MIDDLE SCHOOL STUDENTS' PRIOR EXPERIENCES AND ATTITUDES TOWARD SCIENCE:

A QUANTITATIVE STUDY BY GENDER, RACE, GRADE LEVEL, SOCIOECONOMIC STATUS, AND GIFTEDNESS

by

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(Under the Direction of Tarek Grantham)

ABSTRACT

This dissertation focuses on the prior science experiences of middle school students and its correlation with their attitudes toward the study of science. Through the use of electronic survey, data was collected on 617 middle school students ranging from grades 6-8 in one school in a small city in the Southeastern United States. This data included questions about prior science experiences, current attitudes toward science, and perceived levels of teacher support; gender, race, grade level, socioeconomic status, and gifted status data was also collected and later used for analysis to look for variation. Using data gathered during this survey, I have analyzed the findings and have related them back to the literature collected during the research process. This dissertation also involves the development of a survey instrument.

INDEX WORDS: Science background, Science attitudes, Middle school, Gender, Race, SES, Giftedness

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DEDICATION

I would like to dedicate this dissertation to my families, both the one that lives under my roof and the one I spend 180 days a year with in the trenches. To my three girls – Kelsey, Sydney, and Carley – you are the lights of my life and my inspiration for continuing to learn and grow; to my husband Bobby L. Meeler, who has tirelessly supported my goals and dreams. I would also like to dedicate this to my parents, Edward G. and Jeanne L.Watts, who gave me life and a love for learning. I love you both and thank you for your endless help with childcare during classes and meetings, and for always having a pot of soup and fresh banana bread waiting for me. I would also like to thank my sister, Jennifer O. Watts, for always lending unconditional support and giving me some worthy competition – knowing when and how to “up the ante.”

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CHAPTER ONE:

INTRODUCTION

In many U.S. elementary schools, reading and math instruction takes priority over science and social studies instruction (Center for the Future of Teaching and Learning, 2010); in some cases, science and social studies has been virtually eliminated from the curriculum due to lack of time. In the report mentioned above, 40% of elementary teachers reported spending less than one hour per week on science instruction. This practice has rendered many incoming middle school students with a spotty knowledge of science at best. Research suggests that one of the biggest drops in science achievement takes place between 5th and 8th grade (between age 10 and 14); another drop occurs during later adolescence (Kotte, 1992; Weinberg, 1994, Jones, 2000). It also suggests that student attitudes are strongly connected to achievement; students with more positive attitudes toward a subject tend to achieve at higher levels within that subject. A student's attitude toward a subject may very well be attributed to many variables: his prior experiences with that subject (both positive and negative), his perceptions of teacher support in the classroom, his perceptions of peer support, and his perceptions of parental support and expectations.

Of these four variables, two of them are able to be controlled to some degree by educators in the classroom (prior experiences and teacher support); the other two are not as easily controlled from the school setting; however, they certainly have an impact on student achievement in any given subject. This study is designed to enlighten and empower teachers within the science classroom; as such, the variables of prior experiences and perceptions of teacher support as they impact students' attitudes toward science are the focus of this dissertation.

The date is October 4, 1957; Americans have just learned that the Soviet Union has launched the first artificial satellite in history, Sputnik I. Weighing less than 200 pounds and smaller than a beach ball, the satellite is able to send radio signals and information regarding the upper atmosphere back to Earth. Americans, including President Eisenhower, are caught somewhat off guard; not only does this present a possible military threat during the Cold War (if a satellite can be launched, so can missiles), but it also fuels a space race between two world powers that continued for several decades. The launch of Sputnik I is directly tied with the creation of our National Aeronautics and Space Administration (NASA) in 1958 and the beginnings of organized gifted programming in U.S. schools in the early 1960's (National Association for Gifted Children, 2012). Americans did not want to be left behind as the world advanced around them.

Flash forward to 2012, I am having a discussion with my sixth grade gifted science students about Sputnik and the Space Race. Every spring, we study a unit on the history of the space program, which includes viewing and discussing *October Sky* and building and launching our own rockets. *October Sky* is a movie about the space race based on the true story of Homer Hickam and the "Rocket Boys." We are discussing some scenes in the movie in which Homer's dad continues to discourage Homer from pursuing science as a career (he would rather him continue on the coal-mining path of his family). Elizabeth, a quiet but well-read student, makes a very insightful comment: "It is amazing how those boys did so well *despite* the grown-ups in their lives telling them they would fail; today, we kids have almost everything we need at our fingertips – electronics, information, *and* our parents' support…but you don't see us going to the moon anymore or doing anything really great…I just think that's sad." Her words echo the very frustration felt by science teachers (including me) across the nation. The use of standardized tests has its place in education, but the emphasis placed on their scores has left many teachers just teaching the standards, with not much room left for innovation and inspiring lessons. What has happened to the passion? Do we need another Sputnik-moment to jumpstart us on the right path again? If something does not happen soon, many educators fear that the United States may well be left behind both educationally and economically.

Background of the Problem

As the world around us becomes increasingly technological, nationally it is becoming more and more imperative that we attempt to attract our nation's youth to fields such as math, science, and engineering. Despite No Child Left Behind (NCLB) legislation, children in the United States continue to lag behind other industrialized countries in the areas of science, technology, engineering, and math (STEM), consistently placing in the middle of the list or lower (President's Council of Advisors on Science and Technology, 2011). A report released by the Program for International Student Assessment (PISA) in late 2010 placed the United States 14th in reading, 17th in science, and 25th in math out of 34 industrialized countries (West, 2012). While it has been recognized that American students have much richer "out-of-school" opportunities (e.g. – camps, museums, etc.) to learn about subjects such as science and math than children in most other industrialized countries, those experiences do not tend to lead students to take higher level math and science courses in high school (nor to major in them in college). A considerable amount of recent research is devoted to the absence of women and minority groups in STEM fields; however, the issue also involves the lack of students period in these fields of study, particularly in the United States.

More personally, when I began teaching nearly twenty years ago, I started out as a middle school language arts teacher. In middle school, "language arts" consists of grammar, writing, and literature. As an avid reader and novice writer myself, I thoroughly enjoyed teaching this subject. However, in the spring of 2002 an opportunity presented itself in the form of a position opening in our gifted program. Ready to make a shift for change of scenery, I jumped at the chance. The only problem was that the subject area was life science, for which I had no teacher training. Nonetheless, it did not take long for me to fall in love with the science curriculum; most children are naturally drawn to science and it is unbelievably easy to make it "fun and exciting." As I was enjoying my newfound status as the "cool science teacher with all the neat labs," I was also struck by a shift I noticed in my students. In particular, I found it interesting that in my language arts classes, the girls were so outspoken and always had comments to add to discussions; in my science classes, the girls were oddly silent allowing the boys to lead discussions and often conduct labs. Whereas the boys were more passive learners in the language arts class, the reverse was true in my science classes. While there were exceptions to this pattern, the overall trend was strong enough for me to take notice and start searching relevant literature on this topic. What I learned inspired me to create voluntary single-gender (female) classes for my science students for the past eight years. Based on the literature and my own observations and student interviews, I learned that females often experience a downward spike in science achievement during middle school (grades 6-8), that seemed to be related to a drop in self-esteem that many females can experience during early adolescence. Race, socio-economic status, gifted status, and grade level are other personal characteristics of interest in the analysis. While this dissertation is focused on science education, similar studies could be found to support the same issue in math education.

The main problem that is being addressed by this study is to explore the relationships among students' perceptions of teacher support in their science classrooms, their prior science experiences, and their attitudes toward science.

Purpose of the Study

One of the primary purposes of this dissertation is to collect data about middle school students' attitudes toward science; another is to study what kinds of prior experiences these students have had in the field of science. It is theorized that a person's background knowledge/experience is directly related to his or her attitudes toward that subject (which, in turn, has an impact on achievement). Students' perceptions of teacher support is also investigated. The research questions that guide this dissertation are:

1) What are middle school students' attitudes toward science, specifically related to enjoyment, perceived usefulness, and confidence in the science classroom?
2) What are middle school students' perceptions of science teacher support and reported levels of prior experiences in the field of science?
3) To what extent do personal characteristics (i.e. gender, race, grade level, socio-economic status, and gifted versus non-gifted status) explain observed variance in student perception of teacher support and science experiences?
4) To what extent do personal characteristics (i.e. race, gender, SES, grade level, and gifted status), levels of teacher support, and reported prior science experiences explain variance in students' attitudes toward science?

By investigating the prior science experiences of middle school students at a given site and gathering information concerning their attitudes toward science as a discipline and field of study, this research can shed light on the connection between prior science experiences and science attitudes. If science attitude is closely associated with achievement and pursuit of a subject, then it would stand to reason that educators can help students explore outside the classroom experiences in order to help strengthen the extent of prior experiences. The correlation between students' perceptions of teacher support and attitudes in science is also an important focus of this study that can help educators understand the impact that teacher-student relationships may have on student motivation and achievement.

Significance of the Study

There are many reasons to take students' attitudes toward science into account when considering science achievement. First, attitudes toward a subject are believed to influence a student's selection of courses in high school and college settings and to influence that person's willingness to become involved in extracurricular activities connected to that subject (Kaballa & Crawley, 1985). Second, attitudes toward science are highly correlated to a student's achievement in that subject. Students with positive attitudes toward science tend to have higher scores on achievement measures (Oliver & Simpson, 1988; Weinburgh, 1994). Third, nationwide attitude surveys indicate that, by third grade, fifty percent of students are not interested in science, with females showing a particular decline in scientific interest (AAUW, 1992). Kahle and Lakes (1983) suggested that female disinterest begins in elementary school; the Sadkers (1986) reported that gender differences are more pronounced in middle school; while Weinburgh (1994) stated that they continue into high school and beyond. In a study of children in ten countries, Kotte (1992) reported that differences in males' and females' attitudes toward science widen as student move from elementary to secondary school. Last, the middle school years are a time when gender differences in achievement and attitudes typically widen, with the sharpest increase in differences between the ages of 10 and 14 (Jones, 2000; Kotte, 1992). Based on this evidence, one can conclude that the problem of gender differences in attitudes toward science (and, thus, achievement) is a pervasive issue in the field of education that needs to be addressed.

The potential significance of this study would be to highlight a link between a child's prior experiences in science and his/her attitudes towards science. If there is a strong link between the two, it might suggest that in order to improve scientific literacy it may be necessary to help students obtain some rich background experiences in the field of science. This is particularly true for students who may be on the lower end of the socio-economic scale. Another potential finding might be a correlational link between a student's perception of teacher support and his attitudes in the classroom. Unlike prior experiences, teacher-student interactions and relationships can be controlled in the classroom.

Useful Definitions

Attitudes: The specific attitudes that will be measured are self-confidence in science, general enjoyment of science, the value of science as a course of study, and perceptions of teacher support. The survey was designed with these basic attitudes in mind.

Middle School Student: For the purposes of this study, middle school is defined as grades 6-8. The students are primarily between the ages of 11-14 years. This study will be conducted in a public middle school in the state of Georgia.

Science: In grades 6-8, the public school science curriculum is based on the Georgia Performance Standards, which can be found on the Georgia Department of Education website (www.gadoe.org). In general, 6th grade students study Earth Science, 7th grade students study Life Science, and 8th grade students study Physical Science and Chemistry. The structure of the majority of science classrooms at the proposed data collection site include direct instruction, student-directed activities, labs (both teacher-led and student-led), and individual and common assessments. Many of the students also participate in the annual school science fair (with qualifying students competing at the regional and state levels). Science is one of the primary focuses of the school.

Discrepancy: This is described as the degree to which there is a difference in the response ratings of students taking the survey – analysis will be done by gender, grade level, race/ethnicity, SES, gifted vs nongifted. The researcher hopes to find statistical significance ($p = .05$) in the data analysis within the demographics listed above.

Univariate Analysis: One of the simplest forms of quantitative analysis often described as a single variable with frequency distribution of the respondents who fall within each category. For example, in the proposed study, univariate analysis will be used to determine the percentage of females that make up this study.

Bivariate Analysis: The analysis of two variables simultaneously (X,Y) to look for a relationship between them; it is helpful in testing hypotheses of association and causality. The results are often shown as a scatterplot with a correlation coefficient. In my proposed study, for example, I will be looking for a relationship between background experiences reported and a measure of attitudes toward science.

CHAPTER TWO:

REVIEW OF LITERATURE

In the absence of specific studies which tie together all of the variables under investigation, this literature review pulls information from the salient research from several areas: student attitudes toward science, gender issues related to science instruction and attitudes, age issues related to science instruction and attitudes, and gifted issues related to science instruction and attitudes. Race and socioeconomic status are also addressed within the literature on attitudes, gender, age, and giftedness.

Students' Attitudes in Science Achievement

There are many reasons to take students' attitudes toward science into account when considering science achievement. First, attitudes toward a subject are believed to influence a student's selection of courses in high school and college settings and to influence that person's willingness to become involved in extracurricular activities connected to that subject (Kaballa & Crawley, 1985). Second, attitudes toward science are highly correlated with a student's achievement in that subject (Willson, 1983; Steinkamp & Maehr, 1983). Students with positive attitudes toward science tend to have higher scores on achievement measures (Oliver & Simpson, 1988; Weinburgh, 1994); likewise, students who score highly on achievement measures tend to have more positive attitudes toward science. Third, nationwide attitude surveys indicate that, by third grade, fifty percent of students are not interested in science, with females showing a particular decline in scientific interest (American Association of University Women, 1992). Kahle and Lakes (1983) suggested that female disinterest begins in elementary school; the Sadkers and Sadkers (1986) reported that gender differences are more pronounced in middle school; while Weinburgh (1994) stated that they continue into high school and beyond. In a study of children in ten countries, Kotte (1992) reported that differences in males' and females' attitudes toward science widen as students move from elementary to secondary school. Lastly, the middle school years are a time when gender differences in achievement and attitudes typically widen, with the sharpest increase in differences between the ages of 10 and 14 (Jones, 2000; Kotte, 1992). Based on this evidence, one can conclude that the issues of attitude/achievement and of gender differences in attitudes toward science (and, thus, achievement) is a pervasive issue in the field of education that needs to be addressed.

One empirical study by Weinburgh (1994) is of particular interest. The study took place in a school with similar demographics to my own (for dissertation purposes), it took place in the Southeastern United States, and the survey is very similar to the one constructed for this study (even down to the constructs). Middle school students (n= 1,381) were asked to complete the Attitude Toward Science Inventory: Version A (ATSI) to examine the students' attitudes toward science. The instrument consists of 48 items, to which the students agree or disagree on a 4-point Likert scale. An analysis of data from this study suggested that there are significant differences between males and females in certain constructs of scientific attitudes. Males had an overall more positive attitude toward science than females, and gender influences the student's perception of the teacher and overall enjoyment of the subject. Males were more positive in their enjoyment of science, motivation in science, and self concept of science; females were more positive in their perception of the science teacher and value of science to society. Weinburgh concluded that critical differences did exist between males and females, and that these differences might suggest that males would be more likely to continue scientific education than females. This informed this study by providing a framework for the construction of the survey used in this study.

Gender and Background Experiences/Attitudes in Science

In 1992, the American Association of University Women (AAUW) released the results of a groundbreaking two-year study of the schooling experiences of females from the first days of kindergarten to the end of high school. The report is drawn from over 1,300 empirical studies around the country; the results were disturbing to many in the field of education: specifically, this meta-analysis led to the conclusion that girls were not receiving the same quality (or even quantity) of education as their brothers (AAUW, 1992). The report also revealed the fact that boys are disproportionately overrepresented in special education programs, while girls were sorely underrepresented – leading to questions concerning the identification process and whether or not girls were being overlooked simply because of their ability to mask learning disabilities or because many have a quiet nature and do not stand out in the classroom. On the other end of the spectrum, girls and boys are about equally represented in elementary gifted programs, but as students progress into middle and high school, boys start to outnumber girls in higher level math and the "hard sciences" (such as chemistry and physics). Once they are enrolled in college, very few females (compared to males) choose to major in fields related to science, math, or technology. Twenty years later, this trend remains the same.

One trend that has changed course in the last two decades is the achievement gap that was noted between boys and girls in all academic areas. For many years, it was noted that males perform better than females on achievement tests in math and science; females outperformed males in the areas of reading and verbal ability. More recently, that achievement gap has been closing (and has, in some cases, reversed!). Unfortunately, female advances in achievement have not translated into large numbers of women entering high (elite) levels in the fields of arts, sciences, politics, and eminent positions (Noble, Subotnik, & Arnold, 1999). Rena Subotnik, director of the Center for Gifted Education Policy in Washington, D.C., conducted a longitudinal study of Westinghouse Science Talent Search winners. Building upon Terman's work, one of her goals was to study eminence in women; she concluded that IQ is not a great predictor of eminence or creative productivity. So what does determine what "giftedness" means to adults?

As a group, women are relatively new to many high-powered positions that were not available to them a few decades ago; this has led to conflict between the perceived stereotypical roles of women as nurturers and caregivers and that of successful career women. Many high-achieving gifted women have reported being criticized for taking on traditional male roles (being too "driven"); as a result, many gifted women feel embarrassed and try to hide their intelligence.

Developing Science Orientation: Early Childhood (birth to age 10)

From birth, girls and boys tend to develop at different rates, some skills appearing before others in each gender. Some girls tend to have earlier speech development leading to earlier talking (or having a stronger usable vocabulary than boys of the same age). Despite a parent's best intentions to raise their children “equally,” some skills are just hardwired differently. Because gifted females are more likely to show developmental intellectual advancement earlier than gifted boys (Kerr, 1991), they are more likely to be ready for formal schooling earlier than gifted boys. Girls enter kindergarten with a small advantage in reading skills and fine and gross motor skills; girls are more likely to recognize basic colors, show signs of beginning reading, and write their own name. The gaps between girls and boys are equal to or larger than the gaps favoring white students over ethnic minorities (Salomone, 2003). According to some researchers (Silverman, 1986; Callahan, 1979), identification procedures for giftedness should begin earlier with gifted girls than with gifted boys. In elementary school, gifted girls appear to be highly competent with a more positive perception of academic ability than gifted boys or nongifted peers (Li, 1988; Badolato, 1998). Gifted girls often make better grades and have higher achievement test scores than gifted boys (Kerr, 1991). Gifted elementary girls are often praised for their precociousness, and they often enjoy being the “smart one” in the classroom. Often finishing their work early (and accurately), they sometimes become the “teacher’s helper,” and often help peer tutor other children who may need help. At this age, gifted girls are more similar to gifted boys than average girls in their interests, attitudes, and aspirations (Kerr, 1991). Gifted elementary girls are brimming with self-esteem!

This all begins to change as students enter early adolescence (middle school). By the age of eleven, many gifted girls begin to realize the negative aspects of that gifted title that gave them such prestige in elementary school.

Science Expression: Adolescence

By the time a young gifted girl enters middle school, she begins to realize that it is no longer socially acceptable to be smart; so she begins to hide or downplay her intelligence and abilities so that she can conform to the standards and fit in with her peer group (Kline & Short, 1991). That once precocious young girl is now called “obnoxious” by her friends and even her teachers (Reis, 1987; Badolato, 1998). Research has shown that teacher treatment of gifted males and gifted females differs significantly. Studies by Sadker and Sadker (1984) showed that boys often receive more attention and better instruction; girls are praised for being quiet and cooperative. A teacher may spend more time eliciting a correct answer from a boy, but more quickly just "give" the right answer to a girl. It is very likely that girls and boys within the same classroom receive a very different education (Sadker & Sadker, 1984). Parental expectations for behavior may also impact a female's learning potential. Many young girls are told to mind their manners and act ladylike (which may include being quiet and submissive to authority); however, in order to grow into successful women, smart girls need to "challenge convention, question authority, and speak out about things that need change" (Reis, 2002). This is often in direct controversy to what they are being taught at home (or within their culture).

For many middle school students (gifted and non-gifted alike), the social aspects of school override the academic aspects. Studies have shown that peers of both sexes tend to reject girls who appear to be too smart (Noble, 1989; Badolato, 1998). In order to keep and maintain their social status, gifted girls are willing to hide their intelligence to fit in. This may include low class participation, intentional neglect of work, and increasing social interaction both within and outside the classroom. Physical appearance becomes valued rather than abilities, and gifted girls begin to abandon their aspirations and adapt to traditional feminine roles (Wells, 1985; Badolato, 1998). Researcher Julianne Ryan (1999) relates this to a form of social suicide….killing off the true self and replacing it with a more socially acceptable self. Gifted adolescent females often feel the need to choose between achievement and physical attractiveness (Kerr, Silverman, Ryan, 1999). The two realms do not coexist peacefully. Interestingly, this does not appear to be the case for gifted males, particularly if the intellectual giftedness is paired with another gift (such as athletic ability or musical ability). While boys are likely to see the social advantages of giftedness, girls see far fewer advantages (Kerr, Colangelo, Gaith, 1988).

Another definite shift that has been documented by numerous studies is the decline in self-esteem and confidence experienced by many gifted females as they transition through early adolescence and into the early adult years (Kline & Short, 1991). One study by Kline and Short (1991), examined the patterns of social and emotional change that occur during the school-age (K-12) development of gifted females. Eighty-nine gifted females ranging from 1st-12th grades were administered a 138-item questionnaire, which had items related to themes of school adjustment, interests and activities, family and adult connections, social and leadership issues, planning and goals, thinking styles, and feelings. An analysis of the data gathered revealed that the self-perceived abilities and confidence for girls clearly declined from elementary/primary, through junior high, and further declined through senior high school (Kline & Short, 1991). Interestingly, levels of perfectionism increased and actually became more acute over these years.

Another study by Klein and Zehms (1996), documented the same downward shift in the self-concept of gifted girls in grades 3, 5, and 8. The study examined the self-concept scores of 134 female subjects who were administered the Piers-Harris Self-Concept Scale (an 80 item self-report questionnaire). The results of the girls' responses in each of the three grades were compared. An analysis showed a definite decline between the 3rd and 5th graders; the biggest decline was shown between the 3rd and 8th graders, showing a definite downward shift over time.

By the end of middle school, not only are girls outnumbered by boys in their gifted classrooms, but standardized test scores of gifted females drop below those of their gifted male counterparts. The female academic advantage from elementary school takes a definite negative shift during middle school and follows them right into high school. By middle school, studies show that girls' IQ scores drop and their math and science scores plummet (Pipher, 1994). By the end of high school, males outperform females on the ACT in every area except English (Kerr, 1991). Researchers have looked at the possible causes of this. Aside from the academic/social shift that occurs in middle school, some researchers believe it might be attributed to the fact that girls take fewer advanced courses in high school that might prepare them for college tests (Kerr, 1991).

External Barriers to Science Achievement for Gifted Females

There are many external barriers to achievement that are specific to gifted females: family expectations, cultural expectations, school/teacher expectations, peer group expectations, and the influence of the media.

A child's family (both in the home and extended) and culture have the most significant impact on the values and goals that a child possesses (Rakow, 2005). From day one, girls and boys are often treated differently by their parents and caregivers. Studies have been conducted on the handling of infants/toddlers; one such study (Jacklin, 1989) showed that parents responded to the cries of newborn girls much more quickly than they did to newborn boys, they allowed much more aggressive behavior from toddler boys, and they were much more likely to help young girls with a frustrating task (while allowing the boys to work out the problem). One trip through a toy store will impress a person with how gender-specific toys have become; one can't miss the all-pink girls' aisles and the blues/grays of the boys' aisles. While some toys are created for both genders (such as bikes, games, etc.), it depends upon the family's choice of such items and whether or not they purchase them for their child's use. By the time children reach second grade, sex-role stereotyping is engrained (Rakow, 2005).

Aside from basic gender stereotyping, the socio-economic status of the family can also have an influence. Several years ago, there was a young gifted Hispanic girl in my gifted science class. In class, Rachel did beautiful work; outside of class, her homework and study habits were scattered at best. She struggled to maintain passing grades, so I set up a conference with her mother. As it turned out, Rachel's mom and dad both worked multiple jobs to make ends meet; Rachel was needed at home to help care for her younger brothers and sisters in the afternoon – often cooking dinner and putting the younger ones to bed. This left her little time for studying or doing homework in the evening. So Rachel and I had to find a way to modify her assignments so that she could be successful in the classroom while she helped out at home in the afternoons. Rachel is but one example of many that I have taught over the years, and this phenomenon is not specific to the Hispanic population. As the American economy has fluctuated within the last decade, more and more families have been forced to have both parents working outside the home (Rakow, 2005). This issue appears to more closely related to socio-economic status than it does to race. However, familial values and cultural values are often strongly intertwined – each influencing the other. If the cultural norms dictate that young girls are to be quiet and subservient (ladylike), this expectation trickles down to the family. Parents may encourage their daughters to be polite and helpful. Wanting them to fit in to the society at large, they may inadvertently put more emphasis on social aspects than academic ones, particularly if advanced education (college and beyond) is not anticipated for the child.

Teacher and school expectations can also present an external barrier. Repeated studies have shown that boys are much more vocal in the classroom, are called on more often, and receive much more detailed responses than girls do (Sadker & Sadker, 1986,1994). This has been documented from kindergarten through college (Bernard, 1976; Sandler, 1984). While teachers may not intentionally do so, they often attribute boys' success to natural ability and girls' success to either hard work or luck. Therefore, girls do not necessarily associate their good grades with true ability. Furthermore, as they get older, teachers are less likely to appreciate the girls' gifts and talents; rather, the girls are seen as bossy and obnoxious. Further studies have indicated that attitudes of educators towards gifted and creative females were found to inhibit risk-taking and stifle creativity (Leukhardt, 1981; Kurtzman, 1967).

As a young girl approaches adolescence, her peer group becomes increasingly important. By age 14, most teenagers rank their peer group (friends) above their families in their ability to influence choices and interests (Buescher, 1985). As the middle school girl searches for her identity, she often discovers that her friends (and boys in particular) may not appreciate high intellectual ability or creativity in science. She begins receiving mixed messages about popularity and intelligence; in order to become more popular, many gifted girls decide to downplay their intelligence to "fit in" with the norm. Another tactic used by middle school girls is diversion of attention away from intelligence by becoming involved in extra-curricular activities such as sports or clubs. By high school, gifted girls often feel the need to choose between intelligence and popularity – as they become young adults, the choice becomes between career and family. Referred to as "Sophie's Choice," many young women have trouble meshing the demands of a career path and the need to settle down and start a family (Kerr, 1988; Badalato, 1998; Silverman, 1994). By adulthood, it is likely that the majority of gifted and talented women will settle for far less than their potential (Noble, 1987).

Lastly, the media can also become a strong barrier to science achievement as young girls try to measure up to what the media (television, magazines, etc.) proposes is the norm for feminine beauty and acceptance. For example, many young females on television programs aimed at teens are portrayed as pretty, yet gullible and unintelligent. The plot of the programs often revolve around their relations with friends, how to get the perfect boyfriend, or resolving of social issues particularly pertinent to teenagers. Rarely do the issues of intellect or college goals surface. Magazines aimed at teenagers are just as guilty. Nearly all of the articles and advertisements are aimed at making the young female more beautiful and attractive to the opposite sex or involve self-help guides for friendship issues. Very few (if any) magazines devote space for intellectually stimulating discussions on how to choose the right college or tips on how to be a successful student. Part of this is due to the cultural society at large; magazine companies will print what the readers want to read. If society sends the message that females are appreciated for their beauty (rather than their intellect), then that is what the readers will want to read about. Media role models also follow these gender-specific lines. The majority of politicians and leading experts that are seen in the media are male; the majority of popular female icons are beautiful. There is some crossover, but it is minimal; this may be why female politicians stand out so much – they are a rarity!

Internal Barriers to Science Achievement for Females

There are also many internal barriers to achievement for gifted females: self-esteem levels, effects of attribution theory, and academic achievement/motivation. One of the most well-documented internal barriers for gifted females in science is the drop in self-esteem that occurs at the onset of puberty and continues throughout high school and beyond (American Association of University Women, 1991; Klein & Zehms, 1996; Rakow, 2005). Self-esteem in males develops far differently than it does in females (Badalato, 1998). Females in general start the onset of puberty earlier than boys do. As middle school girls' bodies are changing physically, they are also trying to find their niche socially (while at the same time keep up with their schoolwork). It is no surprise that gifted adolescent females experience dips and drops in self-esteem. Leigh Badalato's work with gifted teens and young adults led to the discovery of four main themes that tend to dominate the gifted female's sense of self-esteem: relationships, maturation, feminine ideals, and nurturing. For many females, identity rests upon their relationships with others. For example, a child may be referred to as Mrs. Smith's daughter; when she gets married, she may be called Mr. Jones's wife; when she has children, she is known as John and Mary's mother. In doing so, she allows "others" to define who she is. This causes dips in self-esteem throughout the span of her life.

As gifted females mature, they must realign their values and change their life direction (Badalato, 1998). Very young gifted girls show aspirations to become doctors, lawyers, or astronauts to the same degree that young gifted boys do. However, as they mature, they begin to realize that becoming a doctor, lawyer, or astronaut will likely mean that they will have to give up (or at least put off) getting married and starting a family. By the time they reach college, many gifted women decide to settle for careers that will allow them to have time for a family as well (such as teaching). A third theme that emerged is the very difficult task of meshing the idea of a strong, positive female with being caring and nurturing. Strong assertive males are seen as powerful leaders; strong assertive females are often perceived as "bitchy, unfeminine, and uncaring" (Badalato, 1998). This is true even in science fields that are dominated by women, such as nursing. To be nurturing may mean to be less powerful; in many societies, women's roles include that of nurturer, making it harder for women to climb into positions of power. The final theme affecting self-esteem is that females are challenged to include themselves as objects of their own nurturing; for some women, caring for everyone else forces them to neglect their own needs.

Attribution theory refers to forces a person attributes to his successes and failures (Eberly, M.; Holley, E.; Johnson, M.; Mitchell, T., 2011). The attributional differences between gifted girls and gifted boys have a huge impact on their success in the classroom and their attainment of knowledge. When asked, many gifted boys attribute their success to just "being good at it." He does well in science because he is just good at it innately. Gifted girls, on the other hand, often attribute success to hard work or luck. If she does not do well on a science test, she just did not study hard enough (or she was unlucky in the questions that were asked). This leads many middle school girls to doubt her own abilities, particularly as the content she is studying becomes more complex. Self-doubt often leads to less class participation, which leads to less understanding and lower grades; thus begins the downward spiral! Matina Horner (1972) discovered an interesting phenomenon during her study of achievement and motivation among the highly gifted. She observed that females (even extremely gifted females) characteristically under-achieve when competing against males, particularly if friendship or intimacy is at stake. Females would rather lose and remain friends with someone than to win and risk losing the friendship. Even as early as the 1940's, Terman's follow-up work with highly gifted young people led him to state that gifted girls and women have an even stronger desire to please others than average girls and women do (Terman, 1947), suggesting that gifted women likely underachieve in vastly greater numbers than women in the average population. This phenomenon has since become called the "Horner Effect," and may explain why some females are not as academically competitive as their male counterparts.

Race, SES, and Science Education

Much research in the past few decades has been devoted to the achievement gap that exists between African-American students and students of other ethnicities, particularly in the fields of math and science (Ferguson, 2007; Haycock, 2001; Jones, 1984; Burton & Jones, 1982; Murphy, 2009). One theme that is consistently found is that the achievement gap, while closing in some areas, is still present in today's schools (Emdin, 2011); furthermore, Emdin also argued that simply holding a teaching certification in the field of science is not enough to help students achieve. Pertinent to this study, he asserted that being able to connect with students (both culturally and intellectually) was vital to student achievement (Edmin, 2011; Fusco, 2001; Lee & Fradd, 1998).

An achievement gap also exists between Hispanic students and students of other ethnicities (Gasparro & Johnson, 2006). Not only is poverty an issue for many Hispanic children, but a certain language barrier exists as well. 2006 census data showed that the poverty level for the Hispanic population (20.6%) was nearly double that of the U.S. average of 9.8% (Gasparro & Johnson). Poverty coupled with poor attendance rates (due to migratory patterns of employment) and often language barriers presents a challenging situation in the best of conditions; the outlook for Hispanic students in poorly funded schools is even bleaker. One recent research study (Goldberg, Enyedy, Welsh, & Galiani, 2009) emphasized how effective teaching science to these children partly in their native language is when trying to close this gap.

In the early 1990's, the term "pedagogy of poverty" was coined to describe the teacher-directed (passive student) scenario that many low-income and minority students are exposed to in science education (Haberman, 1991). The teaching methods in these classrooms are limited to textbook, worksheets, and very basic instruction delivered by the teacher; specifically excluded are student interaction in group problem solving and opportunities to apply learned material. In short, the learning expectations are extremely low for these students. Despite several decades of noting the positive effects of "hands-on" and inquiry science, many poor and minority students are still being handed worksheets to complete in their science classrooms (Barton, 2001; Kozol, 2005). It is no wonder that we are still seeing an achievement gap!

Summary

How students develop science attitudes from early childhood through adolescence can explain the degree to which they enjoy science and find it useful in their daily lives. External and internal barriers also inform their science attitudes, perceptions of teacher support, and science attitudes. This review of literature informed this study by encouraging exploration of middle school students' attitudes toward science and examining their perceptions in relation to demographic variables.

CHAPTER THREE:

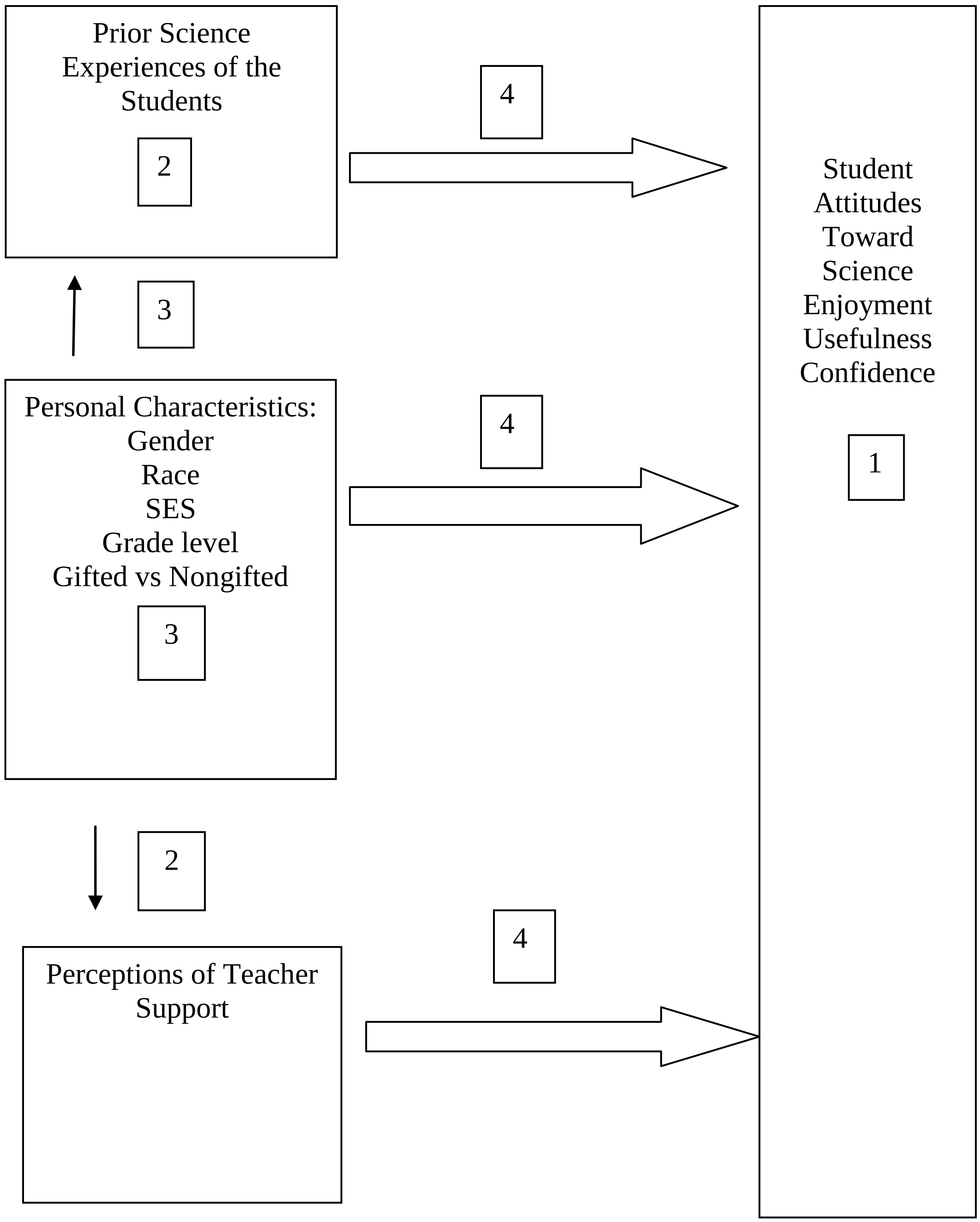
RESEARCH DESIGN AND METHODOLOGY

This chapter describes the methods used to obtain data to answer the study's research questions. The overarching purpose of this study is to determine whether or not there is a relationship between an adolescent's background experiences (including perceptions of teacher support) in the field of science and his attitudes toward the study of science. Within this context, the data will be analyzed by looking at differences in data responses by gender, giftedness (vs. non-identified or non-gifted adolescents), grade level, race, and socio-economic status (SES). There are four main questions driving the research in this study (illustrated in Figure 3.1):

> **Question 1**) What are middle school students' attitudes toward science, specifically related to enjoyment, perceived usefulness, and confidence in the science classroom?
>
> **Question 2**) What are middle school students' perceptions of science teacher support and reported levels of prior experiences in the field of science?
>
> **Question 3**) To what extent do personal characteristics (i.e. gender, race, grade level, socio-economic status, and gifted versus non-gifted status) explain observed variance in student perception of teacher support and science experiences?
>
> **Question 4)** To what extent do personal characteristics (e.g. race, gender, SES, grade level, and gifted status), levels of teacher support, and reported prior science experiences explain variance in students' attitudes toward science?

This chapter is organized into seven sections describing the study's conceptual framework, instrumentation, study population, data collection, data preparation, data analysis, and limitations.

Figure 3.1. Research Design



NOTE: The numbers used correspond to the specific research questions.

Conceptual Framework

The conceptual framework which guides this dissertation seeks to understand how out-of-school engagement with science practices (prior science experiences) and students' perceptions of their science teachers' support influences their attitudes toward science as a field of study. I developed a conceptual framework (see Figure 3.1) that brings together three related constructs. The framework includes: (1) students' perceptions of teacher support, (2) students' reported background (prior) experiences in science, and (3) students' attitudes toward science related to enjoyment of the subject, perceived usefulness of the subject, and confidence in skills needed to succeed in the subject. The attitude constructs were pulled from a similar study by Andrea Weinberg in 2008-09, in which middle school students were administered the *Science and Mathematics Student Motivation Assessment (SMSMA)* during a summer science and math enrichment camp. This survey instrument included five constructs with alphas ranging from .84 to .96 (two of the five constructs were enjoyment of science and usefulness of science). Each of the three main concepts is described below, followed by a discussion of how the concepts shape and change each other over time as they form a coherent framework for data collection and analysis.

A student's perception of teacher support refers to the extent to which the student feels like his teacher supports his learning environment and academic pursuits in the field of science. A qualitative study by Eliott and Page (2010), sought to understand why students enter high school with such low confidence in science, and some of the findings related to their middle school years are indeed relevant to this study. In short, the subjects indicated that their relationship with their teacher was extremely influential in determining their interest and confidence in science: "The characteristics that students said made a good Science teacher were related to their relationship with the teacher. Students want a teacher who is helpful, whom they feel comfortable to approach, who can explain science well and in different ways, and who has a sense of humour (sic) (Eliott & Page, 2010)."

Students' reported background experiences in science refer to the amount of exposure to science-related activities that the subjects had encountered outside of school (such as at home or at camps). Research has established that students who have extensive home based experiences in a field of study have increased confidence in those fields (Ochs/Taylor, 1992; Moll/Amanti/Neff/Gonzalez, 1992/2005; Brickhouse/Lowery/Schultz, 2000). Whether or not increased confidence also leads to more positive attitudes was one of the primary questions of this research study. If more experiences leads to better attitudes, then this has important implications for classroom science teachers.

Students' attitudes toward science is the major focus of this research study. It is theorized by the researcher that a student's attitude (whether positive or negative) toward a field of study has a strong influence on how much effort is put forth to learn material, how much a student achieves, and how likely that student is to go on to a career in that field of study. Currently in the United States, there is a shortage of students entering the STEM fields (Science, Technology, Engineering, Math) at the college level (and even fewer who end of graduating and pursuing careers in those fields. This study seeks to make a connection between a student's perceptions of his teacher, his prior experiences in science, and his attitudes towards science. The logic being that if positive attitudes in science lead to increased participation both at the secondary and collegiate levels, then possibly prior experiences and perceptions of teacher support are important aspects of science education that *can* be controlled in the classroom (when so many other variables cannot).

Table 3.1. Construct Definitions

Definition of Attitude Constructs, Teacher Support, and Prior Science Experience	
Construct Name	Operational Definition
Enjoyment of Science	To what extent does the subject receive internal satisfaction from his participation in science activities
Usefulness of Science	To what extent does the subject find that the knowledge learned in science is valuable both currently and for future pursuits
Confidence in Science	To what extent does the subject feel comfortable with his/her science abilities
Perception of Teacher Support	To what extent does the subject feel that his teacher supports his learning environment (as well as the learning environment in the classroom as a whole)
Prior Science Experience	To what extent has the subject interacted with science activities outside of a school setting

The five constructs above were analyzed independently, and the top three (enjoyment, usefulness, and confidence) were also analyzed as a whole "attitude" score. The reason that perception of teacher support was omitted from the whole "attitude" score was that, unlike the other three constructs, teacher support was very much tied to the current school year. The other four constructs represent the accumulation of attitudes over the lifetimes of the subjects. Therefore, I decided to analyze perceptions of teacher support separately from the other three constructs, and then to look for relationships between teacher perception and the other attitude scores.

Table 3.2

Definitions of Independent Variables

Variable	Operational Definition
Gender	Demographic data was collected on each of the subjects in the study. In the last section of the survey, students were asked to pick "male" or "female" for their gender.
Race	In the survey, subjects were asked to self-report their race/ethnicity in an open-ended question format. In analysis, only "White" and "Black" responses were analyzed due to the low numbers of respondents from any other races/ethnicities.
SES	Subjects were asked to respond to a question concerning free and reduced lunch. Free and reduced lunch status was chosen to represent SES because it is based on the family's income, and it was felt that this is the only question regarding SES that a young student might be able to validly answer.
Grade Level	Subjects were asked to choose whether they were enrolled in 6^{th} grade, 7^{th} grade, or 8^{th} grade within the demographic portion of the survey.
Gifted Status	In the state of Georgia, a student qualifies for gifted services if he meets several criteria: mental abilities score of at least 96%ile, achievement test score of at least 90%ile, creativity assessment score of at least 90%, and motivation score at 90%ile

Table 3.2

Definitions of Independent Variables (continued)

Variable	Operational Definition
	or top 10% of GPA for that grade level (SBOE 160-4-2-.38) . A student can qualify in one of two ways: 1) meeting the mental abilities and achievement scores only, OR 2) meeting the requirements of any three of the four areas listed above. In this survey, students were asked a yes/no question about whether or not they were currently enrolled in any Quest (gifted) or Honor's Level courses.

Of the five independent variables listed above, gender, giftedness, and grade level were the primary focus of the research. During the survey, demographic data on each subject's race/ethnicity and socioeconomic status (SES) was also gathered. This information, while not the primary focus, did allow for additional analysis of the data and opened up possible avenues for future research (see discussion Chapter 5).

Instrumentation

In order to gather data, a researcher-designed instrument (Appendix A) was developed for the purpose of measuring both students' science attitudes and students' prior science experiences. There are three sections to the survey: attitudes (including perceptions of teacher support), prior science experiences, and some open-ended questions that encompass both attitudes and background demographics. The attitudes section was designed with three major themes in mind:

1) Enjoyment of science as a discipline
2) Confidence in scientific ability
3) Usefulness of science as a course of study

Table 3.3 below and on the next page shows each theme and the statements from the survey that are directly related :

Table 3.3 . Final Items for Survey by Strand

Subscale		
Enjoyment		
	E1	I like learning new things about science.
	E5	I like learning about science even when I am not at school.
	E11	I like watching science shows and videos.
	E13	I like reading about or watching news stories related to science.
	E14	I enjoy doing science experiments.
	E17	I really enjoy my science class this year.
	*E20(rev)	I think that my science class this year is boring.
Usefulness		
	U2	I think that science will be useful to me when I am an adult.
	U4	I think that science is important in everyday life.
	U9	I think that science may help me get ahead in life.
	U12	I think that science is useful in solving problems.
	U18	I believe that I will need science for my future career or job.
	U21	I think that what I learn in science will be useful in college.
	*U19 rev	My science class this year is a waste of time.
	*U6 rev	I think that learning about science is a waste of time.
Self-Confidence		
	C3	I am good at doing science labs.
	C8	I can make good grades in science.
	C10	I am better at science than many students in my class.
	C15	I see myself as a science person.
	C16	Others see me as a science person.
	C22	I am certain that I can understand the most difficult material in my text.
	C23	I am confident that I can do an excellent job on science assignments.
	C26	I often raise my hand to participate in discussions or answer questions.
	*C7 rev	I am not very good at science.

*These items were written as reverse items/scores were reversed in analysis.

Part two of the survey consists of questions directly related to prior experiences in science. Some of them are general questions that apply across all fields of science; some of the questions directly tie to either earth, life, or physical science (these three were chosen because they encompass the middle school curriculum). Many of the questions required a frequency response (Never, Once, 2-3 Times, 4 or more Times); a portion of the questions were dichotomous responses (yes or no). Table 3.4 on the next page lists all of the questions related to background experiences (listed by frequency and then by dichotomous response).

Table 3.4. Final List of Prior Experiences Appearing on Survey

	Survey Question
By Frequency	
B34	Not including field trips, I have visited a science museum or aquarium…
B35	Outside of school, I have taken apart or fixed something electronic…
B36	I have spent time watching and identifying birds…
B37	Outside of school, I have built and/or launched a model rocket…
B38	I have used a telescope or star map to observe stars and constellations…
B39	Outside of school, I have designed a computer game…
B40	Outside of school, I have studied nature (such as on a walk through the woods or on the beach)…
B41	I have rescued an injured animal and helped it to get well…
B42	Outside of school, I have built an electric circuit…
B43	Outside of school, I have used a microscope…
B44	I have been inside of a cave…
B45	I have mixed household chemicals together to watch the reaction…
B46	Outside of school, I have used tools and measuring instruments to build something…
B47	I have planted or helped take care of a garden (vegetable or flower)…
B48	Outside of school, I have built a model (such as a volcano or solar system)…
B49	Not including field trips, I have been to a zoo…
Dichotomous Response	
B50	I have participated in 4H or a scout program (Girl Scouts or Boy Scouts)…
B51	I often read nutrition labels on food to see what it contains…
B52	I have collected natural objects (such as rocks, shells, or butterflies)…
B53	I have owned or cared for a pet (this includes family pets)…
B54	In the future, I would consider a career in science or technology…
B55	I often look at the weather forecast for the day or week…

The last section (part three) consists of demographic and open-ended questions, which concern single-gender science groupings and the benefits/drawbacks of such an arrangement. A small portion of students at this site (8.2 %) have been enrolled in a single-gender science class for at least one of their middle school years. The population size was too small to include in analysis, but may be used as a springboard for future research. Demographic questions included gender, race, socio-economic status, gifted course enrollment, and grade level.

Instrument Development

The survey to be used in this study was developed by the researcher over a period of two years. The initial survey (which consisted of the science attitude section only) was designed and piloted in the spring of 2009 with a group of sixth grade students (n=60). The initial survey was a paper-pencil survey. The data was entered into Excel and loaded into an SPSS program. Early SPSS analysis showed that the reliability of many of the items was strong, but that the connection between the items (and how they lined up with the attitudes to be assessed) had some flaws. The survey underwent major reconstruction at this point. The major attitudes were defined and utilized as a springboard for rewriting the questions to be used on the survey. At this point, there were five attitude strands (the first four listed in Table 3.1 and adding beliefs about gender in science). At this time, no questions existed in the survey concerning perceptions of teacher support. Five questions were written for each attitude (giving the survey 25 questions total). Some of the questions were written as reverse items, and the questions were arranged in a random order. The responses included a Likert scale (1-5; 1= strongly disagree; 5= strongly agree).

At this point, the survey went through an extensive review process to help establish validity. In the early stages of this process, several peer teachers critiqued the survey for construct validity. The survey questions were cut apart and headings were made for each of the five attitudes. These teachers were given the five attitudes and asked to place each question under the appropriate "attitude" heading. Twenty-three of the twenty-five questions fit neatly within the attitude categories; two of the questions were problematic. The teachers felt that they could fit in more than one category. These two questions were rewritten before the next stage of the review process. Beliefs about gender and science were removed at this time.

In the next stage of this process, a review panel made up of graduate students, professors, and the researcher (17 people total) spent time picking apart the design and readability of the survey. Due to the fact that children would be taking this survey, much time and effort was spent on making sure that the vocabulary was appropriate and that the format was easy to follow. The number of items was also reduced from 25 to 15. Many words were changed as well as the format of the Likert scale. All reverse items were reworded to be "normal" items. On the Likert scale, it was decided that the numbers should be changed to words; so rather than having the subjects circle "5" for "strongly agree", they now just circle "strongly agree". The review panel felt that children would have an easier time filling out the survey if they did not need to track their eyes to the top to find the key for each number. As a part of this process, several teenaged students looked at the survey to make sure that they understood the questions being asked and the wording of the instrument in general. The rewording for many of these items was pulled from the National Science Survey (US Dept. of Education, 2009) because validity and reliability for this instrument had already been established (seven subscales with alpha scores ranging from .735-.911) . Chart 3.1 shows the original wording of the survey and the modified wording adjusting for middle school level (rather than high school level). The major shift was to convert all of the questions to first person format. In both surveys, the subjects were asked to respond using the same Likert scale (Strongly Disagree, Disagree, Agree, Strongly Agree).

Chart 3.1 Original and Modified Wording from U.S. Department of Ed. Survey

Original Wording from US Dept. of Ed.	Wording as it Appears on the Survey
You see yourself as a science person	I see myself as a science person.
Others see you as a science person	Others see me as a science person.
You are enjoying this class very much	I really enjoy my science class this year.
You think this class is a waste of your time	My science class this year is a waste of time.
You think this class is boring	I think that my science class this year is boring.
How much do you agree or disagree with the following statements about the usefulness of your [fall 2009 science] course? What students learn in this course... is useful for everyday life.	I think that science is useful in solving problems.
will be useful for college.	I think that what I learn in science will be useful in college.
will be useful for a future career.	I believe that I will need science for my future career or job.
You are certain you can understand the most difficult material presented in the textbook used in this course	I am certain that I can understand the most difficult material in the textbook I use in science class this year.
You are confident that you can do an excellent job on assignments in this course	I am confident that I can do an excellent job on assignments in science class this year.
Your science teacher...	My science teacher this year values and listens

values and listens to students' ideas.	to students' ideas.
Your science teacher… treats students with respect.	My science teacher this year treats students with respect.
Your science teacher… treats every student fairly.	My science teacher this year treats every student fairly.
Your science teacher… thinks every student can be successful.	My science teacher this year thinks that every student can be successful.
Your science teacher… thinks mistakes are okay as long as all students learn.	My science teacher this year thinks that mistakes are okay as long as all students learn.
Your science teacher… treats some kids better than other kids.	This year, my science teacher treats some kids better than other kids.
Your science teacher… makes science interesting.	This year, my science teacher makes science interesting.
Your science teacher… treats males and females differently.	This year, my science teacher girls and boys differently.
Your science teacher… makes science easy to understand.	This year, my science teacher makes science easy to understand.

In the next stage, the researcher decided to add a section to the survey that measured a subject's participation in prior science experiences. Many of the items for this section were pulled from existing surveys of student science participation. Some items were added based on the researcher's experiences in the science classroom over the past decade. The goal of this section is to determine whether or not these background experiences have an impact on student attitudes toward science. If a strong positive correlation exists between these two variables, the indication might be that we (as educators) need to help provide enriching background experiences to help children develop a healthy attitude toward science. Once the entire list of 24 items was compiled, it was peer reviewed by an expert panel of ten highly qualified active science teachers ("highly qualified" meaning that they have a degree to teach science and have been teaching middle school science for at least ten years). The expert panel was asked to rate each item in its reliability as an indicator of prior science experience (10 being great; 1 being very poor). At this point, some of the items were removed and replaced by stronger indicators. For example, participation in athletics was removed because the connection was not readily apparent to most of the raters, and participation in 4H/Scout program was added because there is a very active 4H chapter and Boy Scout/Girl Scout program in this community.

This final version with the prior experiences section added was piloted once again with one class of 6th graders, one class of 7th graders, and one class of 8th graders in January of 2012. These students did not participate in the final version of the survey. At the conclusion of the survey, students were asked to circle any words that they found confusing and to make any comments about the structure that they felt needed to be changed. Data gathered from this pilot revealed that the items for each construct were appropriate for measurement and that the layout of the survey was appropriate for data collection with middle school students.

Finalizing the Survey Instrument

Up until this point, the survey existed as a pencil/paper document to be taken in a classroom setting only. It was decided by both the researcher and the committee that children might respond better to an electronic survey than to the simple paper-pencil format. This would allow for two things: one, a better (and hopefully more accurate) response rate, and two, a quicker analysis since the data would already be in an electronic format. The researcher decided to utilize the Survey Monkey program (www.surveymonkey.com) to convert the paper-pencil format to an electronic survey. Students at the University of Georgia have access to this program through the graduate school; so the researcher met with the IT (Instructional Technology) department at the graduate school to gain access codes and instruction on how to use the program. The questions were loaded into Survey Monkey, retaining their original wording from the paper-pencil survey with the exception of a few items which were reversed (see Tables 3.3 and 3.4). These items were reversed because the "forward" version was too wordy and confusing and the researcher felt that they would lead to many invalid responses.

When the survey was completely loaded and ready to administer, the researcher posted it as a link on her ELearn site (ELearn is a program that allows educators to have a web page to post information for students and parents; it is maintained by the county in which the study took place). The research site has several options for electronic administration: a portable wireless laptop cart, a netbook lab, and two computer labs. The researcher experimented with each of the options to see which one would be the most effective means of data collection. The wireless portable laptop cart presented a couple of obstacles – the connections were weak/unstable and there are only about fifteen laptops available at any given time. The wireless netbook lab, while housing a sufficient number of netbooks, presented the problem that simultaneous usage caused the server to bog down taking way too long for the survey to be completed; students lost interest while they were waiting for the next screen to appear. The best option available was the computer labs – one of which is used for daily instruction and the other is able to be reserved by teachers for classes of students in hourly blocks. There were a minimum of 35 computers in each of the labs, and they were hard-wired to the server so the connections were much stronger and more stable. For data collection purposes, both of the hard-wired computer labs were utilized; selection was based on proximity to the subjects being surveyed.

Study Population and Research Site Description

This study was conducted in a suburban public middle school (grades 6-8) on the outskirts of a large city in the southeastern United States. There are 1,040 students currently enrolled in Jones Middle School (name has been changed for confidentiality); 60% are on free and reduced lunch; the ethnic enrollment is 70% Caucasian, 23% African-American, and 7% other. The gifted program at Jones Middle School includes services to 199 students throughout grades 6-8 (of this population, 54% are female and 46% are male; ethnic breakdown closely matches that of the entire school). All students enrolled in the school were invited to complete the survey; the study population was drawn from all of the students who returned the parent consent form for participation (convenience sample).

Of the 1,040 consent forms that were sent home, 814 were returned allowing those students to complete the survey. The students at the research site are quite transient; by the time the final survey was administered in the spring, only 617 of the original 814 students were available to be subjects (a large number had withdrawn and some were simply absent the day of administration). The respondents ranged in age from 11 to 15, with a mean age of 12.78. The respondents were 48.3% male and 51.7% female. The majority of the subjects (68.9%) were not enrolled in a gifted or advanced course; 31.1% reported enrollment in gifted/advanced courses. Of the respondents, 44.4% receive free/reduced lunch, 39.9% did not receive free/reduced lunch, and an additional 15.6% did not know whether they received free/reduced lunch or not. There was a fairly even spread of 6th (38.5%) , 7th (32.8%), and 8th graders (28.7%). The majority of the subjects reported White/Caucasian as their race (57.5%); the next largest population was Black/African-American at 22.0%. Of the remaining respondents, 2.3% were Biracial, 0.2% were Pacific Islander, 0.6% were Asian, and 2.4% were Hispanic (14.9% of the subjects left this question blank).

Table 3.5. Demographics of the Sample Population

Variables	Proportion (%)	Valid N
Grade		
6	38.47	232
7	32.84	198
8	28.69	173
Gender		
Male	48.34	291
Female	51.66	311
SocioEconomic Status		
Free-Reduced Lunch	52.66	267
Non Free-Reduced Lunch	47.34	240
Gifted Status		
Gifted	31.05	186
Non-gifted	68.95	413
*Race		
White	67.76	355
Black	25.68	136

*Race does not include races besides White/Caucasian and Black/African-American. The remaining 6.56% includes subjects of Hispanic, Asian, Pacific Islander, and Biracial origin. The breakdown of these may be found in Appendix F (Sample Population Breakdown).

The researcher has been teaching at the proposed site for fifteen years. This design has some strengths and weaknesses. One strength would be researcher familiarity with the community and school. This is helpful because not only does the researcher understand the protocol of the given school (research site), but there is a sense of trust from parents who will allow their children to be a part of the study (making the data base larger). A weakness of this arrangement is the fact that the researcher knows many of the subjects both in and outside of the school setting. This could potentially lead to bias on the part of the subject responses. In hopes to offset this, the students were administered the survey with their homeroom classes (which are randomly assigned) and a script was written to try to maintain standardized administration of the survey. Students were not offered any type of academic incentive (such as extra credit) to complete the survey. Both parent consent (Appendix D) and minor assent (Appendix E) were obtained from all participants.

Data Collection

In August of 2011, all students enrolled at Jones Middle School took home a copy of the parent consent form (Appendix B) to participate in the science survey during the 2011-2012 school year. This form was sent home strategically on the first day of school in the "first day of school packet" in order to gain the most participation. There are other forms in the packet that need to be filled out and returned; its inclusion in this packet made it much more likely to return. Of the 1,040 sent out, 814 permission forms were returned signed. Due to the nature of some of the survey questions (specific to the 2011-2012 school year), the survey needed to be administered during the second half of the school year. Data collection actually occurred between March-May of 2012. Knowing that the student population is somewhat transient, it was very important to the researcher to obtain as many subjects as possible to account for loss due to student transfer. The researcher's goal was to gather survey data from 750 students (250 from each of the grade levels – 6^{th}, 7^{th}, 8^{th}), being careful to keep the numbers of gifted and special education students consistent for analysis purposes.

The data was collected during morning homeroom (8:40-9:10) to avoid interference with academic instruction. The researcher was present and directed all data collection, which took place in various computer labs across the campus. Locations were chosen based on proximity to the subjects' rooms; all labs are equally equipped with networked computers and contain similar environments (temperature, noise control, ease of access, etc.). Students were given basic oral directions (Appendix D), which were also provided in written format (Appendix E). All subjects individually completed the survey and signed the minor consent form to allow the researcher to utilize the data. The subjects were given candy (mainly Jolly Ranchers and Starburst) in exchange for their participation in this study. The collection of data occurred from February to May of 2012.

Data Preparation

The collected responses from the 617 surveys were exported from SurveyMonkey into an Excel spreadsheet. Initial data cleaning, some re-coding, and an overall assessment of missing data was completed. All of the reverse items were recoded so that they could be compared in the analysis (for example, a "4" response became a "1" response and vice versa, and a "2" became a "3" and vice versa). Questions 50-55 (dichotomous prior science experiences) needed to be recoded to match the data of the other prior experience questions (which were on a 4-point Likert scale); all "yes" answers were coded as "4" and all "no" answers were coded as "1" to be consistent with the "4 plus times" and "never" of the frequency questions. While some data was missing, it was decided that most data sets were complete and no data sets were eliminated from analysis. However, with the exception of question one, every question has a small number of missing values where subjects skipped questions occasionally. This will be discussed further in the missing data section.

The next step was to standardize the data from the open-response items so that they could be entered in to SPSS20. The variable of race was included in this standardization. For the purposes of analysis, "White" and "Caucasian" were included together, "Black" and "African American" were included together, and any response that appeared to be a mixture (such as Black-White, Native American-Black, and Hispanic/White were coded as "Biracial") . Complete data codes for all independent variables may be found in Table 3.6.

After the initial cleanup and coding occurred, the data was imported into SPSS20 so that further preparation could occur. Data fell into one of three categories: nominal, ordinal, or scale. Nominal variables include variables that cannot be intrinsically ranked; for example, in this study, all dichotomous (yes/no) responses fell into this category, as did all demographic information (e.g. race, SES, gifted status). Ordinal variables include variables whose values can be ranked; in this study, most of the responses to the prior experience questions fell into this category. Subjects' responses were ranked from "never" to "four plus times" (number values were assigned to each response), but the distances between the answers were inconsistent. Scale variables are similar to ordinal variables except that the distance between responses is fairly consistent; for example, all of the attitude responses fell into this category because the responses ranged from "strongly disagree" to "strongly agree" (with two choices in between). The decision to keep a neutral response out of the center was intentional; in the original piloted survey, there was a 5-point Likert scale with a neutral middle response choice. The researcher (with committee support) decided to remove the neutral response in efforts to force subjects to choose one direction or the other. The "neutral" response is chosen many times when a subject cannot decide on an answer (or does not understand the question). The resulting survey included a 4-point Likert scale. At the beginning of the analysis, it was necessary to double-check all of the questions in variable view to make sure that they were listed under the appropriate scale. The study methodologist and the researcher then proceeded to create several scales which combined individual variables: *(a) total (sum) enjoyment, (b) total (sum) usefulness, (c) total (sum) confidence, d) total (sum) perceptions of teacher support, (e) total (sum) prior experiences, (f) average enjoyment score, (g) average usefulness score, (h) average confidence score, (i) average perception of teacher support score, (j) total sum of all attitude scales (enjoyment plus usefulness plus confidence), and (k) total average of all attitude scales (enjoyment plus usefulness plus confidence).*

Table 3.6 Data Coding in SPSS

Construct	Codes
Gender	
Male	1
Female	2
Race	
White/Caucasian	0
Black/ African-American	1
Biracial	2
Pacific Islander	3
Asian	4
Hispanic	5
(Nonresponse)	6
Grade Level	
6	1
7	2
8	3
SES (Free/Reduced Lunch)	
Yes (F/R lunch)	1
No (not F/R lunch)	2
Gifted Status	
Yes (Gifted)	1
No (Nongifted)	2

Using the analysis functions of SurveyMonkey and SPSS, the frequencies, means, standard deviations, confidence intervals (95%), and variance were calculated for each question on the survey. This gave the researcher an opportunity to make sure that the answers seemed appropriate for the questions asked; it also gave the researcher a chance to get an overall feel for the results of the survey and to look for outliers. The data for these individual survey questions is reported by strand in Chapter 4. The next step was to calculate the coefficient alpha for each of the constructs to evaluate reliability.

Table 3.7

Distribution and Reliability of Key Measures

Scale	Number of Items	Valid Cases	Missing Cases	Scale Mean	SD	Mean Item Mean	Alpha
Science Attitudes							
Enjoyment	7	600	17	22.13	3.34	3.16	.80
Usefulness	8	600	17	25.38	3.85	3.17	.84
Confidence	9	597	20	25.95	4.34	2.88	.82
Total Science Attitudes	24	590	27	73.45	10.19	3.06	.92
Perc. Teacher Support	7	591	26	23.00	4.04	3.29	.90
Prior Sci. Experiences							
Frequency	16	553	64	34.29	.870	2.14	.84
Dichotomous	6	578	39	18.64	4.14	3.11	.48

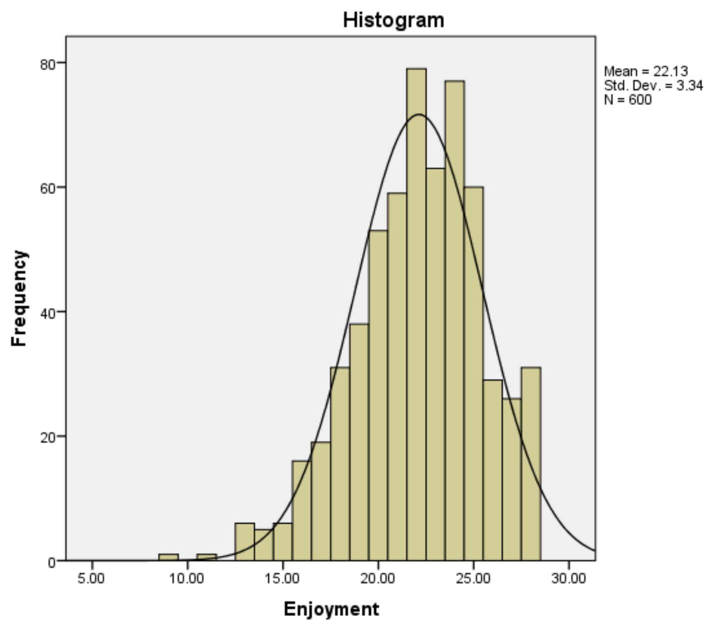


Figure 3.2.
Distribution of Enjoyment of Science Scale

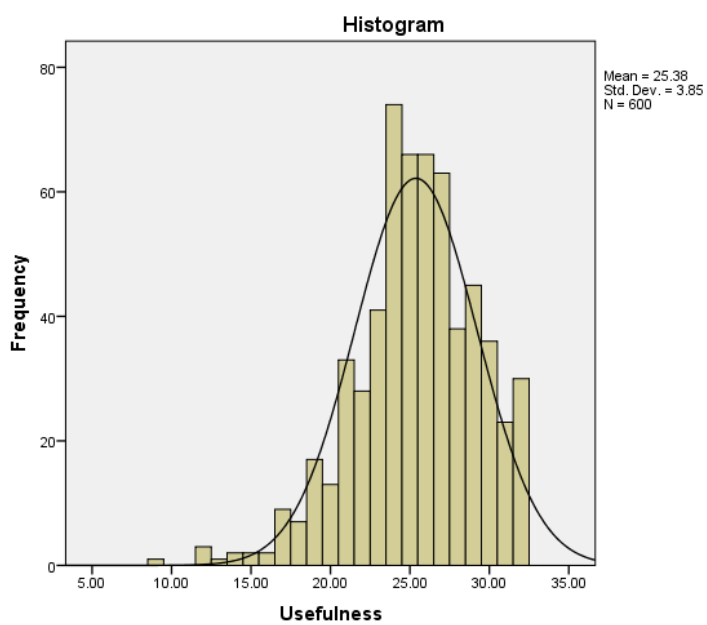


Figure 3.3

Distribution of Usefulness of Science Scale

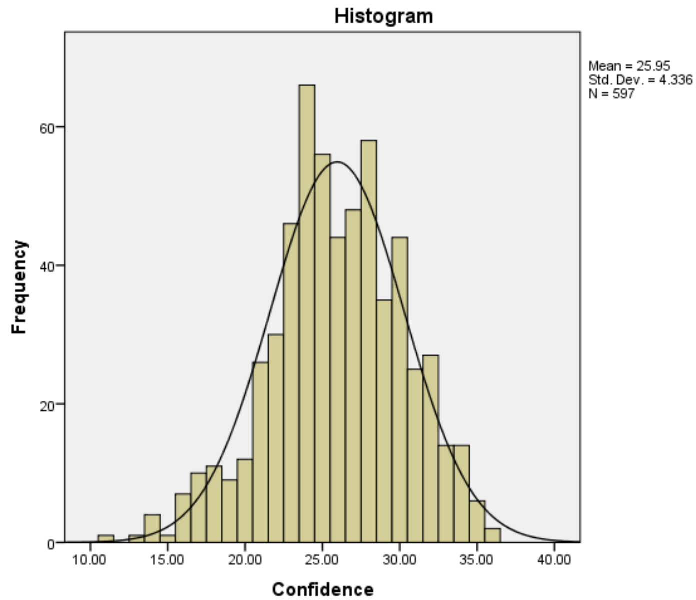


Figure 3.4
Distribution of Confidence in Science Scale

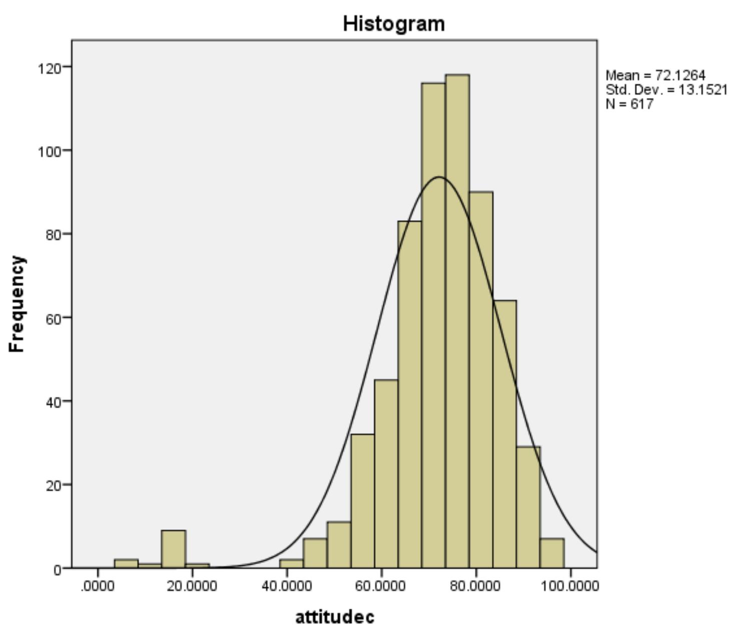


Figure 3.5
Distribution of Overall Science Attitude Scale (Enjoyment+Usefulness+Confidence)

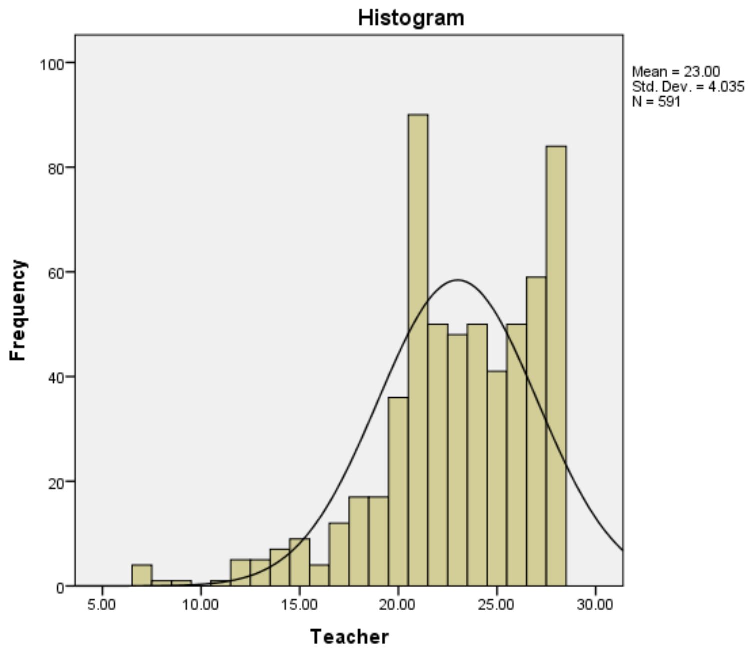


Figure 3.6

Distribution of Perceptions of Teacher Support Scale

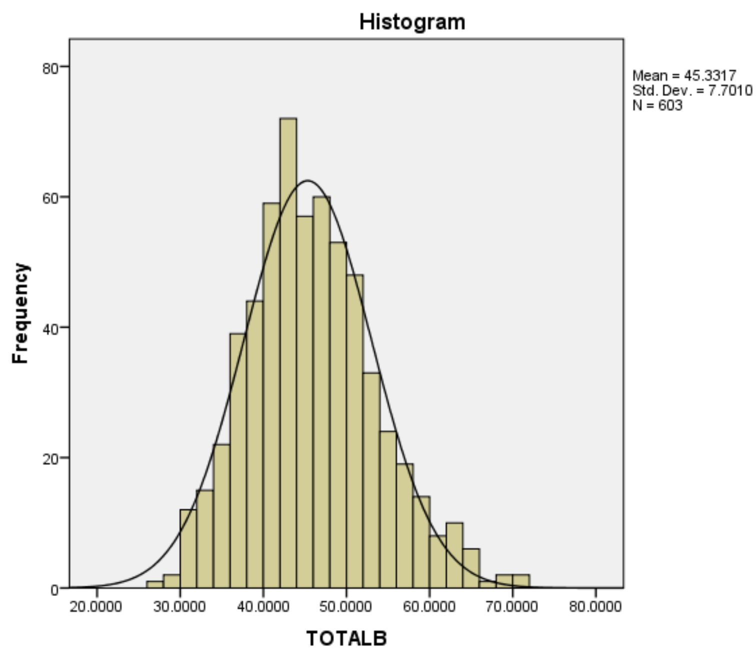


Figure 3.7
Distribution of Prior Science Experiences Scale

The last analysis to be performed in data preparation was to calculate the inter-correlation between each of the three attitude scales: enjoyment, usefulness, and confidence. The correlation coefficient between every scale was significant at the level of .01. Table 3.8 presents the findings.

Table 3.8 Inter-correlations Among Construct Scales

	Enjoyment	Usefulness	Confidence
Enjoyment	1	.724	.656
Usefulness	.724	1	.638
Confidence	.656	.638	1

Data Analysis

Data analysis was performed utilizing SPSS 20.0, available at the University of Georgia and as a downloaded student version (14-day trial version). Some initial analysis was also performed using the filtering and crosstab features of SurveyMonkey (although these were later replicated using SPSS to check for accuracy). Appropriate statistical analyses were chosen to best answer the four research questions in this study. In addition to basic description statistics (means, frequencies, standard deviations), the researcher also utilized bivariate analysis (independent samples T-Test).

Research question #1. What are middle school students' attitudes toward science, specifically related to enjoyment, perceived usefulness, and confidence in the science classroom? This question was addressed by finding the means and standard deviations of all 24 survey questions that were associated with the constructs of enjoyment, usefulness, and confidence in science. These items were then ranked from top to bottom by mean-item-means; this appears in Table 4.1. The scaled means for each subscale (*Usefulness*, *Enjoyment*, *and Confidence*) were also calculated and listed as rank order (Table 4.2).

Research question #2. What are middle school students' perceptions of science teacher support and reported levels of prior experiences in the field of science? This question was addressed by finding the means and standard deviations for each item of the *Perception of Teacher Support* and *Prior Science Experiences* scales. These are listed by rank order in Tables 4.3 and 4.4.

Research question #3. To what extent do personal characteristics (i.e. gender, race, grade level, socio-economic status, and gifted versus non-gifted status) explain observed variance in student perception of teacher support and science experiences? This question was addressed by calculating the scaled means and standard deviations for each item by demographic subgroup (both on the *Perception of Teacher Support* and the *Prior Science Experience* scales). Independent T-tests were performed to check for significance (alpha = .01 level). The results may be found in chapter four.

Research question #4. To what extent do personal characteristics (e.g. race, gender, SES, grade level, and gifted status), levels of teacher support, and reported prior science experiences explain variance in students' attitudes toward science? This question was addressed by the calculation of scaled means and standard deviations by demographic groups for each subscale of *Science Attitudes* as well as *Total Science Attitudes* (summation of *Enjoyment, Usefulness, and Confidence*). Independent T-tests were run to look for statistical significance in all areas with dichotomous variables. Spearman correlations were used in any area that included grade level statistics (ordinal variable). Bivariate correlations among *Science Attitudes, Perceptions of Teacher Support, and Prior Science Experiences* were also performed to look for correlations that might exist among the three main constructs.

CHAPTER FOUR:

FINDINGS

The purpose of this study is to examine middle school students' prior science experiences, their perceptions of teacher support, and their attitudes towards science. This chapter displays the findings of the analyses performed to answer the four research questions that guided this dissertation:

1) What are middle school students' attitudes toward science, specifically related to enjoyment, perceived usefulness, and confidence in the science classroom?

2) What are middle school students' perceptions of science teacher support and reported levels of prior experiences in the field of science?

3) To what extent do personal characteristics (i.e. gender, race, grade level, socio-economic status, and gifted versus non-gifted status) explain observed variance in student perception of teacher support and science experiences?

4) To what extent do personal characteristics (e.g. race, gender, SES, grade level, and gifted status), levels of teacher support, and reported prior science experiences explain variance in students' attitudes toward science?

Research Question 1: Middle School Students' Attitudes Toward Science

The purpose of question one is mainly exploratory in nature. It was the researcher's goal to investigate the attitudes that existed towards science by middle school students. This attitude scale was made up of three subscales: enjoyment of science, perceived usefulness of science as a discipline, and self-confidence in science. Each of the subscales contained 7-9 questions, which were analyzed independently (item analysis) and as a whole strand. An overall "science attitude" score was generated by summing the three subscales (i.e. enjoyment, usefulness, and confidence). Table 4.1 depicts the rank-ordered means of the 24 measured attitudes of science. The item means ranged from 2.25 to 3.61 on a 1(strongly disagree), 2(disagree), 3(agree), and 4(strongly agree) point scale. The frequency table of each item is located in Appendix G.

The highest ranking item was from the *Enjoyment* subscale; it pertains to students' enjoyment of conducting science experiments (M=3.61, SD = .56), indicating that this activity is something that students really enjoy about science. The next two highest ranking items both measured whether students felt that science (and science class) was a waste of time. Both of these were written as reverse items; reverse coding in data preparation revealed that students felt that science in general (mean of 3.45) and science class (mean of 3.54) was not a waste of time. Of the five highest ranking items, three are from the *Usefulness* subscale with means ranging from 3.35 to 3.54. The ten highest ranking items included four of the seven measures of *Enjoyment*, three of the eight measures of *Usefulness*, and three of the nine measures of *Confidence*.

Of the five lowest ranking items, four came from the *Confidence* attitude subscale. This is not surprising since many of the lowest scores (by item analysis) also came from this category. Specifically the items pertaining to being a "science" person (or others seeing them as a "science" person) received the lowest scores. See Appendices H-L for analysis of the demographic subgroups.

Table 4.1

Rank Order Listing of Science Attitudes

Rank	Item	Construct	Item Language	M	SD
1	14	Enjoyment	I enjoy doing science experiments.	3.61	.56
2	*19	Usefulness	My science class this year was a waste of time.	3.54	.60
3	*6	Usefulness	I think that learning about science is a waste of time.	3.45	.63
4	8	Confidence	I can make good grades in science.	3.37	.65
5.5	21	Usefulness	I think that what I learn in science will be useful in college.	3.35	.67
5.5	17	Enjoyment	I really enjoy my science class this year.	3.35	.72
7	*20	Enjoyment	I think that my science class this year is boring.	3.34	.74
8	3	Confidence	I am good at doing science labs.	3.32	.63
9	1	Enjoyment	I like learning new things about science.	3.26	.61
10	23	Confidence	I am confident that I can do an excellent job on assignments in science class this year.	3.14	.66
11	2	Usefulness	I think that science will be useful to me when I am an adult.	3.13	.70
12	*7	Confidence	I am not very good at science.	3.11	.82
13	4	Usefulness	I think that science is important in everyday life.	3.10	.68
14	9	Usefulness	I think that science may help me get ahead in life.	3.07	.67
15.5	26	Confidence	I often raise my hand to participate in science discussions or answer questions in class.	3.05	.73
15.5	11	Enjoyment	I like watching science shows and videos.	3.05	.74
17	12	Usefulness	I think that science is useful in solving problems.	2.93	.67
18	18	Usefulness	I believe that I will need science for my future career or job.	2.83	.90
19	13	Enjoyment	I like reading about or watching news stories related to science.	2.77	.77

Table 4.1 (continued)

Rank Order Listing of Science Attitudes

Rank	Item	Construct	Item Language	M	SD
20	22	Confidence	I am certain that I can understand the most difficult material in the textbook I use in science this year.	2.76	.78
21	5	Enjoyment	I like learning about science even when I am not at school.	2.75	.82
22	10	Confidence	I am better at science than many students in my class.	2.50	.79
23	15	Confidence	I see myself as a science person.	2.44	.86
24	16	Confidence	Others see me as a science person.	2.25	.77

*Reverse-coded Items

Examining the science attitude means by subscales revealed that the mean item mean for the three science attitude scales ranged from 2.88 (confidence) to 3.175 (usefulness). Assuming that the scale is evenly spaced, even the lowest mean is close to 3(agree) and the rest of the means fall between 3(agree) and 4(strongly agree). The mean item mean scores for the *Usefulness* subscale (M=3.17) and the *Enjoyment* subscale (M= 3.16) are relatively close; however, the mean item mean for the *Confidence* subscale is significantly lower than the other two (M=2.88). Table 4.2 depicts the mean item means in rank order for the three science attitude scales.

Table 4.2

Rank Order Listing of Science Attitude Sub-Scales (by Mean Item Mean)

Rank	Sub-Scale	Number of Items	Mean Item Mean	Scale Mean	Scale SD
1	Usefulness	8	3.17	25.38	3.85
2	Enjoyment	7	3.16	22.13	3.34
3	Confidence	9	2.88	25.95	4.34

Research Question 2: Levels of Teacher Support and Prior Science Experiences

This research question concerns middle school students' perceptions of teacher support and about their reported levels of prior experiences in the field of science. The *Perceptions of Teacher Support* subscale was made up of seven items, which were rated in a 4-point Likert scale (1- strongly disagree, 2 – disagree, 3 – agree, 4 – strongly agree). The higher the score, the stronger the student's perception of teacher support. The mean item mean scores ranged from 3.20 ("My science teacher treats every student fairly.") to 3.47 ("I believe that my science teacher thinks that every student can be successful."). Table 4.3 below displays the rank-ordered listing of *Perceptions of Teacher Support* subscale by mean item means and mean item mean standard deviations.

Table 4.3

Rank Order Listing of Perceptions of Teacher Support Subscale

Rank	Item	Item Wording	Mean	SD
1	28	This year, I believe that my science teacher thinks that every student can be successful.	3.47	.68
2	31	This year, my science teacher makes science interesting.	3.33	.71
3	25	My science teacher this year treats students with respect.	3.32	.79
4	24	My science teacher this year values and listens to students' ideas.	3.27	.77
5	29	This year, I believe that my science teacher thinks that mistakes are okay as long as all students learn.	3.21	.69
5	33	This year, my science teacher makes science easy to understand.	3.21	.70
7	27	This year, my science teacher treats every student fairly.	3.20	.78

The *Prior Science Experiences* subscale was made up of twenty-two items, which were rated in a 4-point Likert scale (1- Never, 2 – Once, 3 – Two/Three times, 4 – Four or More times). Scores were reported as mean item analysis due to the nature of each item as a stand-alone item. The higher the mean item mean score, the more extensively the students had experienced that science-related activity. The mean item mean scores ranged from 1.28 ("Outside of school, I have designed a computer game.") to 3.85 ("I have owned or cared for a pet."). The most notable pattern in the data concerns the fact that the more "costly" items ranked lower on the list than items that are seemingly cost-free. All items with mean item means above 3.0 are "cost-free" (other than the time invested); all items with mean item means below 2.0 (with the exception of bird-watching) are activities that are potentially expensive or which rely on equipment (which can be expensive unless the student has ready access). Table 4.4 below displays the rank-ordered listing of *Prior Science Experiences* subscale by mean item means and mean item mean standard deviations.

Table 4.4

Rank Order Listing of Prior Science Experiences Subscale (N=603)

Rank	Item	Mean	SD
1	53. *I have owned or cared for a pet (including family pet).	3.85	.64
2	52. *I have collected natural objects (shells, rocks, etc.)	3.32	1.25
3	55. *I often look at the weather forecast for the day or week.	3.14	1.36
4	40. Outside of school I have studied nature (walks)…	3.11	1.12
5	51. *I often read nutrition labels on food.	3.04	1.40
6	49. Not including field trips, I have been to a zoo…	2.83	1.03
7	47. I have planted or helped take care of a garden.	2.79	1.07
8	54. *In the future, I would consider a career in science/technology.	2.64	1.50
9	50. *I have participated in 4H or similar scout program.	2.623	1.50
10	35. Outside of school, I have taken apart or fixed electronics.	2.62	1.15
11	46. I have used tools/measuring devices to build something.	2.56	1.15
12	34. Not including field trips, I have visited a sci. museum/aquarium	2.54	1.03
13	41. I have rescued an injured animal and helped it to get well.	2.07	1.04
14	45. I have mixed household chemicals together to watch the reaction.	2.05	1.10
15	48. Outside of school, I have built a model (rocket, volcano, etc.)	2.01	1.01
16	43. Outside of school, I have used a microscope.	1.99	1.08
17	38. I have used a telescope or star map to observe stars/constellations	1.98	1.03
18	36. I have spent time watching and identifying birds.	1.80	.99
19	44. I have been inside of a cave.	1.71	.96
20	37. Outside of school, I have built/launched a model rocket.	1.54	.86

Table 4.4 (continued)

Rank Order Listing of Prior Science Experiences Subscale (N=603)

Rank	Item		Mean	SD
21	42.	Outside of school, I have built an electric circuit.	1.35	.74
22	39.	Outside of school, I have designed a computer game.	1.28	.68

*Most items were rated on a 4-point Likert scale; Items denoted with an (*) were rated on a dichotomous scale (4= yes; 1 = no).

Research Question 3: Personal Characteristic Variation in Teacher Support and Prior Experiences

The third research question asked to what extent personal characteristics (i.e. gender, race, grade level, socioeconomic status, and gifted versus non-gifted status) could be used to explain observed variance in student perception of teacher support and reported prior science experiences. In order to calculate this, bivariate analyses were performed on the comparison of means by independent T-tests; the specific analysis was based on the level of measurement. A comparison of means by independent T-tests was conducted for all dichotomous variables (i.e. gender, race, SES, gifted status); grade level was treated as an ordinal variable, therefore, Spearman correlations were calculated with grade level and both perceptions of teacher support and reported prior science experiences. Once variation had been established, the next logical step was to use the Independent T-Test to see if the differences were, in fact, significant (alpha = .01).

The *Total Teacher Perception* subscale was made up of seven items. The purpose of this scale was to determine how much the subjects felt that their teachers supported their educational efforts in science. Unlike the other scales, this is the only scale that was specific to the 2011-2012 school year; the other scales were based on the accumulation of their lifetime experience with science. Therefore, it was decided that teacher perception should be analyzed separately. While every demographic subgroup showed variation, the only group that showed statistically significant differences was the comparison by grade level. The 7th grade mean scores are a bit higher than those for 6th and 8th grade. Pearson correlation calculations show the correlation between grade level and perceptions of teacher support to be statistically significant at the $p>.001$ level. The significance scores for all subgroups may be found in Table 4.5.

Table 4.5

Perception of Teacher Support - Comparison of Means and Standard Deviations

Variable	N	Scaled Mean	Scaled SD
Gender			
Male	291	22.59	4.30
Female	311	23.21	3.87
Race			
White	352	22.77	4.13
Black	133	23.14	4.06
Grade Level			
6	232	22.76	4.22
7	198	23.67	3.79
8	173	22.25	4.12
SES			
Free/Red	267	22.97	4.11
Not F/R	240	22.94	4.02
Gifted Status			
Gifted	186	23.24	4.03
NonGifted	413	22.82	4.05

Independent T-tests were conducted on the *Perceptions of Teacher Support* subscale. Statistically significant differences could not be found by gender, race, socioeconomic status, or gifted status (see Table 4.12 below); however, Pearson correlations between grade level and perceptions of teacher support were statistically significant at the p<.001 level. Sixth grade scaled means (M=22.76, SD = 4.22) and eighth grade scaled means (M = 22.25, SD = 4.12) were quite similar; seventh grade scaled means (M = 23.67, SD = 3.79) were significantly higher than the other grade levels. This indicates that seventh graders feel a stronger sense of teacher support than do sixth and eighth graders in this setting. The degrees of freedom are lower for race and SES because a large number of students left those sections blank or answered "I don't know." Table 4.6 below shows the results of the Independent T-tests for all dichotomous variables.

Table 4.6

Teacher Perception Subscale - Independent T-test Results

Variable	t score	df	p value	significant?
Gender	-1.855	600	.064	No
Race	-.891	483	.374	No
SES	.089	505	.929	No
Gifted Status	1.171	597	.242	No

Significance levels-

*p = .05

**p = .01

***p = .001

The *Total Prior Science Experience* subscale was made up of 22 items. The scaled mean score is an average of the total prior experience score for each subject, which was calculated as a summation of all of the prior experiences that the subject had participated in. The possible responses ranged from 1 (never) to 4 (more than 3 times); the highest possible score would be an 88 on this scale; the lowest possible would be 22. Based on this calculation, a higher score would indicate that a subject had extensive prior experiences in science. Comparing scaled means by gender, race, and grade level revealed some variation, but it was not statistically significant. Comparing means by socioeconomic status showed a significant difference between the prior experiences of students receiving free/reduced lunch (M=50.94, SD = 10.95) and the prior experiences of students not receiving free/reduced lunch (M=53.95, SD = 11.26) at the p=.002 level. Significant differences could also be found in comparing the means of the gifted subjects and the non-gifted subjects. The scaled mean of prior experiences for gifted subjects was 55.55 (SD = 10.81), and the scaled mean of prior experiences for non-gifted subjects was 51.20 (SD = 11.10); this difference was found to be significant at the p<.000 level. A complete breakdown of significance scores may be found in Table 4.7.

Table 4.7

Prior Science Experience - Comparison of Means and Standard Deviations

Variable	N	Scaled Mean	Scaled SD
Gender			
Male	291	52.67	11.46
Female	311	52.32	10.92
Race			
White	351	53.21	11.13
Black	133	51.80	11.66

Table 4.7 (continued)

Total Prior Science Experience - Comparison of Means and Standard Deviations

Variable	N	Scaled Mean	Scaled SD
Grade Level			
6	232	53.11	11.18
7	198	53.05	11.27
8	173	51.05	10.98
SES			
Free/Red	267	50.94	10.95
Not F/R	240	53.95	11.26
Gifted Status			
Gifted	186	55.55	10.81
Non-Gifted	413	51.20	11.10

Independent T-tests were conducted on the *Total Prior Science Experience* subscale. Statistically significant differences could not be found by gender or race (see Table 4.8 below); however, Pearson correlations between grade level and perceptions of teacher support were statistically significant at the $p<.001$ level. Sixth grade scaled means (M=53.11, SD = 11.18) and seventh grade scaled means (M = 53.05, SD = 11.27) were quite similar; eighth grade scaled means (M = 51.05, SD = 10.98) were significantly lower than the other grade levels. This indicates that eighth graders reported fewer prior science experiences than did sixth and seventh graders in this setting. Statistically significant differences could also be found by socioeconomic status and gifted status. Students receiving free/reduced lunch reported fewer experiences (M = 50.94, SD = 10.95) than students who do not receive free/reduced lunch (M = 53.95, SD = 11.26). Gifted students reported more experiences (M = 55.55, SD = 10.81) than their non-gifted peers (M = 51.20, SD = 11.10). Table 4.8 below shows the results of the Independent T-tests for all dichotomous variables.

Table 4.8

Total Prior Science Experiences **-** Independent T-test Results

Variable	t score	df	p value	significant?
Gender	.385	600	.700	No
Race	1.231	482	.219	No
SES	-3.045	505	**.002	Yes
Gifted Status	4.480	597	***<.001	Yes

Significance levels-

*p = .05

**p = .01

***p = .001

Research Question 4: Variance in Students' Attitudes Toward Science

Research question #4 asks to what extent do personal characteristics (e.g. race, gender, SES, grade level, and gifted status), levels of teacher support, and reported prior science experiences explain variance in students' attitudes toward science? This question was answered first by comparing the scaled means and standard deviations of each of the dichotomous personal characteristics on each of the attitude subscales and on the total attitude scale as a whole. Due to the fact that grade level is an ordinal variable, Pearson correlations were calculated for grade level and science attitudes. A comparison of means was conducted on the *Enjoyment* subscale, the *Usefulness* subscale, the C*onfidence* subscale, the total attitude scale, the perceptions of teacher support scale, and the prior background experiences scale. This first step allowed the researcher to simply look for demographic variations. Once variation had been established, the next logical step was to use the Independent T-Test to see if the differences were, in fact, significant (alpha = .01). Next, correlations were calculated to look for connections between perceived teacher support and attitude, and they were also calculated between prior science experiences and attitudes.

The scaled means for the *Enjoyment* subscale indicated that females (M = 22.37, SD = 3.22) scored higher than males (M= 21.85, SD = 3.45); an independent samples T-test revealed that there was not a statistically significant difference in the scores for males' and the scores for females' enjoyment of science ($t(596) = -1.9$; $p = .06$). A comparison of scores by race showed that Black/African-American scores (M = 22.30, SD = 3.40) were a higher than White/Caucasian scores (M = 22.11, SD = 3.36); however, independent sample T-tests also revealed that this difference was also not statistically significant ($t(481) = -.527$; $p = .598$). A comparison of the scores by SES and by gifted status showed that neither of the score differences proved to be statistically significant. A complete list of the results of the Independent T-tests for all five demographic areas of enjoyment may be found in Table 4.6.

Spearman correlations showed that the correlations between grade level and enjoyment was significant at the $p<.001$ level. Scaled mean comparisons by grade level reveal that scores remain constant for sixth (M = 22.56, SD = 3.32) and seventh graders (M = 22.53, SD = 3.13); however, a drop in scaled mean scores is noted for eighth grade students (M = 21.04, SD = 3.35). Means and standard deviations for the *Enjoyment* subscale are presented in Table 4.9.

Table 4.9

Enjoyment Subscale - Comparison of Scaled Means and Standard Deviations

Variable	N	Scaled Mean	Scaled SD
Gender			
Male	291	21.85	3.45
Female	311	22.37	3.22
Race			
White	355	22.11	3.36
Black	136	22.30	3.40
Grade Level			
6	230	22.56	3.32
7	197	22.53	3.13
8	172	21.04	3.35
SES			
Free/Red	265	22.35	3.16
Not F/R	238	21.88	3.41
Gifted Status			
Gifted	185	22.30	3.35
Non-Gifted	410	22.04	3.34

Independent T-test calculations revealed that statistically significant differences could not be found on the *Enjoyment* subscale by gender, race, socioeconomic status, or gifted status. However, with a p value of .06, gender approached significance at the p = .05 level, with females scoring higher than males in the subscale. A comparison by grade level (Spearman's Rho = -0.177) showed that grade level differences *were* statistically significant on the *Enjoyment* subscale at the p <.001 level. Table 4.10 displays the results of the independent T-tests on dichotomous variables for *Enjoyment* of science.

Table 4.10

Independent T-test Results for the Total Enjoyment Scale

Variable	t score	df	p value	Significant?
Gender	-1.9	596	.06	No
Race	-0.527	481	.60	No
SES	1.587	501	.11	No
Gifted Status	.856	593	.39	No

Significance levels-

*p = .05

**p = .01

***p = .001

The scaled means for the *Usefulness of Science* subscale revealed that the average male score (M = 24.92, SD = 4.25) is lower than the average score for females (M = 25.80, SD = 3.39) . Black/African-American scaled averages (M = 25.64, SD = 3.65) were slightly higher than the scaled averages for White/Caucasian subjects (M = 25.38, SD = 3.86). The comparison of scaled averages by SES shows little variation, but the non-free/reduced lunch subjects had a larger spread of data. Scaled averages for gifted students (M = 26.03, SD = 3.88) were higher than the scaled averages for non-gifted students (M = 25.10, SD = 3.81). Independent T-tests were run on all of the demographic variables. The differences between the averages by gender (p=.005) and by gifted status (p=.006) were found to be statistically significant. Complete independent T-test data for usefulness may be found in Table 4.12.

Table 4.11

Total Usefulness of Science Subscale -Comparison of Scaled Means and Standard Deviations

Variable	N	Scaled Mean	Scaled SD
Gender			
Male	288	24.92	4.25
Female	310	25.80	3.39
Race			
White	349	25.38	3.86
Black	133	25.64	3.65
Grade Level			
6	230	25.77	3.80
7	198	25.75	3.67
8	171	24.39	3.96
SES			
Free/Red	265	25.29	3.60
Not F/R	239	25.35	4.01
Gifted Status			
Gifted	185	26.03	3.88
NonGifted	410	25.10	3.81

Independent T-test calculations revealed that statistically significant differences could not be found on the *Usefulness of Science* subscale by race or socioeconomic status. However, with a p value of .005, gender was found to be statistically significant, with females (M = 25.80, SD = 3.39) scoring higher than males (M = 24.92, SD = 4.25) in the subscale. Gifted status also revealed statistically significant differences (p = .006). Gifted students reported a higher scaled average (M= 26.03, SD = 3.88) than non-gifted students (M = 25.10, SD = 3.81). While both demographic groups showed statistically significant differences, it is questionable whether these differences contain substantive importance. A comparison by grade level (Spearman's Rho = -0.139) showed that grade level differences *were* statistically significant on the *Usefulness of Science* subscale at the p =.001 level. Table 4.12 displays the results of the independent T-tests on dichotomous variables for *Usefulness* of science.

Table 4.12

Independent T-test Results for the Total Usefulness Scale

Variable	t score	df	p value	significant?
Gender	-2.821	596	**.005	Yes
Race	-.665	480	.506	No
SES	-.180	502	.857	No
Gifted Status	2.75	593	**.006	Yes

Significance levels-

*p = .05

**p = .01

***p = .001

The scaled means for the *Confidence in Science* subscale show that males' averages (M = 25.97, SD = 4.35) and females' averages (M = 25.91, SD = 4.32) are extremely similar, and Independent T-tests for significance showed the difference to be statistically insignificant. While the differences in the averages by race show a larger gap, it was also found to be insignificant; White/Caucasian students' scaled means are slightly higher than the scaled means for Black/African American students. There is a definite drop in the confidence level of 8th grade students (compared to 6th and 7th); Spearman correlations for grade levels showed a significant correlation (p=<.001) between grade level and confidence levels. The differences by SES were minimal (and not significant), but the differences by gifted status were found to be significant at the p = .001 level. Gifted students' scaled mean score was higher (M = 26.85, SD = 4.18) than the scaled mean score for non-gifted students (M = 25.57, SD = 4.32) . A complete data listing for significance may be found in Table 4.14. Table 4.13 below displays the comparison of means by dichotomous variables.

Table 4.13

Total Confidence - Comparison of Scaled Means and Standard Deviations

Variable	N	Scaled Mean	Scaled SD
Gender			
Male	286	25.97	4.35
Female	309	25.91	4.32
Race			
White	349	26.12	4.42
Black	132	25.67	3.96
Grade Level			
6	231	26.16	4.05
7	196	26.30	4.33
8	169	25.21	4.61
SES			
Free/Red	264	25.69	4.17

Table 4.13 (continued)

Total Confidence - Comparison of Scaled Means and Standard Deviations

Variable	N	Scaled Mean	Scaled SD
Not F/R	238	26.30	4.17
Gifted Status			
Gifted	184	26.85	4.18
Non-Gifted	408	25.57	4.32

Independent T-test calculations revealed that statistically significant differences could not be found on the *Confidence in Science* subscale by gender, race, or socioeconomic status. However, with a p value of .001, gifted status was found to be statistically significant, with gifted students reporting a higher scaled average (M= 26.85, SD = 4.18) than non-gifted students (M = 25.57, SD = 4.32). A comparison by grade level (Spearman's Rho = -0.084) showed that grade level differences *were* statistically significant on the *Confidence in Science* subscale at the p =.05 level. Table 4.14 displays the results of the independent T-tests on dichotomous variables for *Confidence in Science* subscale.

Table 4.14

Independent T-test Results for the Total Confidence Scale

Variable	t score	df	p value	significant?
Gender	.157	593	.876	No
Race	1.032	479	.302	No
SES	-1.645	500	.101	No
Gifted Status	3.390	590	***.001	Yes

Significance levels-

*p = .05

**p = .01

***p = .001

The total attitude scale contained all 24 items, and was the sum of the items from the *Enjoyment of Science, Usefulness of Science, and Confidence in Science* subscales. While there was variation in the scaled averages by gender, race, and socioeconomic status, those differences were not found to be statistically significant. A comparison of mean scores by grade level showed large variations between the 8th grade and the other two grade levels; this is not surprising since this gap also occurred within each of the subscales that made up the total average score. The difference between the 8th grade scores (M=70.50, SD = 10.60) and both the 6th grade scores (M = 74.47, SD = 9.78) and the 7th grade scores (M=74.48, SD = 9.71) were found to be statistically significant at the p<.000 level. Spearman correlation calculations show a significant correlation between grade level and total science attitudes (p<.001). The differences by gifted status were also found to be significant; the difference between gifted students' scores (M=75.10, SD = 10.13) and non-gifted students' scores (M=72.62, SD = 10.07) were found to be significant at the p=.006 level. A complete listing of the results of the independent T-tests for significance may be found in Table 4.16.

Table 4.15

Total Science Attitude - Comparison of Scaled Means and Standard Deviations

Variable	N	Scaled Mean	Scaled SD
Gender			
Male	291	72.61	10.74
Female	311	74.03	9.53
Race			
White	355	73.08	11.69
Black	136	72.36	12.54
Grade Level			
6	232	74.47	9.78
7	198	74.48	9.71
8	173	70.50	10.60
SES			
Free/Red	267	73.21	9.55
Not F/R	240	73.50	10.09
Gifted Status			
Gifted	186	75.10	10.13
Non-Gifted	413	72.62	10.07

Independent T-test calculations revealed that statistically significant differences could not be found on the *Total Science Attitude* scale by gender, race, or socioeconomic status. However, with a p value of .006, gifted status was found to be statistically significant, with gifted students reporting a higher scaled average (M= 75.10, SD = 10.13) than non-gifted students (M = 72.62, SD = 10.07). A comparison by grade level (Spearman's Rho = -0.155) showed that grade level differences *were* statistically significant on the *Total Science Attitude* scale at the p <.001 level. Table 4.16 displays the results of the independent T-tests on dichotomous variables for *Total Science Attitude* subscale.

Table 4.16

Total Science Attitude - Independent T-test Results

Variable	t score	df	p value	significant?
Gender	-1.719	600	.086	No
Race	.602	489	.548	No
SES	-.342	505	.733	No
Gifted Status	2.786	597	**.006	Yes

Significance levels-

*p = .05

**p = .01

***p = .001

Table 4.17 displays the correlation figures for each of the subscales. All of the correlations were positive and statistically significant; the strongest correlation (r = .611) was reported in the relationship between a subject's enjoyment of science and his perceptions of teacher support; nearly 37% of the variance that students reported in science enjoyment can be explained by their variance in perceptions of teacher support. The total science attitude scale also had a strong correlation (r = .591) with enjoyment of science. The two weakest correlations reported are on the confidence subscale; a subject's confidence in science is correlated with his perceptions of teacher support (r = .442) and his prior science experiences (r = .443), meaning that only 20% of the variance in a subject's confidence in science can be explained by the variances in perceptions of teacher support and variances in prior science experiences.

While there is a significant correlation between each of the subscales (and total attitude) and both perceptions of teacher support and prior science experiences, the correlations are in the moderate range. As seen in Table 4.17, the highest correlation is between perceptions of teacher support and enjoyment of science at r = .61, indicating that 37% of the variance in science attitudes may be explained by variations in perceptions of teacher support.

Table 4.17

Bivariate Correlations Between Attitude Subscales, Perceptions of Teacher Support, and Prior Science Experiences

Subscale	Perc.Teacher Support				Prior Science Experiences			
	(N)	(r)	(p)	(r^2)	(N)	(r)	(p)	(r^2)
Enjoyment	600	.61	***<.001	.37	599	.46	***<.001	.21
Usefulness	600	.53	***<.001	.28	599	.45	***<.001	.20
Confidence	597	.44	***<.001	.19	596	.44	*** <.001	.19
Total Attitude	604	.59	***<.001	.35	603	.51	*** <.001	.26

***significant at the .001 level (2-tailed)

CHAPTER FIVE

FINDINGS

Chapter five is devoted to discussion and implications of the research data as it pertains to the data presented in chapter four. This chapter is divided into five major sections: overview of the study, discussion of the findings, implications for practice, implications for research, and recommendations for future research.

Overview of Study

The primary purpose of this study was to investigate the attitudes toward science (including perception of teacher support) that exist in middle school students, and to report the variances that occurred by gender, race, grade level, socioeconomic status, and gifted status. A secondary purpose was to look at the correlations among perceptions of teacher support, prior science experiences, and total attitudes in science; these correlations were used to determine the best model to show how perceptions of teacher support and prior science experiences are related to a student's total science attitude. The four research questions guiding this study were:

1) What are middle school students' attitudes toward science, specifically related to enjoyment, perceived usefulness, and confidence in the science classroom?

2) What are middle school students' perceptions of science teacher support and reported levels of prior experiences in the field of science?

3) To what extent do personal characteristics (i.e. gender, race, grade level, socio-economic status, and gifted versus non-gifted status) explain observed variance in student perception of teacher support and science experiences?

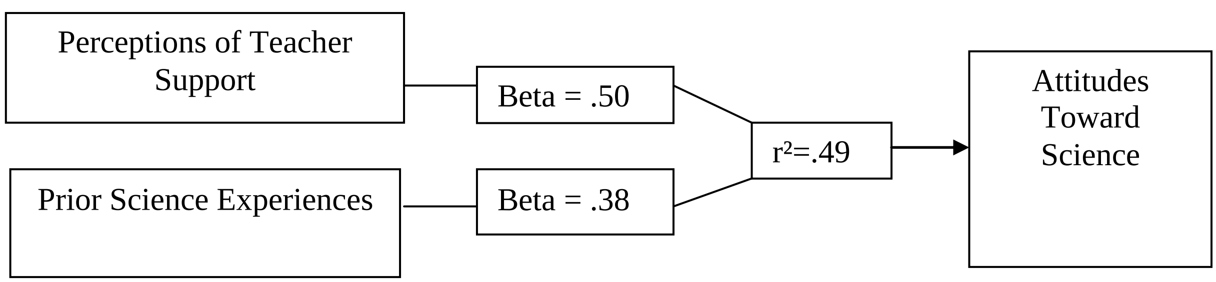
4) To what extent do personal characteristics (e.g. race, gender, SES, grade level, and gifted status), levels of teacher support, and reported prior science experiences explain variance in students' attitudes toward science?

A 66-item survey instrument was developed by the researcher to specifically address the four research questions. This survey was administered electronically to a large group (N=617) of middle school students in one site. The survey was designed to measure each student's general attitude toward science (three subscales: enjoyment, usefulness, and confidence), his perceptions of teacher support in the science classroom, and the extent of his prior experiences in science. The survey was developed over the course of two years; it included several peer review sessions and two separate pilots to help establish construct validity. The science attitudes construct served as the main focus of the instrument, which also included items about perceptions of teacher support and prior experiences in science. These additional items were used to measure correlational strength between a subject's science attitude (including teacher support) and his prior science experiences. The survey included 24 items to measure science attitudes (7 enjoyment, 8 usefulness, 9 confidence), 7 items to measure perceptions of teacher support, 22 questions about prior science experiences, and demographic questions to gather information about gender, race, grade level, socioeconomic status, and gifted status.

The student body (N=1040) at Jones Middle School (name changed for confidentiality) were invited to be a part of this study. Of the population, 814 agreed to participate and 617 actually took part in the survey. The survey was administered through the use of computer labs located at the research site, and it took place during morning homeroom before daily academic instruction began. The data from the surveys was entered into a SPSS database for purposes of statistical analysis. In addition to descriptive statistics, the statistical analysis included (a) mean rankings and (b) bivariate correlations. To address the first and second research questions, the item means and standard deviations were calculated and rank-ordered. The third research question was addressed by the calculations of frequencies and Independent T-tests to find the significance in the variances. The fourth research question was answered first by comparing the scaled means and standard deviations of each of the dichotomous personal characteristics on each of the attitude subscales and on the total attitude scale as a whole. Due to the fact that grade level is an ordinal variable, Pearson correlations were calculated for grade level and science attitudes.

The single most important finding in the study was that *extent of prior science experiences* combined with *perceptions of teacher support* can be used to predict nearly half (49.1%) of a student's attitude toward science. Based on the strongest explanatory predictor and outcome variables for student science attitudes, an explanatory model is presented in Figure 5.1.

Figure 5.1 Explanatory Model for the Predictors of Science Attitudes



Discussion of Findings

Research Question #1. Rank ordering of the 24 science attitude item means was used to answer the question: "What attitudes towards science exist in middle school students?" The entire construct of "science attitude" was made up of three subscales: enjoyment (7 items), usefulness (8 items), and confidence (9 items). The subjects responded using a 4-point Likert scale: 1(strongly disagree), 2(disagree), 3 (agree), and 4 (strongly agree). The ten highest ranking items included four of the seven measures of *enjoyment*, three of the eight measures of *usefulness*, and three of the nine measure of *confidence*. This is not surprising since the measures for *usefulness* and *enjoyment* produced the higher scores of the three subscales ((M) enjoyment = 3.16; (M) usefulness = 3.17). The lower end of the rankings reveal more significant findings for the researcher; of the five lowest ranking items, four of them fall under the *confidence* subscale (M = 2.88).

Interpreted by the researcher, this data indicates that middle school students generally agree (agree=3, strongly agree = 4) that they enjoy science and that they find it to be a useful subject to study. However, they are not as confident in their science abilities. Interestingly, the confidence scores shift from one grade level to the next; there are many possible explanations for this, including content interest, content difficulty, and teacher-student interaction. Of the three attitude constructs, *confidence in science* received the lowest rankings, which is consistent with literature concerning a downward shift in confidence levels for middle school students in science and math. In one recent study (Sorge, 2007), it was determined that this drop in confidence (and in attitudes) occurs most significantly between 5^{th} and 6^{th} grades, and it never is fully restored to its previous levels during middle school at all. This has important implications for middle school science teachers; as confidence levels start to decrease, so does achievement and attitudes related to science. It is imperative that educators help students retain their confidence levels from the first day of middle school forward; waiting until the 8^{th} grade to try to "redeem" students is rarely an effective strategy.

Research Question #2. The second research question was designed to examine students' perceptions of teacher support and students' reported prior experiences in science outside of school. For both scales, the item means were calculated and ranked from highest to lowest. Analysis of the *Perceptions of Teacher Support* scale showed that the mean scores ranged from 3.20 to 3.47 (with 4.0 being the highest positive answer), indicating that students either agreed (3.0) or strongly agreed (4.0) that their science teachers were supportive in the classroom. Considering that this is an important aspect of effective teaching, efforts should be made to build healthy teacher-student relationships to ensure that optimum learning can take place. This is particularly crucial during the middle school years when many adolescents are turning away from adult role models and leaning on their peers for guidance and support (Wigfield, Lutz, & Wagner, 2005). One recent study found that adolescent well-being is associated with school-based experiences, *in particular their perceptions of teacher support* (Suldo, Friedrich, White, Farmer, & Michalowski, 2009). Many suggestions for developing strong teacher-student relationships include steps taken to allow students to have input and influence on their learning environments in conjunction with strong teacher support and involvement. For example, engaging students in school-community service projects allows students the opportunity to improve their community (and school); this is especially powerful when teachers pair together with the students to work on a project together (Carlisle, 2011). Another suggestion for building healthy relationships is encouraging participation in student council groups (that may have an impact on school policy) or in peer support groups (that may engage in student conflict resolution). On the classroom level, allowing students to have choices in discourse methods and classroom politics (such as helping to create the classroom rules and infraction consequences) also creates a sense of mutual respect and trust between teachers and students. An interesting side note concerns research on teacher retention rates and teachers' opinions of classroom climate. According to Sue Roffey (2012), these feelings of mutual respect and belonging are just important in preventing teacher attrition as they are in engaging students in learning. In essence, creating positive classroom climates and healthy teacher-student relationships appears to be a "win-win" situation for both students and their teachers.

Analysis of the *Prior Experiences in Science* scale showed that the mean scores ranged from 1.28 (student having designed a computer game) to 3.85 (student having owned or cared for a pet). Several recent studies have documented the importance of outside-of-school experiences in enhancing science students' interest and achievement in science (Zimmerman, 2012). One noted occurrence in the data is that there is a negative correlation between the cost of an activity and participation in that activity; for example, item 37 asked if the subject had ever built and/or launched a model rocket. More than half of the respondents (65.3%) answered “never”. Building rockets generally costs at the very least $25 for the smallest rocket/launcher available. On the other hand, item 52 asked the subjects if they have ever collected natural objects (such as rocks or shells); 77.5% of the respondents answered yes to this seemingly low-cost (or cost-free) activity. The site of this study contains predominantly low-income students; logically, one could argue that a student’s socio-economic status plays an important role in access to activities outside of school. Based on this logic, implementation of programs designed to aid low income students in pursuing science activities that they might not otherwise have access to may be an effective strategy to increase students’ attitudes toward science.

Research Question #3. The third research question asked to what extent personal characteristics (i.e. gender, race, grade level, socioeconomic status, and gifted/non-gifted status) could be used to explain observed variance in student perception of teacher support and reported prior science experiences. Independent T-tests were performed on all dichotomous variables (i.e. gender, race, socioeconomic status, gifted status); Spearman correlations were calculated on the ordinal variable (grade level).

Analysis of the *Perceptions of Teacher Support* data indicated that there was not a statistically significant difference reported by gender, race, socioeconomic status, or gifted/non-gifted status. Females’ scores were slightly higher (not statistically significant), which is in line with Weinberg’s study (1994), in which females were found to have a more positive perception of their science teachers. However, grade level analysis did reveal differences that were statistically significant ($p<.001$). The score for seventh grade subjects was significantly higher than either sixth or eighth grades. This could be explained by content interest (seventh grade content is life science), or it might be explained by teacher-student relationship dynamics at each grade level. One recent study suggests that teacher-student relationships are key to the personalization of the educational setting (Yonezawa, S.; McClure, L; Jones, M, 2012). This includes greeting students by name, offering extra academic help in the form of tutoring or mentoring, keeping in contact with parents, and helping students to make connections to the world around them through business connection and internship possibilities. An interesting correlation to the data found in this study is that the standardized test scores for the students at this site nearly exactly mirror the data collected about perceptions of teacher support. This has been true for at least the past six years. Science test scores (GCRCT) are low in the 6^{th} grade, skyrocket in the 7^{th} grade, and plummet again in the 8^{th} grade. While not directly related to this study, it provides an interesting connection that might be investigated more fully in a future study.

Analysis of the *Total Prior Science Experiences* subscale indicated that there was not a statistically significant difference reported by gender or race; however, comparisons by socioeconomic status, gifted status, and grade level all revealed statistically significant differences. As mentioned earlier, responses seemed to be linked to the cost associated with the activity; the higher the cost, the lower the participation. Therefore, it is not surprising that subjects of lower socioeconomic status reported lower scores (mean = 50.94) than students of higher socioeconomic status (mean = 53.95). Whether or not a student was enrolled in a gifted/advanced science class also had a significant impact on the data; gifted students scored higher (mean = 55.55) than their non-gifted peers (mean = 51.20). This begs the question as to whether having rich outside of school experiences led to gifted placement, or whether these students have more access to these activities because they are in gifted classes. Direction of causality is not implied; however, it is apparent in the data that students enrolled in gifted classes may have more extensive prior experiences (at least in the field of science) than their non-gifted peers. In relation to students of low SES status, recent case studies of enrichment science programs for under-resourced schools has shown the effectiveness of such programs in providing opportunities for low-income students to broaden their understanding of science (Luehmann, 2009).

Research Question #4. Research question four pulled together all of the various scales and subscales to investigate the relationships among personal characteristics, perceptions of teacher support, reported prior science experiences, and science attitudes. Each of the three attitude subscales (*Enjoyment of Science, Usefulness of Science, and Confidence in* Science) was analyzed individually; the *Attitudes of Science* scale was also analyzed as a total scale as well.

On the total enjoyment scale (sum of all seven items of *enjoyment*), females had a higher mean than males, Black students had a higher mean than White students, 6th graders had the highest mean (which stayed fairly constant through 7th grade, and dropped at 8th grade), students of lower SES scored a bit higher than students of higher SES, and gifted students scored higher than non-gifted students. Of all of these comparisons, only two of them had differences that were statistically significant : the mean score for 7th and 8th graders ($t=4.42$, $df = 367$) and the difference in the mean score for 6th and 8th graders ($t= 4.52$, $df = 400$) was found to be significant at the $p<.000$ level. What this means is that the probability that the 8th grade scores were lower by chance is less than .000. If the null hypothesis is that there is no difference between the scores for 6th, 7th, and 8th graders, then it would be logical to reject the null under these conditions. In conclusion, this data indicates that 8th grade students enjoy science significantly less than their 6th and 7th grade peers. This finding is consistent with literature suggesting a downward spike of students' science attitudes and achievement as they progress from elementary school through middle school to high school (Sorge, 2007).

A comparison of means for the *usefulness* of science indicates that females' mean score is higher than the mean score for males, mean scores for Black students are higher than the mean score for White students, the mean scores for 6th and 7th graders remain consistent but the mean score drops for 8th graders, the mean scores for lower SES students is a bit lower than for students of higher SES, and the mean scores for gifted students are higher than the mean scores for non-gifted students. Of these differences, statistical significance was found in the areas of gender, grade level, and gifted status. The difference between the mean scores of males and females ($t=-2.821$, $df=596$) was found to be significant at the p=.005 level; this indicates that females deem science to be a more useful subject than males do. This, also, is consistent with Weinberg's study (1994), in which females rated science a more "useful" subject than males did. The difference between the mean scores of 7th and 8th graders (t=3.43, df= 367) and the mean scores of 6th and 8th graders (t=3.53, df= 399) is significant at the p=.001 level and p<.000 level respectively. Looking at the data, the 6th and 7th grade scores remained consistent, and the 8th grade scores were much lower indicating that 8th graders did not find the subject of science to be as useful as the 6th and 7th graders. The difference between the mean scores of the gifted students and the non-gifted students (t= 2.75, df = 593) is statistically significant at the p=.006 level. This means that gifted students find the subject of science to be a bit more useful than their non-gifted peers. The researcher hypothesizes that this might be true because the majority of gifted students claim that that they plan to go to college one day or to engage in a career that may be related to science or technology. For this reason, more gifted students might see the usefulness of science (and school education in general).

A comparison of means for *confidence* in science indicates that the mean score for males is a bit higher than the mean score for females, the mean score for White students is higher than the mean score for Black students, the mean score for 7th grade students is the highest followed by the mean scores of 6th and 8th graders, the mean scores for students of lower SES are lower than the mean scores for students of higher SES, and the mean scores for gifted students are higher than the mean scores for non-gifted students. Of these areas, only grade level differences and gifted status differences were found to be statistically significant. The differences between the mean scores for 7th and 8th graders (t=2.325, df = 363) was found to be significant at the p=.021 level; the differences in the mean scores for 6th and 8th graders (t=2.193, df= 398) was found to be significant at the p=.029 level. This was due to the drop in 8th grade scores as compared to 6th and 7th grade scores. This finding correlates with studies conducted by Kline and Short (1991) and Kline and Zehm (1996), which examined the drop in self-esteem and confidence that occurs as students move from upper elementary years through adolescence. This would translate into a drop in confidence in science as well. The other statistically significant difference occurred between the mean scores of gifted students and the mean scores of non-gifted students (t= 3.39, df= 590); the difference was found to be significant at the p=.001 level. Also consistent with the research literature was that the confidence score for males was higher than the confidence score for females, indicating that the confidence level drops more quickly for females than it does for males. However, surprisingly, the total attitude score for females was higher than it was for males

A comparison of mean scores for total science attitude (sum of enjoyment, usefulness, and confidence) revealed that the mean score for females is higher than the mean score for males, the mean score for White students is higher than the mean score for Black students, the mean scores are consistent for 6th and 7th graders but drops for 8th graders, the mean score for students of higher SES is higher than the mean score of students of lower SES, and the mean scores for gifted students is higher than the mean scores for non-gifted students. The differences between scores was found to be statistically significant for grade level and gifted status. The differences between the mean scores for 7th and 8th graders (t=3.77, df=369) and the differences between the mean scores for 6th and 8th graders (t=3.89, df = 403) were both found to be statistically significant at the p<.000 level. This is not surprising since the 8th grade scores dropped (compared to 6th and 7th grade scores) across all subscales. The researcher has a few hypotheses about what might have caused this: for one thing, the 8th grade science curriculum is considerably more difficult than the 6th and 7th grade science curricula. The 8th grade science curriculum is comprised of physics and chemistry, both very abstract concepts. Another possible explanation for this is that the survey was administered in the spring of the school year, at which point many 8th graders are simply ready to get out of middle school (affectionately known as "eighth-grade-it is"). Their scores may have been significantly higher if the survey had been administered earlier in the school year; however, this was not possible because some of the questions assumed that the student had been enrolled in the current science class for at least one semester. The other significant finding was in the differences between the mean scores for gifted students and the mean scores for non-gifted students (t=2.79, df=597); this was found to be significant at the p=.006 level. In other words, gifted students generally have a more positive attitude towards science than their non-gifted peers. This may be due to the fact that the gifted students are often intellectually advanced (among other talents); the researcher would expect their attitudes toward schooling and education in general to be a bit more positive.

A comparison of the findings for perceptions of teacher support revealed that the mean score for females was higher than it was for males, the mean score for Black students was higher than it was for White students, the mean score for 7th graders was higher than it was for 6th or 8th graders, the mean score for students of low SES was the same as the mean score for students of higher SES, and the mean scores for gifted students was higher than the mean score for non-gifted students. Of these comparisons, only the comparison by grade level revealed statistically significant differences. Interestingly, the mean score for 7th graders was significantly higher than the mean score for 6th graders (the mean score for 8th graders was still the lowest). The difference between the mean scores for 6th and 7th graders (t=-2.33, df = 428) was found to be statistically significant at the p=.020 level, and the difference between the mean scores for 7th and 8th graders (t=3.44, df=369) was found to be statistically significant at the p=.001 level.

Comparisons of means for the prior science experience scale revealed that the mean scores of males were higher than the mean scores of females, the mean scores of White students was higher than the mean scores of Black students, the mean scores are consistent for 6th and 7th graders but drop for 8th graders, the mean scores of students of higher SES and higher than the mean scores of students of lower SES, and the mean scores of gifted students are higher than the mean scores of non-gifted students. Of these variables, the biggest findings were in the differences by SES and by gifted status. The differences of the mean scores of students of lower SES and students of higher SES (t=-3.05, df=505) was found to be statistically significant at the p=.002 level. An item analysis of this section (see Appendix) was much more revealing than looking at the total means. Comparison across items reveals a pattern for the SES groupings; if the item had an extreme cost associated with it, students of lower SES were not as likely to have experienced it. For example, survey question 34 asks students to rate how often they have visited a science museum or aquarium; 27.1% of students of lower SES reported that they have never visited a science museum or aquarium (as opposed to only 12.2% of students of higher SES). Whereas one fourth of students of lower SES have never visited a science museum or aquarium, nearly 70% of students of higher SES reported having visited one several times. On the other hand, if the item was cost-free (at least monetarily), the scores between lower SES and higher SES were much more similar. For example, survey question 41 asks students to rate how often they have rescued an injured animal (such as an injured bird or squirrel) and helped it to get well. 38.1% of students of lower SES reported that they had never done this, and 33.2% of students of higher SES reported that they had never done this. On the other hand, about 13% of both groups reported having done this four or more times (lower SES = 13.6%, higher SES = 13.4%). In retrospect, cost-driven activities likely played a heavy role in the differences that were reported by SES. Statistically significant differences were also found between the mean scores of the gifted students and the mean scores of the non-gifted students ($t=4.48$, $df=597$); these differences were actually a bit more significant ($p<.000$) than the differences by SES. The researcher hypothesizes that many gifted students have had a wider exposure to educational activities possibly because of the parenting styles and priorities of many gifted students' parents. In the researcher's classroom experience, a very large percentage of gifted students have a parent (or both parents) who are in some way connected to the field of education – either by being a classroom teacher, a college professor, an FFA camp director, or an administrative position. If this is the case, then a primary focus of the home is likely education; with that focus comes taking the kids to museums, sending the kids away to space camps, more distant traveling, and so forth. This is likely the topic of a whole new dissertation – suffice it to say that the researcher is not surprised by this finding.

Implications for Practice

In summary, this study revealed that the middle school students at this site agree that they generally have a positive attitude toward science. Although differences could be found (some statistically significant) between demographic groups, the mean scores for every subscale fall in the 2.5-3.5 range (3 = agree, 4 = strongly agree). The perceptions of teacher support scale revealed that these perceptions are important in forming a student's attitude toward science (possibly even more important than prior science experiences). The biggest findings in the prior background experiences scale are that students of lower SES have had fewer prior science experiences than students of higher SES (although the researcher admits that this may be tied to activity cost) AND that gifted students have had significantly more prior science experiences than non-gifted students.

What does this mean for science teachers in the classroom and curriculum directors and educational leaders across the state? A child's attitudes towards science is definitely connected to his relationship with his teacher and with his prior experiences in science. This means that not only should we have content specialist teachers in our classrooms (who can help provide some of the prior science experiences through hands-on instruction), but we also need teachers who know how to build a healthy educational relationship with students. No matter how smart a teacher is, if he cannot find a way to connect with h

Limitations

There are a few limitations that are relevant to this study. The study population was a convenience sample drawn from a large group of students. The entire student population was invited, but only those who returned the parent consent form were allowed to participate. The analysis, therefore, was site-specific, as are the generalizations that may be made from this study. Any further generalizations should be made with caution. In quantitative studies involving large amounts of survey data (such as this study), analysis may reveal broad trends in the data; extreme outliers may be "hidden" in the averaging process. Additional studies that are more qualitative in nature might reveal more individual findings.
is students, minimal learning will occur.

Recommendations for Future Study

This quantitative study is only a first step in understanding the complex relationship between a student's prior experiences, perceptions of teacher support, and attitudes toward a subject (not specific to science). Future research could continue to investigate this relationship in other groups of students in the field of science, or it could lay a foundation for future research in other content areas.

Since there was no random sampling, the findings of this study are limited to the research site and possibly the other middle schools in the nearby vicinity. It would be interesting to replicate this study at more research sites locally to be able to compare the results on a county-wide scale. It might also be interesting to replicate this study in a location that is not close by (in another part of the country for example) to be able to compare results.

As with many quantitative studies, this study gave a broad overview of attitudes and experiences in science. One of the key findings in this study is the importance of teacher support in the classroom. It might be interesting to design a qualitative study to be able to delve further into some of the attitudes that the students reported. For example, it would be interesting to be able to set up interviews (or panel discussions) with groups of students to discuss in what ways they felt that their teacher supported them in the classroom.

The most significant finding of this study is that teacher support combined with rich prior experiences in science promote more positive attitudes in science. Of all of the demographic variables presented, grade level status was the most consistently significant variable (statistically); the variables of socio-economic status and gifted status also proved to be significant in the majority of analyses. These findings provide a springboard for possible future research efforts in the fields of gifted education, science education, and middle school education.

The findings related to gifted education show that gifted students have a more positive attitude in general towards science, they deem science a useful subject (more often than their non-gifted peers), and their confidence levels in science are higher. This is not surprising given the “motivation” component of the gifted identification process; many gifted students are motivated learners. What is missing in this analysis is the breakdown of gifted data by gender, race, SES, and grade level. While not the focus of this study, existing data from this study could be used to further analyze these variables; additional studies could also be conducted with solely gifted students across a wider geographic range either concentrated on middle school students or expanded to include elementary and high school students. Qualitative methods (i.e. interviewing, observation, document analysis) might also be employed to look for deeper understanding of the impact that perceptions of teacher support and extent of prior experiences have on gifted students’ attitudes towards science.

Findings related to science education include the importance of teacher support and opportunities to engage in science activities (both inside and outside of school). Given the current nationwide emphasis on science, technology, engineering, and math (STEM) fields, future research endeavors could include studies considering the impact of science education on a student’s eventual career goals. In other words, researching science/math majors and adults who work in STEM-related fields to find out what impacted their field choice. The current study starts at the middle school base and attempts to project its impact onto future pursuits; looking at the issue from current adults and working backwards to early school experiences would be quite insightful. For example, if it is discovered that attending science camps as a child had a major impact on a person’s eventual adult career choice, then maybe an initiative could be established to provide more and varied science camps for kids to attend (with the hopes that it might inspire some of them to pursue that path in college and beyond).

The most significant finding related to middle school education is that students’ interests and attitudes toward science drop as they enter middle school, followed by a drop each successive year. Not only does the literature support this, but the findings of this study mirror this phenomenon as well. It is imperative that educators work to increase student interest, confidence, and application of science. Future research pursuits might include a study of high-performing science programs or schools which are magnet schools for science education. With the new Common Core curriculum being put into place, science is being given new emphasis in the classroom. Research surrounding the impact of this new curriculum (and its methods) will provide a rich area of interest over the next decade. One area not addressed in this study is the drop in science attitudes from elementary (5th grade) to middle school (6th grade), although it is readily found in the literature. A longitudinal study about science attitudes starting from 4th grade and ending in the 10th grade could provide significant data about how science attitudes evolve over time. The ever-changing face of middle school education (and specifically science education) provides a canvas for vast amounts of future research.

Summary and Conclusion

This study was informed by the literature on differences in gender, giftedness, and age with respect to achievement barriers and trends in learning. This study was able to dissect specific attitudes toward science by gender, giftedness, and grade level (as well as by race and SES, although they were not the primary focus). It was also able to gather information about perceptions of how much the students felt that they were supported by their teachers in the science classroom, and in analysis, how important that is in determining attitudes toward science. Lastly, an assessment of students' prior experiences in science was analyzed to look for discrepancies by gender, giftedness, grade level, race, and SES – this was also analyzed and related to students' attitudes toward science.

The study contributes to the literature as it explores student attitudes toward science as it is predicted by prior experiences and perceptions of teacher support. In conducting the initial literature review for this study, the researcher found very few (if any) articles that addressed these constructs together. This study fills a gap in the literature on the connection between prior science experience/perceptions of teacher support and attitudes towards science. It also creates a starting point for further research on effective middle school science practices. Specifically, it highlights the importance of teacher support in the classroom in forming positive attitudes toward science.

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Appendix A – Final Copy of Survey (administered electronically)

1. I like learning new things about science.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree

2. I think that science will be useful to me when I am an adult.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
3. I am good at doing science labs.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
4. I think that science is important in everyday life.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
5. I like learning about science even when I am not at school.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
6. I think that learning about science is a waste of time.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
7. I am not very good at science.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
8. I can make good grades in science.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
9. I think that science may help me get ahead in life.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree

10. I am better at science than many students in my class.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
11. I like watching science shows and videos.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
12. I think that science is useful in solving problems.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
13. I like reading about or watching news stories related to science.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
14. I enjoy doing science experiments.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
15. I see myself as a science person.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
16. Others see me as a science person.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
17. I really enjoy my science class this year.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
18. I believe that I will need science for my future career or job.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
    -

19. My science class this year is a waste of time.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
20. I think that my science class this year is boring.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
21. I think that what I learn in science will be useful in college.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
22. I am certain that I can understand the most difficult material in the textbook I use in science class this year.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
23. I am confident that I can do an excellent job on assignments in science class this year.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
24. My science teacher this year values and listens to students' ideas.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
25. My science teacher this year treats students with respect.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
26. I often raise my hand to participate in science discussions or answer questions in class.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree
27. This year, my science teacher treats every student fairly.
    - Strongly Disagree
    - Disagree
    - Agree
    - Strongly Agree

28. This year, I believe that my science teacher thinks that every student can be successful.
   - Strongly Disagree
   - Disagree
   - Agree
   - Strongly Agree
29. This year, I believe that my science teacher thinks that mistakes are okay as long as all students learn.
   - Strongly Disagree
   - Disagree
   - Agree
   - Strongly Agree
30. This year, my science teacher treats some kids better than other kids.
   - Strongly Disagree
   - Disagree
   - Agree
   - Strongly Agree
31. This year, my science teacher makes science interesting.
   - Strongly Disagree
   - Disagree
   - Agree
   - Strongly Agree
32. This year, my science teacher treats boys and girls differently.
   - Strongly Disagree
   - Disagree
   - Agree
   - Strongly Agree
33. This year, my science teacher makes science easy to understand.
   - Strongly Disagree
   - Disagree
   - Agree
   - Strongly Agree

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34. Not including field trips, I have visited a science museum or aquarium…
   - Never
   - Once
   - 2 or 3 times
   - 4 or more times
35. Outside of school, I have taken apart or fixed something electronic…
   - Never
   - Once
   - 2 or 3 times
   - 4 or more times

36. I have spent time watching and identifying birds…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times
37. Outside of school, I have built and/or launched a model rocket…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times
38. I have used a telescope or star map to observe stars and constellations…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times
39. Outside of school, I have designed a computer game…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times
40. Outside of school, I have studied nature (such as on a walk through the woods or on the beach)…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times
41. I have rescued an injured animal and helped it to get well…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times
42. Outside of school, I have built an electric circuit…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times
43. Outside of school, I have used a microscope…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times
44. I have been inside of a cave…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times
45. I have mixed household chemicals together to watch the reaction…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times
    -

46. Outside of school, I have used tools and measuring instruments to build something…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times

47. I have planted or helped take care of a garden (vegetable or flower)…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times
48. Outside of school, I have built a model (such as a volcano or solar system)…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times
49. Not including field trips, I have been to a zoo…
    - Never
    - Once
    - 2 or 3 times
    - 4 or more times

50. I have participated in 4H or a scout program (Girl Scouts or Boy Scouts)…
    - Yes
    - No
51. I often read nutrition labels on food to see what it contains…
    - Yes
    - No
52. I have collected natural objects (such as rocks, shells, or butterflies)…
    - Yes
    - No
53. I have owned or cared for a pet (this includes family pets)…
    - Yes
    - No
54. In the future, I would consider a career in science or technology…
    - Yes
    - No
55. I often look at the weather forecast for the day or week.
    - Yes
    - No
56. What grade are you in?
    - 6
    - 7
    - 8
57. How old are you?
    - 10
    - 11
    - 12
    - 13

- 14
- 15

58. Do you receive free or reduced lunch?
    - Yes
    - No
    - I don't know
59. Are you taking any Quest or Honor's courses right now?
    - Yes
    - No
60. Is your science teacher male or female?
    - Male
    - Female
61. Are you male or female?
    - Male
    - Female
62. In middle school, have you taken a science class that was single-gender (all boys or all girls)?
    - Yes
    - No
63. If you have taken a single-gender science class, what do you feel were the benefits of this arrangement?
64. If you have taken a single-gender science class, what were the drawbacks of this arrangement?
65. Some people think that boys are naturally better at science than girls, some think that girls are naturally better, and some people think that they are equally capable. What do you think?
66. What is your race/ethnicity?

Appendix B – Parent Consent Form

PARENTAL PERMISSION FORM

I agree to allow my child, ______________________, to take part in a research study titled, "Middle School Students' Attitudes Toward Science" which is being conducted by Mrs. Vicki Meeler, from the Educational Psychology Department at the University of Georgia under the direction of Dr. Tarek Grantham. My child's participation is voluntary which means I do not have to allow my child to be in this study if I do not want to. My child can refuse to participate or stop taking part at any time without giving any reason, and without penalty or loss of benefits to which she/he is otherwise entitled.

The reason for the study is to find out what attitudes children have concerning their interests and abilities in science; the goal of the study is to find out if girls' attitudes differ from boys' attitudes.

- Children who take part will give the researchers information that the researcher hopes may help other children learn science better in the future.
- If I allow my child to take part, my child will be asked to complete a short survey concerning attitudes and beliefs about science. The survey should take less than 10 minutes to complete. This activity will take place during morning homeroom and will not interfere with instructional time. If I do not want my child to take part then she/he will be allowed to study or read as usual. Potential benefits for your child might include better science instruction that takes pre-existing attitudes and beliefs into account.
- The research is not expected to cause any harm or discomfort. My child can quit at any time. My child's grade will not be affected if my child decides not to participate or to stop taking part.
- There will be no individually identifiable information on the survey; no risk or harm is expected from completion of the survey.
- The researcher will answer any questions about the research now, or during the course of the project, and can be reached by telephone at 770.385.6453 or email at meeler.vicki@newton.k12.ga.us. I may also contact the professor supervising the research, Dr. Tarek Grantham, at 706.542.4110 or grantham@uga.edu.
- I understand the study procedures described above. My questions have been answered to my satisfaction, and I agree to allow my child to take part in this study. I have been offered a copy of this form to keep.

_________________________	________________________	__________
Name of Researcher	Signature	Date
__________________________	________________________	
Name of Student	Homeroom	
_________________________	________________________	__________
Name of Parent	Signature	Date

Please sign and return to your child's homeroom teacher. If you would like to have a copy, please write a note on the top of this paper and a copy will be mailed to you.

Additional questions or problems regarding your child's rights as a research participant should be addressed to The Chairperson, Institutional Review Board, University of Georgia, 629 Boyd Graduate Studies Research Center, Athens, Georgia 30602; Telephone (706) 542-3199; E-Mail irb@uga.edu.

Appendix C – Minor Assent Form

June 1, 2011

Minor Assent Form

Dear Participant,

You are invited to participate in my research project titled, "Middle School Students' Attitudes Toward Science." Through this project I am learning about the attitudes that middle school students have toward the study of science.

If you decide to be part of this, you will allow me to survey you concerning your thoughts and feelings about science. The survey is anonymous (will not have your name on it), and should take less than 10 minutes to complete. Your participation in this project is voluntary and will not affect your grades in school. However, because of your participation , science students in the future may benefit from better class structures and assignments.

There are no foreseeable risks or discomforts in completing the survey; however, if you refuse to participate or want to stop participating in this project, you are free to do so at any time without penalty or loss of benefits to which you are otherwise entitled. You can also choose not to answer questions that you don't want to answer.

If you have any questions or concerns you can always ask me or call my teacher, Dr. Tarek Grantham at the following number: 706-542-4110.

Sincerely,

Vicki Lynne Watts Meeler
Department of Educational Psychology
University of Georgia
Meeler.vicki@newton.k12.ga.us

I understand the project described above. My questions have been answered and I agree to participate in this project. I have received a copy of this form.

____
Signature of the Participant/Date

Please sign both copies, keep one and return one to the researcher.

Additional questions or problems regarding your rights as a research participant should be addressed to The Chairperson, Institutional Review Board, University of Georgia, 629 Boyd Graduate Studies Research Center, Athens, Georgia 30602; Telephone (706) 542-3199; E-Mail Address IRB@uga.edu

Appendix D. Oral Directions for Survey Administration

The following script will be used for survey administration:

“Today you will be doing an activity that will help us to gather information about your experiences in science and your attitudes about that subject in school. Please answer as many questions as you can as honestly as you can. This will be anonymous – no one will be able to match the responses to the person who stated them. Your answers will help us to improve science instruction for you and future students in our county. When you are finished, you may log out.”

Appendix E: Written Directions for Survey Administration (appears twice because I cut them in half)

Directions:

1. Log on and go to the Internet
2. On the ICMS webpage, click on “students and teachers”
3. Click on “Elearn”
4. Scroll down the right side until you find “middle school” – click on it
5. Click on Indian Creek Middle School
6. Click on Vicki Meeler
7. Choose 7th grade Life Science
8. Log on “as a guest”
9. In the first box, there are four items – click on “Science Survey”
10. Take the survey
11. When you are finished, click “yes” and log off – sign the consent form and come trade it for a piece of candy☺

Directions:

1. Log on and go to the Internet
2. On the ICMS webpage, click on “students and teachers”
3. Click on “Elearn”
4. Scroll down the right side until you find “middle school” – click on it
5. Click on Indian Creek Middle School
6. Click on Vicki Meeler
7. Choose 7th grade Life Science
8. Log on “as a guest”
9. In the first box, there are four items – click on “Science Survey”
10. Take the survey
11. When you are finished, click “yes” and log off – sign the consent form and come trade it for a piece of candy☺

Appendix F. Breakdown of Sample Population

Grade Level	Number of Students	Gender	SES	Gifted status	race
6th grade	232	110 male 119 female	114 on free/reduced lunch; 74 not F/R	70 gifted 161 nongifted	139 White 52 Black 4 Biracial 1 Pacific Islander 2 Asian 5 Hispanic 29 No race given
7th grade	198	98 male 100 female	78 on free/reduced lunch; 94 not F/R	67 gifted 129 nongifted	116 White 46 Black 4 Biracial 0 Pacific Islander 0 Asian 4 Hispanic 28 No race given
8th grade	173	83 male 90 female	75 on free/reduced lunch; 72 not F/R	49 gifted 123 nongifted	96 White 35 Black 6 Biracial 0 Pacific Islander 2 Asian 6 Hispanic 28 No race given
TOTAL	603 (14 did not respond to grade level)	291 male 309 female (17 did not respond to the gender question)	267 on free/reduced lunch; 240 not on F/R lunch (16 did not answer this question; 94 answered "I don't know")	186 gifted 413 nongifted (18 did not respond to the gifted question)	351 White 133 Black 14 Biracial 1 Pacific Islander 4 Asian 15 Hispanic 85 No race given

Appendix G. Science Attitudes – Frequencies by Questions (E, U, and C)

Table Appendix G1. Enjoyment of Science – Frequency by Question

Survey Question	N	Missing	Frequency / % Strongly Disagree (1)	Frequency/ % Disagree (2)	Frequency/ % Agree (3)	Frequency/ % Strongly Agree (4)
E1 – like learning new things about science	617	0	10/1.6%	24/3.9%	376/60.9%	207/33.5%
E5 – like learning about science even out of school	615	2	46/7.5%	164/26.7%	303/49.3%	102/16.6%
E11 – like watching science shows and videos	604	13	21/3.5%	90/14.9%	332/55.0%	161/26.7%
E13 – like reading about or watching science news stories	601	16	31/5.2%	169/28.1%	310/51.6%	91/15.1%
E14 – enjoy doing science experiments	604	13	3/.5%	14/2.3%	198/32.8%	389/64.4%
E17 – really enjoy my science class this year	604	13	13/2.2%	47/7.8%	259/42.9%	285/47.2%
E20 (reversed) – think my science class this year is boring	603	14	284/47.1%	251/41.6%	54/9.0%	14/2.3%

Table Appendix G2. Usefulness of Science – Frequency by Question

Survey Question	**N**	**Missing**	**Frequency/ % Strongly Disagree (1)**	**Frequency/ % Disagree (2)**	**Frequency/ % Agree (3)**	**Frequency/ % Strongly Agree (4)**
U2 – science will be useful as adult	616	1	15/ 2.4%	72/ 11.7%	347/ 56.3%	182/29.5%
U4 – science is important in everyday life	615	2	13/ 2.1%	77/ 12.5%	363/ 59.0%	162/ 26.3%
U9 – science may help me get ahead in life	603	14	11/ 1.8%	84/ 13.9%	362/ 60.0%	146/ 24.2%
U12 – science is useful in solving problems	604	13	16/ 2.6%	110/ 18.2%	377/ 62.4%	101/ 16.7%
U18 – I may need science for my future career/job	604	13	52/ 8.6%	149/ 24.7%	255/ 42.2%	148/ 24.5%
U21 – what I learn in science will be useful in college	603	14	14/2.3%	24/ 4.0%	299/ 49.6%	266/ 44.1%
U6 rev – learning about science is a waste of time	604	13	309/ 51.2%	264/ 43.7%	24/ 4.0%	7/ 1.2%
U19 rev – science class this year was a waste of time	603	14	353/58.5%	223/ 37.0%	24/ 4.0%	3/ .5%

Table AppendixG3. Self-Confidence in Science – Frequency by Question

Survey Question	N	Missing	Frequency/ % Strongly Disagree (1)	Frequency/ % Disagree (2)	Frequency/ % Agree (3)	Frequency/ % Strongly Agree (4)
C3 – I am good at doing science labs	614	3	6/ 1.0%	36/ 5.9%	326/ 53.1%	246/ 40.1%
C8 – I can make good grades in science	604	13	11/ 1.8%	26/ 4.3%	298/ 49.3%	269/ 44.5%
C10 – I am better at science than many students in my class	604	13	57/ 9.4%	244/ 40.4%	247/ 40.9%	56/ 9.3%
C15 – I see myself as a science person.	604	13	86/14.2%	226/ 37.4%	232/ 38.4%	60/ 9.9%
C16 – Others see me as a science person.	603	14	91/ 15.1%	301/ 49.9%	179/ 29.7%	32/ 5.3%
C22 – I am certain that I can understand difficult text material	602	15	36/ 6.0%	163/ 27.1%	310/ 51.5%	93/ 15.4%
C23 – I can do an excellent job on science assignments	603	14	12/ 2.0%	60/ 10.0%	364/ 60.4%	167/ 27.7%
C26 – I often raise my hand for discussion or answers	601	16	16/ 2.7%	98/ 16.3%	329/ 54.7%	158/ 26.3%
C7 rev – I am not very good at science	604	13	210/ 34.8%	280/ 46.4%	84/ 13.9%	30/ 5.0%

Appendix H – Item Analysis by Gender

Comparing Means and Responses of Enjoyment (E) of Science by Gender

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree – M=male, F=female

Chart H1. Enjoyment of Science – Comparison of Means by Gender

	E1	E5	E11	E13	E14	E17	E20 rev
Mean (M)	3.28	2.64	3.07	2.73	3.55	3.28	3.31
Mean (F)	3.25	2.84	3.02	2.80	3.67	3.42	3.36
N (M)	291	291	291	290	291	291	290
N (F)	311	311	311	309	311	311	311
Stand. Dev (M)	.676	.869	.778	.800	.593	.748	.76626
Stand. Dev (F)	.546	.763	.709	.730	.524	.681	.70862
Average mean	**3.26**	**2.74**	**3.04**	**2.76**	**3.61**	**3.35**	**3.33**
	E1	**E5**	**E11**	**E13**	**E14**	**E17**	**E20 rev**

Chart H2. Enjoyment of Science - Frequency of Responses by Gender

	E1	E5	E11	E13	E14	E17	*E20 rev
% Strongly Disagree (M)	2.4%	10.7%	4.5%	6.9%	0.7%	3.4%	46.2%
% Strongly Disagree (F)	1.0%	4.8%	2.6%	3.6%	0.3%	1.0%	47.9%
% Disagree (M)	5.5%	29.9%	13.4%	28.3%	3.1%	7.6%	41.4%
% Disagree (F)	2.6%	24.1%	16.4%	28.2%	1.6%	8.0%	41.8%
% Agree (M)	54.0%	44.0%	52.6%	49.7%	36.8%	46.7%	9.3%
% Agree (F)	66.9%	53.7%	57.6%	53.4%	29.3%	39.2%	9.0%
% Strongly Agree (M)	38.1%	15.5%	29.6%	15.2%	59.5%	42.3%	3.1%
% Strongly Agree (F)	29.6%	17.4%	23.5%	14.9%	68.8%	51.8%	1.6%

*E20 is written as a reverse item.

Comparing Means and Responses of Usefulness (U) of Science by Gender

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree – M=male, F=female

Chart H3. Usefulness of Science – Comparison of Means by Gender

	U2	U18	U9	U12	U21	U4	U6 rev	U19 rev
Mean (M)	3.10	2.71	3.00	2.88	3.31	3.05	3.41	3.48
Mean (F)	3.16	2.93	3.13	2.98	3.39	3.14	3.48	3.59
N (M)	291	291	290	291	290	291	291	290
N (F)	310	311	311	311	311	311	311	311
Stand. Dev (M)	.777	.920	.703	.708	.712	.713	.716	.656
Stand. Dev (F)	.625	.870	.635	.632	.628	.642	.538	.537
Average mean	**3.13**	**2.83**	**3.06**	**2.93**	**3.35**	**3.10**	**3.45**	**3.54**
	U2	**U18**	**U9**	**U12**	**U21**	**U4**	**U6 rev**	**U19 rev**

Chart H4. Usefulness of Science – Frequency of Responses by Gender

	U2	U18	U9	U12	U21	U4	*U6 rev	*U19 rev
% Strongly Disagree (M)	4.8%	10.7%	3.1%	3.8%	3.1%	3.1%	52.2%	55.9%
% Strongly Disagree (F)	0.3%	6.8%	0.6%	1.6%	1.6%	1.0%	50.2%	61.1%
% Disagree (M)	11.3%	28.5%	15.5%	20.6%	5.2%	13.7%	39.2%	37.2%
% Disagree (F)	11.6%	21.2%	12.5%	16.1%	2.9%	11.6%	47.9%	36.7%
% Agree (M)	53.3%	39.5%	60.0%	59.8%	49.0%	58.4%	6.2%	5.9%
% Agree (F)	59.4%	44.4%	60.1%	65.0%	50.2%	59.8%	1.9%	2.3%
% Strongly Agree (M)	30.6%	21.3%	21.4%	15.8%	42.8%	24.7%	2.4%	1.0%
% Strongly Agree (F)	28.7%	27.7%	26.7%	17.4%	45.3%	27.7%	0.0%	0.0%

*U6 and U19 are written as reverse items.

Comparing Means and Responses of Self-Confidence (C) in Science by Gender

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree – M=male, F=female

Chart H5. Self-Confidence in Science – Comparison of Means by Gender

	C3	C8	C10	C15	C16	C22	C23	C26	C7 rev
Mean (M)	3.29	3.38	2.57	2.40	2.20	2.78	3.09	3.03	3.17
Mean (F)	3.35	3.35	2.42	2.47	2.30	2.74	3.18	3.06	3.05
N (M)	290	291	291	291	290	289	290	290	291
N (F)	311	311	311	311	311	311	311	309	311
Stand. Dev (M)	.658	.691	.790	.883	.763	.785	.682	.771	.80389
Stand. Dev (F)	.599	.619	.783	.826	.773	.778	.641	.689	.83526
Average mean	**3.32**	**3.37**	**2.50**	**2.44**	**2.25**	**2.76**	**3.14**	**3.05**	**3.11**
	C3	**C8**	**C10**	**C15**	**C16**	**C22**	**C23**	**C26**	**C7 rev**

Chart H6. Self-Confidence in Science – Frequency of Responses by Gender

	C3	C8	C10	C15	C16	C22	C23	C26	C7 rev
% Strongly Disagree (M)	1.7%	3.1%	7.2%	16.5%	16.6%	6.2%	3.4%	4.1%	37.8%
% Strongly Disagree (F)	0.3%	0.6%	11.6 %	12.2%	13.5%	5.8%	0.6%	1.3%	31.8%
% Disagree (M)	6.2%	2.7%	39.9 %	37.1%	51.4%	25.3%	8.6%	15.5%	46.0%
% Disagree (F)	5.5%	5.8%	41.2 %	37.6%	48.9%	28.9%	11.3%	17.2%	46.6%
% Agree (M)	53.8 %	47.1 %	41.2 %	36.1%	27.6%	52.6%	63.1%	53.1%	11.7%
% Agree (F)	52.7 %	51.4 %	40.5 %	40.8%	31.8%	50.5%	57.9%	56.3%	16.1%
% Strongly Agree (M)	38.3 %	47.1 %	11.7 %	10.3%	4.5%	15.9%	24.8%	27.2%	4.5%
% Strongly Agree (F)	41.5 %	42.1 %	6.8%	9.3%	5.8%	14.8%	30.2%	25.2%	5.5%

Appendix I. Comparison of Means by Race for Individual Attitude Items (Item Analysis) Comparing Means and Responses of Enjoyment (E) of Science by Race

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree; W=white, B = Black

Chart I1. Enjoyment of Science – Comparison of Means by Race

	E1	E5	E11	E13	E14	E17	E20 rev
Mean (W)	3.30	2.76	3.05	2.75	3.60	3.34	3.31
Mean (B)	3.26	2.76	3.06	2.82	3.63	3.37	3.40
N (W)	355	355	352	352	352	352	351
N (B)	136	136	133	132	133	133	133
Stand. Dev (W)	.604	.799	.701	.778	.546	.730	.762
Stand. Dev (B)	.575	.821	.789	.780	.585	.714	.675
Average mean	**3.28**	**2.76**	**3.55**	**2.79**	**3.62**	**3.36**	**3.36**

Chart I2. Enjoyment of Science – Frequency of Responses by Race (W=white, N= Nonwhite)

	E1	E5	E11	E13	E14	E17	E20rev
% Strongly Disagree (W)	1.4%	6.20%	2.56%	5.40%	0.0%	2.27%	2.56%
% Strongly Disagree (B)	.007%	6.62%	3.01%	4.55%	1.5%	2.26%	1.50%
% Disagree (W)	3.38%	27.32%	14.20%	29.83%	2.84%	8.52%	10.54%
% Disagree (B)	4.41%	27.21%	18.80%	27.27%	.008%	6.77%	6.02%
% Agree (W)	58.87%	49.86%	58.24%	49.43%	34.38%	42.33%	40.17%
% Agree (B)	63.24%	47.79%	47.37%	50.0%	30.83%	42.86%	42.86%
% Strongly Agree (W)	36.34%	16.62%	25.0%	15.34%	62.78%	46.88%	46.72%
% Strongly Agree (B)	31.62%	18.38%	30.83%	18.18%	66.92%	48.12%	49.62%

*E20 is written as a reverse item.

Comparing Means and Responses of Usefulness (U) of Science by Race

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree

Chart I3. Usefulness of Science – Comparison of Means by Race (W=white, B=Black)

	U2	U4	U9	U12	U18	U21	U6rev	U19rev
Mean (W)	3.16	3.09	3.06	2.95	2.83	3.35	3.42	3.52
Mean (B)	3.11	3.17	3.10	2.89	2.86	3.41	3.49	3.62
N (W)	354	355	351	352	352	352	352	351
N (B)	136	136	133	133	133	133	133	133
Stand. Dev (W)	.690	.668	.658	.659	.907	.664	.650	.614
Stand. Dev (B)	.721	.665	.684	.699	.880	.730	.572	.533
Average mean	**3.14**	**3.13**	**3.08**	**2.92**	**2.85**	**3.38**	**3.46**	**3.57**

Chart I4. Usefulness of Science - Frequency of Responses by Race

	U2	U4	U9	U12	U18	U21	U6rev	U19rev
% Strongly Disagree (W)	1.69%	1.97%	1.71%	1.99%	8.52%	2.27%	1.42%	0.28%
% Strongly Disagree (B)	3.68%	1.48%	1.50%	4.51%	6.77%	3.76%	0.75%	0.00%
% Disagree (W)	12.15%	12.39%	13.68%	17.90%	24.72%	3.69%	4.54%	5.41%
% Disagree (B)	9.56%	10.29%	14.29%	16.54%	26.32%	3.01%	1.50%	2.26%
% Agree (W)	54.80%	60.56%	61.82%	62.22%	41.19%	50.85%	44.03%	36.47%
% Agree (B)	58.82%	56.62%	57.14%	63.91%	41.35%	41.35%	45.86%	33.83%
% Strongly Agree (W)	31.36%	25.07%	22.79%	17.90%	25.57%	43.18%	50.0%	57.83%
% Strongly Agree (B)	27.94%	31.62%	27.07%	15.04%	25.56%	51.88%	51.88%	63.91%

*U6 and U19 are written as reverse items.

Comparing Means and Responses of Self-Confidence (C) in Science by Race

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree

Chart I5. Self Confidence in Science – Comparison of Means by Race (W==White, B= Black)

	C3	C8	C10	C15	C16	C22	C23	C26	C7 rev
Mean (W)	3.35	3.38	2.55	2.43	2.31	2.77	3.15	3.03	3.14
Mean (B)	3.27	3.39	2.45	2.41	2.14	2.73	3.18	3.06	3.07
N (W)	354	352	352	352	351	352	352	351	352
N (B)	136	133	133	133	133	133	133	132	133
Stand. Dev (W)	.626	.651	.783	.868	.766	.800	.659	.720	.847
Stand. Dev (B)	.649	.638	.733	.770	.726	.708	.588	.696	.720
Average mean	**3.33**	**3.38**	**2.52**	**2.43**	**2.26**	**2.76**	**3.16**	**3.04**	**3.12**
	C3	**C8**	**C10**	**C15**	**C16**	**C22**	**C23**	**C26**	**C7 rev**

Chart I6. Self-Confidence in Science – Frequency of Responses by Race

	C3	C8	C10	C15	C16	C22	C23	C26	C7 rev
% Strongly Disagree (W)	0.01%	1.70%	8.24%	15.06%	13.39%	6.53%	1.70%	3.13%	5.11 %
% Strongly Disagree (B)	1.47%	1.50%	8.27%	12.03%	16.54%	3.76%	1.50%	0.008 %	3.01 %
% Disagree (W)	5.65%	4.26%	38.35%	36.65%	47.01%	26.70%	10.23%	14.81 %	14.20 %
% Disagree (B)	6.62%	3.76%	44.36%	39.85%	16.54%	30.83%	5.26%	18.94 %	13.53 %
% Agree (W)	51.41%	48.58%	43.47%	38.07%	34.47%	50.28%	59.66%	57.55 %	41.76 %
% Agree (B)	55.15%	48.88%	41.35%	42.86%	22.56%	54.14%	66.92%	53.79 %	57.14 %
% Strongly Agree (W)	42.09%	45.45%	9.94%	10.23%	5.13%	16.48%	28.41%	24.50 %	38.92 %
% Strongly Agree (B)	36.76%	45.86%	6.02%	5.26%	3.76%	11.28%	26.32%	26.52 %	26.32 %

*C7 is written as a reverse item.

Appendix J. Comparison of Means by Grade Level for Individual Attitude Items (Item Analysis)

Comparing Means and Responses of Enjoyment (E) of Science by Grade Level

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree

Chart J1 . Enjoyment of Science – Comparison of Means by Grade Level

	E1	E5	E11	E13	E14	E17	E20 Rev
Mean (6)	3.33	2.81	3.15	2.83	3.67	3.38	3.40
Mean (7)	3.31	2.76	3.04	2.77	3.69	3.45	3.47
Mean (8)	3.12	2.64	2.91	2.67	3.45	3.18	3.08
N (6)	232	232	232	231	232	232	231
N (7)	198	198	198	197	198	198	198
N (8)	173	173	173	172	173	173	173
Stand. Dev (6)	.621	.838	.761	.759	.548	.741	.721
Stand. Dev (7)	.607	.782	.675	.772	.536	.634	.703
Stand. Dev(8)	.583	.835	.776	.757	.574	.747	.735
Average mean	**3.26**	**2.74**	**3.05**	**2.76**	**3.61**	**3.35**	**3.33**

Chart J2. Enjoyment of Science – Frequency of Responses by Grade Level (6, 7, 8)

	E1	E5	E11	E13	E14	E17	E20 rev
% Strongly Disagree (6)	1.3%	6.5%	3.4%	3.9%	0.4%	2.2%	52.8%
% Strongly Disagree (7)	1.5%	6.1%	1.5%	5.6%	0.5%	0.5%	58.1%
% Strongly Disagree (8)	2.3%	11.0%	5.8%	6.4%	0.6%	4.0%	26.6%
% Disagree (6)	4.3%	27.2%	12.1%	26.8%	2.6%	9.1%	35.9%
% Disagree (7)	3.0%	27.3%	16.2%	26.9%	2.0%	6.1%	32.8%
% Disagree (8)	4.6%	26.6%	17.3%	31.4%	2.3%	8.1%	59.5%
% Agree (6)	54.7%	45.7%	50.4%	51.5%	26.7%	37.1%	10.0%
% Agree (7)	58.1%	51.5%	59.1%	52.3%	25.8%	40.9%	7.6%
% Agree (8)	71.7%	50.3%	56.6%	51.2%	49.1%	53.2%	9.2%
% Strongly Agree (6)	39.7%	20.7%	34.1%	17.7%	70.3%	51.7%	1.3%
% Strongly Agree (7)	37.4%	15.2%	23.2%	15.2%	71.7%	52.5%	1.5%
% Strongly Agree (8)	21.4%	12.1%	20.2%	11.0%	48.0%	34.7%	4.6%

Comparing Means and Responses of Usefulness (U) of Science by Grade Level

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree

Chart J3. Usefulness of Science – Comparison of Means by Grade Level

	U2	U4	U9	U12	U18	U21	U6rev	U19rev
Mean (6)	3.13	3.10	3.13	2.97	2.88	3.48	3.59	3.51
Mean (7)	3.19	3.14	3.09	2.94	2.85	3.37	3.63	3.55
Mean (8)	3.06	3.03	2.95	2.87	2.73	3.16	3.35	3.25
N (6)	231	232	231	232	232	232	232	232
N (7)	198	198	198	198	198	198	198	198
N (8)	173	173	173	173	173	172	172	173
Stand. Dev (6)	.669	.735	.673	.711	.894	.638	.603	.610
Stand. Dev (7)	.706	.681	.614	.626	.888	.654	.563	.565
Stand. Dev(8)	.745	.609	.717	.664	.916	.687	.598	.683
Average mean	**3.13**	**3.09**	**3.06**	**2.93**	**2.83**	**3.35**	**3.53**	**3.45**

Chart J4. Usefulness of Science - Frequency of Responses by Grade Level

	U2	U4	U9	U12	U18	U21	U6rev	U19rev
% Strongly Disagree (6)	2.2%	2.6%	1.3%	3.0%	8.2%	1.3%	56.0%	64.7%
% Strongly Disagree (7)	2.5%	1.5%	1.0%	1.5%	7.1%	2.0%	58.1%	66.7%
% Strongly Disagree (8)	2.9%	2.3%	3.5%	3.5%	11.0%	4.1%	36.4%	40.7%
% Disagree (6)	10.0%	14.7%	13.0%	17.7%	22.0%	3.9%	39.7%	31.0%
% Disagree (7)	9.6%	12.6%	11.6%	18.2%	26.8%	3.5%	39.4%	29.3%
% Disagree (8)	16.2%	9.8%	17.9%	19.1%	26.0%	4.7%	54.3%	54.1%
% Agree (6)	60.2%	53.0%	57.1%	58.6%	43.5%	40.1%	3.4%	3.4%
% Agree (7)	54.5%	56.6%	64.6%	65.2%	40.4%	49.5%	2.0%	4.0%
% Agree (8)	53.2%	69.9%	59.0%	64.7%	42.2%	62.8%	6.9%	4.7%
% Strongly Agree (6)	27.7%	29.7%	28.6%	20.7%	26.3%	54.7%	0.9%	0.9%
% Strongly Agree (7)	33.3%	29.3%	22.7%	15.2%	25.8%	44.9%	0.5%	0.00%
% Strongly Agree (8)	27.7%	17.9%	19.7%	12.7%	20.8%	28.5%	2.3%	0.6%

Comparing Means and Responses of Self-Confidence (C) in Science by Grade Level

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree

Chart J5. Self Confidence in Science – Comparison of Means by Grade Level

	C3	C8	C10	C15	C16	C22	C23	C26	C7rev
Mean (6)	3.28	3.40	2.50	2.49	2.24	2.85	3.19	3.08	3.15
Mean (7)	3.39	3.41	2.49	2.47	2.26	2.75	3.21	3.13	3.16
Mean (8)	3.31	3.27	2.50	2.33	2.25	2.66	2.98	2.90	2.99
N (6)	232	232	232	232	231	232	232	232	232
N (7)	197	198	198	198	198	197	198	198	198
N (8)	173	173	173	173	173	172	172	170	17773
Stand. Dev (6)	.590	.636	.80	.816	.734	.794	.674	.698	.810
Stand. Dev (7)	.618	.645	.766	.899	.793	.780	.626	.693	.802
Stand. Dev(8)	.685	.683	.804	.843	.795	.751	.662	.789	.849
Average mean	**3.32**	**3.36**	**2.50**	**2.44**	**2.25**	**2.76**	**3.14**	**3.04**	**3.11**

Chart J6. Self-Confidence in Science – Frequency of Responses by Grade Level

	C3	C8	C10	C15	C16	C22	C23	C26	C7rev
% Strongly Disagree (6)	0.4%	1.7%	9.1%	12.1%	13.4%	4.7%	2.2%	2.2%	37.5%
% Strongly Disagree (7)	1.5%	1.0%	8.6	15.2%	16.7%	6.6%	0.5%	1.0%	36.4%
% Strongly Disagree (8)	1.2%	2.9%	11.0%	16.2%	15.6%	7.0%	3.5%	5.3%	28.9%
% Disagree (6)	6.0%	3.0%	42.2%	35.8%	53.7%	25.9%	8.6%	14.2%	44.0%
% Disagree (7)	2.5%	5.6%	41.9%	34.8%	46.0%	26.4%	9.6%	15.2%	48.5%
% Disagree (8)	9.2%	4.6%	36.4%	42.8%	49.7%	29.7%	12.2%	20.6%	47.4%
% Agree (6)	59.1%	49.1%	38.4%	43.5%	28.6%	49.1%	57.8%	57.3%	14.7%
% Agree (7)	51.3%	44.9%	41.4%	37.4%	32.3%	52.8%	58.1%	53.5%	10.1%
% Agree (8)	47.4%	54.9%	43.9%	32.9%	28.3%	53.5%	66.9%	52.9%	17.3%
% Strongly Agree (6)	34.5%	46.1%	10.3%	8.6%	4.3%	20.3%	31.5%	26.3%	3.9%
% Strongly Agree (7)	44.7%	48.5%	8.1%	12.6%	5.1%	14.2%	31.8%	30.3%	5.1%
% Strongly Agree (8)	42.2%	37.6%	8.7%	8.1%	6.4%	9.9%	17.4%	21.2%	6.4%

Appendix K. Comparison of Means by SES for Individual Attitude Items (Item Analysis)
Comparing Means and Responses of Enjoyment (E) of Science by SES

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree – F=free/reduced; N=No free/red.

Chart K1. Enjoyment of Science – Comparison of Means by SES

	E1	**E5**	**E11**	**E13**	**E14**	**E17**	**E20 rev**
Mean (F)	3.32	2.76	3.07	2.82	3.66	3.37	3.34
Mean (N)	3.22	2.70	2.99	2.71	3.60	3.34	3.33
N (F)	267	267	267	266	267	267	266
N (N)	240	240	240	138	240	240	240
Stand. Dev (F)	.564	.785	.743	.744	.512	.712	.743
Stand. Dev (N)	.578	.827	.769	.778	.607	.727	.714
Average mean	**3.27**	**2.73**	**3.03**	**2.77**	**3.63**	**3.36**	**3.34**
	E1	**E5**	**E11**	**E13**	**E14**	**E17**	**E20 rev**

Chart K2. Enjoyment of Science – Frequency of Responses by SES

	E1	**E5**	**E11**	**E13**	**E14**	**E17**	***E20 rev**
% Strongly Disagree (F)	1.5%	6.4%	3.7%	4.1%	0.4%	1.9%	48.5%
% Strongly Disagree (N)	1.3%	8.8%	3.3%	6.3%	0.8%	2.5%	45.8%
% Disagree (F)	1.5%	27.3%	12.7%	26.3%	0.7%	8.2%	38.7%
% Disagree (N)	4.2%	27.5%	19.6%	30.3%	3.8%	7.5%	44.2%
% Agree (F)	60.7%	50.6%	55.8%	53.8%	30.7%	41.6%	10.9%
% Agree (N)	65.8%	49.2%	51.3%	50.0%	30.4%	43.8%	7.9%
% Strongly Agree (F)	36.3%	15.7%	27.7%	15.8%	68.2%	48.3%	1.9%
% Strongly Agree (N)	28.8%	14.6%	25.8%	13.4%	65.0%	46.3%	2.1%

*E20 is written as a reverse item.

Comparing Means and Responses of Usefulness (U) of Science by SES

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree – F=free/red; N= no free/red.

Chart K3. Usefulness of Science – Comparison of Means by SES

	U2	U18	U9	U12	U21	U4	U6 rev	U19 rev
Mean (F)	3.12	2.76	3.03	2.89	3.34	3.10	3.48	3.57
Mean (N)	3.15	2.87	3.09	2.96	3.34	3.07	3.40	3.50
N (F)	266	267	267	267	266	267	267	267
N (N)	240	240	239	240	240	240	240	240
Stand. Dev (F)	.687	.857	.668	.701	.678	.678	.571	.586
Stand. Dev (N)	.714	.946	.674	.658	.690	.687	.690	.620
Average mean	**3.14**	**2.82**	**3.06**	**2.93**	**3.34**	**3.09**	**3.44**	**3.54**
	U2	**U18**	**U9**	**U12**	**U21**	**U4**	**U6 rev**	**U19 rev**

Chart K4. Usefulness of Science – Frequency of Responses by SES

	U2	U18	U9	U12	U21	U4	*U6 rev	*U19 rev
% Strongly Disagree (F)	1.9%	7.1%	1.5%	3.0%	1.9%	2.2%	52.1%	61.4%
% Strongly Disagree (N)	2.9%	10.0%	2.1%	2.5%	3.3%	2.5%	49.2%	56.3%
% Disagree (F)	12.4%	30.3%	16.5%	21.7%	6.0%	11.6%	44.2%	34.5%
% Disagree (N)	10.4%	22.1%	12.1%	16.3%	2.5%	12.9%	45.0%	38.8%
% Agree (F)	57.1%	42.3%	59.9%	58.8%	48.1%	59.9%	3.7%	3.7%
% Agree (N)	55.8%	39.2%	60.3%	64.2%	51.3%	60.0%	2.9%	4.2%
% Strongly Agree (F)	28.6%	20.2%	22.1%	16.5%	44.0%	26.2%	0.0%	0.4%
% Strongly Agree (N)	30.8%	28.8%	25.5%	17.1%	42.9%	24.6%	2.9%	0.8%

*U6 and U19 are written as reverse items.

Comparing Means and Responses of Self-Confidence (C) in Science by SES

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree – F=free/red.; N= no free/red.

Chart K5. Self-Confidence in Science – Comparison of Means by SES

	C3	**C8**	**C10**	**C15**	**C16**	**C22**	**C23**	**C26**	**C7 rev**
Mean (F)	3.31	3.36	2.39	2.42	2.18	2.83	3.12	3.03	3.04
Mean (N)	3.40	3.39	2.63	2.45	2.29	2.73	3.18	3.05	3.18
N (F)	267	267	267	267	267	265	266	266	267
N (N)	239	240	240	240	240	240	240	239	240
Stand. Dev (F)	.628	.612	.808	.825	.736	.783	.623	.708	.849
Stand. Dev (N)	.605	.656	.737	.876	.770	.726	.631	.740	.771
Average mean	**3.36**	**3.38**	**2.51**	**2.44**	**2.24**	**2.78**	**3.15**	**3.04**	**3.11**
	C3	**C8**	**C10**	**C15**	**C16**	**C22**	**C23**	**C26**	**C7 rev**

Chart K6. Self-Confidence in Science – Frequency of responses by SES

	C3	**C8**	**C10**	**C15**	**C16**	**C22**	**C23**	**C26**	**C7 rev**
% Strongly Disagree (F)	0.7%	0.7%	12.0%	12.0%	15.7%	4.9%	1.1%	2.3%	32.2%
% Strongly Disagree (N)	1.3%	2.1%	5.8%	15.8%	14.2%	5.4%	1.3%	3.3%	36.3%
% Disagree (F)	6.7%	4.9%	45.3%	44.2%	53.9%	26.0%	10.5%	16.9%	44.9%
% Disagree (N)	2.5%	3.3%	34.6%	33.3%	47.5%	27.5%	8.8%	14.6%	50.0%
% Agree (F)	53.6%	51.7%	34.1%	34.1%	26.6%	50.6%	63.2%	56.8%	17.2%
% Agree (N)	51.5%	48.3%	50.0%	40.8%	33.3%	56.3%	60.8%	55.2%	9.6%
% Strongly Agree (F)	39.0%	42.7%	8.6%	9.7%	3.7%	18.5%	25.2%	24.1%	5.6%
% Strongly Agree (N)	44.8%	46.3%	9.6%	10.0%	5.0%	10.8%	29.2%	26.8%	4.2%

*C7 is written as a reverse item.

Appendix L. Comparison of Means by Gifted Status for Individual Attitude Items (Item Analysis)

Comparing Means and Responses of Enjoyment (E) of Science by Gifted Status

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree – G=Gifted; N=Not Gifted

Chart L1. Enjoyment of Science – Comparison of Means by Gifted Status

	E1	**E5**	**E11**	**E13**	**E14**	**E17**	**E20 rev**
Mean (G)	3.21	2.81	3.06	2.75	3.65	3.42	3.38
Mean (N)	3.29	2.71	3.04	2.78	3.60	3.32	3.31
N (G)	186	186	186	185	186	186	186
N (N)	413	413	413	411	413	413	412
Stand. Dev (G)	.601	.809	.707	.818	.582	.687	.704
Stand. Dev (N)	.618	.829	.764	.741	.551	.728	.752
Average mean	**3.25**	**2.76**	**3.05**	**2.77**	**3.63**	**3.37**	**3.35**
	E1	**E5**	**E11**	**E13**	**E14**	**E17**	**E20 rev**

Chart L2. Enjoyment of Science - Frequency of Responses by Gifted Status

	E1	**E5**	**E11**	**E13**	**E14**	**E17**	***E20 rev**
% Strongly Disagree (G)	1.6%	6.5%	2.2%	7.0%	1.1%	1.6%	48.9%
% Strongly Disagree (N)	1.7%	8.2%	4.1%	4.4%	0.2%	2.4%	46.1%
% Disagree (G)	4.8%	24.7%	15.6%	28.1%	2.2%	6.5%	41.4%
% Disagree (N)	3.6%	28.3%	14.8%	28.0%	2.4%	8.2%	41.7%
% Agree (G)	64.5%	50.5%	56.5%	48.1%	28.0%	40.3%	8.1%
% Agree (N)	58.6%	47.7%	54.0%	53.3%	34.6%	43.8%	9.5%
% Strongly Agree (G)	29.0%	18.3%	25.8%	16.8%	68.8%	51.6%	1.6%
% Strongly Agree (N)	36.1%	15.7%	27.1%	14.4%	62.7%	45.5%	2.7%

*E20 is written as a reverse item.

Comparing Means and Responses of Usefulness (U) of Science by Gifted Status

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree – G=Gifted, N= Not Gifted

Chart L3. Usefulness of Science – Comparison of Means by Gifted Status

	U2	U18	U9	U12	U21	U4	U6 rev	U19 rev
Mean (G)	3.23	2.99	3.17	3.09	3.44	3.12	3.48	3.54
Mean (N)	3.09	2.76	3.01	2.86	3.32	3.08	3.44	3.53
N (G)	186	186	185	186	186	186	186	186
N (N)	412	413	413	413	412	413	413	412
Stand. Dev (G)	.684	.930	.686	.609	.614	.671	.581	.607
Stand. Dev (N)	.711	.876	.661	.687	.694	.690	.649	.597
Average mean	**3.13**	**2.83**	**3.06**	**2.93**	**3.36**	**3.09**	**3.45**	**3.54**
	U2	**U18**	**U9**	**U12**	**U21**	**U4**	**U6 rev**	**U19 rev**

Chart L4. Usefulness of Science – Frequency of responses by Gifted Status

	U2	U18	U9	U12	U21	U4	*U6 rev	*U19 rev
% Strongly Disagree (G)	2.2%	8.6%	2.2%	1.6%	1.6%	2.2%	51.6%	59.7%
% Strongly Disagree (N)	2.7%	8.5%	1.7%	3.1%	2.7%	2.2%	51.3%	58.3%
% Disagree (G)	8.1%	17.7%	9.7%	9.7%	1.6%	10.8%	46.2%	35.5%
% Disagree (N)	13.1%	28.1%	16.0%	21.8%	5.1%	13.6%	42.4%	37.4%
% Agree (G)	54.8%	39.8%	56.8%	67.2%	48.4%	60.2%	1.1%	4.3%
% Agree (N)	56.8%	42.9%	61.5%	60.5%	49.8%	58.4%	5.1%	3.9%
% Strongly Agree (G)	34.9%	33.9%	31.4%	21.5%	48.4%	26.9%	1.1%	0.5%
% Strongly Agree (N)	27.4%	20.6%	20.8%	14.5%	42.5%	25.9%	1.2%	0.5%

*U6 and U19 are written as reverse items.

Comparing Means and Responses of Self-Confidence (C) in Science by Gifted Status

Scale: ranged from 1-4; 1 being strongly disagree; 4 being strongly agree – G=Gifted; N=Not Gifted

Chart L5. Self-Confidence in Science – Comparison of Means by Gifted Status

	C3	C8	C10	C15	C16	C22	C23	C26	C7 rev
Mean (G)	3.39	3.46	2.68	2.57	2.41	2.87	3.22	3.05	3.21
Mean (N)	3.30	3.33	2.42	2.38	2.18	2.73	3.10	3.05	3.07
N (G)	185	186	186	186	186	186	186	185	186
N (N)	413	413	413	413	412	411	412	411	413
Stand. Dev (G)	.609	.598	.745	.869	.809	.791	.630	.707	.781
Stand. Dev (N)	.635	.677	.798	.843	.742	.765	.676	.734	.832
Average mean	**3.33**	**3.37**	**2.50**	**2.44**	**2.25**	**2.77**	**3.14**	**3.05**	**3.11**
	C3	**C8**	**C10**	**C15**	**C16**	**C22**	**C23**	**C26**	**C7 rev**

Chart L6. Self-Confidence in Science – Frequency of Responses by Gifted Status

	C3	C8	C10	C15	C16	C22	C23	C26	C7 rev
% Strongly Disagree (G)	1.1%	1.1%	2.7%	12.4%	12.4%	4.8%	1.1%	1.6%	38.7%
% Strongly Disagree (N)	1.0%	2.2%	12.6%	15.3%	16.0%	6.1%	2.4%	2.9%	33.2%
% Disagree (G)	3.2%	2.2%	40.9%	31.2%	42.5%	24.2%	8.1%	17.3%	47.8%
% Disagree (N)	6.8%	5.3%	40.2%	40.2%	53.4%	28.5%	10.9%	15.6%	45.8%
% Agree (G)	50.8%	46.8%	42.5%	43.5%	37.1%	50.5%	59.1%	55.7%	9.1%
% Agree (N)	54.0%	50.1%	40.2%	36.1%	26.7%	52.3%	60.7%	54.7%	16.0%
% Strongly Agree (G)	44.9%	50.0%	14.0%	12.9%	8.1%	20.4%	31.7%	25.4%	4.3%
% Strongly Agree (N)	38.3%	42.4%	7.0%	8.5%	3.9%	13.1%	26.0%	26.8%	5.1%

*C7 is written as a reverse item.

Appendix M – Prior Science Experiences – Item Analysis (Total Score)

Chart M1. Prior Science Experience Frequency Responses

	% Never	% Once	% 2-3 times	% 4 or more times
B34 - museum	20.7%	24.7%	34.8%	19.8%
B35 - electronics	23.0%	23.2%	23.0%	30.8%
B36- birdwatching	52.7%	24.2%	14.2%	9.0%
B37 - rocketry	65.3%	21.3%	7.7%	5.7%
B38 - telescope	42.9%	27.0%	19.0%	11.0%
B39 - computers	81.6%	11.4%	4.2%	2.8%
B40 – nature walk	14.9%	13.5%	17.7%	53.9%
B41 – animal resc	37.5%	30.5%	19.3%	12.7%
B42 - electrical	77.1%	14.4%	4.9%	3.7%
B43 - microscope	45.6%	22.1%	19.6%	12.6%
B44 - cave	56.4%	24.4%	11.1%	8.1%
B45 - chemicals	43.1%	23.9%	18.2%	14.9%
B46 - measuring	24.6%	23.1%	23.8%	28.5%
B47 - gardening	15.4%	23.6%	27.5%	33.5%
B48 - models	39.5%	30.4%	19.6%	10.5%
B49 - zoo	13.9%	20.7%	33.6%	31.9%

Chart M2. Prior Science Experience Dichotomous Responses

	% No	%Yes
B50 – 4H scouts	45.9%	54.1%
B51 - nutrition	32.2%	67.8%
B52 - collections	22.5%	77.5%
B53 - pets	4.8%	95.2%
B54 – sci career	45.5%	54.5%
B55 - weather	28.7%	71.3%

Appendix N – Prior Science Experiences – Item Analysis by Gender

Prior Experiences in Science Variation by Gender (M=male, F=female)

Chart N1. Prior Science Experience Frequency Responses by Gender

	% Never (M)	%Never (F)	% Once (M)	% Once (F)	% 2-3 Times (M)	% 2-3 Times (F)	% 4+ Times (M)	% 4+ Times (F)
B34 - museum	21.4	20.1	30.3	19.4	27.9	41.1	20.3	19.4
B35 - electronics	16.3	29.4	17.6	28.4	23.2	22.6	42.9	19.7
B36-birdwatching	54.0	51.6	21.8	26.1	14.2	14.2	10.0	8.1
B37 - rocketry	54.5	75.6	26.4	16.3	10.4	5.2	8.7	2.9
B38 - telescope	41.5	44.3	27.7	26.5	18.3	19.7	12.5	9.4
B39 - computers	74.8	88.2	14.8	7.8	5.2	3.3	5.5	0.7
B40 – nature walk	17.0	12.9	14.5	12.6	14.2	20.7	54.3	53.7
B41 – animal resc	41.2	34.2	31.8	29.0	17.6	20.8	9.3	16.0
B42 - electrical	71.3	82.4	15.2	13.7	7.6	2.3	5.9	1.6
B43 - microscope	43.9	47.3	21.5	22.8	19.7	19.3	14.9	10.6
B44 - cave	52.6	60.1	24.7	24.1	10.3	11.6	12.4	4.2
B45 - chemicals	44.3	41.7	21.8	25.9	16.6	19.7	17.3	12.6
B46 - measuring	18.7	30.2	20.1	26.0	22.8	24.4	38.4	19.3
B47 - gardening	21.7	9.7	25.2	22.3	22.7	31.6	30.4	36.5
B48 - models	33.3	45.5	35.7	25.5	19.9	19.0	11.0	10.0
B49 - zoo	16.3	11.7	22.1	19.4	33.2	33.7	28.4	35.3

Chart N2. Prior Science Experience Dichotomous Responses by Gender

	% No (M)	%No (F)	% Yes (M)	% Yes (F)
B50 – 4H scouts	53.8	38.7	46.2	61.3
B51 - nutrition	38.6	26.1	61.4	73.9
B52 - collections	28.2	16.9	71.8	83.1
B53 - pets	5.2	4.5	94.8	95.5
B54 – sci career	42.4	48.6	57.6	51.4
B55 - weather	33.2	24.5	66.8	75.5

Appendix O – Prior Science Experiences – Item Analysis by Race

Chart O1. Prior Science Experiences Frequency Responses by Race (W=white, B=Black)

	% Never (W)	%Never (B)	% Once (W)	% Once (B)	% 2-3 Times (W)	% 2-3 Times (B)	% 4+ Times (W)	% 4+ Times (B)
B34- museum	20.80	23.49	24.50	23.49	32.19	34.94	22.51	16.27
B35 - electronics	22.57	24.10	23.43	22.90	22.86	23.49	31.14	29.52
B36- birdwatching	53.16	48.50	22.13	30.54	13.79	15.57	10.92	5.39
B37- rocketry	64.76	71.60	20.92	18.52	8.30	5.55	6.02	4.32
B38 - telescope	40.00	46.95	30.86	22.56	18.57	18.90	10.57	11.59
B39 - computers	82.13	83.73	10.95	9.63	3.46	4.22	3.46	2.41
B40 – nature walk	11.75	16.17	12.32	16.77	18.34	17.38	57.59	49.70
B41 – animal resc	36.21	38.18	31.32	29.70	19.54	16.97	12.93	15.15
B42 - electrical	75.07	78.53	15.19	14.72	4.58	4.91	5.16	1.84
B43 - microscope	42.86	48.19	23.71	21.69	21.14	16.27	12.29	13.86
B44 – cave	53.85	62.28	23.08	25.75	12.54	7.19	10.54	4.79
B45 – chemicals	44.13	40.96	24.36	24.70	17.77	18.07	13.75	16.27
B46 – measuring	22.00	27.71	21.71	26.51	25.14	20.48	31.14	25.30
B47 - gardening	15.27	14.55	23.92	24.24	26.51	26.67	34.29	34.55
B48 - models	41.14	38.32	29.71	31.13	17.71	22.75	11.43	7.78
B49 – zoo	12.07	15.66	22.13	16.87	30.75	38.55	35.06	28.92

Chart O2. Prior Science Experiences Dichotomous Responses by Race

	% No (W)	%No (B)	% Yes (W)	% Yes (B)
B50 – 4H/scouts	43.27	47.59	56.73	52.41
B51 - nutrition	34.10	30.06	65.90	69.94
B52 – collection	23.05	21.56	76.95	78.44
B53 – pets	4.32	4.82	95.68	95.18
B54 – sci career	41.38	50.30	58.62	49.70
B55 - weather	26.86	27.71	73.14	72.29

Appendix P – Prior Science Experiences – Item Analysis by Grade Level

Chart P1. Prior Science Experience Frequency Responses by Grade Level

	% Never (6)	%Never (7)	% Never (8)	% Once (6)	% Once (7)	% Once (8)	% 2-3 Times (6)	% 2-3 Times (7)	% 2-3 Times (8)	% 4+ Times (6)	% 4+ Times (7)	% 4+ Times (8)
B34 - museum	18.2	22.4	22.0	30.3	16.8	26.0	34.2	36.7	33.5	17.3	24.0	18.5
B35 - electronics	25.5	20.8	22.1	22.1	23.9	23.8	25.5	21.3	21.5	26.8	34.0	32.6
B36-birdwatching	50.2	47.7	61.6	21.2	27.9	23.8	16.5	16.2	8.7	12.1	8.1	5.8
B37 - rocketry	65.2	63.6	67.3	22.6	22.6	18.1	6.1	8.2	9.4	6.1	5.6	5.3
B38 - telescope	41.7	37.6	50.6	25.2	31.5	24.4	20.9	18.8	16.9	12.2	12.2	8.1
B39 - computers	82.8	78.8	83.1	9.3	14.6	10.5	4.0	3.5	5.2	4.0	3.0	1.2
B40 – nature walk	14.5	14.1	16.2	9.6	12.1	20.2	19.3	16.7	16.8	56.6	57.1	46.8
B41 – animal resc	40.8	33.3	38.0	26.8	36.4	28.7	19.7	22.2	15.2	12.7	8.1	18.1
B42 - electrical	80.4	75.9	73.8	11.7	15.4	16.9	4.3	3.6	7.0	3.5	5.1	2.3
B43 - microscope	45.3	38.6	54.1	21.6	27.9	16.3	22.8	16.8	18.6	10.3	16.8	11.0
B44 - cave	62.5	49.5	56.1	20.3	29.8	23.7	9.9	10.6	13.3	7.3	10.1	6.9
B45 - chemicals	47.6	41.1	39.3	21.4	25.4	25.4	17.9	16.2	20.8	13.1	17.3	14.5
B46 - measuring	26.7	20.9	26.0	20.3	30.1	19.1	28.4	20.9	20.8	24.6	28.1	34.1
B47 - gardening	13.0	13.9	20.3	22.1	24.7	24.4	26.0	30.9	25.6	39.0	30.4	29.7
B48 - models	33.2	37.4	50.6	28.9	35.9	26.2	23.3	17.7	16.9	14.7	9.1	6.4
B49 - zoo	14.3	13.7	13.4	21.3	16.8	24.4	32.2	37.6	30.8	32.2	32.0	31.4

Chart P2. Prior Science Experience Dichotomous Responses by Grade Level

	% No (6)	%No (7)	% No (8)	% Yes (6)	% Yes (7)	% Yes (8)
B50 – 4H scouts	44.4	44.3	49.7	55.6	55.7	50.3
B51 - nutrition	28.1	36.4	32.7	71.9	63.6	67.3
B52 - collections	15.2	24.5	30.2	84.8	75.5	69.8
B53 - pets	3.9	3.6	7.5	96.1	96.4	92.5
B54 – sci career	44.2	45.7	47.1	55.8	54.3	52.9
B55 - weather	25.2	27.4	34.7	74.8	72.6	65.3

Appendix Q – Prior Science Experiences – Item Analysis by SES

Chart Q1. Prior Science Experiences Frequency Responses by SES (F=free/reduced lunch; N= does not receive free/red. lunch)

	% Never (F)	%Never (N)	% Once (F)	% Once (N)	% 2-3 Times (F)	% 2-3 Times (N)	% 4+ Times (F)	% 4+ Times (N)
B34	27.1	12.2	28.6	19.3	28.9	42.0	15.4	26.5
B35	22.6	21.0	23.7	26.1	26.3	21.0	27.4	31.9
B36	48.7	55.9	29.2	21.8	12.7	13.9	9.4	8.4
B37	68.4	63.0	20.9	21.8	7.2	7.1	3.4	8.0
B38	48.5	37.2	25.0	29.7	15.2	23.4	11.4	9.6
B39	82.2	84.0	10.6	8.4	3.8	5.0	3.4	2.5
B40	19.6	12.6	14.3	10.5	19.2	15.9	46.8	61.1
B41	38.1	33.2	29.8	31.9	18.5	21.4	13.6	13.4
B42	82.1	74.8	11.4	16.0	3.8	3.4	2.7	5.9
B43	50.2	40.0	21.1	21.3	19.2	22.1	9.4	16.7
B44	65.5	44.6	21.0	31.3	7.1	14.2	6.4	10.0
B45	42.5	38.7	25.9	24.8	17.3	23.1	14.3	13.4
B46	30.5	17.1	23.3	22.9	23.3	24.6	22.9	35.4
B47	17.0	14.7	24.2	22.3	28.4	26.9	30.3	36.1
B48	41.6	42.5	32.2	25.8	19.1	19.2	7.1	12.5
B49	19.5	8.9	21.8	18.6	30.5	38.4	28.2	34.2

Chart Q2. Prior Science Experiences - Dichotomous Responses by SES

	% No (F)	%No (N)	% Yes (F)	% Yes (N)
B50	47.7	45.8	52.3	54.2
B51	30.3	34.2	69.7	65.8
B52	23.6	23.6	76.4	76.4
B53	5.6	3.4	94.4	96.6
B54	48.3	44.8	51.7	55.2
B55	28.9	29.4	71.1	70.6

Appendix R – Prior Science Experiences – Item Analysis by Gifted Status

Chart R1. Prior Science Experiences Frequency Responses by Gifted Status (G=Gifted, N= Not Gifted)

	% Never (G)	%Never (N)	% Once (G)	% Once (N)	% 2-3 Times (G)	% 2-3 Times (N)	% 4+ Times (G)	% 4+ Times (N)
B34 – museum/aq.	10.3	25.3	17.8	27.7	42.7	31.1	29.2	15.8
B35 – electronics	16.2	26.0	27.6	21.2	21.6	23.6	34.6	29.2
B36- bird watching	50.5	53.4	23.9	24.3	18.5	12.4	7.1	10.0
B37 – rocketry	63.4	66.0	22.0	21.2	7.0	7.9	7.5	4.9
B38 - telescopes	37.3	45.1	28.1	26.8	22.2	17.6	12.4	10.5
B39- computers	79.9	82.2	11.4	11.5	5.4	3.7	3.3	2.7
B40- nature study	11.4	16.6	10.3	14.6	18.4	17.3	60.0	51.5
B41- animal recov	37.8	37.3	30.3	30.6	21.6	18.1	10.3	14.0
B42 - electrical	73.5	78.9	15.1	14.0	5.4	4.4	5.9	2.7
B43 - microscope	35.5	50.1	23.7	21.4	23.7	17.8	17.2	10.7
B44 – cave	48.4	59.8	23.7	24.7	15.6	9.2	12.4	6.3
B45- chemicals	38.4	45.1	20.0	25.6	24.9	15.4	16.8	13.9
B46 – tools & bldg.	17.7	27.7	20.4	24.3	30.6	20.9	31.2	27.0
B47 - gardening	15.3	15.6	22.4	24.1	28.4	26.6	28.4	26.6
B48 – models	39.2	39.3	28.0	31.6	19.4	19.9	13.4	9.2
B49 – zoo	7.1	16.8	19.0	21.4	31.5	34.5	42.4	27.3

Chart R2. Prior Science Experiences - Dichotomous Responses by Gifted Status

	% No (G)	%No (N)	% Yes (G)	% Yes (N)
B50 – 4H/scouts	42.5	47.3	57.5	52.7
B51 - nutrition	29.2	33.1	70.8	66.9
B52- collections	16.1	25.2	83.9	74.8
B53- pets	3.3	5.6	96.7	94.4
B54- sci career	31.4	51.6	68.6	48.4
B55 - weather	25.9	29.9	74.1	70.1