinguistic approach using a graphic organizer on the unpacking of complex sentences with adverbial clauses with African American fifth and sixth grade students? and, (2) What are the effects of a metalinguistic approach used to unpack complex sentences on the comprehension of science text among African American fifth and sixth grade students? Visual inspection analyses, mean averages of data points, and Improvement Rate Difference (IRD) scores were used to analyze data for intervention effectiveness.

Unpacking Text and Text Comprehension across Participants

Rate of Achievement

The total number of instructional lessons in which the students participated ranged from six to seven lessons. The number of instructional lessons varied based on the needs of the participant. Each participant was seen in a quiet resource room designated for individual educational activities. Lynn and Dana required a total of six lessons and Pam required seven lessons to complete the instructional program. Lynn and Dana met the criterion performance level after each lesson and did not require repetition of any of the instructional lessons. Two sessions were required for Pam to meet the criterion performance level for the subordinate conjunction lesson. Table 4 provides a summary of the instructional lessons and instructional time for each participant.

Table 4: Instructional Lessons

Instructional Lessons

Participants	Total number of instructional lessons	Lesson Topic	Instructional Time
Lynn	6	L1	39 min 00 sec
		L2	41 min 00 sec
		L3	52 min 58 sec
		L4	53 min 00 sec
		L5	56 min 04 sec
		L6	44 min 00 sec
Dana	6	L1	41 min 00 sec
		L2	55 min 12 sec
		L3	43 min 00 sec
		L4	56 min 00 sec
		L5	55 min 07 sec
		L6	46 min 00 sec
Pam	7	L1	47 min 00 sec
		L2	24 min 06 sec
		L3	51 min 00 sec
		L4	53 min 18 sec
		L5	41 min 47 sec
		L5	57 min 00 sec
		L6	39 min 23 sec

Level of Achievement

Intervention probes were collected for each participant following the completion of all instructional lessons. The intervention probes measured the participants' ability to unpack complex sentences using the sentence deconstruction map and their ability to comprehend

science text by completing a reading comprehension quiz. Table 5 provides a summary of the intervention probe and instructional time for each participant. A more detailed description of the intervention probe sessions can be found in Appendix D (see pp. 150). Specifically, this description provides a report of the participants' performance on evaluative activities completed during the intervention probes, the percent accuracy on sentence deconstruction mapping activities, and reading comprehension quizzes. This information is provided for descriptive purposes and did not compromise dependent measure findings.

Table 5: Summary of Intervention Probe Sessions

Participant	Total # of Probe Sessions	# of Supplemental Review implemented	Time range of probe sessions. (minutes/seconds)
Lynn	5	1	15 min/36 sec- 16 min/7 sec
Dana	9	3	16 min/52sec- 20 min/ 16 sec
Pam	5	3	17 min/35 sec- 23 min/45 sec

Figure 4 displays the percentage of participants' accuracy in unpacking complex sentences and science comprehension scores across the phases. The trend lines for unpacking of complex sentences and comprehension of science text followed similar patterns, characterized by gradual increases in scores during the instructional phase. Lynn and Dana maintained an increase of at least 50% (range = 51.2% -57.7% increase) in the percent accuracy on the unpacking measure from baseline to instruction, and at least a 20% (range =20.7%-35.5% increase) increase in percent occurring on the comprehension of science text measure from the baseline phase to intervention phase.

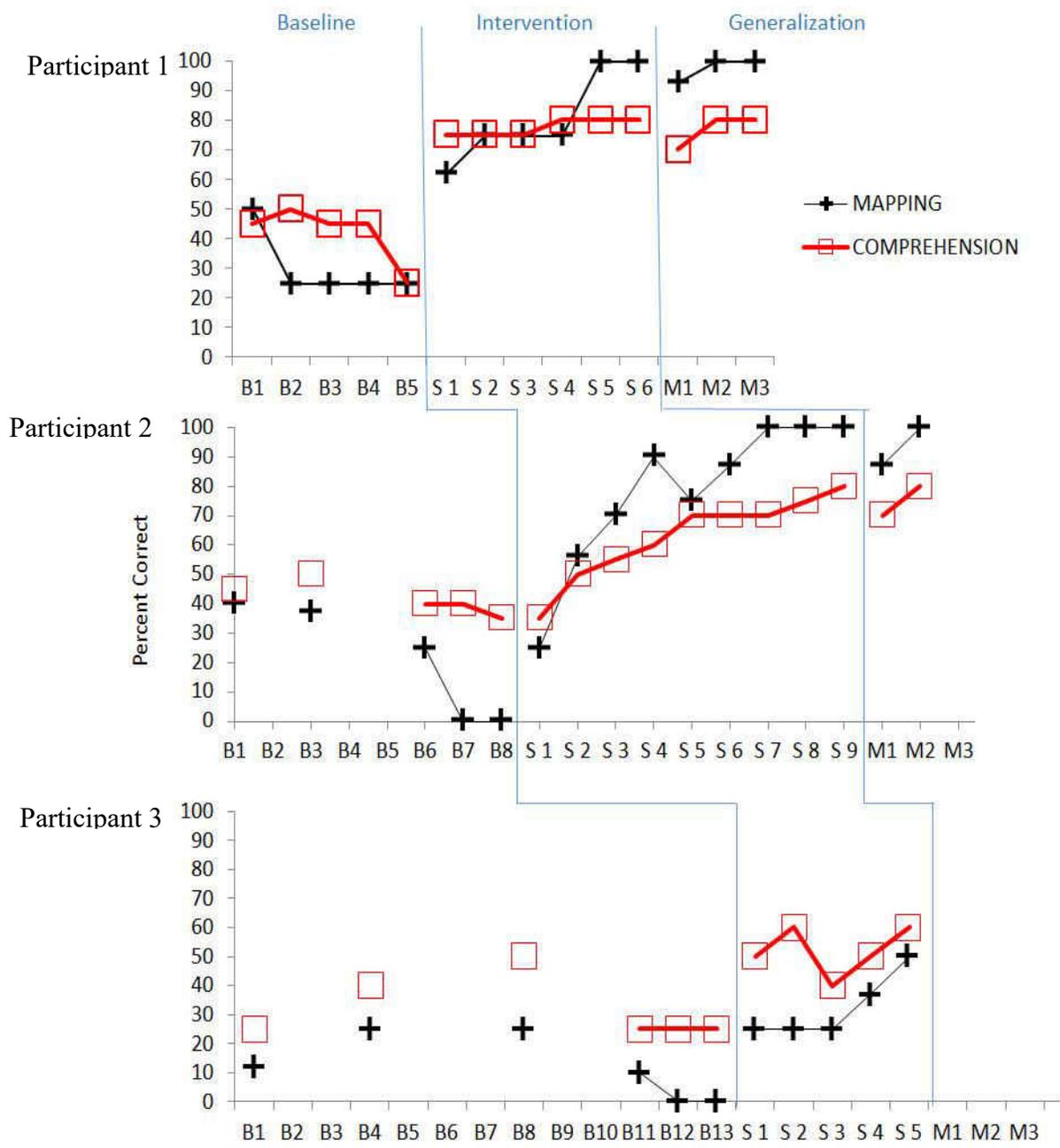


Figure 4: Percentages of participants' accuracy of unpacking and reading comprehension

Lynn. During baseline, Lynn's scores for unpacking ranged from 25% to 50% accuracy, resulting in an average of 30% accuracy. Her scores for reading comprehension ranged from 25% to 45%, resulting in an average of 42% accuracy. Lynn exhibited a declining trend during baseline for both variables. Following baseline, Lynn showed a steady increase in her ability to unpack complex sentences (mean average=81.2% accuracy) and to comprehend science text (mean average = 77.5% accuracy). She showed a higher level of performance with unpacking sentences than she did comprehending science text.

Dana. During baseline Dana's scores for unpacking ranged from 0% to 40%, resulting in an average of 20.4% accuracy. Her scores for reading comprehension ranged from 35% to 45%, resulting in an average of 42% accuracy. Dana exhibited a declining trend during baseline for both variables. Following baseline, Dana showed a steady increase in her ability to unpack complex sentences (average = 78.1% accuracy) and to comprehend of science text (average = 62.7% accuracy). She showed a higher level of performance with unpacking sentences than she did comprehending science text.

Pam. During baseline, Pam's scores for unpacking ranged from 0% to 12%, resulting in an average of 12% accuracy. Her scores for reading comprehension ranged from 25% to 45%, resulting in an average of 42% accuracy. While, there was a slight increase in scores for Pam, it was not maintained throughout the study. For example, following baseline, Pam required more time to evidence increased unpacking accuracy scores. Pam's data point for comprehension demonstrated some variability. The data points demonstrated an increasing trend and then decreased, and ended with a rising trend. The average for accuracy of comprehension of science

text was 52%. Pam demonstrated higher accuracy scores for comprehension of science text than for unpacking of complex sentences.

Maintenance

Maintenance probes were conducted at intervals of two, four, and six weeks post-instruction for Lynn and Dana. Maintenance probes were not completed for Pam, due to her inability to complete the study. Lynn and Dana demonstrated maintenance of unpacking complex sentence with an average of 95.6%, and comprehension of science text with an average of 75.9%.

Improvement Rate Difference

Table 6 summarizes Improvement Rate Difference (IRD) scores for participants when comparing Baseline to Intervention. When considering that IRD scores of .8 and greater are considered large effect sizes (Parker, Vannest, & Brown, 2009).

Table 6: IRD: Comparison of Baseline Performance to Intervention Performance

Participants	Unpacking Complex Sentences	Reading Comprehension of Science text
Lynn	1.00	1.00
Dana	0.8889	0.7778
Pam	0.375	0.6333
Average	0.754633	0.8037

Table 7 presents the IRD results between baseline phases and the maintenance phase. While data were collected for Lynn and Dana, Lynn’s inability to complete her participation in

the investigation in light of a family crisis prevented maintenance data collection for this participant. Lynn and Dana's perfect IRD scores (1.0) indicated a significant intervention effect on participant ability maintain acquired unpacking had comprehension skills.

Table 7: IRD: Comparison of Baseline Performance to Maintenance Performance

Participants	Unpacking Complex Sentences	Reading Comprehension of Science text
Lynn	1.00	1.00
Dana	1.00	1.00
Pam	N/A	N/A
Average	1.00	1.00

CHAPTER V: DISCUSSION

The purpose of the present study was to examine the impact of a metalinguistic instructional approach to facilitate the comprehension of text found in the discipline of science. The primary goal was to determine whether such an instructional approach, consisting of explicit instruction in adverbial clauses, would have a positive effect on African American students' ability to unpack complex sentences and comprehend science text. This chapter will discuss the conclusions for the findings of each research question and the study in general, as well as limitations, practical implications and recommendations for future research.

Research Question One

What are the effects of a metalinguistic approach using a graphic organizer on the unpacking of complex sentences with adverbial clauses with African American fifth and sixth grade students?

It was hypothesized that following the implementation of a metalinguistic approach, the fifth and sixth grade students in this study would be able to unpack complex sentences with adverbial clauses using a graphic organizer. The findings of this study indicated that African American fifth and sixth grade students improved their ability to identify adverbial clauses following the use of a metalinguistic approach. Participants, Lynn and Dana demonstrated independent use of the graphic organizer to unpack complex sentences. While Pam demonstrated an increase in percentages from the baseline phase to the intervention phase (i.e., average baseline phase percentage= 12%, average intervention phase percentage= 32.4%) she did not demonstrate as much progress as the other participants.

In this current study, the IRD scores for all participants were in the moderate range for baseline and intervention phases. *Additionally*, the IRD scores between the baseline phase and the intervention phase indicated that the intervention had a strong effect on the participants' progress. A possible explanation for this outcome could be that in this study, explicit instruction was utilized to teach the participants about complex sentences and adverbial clauses. The investigator utilized a graphic organizer to model how to unpack complex sentences. The participants were provided with opportunities to practice using the graphic organizer with the instructor, followed by independent practice. The investigator incorporated the use of this tool and explicit instruction in reading science text. The participants used the tool to discuss what they were reading and to share relevant experiences. Overall, instead of being passive listeners, they actively participated in reading the passages in the science text.

The findings of this study corroborate the recommendations of disciplinary literacy scholars (Fang & Schleppegrell, 2010; Moje et. al., 2008; Schleppegrell & Oliveira, 2006; Shanahan & Shanahan, 2008) with regard to close analysis of language within a specific discipline. Schleppegrell and Oliveira (2006) reported qualitative data from a project that used Systemic Functional Linguistics (SFL) to closely analyze passages from history textbooks. In their study secondary teachers in the project used this strategy to engage students in discussions of history content in order to explore the meanings in texts written by historians. The authors detailed the activities and benefits of the strategies as outlined by the participating teachers.

The findings in this study also support the theoretical framework of systemic functional linguistics and research that highlights the importance of syntax in meaning (Halliday, 1994; Halliday & Matthiessen, 2004; Nippold, Mansfield, Billow, & Tomblin, 2008; Scott, 2009). SFL

is a theory of language that links language forms with the meanings they present, and it offers a metalanguage for talking about the language that can help learners relate language and content.

The participants in this study were engaged in discussions of adverbial clauses found in science text. In this study the investigator used a graphic organizer and a sentence deconstruction map, to guide the students through the analysis of complex sentences. The participants were able to engage in discussions about adverbial clauses and the investigator modeled how to unpack complex sentences. Unpacking, defined in this study, was the process of providing students with sentences and requiring them to identify the adverbial clause, subordinate conjunction, and to determine the meanings of the sentences. In other words, the participants were not just reading and answering questions about the sentences, they were involved in discussing language, and in particular, adverbial clauses. This study was a departure from other studies because it focused exclusively on the use of a specific instructional approach that targeted a specific clause structure.

Research Question Two

What are the effects of a metalinguistic approach to unpacking complex sentences on the comprehension of science text among African American fifth and sixth grade students?

It was hypothesized that following the implementation of a metalinguistic approach to unpack complex sentences, the fifth and sixth grade students in this study would improve their reading comprehension of science text as measured by reading comprehension quizzes.

Findings of this study indicated that African American fifth and sixth grade students improved their reading comprehension following the use of the metalinguistic approach.

Two participants, (e.g., Lynn and Dana) demonstrated continued progress in reading comprehension and maintained the constructs taught in the instructional approach used in this study. The third participant (e.g., Pam) showed progress in her reading comprehension; however, her scores, displayed through visual analysis, were not very high. Her average reading comprehension score during the baseline phase was 31.6%, and during the intervention phase was 52%. This investigator suspected a possible language and learning disability; however, there was no record of a diagnosed disability in her cumulative school file. Although Pam's percentages were low and she did not complete the study, data indicated that she was demonstrating some benefit from the intervention. Overall, the IRD scores between the baseline phases and the intervention phases, indicated that the intervention had a strong effect on the participants' progress.

Similar to the results for the first research question, the IRD scores for reading comprehension were in the moderate range for baseline and intervention phases. The IRD scores within the maintenance phase were within the high range and were stable. IRD scores for the maintenance phase were only collected for participants, Lynn and Dana. Pam discontinued the study due to a personal crisis. These IRD scores offer credibility to the outcomes obtained in this study. Although it took some time for the participants' performance to stabilize following instruction, the rising trends indicated that their skills remained stable over time, suggesting that they had truly acquired and assimilated the new skills.

During the intervention phase the participants were provided with explicit instruction and were required to complete tasks that were sequentially implemented by the instructor. As noted previously, explicit instruction provides opportunities for instructors to model strategies, provide

opportunities to practice and review content. Therefore, it was anticipated that the participants' gradual learning of talking about the meaning provided by the adverbial clauses and their understanding of the reading passage would improve due to the use of explicit instruction. Interestingly some of the participants demonstrated use of evidence-based reading strategies (e.g. main idea, details, background knowledge) during the study. For instance, Lynn had worked with a reading specialist during the 2012-2013 school year. During this study, she demonstrated the use of several strategies (e.g., note-taking and underlining key words) to locate important information after reading long text. Dana and Pam often used background knowledge to answer reading comprehension questions. This variable may have had an impact on the reading comprehension, but was not specifically examined in this study. However, the use of the metalinguistic approach provided an opportunity to allow the participants to use additional reading comprehension strategies.

This present study addresses the impact of explicit instruction in syntax on reading comprehension and contributes to the existing knowledge (Bentin, Deutsch, & Liberman, 1990; Hirschman, 2000; Scarborough, 1998; Scott, 2009; Stillman & Scott, 2009). Sentence complexity can create comprehension problems for struggling readers. In a study by Hirschman (2000) fables were used to teach the students to identify complex sentences. This research found positive outcomes for explicitly teaching sentence complexity to 9-to 10-year-old children with Specific Language Impairments (SLI). According to Andrews, et al., (2006), sentence combining is a well-researched technique in helping students produce more oral and written complex sentences. Additionally, several studies exist that note the positive effects of sentence

combining on reading comprehension (Eisenberg, 2006; Neville & Searls, 1985; Wilkinson & Patty, 1993).

This study, like Hirschman's, found positive outcomes by utilizing explicit instruction. Nonetheless, this study targeted a specific clause structure within the discipline of science, and the participants were not identified as SLI. This study analyzed sentences by unpacking complex sentences instead of combining clauses. The data from this study supports the literature (e.g., Nation & Snowling, 2000; Wiseheart et al., 2009; Scott, 2009) that stresses that analyzing syntactical structures is important to reading comprehension. Further research is warranted to strengthen this case.

Correlation of Language Variation, Reading Comprehension, and Sentence Analysis Skills

The approach used in this study to improve comprehension of science text, specifically among African American students, contributes to the literature on instructional practices for African American students in the content area of science. Past research has focused on the attitudes of African American students, teacher perceptions of African American students in the science classroom, and the contrast of home and classroom culture (Brand & Glasson, 2004; Gilbert & Yerrick, 2001; Parsons, 2008). Brown et al. (2010) examined how language may affect science learning in CLD students. Similar to previous studies (e.g., Arons, 1983; Lemke, 1990; Seiler et al, 2001), Brown et al. (2010) study called for the implementation of instruction that consisted of scaffolding to assist students in understanding the language of science. Their study provided web-based science lessons that focused on technical vocabulary found in science text. Technical terms were presented to students' using everyday language before introducing

the scientific term. Based on the results of this study, the students improved their vocabulary and reading comprehension.

Similar to Brown et al. (2010), this study had an interest in how the language may impact learning for African American students in the content of area of science. As indicated in the first chapter, this investigator was interested in the difference, if any, in the progress of students that presented with African American English (AAE) dialect. The DELV-Screening test was used to identify the degree of language variation in each participant. Lynn's DELV screening results indicated that she did not present with a strong language variation from Mainstream American English (MAE), however, Dana and Pam presented with a strong variation from MAE.

Based on this study's results, Lynn made the most gains following intervention. Interestingly, Lynn had the same percentage in passage comprehension as Dana, whose language varied strongly from MAE. The results indicate that Dana's percentage increase in comprehension and unpacking was similar to Lynn's. Pam's had the lowest percentages in unpacking complex sentences and comprehending science text. A surface analysis of the data would suggest that a strong language variation from MAE could have had an impact on the student's performance in unpacking complex sentences and reading comprehension. However, these data alone cannot be used to conclude that dialect was a strong factor on the participants' performance.

Each participants' motivation and demographics (e.g., home environment and personal circumstances) may have had an impact on their performance in the study. For example, during the study, Lynn was very motivated and eager to perform well on all tasks presented to her.

Dana demonstrated the potential to perform similarly to Lynn, but she did not display the same motivation and focus (e.g., She rushed through the quizzes). Pam was cooperative during the sessions, but became easily frustrated with the lesson (e.g., yawned constantly during instruction; often questioned the investigator about the final date for the study; or would not respond to challenging questions). These behaviors appeared to impact the performance of the participants in this study. However, this variable was not formally measured to determine the effect.

Further research is needed to closely examine the language variations of dialect speakers and its impact on reading. According to Rickford, Sweetland, Rickford, and Grano (2013) limited experimental evidence exists addressing this matter. Research regarding dialect and reading comprehension continues to be an area of need, since a majority of studies have focused on AAE phonology and morphology and its impact on reading miscues. Research regarding AAE and reading comprehension has not produced clear empirical findings or implications, due to the difficulty of designing studies with adequate controls as well as the difficulty in utilizing adult AAE as a theoretical framework (Craig & Washington, 2004; Rickford, Sweetland, Rickford, & Grano, 2013). Although, this study may provide descriptive information about the participants this study cannot generalize that AAE has a direct impact on students' ability to benefit from a metalinguistic approach to unpack complex sentences and improve reading comprehension of science text. However, these findings provide a springboard for future research that would address the dialect variable.

Limitations

This study employed a single-case experimental multiple probe across participant's research design to answer the two research questions in this study. Single-case experimental designs are ideal tools for establishing the viability of treatments in real-life settings (Kratochwill et al., 2010). This design allowed the investigator to work closely with participants and to observe the participants' progress. Specifically, the investigator was able to observe the participants' responses to the various lessons within the instructional protocol. This design also allowed the investigator to examine those components of the protocol that might need to be reviewed and revised. Although group designs may result in large effects for an intervention, it often does not provide the venue for discussing the specific details of the intervention and how it might need to be adjusted for individual students who are struggling. The advantage of honing in on the usefulness of a tool and revising specific components of the tool in response to the participants' progress is often lost in a large group design.

Subject Selection. The participants for this study were selected based on principal recommendation and the scores they obtained on the reading portion of the SAT-10 assessment administered by the school. The students were not administered additional assessments to measure language comprehension and reading comprehension, therefore the language component (e.g., vocabulary, decoding) having the most impact on reading comprehension was not captured. This information could have been useful in the development of the instructional lessons to meet the learning needs of the participant and to rule out possible language and learning deficits. For example, in this study, Pam evidenced characteristics of a language disorder, which was identified by the investigator, based on her experience as a licensed and certified speech-

language pathologist. However, this participant did not have a reported history of special education services or needs. Replication of this study with the use of additional assessments of students' language and literacy skill as well as the degree of dialect usage would strengthen the internal validity of the research.

Generalizability. The generalizability of this study's findings is subject to certain limitations. First, during the intervention probes, the passages were read aloud to the participants. However, in a general classroom setting, read alouds are typically a small part of a student's day, particularly in the middle and high school grades. The student may be asked to read his or her own text silently or aloud.

In this study, the use of read alouds were selected to take the pressure off the participants who were identified as readers who struggle. Although, the findings of this study may provide some evidence in support of the effectiveness of read alouds for students that struggle with oral reading, the practice of read alouds may not be easily replicable since this approach is not consistently used in all classrooms. Further research could focus on the use of other strategies, such as choral reading. Choral reading is when students are engaged in the act of reading text aloud together. Choral reading can be teacher-led or student-led. This reading strategy allows students to read text that may be too difficult for them to read on their own and has proven to be effective in improving reading fluency and comprehension (Paratore, 2000; Paratore & McCormack, 2011).

Secondly, the population studied was a very small sample of African American students. The study consisted of three African American females with English as their primary language. However, two of the three participants did present with strong features of non-mainstream dialect

as measured by the DELV-Screening Test. All students qualified for free or reduced lunch and were considered as students with low socioeconomic status (SES). They also presented with varied family structures. Lynn resided in a two parent-home and both parents had college degrees. Dana came from a single-parent home. Her mother had a high school education and was currently enrolled in the local community college. Pam came from a two parent home. Both parents received high school diplomas and were employed in minimum wage jobs. Therefore, the results of this study are not generalizable to students from various family demographics and socioeconomic status. Future studies should incorporate this variable in order to address generalizability.

The participants in this study were limited to African American fifth and sixth grade females attending a private school in Durham, North Carolina, with no known language and learning disability at the time of the study. Therefore the study's results cannot be generalized to African American adolescent males, students in high school, adolescents attending public schools in North Carolina or other states, or students from other ethnic or linguistic backgrounds.

Lastly, while the DELV-Screener was used to identify language variation, the data from this study cannot be generalized to adolescent speakers of African American English (AAE) dialect. While the participants in this study demonstrated positive outcomes, replication of this study with increased sample size and varied population, specifically examining population's dialect status, is required to strengthen the external validity and generalizability of these results.

Student Attrition. This study began with three participants. Participant 3 was able to complete the baseline and intervention phase of the study but did not complete the study to its

entirety due to personal trauma. Hence, maintenance probes were not completed for this participant.

The primary investigator could not control for the absences of the participants. During the initial phase of this study, the primary investigator did have some difficulty getting participant 2 and 3 to attend sessions consistently. However, the primary investigator volunteered to pick up participant 2 and return her home for the duration of the study. The attrition of participants can be interpreted as a limitation as it affects the frequency of replication across participants and limits the generalizability of the study.

Assessment Methods. The assessments utilized for this study were either pre-published and/or assessments designed by the investigator to assess comprehension of science text. The multiple choice questions were from the Jamestown Timed Reading Plus in Science (Glencoe, 2003). The primary investigator contacted the company to determine how the questions were developed; however, this information was not available.

The open-ended questions were developed based on the adverbial clauses found in the science text. Therefore, this study did not utilize a standardized measure. This was a challenging task. Although there were standardized measures to assess general reading comprehension, there were no available standardized assessments that specifically measured the comprehension of science text. Therefore, the investigator developed questions based on the specific text to assess the participant's understanding of the language found in science text.

Assessment of reading comprehension has been a concern for decades. According to Carlisle and Rice (2004), there is no single measure available that appropriately assesses all

aspects of reading comprehension. Assessment in this study served the purpose of monitoring progress. Curriculum-Based Measures (CBM) have been deemed valid and reliable tools to obtain quantitative data of students' response to classroom instruction (Shin, Deno, & Espen, 2000). Although, the measures in this study did not necessarily assess classroom instruction, the measures did provide data regarding each participant's progress in the specific content area of science. The data provided information to determine if the participant needed additional review or practice to acquire the target concepts. Replication of the study should include the collaboration of the researcher and experts (e.g., experts in science and literacy, such as a reading specialist), in the development of appropriate assessments to measure higher order thinking skills and understanding of content to strengthen the validity and reliability of the tool.

Location/Duration. Another limitation of this study is that the intervention occurred during a summer program instead of the regular school year. The primary investigator and participants worked in a room designated as the teacher workroom and lounge during the school year. The room consisted of a whiteboard and school supplies. The investigator reorganized the space in order to establish a learning environment for the participants. However, this setting did not match the typical physical learning environment that students experienced during the school year. The workroom had stacks of unused books, a wall bookshelf of papers and culinary supplies, copy machine, laminating materials, couch, and a refrigerator. During the summer program, the students were not engaged in daily instruction in the content-area of science or language arts similar to their regular school year. This study utilized a one-on-one model, typical of an individual instructional approach and not a group approach.

Instructional Practice. During this study the primary investigator did not consult with science teachers since they were not available during the period of this study. Having access to the science teachers and information on their instructional practices may have yielded more significant results about the instructional practices that had been used with students in the area of science. This information could have provided more direction in the design of the instructional protocol, particularly the preliminary lessons. For instance, maybe the lessons could have focused a little more on vocabulary instead of lessons on dependent and dependent clauses.

Access to the actual core and supplemental texts used by the students throughout the year would have allowed students to see the importance of the approach used in the study and its' applicability to the specific content area. Finally, the opportunity to work collaboratively with the science teachers could have led to their adaptation of the approach used in this study in their classrooms.

Overall, the instruction in this study spanned over 18 sessions over a period of 10 weeks. Therefore, research is warranted to examine the effectiveness of the intervention during the school year. Implementing the intervention within the schools and for a longer duration would allow for the intervention to supplement the classroom units. Also, implementing this intervention during the school year could have a positive impact on student motivation. The students might have a better understanding of the relevance of the instructions and corresponding tasks to their academic success. Lastly, by implementing the intervention during the school year, the primary investigator could use other standardize measures such as reading and content-area benchmark assessments to measure progress; particularly if this approach is used to address the content used in the classroom.

Limited types of science texts. The passages used in this study consisted of topics of General Science. This study did not examine text found in science subjects; such as biochemistry, physics, geography, or psychology, which is often taught at the secondary level. Therefore these results cannot be generalized to all scientific subjects. More research is warranted in studying various types of sciences within higher grade levels.

Qualitative Interview. This study did not have a qualitative component to address social validity of the study. Social validation is established in order to determine the real-life functionality and value of an instructional program (Kazdin, 1982; Schlosser, 2005). This information could have been obtained via student and/or parent questionnaires or oral interviews. Social validation data could be used to evaluate the program. Although, a formal method was not used to collect this information, the primary investigator did record anecdotal notes of spontaneous student and parent feedback. For example, one student noted that she really liked the deconstruction maps, but did not like reading the passages. She also noted that reading the passages took too much time. The mother of one participant shared that she had noticed a change in her daughter's confidence in reading and exam grades in History and Science. Replication of this study should include measures to obtain social validation to determine the value of the intervention to those involved.

Implications for Practice

This study examined the effectiveness of a metalinguistic language approach grounded in functional language analysis on the unpacking of text and the reading comprehension of African American fifth and sixth grade students. The information gleaned from this study helps to fill the

gap regarding the effectiveness of literacy approaches and the performance of African-American students in the content area of science. This study has several practical implications.

With the adoptions of rigorous learning standards, such as the Common Core State Standards (CCSS) there is a continued need for evidence-based practices for older students. Rigorous standards, such as the CCSS, has as a primary goal to assist students to acquire advanced literacy skills in order to succeed in the workforce and post-secondary educational settings. However, according to the NAEP (2013) report, eighth and twelfth grade students continue to perform below proficient levels.

This study suggests that there is a need to implement strategies that require students to analyze language in the earlier grades in order to meet the language demands required in later middle and high school text. According to Yore and Treagust (2006), students need opportunities to interact with science text in early elementary grades in order to develop the knowledge and skills to master science literacy. Science text is characterized by complex syntactical structures and sentence complexity can create comprehension problems, particularly among students that are struggling readers (Fang, 2012). Research supports the need for instruction to improve students' ability to manipulate syntax to better understand what they are reading (Cain & Oakhill, 2007; Scott, 2009).

This study supports the use of discipline specific literacy approaches, particularly one employing a metalinguistic approach. Much of the literature discussing literacy strategies and approaches is often geared towards classroom teachers and reading coaches. However, with educational reform initiatives, such as Race to the Top, all educators are responsible for student success. According to the American Speech Language Hearing Association (ASHA, 2001),

speech-language pathologists' (SLP) knowledge in language places them in a position to support reading and writing instruction since language is the foundation for literacy skills and literacy skills are the foundation for academic success.

In 2010, ASHA published a policy statement describing the roles and responsibilities of speech-language pathologists working in the school setting. The policy paper lists several critical roles and responsibilities. For the purpose of this study, the three critical roles that support SLPs' stake in students' education are: (a) providing unique contributions to curriculum; (b) highlighting language/literacy; and, (c) providing culturally competent services.

ASHA (2010) also recommends effective collaboration within the school setting. Collaboration allows for partnerships in meeting students' needs and serving them effectively. SLPs need to collaborate with teachers to support instruction; therefore, school-based speech-language pathologist can work collaboratively with teachers to implement a similar program focusing on the use of a metalinguistic language approach or service delivery model. This study can serve as a guide for the development of high-quality professional development for educators and school-based speech-language pathologists to better serve their students in content-area classrooms.

Future Research

The contributions of this student are two-fold. First, this study fills the gap in the research literature regarding the effectiveness of a metalinguistic approach grounded in functional language analysis on the reading comprehension of African American fifth and sixth grade students. Results of this study suggest that fifth and sixth grade African American students

with below grade-level reading skills can improve their ability to comprehend science text through the use of a metalinguistic approach. Secondly, this study is one of the few studies that addresses approaches for discipline-specific literacies. Several recommendations for future research are offered, considering the limitations of this study noted in the previous section.

One recommendation is for the replication of this study using a larger sample size. Another recommendation is for the use of a group design. Although the use of a single-subject design provided the opportunity to closely analyze the effect of a novel intervention with study participants, the use of a group design can allow for the use of a randomized control experimental group design. This type of group design can control for the effects of history and maturation, increase the generalizability of the results, and control for dialect.

Although the investigator suggests that this program could be beneficial for a summer program, future research should consider implementing a similar study at the beginning of the school year rather than the summer. Implementing the study during the entire school year would provide the SLP with the opportunity to work collaboratively with content-area teachers, and other literacy specialists. The primary investigator could have access to text that are aligned with the curriculum and the accompanied benchmark assessments as measures. Additionally, by implementing the study at the beginning of the school year, the intervention could be well established before the daily routine changes as the school year progresses. For instance, daily routines are impacted by field trips, state testing, teacher professional development and holidays.

There is relatively a limited number of experimental research studies examining reading as it relates to dialect variation (Rickford, Sweetland, Rickford, & Grano, 2013). In this current investigation, African American English (AAE) dialect was not a primary focus, but was used to

describe the participants of the study. Further research should investigate the reading and writing of speakers of AAE within discipline specific subjects, including science. It would be of interest to determine if the use of graphic organizers to unpack complex sentences, as part of contrastive analysis instruction, would improve understanding of science text as well as written language.

Another area for future research is the use of this instructional approach with a varied population, particularly high school students. The topic of disciplinary literacy often refers to middle and high school students; however, more research has been conducted with middle school students (Scammaca et al., 2007). High school students are required to analyze text at a more advanced level in preparation for the workforce or post-secondary education. Additionally, discovering the language and literacy skills necessary to manipulate the language of various types of sciences, (e.g., Chemistry, Biology, Physics, Engineering, Sports Medicine, Computer Science, and Mechanical Science) are further areas of research. These various areas would also call for future research of other clause structures, such as adjective and nominal clauses.

Research is needed to examine the effectiveness of discipline-specific approaches that may include instruction of more basic components of language and literacy, (e.g., such as vocabulary or understanding the text main idea on the language literacy skills) in adolescents with language and learning disabilities. In this study one participant appeared to exhibit characteristics of a language disorder. The school principal was concerned about this participant's progress and had planned to make a referral to determine if this student had a disability. According to Ehren, Murza, and Malani (2012), students who are struggling with reading still need the exposure to complex semantic-syntactic structures found in disciplinary text. However, the sufficiency of focusing on discipline-specific literacy for adolescents who

struggle has been called into question (Flagella-Luby, Graner, Deschler, and Drew, 2012). Therefore, research on the use of discipline-specific approaches and its use with struggling readers is warranted, especially in youth with language and learning disabilities.

While the results of the present study suggest that the instructional protocol implemented in the investigation was effective and efficient, a component analysis could be completed to further investigate which step in the instructional protocol had the most impact. For example, it would be important to know if similar results could be obtained without implementing the lesson on simple and complex sentences or whether emphasizing the use of the sentence deconstruction map for a longer period of time would have yielded better outcomes. Further investigation on the hierarchal steps of the instructional approach and its' impact on unpacking and reading comprehension is warranted. Details from that information would be helpful in revising the instructional approach and contributing to its' effectiveness on student outcomes.

Finally, research could examine the collaborative implementation of this approach by SLPs and content-area teachers. Although this approach was implemented using a one-on-one model, it would be beneficial to see how this approach could be implemented in the classroom setting. The teacher and the SLP could work collaboratively to engage students in the close analysis of the language used in a specific discipline. Each professional could bring their specific expertise to this collaboration and use the findings of this study to determine what aspects of the instructional approach is most useful in producing beneficial academic outcomes for all students.

Conclusion

This study investigated the effects of a metalinguistic approach on African American fifth and sixth grade students' and their ability to unpack complex sentences and comprehend science text. The results of this investigation suggest that it is possible for students to benefit from instruction and analyzing language closely for meaning.

This study provided quantitative data to support the effectiveness of this type of intervention. Implementing a single-case experimental multiple-probe design allowed the investigator to draw some conclusions about various components and necessary adjustments to the intervention. In future research, it will be important to employ a group design to further evaluate science literacy among African American students, since they continue to lag behind other student populations in the area of science (NAEP, 2011).

This study highlighted the role of school-based SLPs' and their stake in language and literacy. According to the American Speech-Language Hearing Association (ASHA, 2001), SLPs are professionals with expertise in normal and disordered language development and acquisition. Specifically, SLPs have extensive knowledge of language (e.g., syntax, phonology, morphology, semantics and pragmatics) and are qualified to take on roles related to reading and writing development. This study also advocates a collaborative approach and the role of the SLP for addressing the language and literacy needs of students with and without IEPs.

Further research is warranted to continue to investigate the use and effects of a metalinguistic approach with a variety of students and across the content area of science. Finally, with the adoption of rigorous learning standards across the nation, this study advocates

for continued research on the use of a research-based instructional protocol to improve academic performance with text of specific disciplines.

**APPENDIX A: METALINGUISTIC APPROACH INSTRUCTIONAL
PROTOCOL**

**Instructional Program Content
Instructional Procedures/Guided Script**

1. INTRODUCTORY SESSION

Materials	Say and/or Do
Advance Organizer Diagnostic Evaluation of Language Variation (DELV) Screening Test (Age 4-12 years)	<p><i>“Good afternoon, I am Karen Davis and I am from the University of Central Florida. I am working on a project about how to help students understand what they read; particularly in the subject area of Science.</i></p> <p><i>To begin my project, I need to get some information about how you understand sentences and talk about pictures and stories. So, I am going to give you a short test that will give me that information.</i></p> <p><i>I want you to relax. This is not a test that you have to worry about getting right.” Just answer the questions the best you can. I am not expecting you to get everything right.” This is not a test that will affect your grades in any form or fashion.”</i></p> <p>Administer the DELV-Screening Test to each student.</p>

Italicized Text: Guided script for the instructor to verbalize.

Bolded Text: Actions

2. BASELINE PHASE

Materials	Do and/or Say
<p>Advance Organizer</p> <p>Sentence Deconstruction Map with a Science complex sentence consisting of an adverbial clause pre-printed in Box 1 of the map.</p> <p>Science passage rich with adverbial clauses.</p> <p>Paper and pencil</p>	<p>Researcher will present advance organizer to students to introduce the objectives of the session.</p> <p><u>Researcher Script Guide:</u></p> <p><i>“Today you are going to complete two tasks that will give me information about how well you can read a science passage and understand it.</i></p> <p><i>1.) First, you will be given, what I call a sentence deconstruction map. I will provide you a complex sentence and the map will ask you questions about the sentence and you need to fill in the boxes in the map.”</i></p> <p><i>2.) Second, you will read a science passage. After you read the passage you will answer multiple choice questions.</i></p> <p><i>Before you complete the sentence deconstruction map, I will give you an overview. If you do not know the answer that is ok. I do not expect you to know everything at this moment, but do your best.</i></p> <p><u>Task 1: Sentence Deconstruction Map</u></p> <p>Researcher will present a copy of the sentence deconstruction map with a sentence printed in Box 1 titled “Sentence”. (The sentence can be written in by instructor or read aloud; however, having it preprinted saved time).</p> <p>Read the sentence aloud to the student.</p> <p><i>Box 2 (Adverbial clause) requires you to write down the adverbial clause in this box.</i></p>

Now let's look at the map, Box 3 (Subordinate Conjunction) requires you to find the subordinate conjunction within the sentence and write it down. It is ok, if you do not know the answer, just write down your best guess.

Let's look at Box 3 (Subject) requires you to write down the subject following the subordinate conjunction.

Box 3 (Verb) requires you to find the verb within the sentence and write it in this box.

Box 4 (Question Type the clause may answer) requires you to identify the type of question this adverbial clause would answer. You will place a check mark next to one of the question types: How, When, Where, Why, and Under what condition.

After you have marked your choice, I will read the sentence aloud again as you read along.

Once I have read the entire sentence again, Box 5 (Information learned from the sentence) will require you to write your understanding of the sentence after you have gone through the earlier steps. You are expected to write a complete sentence or sentences to express your thoughts. Your sentence or sentences need to include a subject and a verb. Your response will need to make sense. Lastly, there should be at least two new words in your answer. In other words, you should not write down or repeat the same sentence that is in the first box as your answer.

Remember, I just want you to do your best. You will learn more about how to use this map in later lessons.

The instructor will give the student a blank sentence deconstruction map with the target complex sentence printed in the Box 1. The instructor will read the sentence aloud. The student will proceed to fill in the map. Once the map is complete, the instructor will take up the student's sentence deconstruction map and place in student's file folder.

Task 2: Science Passage and Reading Comprehension Quiz

“Next, you will read a science passage and answer questions about what you read. I will read the passage out loud and you will follow along by reading or listening. I do not expect you to be perfect, but I want you to do your best. So let’s get started. Remember, you can read along as I read the passage. If it is easier for you to listen, please pay close attention.

During the reading, the instructor will check to see if the student is listening by asking one main idea or detail question, or verbally redirecting student back to the task.

Following the reading, the instructor will provide the reading comprehension quiz. The questions will be read aloud to the student. However, if the student is a strong decoder, he/she can read the sentences independently.

“Here is the 10-question reading comprehension quiz. You will have 10 minutes to complete this quiz. You can refer back to the reading passage to help you answer the question. I will also read the questions aloud to you.

Once the student are done with the multiple choice questions, the instructor will collect the passages and quiz. The instructor will conclude the lesson by thanking the student for his/her efforts and will communicate the expectations for the next task.

INSTRUCTIONAL PHASE

A. LESSON 1: ADVERBS

Materials	Do and/or Say
<p>White Board</p> <p>Adverb worksheets</p> <p>Post-It Chart Paper</p>	<p>The instructor will present advance organizer to students to introduce the objectives of the session.</p> <p><i>Today we are going to learn about adverbs. You will participate in a few activities to improve your understanding of this word/part of speech. This will help you understand adverbial clauses which will be discussed in later lessons.</i></p> <p><u>INTRODUCTION</u></p> <p>Post or write the term, “adverb” on a board or sheet a paper.</p> <p>Ask the student if he/she knows the definition of an “adverb.” Wait for the student’s response. If the student provides the correct or incorrect definition, acknowledge the student’s response by reiterating the correct response or provide the expected definition.</p> <p><i>An adverb is a word that tells us how, when, where, and how much something happens or happened.</i></p> <p>Provide an example of each type of adverb in a sentence. The instructor can write the sentences or have sentences prepared</p> <p><i>I am going to show you examples of the different types of adverbs. Let’s take a look at the first sentence.</i></p> <ol style="list-style-type: none"> 1. <i>A predator can pounce on its’ prey unexpectedly” (How)</i> 2. <i>Earthworms will suddenly move closer to the surface of the ground. (When)</i>

3. *Frogs bury themselves **near** the muddy edge of a pond. (Where)*
2. *Camouflage is **often** used to trap its prey. (How much or under what condition).*

(You can use any sentence that you see fit. Just be sure it is a sentence from science text).

The instructor will highlight the adverb and explain to the student what the type of information that the adverb provides.

After the presentation of all the adverb types, provide a worksheet of 10 sentences consisting of adverbs (Worksheets can be instructor made, or from workbooks or websites, such as www.k12reader.com, 100% Grammar). Have the student to identify the adverbs in the sentence and to verbalize what information the adverbs provide (e.g., when something happens, or how something happens).

Now that you and I have discussed the different types of adverbs, I am going give you a worksheet with sentences for you to practice identifying the adverbs. When you are done, we will go over your answers.

Review student's answers and provide feedback.

The instructor will then provide student with a 4-5 sentence paragraph and have the student to identify the adverbs within the paragraph

Now that you have practiced identifying adverbs in sentences, you will practice identifying adverbs in a paragraph. I will read the paragraph aloud and give you time to identify the adverbs.

Review student's answers and provided feedback regarding the correct identification of the adverbs. After the review, engage the student in discussion about the paragraph. Ask questions about how or why something was done. The instructor should highlight how the adverbs assisted in providing that information.

To end the session, I want you to be sure you understand adverbs. So I am going to ask you to identify adverbs in these sentences by yourself.

	<p>The instructor will provide the student a worksheet of 8 sentences to identify adverbs with 100% accuracy independently. If student, meets criteria, move on to then next lesson.</p> <p><i>If student does not meet criteria, provide more practice and review. Then select new sentences for the student to work on independently.</i></p>
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B. LESSON 2: SIMPLE AND COMPLEX SENTENCES

Materials	Do and/or Say
<p>White board</p> <p>Post-It Poster Paper</p> <p>Dry erase markers</p> <p>Paper</p> <p>Worksheets</p> <p>Pencil</p>	<p>The instructor will present the advance organizer:</p> <p><i>In this lesson, we will first review the adverbs that you learned in the earlier lesson.</i></p> <p><i>After the review, I will introduce to you the terms/words “simple and complex sentences.” I will also define these terms/words.</i></p> <p>The instructor will write the word ‘adverb’ on the Post-it Poster Paper. This Paper will serve as the interactive word wall. The instructor can write the word on the white board, if he or she does not have access to Post-It Paper.</p> <p><i>Yesterday, we learned about adverbs. Tell me what you remember about adverbs.</i></p> <p>Wait for student’s response. If the student provides the correct answer, confirm the answer. If the student provides the incorrect answer, review the definition and provide an example for review.</p> <p>Following student’s response, the instructor will provided 2-3 sentences for student to identify adverbs in the sentences with 100% accuracy.</p> <p>After the review, present the purpose of the this lesson:</p> <p><i>The purpose of this lesson is to teach you how to recognize the difference between simple and complex sentences.</i></p> <p><i>Remember when I told you that science text contain many complex sentences. Therefore, it is important for you to know what these sentences look like.</i></p>

Science textbooks are written by scientist. These professionals tend to use long sentences to tell you about a topic.” Sometimes we have to break down long sentences to make sure we understand it.”

Do you recall simple sentences and complex sentences?

Wait for student’s response.

“Let us take a look at these two sentences.”

Instructor will present two types of sentences: 1.) simple sentence example 2.) complex sentence example.

Can you tell me the difference between these two sentences?

Wait for a response. The expected response should be that the second sentence appears to have another thought or more words. The instructor needs to acknowledge the response and indicate to the student if he/she has a clear understanding or not.

Introduce the term “simple sentence,” by writing it on the whiteboard. Followed by the definition.

A simple sentence is a group of words that express a complete thought. A simple sentence contains a subject and a verb.

Provide another example of a simple sentence.

Here is an example of a simple sentence:

The sea otter eats the sea urchin.

Notice this is a complete thought and this sentence has a subject: Sea otter, the verbs; eats, and direct object: sea urchin.

Introduce the term “complex sentence,” by writing it on the whiteboard. Followed by definition.

A complex sentence is a group of words that consist of a complete thought and an incomplete thought. They are typically longer than simple sentences.

(NOTE: Most definitions for complex sentences consist of the terms “clauses” but to avoid confusion, the developer used the aforementioned definition to give the students a quick way to identify complex sentences.)

Here is an example of a complex sentence:

“Because sea urchins are soft, sea otters are able to eat these invertebrates easily.”

As you can see, the obvious difference is that this sentence is much longer than the simple sentence. We are given much more information as well. Just like the simple sentence, complex sentences contain subjects and verbs; just more of them. You also may notice the punctuation mark, comma. The comma often requires the reader to pause for a moment before reading the remainder words. However, not all complex sentences will have a comma.

As I indicated in the definition, the complex sentence consists of groups of words that are complete thoughts and groups of words that are incomplete thoughts. Let’s look at the group of words before the comma.

Instructor will read “Because...soft,” (these groups are words is the dependent clause, but that term is not being used at this point in the instruction). The instructor will highlight the subject and verb and then ask the student if it is a complete thought.

“Because the sea urchin are soft...” is a group of words that consist of a subject and verb. The subject is _____. (sea urchin) and the verb is _____.(are)

Do you think this is a complete thought?

(wait for a response)

No, it is not a complete thought. It leaves us thinking that we need more information about the sea urchin. This group of words tells me the subject and the verb, but not necessarily the object of the verb.

Ok, now let us take a look at the second group of words following the comma. “..sea otters are able to eat these invertebrates easily.”

The subject is _____ (sea otters) and the verb phrase _____ (are able to eat)

Do you think this is a complete thought?

(wait for a response)

Yes, it is a complete thought. This group of words tells me who or what the sentence is about; which is the subject of the sentence (subject). It tells me what the subject is doing/the action which is the verb, and the object of the verb, which is the receiver of the action. So, as you can see, I have more information from this group of words.

We are going to practice identifying simple sentences and complex sentences.

Provide student with a worksheet with a mix of SS and CS (The instructor can choose to write the sentences quickly on a whiteboard or chart paper).

Have student to identify the SS sentence and ask why he/she made the selection. Following this task, have the student to verbally generate one simple sentence and one complex sentence. If you feel the student needs more practice you can request the student to generate more sentence types.

Now I am going to give you a paragraph. We will read each sentence and I want you to correctly identify simple and complex sentences.

	<p>Provide a 5 sentence paragraph and have student to highlight the simple sentence a designated color and highlight a complex sentence with a different color. An alternative is to have the student to read the targeted sentence type.</p> <p>After completing the paragraph activity, provide a summary and proceed to assessment.</p> <p><u>Assessment</u></p> <p>The student is provided with a worksheet of 8 simple and complex sentences, students will identify complex and simple sentences with 100% accuracy.</p>
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LESSON 3: CLAUSE-INDEPENDENT AND DEPENDENT CLAUSES

Materials	Do and/or Say
<p>White board</p> <p>Post-It Poster Paper</p> <p>Dry erase markers</p> <p>Paper</p> <p>Worksheets</p>	<p>Review</p> <p>The instructor will present the advance organizer:</p> <p><i>In this lesson, we will quickly review the following topics that you learned in the earlier lesson.</i></p> <ul style="list-style-type: none"> • <i>Simple and Complex Sentences</i> • <i>Adverbs</i> <p><i>After the review, I will introduce to you to the term, “clause” I will also define this term/word.</i></p> <p>Instructor will write the words, “simple sentences,” and “complex sentences” under the word “adverb” on the post-it poster paper or white board.</p> <p><i>Yesterday, we learned about Simple and Complex Sentences. Tell me what you remember about simple and complex sentences.</i></p> <p>Wait for student’s response. If the student provides the correct answer, confirm the answer. If the student provides the incorrect answer, review the definition and provide an example for review.</p> <p>Following student’s response, the instructor will provided 5 sentences for student to identify simple and complex sentences with 100% accuracy.</p> <p><i>Now that you understand simple and complex sentence I am going to introduce to you a term that is often used to refer to simple sentences and are parts of a complex sentence.</i></p> <p>Write the term, “clause,” on the whiteboard.</p>

<p>Pencil</p>	<p><i>Have you heard the term “clause” before? If so, do you know what it is?</i></p> <p>(wait for the response)</p> <p>If the student knows or does not know the definition, the instructor will acknowledge the student’s answer and provide the correct answer.</p> <p><i>A clause is a group of words with a subject and a verb</i></p> <p>The instructor will provide an example clause and highlight the subject and the verb in that clause.</p> <p><i>There are two types of clauses: an independent and a dependent clause.</i></p> <p><i>An independent clause is a clause that can stand alone as a sentence and expresses a complete thought.</i></p> <p>(provide an example: “Dung beetles shape manure into little balls”)</p> <p><i>What does this remind you of from the previous lesson?</i></p> <p>(Wait for a response).</p> <p><i>It reminds you of the group of words that are complete thoughts, which were the simple sentence. Remember this was also the part of the complex sentence, which expressed a complete thought.</i></p> <p><i>A dependent clause is a clause that can’t stand alone as a sentence.</i></p> <p>(Provide an example: “Because dung is moist”).</p> <p><i>Again, what does this remind you of from our previous lesson?</i></p> <p>(Wait for a response).</p> <p><i>It reminds us of the group of words within the complex sentence that are an incomplete thought.</i></p>
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	<p><i>In science texts the author uses a lot of clauses; particularly dependent clauses.</i></p> <p><i>There are several types of dependent clauses. However, the one dependent clause that is found often in science text is an adverbial clause, which we will talk about in the next lesson.</i></p> <p><i>One important thing I want you to remember. You will always find a subject and verb in both dependent and independent clauses.</i></p> <p>Take a moment to compare the clauses that you presented by placing the letter “S” above the subject of the clause and the letter “V” above the verb of the sentence.</p> <p><i>We are going to practice identifying independent (IC) and dependent clauses (DC).</i></p> <p>Provide student with a worksheet with a mix of IC and DC (The instructor can choose to write the sentences quickly on a whiteboard or chart paper). Have student to identify the clause types and ask why he/she made the selection. Following this task, have the student to verbally generate one IC and one DC. If you feel the student needs more practice with a particular clause you can provide more clauses to produce or identify. When student is able to produce or identify independently, proceed to the next task.</p> <p><i>Now I am going to give you a paragraph. We will read each sentence and I want you to correctly identify simple and complex sentences.</i></p> <p>Provide a 5 sentence paragraph and have student to highlight the IC a designated color and highlight a DC with a different color. An alternative is to have the student to read the targeted clause type.</p> <p>After completing the paragraph activity, provide a summary and proceed to assessment.</p> <p><u>Assessment</u></p>
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	Given a worksheet of 8 independent clauses and dependent clauses the student will identify each clause with 100% accuracy.
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C. LESSON 4: ADVERBIAL CLAUSES AND SUBORDINATE CONJUNCTION WORDS

Materials	Do and/or Say
<p>Sentence</p> <p>Deconstruction Map</p> <p>Post-It Chart Paper</p> <p>Paper</p> <p>Pencil</p> <p>Dry Erase markers</p>	<p>Review</p> <p>The instructor will present the advance organizer:</p> <p><i>In this lesson, we will quickly review the following topics that you learned in the earlier lessons.</i></p> <ul style="list-style-type: none"> • <i>Independent and Dependent Clauses</i> • <i>Simple and Complex Sentences</i> • <i>Adverbs</i> <p><i>After the review, I will introduce to you to the term, “adverbial clause” I will also define this term/word.</i></p> <p>Instructor will write the words, “Independent Clause” and Dependent Clause under “simple sentences,” and “complex sentences” under the word “adverb” on the post-it poster paper or white board.</p> <p><i>Yesterday, we learned about Independent and Dependent Clauses. Tell me what you remember about independent and dependent clauses.</i></p> <p>Wait for student’s response. If the student provides the correct answer, confirm the answer. If the student provides the incorrect answer, review the definition and provide an example for review.</p> <p>Following student’s response, the instructor will provided 5 sentences for student to identify independent and dependent clauses with 100% accuracy.</p>

<p>Clear Sheet protectors</p>	<p>Proceed to ask the student for the definition and example of simple and complex sentences, and adverbs.</p> <p><i>“Can you tell me without looking at the word wall the definition of: a.) simple sentence b.) complex sentence c.) adverb.”</i></p> <p><i>It is important for you to remember what these parts of speech mean because it will help you understand today’s lesson.</i></p> <p>Write the term, “adverbial clause,” on the whiteboard.</p> <p><i>Today we are going to talk about adverbial clauses. If you recall from the discussion in the last lesson, I told you that for the remainder of this program we will focus on dependent clauses. What is a dependent clause?</i></p> <p>(Wait for a response).</p> <p><i>In science text there are a lot of sentences with dependent clauses. The clause that we will talk about for today and for future lessons is adverbial clauses. Do you see a word from the word wall within the word adverbial?</i></p> <p>(Wait for a response).</p> <p><i>Yes, the word “adverb”. What do you remember about adverbs? What information do adverbs provide you?</i></p> <p>(Wait for a response).</p> <p><i>Yes, they tell us how, when, where, why, how much, and under what condition something happens. Well, adverbial clauses kind of function in the same way. Adverbial clauses answer most of the same types of questions as adverbs.</i></p> <p><i>An adverbial clause is a dependent clause that describes verbs and gives details about the main event in a sentence. Because they are clauses, remember, they contain a subject and a verb, but do not express a complete thought. Therefore, they cannot stand alone by</i></p>
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themselves. These adverbial clauses will need an independent clause for the sentence to make sense.

The instructor will write the following information with the bullet points on the white board, chart paper, or a sheet of paper.

Take a look at these examples. Adverbial clauses assist in answering the following questions, and begin with the words in parenthesis. I am going to talk to you in more detail about these words in the parenthesis.

- **When did it happen? (as, when, while, before, after, until, once)**
 - **“When weeds would start to grow in the prairie, the bison would get rid of them.”**
- **Why did it happen? (because, since)**
 - **“Because animals adapt to new conditions, they are able to survive a changing habitat.”**
- **Under what condition? (if, although)**
 - **“If a predator wants to eat a certain animal, it can pounce on its prey unexpectedly.”**

Another key characteristic of adverbial clauses is that they often begin with subordinate conjunctions. Do you know what subordinate conjunctions are?

(wait for a response)

Subordinate conjunctions are words or a word that introduces the dependent clause, in this case the adverbial clause.

The instructor will take a post-it chart paper consisting of a list of common subordinate conjunctions.

What I have posted here for you to see is a list of common subordinate conjunctions. They are categorized for you. These categories give you with a clue as to what type of information the conjunction assists in providing to you as the reader.

	TIME	CAUSE	PLACE	COMPARISON/OPPOSITION	CONDITION
	After	Because	Where	Even though	If
	Before	Since	Wherever	Although	Unless
	When	Now that		Though	Only if
	While	As		Whereas	Whether or not
	As	As/so long as		While	Even if
	By the time	So		As	In case (that)
	Since	In order that		As if	In the event (that)
	Until			As though	
	As soon as				
	Once				
	As/so long as				
	The first time				

The instructor will write the following sentence below on the white board or sheet of paper for the student to view:

“Because plants cannot move, they have no use for feeling pain as a warning system”

Let’s take a look at this sentence. The adverbial clause, that is a dependent clause, is underlined for you. As you now know, dependent clause is an incomplete thought.

“Because plants cannot move...” is not a complete thought, it leaves me wondering about what is next. That is the first thing we recognize. Now to be sure that this is a dependent/adverbial clause we should look for the subordinate conjunction. According to the definition of subordinate conjunctions, where would we find it in the adverbial clause?

(Wait for a response).

Yes, at the beginning. What is the first word in that clause?

(wait for a response)

It is “Because.” Do you see this word on the subordinate conjunction word wall? Yes. Ok, so I am going to circle the word, “Because”. Remember, clauses have a subject and a verb. Typically when you identify that subordinate conjunction the subject and verb will follow. Once you have identified these things, you have found your adverbial clause. Let’s practice a few more.

Write at least five more sentences with the adverbial clause underlined and request that the student circle the subordinate conjunction. After this task proceed with providing the student with a blank sentence deconstruction map. The instructor will demonstrate the use of the map for the student.

You will get more practice with subordinate conjunctions in the next lesson. I just wanted to give you an introduction to better understand the adverbial clause. The next thing I am going to show you is how to unpack a complex sentence. We just practiced identifying the components of an adverbial clause. Now I want to show how to identify the adverbial clause within the complex sentence. Remember the complex sentence with have the adverbial clause plus an independent clause.

Adverbial clauses are found in a couple positions in a sentence. They can occur at the beginning of sentence, which is called the ‘Opener’, and they can be found at the end of the

sentence, which is called the 'closer'. I will go over both for you and show you examples using the sentence deconstruction map.

Take out the sentence deconstruction map and show it to the student.

Sentence Deconstruction Map

Sentence:

As a muscle contracts, it pulls on a bone and moves an arm or leg.



Subordinate conjunction word (1pt)	Subject (1pt)	Verb (1pt)
As	a muscle	contracts



Adverbial Clause (1 pt.)
As a muscle contracts

What type of question does this clause answer (1pt)	
<input type="checkbox"/>	How
<input type="checkbox"/>	When
<input type="checkbox"/>	Where
<input type="checkbox"/>	Why

	Under what condition
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(Read the entire sentence again)



**In your own words, what information does this sentence tell you?
(3pts)**

This sentence tells me what happens when muscles contract and how the leg and arm bones moves. I learned that arms and legs are able to move when muscles tighten and pulls the bone in a bending position.

Do you remember this graphic organizer/map that I gave you at the beginning of this program? I asked you to complete it to the best of your ability. In this lesson, I will show you how this graphic organizer/map can help you understand adverbial clauses better. I will do this by showing you how to “unpack” the complex sentences.

When I say “unpack” it is like taking apart the pieces of something to see how things really fit together. Unpacking will basically be identifying the adverbial clause and see what type of information the clause is telling us. For instance, you will be able to answer if the clause telling you about when something happens? If the clause telling you why something happens? If the clause telling you under what condition something is happening?

Let me begin by showing you as we discuss Openers, which are adverbial clauses found at the beginning of the sentence.

The instructor will take out a blank sentence map and place it in a sheet protector. This allows the instructor to use a dry erase marker to write on the sheet and make corrections easily. (The map can be drawn on the board, used within a power point. The instructor can be creative as to what medium is used to allow the student to work with the sentence deconstruction map).

Example (Fang, 2006):

OPENER: Adverbial clause occurs at the beginning of the sentence

The instructor will write the sentence in the box and read the sentence aloud. (Note: Sentences can be preprinted on the forms).

Box 1

Sentence:

When the eggs hatch, the young reptiles are fully developed.



“Let’s look at this sentence. The first question I am going to ask myself is, “Can I immediately find this adverbial clause?” If I say yes, then I need to ask, How do I know that it is an adverbial clause? What was the one of the key characters of an adverbial clause that we discussed in the previous lessons? (Wait for a response). One, it is a dependent clause. I would then say to myself, “What I remember about dependent clause is that they are incomplete thoughts and cannot stand alone. So, I should look for the group of words in this sentence that do not provide a complete thought. (Then ask the student which group of words are not a complete thought.

(Wait for a response).

Yes, “When the eggs hatch,” are the group of words that is a complete thought. Therefore, it is the adverbial clause and it is at the beginning of the sentence.”

The investigator will write the adverbial clause in the designated box in the organizer, which is Box 2a.

(Note: Notice the arrow between Box 2a and 2b is a two way arrow. The instructor will focus on adverbial clause as a whole first, since the discussion of dependent clause was introduced before adverbial clauses and subordinate conjunctions. Based off of previous experience with teaching adverbial clauses. Some students will identify the adverbial clause first and confirm it is an adverbial clause by identifying the subordinate conjunction followed by the subject and verb. Some students will find it easier to identify the subordinate conjunction followed by the subject and verb first to identify the adverbial clause.)

Box 2

a.

Adverbial Clause (1 pt.)
When the eggs hatch

b.



Subordinate conjunction word (1pt)	Subject (1pt)	Verb (1pt)

Now the next thing I want to do is to make sure I know this is an adverbial clause by finding the subordinate conjunction, subject, and verb.

In Box 2b, there are 3 boxes. The first box requests the subordinate conjunction. I would say to myself, "I remember from my lesson that subordinate conjunctions introduces the adverbial clause; therefore, the word or words will be found at the beginning of the

adverbial clause. As I look the adverbial clause, the first word is “When” If I can’t remember all of the common subordinate conjunctions, I will check the word wall. Look there it is, “when” is on the list. Now the next thing I remember is that I need to look for the subject and the verb. According to my earlier lesson, subject and verb will follow behind the subordinate conjunction. I see the subject ‘the eggs’ and the verb ‘hatch’ It is confirmed that this is indeed is our adverbial clause.

As we move to later lessons which will consist of us talking more about subordinate conjunctions. What you may find yourself doing with this map is completing the components of 2b first before 2a. As you see, there is a two way arrow between Box 2a and Box 2b. This is to let you know that you may be able to identify the adverbial clause first and then confirm it is an adverbial clause by finding the components which are subordinate conjunction, subject and verb, which is how I just showed you. I want to show you by understanding what a dependent clause is, you can find your adverbial clause. Especially if you find it difficult to pinpoint the subordinate conjunctions words immediately.

Box 2

a.

Adverbial Clause (1 pt.)
When the eggs hatch

b.



Subordinate conjunction word (1pt)	Subject (1pt)	Verb (1pt)
When	the eggs	hatch

Next we need to move to Box 3, which requires the reader to determine what type of question the adverbial clause answers.

Take a look at the subordinate conjunction, which is 'when' on the word wall, 'when' falls under the category of time. So, what type of question would this clause answer? (**Wait for a response**).

If the instructor does not get a response, the instructor will guide the students by asking the following questions:

- Does this clause tell us **how** something happens?
- Does the clause tell us **where** something happens?
- Does clause tells us **when** something happens?
- Does the clause tell us **why** something happens?
- Does the clause tell us **under what condition** something happens?

Now, which type of question does this clause help us answer:

(correct answer: b.) when)

The correct answer is when.

The instructor will place a check next to the correct answer.

What type of question does this clause answer (1pt)		
	<input type="checkbox"/>	How
	<input type="checkbox"/>	When
	<input type="checkbox"/>	Where
	<input type="checkbox"/>	Why
	<input type="checkbox"/>	Under what condition

Now, we have talked about the adverbial clause and what type of information the clause tells us. So after reading this entire sentence, what information does this sentence tell you?"

(Read the entire sentence again)



**In your own words, what information does this sentence tell you?
(3pts)**

This sentences tells me that reptiles are have all of their parts once they come out of the egg. Also, when they are inside the egg they have not finished developing.

The sentence tells us that reptiles are developed when they hatch from the eggs. So, if someone ask you the question, when are reptiles developed? You would respond, when they come out of their shell.

“Let’s try another one.” This time we will practice with a closer, that is an adverbial clause located at the end of a sentence.

- Scientists have a hard time figuring out how the ecosystem works because it has many connections.

The instructor will repeat this process again using the above example sentence.

After the instructor has demonstrated unpacking with the use of the map, allow the student to practice unpacking complex sentences by using the sentence deconstruction

map. Provide 5 sentences for practice. More practice can be provided based on the instructor's judgment.

Assessment:

1. Given five adverbial clauses, the student will identify the subordinate conjunction with 100% accuracy.
2. Given five complex sentences, the student will identify the adverbial clause with 100% accuracy.

D. LESSON 5: SUBORDINATE CONJUNCTION WORDS

Materials	Do and/or Say
<p>Sentence Deconstruction</p> <p>Map</p> <p>Word Wall with the previous terms</p> <p>Chart Paper (word wall with the subordinate conjunction)</p> <p>Paper</p>	<p>Review</p> <p>The instructor will present the advance organizer:</p> <p><i>In this lesson, we will quickly review the following topics that you learned in the earlier lessons.</i></p> <ul style="list-style-type: none"> • <i>Adverbial clauses and subordinate conjunctions</i> • <i>Independent and Dependent Clauses</i> • <i>Simple and Complex Sentences</i> • <i>Adverbs</i> <p><i>After the review, we are going to work on subordinate conjunctions</i></p> <p>Instructor will write the words, “Adverbial Clauses” and “ Subordinate Conjunctions” on the Word Wall (Post-It paper or white board)</p> <p><i>Yesterday, we learned about adverbial clauses. Tell me what you remember about adverbial clauses.</i></p> <p>(Wait for a response)</p> <p><i>You were also introduced to the term subordinate conjunction. Tell me what you remember about subordinate conjunctions.</i></p> <p>Wait for student’s response. If the student provides the correct answer, confirm the answer. If the student provides the incorrect answer, review the definition and provide an example for review.</p>

<p>Pencil</p> <p>Dry erase markers</p>	<p><i>Yesterday we went over a lot of information. I talked with you about the sentence deconstruction map and showed you how to use it to identify adverbial clauses and subordinate conjunctions.</i></p> <p><i>Today we are going to talk a little more about subordinate conjunctions.</i></p> <p>Direct the student’s attention to the Word Wall consisting of the categories of subordinate conjunctions.</p> <p>The instructor will discuss each category and provide an example of the subordinate conjunction in the sentence.</p> <p>The student will then be asked to provide an example using the target subordinate conjunction.</p> <p>The instructor will use the sentence deconstruction map to practice identifying the subordinate conjunction in the adverbial clause.</p> <p>The instructor will practice with the sentence deconstruction map together. Then, the student will be given independent practice.</p> <p>Students will be given a short paragraph from a science text to practice identifying the adverbial clauses and will discuss what the paragraph is about and answer instructor generated questions about the paragraph.</p> <p><i>Now that we have practiced, let us practice finding adverbial clauses and subordinate conjunctions within a paragraph.</i></p> <p>The instructor will provide the student with a printed paragraph. The instructor will read aloud the paragraph as the student follows along. After the read aloud, the instructor and student will then identify the adverbial clauses and subordinate conjunctions using the sentence deconstruction map.</p> <p>The Instructor will answer any questions that the student may have or provide any clarification. The instructor will engage the student in discussion about the paragraph. The discussion should be characterized by the student talking about the</p>
--	---

	<p>understanding gained from unpacking the complex sentence and what it does for his/her overall understanding of the paragraph.</p> <p>Following the discussion the instructor will generate wh-questions about the paragraph. Regardless is the student provides correct or incorrect answer to the questions, the instructor needs to show how the new understanding of the adverbial clauses can help answer the questions.</p> <p>Assessment</p> <p>Student will identify the subordinate conjunction in an 8 complex sentences with 100% accuracy.</p>
--	--

E. LESSON 6: PRACTICE WITH ENTIRE PASSAGE

Materials	Do and/or Say
<p>Sentence Deconstruction</p> <p>Map</p> <p>Jamestown Reader</p> <p>Science Passages used</p> <p>during the Baseline</p> <p>Phase.</p>	<p>Review</p> <p>The instructor will present the advance organizer:</p> <p><i>In this lesson, we will quickly review the following topics that you learned in the earlier lessons.</i></p> <ul style="list-style-type: none"> • <i>Adverbial clauses and subordinate conjunctions</i> • <i>Independent and Dependent Clauses</i> • <i>Simple and Complex Sentences</i> • <i>Adverbs</i> <p><i>After the review, we are going to work on reading an entire passage like you did when we first started working together.</i></p> <p>Verbally assess, student’s understanding of the previous term by asking them to tell you the definitions and to give you an example.</p> <p>Emphasize the focus of the dependent clause, the adverbial clause and why it is important in science text.</p> <p>Present the students with a five sentence paragraph along with a sentence deconstruction map. As the student to identify the adverbial clauses and subordinate conjunctions within complex sentences found in the paragraph. Provide feedback and any further examples as needed.</p> <p>Present to the student one of the passages from the baseline phase of the study.</p>

	<p>The instructor will work on each paragraph of the passage one at a time. The instructor will read the paragraph aloud as the student listens.</p> <p><i>You may remember this passage from the time I had you just reading it and answering questions. We are going to read this again and see how discuss how unpacking can help in understanding the overall passage.</i></p> <p><i>I am going to read one paragraph at a time aloud to you and you will read along. After we read the paragraph, I want you to take time to identify complex sentences and find the adverbial clauses. I will define words that may be unfamiliar to you. If there is something you do not understand please do not be afraid to ask.</i></p> <p>Read the title to the student. Assess student’s background knowledge by asking the student what he/she may know about the topic. Proceed to read aloud the paragraph to the student. After reading the paragraph ask the student what were some key points that stuck out to him or her. Ask what the paragraph mainly talked about. Indicate to the student that it is ok to jot down notes to the side to remember what the paragraph was about.</p> <p>After that, then ask the student to identify, if any, the complex sentences within the paragraph. Proceed to unpack the complex sentence. Have the map available for the student to use. After going through the process of unpacking, ask the student again, what the paragraph is about and the overall information learned.</p> <p>Continue to do this with the remaining paragraphs.</p> <p>After the, the instructor has gone through the entire reading passage, proceed to answer the wh-question. Discuss with the student the differences in his/her answers, if any, from the baseline phase to the current performance.</p> <p>Assessment</p> <p>The student’s ability to comprehend the entire passage will be assessed during the intervention probe phase without any feedback.</p>
--	---

APPENDIX B: INTERVENTION FIDELITY CHECKLIST

Fidelity Checklist

Instructional Step	Instructional Components	Implementation of Step	
		Correct	Incorrect
Introduce the instructional goal and learning outcome	Review previous lesson objectives (e.g., adverbs, dependent clauses, adverb clauses).		
	Introduce the key terms and provide definitions		
Describe and Model	The lesson's topic is defined and described (e.g., subordinate conjunctions are defined and the function of this part of speech is explained).		
	Investigator provides examples of the key concepts <ul style="list-style-type: none"> • Verbal presentation • Written presentation 		
Practice	Participants are provided opportunity to practice the key concepts (e.g. completing worksheets, practicing on whiteboard, or providing verbal examples).		
Control Practice & Feedback	Investigator guide participant during practice activities		
	Investigator review work and provide feedback		
TOTAL			

Calculations

Total # of Correctly Implemented Components / Total # of Correctly Implemented Components + Total # of Incorrectly Implemented Components

_____ / _____ = _____

APPENDIX C: SENTENCE DECONSTRUCTION MAP AND CRITERION

Sentence Deconstruction Map

Sentence:

As a muscle contracts, it pulls on a bone and moves an arm or leg.



Subordinate conjunction (1pt)	Subject (1pt)	Verb (1pt)
As	a muscle	contracts



Adverbial Clause (1 pt.)
As a muscle contracts



What type of question does this clause answer (1pt)		
		How
		When
		Where
		Why
		Under what condition

(Read the entire sentence again)



In your own words, what information does this sentence tell you? (3pts)

APPENDIX D: DESCRIPTION OF INTERVENTION PROBE SESSIONS

Description of Intervention Probes Implemented Following all Instructional Lessons

		Lynn			Dana			Pam		
Intervention Probes		% ^a	Total Time ^b	Supplemental Review Description ^c	%	Total Time	Supplemental Review Description	%	Total Time	Supplemental Review Description
Probe 1	<u>Unpacking</u> The participant was provided a complex sentence and a sentence deconstruction map to complete.	62%	2:23	Following probe 1, the investigator reviewed subordinate conjunctions and adverbial clauses using the sentence deconstruction map.	25%	5:13	Following probe 1, the investigator reviewed subordinate conjunctions and adverbial clauses using the sentence deconstruction map.	25%	3:12	Following probe 1, the investigator reviewed subordinate conjunctions and adverbial clauses using the sentence deconstruction map.
	<u>Comprehension</u> A 400-word passage was read aloud to the participant. Following the reading of the passage, the participant was	75%	13:13	Following probe 1, the investigator reviewed adverbial clauses found in a passage and engaged participant in discussion as to what	35%	15:03	Following probe 1, the investigator reviewed adverbial clauses found in a passage and engaged the Dana in discussion as to what	50%	18:31	Following probe 1, the investigator reviewed adverbial clauses found in a passage and engaged Pam in discussion as to what information the

	provided a 10-question quiz.			information the clause provides. The participant was reminded of prerequisite note-taking strategy to assist in locating key points found throughout the passage.			information the clause provides. Dana was reminded of prerequisite note-taking strategy to assist in locating key points found throughout the passage.			clause provides. Pam was reminded of prerequisite note-taking strategy to assist in locating key points found throughout the passage.
Probe 2	<u>Unpacking</u> The participant was provided a complex sentence and a sentence deconstruction map to complete.	75%	2:27	No Supplemental Review	56%	4:58	Following probe 2, the investigator utilized a bubble map to review dependent clause, adverbial clause and subordinate conjunctions. The investigator and Dana practiced completing a sentence	25%	2:58	Following probe 2, the investigator utilized a bubble map to review dependent clause, adverbial clause and subordinate conjunctions. The investigator and Pam practiced completing a sentence deconstruction map.

							deconstruction map.			
	<u>Comprehension</u> A 400-word passage was read aloud to the participant. Following the reading of the passage, the participant was provided a 10-question quiz.	75%	13:43	No Supplemental Review	50%	14:47	Dana practiced reading a passage, discussed the complex sentences within the passage, and answered wh-questions pertaining to the passage.	60%	14:37	Pam practiced reading a passage, discussed the complex sentences within the passage, and answered wh-questions pertaining to the passage.
Probe 3	<u>Unpacking</u> The participant was provided a complex sentence and a sentence deconstruction map to complete.	75%	2:08	No Supplemental Review	70%	4:33	No Supplemental Review	25%	2:42	Following probe 3, the investigator did review adverb clauses found in a passage and engaged Pam in discussion as to what information it tells you. Pam was also reminded of prerequisite note-taking strategy to

										assist in locating key points found throughout the passage.
	<u>Comprehension</u> A 400-word passage was read aloud to the participant. Following the reading of the passage, the participant was provided a 10-question quiz.	75%	13:27	No Supplemental Review	55%	15:09	Following probe 3, the investigator and Dana reviewed a passage and discussed the note-taking strategy to assist in locating the information to answer questions.	40%	21:03	Following probe 3, the investigator utilized a bubble map to review dependent clause, adverb clause and subordinate conjunction words. The investigator and Pam practiced completing a sentence deconstruction map.
Probe 4	<u>Unpacking</u> The participant was provided a complex sentence and a sentence deconstruction	75%	2:17	No Supplemental Review	90%	4:41	No Supplemental Review	37%	3:04	No Supplemental Review

	map to complete.									
	<u>Comprehension</u> A 400 word passage was read aloud to participant. Following passage, participant was provided a 10-question quiz.	80%	13:21	No Supplemental Review	60%	15:17	No Supplemental Review	50%	18:13	No Supplemental Review
Probe 5	<u>Unpacking</u> The participant was provided a complex sentence and a sentence deconstruction map to complete	100%	1:57	No Supplemental Review	75%	3:15	No Supplemental Review	50%	2:57	No Supplemental Review
	<u>Comprehension</u> A 400 word passage was read aloud to participant. Following	80%	13:10	No Supplemental Review	70%	14:28	No Supplemental Review	60%	19:27	No Supplemental Review

	passage, participant was provided a 10-question quiz.									
Probe 6	<u>Unpacking</u> The participant was provided a complex sentence and a sentence deconstruction map to complete	n/a	n/a	n/a	87%	3:23	No Supplemental Review	x	x	x
	<u>Comprehension</u> A 400 word passage was read aloud to participant. Following passage, participant was provided a 10-question quiz.	n/a	n/a	n/a	70%	14:34	No Supplemental Review	x	x	x

Probe 7	<u>Unpacking</u> The participant was provided a complex sentence and a sentence deconstruction map to complete	n/a	n/a	n/a	100%	2:59	No Supplemental Review	x	x	x
	<u>Comprehension</u> A 400 word passage was read aloud to participant. Following passage, participant was provided a 10-question quiz.	n/a	n/a	n/a	70%	14:49	No Supplemental Review	x	x	x
Probe 8	<u>Unpacking</u> The participant was provided a complex sentence and a sentence deconstruction	n/a	n/a	n/a	100%	2:12	No Supplemental Review	x	x	x

	map to complete									
	<u>Comprehension</u> A 400 word passage was read aloud to participant. Following passage, participant was provided a 10-question quiz.	n/a	n/a	n/a	75%	14:43	No Supplemental Review	x	x	x
Probe 9	<u>Unpacking</u> The participant was provided a complex sentence and a sentence deconstruction map to complete	n/a	n/a	n/a	100%	2:09	No Supplemental Review	x	x	x
	<u>Comprehension</u> A 400 word passage was read aloud to	n/a	n/a	n/a	80%	14:37	No Supplemental Review	x	x	x

participant. Following passage, participant was provided a 10- question quiz.										
--	--	--	--	--	--	--	--	--	--	--

Note.

(x) denotes that probe sessions were not administered because the participant withdrew from study due to personal crisis, n/a represents that the participant met the criterion and did not receive any more probes after probe 5.

^a% = percentage that the participant obtained for that particular probe.

^bTotal time = This column presents the amount of time used for participant to complete the sentence deconstruction tasks and the reading comprehension tasks.

^cSupplemental Review Description = describe the activities that took place following the intervention probe. The activities served as review of key concepts taught in the instructional lessons.

**APPENDIX E: READING PASSAGES OPEN-ENDED QUESTION
RUBRIC**

Reading Passages Open-ended Question Rubric

0	<ul style="list-style-type: none">• The student's response is completely irrelevant or off-topic.• The student's response is a repetition of the sentence found in the text.
1	<ul style="list-style-type: none">• The student restates the question.• The student responses contain a subject and verb.• The student provides a vague response and no use of the text.
2	<ul style="list-style-type: none">• The student restates the question.• The student's response contains a subject and verb.• The student's response is not completely in his/her own words. (e.g. only 2 -3 words have been changed from the sentence.• The student's response does not extend to relevant experience or clear understanding of the reading passage.
3	<ul style="list-style-type: none">• The student restates the question.• The student's response contains a subject and verb.• The student's response is in his/her own words.• The student's response includes sentences indicating clear understanding of the designated paragraph.• The student's response is extended to relate to a relevant experience or new thought.

APPENDIX F: INSTITUTIONAL REVIEW BOARD APPROVAL LETTER



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Orlando, Florida 32826-3246
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www.research.ucf.edu/compliance/irb.html

Approval of Human Research

From: **UCF Institutional Review Board #1
FWA00000351, IRB00001138**

To: **Karen C. Davis**

Date: **April 22, 2013**

Dear Researcher:

On 4/22/2013, the IRB approved the following human participant research until 4/21/2014 inclusive:

Type of Review: UCF Initial Review Submission Form
Project Title: Comprehension of science text among African American fifth grade students: Effects of a metalinguistic approach.
Investigator: Karen C. Davis
IRB Number: SBE-13-09320
Funding Agency:
Grant Title:
Research ID: N/A

The scientific merit of the research was considered during the IRB review. The Continuing Review Application must be submitted 30 days prior to the expiration date for studies that were previously expedited, and 60 days prior to the expiration date for research that was previously reviewed at a convened meeting. Do not make changes to the study (i.e., protocol, methodology, consent form, personnel, site, etc.) before obtaining IRB approval. A Modification Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at <https://iris.research.ucf.edu>.

If continuing review approval is not granted before the expiration date of 4/21/2014, approval of this research expires on that date. When you have completed your research, please submit a Study Closure request in iRIS so that IRB records will be accurate.

Use of the approved, stamped consent document(s) is required. The new form supersedes all previous versions, which are now invalid for further use. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Participants or their representatives must receive a copy of the consent form(s).

In the conduct of this research, you are responsible to follow the requirements of the Investigator Manual.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 04/22/2013 11:06:58 AM EDT

IRB Coordinator

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Title Doctoral Student

**APPENDIX H: MOUNT ZION CHRISTIAN ACADEMY AGREEMENT
LETTER**

Mount Zion Christian Academy

Home of the Mighty Warriors – "Achieving Excellence Through Jesus Christ"

3519 Fayetteville Street
Durham, NC 27707
Telephone (919) 688-4245 Ext. 243/244
Fax (919) 688-2201

Apostle Donald Q. Fozard, Sr., Superintendent

July 1, 2013

To whom it may concern:

Mount Zion Christian Academy is an enthusiastic partner with the University of Central Florida and Karen Davis in her dissertation study examining the effects of an instructional method to improve comprehension of science texts. This study is designed to add to the evidence base regarding effective interventions in addressing disciplinary literacy.

We agree to work with Karen Davis and her dissertation committee during the course of her study and support the research endeavors. We look forward to participating in collaborative efforts with university faculty to further the research base and promote student learning.

As a principal partner, Mount Zion Christian Academy administration will assist in project activities, such as access to student records, supplying of workspace, teacher and parent support.

We believe that this innovative opportunity will lead to greater student learning and advance the empirical data for the use of reading comprehension approaches with discipline specific texts. As Florida moves to improve student performances in content areas; such as science, technology, and math, particularly among minority students, the results of this study may prove to be a lynchpin in student instruction.

Sincerely,



Henrietta Scott
Principal, Mount Zion Christian Academy

APPENDIX I: INFORMED CONSENT FORM

Consent Form



Comprehension of Science text by African American fifth and sixth grade students: The effects
of a metalinguistic approach

Informed Consent

Principal Investigator(s): Karen C. Davis, M.Ed., CCC-SLP

Faculty Supervisor: Linda Rosa-Lugo, Ed.D, CCC-SLP

Investigational Site(s): Mount Zion Christian Academy
University of Central Florida, Department of Communication
Sciences and Disorders

How to Return this Consent Form: Please read the following information. Please sign and return to your child's classroom teacher.

Introduction: Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being asked to allow your child to take part in a research study which will include *a total of 3 students at Mount Zion Christian Academy (MZCA)*. Karen C. Davis, the primary investigator will be the one person working with your child. Ms. Davis is a licensed and certified speech-language pathologist and a doctoral student at the University of Central Florida. Your child is being invited to take part in this research study because he or she is an African American student at MZCA that has been identified as having some difficulty in the context of Science and reading.

The person doing this research is Karen C. Davis of Department of Communication Sciences and Disorders at the University of Central Florida. Because the researcher is a graduate student, she is being guided by Dr. Linda I. Rosa-Lugo, a UCF faculty supervisor in the department of Communication Sciences and Disorders.

What you should know about a research study:

- Someone will explain this research study to you.
- A research study is something you volunteer for.
- Whether or not you take part is up to you.
- You should allow your child to take part in this study only because you want to.
- You can choose not to take part in the research study.
- You can agree to take part now and later change your mind.
- Whatever you decide it will not be held against you or your child.
- Feel free to ask all the questions you want before you decide.

Purpose of the research study: The primary purpose of this study is to explore the effects that explicit instruction of adverbial clauses will have on African American (AA) students' comprehension of science text. Additionally, the study will examine increased use, if any, of adverbial clauses in AA students' written language. While the primary goal of my proposed dissertation is to investigate the effect of explicit instruction of adverbial clauses to facilitate reading comprehension in the content area of science among AA pre-adolescents, the study is also interested in possible correlations between African American English (AAE) dialect, students' comprehension skills, and written language.

What your child will be asked to do in the study: The six participants in this study will be split into two groups of three. The participants will go through 3 phases: Pre-assessment phase, Instructional Phase, and Generalization Phase. During the pre-assessment phase, the participants will receive a screening to determine if they speak a non-mainstream dialect. They will also answer wh-questions and produce a written retell following the reading of a science passage.

In the instructional phase, the participants in this study will be engaged in individual instruction for 30-50 minutes three to four times a week. The instruction will focus on teaching them about adverbial clauses and how they impact the comprehension and composition of science text. The tasks that will be presented to the participants will consist of students reading science passages followed by multiple choice questions. The participants will be engaged in a written task as well. They will be asked to write a retell of what the passage was about. The multiple choice questions and written retell will serve as the tools to measure participants understanding of the reading passage. The participants will also be engaged in activities that will provide opportunities for them to demonstrate their understanding of the lesson.

Location: The instruction will take place in a designated room at the facility in which the afterschool will take place.

Time required: We expect that your child will be in this research study for six weeks. The study will begin July 7 and end September 1, 2013. The instructional sessions will take place three to

four times a week for 30-50 minutes per session. The sessions will take place during the summer enrichment program hours, which are from 8 am to 2pm.

Audio or video taping: Your child will be videotaped during this study for fidelity of implementation and reliability checks. If you do not want your child to be videotaped, your child will <not> be able to be in the study. Discuss this with the researcher or a research team member. If your child is videotaped, the tape will be kept in a locked, safe place in the primary researcher's office on the UCF campus. The tape will be erased or destroyed at the completion of the study.

Risks: There are no expected risks for taking part in this study. There are no reasonably foreseeable risks or discomforts involved in taking part in this study.

Benefits: We cannot promise any benefits to you, your child, or others from your child taking part in this research. However, possible benefits include improvement in comprehension of expository text and written composition. Also, the information we gather from this study may be used to help further the research base about disciplinary literacy approach to improving reading comprehension of pre-adolescents and adolescents in content areas.

Compensation or payment: There is no compensation, payment or extra credit for your child's part in this study.

Confidentiality: We will limit your personal data collected in this study. Efforts will be made to limit your child's personal information to people who have a need to review this information. We cannot promise complete secrecy. Organizations that may inspect and copy your information include the IRB and other representatives of UCF.

Study contact for questions about the study or to report a problem: If you have questions, concerns, or complaints, or think the research has hurt your child talk to Karen C. Davis, Graduate Student, Communication Sciences and Disorders, College of Education, (404)668-9238 or Dr. Linda I. Rosa-Lugo, Faculty Supervisor, Department of Health Professions at (407) 823-4798 or by email at kdavis3236@knights.ucf.edu and lrosalugo@ucf.edu.

IRB contact about you and your child's rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901. You may also talk to them for any of the following:

- Your questions, concerns, or complaints are not being answered by the research team.

- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You want to get information or provide input about this research.

Your signature below indicates your permission for the child named below to take part in this research.

DO NOT SIGN THIS FORM AFTER THE IRB EXPIRATION DATE BELOW

Name of participant

Signature of parent or guardian

Date

Printed name of parent or guardian

- Parent
- Guardian (See note below)

-
- Obtained
- Not obtained because: **[NOTE: REMOVE ALL OPTIONS NOT APPROVED BY THE IRB]**
- IRB determined that assent of the child was not a requirement
 - The capability of the child is so limited that the child cannot reasonably be consulted.

APPENDIX J: READING COMPREHENSION PASSAGES AND QUIZZES

Gymnastics: A Sport of Balance

Controlling body position is crucial to success in the sport of gymnastics. Gymnasts train a great deal to increase their strength and range of motion. The strength and flexibility allow them to hold poses and change positions on the floor as well as on apparatus that consists of such structures as bars, beams and rings. Before they train on equipment, gymnasts learn the basic body shapes and movements while training on the floor.

All the training in the world would be useless, if a gymnast does not have a sense of balance. It is a key to this sport. Balance is a natural process of the body that is controlled by the brain. The brain receives information from the nerves throughout the body and uses it to direct movements that maintain balance. Joints, muscles, the skin, the eyes, and especially the inner ear also play a role in balance.

As a gymnast performs, the brain must tell the rest of the body in a split second what adjustments to make to maintain balance. It sends signals through the nerves to various muscles. The signals cause muscles to contract, or tighten. As a muscle contracts, it pulls on a bone and moves an arm or leg. The brain determines which bones move and how much they move.

Vaulting is one event in gymnastics that shows how nerves and the brain work together to control balance. When the gymnast performs a vault, the gymnast first runs toward a springboard and jumps onto it. The springboard propels the gymnast toward a padded horizontal beam called a horse, which is about 1.2 meters (3 2/3 feet) high. As the gymnast come off the board, the brain directs the arms and legs to the proper positions to maintain balance. Nerves along the joints and muscles send information to the brain, as the body positions in the air. The brain then sends signals to make any necessary adjustments. The brain uses data from the eyes to control the precise placement of the hands on the horse. As the hands touch the horse, nerves in the skin give the brain more information about the body's placement, such as whether it is leaning to the left or the right. The brain instructs the hands to push off the horse and into the air, when the gymnast performs twists or other acrobatic movements. The gymnast must land standing up on a mat, which requires precise balance. Since the movement of liquid in the passageways of the inner ear creates nerve signals, the brain rebalances the body.

Gymnastics: A Sport of Balance

1. Gymnasts concentrate on developing muscles
 - a. in all parts of the body.
 - b. mainly in the legs.
 - c. mainly in the arms.
2. One can infer that as a gymnast trains over a long period of time, her or his sense of balance.
 - a. stays about the same.
 - b. gets a little bit worse.
 - c. improves.
3. It is likely that the most dangerous part of a vault is when the gymnast
 - a. is running up to the springboard.
 - b. is touching the horse.
 - c. is landing on the mat.
4. One can infer that the entire process of performing one vault takes
 - a. one second
 - b. several seconds
 - c. close to a minute
5. To maintain balance during vaulting the brain relies on information from
 - a. only the inner ear.
 - b. only the arms and legs.
 - c. several parts of the body.
6. When must the brain tell a gymnast's body to adjust to maintain balance?
7. Under what condition does the muscle pull on the bone to move an arm or leg?
8. Explain what the brain does when the gymnast's hand touches the horse.
9. How does the body regain balance?
10. When does the brain instruct the gymnast hands to push off the horse?

Training to be an Astronaut

Astronauts come from a variety of professions. Teachers, authors, doctors, scientists, and pilots are some of the people who have become astronauts. They share a love of science, a sense of adventure, and extensive training. To get into the U.S space program, a person must have a strong background in math and science. Since a person also has to pass medical, fitness, and mental tests, the space program looks for people in good health who work well with others.

The National Aeronautics and Space Administration, or NASA, runs the space program. Even when NASA invites a person to join the space program, that person is not yet an astronaut. First, new recruits go through a year of classroom training. They learn how a space shuttle works. They study weather, space, and computers. If they do well, they are accepted as astronauts.

While new astronauts goes through years of special training, they learn skills that come in handy during space missions. The astronauts might work with scientists making shuttle equipment or work with mission control to contact crews in space.

Some astronauts know how to fly jets when they enter the program. They maintain their skills by flying often. Astronauts who do not know how to fly receive pilot training. All astronauts need to learn how to fly a space shuttle using the shuttle control panels. They also practice landing an aircraft similar to the shuttle.

Astronauts undergo underwater training exercises because they have to learn to feel what it is like to move around in a space suit. So that astronauts can experience weightlessness, they ride in a jet nicknamed “the vomit comet.” The jet repeatedly climbs high into the air and then plunges into dives of up to 3 kilometers (2miles). Astronauts experience weightlessness for 30 to 60 seconds while they partake in these long dives. The jet might dive 40 times in a day. Some astronauts feel sick to their stomachs after a while.

Because astronauts have to be prepared for any kind of emergency on a mission, they learn all kinds of survival skills. These skills include parachuting over land and water, rafting, and camping with only a small survival kit.

Astronauts are assigned to a mission after they have completed years of training. They then train with other members of the crew to prepare for a mission. Most of the missions require the astronauts to perform important experiments in space.

Training to be an Astronaut

1. One skill an astronaut learns in training is how to
 - a. speak foreign languages
 - b. ride a bicycle
 - c. fly a shuttle using the shuttle control panels.
2. Why do astronauts ride in the Vomit Comet?
 - a. to experience weightlessness
 - b. to relax and have fun
 - c. to train for their physical exams
3. The article suggests that people in poor health
 - a. are surprisingly good astronauts.
 - b. often become astronauts.
 - c. will not be chosen to become astronauts.
4. It is possible to conclude from the article that a new astronaut in the space program
 - a. flies on a shuttle mission right away to gain experience.
 - b. works in the space program to gain knowledge
 - c. knows a lot and does not need to learn new things.
5. It is possible to conclude from the article that astronauts have
 - a. no training.
 - b. little training.
 - c. a great deal of training.
6. When are astronauts assigned to a shuttle mission?
7. When might astronauts work with scientists to make shuttle equipment?
8. Why must astronauts learn survival skills?
9. When does NASA consider a person an astronaut?
10. Why do astronauts train in an underwater tank?

Precipitation

Precipitation is defined as any water that falls from the atmosphere. This water can take different forms, including rain, snow, hail, and sleet.

Rain consists of drops of water that fall from clouds. Warm air picks up tiny drops of moisture from Earth's oceans, lakes, rivers, and streams. This moisture is called water vapor. Warm air tends to rise; and as it rises, it cools. Since cool air cannot hold as much moisture as warm air, the water vapor attaches to bits of dust or pollen and forms droplets. These droplets form clouds. As more and more water vapor attaches to the droplets, they become too heavy to float in the air, and they fall as rain.

If the temperature is very cold, the water vapor freezes around the bits of dust or pollen and forms crystals. As more and more vapor freezes onto the crystals, they grow into snowflakes. When the snowflakes get heavy enough, they fall to the ground.

A single snowflake can contain up to 200 crystals. There are four basic shapes of snow crystals. One looks like a long needle. This type of crystal forms only high in the atmosphere where the air is coldest. The other three shapes each have six sides. One looks like a hollow column, another looks like a flat hexagon, and the third looks like a star. The shape of a crystal depends on the temperature and humidity at which the crystal forms. All snow crystals are symmetrical; that is, if you cut the crystal in half, each half will be a mirror image of the other.

Hail consists of balls of ice that form in layers. Within the storm clouds are wind currents that flow upward. These winds carry water droplets up to colder air, where they freeze into ice particles. As the ice particles begin to fall, the wind currents may push them back up again. Layers of ice continue to form on the ice particles until balls of ice form. Eventually these balls become too heavy for the upward winds to lift them. They become hailstones and fall to the ground. Most hailstones are smaller than a dime, but sometimes they can be much larger.

Sleet forms when rain travels through very cold air near the ground and becomes partly frozen. Sleet can form a dangerous coating of ice on roads, windshields, and telephone wires.

Precipitation

1. One can conclude from reading this article that
 - a. water moves from Earth into the atmosphere and back to Earth, over and over
 - b. the ocean is losing too much water into the air and is gradually drying up.
 - c. lakes are made of water vapor.
2. One can assume from reading this article that all forms of precipitation do not
 - a. fall from clouds.
 - b. have the same or nearly the same temperature.
 - c. contain bits of dust and pollen
3. Very high clouds are more likely to be made of
 - a. water droplets
 - b. ice crystals
 - c. sleet
4. If hail the size of golf balls began to fall, one could infer that
 - a. the hail formed in clouds with very strong upward wind currents.
 - b. wind pushed hailstones together as they fell from the sky.
 - c. huge hailstones exploded high in the atmosphere.
5. Tree branches are most likely to break when they are covered with large amounts of
 - a. snow
 - b. rain
 - c. sleet
6. When does warm air cool?
7. When do water droplets form?
8. Why does water vapor attach to dust?
9. How does water vapor develop into snowflakes?
10. When does sleet form?

Why is the Ocean Blue?

When we say that an apple is red or a leaf is green, we mean that each appears to be these colors when seen in ordinary light. The way an object reflects and absorbs light determines its color.

The concept of light has proved to be very challenging for scientists. Light is energy that sometimes behaves like waves and sometimes behaves like particles. When people use the word light, they are usually referring to electromagnetic energy that can be seen by the human eye.

Light behaves like waves when it produces colors. White light—such as sunlight—contains a mixture of colors. Each color of light has a different wavelength, or distance between waves. When a person shines a beam of white light through a piece of glass called a prism, the glass bends the waves at different angles. The result is a rainbow of colors—red, orange, yellow, green, blue, indigo, and violet. This range of colors is known as the spectrum. Red is the color of the spectrum with the longest wavelength, and violet is the color with the shortest.

When light strikes an object, some wavelengths of light are absorbed. Others are reflected. An object appears a certain color because of the color of light it reflects. A leaf looks green because it reflects the green light. An apple looks red because it reflects the red light. Some objects absorb all colors of light, and some absorb none. An object that appears black absorbs all colors of light. None are reflected. On the other hand, an object that appears white reflects all colors of light. None are absorbed.

The relationship between light and color can be seen by viewing a red apple in blue light. In this light, the apple does not look red because there is no red light for the apple to reflect. Because the apple's skin absorbs all other colors of light, the apple looks black.

A few substances, such as glass and water do not reflect much light. Some wavelengths of light travel through these materials, and other wavelengths are absorbed. Red stained glass, for example, allows red light to pass through it and absorbs all other colors. When sunlight shines on ocean water, a different process takes place. The light strikes tiny particles in the water and is scattered, or reflected in many directions. Blue light scatters more intensely than other colors, so the water usually appears blue.

Why is the ocean blue?

1. You can infer from the information in the article that a banana appears yellow because it
 - a. absorbs yellow light
 - b. absorbs all light.
 - c. reflects yellow light.
2. You can infer that fruit punch appears red because
 - a. the punch reflects all other colors.
 - b. the punch scatters red light most intensely.
 - c. the punch does not absorb any light.
3. It is likely that a black object placed in sunlight will become hotter than a white object because
 - a. the wavelength of black light is longest.
 - b. black absorbs white light, whereas white reflects it.
 - c. light passes through the black object.
4. You can infer that the deepest parts of the ocean are dark because as light passes through hundreds of meters of water
 - a. only black light is not absorbed.
 - b. none of the light is absorbed.
 - c. all colors of light are eventually absorbed.
5. The article suggests that all color in the world is the result of
 - a. light
 - b. paints
 - c. dyes
6. What happens when a person shines white light through a prism?
7. Why does an object appear a certain color?
8. According to the article, why would an apple look black?
9. What happens when sunlight shines on ocean water?
10. Why does ocean water appear blue?

How Humans Hear

Everything that humans hear is in the form of waves. Just as the eye sees light waves in the form of colors, the ear hears sound waves in the form of noises. The ear and the eye translate these different waves into nerve signals that the brain can make sense of. The hearing process consists of several steps.

Sound waves are created when something vibrates in the air. For example, if you drop a fork on a table, the fork vibrates and creates sound waves. Sound waves are absorbed by a part of the ear called the eardrum. As the sound hits the eardrum, it sets off a chain reaction. The eardrum vibrates, creating movements in a group of small bones. The bones are attached to the cochlea, a structure that is shaped like a snail's shell. The movements of the small bones create motion in a liquid within the cochlea. The liquid covers small hairs called cilia, which move whenever the liquid moves. The cilia are attached to nerve cells that send signals to the brain. The brain analyzes these signals and identifies the sound that created them.

The ears and brain have a remarkable ability to recognize particular sounds. For example, a mother often can tell when her baby is crying even if there are other crying babies in the same room. This is because the sound of her baby's cry has special meaning to her and the brain has recorded its importance.

The ability to recognize sounds improves with experience. As the brain receives information about sounds from day to day, it stores the information in its memory. When the brain hears new sounds, it assigns meaning to them based on the information already in the memory. This is why certain words or songs can make a person happy. Often it is not the words or songs themselves that cause this feeling. The sounds are linked to happy memories for that person.

Another hearing process controlled by the brain involves determining where a sound is coming from. One ear is usually closer to the source of a sound than the other ear is. Sound waves are stronger when they reach the ear that is closer. They also reach the closer ear first. A part of the brain called the sensory cortex recognizes these differences and uses them to determine the location of the source of the sound.

How Humans Hear-Quiz

1. One can conclude from the article that sounds that make a person happy or sad often do so because of the person's
 - a. experiences.
 - b. taste in music.
 - c. intelligence.
2. The article suggests that if a person's eardrums are badly damaged,
 - a. sound will simply bounce off it.
 - b. the brain will not be able to identify sounds.
 - c. the sensory cortex will stop working.
3. You can infer that the easiest sounds for a brain to recognize are those that
 - a. are loudest
 - b. have been heard most often
 - c. are the most pleasant
4. A mother can probably recognize the sound of her baby's cry in a very loud room because
 - a. she knows that the cry means the baby is seriously ill.
 - b. the cry is much louder than all of the other sounds put together.
 - c. her brain has assigned great importance to that sound.
5. One can infer that if a person has lost the hearing in one ear, it will be most difficult for that person to identify
 - a. the loudness of a sound.
 - b. where a sound is coming from.
 - c. what is making a sound.
6. How does a fork create sound waves?
7. What happens as sound hits the eardrum?
8. When does the brain store information in its memory?
9. When do sound waves become stronger?
10. How does the brain assign meaning to new sounds?

What Good Is Sleep?

The human body needs sleep to stay in good health. Not sleeping well can cause a person to feel more than just tired. Lack of sleep can also make it difficult to think clearly. The person may feel as if he or she has no energy. Some people may become moody and bad tempered without deep sleep. To find out why the human body needs to sleep, scientists study body activities and brain waves during sleep.

Scientists suspect that there are several reasons that people need to sleep. One theory is that sleep restores energy and gives the body and mind time to recover from the day's activities. Some scientists believe that the main purpose of sleep is to allow the body to save energy.

Different types of sleep may have different effects on the body and mind. There are two types of sleep----quiet sleep and active sleep.

When people fall asleep, they move through four stages of quiet sleep. In the first stage, the muscles relax, but the mind is still aware of its surroundings. In stage two, the heart rate and breathing slow down. The mind is no longer aware of the outside world. In stages three and four, the mind and body continue to slow down, and muscles relax completely. Stage four is the deepest period of quiet sleep.

When a person is in quiet sleep, the body moves from stages one to four and then backward to stages two or one again. It moves back to stage four, and then, after about an hour and a half of quiet sleep, the body moves into active sleep.

The mind and body functions speed up while a person is in active sleep. This type of sleep is sometimes called dreaming sleep. Most dreaming occurs during active sleep. Scientists call active sleep REM, or rapid eye movement, sleep. During this stage, the eyes move back and forth very quickly under the eyelids. The body stays in active sleep for less than half an hour. Then it begins the stages of quiet sleep again.

The cycle of quiet sleep and active sleep repeats many times as people sleep throughout the night. Each type of sleep is needed for a person to feel well rested, but scientists believe the two types help the body in different ways. They believe that quiet sleep restores energy to the body and that active sleep stores the mental energy needed for learning and clear thinking.

What Good is Sleep

1. The article suggests that not sleeping well can cause a person to feel
 - a. energized
 - b. hungry
 - c. low on energy
2. It is possible to conclude from the article that studying how the body sleeps helps scientists understand
 - a. why people need sleep
 - b. how people can do without sleep
 - c. why sleep is often harmful
3. The article suggests that quiet sleep and active sleep
 - a. restore energy in different ways
 - b. restore energy in the same way
 - c. do not restore energy
4. It is likely that a person who had quiet sleep without active sleep for a few nights would
 - a. have very tired muscles.
 - b. not have the usual amount of mental energy
 - c. be more rested than usual
5. It is possible to conclude from the article that sleep is
 - a. needed to function well
 - b. not needed to function well
 - c. more important as one gets older.
6. Why do scientists study body activities and brain waves during sleep?
7. When do people move through the four stages of sleep?
8. When does the mind and body function speed up?
9. How often does the cycle quiet and active sleep occur?
10. How long does the body stay in active sleep?

Fungi are Alive

You might think that all living things are classified as either plants or animals, but there are some mysterious little organisms which are neither, yet are still alive. Many are invisible, hiding deep in the ground or floating silently on the air. Unlike plants, they do not rely on the heat or light of the sun for survival. They have no chlorophyll and do not create food through photosynthesis. They must find a source of nutrients outside themselves. They are very adaptable to any weather conditions. When temperatures fall too low to support life, they go into a deep sleep. This sleep is like the hibernation state that some animals use during the coldest part of the winter. While they are in this inactive state, they wait for living conditions to get better. These mysterious little creatures are all around us and we call them fungi.

We use fungi's extraordinary abilities to help us produce some of our favorite foods. If you enjoy biting into a nice, fluffy piece of bread, you can thank the yeast that helped the bread rise. Yes, yeast is a fungus. If you like mushrooms on your pizza or in your salad, you are eating fungi, too.

Because of fungi, we are able to control nasty infections with antibiotics. You may have heard of the most common antibiotic: penicillin. Dr. Alexander Fleming discovered penicillin in 1928 completely by accident. He left his science experiment out on the counter instead of cleaning up after himself. When he came back from his vacation, a strange bluish fungus was growing on it. Penicillin had been discovered.

As people become more aware of better ways to meet our survival needs without harming our planet, we are finding more and more uses for fungi. We can create pesticides to control insects and make detergents that are more Earth friendly. It makes sense that fungi can do things without harming Earth. They have been turning dead plant materials into rich soil for thousands of years. They eat the nutrients that would otherwise be wasted. Without them, we'd be walking around on thick layers of dead leaves and other discarded plant materials.

Although there are many good things about fungi, we must not forget that some fungi are harmful. There are certain varieties that will make us sick or give us skin reactions, like athlete's foot. It is important to be aware of the various types of fungi. We can benefit from the good fungi and protect ourselves from the harmful ones.

Fungi are Alive

1. Fungi can't make their own food because
 - a. it does not have chlorophyll.
 - b. it is an animal.
 - c. they are just like plants.

2. Fungi is beneficial to people because
 - a. it can be used to make clothes
 - b. it can be used only to make food
 - c. it is good for the environment

3. One can conclude that fungi is important to the medical profession because
 - a. fungi produced penicillin
 - b. fungi produces rich soil
 - c. fungi produces skin rash.

4. One can infer, if the world did not have any fungi it would
 - a. be very healthy.
 - b. be very dirty.
 - c. be just the way it is now.

5. The author concludes that it is important to know about fungi so that
 - a. people know how to grow them
 - b. people can know the difference between safe and dangerous fungi.
 - c. people can only study it for research projects.

6. When do fungi go into deep sleep?

7. When did Dr. Flemings discover blue fungus growing on his experiment?

8. How are people finding more uses for fungi?

9. What fungus is used to make bread?

10. How does fungi help the earth from been covered with dead plant materials?

Stone, Brick, and Concrete

Many modern building materials were first used in ancient times. Stone, brick, and concrete have been used in building for thousands of years. Until recent times, the ways in which people got and made these materials changed little.

More than 4,000 years ago, ancient Egyptians built great pyramids with huge blocks of stone. There were large deposits of limestone in Egypt. To break off slabs of stone from the deposits, workers used copper tools and wooden wedges. First they carved grooves in the stone with their tools. Then they put wedges into the grooves and soaked the wedges with water. Water causes wood to expand, so the wedges made the rock split into slabs. The workers moved the slabs to building sites using sleds, rafts, and ramps. This process changed little until the 17th century, when gunpowder was first used to split stone from deposits. In recent times, drills powered by motors have made the job much easier.

The first bricks were sun-dried mud bricks made in the ancient Middle East more than 6,000 years ago. In order for workers to make the bricks, they poured mud into molds and baked them in the sun. Fired bricks began to be widely used during the Roman Empire. The Romans baked, or fired, these clay bricks in ovens called kilns to make them strong. Firing bricks made them waterproof, too. The Romans cemented bricks together with a strong mortar made from limestone and volcanic ash. Today, bricks are produced in large plants with the use of machines.

The ancient Romans developed the cement they used as mortar into the first concrete. They mixed volcanic ash with powdered limestone and crushed stone. Building was faster and easier than ever with the use of concrete. Instead of laying brick walls, the Romans built wooden frames that they filled with concrete. Once the poured concrete walls were dry, the wooden frames were torn down. With concrete, new structures such as domes could be built.

Concrete changed little until the 19th century. As people began to experiment with different mixes of materials, they developed stronger concrete. They also began using iron together with concrete. Supporting concrete with iron beams proved to be a very strong building method. As steel began to replace iron, it was possible to build skyscrapers for the first time. Engineers have combined ancient building materials with modern ones so they can create stronger structures than ever before.

Stone, Brick and Concrete

1. The article suggests that stone, brick, and concrete have been used
 - a. in both ancient and modern times.
 - b. mostly by people in Europe.
 - c. only since the oven was invented.
2. One can infer that one of the reasons the Egyptian pyramids are still standing today is that
 - a. the ghosts of pharaohs have protected the pyramids.
 - b. the Egyptian government has rebuilt the pyramids several times.
 - c. the Egyptians used strong building materials and good construction methods.
3. It is likely that firing bricks makes them stronger because heat
 - a. melts some minerals into iron.
 - b. changes the clay into concrete.
 - c. causes chemical changes in the clay.
4. Why might motor-powered drills have replaced gunpowder as a way of breaking up rock?
 - a. drills are more exact and less dangerous.
 - b. gunpowder became very expensive to buy.
 - c. the supply of gunpowder ran out.
5. From the article, one can infer that the strongest buildings in use today
 - a. are made from a combination of building materials.
 - b. are made completely of steel.
 - c. are made of brick.
6. Why did engineers combine ancient and modern building materials?
7. How did Middle Eastern workers make bricks?
8. How did the Romans use wooden frames to mold concrete?
9. When was it possible to build skyscrapers?
10. Why did Egyptian workers' process for breaking slabs change in the 17th century?

Gravity and Air Resistance

A baseball thrown to a batter and a leaf blown from a tree are two examples of how natural forces act on objects in the air. When an object is released in the air, it usually falls downward. To understand what happens to an object in the air, one needs to understand the concept of gravity and the effect of air resistance. On Earth, gravity can be thought of as a downward force. Air resistance is an upward force on a falling object. The combination of these two forces is what makes an object fall at a particular speed, or velocity.

Gravity, one of the most basic forces of nature, makes objects fall because it is the force that pulls objects toward Earth. If a person let's go of two objects that are the same size, shape, and weight, they will fall at the same speed.

Even though air is actually gas that consists mainly of nitrogen and oxygen, many people think of air as being weightless. Earth's atmosphere contains quadrillions of tons of air. Air resistance is the force of the air pushing against a moving object. Air resistance is also called drag. The amount of air resistance an object encounters when it falls depends primarily on its weight, size, and shape. For example, suppose a 13-pound sheet of plastic and a 13-pound bowling ball were dropped from the top of a tall building at the same time. The bowling ball would hit the ground long before the sheet of plastic would. The reason is that the plastic would encounter more air resistance on its way down mainly because the plastic sheet has a much larger surface than the bowling ball does. More air would be pushing against the plastic than would be pushing against the bowling ball.

If two objects are the same shape and the same weight, their size will usually determine which falls faster. A 13-pound plastic ball is larger than a 13-pound steel ball. More air will push on the larger object, so the steel ball will fall faster.

Although a person weighs more wearing a parachute, the parachute takes advantage of air resistance to slow down a person's fall. The person will fall slowly because an open parachute creates a large surface area and much more air resistance.

Gravity and Resistance

1. One can infer that the reason a leaf falls slowly from a tree is that a leaf has
 - a. resistance to gravity.
 - b. a large surface area for an object of its weight.
 - c. magnetic attraction to a tree.
2. If an oak board and an oak cube of the same weight were dropped from the top of a building at the same time, which would hit the ground first?
 - a. the board would.
 - b. the cube would.
 - c. they would hit at the same time.
3. If the speed of an object increases as it falls, then an object dropped from a higher distance has a final speed that is _____ an object dropped from a lower distance.
 - a. slower than
 - b. faster than
 - c. the same as
4. It is likely that a strong wind causes objects to fall _____.
 - a. faster.
 - b. at the same speed as they would otherwise.
 - c. more slowly.
5. One can infer that without air resistance, all objects would fall _____.
 - a. slowly.
 - b. at speeds much different from another.
 - c. at about the same speed as one another.
6. Why does gravity make objects fall?
7. Why would a plastic sheet encounter more air resistance than a metal box.?
8. Explain how a parachute causes a person to fall more slowly?
9. What knowledge does a person need in order to understand what happens to objects in the air?
10. What three characteristics of an object determine the amount of air resistance it will encounter when falling?

A Mental Disorder

Schizophrenia is a word to describe a complex mental disorder. It describes a set of conditions that makes it difficult for a person to distinguish between what is real and unreal, think clearly, manage emotions, and relate to others. Schizophrenia affects 2.4 million American adults. Although it affects men and women, schizophrenia most often appears in men in their late teens and early twenties.

Since schizophrenia interferes with a person's ability to think clearly, control emotions, make decisions and relate to others, it impairs a person's ability to keep a job and take care of himself. People with schizophrenia experience psychosis, when they see or hear things that don't exist, talk in confusing ways, or feel someone is watching them. This is one of the major characteristics of the disorder. A girl with schizophrenia described an experience as follows: "I went to my teacher and said to her, 'I am afraid...' She smiled gently at me. But her smile did not calm me; it only made me more nervous. Because I saw her teeth, my attention was focused on how bright and white they were. Soon that's all I could see, as if the whole classroom were nothing but teeth trying to bite me. Terrible fear came over me."

Unfortunately there is no single treatment or medicine to cure this disorder. Because the cause and course of schizophrenia is unique for each person, finding the causes has been difficult for researchers. However, some research studies have linked schizophrenia to various causes such as brain structure, chemical balance and environmental causes.

Because the disorder may cause unusual and inappropriate behavior, people who are not effectively treated are often misunderstood by the public. Therefore, many people with schizophrenia are placed in prisons, or become homeless. Schizophrenia is also associated with violent behavior, but that is not true for the majority of people with this disorder. Most people living with this disorder are not violent but are withdrawn. If schizophrenia is not addressed, people with this disorder can experience a serious risk of suicide.

Schizophrenia is a manageable disorder when a person is engaging in treatment. While there is no single treatment for schizophrenia, people with this disorder can live satisfying lives with the help of therapy, medication and family support. However, one of the biggest challenges of treatment is getting a person with schizophrenia to take medication. Before a person can take medication, he or she must be aware that a mental illness exists.

Mental Disorder

1. People with schizophrenia in general
 - a. show the same type of behavior
 - b. have their own views of reality
 - c. are never misunderstood by the public
2. According to this article, people with schizophrenia are
 - a. able to control their emotions
 - b. very tolerant of social criticism
 - c. always aware of their hallucinations
3. The author presents the experience of a girl with schizophrenic to
 - a. show how kindness can be misunderstood.
 - b. prove that the people with schizophrenia are aware of their illness.
 - c. illustrate that people with schizophrenia disrespect authority
4. The purpose of this article is to inform readers about
 - a. medication for many mental disorders
 - b. a specific mental disorder
 - c. the public's belief about mental disorders
5. One can infer that if a person with schizophrenia receives treatment
 - a. he/she decreases his/her chances of experience suicide
 - b. he/she will go to prison
 - c. he/she will never have to take medication ever again.
6. When is schizophrenia manageable for a patient?
7. What can happen to a person, if schizophrenia is not taken care of?
8. Why has it been difficult for researchers to find the cause of this mental disorder?
9. Describe specifically how life is hard for people living with schizophrenia.
10. What age group and gender does schizophrenia often affect?

Cosmetics

Many cosmetics sold today are labeled as hypoallergenic. This means that they can be used by a large number of people who may be allergic to the ingredients in other cosmetics.

However, just because a company says that a product is hypoallergenic does not make it so. The idea of hypoallergenic cosmetics is so unclear that it does not give any real protection for the user.

If you have allergies, the best way to make sure you are buying a cosmetic that you can use safely is to buy small amounts at first. Test the product. Use a little of it on your arm. If it causes a problem, then you know you shouldn't buy any more.

Cosmetics are generally safe if used according to the instructions on the label. But cosmetics, like any other product, can be harmful if they are not used correctly.

Before using any cosmetic, read the label carefully and follow directions exactly. This is very important when using antiperspirants, hair-removing product, hair dyes and colors, home permanents, and skin packs.

To see if you are allergic to a cosmetic, apply a small amount on the inside of your forearm. Leave it for 24 hours. If you notice any redness or blisters, don't use it again. In the case of hair preparations, do a patch test. Use it as directed on one small area of the hair and scalp to see whether there is a problem before using it for the entire area. Be very careful using eye cosmetics to avoid possible damage to the eyes.

If a cosmetic causes any burning, breaking out, stinging, or itching, stop using it. If the condition seems to be serious, see your doctor. Report any problems to the company that makes the product and to the FDA. You will be doing a public service.

Don't let children play with cosmetics. Keep cosmetics out of their reach.

Cosmetics are very important to our well-being. When we feel attractive, we feel accepted and secure. But cosmetics cannot change us permanently. They cannot make us suddenly look younger, make our bodies healthier, or prevent wrinkles.

When you're buying cosmetics, keep in mind that they are made to bring out your good features or cover up some flaws. But they cannot make you over, nor can they assure your living happily ever after.

Cosmetics

1. One can infer that cosmetics
 - a. can cause blindness
 - b. improve our self-image
 - c. are unnecessary for men
2. The author warns that cosmetics cannot
 - a. improve a person's health
 - b. make us feel attractive
 - c. enhance a person's good features
3. In writing this passage, the author uses _____ to inform the reader about cosmetics.
 - a. facts
 - b. interesting interviews
 - c. excellent comparisons
4. The purpose of this article is to tell the reader about
 - a. specially formulated cosmetics
 - b. cosmetics in general
 - c. the use of imported cosmetics
5. Cosmetics present a threat to a person's health because of their
 - a. application
 - b. ingredients
 - c. overuse
6. When should you read the labels of a cosmetic product?
7. When should you see a doctor after applying a cosmetic product?
8. Why would a person apply a small amount of cosmetic product on their forearm?
9. Under what conditions are cosmetics generally safe to use?
10. When should a person use the patch test?

Lend an Ear

Noise is ear pollution. It is often called “unwanted sound.” If a sound is something you like, a song, or a call from a friend, it is just a sound. But if you are trying to sleep or study, then this sound becomes a noise.

This “unwanted sound” has an effect upon our bodies. For example, loud noises can cause a loss of hearing. Even wanted sound, such as amplified hip-hop music, can hurt your hearing, though you may not think of it as noise. The first warning that a sound may be loud enough to hurt is called “ear distress.” This would be felt as a pain or heard as a ringing noise in the ear. People should be examined by a doctor, if they have this complaint of ringing noise in the ear.

Noise of any kind may make you nervous or affect your sleep. Noise can also affect your speech and your ability to think. Noise has been linked to case of heart disease, ulcers, mental illness, and other sicknesses.

Although noise effects our bodies, it is not always bad. It does have a place in our lives. You may not like to hear car horns, but they do warn you of oncoming cars when you cross a street. A thumping noise from a bicycle tire tells you that the tire may be flat. Also, one noise can help block out another unwanted noise. An example is when a person plays loud music in an office, so that it drowns out the sounds of people talking.

Sound is made by air pressure on your eardrums. For instance, when you clap your hands, air is pushed out from between your hands. At almost the same time the air is pushed from your hands, air in your ears pushes your eardrum inward. Your ears signaled your brain to give you the feeling of a clap sound.

The number of sound waves hitting your eardrums each second controls the highness or lowness of the sound you hear. The strength of sound waves is measured by a sound level meter. The meter uses units called decibels. A whisper amounts to about 20 decibels. A jet plane 100 feet away is about 140 decibels. A sound of about 120 decibels can hurt the ears. Eventually, the ear becomes damaged from such loud noises. Whenever people work around heavy equipment operation, they must take care to protect their hearing by wearing earplugs. It's a good thing that the average speaking voice reaches only 60 decibels. Otherwise, we might all be a little deaf.

Lend an Ear

1. This article is about
 - a. ear pollution
 - b. jet plane noises
 - c. sound level meters

2. One can conclude that listening to amplified hip-hop music can result in
 - a. lack of balance
 - b. slight hearing loss
 - c. weight gain

3. One can infer from the article that
 - a. noise can cause illness
 - b. many people are born deaf
 - c. sound is always pleasing

4. We hear when the ear sends a message to the
 - a. brain
 - b. eyes
 - c. heart

5. Noises that are over 120 decibels are
 - a. harmful
 - b. helpful
 - c. peaceful

6. Under what condition does a sound become a noise?

7. What happens to the eardrum as air is pushed through the clapping of a person's hand?

8. When should someone see a doctor about their ears?

9. When should people wear protective earplugs?

10. According to this article, why would someone play loud music in the office?

Technology for people with hearing and visual impairments

A person who has some hearing loss or who can't hear at all is said to have a hearing impairment. Modern technology can help people with hearing loss. Technology involves using science to make devices that do useful things.

Many people with some hearing loss wear hearing aids. A hearing aid is a small device that is powered by a battery. The hearing aid picks up sound waves and turns them into electrical signals. After sound waves are turned into electrical signals, the hearing aid sends the signals to speakers that turn them into sound loud enough for the person to hear. People with hearing impairments can communicate on the phone by using special keyboard devices that send and receive text messages over phone lines. A light flashes when the phone rings.

Special alarms have been developed for people with hearing loss. A fire alarm makes a light flash when a person is awake and makes a pillow vibrate when the person is asleep. An alarm clock can have a flashing light or a loud buzzer, or it may cause the mattress to shake.

Thanks to technology, people with hearing loss can enjoy home entertainment. Since television has closed captioning, people with hearing loss can watch TV shows or movies. Close captioning shows the actors' words in text on the screen.

Technology also can help people who are visually impaired. This means that the person has lost some sight or is blind. A screen reader lets a blind person use a computer. As the blind person types, the screen reader speaks the words in a humanlike voice. Other programs magnify the print on the screen.

Braille is a means for enabling a person who is blind to read and write. Braille uses patterns of raised dots that can be read with the fingers. A Braillewriter is a machine that types in Braille. The user hits keys that make the dots on a special kind of paper. Talking note takers also use Braille. As a student take notes by typing on the device, the notes are read aloud and can be printed in Braille.

A new technology for visually impaired people involves signs that talk. Small machines that send out signals are placed along streets or in buildings. A person uses a hand-held device to scan an area. For example, when a person points the device one way, the device might say, "restroom." If the device is pointed in another direction it might say, "stairs." San Francisco is one of the cities that have these signs in place.

Technology for people with hearing and visual impairments

1. One can conclude from reading this article that
 - a. technology is much more helpful to people with hearing impairments than to people with visual impairments.
 - b. technology can help just a small percentage of people who have hearing loss.
 - c. there are many devices that make life easier for people with disabilities.
2. In the future, it is most likely that
 - a. all computers will print in Braille.
 - b. computers will have more features for people with disabilities.
 - c. guide dogs will no longer be needed.
3. A person who is deaf would benefit most from
 - a. a device that sends text messages over phone lines.
 - b. a hearing aid.
 - c. talking signs.
4. A person who is blind and wants to get around in a large city would be most helped by
 - a. talking signs.
 - b. a screen reader.
 - c. a hearing aid.
5. Of the following, the one that does not use technology is
 - a. a flashing fire alarm.
 - b. a talking watch.
 - c. sign language.
6. How does a fire alarm wake a person with a hearing loss?
7. When do hearing aids send sound waves to speakers?
8. How are people with hearing loss able to watch TV and movies?
9. What happens as students with visual impairments use the Talking Note Taker to type papers?
10. How are talking signs helpful to people with visual impairments?

Recycling can reduce pollution

Each year in the United States, the average family throws out about a ton of trash. Paper, plastics, glass, and cans make up more than half of the trash thrown away. Food waste makes up another third. People in the United States use about 90 million glass bottles and 46 million cans every day. Although some will be recycled, much of this glass and metal simply becomes garbage.

Pollution caused by waste is a complex problem. Waste disposal companies bury most garbage in landfills. Many landfills are full, and land for new sites is hard to find in some areas. Over time, trash slowly dissolves into chemicals. Some of these chemicals are poisonous and can pollute water. Another way to dispose of trash is to burn it. If trash is taken to incineration plants, the trash is burned to produce energy. Although this is a beneficial use of trash, some of the gas produced in the process pollutes the air.

People can restrict the amount of trash they produce in order to cut down on pollution caused by waste. They can do this by “reducing, reusing, and recycling.” So that they can reduce the use of waste, people limit the amount of new goods they use. Ways to reduce include using both sides of a sheet of scratch paper and using cloth bags for shopping. Buying products made from recycled paper, plastic, or glass is another way to reduce.

To reuse, people can save bags, containers, clothing, books, and toys so that they can be used more than once. Plastic bags and containers can be washed and reused. Clothing, books, and toys can be passed on to others for their use instead of being thrown away.

When people recycle waste, they separate from their trash the materials that can be used again to make new products. Paper, cans, glass, and plastic can be recycled. The most inexpensive material to recycle is paper. In many communities, workers pick up recyclable goods directly from homes. If people live in communities that do not have pickup service, they may need to bring their recyclables to a nearby recycling center.

Another way to recycle is to compost food waste. People can pile raw food waste outside in a wooden bin with straw or dead leaves. The food waste and plant matter break down and can be used to fertilize gardens. By recycling, reducing, and reusing the products we consume, we can cut down on trash and pollution.

Recycling can reduce pollution

1. The article suggests that garbage disposal is a problem in the United States because
 - a. pollution is destroying many cities.
 - b. in some areas there are fewer and fewer place to put garbage.
 - c. so many people are recycling that there are not enough factories to handle the material.

2. You can infer that recycling decreases pollution by
 - a. reducing trash.
 - b. making more trash.
 - c. burning trash.

3. From the information in the article, you can infer that one problem that old landfills create is
 - a. taking up space that should be used for factories that produce glass.
 - b. causing more air pollution than automobiles.
 - c. leaking poisonous chemicals into underground water supplies.

4. If there was a large amount of spoiled food in the back of a refrigerator, what could a person do with it help the waste problem?
 - a. throw it in the garbage immediately.
 - b. put it in a compost pile.
 - c. take it to a recycling center.

5. It is possible to conclude from the article that _____ household waste is being thrown away.
 - a. too much
 - b. the right amount of
 - c. not enough

6. How can people cut down on pollution?

7. When should people bring recycled items to a local recycle center?

8. Why do people limit the amount of use of new goods?

9. What happens to trash that is taken to an incineration plant?

10. How can burning trash cause pollution?

The Organs of the Body

The human body is truly a wondrous machine. Inside it are billions of tiny units called cells, which perform the many actions needed to keep people alive. Day in and day out, the body is working. Even when a person is sleeping, the body still breathes and pumps blood to all of its parts. The way the body works is a mystery to most people, and scientists are only beginning to understand it.

The countless cells in the body are grouped into tissues. Each tissue has a purpose. For example, there are tissues that line the mouth, tissues that form muscles, and tissues that make up the heart. The heart is one example of a group of tissues called an organ.

An organ is simply a group of two or more kinds of tissue that has one main purpose. The heart's purpose is to pump blood. The heart is known as a vital organ because the body cannot survive without it. As the heart pumps, it moves blood rich in oxygen to all tissues. All other organs depend on the heart because they need oxygen to survive. They also depend, to different degrees, on other organs.

Organs that work together are called organ systems. One example of an organ system is the circulatory system. This system includes the heart, the blood, and the lungs. The lungs are involved in the system because they resupply the blood with oxygen while removing carbon dioxide. When the heart pumps blood into the lungs, the blood picks up oxygen and is then pumped to other tissues.

Another example of an organ system is the digestive system. This system changes the food that people eat into the energy that cells need to do their work. The system begins with two organs called the tongue and the esophagus. Food first enters the body through the mouth. After the food has been chewed, the tongue moves it into the esophagus. The esophagus is a long tube that pumps the food from the mouth to the stomach, another organ. Once the food is in the stomach, it is stored until it is mixed with digestive juice. The digestive juice breaks the food up into smaller pieces. The food then moves to the small intestine, where it is mixed with other juices. Any material that is not digested moves into the large intestine.

The Organs of the Body

1. People breathe and their hearts beat while they sleep, which means
 - a. most parts of the brain are wide awake at night.
 - b. Some parts of the body are always working
 - c. the blood contains more oxygen at night than it does during the day.
2. Which of the following statements is most likely true?
 - a. The tongue is the most important organ within the digestive system.
 - b. For an organ system to work properly, separate organs must do their jobs.
 - c. Scientists now know exactly how the human body works.
3. The article suggests that
 - a. every cell within the body depends on every other cell.
 - b. most people lack the digestive juices that break down food.
 - c. if one organ fails, other organs may not survive.
4. If a region of the body stopped receiving blood,
 - a. the tissues in the region would survive on stored oxygen for two or three weeks.
 - b. a heart attack would occur.
 - c. the cells, tissues, and organs within that region would die.
5. One can infer that a part of the body made up of one type of tissues
 - a. is an organ.
 - b. is not an organ.
 - c. has at least three kinds of cells.
6. When does the tongue move the food to the esophagus?
7. What happens when the heart pumps blood into the lungs?
8. Why are the lungs part of the circulatory system?
9. Why is the heart considered a very important organ?
10. When does blood, rich in oxygen, move to the tissues of the body?

Life Cycles of Wildflowers

A wildflower is a flowering plant that grows in the wild. Like other flowering plants, wildflowers have seeds that form in flowers when grains of pollen join with eggs found at the base of the petals. Wind and insects help transport pollen to the eggs.

The life cycles of wildflowers vary. Some wildflowers live short lives and grow flowers just once. Others live for many years and flower many times. All flowers, including wildflowers, are referred to as annuals, biennials, or perennials, depending on the length and pattern of the plant's life.

Annual plants grow, flower, and produce seeds in a year or less. Texas bluebonnet, daisy fleabane, and Indian paintbrush are examples of annual wildflowers. Summer annuals grow in the springtime and flower by fall. The seeds of winter annuals grow into plants in the fall. The winter annuals live through the winter and flower in the spring. Annuals will die as soon as their flowers form seeds.

Annual wildflowers often grow in places where few other plants can survive all year. For part of the year, the climate in these places may be too harsh. The wildflowers survive these harsh seasons as seeds because seeds can survive harsh conditions that plants cannot. It is hard for annuals to grow among plants that live for many years. Since annuals have short lives, they cannot compete for space in the sun and soil. Annual wildflowers often can be seen alongside roads in cleared lots.

Wildflowers that live for two growing seasons are called biennials. Desert marigolds and some types of black-eyed Susans are examples of biennials. During the first growing season, this kind of wildflower grows and gathers strength. It takes in energy from the sun to make food that is stored in a thick root called a taproot. The second growing season begins after winter. Before the second growing season ends, a biennial plant flowers and forms seeds. The plant dies after seeds are formed.

Many wildflowers are perennials that can live for years and years. Examples are dandelions and violets. Some of these plants flower every year. They produce many seeds in their lives. Others, like the water lily, grow for a few years before they flower and produce seeds. Perennial plants depend on their roots to live through cold winters. The roots stay alive when the rest of the plant dies. In spring, new stems, leaves, and flowers grow from the roots.

Life cycle of wild flowers-Quiz

1. It is possible to conclude from the article that wildflowers grow
 - a. only in the summer.
 - b. only in the spring and fall.
 - c. in every season of the year.
2. The article suggests that if a wildflower did not grow flowers,
 - a. seeds would still be formed.
 - b. no seeds would be formed.
 - c. seeds would be formed only in good weather.
3. The article suggests that during harsh seasons, wildflowers
 - a. survive as seeds or roots.
 - b. die out.
 - c. grow quickly.
4. It is likely that annual wildflowers would grow well
 - a. in thick jungles.
 - b. in deserts that get occasional rain.
 - c. among perennial wildflowers.
5. If a plant in the wild has no visible flowers in the spring, it
 - a. cannot be a wildflower.
 - b. must be dead.
 - c. could be a summer annual.

6. When the rest of a perennial plant dies, what happens to the rest of the root?
7. Why are annual wildflowers able to survive harsh seasons?
8. When does a biennial plant bloom and form seeds?
9. How is a flower labeled as annual, perennial, or biennial?
10. How do wildflower seeds form?

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