RESIDENT SCIENTISTS IN THE CLASSROOM:

SECONDARY SCIENCE STUDENTS' ATTITUDES TOWARDS SCIENCE IN THE

NSF GK-12 PROGRAM *PROJECT FLOWING WATERS*

THESIS

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RESIDENT SCIENTISTS IN THE CLASSROOM: SECONDARY SCIENCE STUDENTS'

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FLOWING WATERS

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DEDICATION

I would like to dedicate this thesis to my cousins Robert Kam Jr. and Justin Kam and their beloved step mother, Lana Kam, and father, Robert Kam Sr., whom both lost their lives to cancer. Robbie and Justin don't forget to take care of each other.

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RESIDENT SCIENTISTS IN THE CLASSROOM: SECONDARY SCIENCE

STUDENTS' ATTITUDES TOWARDS SCIENCE

IN THE NSF GK-12 PROGRAM PROJECT FLOWING WATERS

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The National Science Foundation (NSF) and Texas Pioneer Foundation supported program Project Flowing Waters is a NSF Graduate STEM Fellows in K-12 Education (GK-12) program, that funded ten doctoral students in the Texas State University Biology and Geography Departments to serve as "resident scientists" in high and middle school science classrooms. This study examines the first two years of this program in the 2008-2009 and 2009-2010 school years. The science teachers were from two junior high schools and one high school in the San Marcos Consolidated Independent School District

(SMICSD). The education part of Project Flowing Waters was to provide SMCISD science classrooms with a "resident scientist" who would develop inquiry science lessons and describe their scientific research to secondary students. Project Flowing Waters GK-12 fellows, "resident scientists", had two jobs; to conduct scientific research and to collaborate with local secondary science teachers on inquiry science lessons. Through this program, middle and high school students experienced resident scientist led inquiry lessons and field trips to enable them to master the science Texas Essential Knowledge and Skills, (TEKS) throughout the entire academic year. The purpose of this study was to determine the secondary school students' attitudes towards science before and after their experiences with the NSF GK-12 fellows, "resident scientists". The primary data sources in this study are pre and post student attitude surveys. Other secondary data include applications, lesson plans, research posters, pictures, test results and demographic information.

We analyzed the attitudes of secondary school students (n= 126) in 2 science teachers classes in the first year and (n=284) in 5 science teachers' classes that had NSF GK-12 Fellows. We compared their attitudes prior to and after their experiences with resident scientists. We analyzed their attitudes on six dimensions: 1. *Beliefs About Science*, 2. *Beliefs About Own Science Ability*, 3. *Importance / Usefulness of Science*, 4. *Effort that they put into their science work*, 5. *Parent/Guardian Involvement*, and 6. *Expectancy for Higher Education*.

There were significant differences ($p<0.05$) in students' attitudes before and after a year with resident scientists in the first and second year. In the first year, there were significant differences in a positive direction in students' attitudes towards *Beliefs About Science* in one of the two teachers' classes. And, in the second year, there were also significant changes in a positive direction in students' attitudes towards *Beliefs About Science* in three of the five teachers' classes. Also, in one of the teachers' classes there was a significant difference in a positive direction in their *Expectancy for Higher Education*.

Students provided comments concerning their GK-12 fellows, resident scientists, in the open-ended sections of the survey. The most frequent comments were that resident scientists were "cool" and "helpful". They also felt that they were more clear, were interesting, taught a lot, taught with more detail, had good labs, and made science learning fun. In terms of aquatic science, the students commented frequently that they learned about endangered species, the ecosystem, and blind salamanders.

CHAPTER I.

INTRODUCTION

Resident scientists in the classroom: secondary science students' attitudes towards science in the NSF GK-12 program Project Flowing Waters

This study encompasses the pilot study in the first year, 2008-2009, and the second year, 2009-2010 of *Project Flowing Waters*. The program is funded and supported by the National Science Foundation (NSF) Graduate Teaching Fellows in K-12 Education (GK-12) program and the Texas Pioneer Foundation that provides substantial training fellowships to support graduate students in the STEM disciplines. NSF is attempting, through the GK-12 program, to improve the communication, collaboration, and team building skills of the future science professoriate. In this program, graduate students develop and implement science lessons that are "inquiry-based." This is to capitalize on children's natural tendencies to ask the question "Why?" by providing learning environments that encourages questions. With the development of these inquiry-based lesson plans, graduate students learn to communicate complicated science concepts. The Texas State University-San Marcos GK-12 program, *Project Flowing Waters*, has established a collaborative partnership with the local school district, San Marcos Consolidated Independent School District (SMCISD). The schools included in this study are Goodnight Middle School, Phoenix Alternative High School, San Marcos High School and Miller Middle School. The 2008 and 2009 NSF GK-12 fellows were trained by Dr. Julie Westerlund (PI) through the course BIO 7100 *Professional Development - Inquiry Science Teaching* that was initiated in June 2008. This professional development course trained doctoral level graduate students in inquiry science teaching, national and state science standards, and the nature of science. The ultimate goal of the *Project Flowing Waters* program is to prepare the graduate students to teach using inquiry-based techniques beyond their tenure in *Project Flowing Waters*.

Rationale of the Study

Science is generally taught in the United States using didactic methods of teaching (Alberts, 2009). Alternatively, inquiry based science teaching, shown to be effective in science learning, is not being utilized (Alberts, 2009). The National Science Education Standards [NSES] promotes the use of inquiry-based teaching in the United States by emphasizing the importance of students questioning the world around them. In addition, the mission statement of the NSES is to "guide the nation toward a scientifically literate society" (NRC p. 11, 1996).

International science tests are often used as measures of scientific literacy in nations. The Program of International Student Assessment (PISA) was developed as an organization to assess the different levels of academic progress for fifteen-year-olds in countries all over the world. The scale of assessment ranges from 0-650. The United States in 2009, ranked 23rd with an average score of 502 versus Shanghai-China with an average score of 575, and putting it first in ranking of participating countries (OCED, 2009). The most recent 2009 Third International Mathematics and Science Study (TIMSS) results for the United States had 4th graders ranking at third place of participating countries with a score of 565. South Korean 4th graders ranked first with a score of 597. The international average was 524 (TIMSS Science Study, p. 3, 2011). The United States 8th graders placed 17th with a score of 534 with Singapore ranking first with a score of 607 (TIMSS Science Study p. 5, 2011). The international average was 516. By the 12th grade, United States students ranked 16th place with a score of 480 and below the international average of 500. Sweden students ranked first with a score of 559 (TIMSS Science Study p. 8, 2011). The declining performance of the students as they progress through the grade levels may indicate a need to increase science education into the secondary school system (TIMSS Science Study p. 11, 2011).

The National Assessment of Educational Progress (NAEP) is a national test of scientific literacy in the United States. The National Center for Education Statistics is an organization that reports the scores from the NAEP (NRC, 2011). The NAEP is considered the nation's *educational yardstick* since 1969. The test scores are broken down on a scale from 0 to 300 where 150 is the median that represents a basic level of understanding of the subject matter and 165 represents a proficient level of the subject matter (TNRC p. 1, 2011). Similar to the TIMMS, the NAEP science scores decrease as students progress through the grade levels. The 4th grade 2009 science results showed 72% performing above the basic level and 34% performing above proficient (TNRC p. 7, 2011). The 8th grade results indicate 63% performed at or above the basic level, and 30% performed at or above proficient (TNRC p. 24, 2011). Lastly, the 12th grade level results indicate 60% of the students perform at the basic level and 21% performed at or above proficient (TNRC p. 45, 2011). To raise the secondary students' proficiencies in the field of science, there needs to be improvement in the secondary educational environment. The program *Project Flowing Waters* provide changes to the secondary classroom environments through the presence of resident scientists in the classrooms every week.

Project Flowing Waters "is founded on the interdisciplinary theme of water and emphasizes inquiry-based teaching of science related to water" (Project Flowing Waters, 2010). This program encourages inquiry-based teaching through the use of inquiry trained resident scientists in the classroom to encourage the development of higher level cognitive thinking skills (Project Flowing Waters, 2011). The purpose of this study is to see if secondary science students have changed their attitudes in six specific dimensions after a resident scientist has been in their classroom for 8 months. These dimensions include: 1. *Beliefs about Science*, 2. *Beliefs about Own Science Ability*, 3. *Importance / Usefulness of Science*, 4. *Effort that they put into their science work*, 5. *Parent/Guardian Involvement*, and 6. *Expectancy for Higher Education*.

Research Question

Are there differences in secondary students' attitudes towards science in six specific dimensions after being with GK-12 fellows, resident scientists, for 8 months?

CHAPTER II.

LITERATURE REVIEW

Scientific Inquiry

Understanding science concepts is important in modern society as more decisions are being made regarding the environment, health, and the implementation of technology into our daily lives. The National Research Council (NRC), one of the societies of the National Academy of Science that sets the standards for research and science education. The NRC recommends that teaching for the understanding of science concepts should be "based on the conviction that scientific inquiry is at the heart of science and science learning" (National Research Council, (NRC p. 15, 1996). Inquiry is defined by the NRC.

> Inquiry is a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and considerations of alternative explanations (NRC, p. 23, 1996).

In science classes students need to be encouraged to develop their own ideas and to be able to explore them. Teachers who practice inquiry-based teaching act as "coaches" instead of "judges". They encourage their students to think like scientists when exploring problems or ideas (NRC p. 88, 1996). It is expected through inquiry-based science teaching that students will be able to transfer scientific thinking skills into their everyday lives when making critical decisions. For example, if there is an opportunity to invest in the stock market, the students can gather facts and weigh their decision based on previous knowledge and historical patterns in the stock market. Students' use of inquiry skills to make decisions about a company may be based upon their exploration of the stock market instead of company advertising sent to them. Or, they may need to make decisions about their own health or the health of the planet that requires scientific thinking skills. This illustrates the value of critical thinking in everyday life.

Inquiry-Based Teaching

Inquiry-based teaching provides opportunities for students to explore and question their world. "Science provides a special way of looking at the world" stated scientist and educator John A. Moore (Alberts, 2009). He believed that science is based not only knowledge but the necessity to question what is around them to acquire more knowledge. Also, students who participate in active scientific discussions are able to interpret or begin to interpret scientific explanations and not just "know" scientific information (Alberts, 2009). In order for students to participate in discussions, students need to be interested in the topic and want to have their voices heard. The primary functions of inquiry-based teaching are to foster interest and understanding in science so students will become active participants in discussions about science.

History of Inquiry-Based Teaching

Individuals throughout history have come to understand science through inquiry-based methods. Galileo, in the 1500s, along with many other Italians during the

Renaissance period, found that using your senses and reasoning were the best ways to come to know the world (Finley & Pocovi, 2011). Educational philosopher John Dewey, in the early 1900s, emphasized that *scientific thinking as a state of mind* should be taught in science rather than science simply as an accumulation of knowledge (Bybee, 2011). J. Frank Dame, a contemporary of Dewey, stated, “The idea of knowledge for its own sake is abandoned as being narrow and selfish” (Dame, p. 107, 1939). He believed that “the purpose of the school is supposed to *kindle and awake enthusiasm* in the human being” (Dame, p. 107, 1939). There are different ways to *kindle and awake enthusiasm* and to teach *scientific thinking as a state of mind.* For example, Louis Agassiz, who developed the concept of a global “ice age” in the recent geological post and taught at Harvard, directed field trips and encouraged his students to create their own collections (Bybee, 2011). Charles W. Eliot, Harvard University President from 1869 to 1895, encouraged the use of laboratories in science courses (Bybee, 2011). And, Joseph J. Schwab in the 1950s and 1960s encouraged students to participate in discussions. Schwab also encouraged science teachers to provide readings, reports, and books about research to their students. And, he encouraged teachers to have their students read and discuss theories, alternative explanations, experiments and use of evidence (Bybee, 2011). F. James Rutherford, in 1964, formalizes that *inquiry-based teaching of science* is about teaching the scientific processes and critical thinking, rather than rote memorization (Bybee, 2011). Also, during the 1960s, the Biological Sciences Curriculum Study (BSCS) begin preparing textbook series that were all inquiry-based. In the 1980s, BSCS created the 5E Method that became the industry standard for inquiry-based teaching in science education.

The steps in the 5 E Model are:

- Engagement
  - Tap prior knowledge
  - Identify Misconceptions
  - Spark interest in the topic
  - Focus learners' thinking
- Exploration
  - Provide learners with common, concrete experiences with skills and concepts
  - Observe and listen to students
  - Ask probing questions
  - Act as a consultant
- Explanation
  - Encourage students to explain concepts in their own words
  - Ask for justification
  - Use students' previous experiences as the basis for explaining concepts
  - Clarify and correct misconceptions
- Elaboration
  - Apply same concepts in a new context resulting in deeper and broader understanding
  - Encourage the students to apply the concepts/skills to new situations via new activities
- Evaluation
  - Observe students as they apply new concepts and skills
  - Assess in both knowledge and skills

BSCS (Biological Sciences Curriculum Study, 1989)

In 1985, Rutherford launched Project 2061, an inquiry-based curriculum, that spear-headed the inquiry-based movement to create the National Science Education Standards [NSES] that were published in 1996. (NRC,1996; Bybee, 2011). The NSES is based upon the foundation of inquiry-based science teaching.

Need For Inquiry-Based Teaching-Creativity

A ten-year study of 20,000 middle-class American students in grades 6 through 10 showed that 40% of students that regularly attended school were "disengaged" from learning (Alberts, 2011). How are students disengaged in learning if they are born with a natural curiosity? If their curiosity is dismissed by adults, then children will begin to develop the passive and unquestioning persona of an adult (Alberts, 2011). The dismissal of curiosity also leads to a decrease in creativity where *out of the box* thinking becomes obsolete. Kyung Hee Kim determined that creativity has been declining since 1990 after analyzing 300,000 Torrance scores of children and adults (Bronson & Merryman, 2011). The Torrence test is scored using picture and oral formats where a detailed manual is used to score and interpret results within populations (Torrance Scoring, 2011). The Torrance score is based on elementary school children's ability for creativity. An increase in television watching and video games since 1990 instead of "engaging in creative activities" may explain the decrease in scores (Bronson & Merryman, 2011). A classroom where students are doing inquiry-based activities generally have a high level of energy, students are interacting with materials, and activities tend to be more open rather than highly structured (Wheeler, 2011). This type of learning environment fosters creativity and thinking *out of the box*.

Inquiry-Based Learning Environment - Characteristics and Examples

Thinking *out of the box* and creativity thrives in inquiry-based learning environments with specific characteristics. Wheeler (2011) described these characteristics as "three faces of inquiry-based teaching". The first face is an image of children that are engaged in classroom activities with a high level of energy (Wheeler, 2011). The second face Wheeler describes is an image of students interacting with the material in the classroom (Wheeler, 2011). Finally, the third face is when students become responsible for their own learning (Wheeler, 2011). These "faces" of inquiry can be further illustrated with specific classroom examples. The first "face" is illustrated by a teacher who encourages her students to ask questions as to why the water level in a bowel in the classroom was lowering without providing possible explanations (Bybee, 2011). This gave the students the freedom to discuss the problem and come up with their own solutions. In classroom number two, the teacher passed out different models of several brachiopods and then proceeded to ask questions about their observations of the many different species (Bybee, 2011). This allowed students to piece the puzzle together themselves regarding offspring, mutations, and the characteristics of biological evolution (Bybee, 2011). In classroom number three, students read books and then discussed what guided scientists to their discoveries showed the abilities of students to decipher information through their own studies (Bybee, 2011). The inquiry-based instruction in all three classrooms changed the atmosphere of the students' learning environments and allowed students to think on their own and share ideas with others. By doing this, the teachers were able to teach the students a different way to perceive information and view the world.

Teachers in inquiry-based classroom environment encourage the "Why? Why?" type of questioning thereby allowing the students to discover answers and not just regurgitate knowledge. In an inquiry-based laboratory activity, the atmosphere tends to be more concept building rather than an atmosphere of predetermined results (Finley and Pocovi, 2011). An interview with nineteen college professors found that inquiry-based teaching increased motivation and critical thinking in their students during classroom activities (Brown, Abell, Demir, and Schmidt, 2011). These increases are through the students' abilities to relate information to their own life and background to create their own rational ideas. Students who question the world around them by using ones own background and knowledge, opens up paths for creativity. Furthermore, if students have opportunities to question their world with others, it stimulates the building of ideas through collaboration.

It is important for students to feel like they are a part of their own learning in the classroom. In inquiry-based classrooms, students are asked to think through their own thought process and encouraged to participate in the classroom. In traditional classrooms, teachers typically ask students questions that have a right or wrong answer. For example, a teacher giving a “question-and-answer activity” as the primary learning activity of the classroom will stifle the students’ ability to think of other possibilities through the creative process (Swhartz, Y., Weizman, et al., 2009). With inquiry-based teaching, students are encouraged to express their own ideas, evaluate and critique their own ideas and those of their peers, as well as revise and integrate these ideas (Swhartz, Y., Weizman, et al., 2009). Students in inquiry classrooms ask questions that are centered around their interests and misunderstandings (Swhartz, Y., Weizman, et al., 2009).

Cooperative learning and Inquiry-Based Techniques

Cooperative learning in the classroom using inquiry-based techniques creates an atmosphere of increased understanding and retention of scientific concepts (Lord, 1994). Cooperative learning is much like inquiry-based as it pairs students into small groups and they are presented with a problem (Lord, 1994). It is beneficial for student learning that students learn to work in cooperative teams. As a team it may be easier for them develop their own ideas, conclusions, strategies, and furthermore, their questions are often more open-ended (Lord, 1994). The American Association for the Advancement of Science

(AAAS) recommends that "students work in teams to investigate and come up with solutions to problems posed by the course professor" (Varma-Nelson, Cracolice, & Gosser, 2005). The AAAS further recommends that students openly create their own procedures rather than follow the familiar "step-by-step" directions (Lord, Shelley, & Zimmerman, 2007). Learning outcomes from cooperative learning within an inquiry-based environment results in the following:

1 Higher achievement and increased retention
2 Greater use of higher level reasoning strategies, and increased critical reasoning competencies
3 Greater ability to view situations from others' perspectives
4 Higher achievement and great intrinsic motivation
5 More positive, accepting and supportive relationships with peers regardless of ethnic background, sex, ability or social class difference or handicapping conditions
6 More positive attitudes toward subject areas, learning and schools
7 More positive attitudes toward teachers, principals and other personnel
8 Higher self-esteem based on self-acceptance
9 Greater social support
10 More positive psychological adjustment and health
11 Less disruptive and more on task behavior
12 Greater collaborative skills and attitudes necessary for working effectively with others.
(Shrover, 1989):

NSF GK-12 Programs – Inquiry-Based Teaching

At Binghamton University in New York, a GK-12 program was designed to strengthen the connection between K-12 and postsecondary education (Stamp & O'Brien, 2005). The Binghamton GK-12 program stressed inquiry-based teaching. Their focus was to develop 5E teaching cycles and implement them in the classroom using graduate students, GK-12 fellows, in the classroom (Stamp & O'Brien, 2005). The Binghamton program stressed that the "power of the 5E teaching cycle," in that the 5E "addresses how to develop key concepts incrementally and to provide an integrated structure for curriculum" (Stamp & O'Brien p. 78, 2005). Program teachers and fellows "cycle" through each concept as needed and then recycle the concept before proceeding to the next unit. It is possible to even double back to another cycle. Twenty-four graduate teaching fellows and nine undergraduate teaching fellows collaborated with thirty-eight teachers in grades 3 through 6 results and showed a change in students' abilities to succeed (Stamp & O'Brien, 2005). They discovered that children labeled "learning-challenged", were not even though they were continually told that they were by the school and others (Stamp & O'Brien, 2005). The results from this program, based upon the 5E method, also indicated that teachers were more confident in the abilities of their students to learn the "science behind the terms" (Stamp & O'Brien, 2005).

The Cornell Science Inquiry Partnerships (CISP), another NSF GK-12 program, encouraged their GK-12 fellows to develop their own lesson plans that were focused on inquiry-based learning for K-12 teachers and students (Trautmann & Krasney, 2006). The CISP program has improved graduate students' teaching skills according to faculty reports and fellows have gained more valuable teaching career experiences than just being teaching assistants at the university (Trautmann & Krasney, 2006). Pre and post surveys of exiting graduate students from the program showed an improvement in not only their research and scientific knowledge but also increased the graduate students' abilities to communicate complicated scientific jargon into terminology and concepts that middle school students can understand (Trautmann & Krasney, 2006).

Student Attitudes Towards Science

The key to changing the attitudes of students in a positive direction towards science is to connect the relevance of science to their life. Promoting interest in science involves emphasizing personal relevance of the subject matter (Hulleman & Harackiewicz, 2009). Students that lack motivation in the science classroom benefit from hands-on activities where real life experiences are emphasized (Hulleman & Harackiewicz, 2009). If students feel the subject is unimportant to their life, they will not want to expend any effort studying it (McGinnis & Robert-Harris, 2009). Inquiry-based teaching is based upon exploring the world of the students and less upon regurgitation of knowledge. Also, a student's sense of self can relate to their ability to do well in school. When a student has a "positive perception of self" then that student has "a personal characteristic that tends to be associated with achievement motivation and success in school learning" (Wang & Lindvall, 1984). Inquiry-based teachers need to encourage students to step away from the normal regurgitation of knowledge and into exploring one's world more. For students, there needs to be some confidence to even pick up a scalpel for dissection or have the confidence to raise a hand to ask a question when asked for personal observations. The student must feel safe and confident in the classroom in order for inquiry-based teaching to be successful (Wang & Lindvall, 1984).

There are gender differences between secondary students' attitudes towards science and science achievement in 29 countries across Europe, Asia and Africa as indicated in the Relevance of Science Education (ROSE) study. The ROSE study examined showed students' responses to the question 'I like school science better than most other school subjects' (Osborne & Dillon, 2008). The seven countries with the greatest gender difference regarding success and interest in science were Trinidad, Israel, England, Japan, Denmark, Norway, and Zimbabwe all with females having the lower scores (Osborne & Dillon, 2008). Females had lowest interest scores and lowest achievement scores. In contrast, Uganda and Central Region (Ghana) showed absolutely no difference in gender in regards to success and interest in science (Osborne & Dillon, 2008).

The international TIMMS [Third International Mathematics and Science Study] data also showed a relationship between student achievement and student attitudes to science conducted in 1998 (Osborne & Dillon, 2008). The difference between the TIMMS study and the ROSE study is that there are no gender differences presented in the TIMMS results and countries in the North American continent are included in the TIMMS (Osborne & Dillon, 2008). In the United States, unfortunately, less than 30% of the students have a positive attitude towards science (Osborne & Dillon, p. 10, 2008). Interestingly, South Africa had the lowest science achievement scores but had the most positive attitude about science (Osborne & Dillon, p. 14, 2008). Both South Korea and Japan ranked highly in science achievement but showed the lowest results for positive attitudes about science (Osborne & Dillon, 2008). Japan scored around 597 while Japan scored over 600 with the United States just hovering around 550 (Osbourne & Dillom, p. 14, 2008). The rest of the 31 countries that participated in the study all showed a trend with an increase in science achievement scores and a decrease in positive attitudes about science (Osborne & Dillon p. 12, 2008). The general trend in the results of the study show that there is less positive attitudes towards science in more developed countries (Osborne & Dillon p. 14, 2008). This trend may indicate a need to study further on how we in the United States teach science and how it relates to science attitudes and achievement.

Chapter III.

BACKGROUND

Research Procedure

In order to examine the research question concerning secondary students' attitudes towards science in six specific dimensions as after being with GK-12 fellows, secondary science teacher and fellow partnerships were established. These partnerships were established by the program PIs. Program PIs determined the pairing of fellows to teachers based upon subject content, grade level, and compatibility. They tried to pair the fellows' research areas with the subject areas of the teachers. For example, a fellow with a geology research background was paired with an Earth Science teacher. The teacher and fellow pairings were established each year in May at the *Headwaters* Meeting. At this 2 day meeting, the new fellows were able to work one-one-one with their partnered teacher on inquiry-based curriculum that would be taught during the following school year. After the May *Headwaters* Meeting, the fellows were trained in inquiry-science teaching during the first summer school session. Dr. Julie Westerlund trained the fellows in the 5E inquiry-based teaching model for lesson planning in the summer course *BIO 7100 Professional Development-Inquiry Science Teaching*. In the course, fellows created 5E lessons based upon the TEKS (Texas Essential Knowledge and Skills) standards in their assigned grade levels. Later in August, the fellows and their partnered teacher reconvened at the 2-day *Confluence* Meeting whereby they continued to work together on inquiry-science based lessons. The 5E lesson topics came from the development of the partnerships in the *Headwaters* and *Confluence* meetings. In September and in April of the following year, the fellows and their partnered teachers surveyed their secondary school students about their attitudes towards science and their resident scientists.

Site Demographics

There are three schools selected for this study Owen Goodnight Middle School, Miller Middle School, and San Marcos High School. The following is the demographics for the 2009-2010 school year. The demographics for Owen Goodnight Middle School are 5% African American, 73.2% Hispanic, 20.8% White, 0.1% Native American, and 0.9% Asian/Pacific Islander (Texas Education Agency Academic Excellence Indicator System, 2010). For Miller Middle School 4.8% are African American, 61.4% Hispanic, 32.1% White, 0.3% Native American, and 1.4% Asian/Pacific Islander (Texas Education Agency Academic Excellence Indicator System, 2010). San Marcos High School demographics are 6.8% African American, 65.9% Hispanic, 26.3% White, 0.2% Native American, 0.8% Asian/ Pacific Islander (Texas Education Agency Academic Excellence Indicator System, 2010). The number of students who participated and we received results from in the classes is shown in Table 1 below. Cohort 1 is the first year (08-09) of the study and cohort 2 is the second year (09-10).

Table 1. Number of Students that Participated in Study

Number of Students that Participated in Study

Teacher	Cohort	Number of students (n)
Bailey	1	68
Sam	1	59
Angela	2	25
Bailey	2	78
Carrier	2	59
Derek	2	23
Eleanor	2	44
Total	1, 2	356

Teacher Portraits

To create teacher portraits, information was obtained from the teacher application forms (See Appendix C).

Table 2. Teachers' Credentials

Teachers' Credentials

Teacher	Cohort	School	Education	Years of Experience
Angela	2	High School	Bachelors in a Science w/ minor in a Science	<5
Bailey	1,2	Middle School	Bachelors in a Science	>20
Carrie	2	High School	Masters in a Science	<10
Derek	2	Middle School	Bachelors in a non-Science w/ minor in a Science	>20
Eleanor	2	Middle School	Bachelors in a non-Science	<5
Sam	1	High School	Bachelors in a Science w/ minor in in a Science	<10

Table 3. Teacher Portraits

Teacher Portraits

Pseudonyms are used for confidentiality purposes.

Teacher	Thoughts About Teaching and Most Frequent Used Techniques in the Classroom
Angela	Angela is a new high school science teacher with less than five years teaching experience. She holds a Bachelor's degree in a science and is certified with a Biology 8-12 Teaching Certificate. This is her first year in the Project Flowing Waters program. Angela hopes that by working with the fellows, students will be able to focus on environmental issues in the local area. She stated, "I would like to explore topics such as water quality, species diversity and ecological impacts, using the natural resources of the San Marcos and other surrounding areas." Angela also hopes "that the students will provide the fellows with an eagerness to learn more about the natural wonders that San Marcos and the surrounding rivers have to offer."
Bailey	Bailey is a middle school teacher that has an undergraduate degree in science with more than 20 years experience in teaching. When asked how this teacher plans on incorporating the NSF Project Flowing Waters Program into their instruction Bailey stated "to create new lessons that would aid in student understanding of major science concepts. The experience last year was overwhelmingly positive. Student interest in science developed as hands on inquiry activities increased." Bailey's answers about the NSF K-12 fellow in the classroom by stating that she feels "real life examples of being in the classroom will help university level scientist see the real need that our students in the community have. Think Globally, Act Locally." Bailey understands that middle school students are at a "fragile age, first hand observations and experiences with them is beneficial to anyone working with them. Role modeling is of up most importance and a real scientist in the classroom is awesome." This is what she feels that the resident scientist needs to understand when entering into instruction in the classroom.

Table 3 Continued

Eleanor	Eleanor is a middle school teacher that does not have an undergraduate degree in science. This teacher believes that "students would gain from this experience is that they would have another young adult with a passion for science in the classroom in the fellow." In addition "students would benefit from this grant" by cooperating "like the guidelines state, the opportunities for lab activities and other hands-on experiences such as field trips we plan will be great in number and designed to reinforce the TEKS' concepts." This is the idea that Eleanor plans on incorporating the NSF K-12 Program in her classroom. Eleanor shares that her "classroom is equipped with the latest technology, which is a resource for any student." She also states that she is "not afraid to try new and different things because we learn from every experience – especially how the experience can be improved and made more valuable." Eleanor emphasizes that "fellows needing training on is an understanding of the TEKS" and Eleanor believes that the fellows will need to "modifying their knowledge and lessons or presentations to a level our students understand."
Sam	Sam is a high school teacher that has less than ten years' experience teaching and has both an undergraduate major and minor in a science. Sam admires how the program "offers students an additional mentor that brings a new perspective and personality into the classroom." Sam provides a "safe learning environment that encourages active participation while demanding individual responsibility and higher level thinking." Sam states that her students need to be "eager and continual learner." Sam emphasizes that the fellows must have "a willingness to accept input on the teaching and learning process is crucial" and that the fellow will also "need to be very flexible and ready to have fun."
Carrie	Carrie is a high school teacher with over ten years of experience and specializes in Chemistry. This teacher uses films, movies, video, DVD, slides, and power point presentations. Open-ended labs, problem solving activities, and discovery learning are

Table 3 Continued

	techniques that Carrier prefers to use the most in their classroom instruction. This teacher also incorporated Bloom's higher level questioning and calls on students randomly in class. She wanted each student to participate in classroom instruction and tap into their own unique learning style. Carrier focuses on using national and state/district standards as required for their school.
Derek	Derek is a middle school teacher that does not have a degree in science but does have a minor in science. This teacher uses films, movies, video, DVD, slides, and power point presentations. His use of open-ended labs, problem solving activities, and discovery learning is similar to Carrie's practices in the classroom. Incorporating student experiences and lab demonstrations / instructions is important to this teacher as well as calling on students randomly and incorporating Bloom's higher level questioning. Derek also believes, like Carrie, that identifying the individual learning skills a student has and encouraging each student to participate in class are important teaching practices. Derek adheres to following the state/district standards required by San Marcos Consolidated Independent District.

Fellow Portraits

To create fellow portraits, information was obtained from the fellow applications and their teaching journals.

Table 4. Fellow Portraits

Fellow Portraits

Fellow's Teacher------	**Cohort-----**	**Year in Program**	**PhD Program**
Bailey	1	1st Year	Biology - Aquatic Resources
Sam	1	1st Year	Aquatic Resources
Angela	2	2nd Year	Biology - Aquatic Resources
Bailey	2	2nd Year	Biology - Aquatic Resources
Carrie	2	2nd Year	Physical Geography
Derek	2	2nd Year	Physical Geography
Eleanor	2	2nd Year	Biology - Aquatic Resources

Table 5. Teaching Style

Teaching Style

Fellow's Teacher	Fellow Portraits
Angela	Angela's fellow was in his second year of the program. He focused on the benefits of utilizing field trips for educational purposes. "Students seemed very interested in the fish morphology/habitat activity as it tied in to a previous field trip to the Blanco River that we took earlier in the year. Also some of the students were somewhat familiar with a few of the species that they had previously encountered in the San Marcos River."
Bailey 1	Bailey's first fellow was in her second year of the program, for the 2008-2009 school year and described her research extensively to the students throughout the year. This was her first year of the program. The culture in this classroom supported a lot of questions from the students with the presence of physical specimens. "I brought root nodules and some bacterial plates (well sealed) of "Frankia" bacteria growing on them. I showed them all of it. I passed it around in the pre-AP class even though the roots were "gross" everyone touched them and passed it around. In the 3rd and 4th periods I just showed them on the overhead and walked around with the plates." "They really liked the idea that on my trip this summer I cultured a new kind of Frankia bacteria from these root nodules and that I get to name it. One of the teachers came in at the end of 7th period to say that her students love me and are very interested and I'm so smart and what not. It was nice." "Also in 6th period one of the kids asked, in the first 5min of class, why does a whale breech? So "Bailey" and I had no idea so while she was talking rules I goggled it and we answered their question. They had such good questions even about my work, also that I didn't know the answer too: how old are the root nodules, we asked and showed about a big root has big nodules and a smaller younger root has smaller nodules, where they were in the soil.

Table 5 Continued

	Today was a nice day." This fellow and the teacher also discussed curriculum and how to incorporate it into the lab activities to strengthen inquiry based teaching.
Bailey 2	Bailey's second fellow, in his second year of the program for the 2009-2010 school year found it useful to take the class out of the classroom at every opportunity. Bailey worked with this fellow in improving the condition of the pond at the school to allow easier access for the students and teachers. "We continued with the pond. The trip is going great…a good way to incorporate the outdoors with the curriculum." "They were fully engaged and really took ownership of ecology when applied to their pond." "They just loved getting outside and getting their hands on things"
Carrie	Carrie's fellow, in her second year of the program, enriched the curriculum with real world issues and access to scientists. "In the classroom this week, I presented a talk on the "Great Pacific Garbage Patch", during which I led students in discussions about the effects of the gathering plastics in our oceans. We discussed phase changes and chemical compounds in plastics, as they had recently learned about compounds and finished up a unit on phase changes. It was surprising to see how many students had not heard of the problem with plastics in the oceans. One of the goals of this talk was to link what the students were learning about to real-life scientific problems and research that are currently being conducted across scientific disciplines. We also had a discussion about the types of scientists that might be involved in this type of research (which, of course, included chemists)." "The students really seemed to enjoy hearing about a real world issue that made what they were learning about relevant." "Thursday is also the day that the forensic scientist came in to talk to the class. She brought in a skeleton cast and a simple fingerprint dusting kit. She discussed forensic sciences with the class, covering the various aspects of

Table 5 Continued

	forensics from the crime scene to skeletal identification. The class was highly interested in what she had to say and had been excited about her visit."
Derek	Derek's fellow is in his second year in the program. This week "Teacher Derek" and I did a lab created by "another " fellow that examined chemical reactions. Using mostly household chemicals students had to identify exothermic and endothermic chemical reactions. The students did this by recording the temperatures every 30 seconds to determine if there was a cooling or heating during the reaction. Students had to think critically on what was occurring and why the reaction was endothermic or exothermic." The other fellow's "lab was great, students were not only engaged, but excited to learn chemistry. The only difficulty was keeping some of the non-Pre-AP students moving forward." The fellow incorporated a lot of ideas from other fellows and from what the teacher and fellow, from the previous year, had developed.
Eleanor	Eleanor's fellow is in his second year in the program. "I placed a box for science questions in the classroom the following week and asked students to contribute any science-related questions they have. The response was good and I so far have answered 3 questions in class with 12 more waiting. The box is good in that it allows us to encourage their curiosity without getting off-track during class. Now we just say, "that sounds like a good question for the box" and they go put it in." The box was one of the highlights of the semester reported by both the fellow and the teacher.
Sam	Sam's fellow is in his first year in the program. "I helped the students with their assigned project reporting on famous scientists of the past. I took them (the students) to the library to research their scientists using computers and other resources. Part of their assignment was to produce a poster or power point presentation about their scientists. I helped students with computer problems, search issues, and completing their research and presentations." There were

Table 5 Continued

many meetings between the fellow and the teacher to collaborate on lesson plans.

Achievement on the 2007 through 2010 8th grade Science TAKS tests

TAKS is [Texas Assessment of Knowledge and Skills] that is given to 8th graders. The purpose of TAKS is test students in all academic areas for accountability purposes (Texas Education Agency, 2011). The results for Miller Middle School and Goodnight Middle School 8th grade science achievement results are provided here.

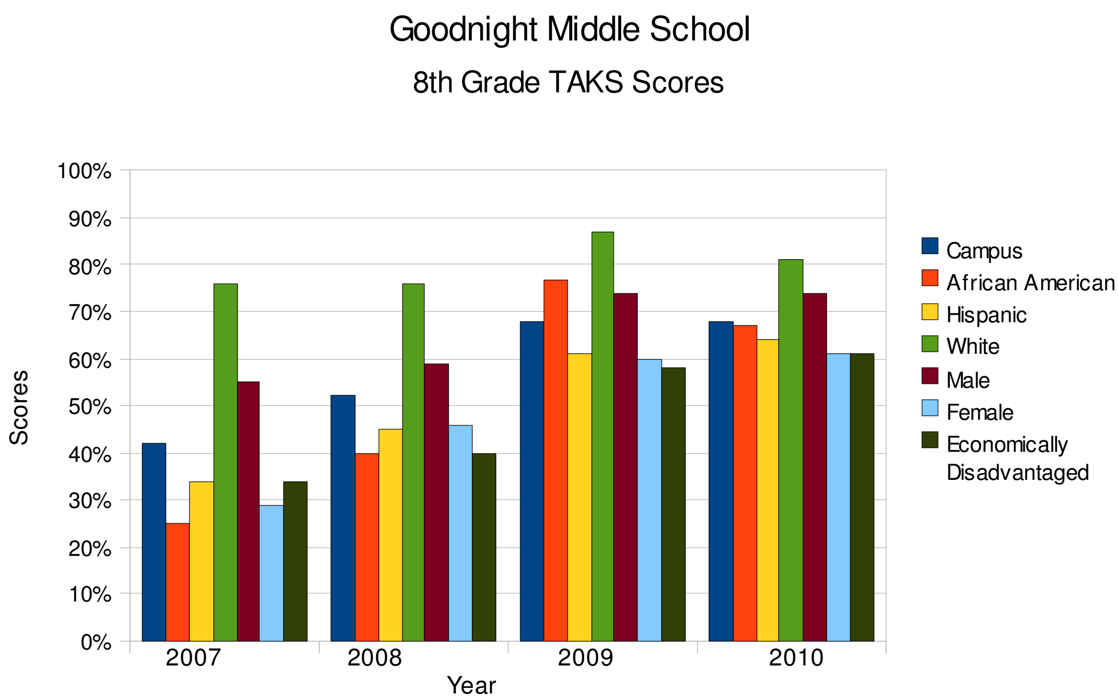

Figure 1. 2007-2010 Science 8th Grade TAKS Results for Goodnight Middle School (Texas Education Agency Academic Excellence Indicator System, 2010)

Goodnight Middle School had increases in overall campus science TAKS scores and in Hispanic, African-American, Female, and Economically Disadvantaged science TAKS scores since 2007 as shown in Figure 1. African American science TAKS test scores increased by 37% in 2009. The female test scores have increased from 2008 to 2009 by 20% and the males increased by 15%. Also, at Goodnight Middle School, the Hispanic students experienced an increase of 16% in 2009. The economically disadvantaged category increased by 18% from 2008 to 2009. These increases in certain demographical areas of Goodnight Middle School had a substantial impact on the overall score of the school by an increase of 16%. Goodnight Middle School is the site of the Goodnight Pond that the teachers and the resident scientists have been utilizing to implement their 5E inquiry based teaching.

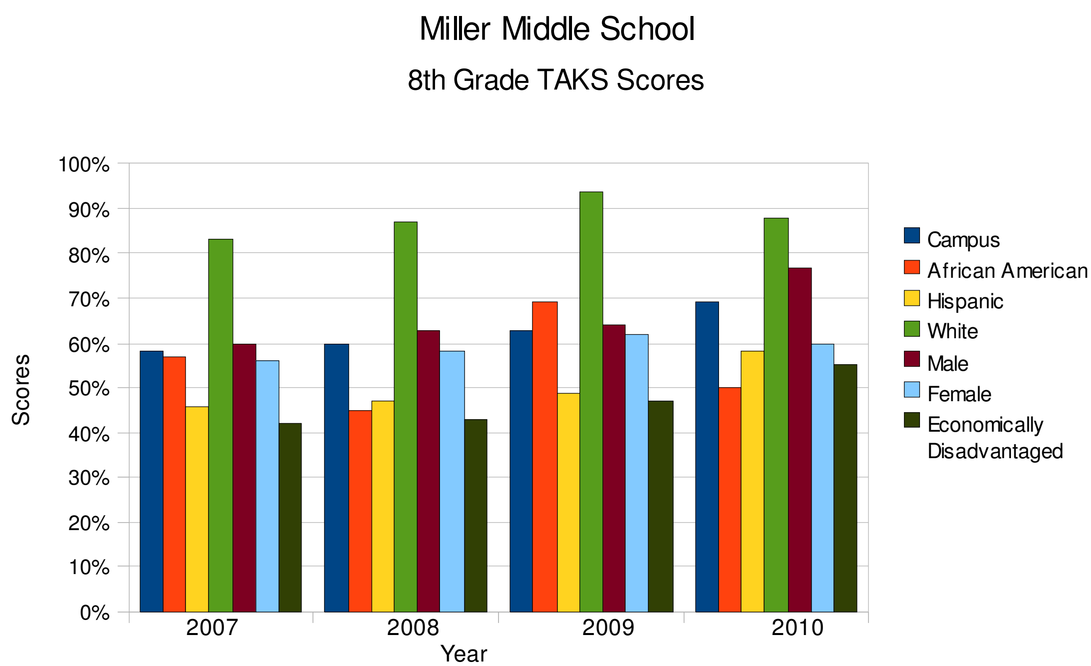

Figure 2. 2007-2010 Science 8th Grade TAKS Results for Miller Middle School (Texas Education Agency Academic Excellence Indicator System, 2010)

Although the increase in science 8th grade TAKS scores at Miller Middle School (see Figure 2) have not been as dramatic as Goodnight Middle School (see Figure 1), there have still been increases since 2007. Overall campus results for both middle schools has improved. The test results for African Americans has increased 37% from 2008 to 2009 at Miller Middle School. Miller Middle School does not have an outdoor learning laboratory such as the Goodnight Pond. A couple of resident scientists and teachers have attempted to create the Miller Woodlands behind the school as an outdoor learning laboratory.

Chapter IV.

METHODOLOGY

Research Design and Procedure

The teachers and fellows were given student attitude surveys, previously used in the NSF Scientific Work Experience Programs for Teachers (SWEPTs) programs (http://scienceteacherprogram.org/SWEPTStudy/instruments.html), in September and in April. They were administered, collected, scored and then paired at the end of the school year. Then the pre and post scores were used to calculate a one tailed t test for significance.

Data Collection and Instruments

The fellows and their partnered teachers administered the pre and post science attitude surveys (see Appendix A and B) to students who had parental permission to participate in Project Flowing Waters in accordance with the Institutional Review Board (IRB) guidelines (IRB 2008-62370). The pre and post-surveys were collected each year during September and April respectively. The survey consisted of questions previously used in the Student Pre-attitude and Student Post-attitude surveys in science used in the NSF Scientific Work Experience Programs for Teachers (SWEPTs) programs (http://scienceteacherprogram.org/SWEPTStudy/instruments.html). I also included an open-ended student comments section. According to the SWEPT site, "*The instrument went through a rigorous review process with participating SWEPT Managers and* *members of the study's Advisory Board. The instrument was pre-tested on student respondents prior to its use in the SWEPT evaluation."* In this study, the surveys were hand-scored and pre and post surveys were matched via handwriting, gender, and month of birthday.

The *Beliefs About Science* survey questions were taken from the parts of the SWEPT surveys that were used to calculate the results for *Beliefs About Science* dimension. These statements repeatedly bring up statements directly related to scientists. The students choose whether they Strongly Agree (SA), Agree (A), Not Sure (NS), Disagree (D) or Strongly Disagree (SD) The statements are as follows and scored:

		SD	D	NS	A	SA
c.	Scientists often don't have very good social skills.	5	4	3	2	1
g.	Scientists usually work with colleagues as part of a team.	1	2	3	4	5
m.	Working as a scientist sounds pretty lonely to me.	5	4	3	2	1
n.	Studying hard in science is not cool to do.	5	4	3	2	1

In the SWEPTS student attitude survey, the higher number on each of the items is considered a more positive attitude about science. To score responses of subjects, the Strongly Agree choice was given a score of five and the Strongly Disagree choice a one for the worded items. A reversed scoring procedure was used for the negatively worded items such as items c, m, n.

Importance/usefulness of science survey questions has statements that focus on what students think of science affecting different parts of their life. Questions taken from the SWEPT study that were used for this section are as follows:

		SD	D	NS	A	SA
b.	Science is useful in every day.	1	2	3	4	5
e.	Science challenges me to use my mind.	1	2	3	4	5

		SD	D	NS	A	SA
f.	The science instruction that I have received will be helpful for me in the future.	1	2	3	4	5
i.	Advancements in science and mathematics are largely responsible for the standard of living in the United States.	1	2	3	4	5
k.	Knowing science really doesn't help get a job.	5	4	3	2	1
p.	Overall, science and mathematics have caused more good than harm in our lives.	1	2	3	4	5

For the *Beliefs about own science ability* dimension, the survey questions contained statements that address students feelings while they are "doing" science. The following questions were taken from the SWEPT study for the survey:

		SD	D	NS	A	SA
a.	I enjoy science.	1	2	3	4	5
d.	Doing science often makes me feel nervous or upset.	5	4	3	2	1
h.	I am good at science.	1	2	3	4	5
j.	I usually understand what we are doing in science class.	1	2	3	4	5
l.	Science is difficult for me.	5	4	3	2	1
q.	I will probably take more advanced science courses available to me at this school.	1	2	3	4	5

For the *Effort that they put into their science work* dimension, points were awarded for each level of work they put into their studies. This ranged from not trying very much at all into their work to working as hard as they can. There were increasing points awarded for increasing effort. The following points are awarded as follows:

	Pre	Post
I don't try at all………………………………………………………...	1	1
I do just enough to get by………………………………….……….	2	2
I give an average amount of effort…………………………………	3	3
I try pretty hard, but not as hard as I could………….....................	4	4
I work as hard as I can……………………………………….…..	5	5

For the *Expectancy of Higher Education* dimension, the survey question concerned the level of education that students wish to pursue. The score value increases with the level of education. The following is the Pre and Post value as follows:

		Pre	Post
a.	high school…………………………………………………	1	1
b.	vocational school……………………………………………..	2	2
c.	college………………………………………………………	3	3
d.	graduate school……………………………………………….	4	4

The last section of the survey, *Parent/Guardian Involvement* dimension was changed in the second year by adding more questions concerning parental involvement (See Appendix A and B). I did this to increase the richness of the dimension by asking more about the students' perceptions. A few questions in the second year were altered to include specific recreational interactions that the students could have with their local natural water source, the San Marcos River:

		SD	D	NS	A	SA
a.	My parents/guardians expect me to complete college.	1	2	3	4	5
b.	My parents/guardians often help me with my school work.	1	2	3	4	5
c.	My parents/guardians reward me for getting good grades.	1	2	3	4	5
d.	My parents/guardians are very busy and don't have much time to help with my school work.	5	4	3	2	1
e.	My parents/guardians think that science is a very important subject.	1	2	3	4	5
f.	My parents/guardians would like me to have a career in science, mathematics, or engineering.	1	2	3	4	5
g.	My parents/guardians make sure I do my homework assignments.	1	2	3	4	5
h.	My parents/guardians ask me about what I am doing in school.	1	2	3	4	5
i.	My parents/guardians often take me hiking, camping, boating, fishing, or hunting.	1	2	3	4	5
j.	My parents/guardians have taken me to the San Marcos River or other rivers/lakes to look at animals, plants and different rocks and/or go on nature walks.	1	2	3	4	5
k.	My parents/guardians think that protection and/or conservation of native plants and animals is important.	1	2	3	4	5
l.	My parents/guardians have taken me to the San Marcos river for picnics, tubing, and water sports activities.	1	2	3	4	5

The open-ended student comments section contained three questions in both years. The first question (#1) is the only question that was on both pre and post surveys. The other two questions (#2, #3) were only on the post surveys.

The following questions were asked on the survey:

1. What are your thoughts about the resident scientist in your classroom? (Short answer).
2. Has the resident scientist affected your learning of science? (Circle one: Yes/No) If yes, what way has the resident scientist affected your learning? (Short Answer)
3. Have you learned about the San Marcos River, water ecosystems, or endangered species this semester (Circle one: Yes/No) If yes, what are some things that you learned?(Short Answer)

The answers to these questions were coded together based upon similar words. For example, "he is cool" and "cool scientist" were placed together. This was conducted based upon traditional qualitative research techniques involving code classification where similar repeating phrases were placed into categories (Patton p. 403, 1990). The top five codes were determined for each question. A secondary analysis concerning positive, negative, indifferent and no response statements per question was conducted. Student remarks were coded as positive, negative, indifferent or no response. Phrases like cool, smart, and awesome were considered positive comments. Any phrase that sounded productive or positive like "made learning more fun" was also included in the positive category. Words like "nothing" or calling the fellow a negative name was considered a negative comment. The comment "I don't know" was considered an indifferent comment. Again, the positive phrases are about how learning or how their experience with the resident scientist was a benefit to them. Any negative comments contain negative connotations like the name calling and the statement "nothing". Indifferent is solely based on the statement "I don't know".

Statistical Analysis

Statistical analysis was used in this study to see if there was a significant change in student attitudes in the six dimensions mentioned earlier: 1. *Beliefs About Science*, 2. *Beliefs About Own Science Ability*, 3. *Importance / Usefulness of Science*, 4. *Effort that they put into their science work*, 5. *Parent/Guardian Involvement*, and 6. *Expectancy for Higher Education*. Any changes in these dimensions were identified using the pre and post student attitude surveys. To determine whether the changes were significant, we used both the null hypothesis that there was no difference between the means of the pre and post scores and an alternate directional hypothesis whereby we predict that the mean of post scores > mean of the pre scores. Essentially, we predicted that students' attitudes would improve as indicated by higher numbers from 1 to 5, on the scoring of the surveys. Since there was a predicted direction in the positive direction, a one-tailed t test was selected due to its sensitivity. The one-tailed t-test is performed if the results are interesting only if they turn out in a particular direction (Stockburger, http://www.psychstat.missouristate.edu/introbook/sbk25m.htm). In this case the pre scores are always subtracted from the post scores. The one-tailed t test makes use of the positive (mean of the post minus mean of the pre) differences only. P value scores greater than >.05 would indicate no significance and thus, we could <u>not</u> reject the null hypothesis that there is no difference between the means of pre and post scores. If on the other hand, p value scores less than <.05 are obtained, then 1) the null hypothesis can be rejected and 2) there is a significant difference in the positive direction, in this case that the post scores are significantly higher (more positive) than the pre scores (Bartz, 1981). There were two teachers' classes in the first year and five teachers' classes in the second year. A one-tailed t test was performed on each of the six dimensions if a positive trend (higher post scores) was seen.

CHAPTER V.

RESULTS

Attitude Dimensions

A positive trend in the differences *between* post and pre survey scores was seen in the first year for both Bailey and Sam in the *Beliefs About Science* dimension. As can be seen in Table 6, the positive differences are noted with an asterisk. There was not a consistent positive trend in the other dimensions in the first year. Those results that are not positive in the other dimensions may indicate the inability of the research design to detect impact from the program in those dimensions. In the second year, a positive trend was also seen in four out of the five teachers in the *Beliefs About Science* dimension as shown in Table 7. Notably, there was also a positive trend in the dimensions *Beliefs about own Science Ability*, and *Importance and Usefulness of Science* and *Expectancy for Higher Education* for 2 of the 5 teachers. Again, as in year 1, year 2 results that are not positive in certain dimensions may indicate an inability to detect impact of the program. To determine if there were significant differences in a positive direction, a one-tailed t test was performed on all the data that had a positive trend. The raw data that did not show a trend in a positive direction in Table 6 and 7 were not analyzed statistically since a one-tailed t was employed based upon both the null hypothesis that there is no difference and an alternative directional hypothesis towards a positive trend. If there is no significance as demonstrated through the t test, that does not negate that there are no results in the study. Other factors outside of the t test's ability may not be calculable. The lack of significance also maybe caused from the study group being too small. The raw data for the study showing the pre- mean, post mean, and the difference between the two (post minus pre) are as follows:

Table 6. Raw Data for All Dimensions in Study for 2008-2009

Raw Data Results for Attitude Dimension Survey

Dimension	***Teacher***	***Raw Data***		
		Pre-mean	*Post mean*	*Difference*
Beliefs About Science	Bailey	13.28	13.44	0.16*
	Sam	12.91	13.44	0.53*
Beliefs About Own Science Ability	Bailey	22.19	21.67	0.52
	Sam	17.32	18.25	0.92*
Importance / Usefulness Of Science	Bailey	21.62	22.12	0.50*
	Sam	21.41	20.65	0.76
Effort that they put into their science work	Bailey	3.90	3.74	0.16
	Sam	3.40	3.50	0.10*
Parent / Guardian Involvement	Bailey	5.90	5.90	0.00
	Sam	5.51	5.65	0.14*
Expectancy for High Education	Bailey	3.11	3.08	0.03
	Sam	3.00	2.98	0.02

* positive trend

Table 7. Raw Data for All Dimensions in Study for 2009-2010

Raw Data Results for Attitude Dimension Survey

Dimension	***Teacher***	***Raw Data***		
		Pre- mean	*Post mean*	*Difference*
Beliefs About Science	Angela	14.61	15.26	0.65*
	Bailey	13.8	14.42	0.62*
	Carrie	14.65	15.33	0.67*
	Derek	14.06	14.83	0.77*
	Eleanor	14.41	14.20	0.22
Beliefs About Own Science Ability	Angela	23.38	20.33	3.04
	Bailey	22.53	23.04	0.05*
	Carrie	23.23	22.80	0.43
	Derek	21.74	22.44	0.69*
	Eleanor	21.83	21.61	0.22
Importance / Usefulness Of Science	Angela	24.70	23.30	1.39
	Bailey	22.77	22.13	0.64
	Carrie	23.19	23.89	0.70*
	Derek	22.49	23.20	0.71*
	Eleanor	22.40	22.34	0.06
Effort that they put into their science work	Angela	4.04	3.60	0.44
	Bailey	3.91	3.82	0.08
	Carrie	4.10	3.92	0.18
	Derek	4.00	4.03	0.03*
	Eleanor	4.21	4.16	0.05
Parent / Guardian Involvement	Angela	43.74	40.83	2.91
	Bailey	42.24	41.23	1.01
	Carrie	42.09	41.33	0.76
	Derek	43.32	40.67	2.65
	Eleanor	42.54	40.71	1.83
Expectancy for High Education	Angela	3.48	3.24	0.24
	Bailey	3.10	3.13	0.03*
	Carrie	3.34	3.53	0.19*
	Derek	3.28	3.16	0.12
	Eleanor	3.41	3.41	0.00

* positive trend

Student Pre- and Post Survey Results 2008-2009

This study detected statistical significance in the *Beliefs About Science* dimension in the first year. The mean difference in Sam's classes was significant, p<.05, in the positive direction in the *Beliefs About Science* dimension (see Table 8). The null hypothesis, that there is no difference between the pre and post scores, was not rejected in the other dimensions.

Table 8. 2008-2009 Significant Differences of the Attitude Dimension Survey

Significant Difference of the Attitude Dimension Survey 2008-2009

	Teacher	
Dimensions	***Bailey***	***Sam***
	n=68	n=54
Beliefs About Science		(p=.04)

The mean differences in Bailey's, Carrie's and Derek's classes all were significant in the positive direction concerning *Beliefs About Science* in the second year (see Table 9). The only other significant difference in the second year in the positive direction was in Carrie's classes for *Expectancy for Higher Education* (see Table 9). The null hypothesis, that there is no difference between the pre and post scores, was not rejected in the other dimensions.

Student Pre- and Post Survey Results 2009-2010

Table 9. 2009-2010 Significant Differences of the Attitude Dimension Survey

Significant Differences of the Attitude Dimension Survey 2009-2010

	Teacher				
Dimensions	***Angela***	***Bailey***	***Carrie***	***Derek***	***Eleanor***
	n=25	n=76	n=55	n=69	n=44
Beliefs About Science		(p=.03)	(p=.02)	(p=.01)	
Expectancy For Higher Education			(p=0)		

Overall Pre- and Post Student Remarks

The student answers to the first question, "What are your thoughts about your resident scientist?", on both pre and post tests, were highly varied. (See Appendix D and E). The four most common responses (codes) were "cool", "good", "helpful", and "fun" in both years. The student answers to the second question is "Has the resident scientist affected your learning?" are in Table 10. Table 10 indicates the teachers, the cohort, and whether the student population answered yes or no about their learning from the resident scientists. Note that, in all of the teachers' classes, the students indicated that the resident scientist had affected their learning. This is indicated by the higher number of yes answers to no answers. The responses to the second part of that question, "If so, in what ways?" can be found in Appendix D and E. There was a wide variety of answers based upon the types of activities that were designed by the teacher and their fellows.

Table 10. Results for “Has the resident scientist affected your learning?” (post)

Teacher	***Cohort***	***Has the resident scientist affected your learning? (post)***	
		Yes	No
Bailey	1	59	11
Sam	1	26	30
Angela	2	17	3
Bailey	2	65	9
Carrie	2	40	13
Derek	2	55	8
Eleanor	2	35	8

In Table 11, student responses (yes or no) are shown per teacher concerning whether they had learned anything about the San Marcos River or endangered species results.

Table 11. Results for “Have you learned about the San Marcos River, or endangered species this semester?” (post)

Teacher	***Cohort***	***“Have you learned about the San Marcos River, or endangered species this semester?” (post)***	
		Yes	No
Bailey	1	43	23
Sam	1	18	42
Angela	2	21	2
Bailey	2	59	12
Carrie	2	40	13
Derek	2	68	3
Eleanor	2	33	10

In all of the teachers’ classes, except Sam, most of the students indicated they had learned about the San Marcos Rivers and/or endangered species. The responses detailing in what they have *learned about the San Marcos River and endangered species* can be seen in Appendix D and E. Further details concerning this area are discussed in the “Individual Classroom Post Survey Results 2008-2009” section and in the “Individual

Classroom Post Survey Results 2009-2010" section. Each student population had unique experiences with their teacher and resident scientist.

Individual Classroom Pre- and Post Survey Student Remarks 2008-2009

During the first year in Sam's and Bailey's classroom there were positive, negative and indifferent remarks concerning the resident scientist. Figures 3 and 4 illustrate the ways students were affected with the resident scientist in the classroom.

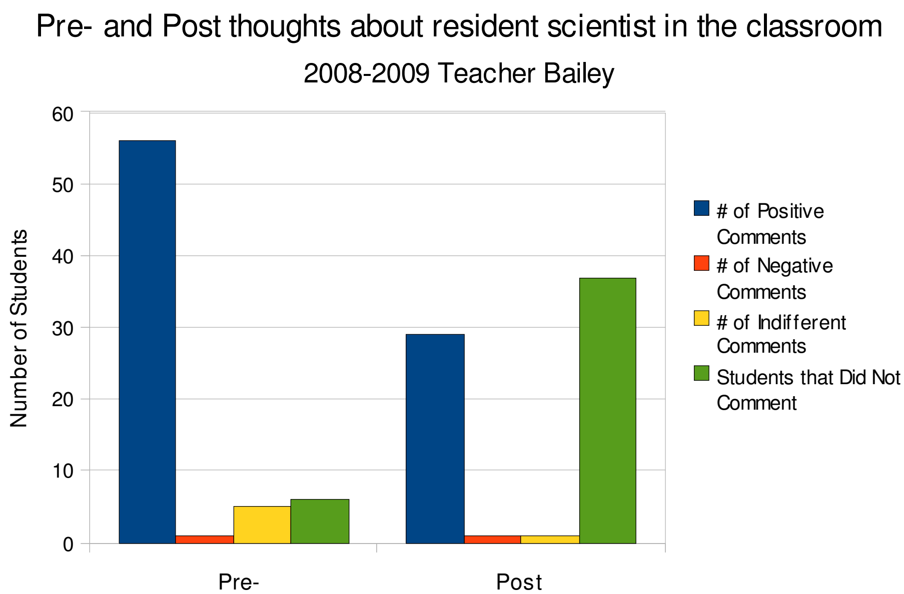

Figure 3. Teacher Bailey Pre and Post "Thoughts about the resident scientist in your classroom" student remarks 2008-2009

In Bailey's class the post results show that 59 of the students stated that they were affected by the resident scientist and 11 stated that they were not. Of the 59 students who reported that they were affected, 11 of the students said they "taught me more / learned more", 6 of the students stated that the resident scientist was "helpful", 5 of the students said they "explained it to me / easier to understand" and 4 of the students stated the resident scientists "made learning fun / fun labs". The comments from Bailey and the resident scientist journals were all very positive. They praised each other and that positive attitude seemed to positively affect the students' perceptions of their experiences. The post survey results did not show as many positive comments as the pre-survey but there was a noticeable decrease on indifferent comments made by the students. There was a large increase in students that did not comment. We are not clear as to why nearly 37 did not answer the open-ended question. It may have been due to an unintended time constraints while taking the surveys or the students may just not have felt like completing the survey.

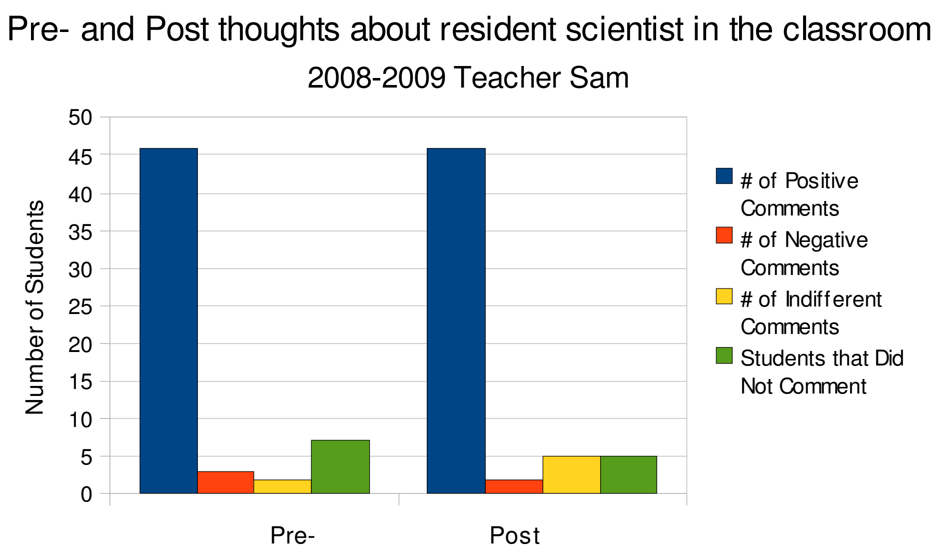

Figure 4. Teacher Sam Pre and Post "Thoughts about the resident scientist in your classroom" student remarks 2008-2009 have felt like completing the survey

Teacher Sam had 26 students that said that the resident scientist affected their learning and 30 students stated that they were not affected. This is the only result where more students reported "no" than "yes". This contradicts the comment section results as post results show less negative comments. In Sam's class, the students were very positive about the resident scientist in the beginning of the year and also at the end of the school year. In this class, students enjoyed field trips to the Blanco River to study stream flow. The teacher and the fellow used labs often where they educated the students on various ways to use lab equipment.

Individual Classroom Pre- and Post Survey Student Remarks 2009-2010

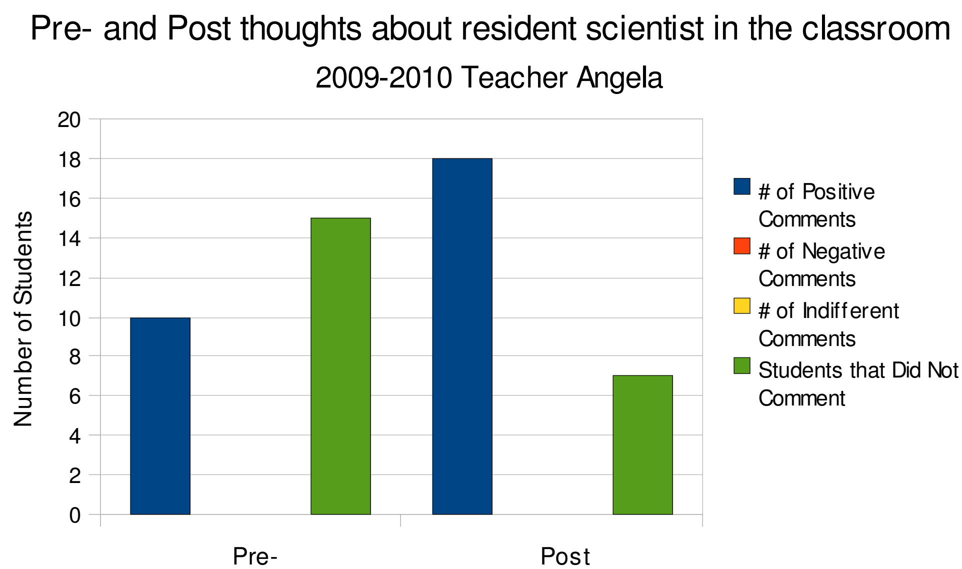

Figure 5. Teacher Angela Pre and Post "Thoughts about the resident scientist in your classroom" student remarks 2009-2010

For Angela's resident scientist there was only one negative comment of "don't get it". When the students were asked if the resident scientist had affected their learning 17 of the students said yes while 3 stated no. This is also represented with the increase in post positive comments from the pre. There was also a decrease in students that had chosen not to comment. In this class, the resident scientist implemented a lot of visual aids with specimens and powerpoint presentations. For this resident scientist, genetics was a central topic when working with the students. Genetics was used to help student understand species and how genetics account for the various "fingerprints" of species.

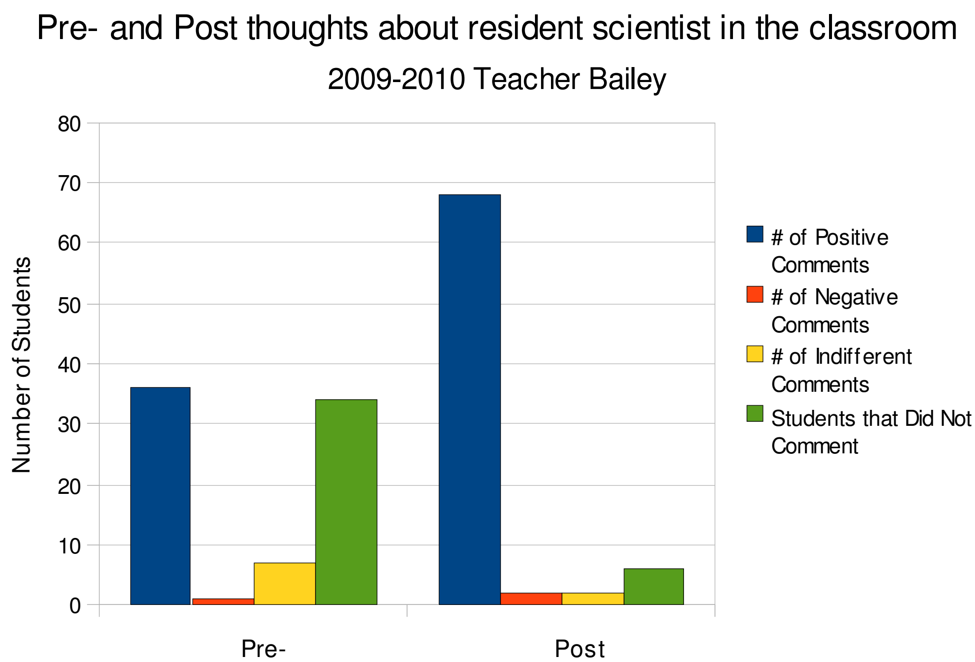

Figure 6. Teacher Bailey Pre and Post “Thoughts about the resident scientist in your classroom” student remarks 2009-2010

Teacher Bailey’s resident scientist student surveys reported that 65 of the students were affected in their learning by the resident scientist. Only 9 students said that the resident scientist did not affect their learning. Only one of the student comments stated “I don’t know” when asked how the resident scientist affected their learning. The most prominent comment with a total of 8 students is that they “understand science more” through their interactions with the resident scientist. The students looked at live microscopic organisms that they collected from Goodnight pond. They also got to create a food web based upon the pond. The teacher and the fellow collected fish from the pond where the characteristics of the fish were noted by the students and they identified each one.

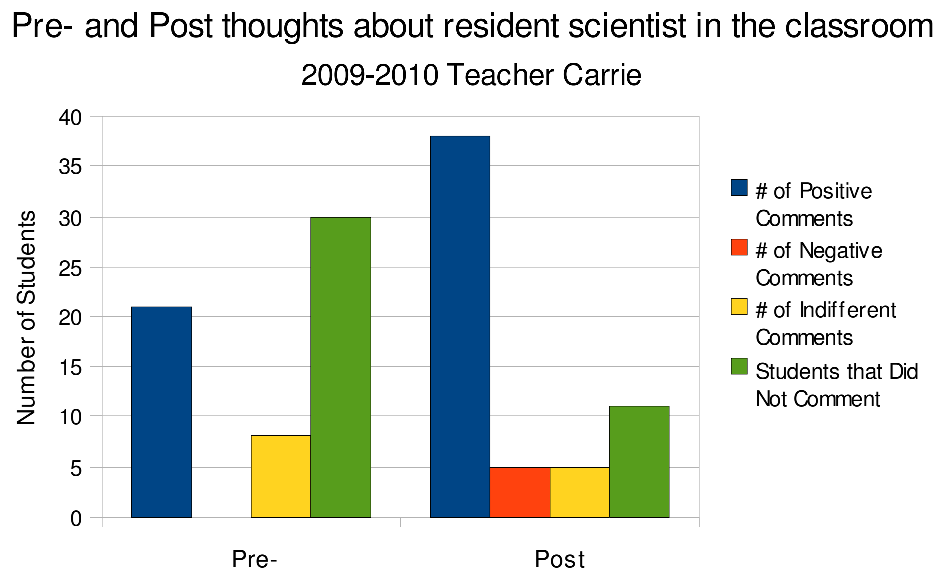

Figure 7. Teacher Carrie Pre and Post "Thoughts about the resident scientist in your classroom" student remarks 2009-2010

In Carrie's class, 40 of the students felt that the resident scientist affected their learning whereas 13 students did not believe that the resident scientist affected their learning. The most common remark, made by 5 students, was that the resident scientist "taught us what we didn't know / learned a lot". According to this resident scientist's journal, he put much of his own work into the classroom activities. He also used current events concerning pollution and how it affects bodies of water like the ocean and not just the local watershed.

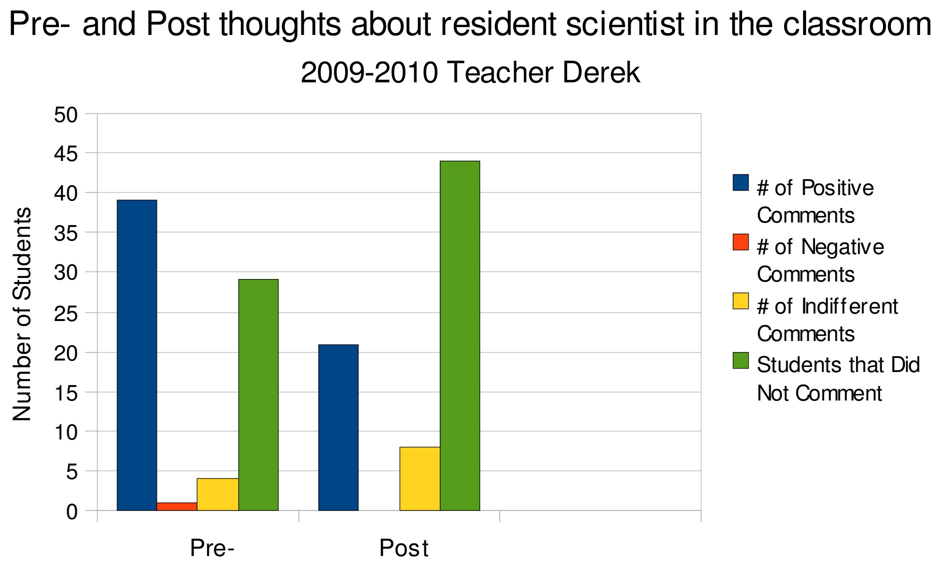

Figure 8. Teacher Derek Pre and Post "Thoughts about the resident scientist in your classroom" student remarks 2009-2010

Derek's resident scientist's students reported that 55 of the students were affected in their learning by the resident scientist while 8 of them stated they were not affected. The most common remark from students, from 8, stated that the resident scientist made it "easier to understand". The fellow to excelled in his communication techniques with the students as they really focused on not what the students learned but how the students could relate to it. Part of the goal of *Project Flowing Waters* was to improve communication between scientists and students. There is a decrease in positive results from the pre- and post surveys but a substantial increase in students that did not comment. It is not clear why this had occurred.

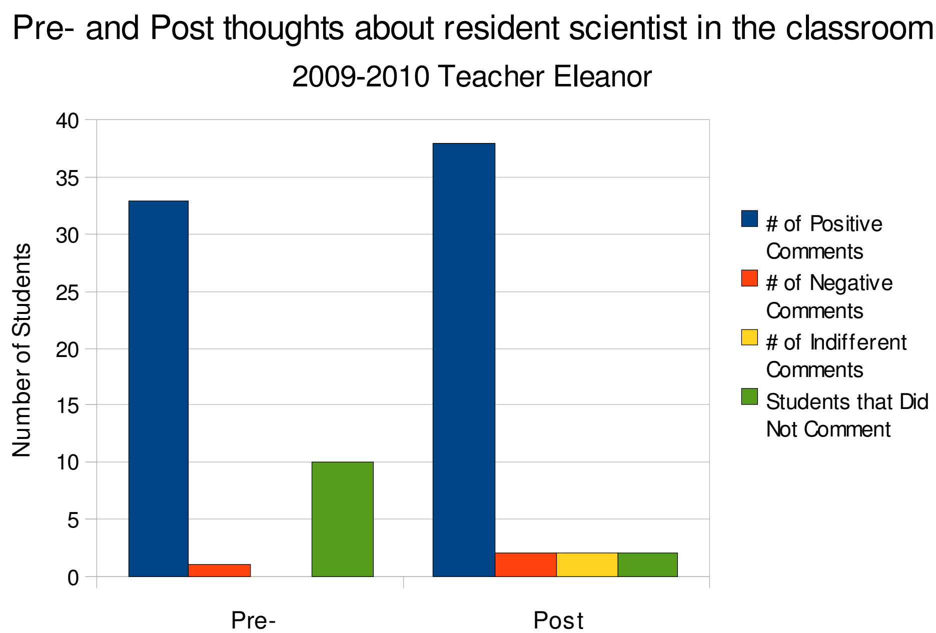

Figure 9. Teacher Eleanor Pre and Post "Thoughts about the resident scientist in your classroom" student remarks 2009-2010

Eleanor's resident scientist has 35 students saying that they were affected in their learning by the resident scientist with only 8 stating that they were not affected by the resident scientist. There were a total of 44 paired surveys for this teacher in the second year. Of all the students comments, 6 of the students stated that the resident scientist "help understand" the material. The resident scientist implemented a technique called Science Box Questions. This box allowed students to ask more detailed and off-topic questions to be answered the next day. Not only was this good for time management but also let the teacher, fellow, and students explore their understanding of science more. The resident scientist also focused a lot on the "Why? Why?" questions that students would ask during inquiry-based learning experiences.

Post survey results for "In what ways have they affected your learning?"

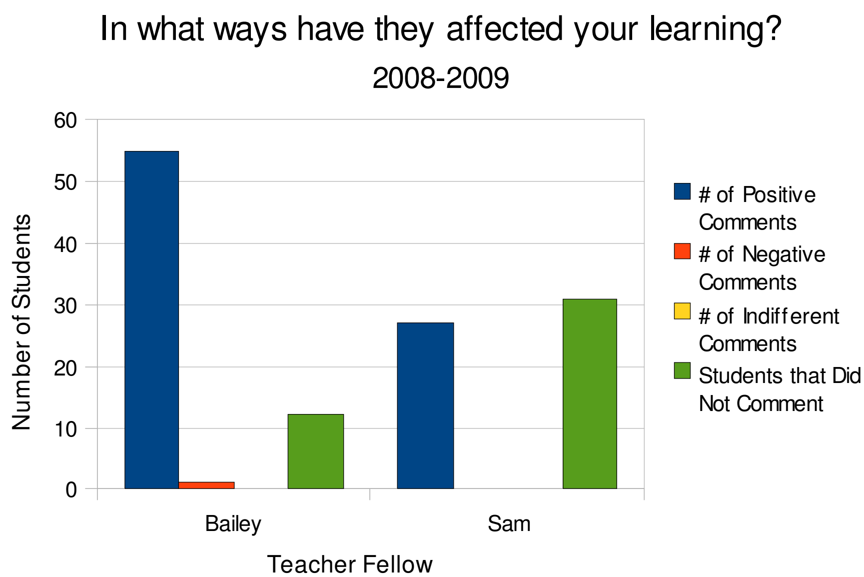

Figure 10. "In what ways have they affected your learning?" student remarks 2008-2009

This graph shows the difference between the student populations in Bailey's and Sam's classrooms. Sam had 27 positive comments about how their learning was affected by the resident scientist with 18 students commenting about what they learned about the San Marcos River and endangered species. Bailey had 55 positive comments about how their learning was affected with 31 positive comments about what they learned about the San Marcos river and endangered species. Bailey had 68 total paired surveys and Sam had 58 paired surveys. All the comments can be reviewed in Appendix D. Sam's students commented that the resident scientist "taught me more / learned more / knowledgeable and detailed", "explained it to me / easier to understand", and that they were "helpful" were the top three grouped phrases. Bailey's students had an easier time to make a comment about how the resident scientist affected their learning as (56) students commented in this section. The three most used comment categories are "made me pay attention because it was more fun / made it more interesting", "helps with the labs / helps me understand things better / questions", and "taught me a lot / things I didn't know".

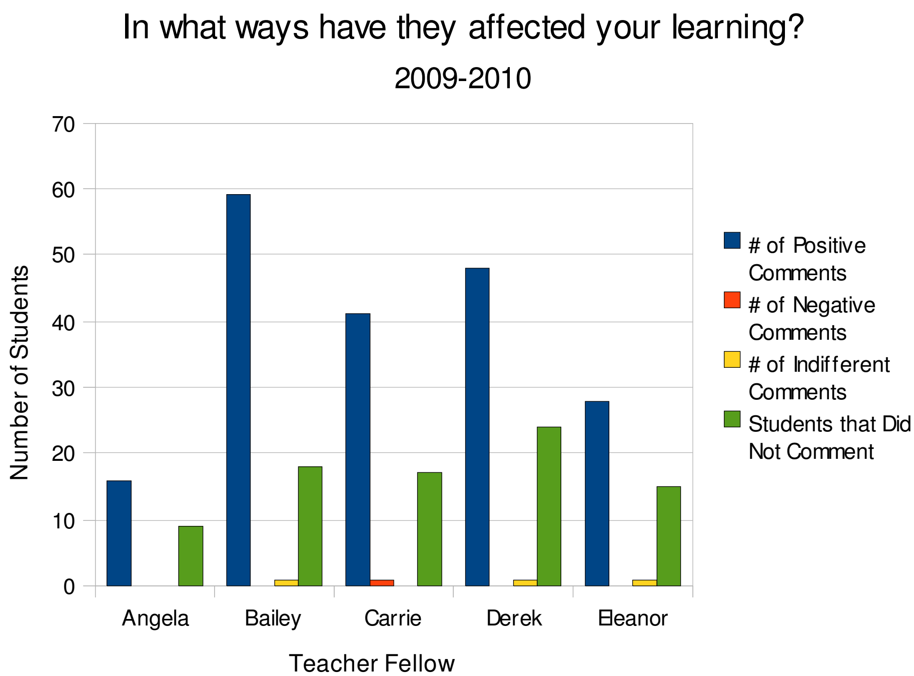

Figure 11. "In what ways have they affected your learning?" student remarks 2009-2010

There is a trend with student responses to "In what ways have they affected your learning?" in that many of the students did not specifically state how the resident scientists affected their learning. For example, Angela had 16 students provide positive comments on what ways the resident scientist had affected their learning with no indifferent or negative comments. However, there are 25 paired surveys for Angela's class so many of the students did not bother to complete the survey as to how the resident scientist affected their learning. Also, Bailey had 41 positive comments and 1 negative comment giving them a total of 42 responses when there is a total of 78 paired surveys. Derek had 59 paired surveys providing 21 positive comments and 8 indifferent. Eleanor has 44 paired surveys with 28 positive comments and 1 indifferent. It appears that students may have had a hard time defining how the resident scientist affected their learning. The positive, negative and indifferent comments are shown in Appendix E. As can be seen from their comments in Appendix E, the students had unique experiences with each of the paired teachers and fellows.

Angela's positive student comments were "genetics / fish", "taught me a lot / understand science more", and "good at answering questions / better understanding" are the top three categorized comments regarding what students were affected by their resident scientist. The three main positive comments from Bailey's class are "made it more interesting / understand science more / made it fun and/or better to understand", "either and/or frogs, ecosystem, showed me science, species, wildlife, abiotic, water, and food chains", and "several things / I know more now / teaching me science / made me more aware / how to use or make things". Each classroom experience was different from one another, thus the way the comments were grouped varied greatly. Carrie's positive student comments are "made me understand / better understanding / provided more in class than normal / understand teaching and informative / good at explaining things", "taught us what we didn't know / learned a lot / interesting and I have learned new things / cool and talks about stuff", and "helpful and either especially during labs". Then the three top positive comment categories for Derek were "fun and/or but serious, helpful, learned a lot", "I pay more attention to them / make science more interesting / easier to understand / elaborates", and "we do labs that help / labs are fun / hands on". Eleanor's top three categories for positive comments were "endangered species / ecosystem / water cycle / little animals / animals / aquatic life / food chain / fish / endangered ecosystem", "fish or species in the San Marcos River or in an ecosystem", and "school pond and/or rice in the San Marcos River / we went to the pond / birds like the American Coot and the pond ecosystem".

Post survey results for "If so what did you learn about the San Marcos River or endangered species?"

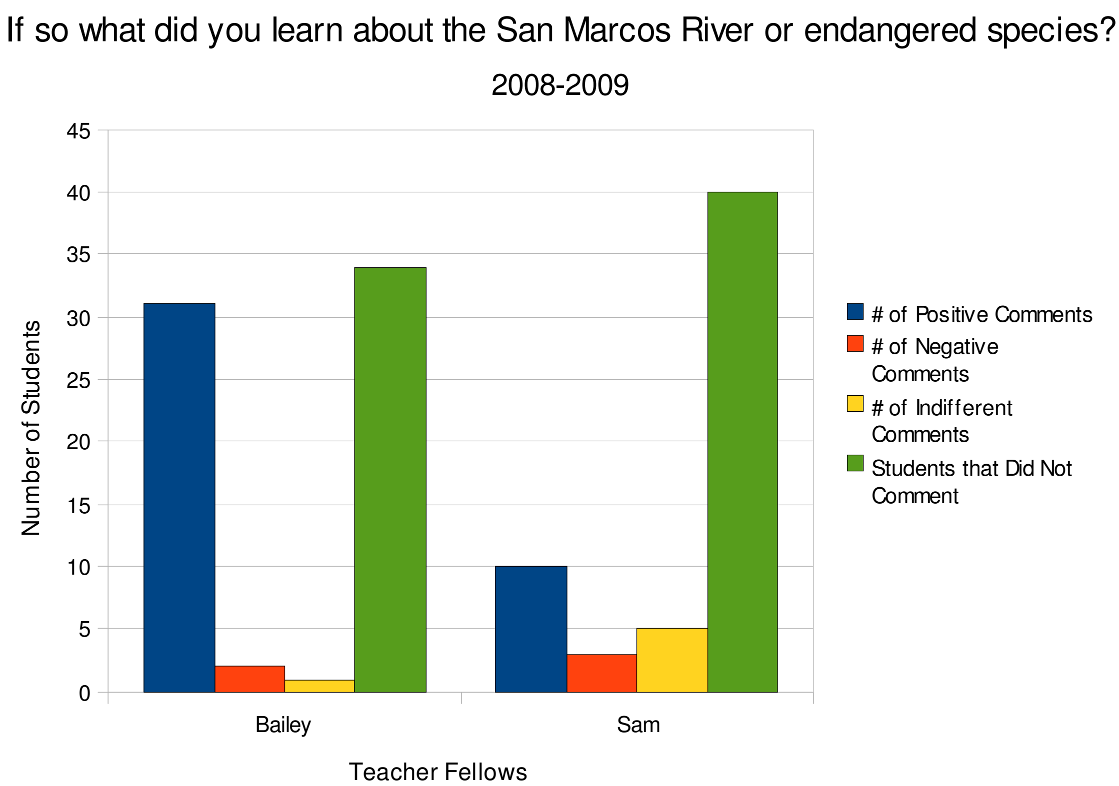

Figure 12. "If so what did you learn about the San Marcos River or endangered species?" student remarks 2008-2009

In the first year, in Bailey's classes, less students commented (34 students) about what they "learned about the San Marcos River and endangered species" than "how the residents scientist affected their learning" (56 students). In the first year, in Bailey's classes, the ratio of students learning to not learning about the San Marcos River or endangered species was dramatically different than their attitudes about how the resident scientists affecting their learning. As shown in Table 11, there were 43 students that stated that they learned something and 23 stated that they did not. There were 3 students that made negative comments about not learning anything. Most importantly, the majority of the students, as shown in Figure 12, did not even comment about these areas indicating that they may not have been exposed to these topics. The resident scientist and Bailey addressed more than just aquatic science in their other lab activities and may not have been centered on the San Marcos River and endangered species.

Sam had 42 students state that they did not learn anything about the San Marcos River or endangered species with 18 reporting that they had learned about these topics as shown in Table 11. This is the only class in the study where more students reported that they did not learn about these aquatic science topics. As mentioned earlier with Bailey's classes, these particular aquatic science topics, the San Marcos River and endangered species, may not have been emphasized in the research scientist's lessons. This may also explain why there were many students that did not comment on this question. Also, there were 5 students that reported that they "don't remember / forgot" about what they learned.

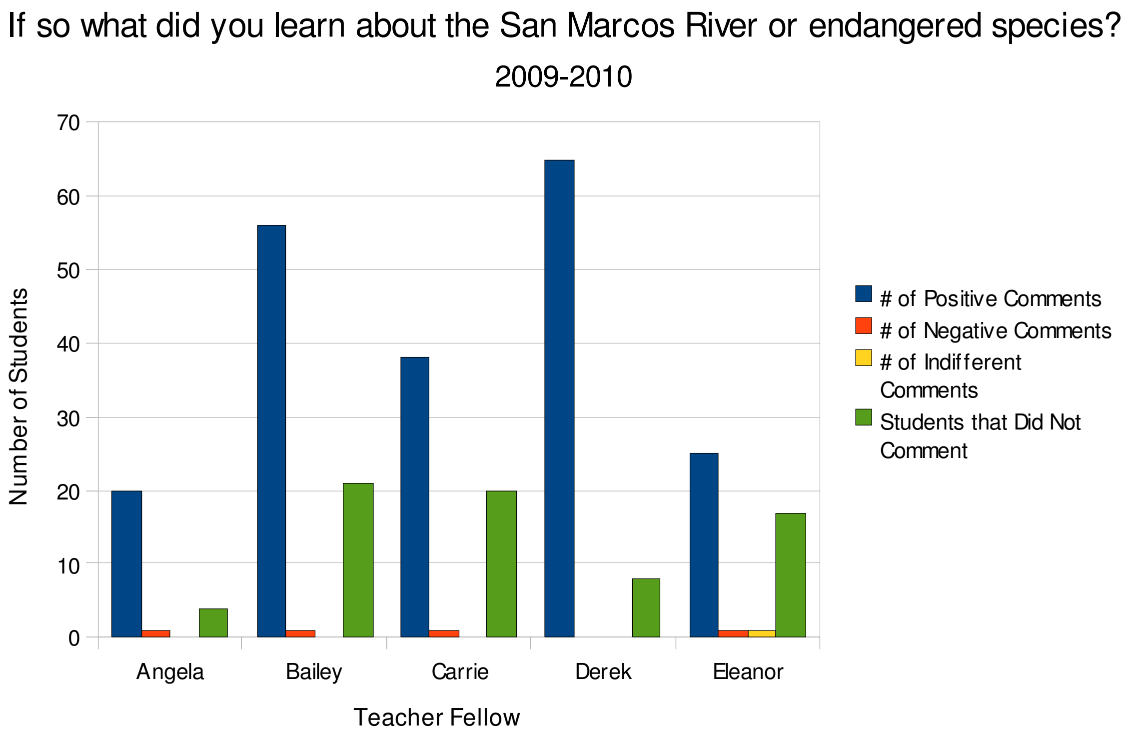

Figure 13. "If so what did you learn about the San Marcos River or endangered species?" student remarks 2009-2010

In the second year, Angela had 21 students indicate that they had learned about the San Marcos river or the endangered species while 2 students stated that they had not. The main sets of comments from the students were "catfish / DNA in fish / about fish in the water". Lesson plans showed that the fellow and the teacher utilized the water bodies surrounding San Marcos to demonstrate the vast array of fish in the area. There was even the idea of different populations of fish breeding and producing a new species.

Each of the classes had unique experiences with their teacher and resident scientist. Bailey's resident scientist student surveys had results of 59 students indicating that they had in fact learned about the San Marcos River or the ecosystem during the semester and had only 9 students indicate that they did not learn anything. As indicated in Table 11, this was very different from the previous first year where only 43 students that stated that they learned something and 23 stated that they did not. The top two comments were about “blind salamanders” and “species in the river” by a population of 5 students each commenting on them. The fellow resident scientist for Bailey brought a lot of their interest in herpetology and entomology to the classroom. They correlated the health of the river by the amount of species in it and how the dynamics of the river would change drastically if one species was no longer present. This gave students a bigger picture of the environment and how the smallest species can have such a large effect on the bigger picture.

Carrier also had more yes, 40, than no, 13, comments regarding if they learned anything about the San Marcos River or endangered species as shown in Table 11. The most common remark by the students about what they learned about the San Marcos River or endangered species was “how pollution effects the environment / ecosystem / species” as mentioned by 8 students.

In Derek’s classes, 68 students reported that they had learned about the San Marcos River or endangered species. Only 3 of them reported that they did not learn about these topics as shown in Table 11. The resident scientist for Teacher Derek had 13 students comment that they learned about “species in the ecosystem”. This fellow implemented their lesson plans encompassing not only the San Marcos River, endangered species, and pollution but related everything to the processes of it all. The food chain and the water cycle were discussed for the San Marcos River and the school’s pond as well as for other places in the world. The use of the San Marcos River and the school’s pond allowed students to see the purpose and understand the importance of these aquatic systems in their own backyard. This is an excellent example of inquiry-based teaching where the students got the actual hands-on learning that conventional science classroom atmospheres do not provide.

The students with Eleanor's resident scientist reported that 33 of them learned about the San Marcos River or endangered species and 10 of them reported that they did not. Of all the comments about what the students learned 4 of the students made the most comments regarding "blind salamanders". This was followed by 3 students commenting that they learned about "endangered species and blind salamanders".

Each of the resident scientists had their own *fingerprint* regarding the execution of the 5E method of inquiry-based teaching. The results were primarily positive as the majority of the student responses responded "Yes" when asked if the resident scientists affected their learning and if they learned anything about the San Marcos River. This may indicate that the students accepted their resident scientists and were receptive about their local ecosystem and that San Marcos River.

CHAPTER VI.

DISCUSSION

Pre- and Post Survey Results

The results from two years of the study have shown significant positive trend in the dimension *Beliefs About Science*. In the first year, 2008-2009, there were positive trends in Sam's classes that showed significance. In the second year, 2009-2010, there were positive trends in classes in teachers Bailey, Carrie, and Derek that showed significance. Thus, in both years of the study, there were significant differences in a positive direction between pre and post surveys in the dimension Beliefs About Science. Also, there was a significant difference in a positive direction in the dimension *Expectancy for Higher Education* in Carrie's classes in the second year 2009-2010.

8th Grade Science TAKS results and Project Flowing Waters

The results from two years of the study have shown improvements in student attitudes in primarily one dimension, *Beliefs About Science*. To be determined yet is whether those results from correlate to increases in the students' science TAKS results in some demographic groups particularly at Goodnight Middle School (see Figure 1). It is possible that there is correlation between the presence of resident scientists in the Goodnight 8th grade science classrooms, and increases in the TAKS science test scores for 8th graders in 2009 as Project Flowing Waters began in 2008. Goodnight Pond at Goodnight Middle School was utilized by teachers and the resident scientists to implement their 5E inquiry based teaching. The pond became an asset to the teachers, students, and resident scientists. It is not clear whether activity at the pond and other inquiry-based science lessons may have played a role in the increase of 8^{th} grade science TAKS scores for the school or some other factors.

Conclusion

The research question that guided this study was “Are there differences in secondary students’ attitudes towards science in six specific dimensions after being with GK-12 fellows, resident scientists, for 8 months?” This study demonstrated a significant difference in student attitudes in one dimension in the two years since its inception in 2008. Primarily, this was seen in one dimension *Beliefs About Science*. Sam for 2008-2009 and teachers Bailey, Carrie, and Derek for 2009-2010 all showed significant differences in a positive direction for *Beliefs About Science*. Interestingly, it was only seen in four of the seven classes. There were also many positive comments in the fellows’ journals regarding the success of activities in the classroom. As mentioned earlier, “A classroom where students are doing inquiry-based activities generally have a high level of energy, students are interacting with materials, and activities tend to be more open rather than highly structured” (Wheeler, 2011). The GK-12 fellows in Project Flowing Waters acknowledged the enthusiasm in the classroom as a gauge for the success of a lesson plan. In the literature review it was also mentioned, by Stamp and O’Brien (2005), that a program that was based on the 5E method gave teachers more confident in the abilities of their students to learn the “science behind the terms” (Stamp & O'Brien, 2005). The inquiry-based instruction in the three classrooms in this other 5E method study showed a change in the atmosphere of the students’ learning environments that had allowed the students to think and share those thoughts with others. A changed more active environment could be the key to explain the significant difference that was indicated between the pre and post surveys in the dimension *Beliefs About Science*. The *Beliefs About Science* dimension concerns views about science and scientists. One of the questions concerns whether scientists have very good social skills. After being with a real scientist for a year in their classroom, students may view scientists as being more sociable than before they knew one. Also, by being able to get to know a scientist each and every week, student may also come to better understand that scientists can work as "part of a team" and they are not necessarily lonely people. Finally, that studying science might be a cool thing to do. All of these ideas about science and scientists are contained in the *Beliefs About Science* dimension.

Even with more inquiry activities provided by the resident scientists, *Beliefs About Own Science Ability* had no significant changes between pre and post surveys. Students in this program should enjoy science more, feel good about science, or understand it better. That was not shown with the *Beliefs About Own Science Ability* dimension survey items since there was a lack of significance. This is interesting since the students across all of the classes reported more positive than negative comments in the open-ended question sections and that their learning had been affected by their resident scientists.

It is also possible that students felt the more they begin to understand a subject like science, the more they realized they did not know as much as they thought they did.

The *Expectancy for Higher Education* results for the 2009-2010 school year had a significant difference in pre-/post surveys in a positive direction only in Carrie's class.

This could be due to that most of the students were 11th graders which may make them more interested in career opportunities and higher education. Also, Carrie's class had focused on current events. Her resident scientist related the local water system to the San Marcos River and to the ocean. Her ability to engage the students using the 5E method allowed the resident scientist to teach a different perspective and world view. This alternate view of comparing the San Marcos Watershed to the ocean may have also increased their awareness of their communities' impact on water quality. The significant difference may also be attributed to the resident scientists' rapport with the students since the positive comments about the resident scientist on the post surveys nearly doubled from the pre- scores.

In regards to the science 8^{th} grade TAKS scores, it is difficult to determine the impact of *Project Flowing Waters* with the TAKS scores. Other science enrichment programs within the schools may have also contributed to the increased scores. There was an increase found in both Miller and Goodnight Middle Schools after the inception of the program but there was also some fluctuation in scores in 2009-10.

Future Research Questions

A future research question for *Project Flowing Waters* in year three and beyond would be to see whether student attitudes in the *Beliefs About Science* dimension continued to change significantly from pre to post surveys. If so, further questions might concern the variables in the classroom that can contribute to demonstrate significant changes in attitude. It would also be interesting to see whether there are gender and scholastic ability differences in the student attitudes. For example, are Advanced Placement, Pre Advanced Placement, Honors, and Regular students affected differently by resident scientists? Lastly, it would be interesting to see if there are changes in student attitudes concerning science and resident scientists when they have had resident scientists over several years.

APPENDIX A:

Anonymous Student Attitudes about Science Instruction

Name of **Science Teacher** ______________________________**Class Period** _________

DIRECTIONS: The statements in this survey have to do with your opinions and beliefs about science instruction in school and the importance of science in your life. Please read each statement carefully, and **circle the number that best expresses your own feelings.**

Remember that this is not a test, and there are not "right" or "wrong" answers.

1. Read the statements below. Circle the number that expresses your feelings.	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
a. I enjoy science	1	2	3	4	5
b. Science is useful in every day	1	2	3	4	5
c. Scientists often don't have very good social skills	1	2	3	4	5
d. Doing science often makes me feel nervous or upset	1	2	3	4	5
e. Science challenges me to use my mind	1	2	3	4	5
f. The science instruction that I have received will be helpful for me in the future.	1	2	3	4	5
g. Scientists usually work with colleagues as part of a team	1	2	3	4	5
h. I am good at science	1	2	3	4	5
i. Advancements in science and mathematics are largely responsible for the standard of living in the United States.	1	2	3	4	5
j. I usually understand what we are doing in science class	1	2	3	4	5
k. Knowing science really doesn't help get a job	1	2	3	4	5
l. Science is difficult for me.	1	2	3	4	5
m. Working as a scientist sounds pretty lonely to me.	1	2	3	4	5
n. Studying hard in science is not cool to do	1	2	3	4	5
o. Even without a strong background in science, I will probably end up with the kind of job I want.	1	2	3	4	5
p. Overall, science and mathematics have caused more good than harm in our lives	1	2	3	4	5
q. I will probably take more advanced science courses available to me at this school.	1	2	3	4	5
r. My parents/guardians often take me hiking, camping, boating, fishing or hunting	1	2	3	4	5
s. My parents/guardians take me to the San Marcos River for activities	1	2	3	4	5
t. My parents/guardians think that protection and/or conservation of native plants and animals is important.	1	2	3	4	5

2. How much effort do you usually put into your science work? (Circle one)

I don't try at all………………………………………………………… 1

I do just enough to get by…………………………………………… 2

I give an average amount of effort………………………………… 3

I try pretty hard, but not as hard as I could……….......... 4

I work as hard as I can……………………………………………… 5

3. How far to do you expect to go in school? (Circle one)

a. high school,

b. vocational school

c. some college

d. college graduate

e. graduate school

4. What are your thoughts about the resident scientist in your classroom? (Short answer)

5. Has the resident scientist affected your learning of science? (Circle one: Yes/No) If yes, in what way has the resident scientist affected your learning? (Short Answer)

6. a. Have you learned about the San Marcos River, water ecosystems, or endangered species this semester? (Circle one: Yes/No) If yes, what are some things that you learned? (Short answer)

7. I was born in the month of ______________________. Sex: Male or Female (Circle one)

The scoring of the survey goes as follows:
Strongly Disagree = 1, Disagree = 2, Not Sure = 3, Agree = 4, Strongly Agree = 5

Beliefs About Science.
(Section 3) c.*, g., m.*, n.*

Beliefs About Own Science Ability.
(Section 3) a., d.*, h., j., l.*,q.

Importance / Usefulness of Science.
(Section 3) b., e., f., i., k.*, p.

Effort That They Put Into Science Work.
Single scored question #3

Parent / Guardian Involvement.
(Section 5) f., h.
* denotes negative questions where values are numerically reversed for scoring
Expectancy For Higher Education (single-scored question)
A=1, B=2, C=3, D = 4

APPENDIX B:

Anonymous Student Attitudes about Science Instruction [Spring 2010]

Name of Science Teacher ____________________________Class Period _________

Name of my favorite pet ____________ My favorite color ___________ My favorite food __________
Male or Female (Circle One)

1. **What are your thoughts about the resident scientist in your classroom? (Short answer)**

2. **Has the resident scientist affected your learning of science? (Circle one: Yes/No) If yes, what way has the resident scientist affected your learning? (Short Answer)**

3. DIRECTIONS: The statements in this survey have to do with your opinions and beliefs about science instruction in school and the importance of science in your life. Please read each statement carefully, and **circle the number that best expresses your own feelings. Remember that this is not a test, and there are not "right" or "wrong" answers.**

3. Read the statements below. Circle the number that expresses your feelings.	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
a. I enjoy science	1	2	3	4	5
b. Science is useful in every day	1	2	3	4	5
c. Scientists often don't have very good social skills	1	2	3	4	5
d. Doing science often makes me feel nervous or upset	1	2	3	4	5
e. Science challenges me to use my mind	1	2	3	4	5
f. The science instruction that I have received will be helpful for me in the future.	1	2	3	4	5
g. Scientists usually work with colleagues as part of a team	1	2	3	4	5
h. I am good at science	1	2	3	4	5
i. Advancements in science and mathematics are largely responsible for the standard of living in the United States.	1	2	3	4	5
j. I usually understand what we are doing in science class	1	2	3	4	5
k. Knowing science really doesn't help get a job	1	2	3	4	5
l. Science is difficult for me.	1	2	3	4	5
m. Working as a scientist sounds pretty lonely to me.	1	2	3	4	5
n. Studying hard in science is not cool to do	1	2	3	4	5
o. Even without a strong background in science, I will probably end up with the kind of job I want.	1	2	3	4	5
p. Overall, science and mathematics have caused more good than harm in our lives	1	2	3	4	5
q. I will probably take more advanced science courses available to me at this school.	1	2	3	4	5

3. How much effort do you usually put into your science work? (Circle one)

I don't try at all……………………………………………………..	1
I do just enough to get by……………………………………	2
I give an average amount of effort………………………………..	3
I try pretty hard, but not as hard as I could…………….........	4
I work as hard as I can……………………………………………..….	5

4. How far to do you expect to go in school? (Circle one)

a. high school, b. vocational school, c. college, d. graduate school

5. Have you learned about the environment this semester (Circle one: Yes/No)
If yes, what are some things that you learned? (Short Answer)

6. Student interpretation of parent/guardian involvement.

Read the Statements below. Circle the number that expresses your feelings.	**Strongly Disagree**	**Disagree**	**Not Sure**	**Agree**	**Strongly Agree**
a. My parents/guardians expect me to complete college.	1	2	3	4	5
b. My parents/guardians often help me with my school work.	1	2	3	4	5
c. My parents/guardians reward me for getting good grades.	1	2	3	4	5
d. My parents/guardians are very busy and don't have much time to help with my school work.	1	2	3	4	5
e. My parents/guardians think that science is a very important subject.	1	2	3	4	5
f. My parents/guardians would like me to have a career in science, mathematics, or engineering.	1	2	3	4	5
g. My parents/guardians make sure I do my homework assignments.	1	2	3	4	5
h. My parents/guardians ask me about what I am doing in school.	1	2	3	4	5

7. Student Attitudes about Aquatic Science

Read the statements below. Circle the number that expresses your feelings.	**Strongly disagree**	**Disagree**	**Not sure**	**Agree**	**Strongly agree**
a. Human activities in a river's watershed can increase the turbidity of the water (e.g., make the river more cloudy)	1	2	3	4	5
b. The protection of water quality of Spring Lake at the headwaters of the San Marcos River is essential for the water quality of the San Marcos River.	1	2	3	4	5
c. The San Marcos River would be more fun if we did not have to protect the endangered species in the river.	1	2	3	4	5
d. All endangered species have the right to exist.	1	2	3	4	5
e. There should be limits on how much water a person can use for watering lawns.	1	2	3	4	5
f. My parents/guardians often take me hiking, camping, boating, fishing or hunting.	1	2	3	4	5
g. My parents/guardians take me to the San Marcos River for activities observing nature like hiking, animal watching, looking at rocks, or to look at plants.	1	2	3	4	5
h. My parents/guardians think that protection and/or conservation of native plants and animals is important.	1	2	3	4	5
i. My parents/guardians go on nature walks with me.	1	2	3	4	5
j. My parents/guardians take me to visit a science museum.	1	2	3	4	5
k. At home I watch scientific and mathematics TV shows (e.g. NOVA, Discovery Channel, Bill Nye the Science Guy, etc.)	1	2	3	4	5
l. I read science or mathematics magazines and/or news magazines.	1	2	3	4	5
m. I have collected information about careers in science or mathematics.	1	2	3	4	5
n. My parents/guardians take me to the San Marcos river for picnics, tubing, and sports activities.	1	2	3	4	5

The scoring of the student attitude surveys is as follows:

Strongly Disagree = 1, Disagree = 2, Not Sure = 3, Agree = 4, Strongly Agree = 5

Beliefs About Science.
(Section 3) c.*, g., m.*, n.*

Beliefs About Own Science Ability.
(Section 3) a., d.*, h., j., l.*, q.

Importance / Usefulness of Science.
(Section 3) b., e., f., I., k.*, p.

Effort That They Put Into Science Work (single-scored question).

Parent / Guardian Involvement.
(Section 6) a., b, c., d.*, e., f., g., h.,
(Section 7) f., g., h., n.
* denotes negative questions where values are numerically reversed for scoring

Expectancy For Higher Education (single-scored question)
A=1, B=2, C=3, D = 4

APPENDIX C:

Teacher Application for Project Flowing Waters
(http://www.bio.txstate.edu/~pfw/docs/Teacher%20Application%202010.pdf)

TEACHER DEMOGRAPHIC INFORMATION FORM

Science Teacher

Name:
Gender:
Ethnicity:

Educational Background

Major, Degree:

Institutions Attended:

Occupational History

Teaching – grade levels, subjects taught, teaching certifications held:

Relevant non-teaching employment:

Professional development/enrichment programs:

Teaching awards:

Active professional memberships:

Voluntary professional activities:

TEACHER ESSAY APPLICATION FORM

Briefly describe your ideas on how you would like to incorporate the NSF *Program Project Flowing Waters* into your curriculum or instruction. Use additional pages if necessary.

Briefly describe what personal and professional attributes and/or opportunities you, your classroom, and your students will be able to provide for a GK-12 Fellow (Resident Scientist) working with you in your classroom. Use additional pages if necessary.

Briefly describe any special training you think a Resident Scientist would require before participating in your classroom. Use additional pages if necessary.

COURSE SCOPE AND SEQUENCE

For each course to be taught in 2008-2009 academic year provide the following information **with** the Scope and Sequence for your course.

1. Course Title
2. Grade Level
3. Start and End Date
4. Course Description
5. Required Course Materials
   Common Course Activities (number of labs per week, small groups, pod casts, videos, student projects, powerpoint presentation, use of internet, etc.)

6. Course Outline with Time Line (approximate dates) for Delivery

7. Desired Fellow (Resident Scientist) Activities for Topics in Course Outline

APPENDIX D:

2008-2009 Student Survey Comment Results

<u>Teacher Bailey</u>

<u>Pre thoughts about resident scientist in your classroom.</u>

POSITIVE COMMENTS
either cool, fun, helpful, good, different way of thinking/ new stuff, knowledgeable, nice and/ or smart. 32
helpful and more hands on / makes it easier to understand and easy to get along with / sweet because we get labs when they are around 3
ok 6
cool that a scientist would make time for this or great idea 2
very intelligent person, smart and knows a lot 2
either awesome, smart, funny, nice, and helpful 4
like her a lot / they are the best / enjoy them 5
good and more detailed answers to questions 2
NEGATIVE COMMENTS
they are annoying 1
INDIFFERENT
don't know or nothing 4
alright if they are in the classroom 1

<u>Post thoughts about resident scientist in your classroom.</u>

POSITIVE COMMENTS
cool 9
either good, good helper, fun, detailed, cool, nice, awesome, smart and/or helpful 20
ok, explains things easier – liked the experiments 2
smart or fun and better learning environment / labs 3
ok 5
funny, cool, intelligent, kind, kinda crazy and/or smart 3
nice, good teacher / likes to be around 3
cool, makes science fun, and easy to understand 2
everyone is giving their best 1
super smart, learned so much, like them a lot 2
cool to have scientist in the class / explains things really well 2
awesome, took us to the pond (pond is awesome) and helped a lot 2
better than my teacher / best ever / learned a lot 2
cool to have more than one teacher / answers questions that my teacher can't 2
taught me a lot about plants and animals 1
started weird but turned out cool and interesting 1

NEGATIVE COMMENTS
not seen them in a while 1
INDIFFERENT
don't care 1

In what ways have they affected your learning?

POSITIVE COMMENTS
either smart, good, helpful, cool, easier, fun 4
easier 2
explained it to me / easier to understand 5
made learning fun / fun labs 4
helpful 6
taught me more / learned more / knowledgeable and detailed 12
by being there in the room 1
I like biology now 1
helpful/taught more about plants, wildlife, ecosystem, and food webs 4
helpful and shows us what it is like to be a scientist 1
tell me stuff and/or answered questions 2
science is better / understand better 2
made it easier to learn harder things 1
taught more about physics and/or chemistry 2
showed a lot of new stuff / helpful projects 2
they worked hard with us / made me love science more 2
went to pond and did experiments / learned more about pond 2
went to the pond 2
NEGATIVE COMMENT
distracted 1
INDIFFERENT
N/A

If so what did you learn about the San Marcos River or endangered species?

POSITIVE COMMENTS
ecosystems are important to other animals 2
water is clean and/or keeps the same temperature 3
it has life in it and/or they depend on each other 7
a lot 1
field trip to the pond / its full of water / there is a pond 3
either the salamander, endangered species, water from springs, Texas Wild Rice, algae, animals, and/or the food web. 7
look at the chart it says a few things 1
humans effect the river 1
San Marcos has the cleanest water in the world 1
either protect the environment, water, plants and animals 3

two species of frogs has died out	1
about turtles	1
NEGATIVE COMMENTS	
not learned but been there	1
didn't learn anything	1
INDIFFERENT	
don't know / don't remember	1

Teacher Sam

Pre thoughts about resident scientist in your classroom.

POSITIVE COMMENTS	
helpful and/or I look forward to them and/or smart	11
good teacher / good person	3
ok, sometimes helpful	1
cool and seems very well educated	1
nice / cool and/or helpful	6
good / helps us understand understands	5
cool but, doesn't talk that much	1
cool, easy to understand / explains things well	2
good or cool and we get to go on field trips	2
cool and should come more often / I like them	2
I think their job would be fun to have / good scientist	2
either or all fun, cool, smart	7
brought more fun or interesting	2
enjoyed the presentation	1
NEGATIVE COMMENTS	
didn't talk much / boring	2
doesn't talk much	1
INDIFFERENT	
doesn't do much but organized a field trip	1
ok, don't really know them	1

Post thoughts about resident scientist in your classroom.

POSITIVE COMMENTS	
helpful and either respectful, nice, good, awesome, fun, or smart	13
taught us a lot, field trips, and easier to understand	1
ok, don't know them well, cool	1
either cool, smart, nice, ok, awesome, or cool and nice	15
ok, not really in the class	1
cool and teaches us a lot / helpful	2
a great student teacher	1
nice, polite, and/or a good teacher	2
cool, makes science easy and fun	1
interesting stories	1
ok, not horrible	1
helpful and encouraging	1
smart / knows a lot	2
good and getting along with and nice helper	1
quiet but cool	1
either nice or cool and listens but they are shy	2

NEGATIVE COMMENTS
boring 1
not here most of the time 1
INDIFFERENT
alright 2
don't know them that well 1
no real thoughts about it / don't care 2

In what ways have they affected your learning?

POSITIVE COMMENTS
science knowledge has improved / increased 2
the first field trip taught me a lot and I like physical learning 1
field trips make us want to learn more 2
made me pay attention because it was more fun / made it more interesting 4
helps with the labs / helps me understand things better / questions 7
taught me a lot / things I didn't know 4
resident scientist makes me think / different way to learn with labs 2
makes science more fun 3
learned a lot or helpful and explained things better/well 2
NEGATIVE COMMENTS
N/A
INDIFFERENT
N/A

If so what did you learn about the San Marcos River or endangered species?

POSITIVE COMMENTS
how fast water goes / how to calculate flow, volume, and resistance of water 2
litter kills the animals / protect endangered species 2
cut back on water usage / protect the water 2
field trip 1
different kinds of fish and animals 1
endangered species in the San Marcos River 1
salamanders are endangered and there is a lot of plant life 1
NEGATIVE COMMENTS
didn't go on the trip 1
nothing 1
not much 1
INDIFFERENT
don't remember / forgot 5

APPENDIX E:

2009-2010 Students Survey Comment Results

<u>Teacher Angela</u>

<u>Pre thoughts about resident scientist in your classroom.</u>

POSITIVE COMMENTS
nice and/or smart 2
exciting / excited about upcoming activities 2
helps with the learning 1
cool 4
like it 1
don't know yet 1
NEGATIVE COMMENT
N\A
INDIFFERENT
N/A

<u>Post thoughts about resident scientist in your classroom.</u>

POSITIVE COMMENTS
helpful and either nice or cool 3
down for his set 1
cool 4
really informative 1
good person that does his job well / good teacher that was fun and challenging / makes learning science fun 3
nice and smart or helpful / explains things well / I like a lot 4
cool and we do interesting experiments / fun experiments help me learn better 2
NEGATIVE COMMENTS
N/A
INDIFFERENT
N/A

In what ways have they affected your learning?

POSITIVE COMMENTS
genetics / fish 3
taught me a lot / understand science more 4
good at answering questions / better understanding 3
discover new things / interesting 3
makes things simple with visuals / fun and easy to learn 3
NEGATIVE COMMENT
N/A
INDIFFERENT
don't get it 1

If so what did you learn about the San Marcos River or endangered species?

POSITIVE COMMENTS
catfish / DNA in fish / about fish in the water 9
lots of things / everything 2
pollution and/or invasive species 3
ecosystem and human involvement / it is important to our city 2
either or all water temperature, endangered species, and invasive species 3
fun experiments with living creatures 1
NEGATIVE COMMENT
sort of and not really 1
INDIFFERENT
N/A

Teacher Bailey

Pre thoughts about resident scientist in your classroom.

POSITIVE COMMENTS
could help me succeed in science 2
cool and/or fun, helpful, learn more 16
either great idea, fun, good, good idea 8
depends on what topic 1
excited to learn from a person with experience / smart and knows a lot of stuff / cool to work with a real scientist 5
it will be interesting / look forward to it 4
NEGATIVE COMMENTS
doesn't matter 1
INDIFFERENT
don't know / not sure 7

Post thoughts about resident scientist in your classroom.

POSITIVE COMMENTS
very good teacher that is fun and interesting / good at teaching science 4
either great, fun, awesome, cool, and helpful 27
cool and either smart, helpful, nice, makes learning fun, makes learning fun, hands on, a friend, and answers questions 11
makes science more interesting / great and learn more with them 2
friendly helper and either nice and smart 2
great and talked a lot about frogs and ecosystem and aquatic science 2
good and either eager, I want them to return, scientist, fun, helped learn, and enjoyed it 9
they are ok 1
great experience / better than our regular teacher / knowledgeable and answered questions 3
helpful and understand labs better / interesting and easy to follow 2
fun, made learning easy, learned a lot, nice, or fun to go to the pond 5
NEGATIVE COMMENTS
ok but can be boring 1
they are a beast 1
INDIFFERENT
indifferent 1
I don't know 1

In what ways have they affected your learning?

POSITIVE COMMENTS
good labs / labs helped understanding 2
made it more interesting / understand science more / made it fun and/or better to understand 15
made me work to learn more / think harder / I learned more and got better at science / new way at looking at things 5
personal experiences and opinions 2
observe the environment or the way of looking at things like bugs and diseases / I know how to improve the ecosystem 3
interesting, easier to learn, and answered most of the questions 1
either and/or frogs, ecosystem, showed me science, species, wildlife, abiotic, water, and food chains 7
several things / I know more now / teaching me science / made me more aware / how to use or make things 9
about the stars / clay is gray 2
made me want to still be a vet / help animals / every animal is special 3
stuff in the water and I learned a lot / we went to a pond 2
interested about ponds and water and how to keep it healthy 2
easier to learn from someone that does it for a living / explains better / knowledgeable 3
helps a lot / helped me learn 3
NEGATIVE COMMENT
N/A
INDIFFERENT
I don't know 1

If so what did you learn about the San Marcos River or endangered species?

POSITIVE COMMENTS
either causes and effects, species, plants, animals and the ecosystem 4
workings and / or connections of an ecosystem, what would happen if there was no Daphnea or invasive species and how they affect the ecosystem, species like salamanders and why river is clean in certain areas 7
too much to put in a short answer 1
how to improve the river and or protect the river 2
food chain in the ecosystem / fish and protect the river / blind salamanders / endanger frogs and extinct animals 7
a lot of new things 3
cleanliest of water and microorganisms / algae in sewell park is endangered 2
endangered species, live organisms, blind salamanders, fish, frogs, plants, invasive species, food system, Daphnea, pond, and all kinds of ecosystems 11
cool and interesting things 1
a lot of things live here / river has species that only live here so be careful what we do 3
we have an aquifer / it is supported by a spring 2

either San Marcos River is clean and has many animals, microorganisms in the water, water is clean, fish and a lot of other stuff, species in the river, it is a unique river and where the river flows, animals that live there, and history of it and that scientist from all over the world come to study it 13

NEGATIVE COMMENT

nothing 1

INDIFFERENT

N/A

Teacher Carrie

Pre thoughts about resident scientist in your classroom.

POSITIVE COMMENTS
a good thing to help us / cool but hard 2
explained everything well, kept my attention, good teacher, enjoyable 1
fun but doesn't stay long / don't know yet, friendly 2
very good teacher that is fun and interesting / good at teaching science 16
NEGATIVE COMMENTS
N/A
INDIFFERENT
don't know yet 2
hasn't done a lot with us 1
no thoughts 5

Post thoughts about resident scientist in your classroom.

POSITIVE COMMENTS
ok 1
either and cool, good, fun, great, nice, social, hard working, informative, useful, smart, experienced, intelligent, awesome, interactive, enjoyable, explored jobs, knowledgeable 19
well organized but not broad on their topics 1
haven't seen them in awhile, their cool 1
fun because she teaches current events / amazing and wonderful teacher / power points are educational 3
helpful and either knowledgeable / smart, during labs and good power points, knowledgeable, brilliant, not a distraction, good, nice, good, kind 13
NEGATIVE COMMENTS
not enough information 1
don't see them much / didn't notice 2
teaching about the environment gets old 1
goes over things to quickly, like them as a person not a teacher 1
INDIFFERENT
we get off topic to discuss things with the resident scientist 2
alright, didn't interact very much 1
don't know 1
like them but they only focused on their field 1

In what ways have they affected your learning?

POSITIVE COMMENTS
more information about what I have already learned 2
enhanced my scientific knowledge about the environment / taught me a lot about water problems that are not commonly known 2
made me understand / better understanding / provided more in class than normal / understand teaching and informative / good at explaining things 6
taught us what we didn't know / learned a lot / interesting and I have learned new things / cool and talks about stuff 8
helpful and either especially during labs 6
green chemistry / water and fuel efficiency / increased interest/knowledge on energy efficient/eco-friendly science 3
sparked my interest in science / pursuing another career / interested in career / brought someone in to talk about forensic science / brought my attention to a field of science I did not know about 5
ecosystem and how to help the environment / pollution and the earth / explained the severity regarding the trash in the ocean / humans killing the ecosystem / pollution 6
what they do and interests / more into it / explains things well and helpful 3
NEGATIVE COMMENT
we already know how bad the environment is 1
INDIFFERENT
N/A

If so what did you learn about the San Marcos River or endangered species?

POSITIVE COMENTS
water is vital and only 1% is clean / water testing and what is in water / pH and chemicals in the river / taste of water and where it comes from 5
kind of / stuff 2
it is important to preserve the environment / need to keep it clean / pH affects flowers growth of flowers and pollution 3
pollution and either the sources of it, chemical content, water, endangered species, its effect on pH, and how pollution effects the environment / ecosystem / species 18
little creatures we should be saving / how things live in the environment / about what is in the water around us / endangered species 5
studies done at the San Marcos River / how San Marcos River is different / conserve and clean the San Marcos River / San Marcos River comes from a close, closed spring or species and chemicals there 5
NEGATIVE COMMENT
you don't want to know 1
INDIFFERENT
N/A

Teacher Derek

Pre thoughts about resident scientist in your classroom.

POSITIVE COMENTS
either good, awesome, ok, fun, cool, help learn, better understanding, or teaches more 16
amazing and helpful / weird and curious / great and nice 3
interesting and either cool, closer to age, know what they have learned, exciting, or helpful. 17
fun and either exciting, awesome, or enjoyable. 3
NEGATIVE COMMENTS
don't care 1
INDIFFERENT
don't know 3
not seen this person 1

Post thoughts about resident scientist in your classroom.

POSITIVE COMMENTS
helpful and/or good activities 4
either opinions, ok, great, good, like it, or awesome 9
nice and/or either helpful, good and made science interesting, and nice to have another teacher8
fun and/or either good with labs, easy and nice, interesting, liked having them around, good, helpful, and educational. 14
cool and/or either helpful, detailed, fun, teaches in fun ways, and knowledgeable. 8
make things more interesting / learned more 2
smart and/or other helpful, nice, awesome, fun, or cool. 8
NEGATIVE COMMENTS
he was a beast 1
it bit 1
INDIFFERENT
no comment 1
nothing 1

In what ways have they affected your learning?

POSITIVE COMENTS
made it easier / made me want to get an education in science 2
informative and fun / interesting facts / easier to take notes 3
fun and/or but serious, helpful, learned a lot 10
I pay more attention to them / make science more interesting / easier to understand / elaborates 17
we do labs that help / labs are fun / hands on 7

enjoyable or awesome 2
I love science / science is not boring 2
learning science can be fun / learned about animals or about things in the water 5
NEGATIVE COMMENT
N/A
INDIFFERENT
not sure 1

<u>If so what did you learn about the San Marcos River or endangered species?</u>

POSITIVE COMMENTS
fish or species in the San Marcos River or in an ecosystem 21
know stuff / cleanliness of the water / dirt / rocks and animals 5
school pond and/or rice in the San Marcos River / we went to the pond / birds like the American Coop and the pond ecosystem 5
endangered species / ecosystem / water cycle / little animals / animals / aquatic life / food chain / fish / endangered ecosystem 27
species and types of water / blind salamanders are endangered / some bugs and fish are gross 4
love the river and mad that Aquarena Springs Theme Park closed / Edwards Aquifer 3
NEGATIVE COMMENT
N/A
INDIFFERENT
N/A

Teacher Eleanor

Pre thoughts about resident scientist in your classroom.

POSITIVE COMENTS
nice, fun, friendly, and safe or nice, smart, and kind 2
either ok, awesome, good, cool, I liked it, or nice. 14
fun and/or either smart, nice, great, learned a lot 8
good scientist / good teacher that explains things well / enjoy having one / awesome and interesting / looks like an active person 5
like them and look forward to seeing them again / taught me a lot and want to come again 2
fine with me, I like science / I like them 2
NEGATIVE COMMENT
like them but it could be more fun 1
INDIFFERENT
N/A

Post thoughts about resident scientist in your classroom.

POSITIVE COMENTS
smart and teaches a lot / great with science / do more labs 3
either better, good, great, awesome, fun, alright, cool, useful, or ok 9
cool and/ or either like them, fun, knowledgeable 7
helpful and/or nice, fun, or cool 5
good and has done some neat things / easy to understand 2
nice and/or easier to understand, easier to understand 2
like having them around, knowledgeable, and enjoy their teaching / likeable and helpful / energetic and focused / like them there to ask questions 5
it's like having two teachers / taught me a lot and I look up to them / I Iike them better than my teacher / great and helpful teacher / like it and it is a positive impact on our class 5
NEGATIVE COMMENTS
don't care for her 1
ok, but experience was average 1
INDIFFERENT
I don't know 1
what are they going to do 1

In what ways have they affected your learning?

POSITIVE COMENTS
makes it challenging and fun / all kinds of stuff / more stuff / assignments are easier 3
help understand / helpful / easier examples to help understand 13
taught me a lot / stuff I never knew before / teaches with more detail / makes thing clear 4
someone else to ask questions / take learning science more serious 2
fun and/or easier, made it easier, explains things in detail and cool activities 3
how skunks make their stink / salamanders 2
teaches me about the oceans scientifically (my goal career) 1
NEGATIVE COMMENT
N/A
INDIFFERENT
didn't have a resident scientist last year 1

If so what did you learn about the San Marcos River or endangered species?

POSITIVE COMENTS
food web / fish and water / different species / endangered species, salamanders, ecosystem, and the food chain 5
aquatic ecosystems have producers, consumers, and decomposers / species in the river and why it is special 2
endangered species and either blind salamanders, how to help / why it happens, endangered species in the rainforest, and the ecosystem 7
blind salamanders and/or either developed to live in the dark, animals, and their predators 6
clean water from the aquifer, endanger species is the blind salamander / how things in water depends on other things to survive 2
salamanders and/or plants, fish / protect salamanders and ecosystem 3
NEGATIVE COMMENTS
not that much 1
INDIFFERENT
never went inside, just heard of it 1

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