Inquiry, Inquiry, Inquiry. What's the Buzz All About? A Pre-Service Teacher's Adventure to Include an Inquiry Stance to the Fifth Grade Animal Unit

A. Background Information:

The journey to finding my science teaching style has been one of exploration, expression, and experimentation. During the fall semester, I was required to teach three inquiry-based science lessons. Inquiry and evidence were the words that our professors kept emphasizing each time we met for class. The proscribed approach in teaching science seems to be moving toward inquiry, but I wanted to know just why it is so special. Was I going to see a change in my students through these inquiry-based lessons? Naturally, I was both nervous and excited to perform experiments with the students, and to teach using the inquiry approach that I learned in my science education course. But I was curious to see how the students would respond.

My fifth grade students were studying a geology unit, and I decided to teach them inquiry-based lessons on the layers of the earth. By using science talks as pre-assessments, I realized the students had many misconceptions about the different layers. This information enabled me to use their misconceptions as a starting point for the lessons. In order for me to teach through the inquiry stance, I had to have a strong knowledge base for the content that I taught. I spent a great deal of time researching the topic, using both the Internet and the library, as well as discussing the content with my science teachers. When I was comfortable with my knowledge of the topic, it was time for me to introduce the lessons to my students. During the lessons, I asked the students some thought provoking questions, and provided them with enriched, hands-on activities. Thus the students became experts on the different layers of the earth.

Once I reviewed the student artifacts, I realized that inquiry-based lessons seemed to make a difference in the way my students were learning. As a teacher, I was excited to hear that my students were still talking about those experiments months later, still remembering the key information that they had learned. When I observed that the children appeared to be interested in science and were truly learning the information, I felt compelled to continue teaching this way.

It wasn't until our unit-planning meeting with the other fifth grade teachers that the term "inquiry" was discussed. My mentor teacher suggested that the animal unit for science seemed like it was somewhat outdated, and that more of an inquiry-based approach was needed in the existing lessons. Andrea (a fellow fifth grade intern at my school), and I looked at each other and winked, because we had worked closely on the previous inquiry-based lessons together, and we were up for the challenge. We knew that the animal unit was our unit as interns to teach, and we wanted to make it as exciting as possible.

Immediately following the meeting, Andrea and I met with our science professors to see if they had some ideas for us about how to make a few inquiry-based lessons. Not looking at the big picture, our professor thought that it would be a great idea for us to do our inquiry project together, based on incorporating inquiry into our science unit. Immediately we were excited to start our journey, and that is how my inquiry project was born.

After Andrea and I had an "inquiry sleepover", we realized that our projects were moving in two very different directions. I was more interested in the student outcomes of the inquiry lessons, while Andrea wanted to know how the inquiry approach would help her as a beginning teacher in a different school district next year. With the strong collaboration that Andrea and I have together as teachers and friends, we were sure that we could gather enough evidence and research to support our projects.

Knowing that many resources exist in the field of science, including experts, teachers, and literature, I felt confident that I would have the necessary support to teach my science lessons in an age-appropriate, inquiry-based manner. Published in the *Institute for inquiry (2000),* the following list are components of what inquiry-based science should look like.

- ✔ Children view Themselves as Scientists in the Process of Learning
- ✔ Children Accept and "Invitation to Learn" and Readily Engage in The Exploration Process
- ✔ Children Play and Carry Out Investigations
- ✔ Children Communicate Using a Variety of Methods
- ✔ Children Propose Explanations and Solutions and Build a Store of Concepts
- ✔ Children Raise Questions
- ✔ Children Use Observations
- ✔ Children Critique Their Science Practices

Expert, Rick Duvall (2001) shares the importance of an inquiry-driven science classroom,

> In each of these classrooms, we witness students and teachers who are questioning, observing, raising counter-arguments, suggesting alternative sources of information, and offering productive feedback. The teachers in these classrooms have learned how to encourage students to be deeply thoughtful as they question, explore their own ideas and the ideas of others, and actively investigate. While they know that they could "cover" the curriculum much more rapidly through lecturing and telling the students the "correct" scientific ideas, they realize that genuine learning is an active process, and they prefer to guide the students in actively "uncovering" the curriculum by setting up appropriate learning situations. Each member of the class is valued as both a learner and as a teacher. They (students) are expected to share the results of their investigations with either orally or in writing, so they can teach and learn from each other. The teachers have created a climate for collaboration by helping their students build an atmosphere of mutual respect and admiration. These teachers have learned how to give students ownership of their own thoughts and control of their own investigations without unstructured chaos erupting in the classroom (2-3).

Not only do experts in the science community value the inquiry approach to teaching. Our science methods instructor and professor taught our SCIED 458 methods course using the inquiry stance. As a student, I learned the components of inquiry, and experienced these lessons from my instructor and professor. Through much needed support and guidance, my instructor, Kimber Mitchell, has played an integral role in helping me to set the tone for an inquiry-based classroom. Through her knowledge and research, Kimber has worked with Andrea and I throughout our entire project, sharing her expertise and passion for inquiry. With the support and evidence from many resources stating that inquiry is the best way to teach students science, I began the transformation from a teacher who follows the lesson in the prewritten packaged unit, to a teacher who completely tries something new, in hopes to motivate my students in science.

Many wonderings emerged, as I thought about taking an inquiry-based approach to teaching science. My overarching question was, "How can I incorporate more meaningful inquiry-based lessons into the fifth grade Animal Unit, and what are the student outcomes?" Earlier in the semester, I had a taste of teaching inquiry-driven lessons, but I felt that I needed much more experience and evidence to be fully convinced that this is the best approach to teaching science. Along with this question about student outcomes, I also wondered; "How do the students feel about inquiry-driven science lessons compared to traditional, teacher directed science lessons? How do students benefit from inquiry-based science lessons? Will I be able to see a difference in the depth of the students' explanations of the concepts that they will be learning?" All of these questions would require supporting evidence. Therefore, creating meaningful opportunities for data collection would be crucial in finding answers to my questions.

*** Turn to page A1 in the Appendices for a list of my inquiry wonderings.**

B. My Inquiry Plan

My inquiry project conveniently became a natural part of my classroom because it focused on science instruction, which is part of the district's curriculum. Changing the structure of our science lessons was necessary in order to support the inquiry-based stance. Wonderings are a crucial aspect of the inquiry-based approach. Therefore, I needed a way to keep track of student questions so that at any time, we could return to our questions to review what we had learned. Colored butcher-block paper became a staple for our science class. Nearly every new lesson that was introduced included some form of large paper as a source for gathering student questions and current knowledge about a given topic. Rather than beginning a lesson by giving the students background information, I found that it was necessary to find out what they already knew by giving the entire class informal pre-assessments. KWL charts, class discussions, students as scientists, experimenting, observing, and collecting data and evidence were the driving forces behind my methods of teaching science. This approach put the responsibility into the hands of the learners. I immediately began referring to the students as scientists, hoping to create a positive environment, full of enriched, self-motivated learners. Grouping became a large part of our science class because I designed many activities for the students to work closely together. Careful planning was necessary when grouping students based upon ability levels and personalities.

Data collection became the essential mode to learning about my students as science learners. I wanted to have a broad range of data, in order to provide strong evidence leading to claims about the impact of inquiry-based lessons. Since I have a special interest in student outcomes, I centered my data collection on the children. Student artifacts such as worksheets, data collection notes, drawings, observations, pre-assessments, questions, projects, reports, explanations, quizzes and tests were analyzed. Both student and parent questionnaires were given in order to gain insight directly from the learners and their parents, who know them best. Observation notes from my student teaching supervisor proved to be helpful in analyzing the manner in which I present the information to my students. Informal and formal post-assessments were used as evidence to support my claim about the importance of inquiry. Student behavior, my weekly journals, lesson plans, rubrics, videotapes for reference and analysis, literature, teachers, and experts in the field of scientific community all provided tools that aided in the analyzing process. With all of the pieces of data that I have collected, I feel strongly about the claims that I have made as a pre-service science teacher.

Soon after, I began collecting student work for my inquiry project. I quickly realized that I needed a formal way to organize all of my artifacts. I bought a very large expanding file folder with nineteen folders, which built up quickly, leaving no room for any more papers. I made a file for each inquiry-based lesson that I taught, and filed all of the student work in that particular folder. I began to organize more than just student work. I made specific files for my lesson plans, response journals, observation notes from my student teaching supervisor, personal notes, pictures, and additional resources. Now, whenever I needed to look at anything pertaining to my inquiry project, it was all neatly located in one place. Being organized from the start allowed me to feel more comfortable with the gigantic amount of student work and teacher artifacts that I had collected because I knew that my organization would help preserve my sanity when it came time to analyze my data.

Due to the enormous amount of student artifacts, it was easy to become very overwhelmed. Instead of going through each artifact from my twenty-five students, I chose to closely analyze work from nine students of different ability levels from my class. Once I had decided whose work would best fit the different ability levels, sorting my data became simple. I sat down and pulled data for nine students from each of the lessons that I had taught during the animal unit.

I began looking for trends among all levels of students. Careful reading of individual student responses led me to many conclusions, each of which supported my claims about inquiry-based science lessons. As I read through the entire collection of student and parent artifacts, I often made symbols to represent things that I felt supported my claims. For example, while examining each part of the parent questionnaires, I would draw a hand if the parent talked about "hands-on activities," or draw a talking mouth if the parent mentioned the importance of class discussion. I decided that it would be most effective if I slowly and carefully examined student work one science lesson at a time. This process allowed me to compare the quality of student work among numerous students on one particular lesson. When I felt I had found all of the crucial pieces of evidence to support my claims, I moved on to analyze the next lesson. This process continued until I was satisfied with the information I had gathered from the student work, student responses, and surveys.

Now it was time to gather supporting evidence from literature. I found many wonderful online articles about teaching science through the inquiry approach, and how it has a positive effect on student learning. The inquiry book from our SCIED 458 class was also a wonderful resource. I not only had professionally written documents as resources, but I also had veteran teachers and professors to help me reflect on my science teaching. With all of my data and resources, I found it easy to pull it all together to build a strong claim that supports my belief about the importance of students experiencing science through inquiry.

C. What I Learned

***Turn to Page A-2 in the Appendices to view a complete list of my claims.**

Claim 1. Collaboration among teachers enhances the quality of teaching, thus leading to greater student success.

Evidence

When Andrea and I had decided to collaborate on our inquiry project, we initially believed that we would be working on every aspect of the project together. However, we were wrong. As stated in *The Reflective Educator's Guide to Classroom Research*, "Sometimes teachers engage in individual inquiry projects that focus on the same topic, but explore different questions and wonderings about that topic. When this happens, a potential exists for inquiries to intersect and collaboration to occur at the juncture of that intersection" (Dana, 59). This is exactly what had happened with Andrea and I. Andrea wanted to know more about the teacher aspect of teaching science through the inquiry approach, while I was more interested in the student outcomes of inquiry-based lessons. Even though our wonderings were split, we still turned to each other for support throughout the entire inquiry process.

Excited, overwhelmed, and a little nervous, Andrea and I met with our SCIED 458 instructor to discuss the beginning of our inquiry-based teaching approach. As we flipped through the animal unit, we came to the conclusion that the areas of study within the unit were organized in a manner that did not seem to make much sense. Immediately, we decided that the students would benefit most if the sections were organized in a manner in which the students learned first about what they are familiar with, vertebrates. After vertebrates, we would then study invertebrates. Now that we had rearranged the unit, it was time to start choosing lessons which best reflected the concepts to be learned. There were many fun but similar lessons, which matched the same state standards for science. Instead of covering a large number of lessons in a short amount of time, we felt that the students would benefit from fewer, in depth, interactive experiments that were highly concentrated around through-provoking questions and concepts, supporting the inquiry approach.

Through collaboration with Andrea Sanko, and our Science 458 methods instructor, Kimber Mitchell, we were able to generate the animals necessary for our first lesson in the animal unit, the live animal observations. Mrs. Mitchell provided us with a yellow rat snake, cockroaches, and a chicken. I brought my pet tree frog, and we borrowed the classroom rabbit from a first grade classroom. Without this essential collaboration, we would not have been able to gather the animals necessary to make this live lesson live inquiry-based, with real animals representing each class of vertebrates.

***Turn to Appendix I-2 to view pictures from the animal observations.**

After meeting on a daily basis with Andrea, we reflected on our lesson for the day, focusing upon what went great and what could have been better.   For example, after our animal kickoff, I recorded observations that the students had generated from the live animals.

I made a long list for each animal on a different color of butcher-block paper as the students called out their observations. As an hour passed, I realized that we were still doing the same thing, and the students were looking more bored by the minute. Finally, after an hour and a half, the recording was complete, but the children were practically asleep. The content that the students had shared was amazing, but the way that I organized their data was definitely not the best approach.

After the lesson, my mentor teacher asked me how I felt the lesson went, and I told her I was disappointed in the way I chose to record the observations because I had lost the students' interest. She recommended that I reflected with Andrea because she had done the same lesson that day. At the end of the day, I couldn't wait to talk to Andrea. A little frustrated and disappointed in myself, I trudged over to Andrea's classroom. We both shared how we recorded the observations, and I soon came to realize that Andrea's approach would have worked much better in my classroom.

Instead of recording observations for each animal on a separate large piece of paper, Andrea used one piece of butcher-block paper to record all of the observations. This graphic organizer was concise, and clear. Andrea made columns for each animal, and then listed each animal's characteristics below the animal's name. This method of recording data only took Andrea's students thirty-five minutes because she didn't write down every single observation, and the categories were more organized. From this simple reflection, I realized what not to do. Since that first lesson, my timing has been much more concise, and the students are never bored, because I am always moving them from one thing to the next, through many transitions.

The previous example is one of many where Andrea and I worked together to comprise/revise the most engaging, well-planned inquiry-based lessons that we could. As stated by the National Research Council (2000),

> Collaboration can be an important catalyst of change. New understandings develop and new classroom practices emerge when teachers collaborate with peers and experts. Collaborative working relationships among teachers provide a very important context for the re-assessment of educational values and beliefs. Collaboration stimulates the reflection that is fundamental to changing beliefs, values, and understandings (140).

*** Turn to Appendix H-1to read my journal about my reflection with Andrea Sanko.**

***Turn to Appendix I-1 to view a picture of me with Andrea Sanko, my fellow collaborator.**

After meeting about each lesson that we planned to teach, Andrea and I created what we felt to be the most creative, engaging, and motivating inquiry-based lessons. The reflection process after the lessons were taught was priceless to my learning to hear about the success, not only in my classroom, but in Andrea's as well. This confirmed my beliefs about the importance of inquiry in my classroom. Not only was it fun to collaborate with a fellow teacher, but I also feel that, based on student artifacts, students are enjoying science more because more brainpower is going into the planning of lessons than just my own.

Not only did Andrea Sanko and I plan lessons together, we reformed the animal unit test together. Instead of less demanding questions, Andrea and I incorporated more inquiry-based questions that would lead to the evaluation of the depth of student understanding. For instance, each student had to write a paragraph about how an owl pellet is formed. The paragraph would be worth three points, due to the high-cognitive demand of the task, whereas most questions were only worth one point each. This task might seem overly demanding on a large unit test for fifth graders, but due to the success we had seen throughout the unit, we felt that our students would not have any trouble with this task. While observing my data, I found that twenty-one out of twenty-four students received all three points for their paragraphs, and the other three students received partial credit, losing points for the lacking depth of their explanations. This outcome alone says the importance of inquiry-based exploration. The students' opportunity to pull apart a real owl pellet, researching which animals a particular owl ate, led not only to student interest and motivation, but also to a profound understanding of the process that an owl must make in order to produce a pellet.

Not only does the collaboration process aid in the classroom, but it also provided Andrea and I with a tremendous opportunity to share our inquiry project with members of the National School Development team. During our presentation, we shared how we arrived at our wondering, how our wonderings divided into two projects, how we have collaboratively worked together, and the impact of teaching science as inquiry. I felt empowered to share our project with fellow members of the education community, and to build my professional voice.

Claim 2. Students are interested and motivated in science and take pride in their learning.

Evidence

From the first inquiry-based lesson in January, I observed a change in my students' attitudes towards science. Rick DuVall (2001), author of "Cultivating Curiosity with Comfort: Skills for Inquiry-Based Teaching" says, "When doing the task becomes pleasurable, learners are intrinsically motivated to continue doing it, which results in more experiences, and the cycle continues" (2). With the inquiry-driven lessons, I have found that the students do want to continue their science learning, and are sad when science class is over. Beginning with the first inquiry-based lesson in January, the students were making live animal observations. The students were divided into groups, each of which was assigned to an animal. After specific instructions and expectations were addressed, the students took their note taking papers and pencils and headed next door, where we had a large snake, cockroaches, a tree frog, a chicken, and a rabbit, one animal from each of the classes of vertebrates. The students spent one fifty minute session and another thirty-minute session observing their group's animal, along with touching and observing all of the other animals. The students were motivated to find out everything they possibly could about their animal because the animal was right in front of them, and it was extremely exciting. This inquiry-based activity served as one that sparked the interest of all learners, and was a great opener to our animal unit. Thankfully, this was just the beginning of the high interest and motivation to succeed in science that the students experienced in my science classroom.

The student surveys and science talks especially caught my interest because all of the inquiry-based lessons were mentioned as being the favorite lesson. I was really touched when my mentor teacher shared with me that in previous years, the overall favorite lesson in the animal unit was one that was fun, but had little connection to the animal unit, and was not inquiry-based. However, this was not the case this year. I felt an overwhelming sense of joy when every single inquiry-based lesson was a favorite for someone in my class. This evidence led me to feel the power of inquiry. Students are definitely interested and motivated because their interest is ignited, and the students are asking their own questions, thus taking pride in their learning. In just one of many instances, "Kevin" commented on his vertebrate report; "My favorite part was when I found out that the gorilla can be eight feet tall and have an arm span of seven feet." Another student said, "I liked it (animal report) because we got to choose our animal and we got to be like a scientist and research." Yet another student replied, "I learned amazing facts about my animal, the leopard, that I couldn't believe!" Each of these students is at very different ability levels. The important realization is that all students can thrive in inquiry, because they are learning about what interests them, not what interest the teacher or other students. Inquiry is very individualized to the learner. Therefore, students take pride in their personal wonderings, their research leading to scientific answers, and the new knowledge that they have gained. Clearly supported by my students, “Mark” said during open discussion, science talk, “Yeah that was cool because we got to ask our own questions instead of you asking questions.” As Piaget’s cognitive dissonance theory states, “(Hands-on, inquiry-based instruction) motivates students to challenge their existing mental constructs and misconceptions.” To support Piaget’s cognitive dissonance theory, one of my students directly reflected on her experience with her animal report. “Jenny” said,

> I learned a lot about sloths. Before, I did this assignment with the sloths, I thought a sloth was a nasty green thing with big claws and hangs on a tree, and it is very slow. Now I know much more about it, and I don’t think it’s nasty anymore.

Listed below are additional comments about the animal report from all students of different ability levels:

- ✔ ”My favorite part was choosing my animal. I liked finding out things about my animal that I didn’t know. I also enjoyed presenting.”
- ✔ ”I didn’t like that I didn’t get to share my whole project.”
- ✔ ”I liked looking on the computer for information about the chimpanzee. I also liked using multiple resources.”
- ✔ ”It was fun going to the computer lab to find information”
- ✔ ”I liked picking out animals. I liked learning about horses. How big they get, how many babies they have, how long they live.”
- ✔ ”I liked getting info. off the Internet. I enjoyed learning about toxins in the garter snake.
- ✔ ” I liked typing it up.”

All of these responses convinced me that the inquiry-based approach, where students ask their own questions and research their own wonderings, is very powerful. It was very rewarding to read these highly insightful comments after the reports were completed. The animal report still stands as the favorite lesson for many of my students.

The science talk, (a small group of students who sit in a circle, and share their personal experiences about scientific concepts) proved to be an amazing piece of evidence to support my claims about the strong impact that inquiry has on student learning. As I have learned, students of all heterogeneous groups participated, and succeed in the science talk. This is not uncommon, as the author of *Talking their way into science (1995)* says,

> The ownership expanded. Science Talks enable new voices to emerge as authoritative because the hierarchy of the classroom is blurred when the teacher moves out of an authoritative role. I have found as I have worked with my own classes and with other teachers that the open ended format of the talks allows children who are not high achievers to show that they are keen observers of the world and powerful creative thinkers. In effect, the Science Talks, by considering questions whose answers are not known, invite every child to participate. The process of constructing an answer with others, of using everything that's been observed and imagined, stimulates more participation in science than a recitation of information from a book (23).

I believe that beyond the fact that the students felt comfortable participating, this science talk focused around students who were excited to share what they had experienced in our animal unit. Because this talk focused around what the students had experienced already in class, rather than discussing the children's thoughts about a concept that has not yet been taught , the students are proud to be the experts of their knowledge, and to share it with others.

*** For evidence from my science talk, you can read my reflection journal on page H-2of the Appendices.**

With the numerous pieces of evidence that I have shared, I feel certain that well-planned, true inquiry-driven lessons capture the interest and motivation of all students. Next, I will be discussing more examples of how the different components of inquiry are in full motion in my science classroom.

Claim 3. Inquiry is an important aspect of learning in the classroom. Students engage, explore, explain, elaborate, and evaluate new information, in order to gain knowledge and a deeper understanding of the content.

Evidence

From the beginning of the school year, I have referred to the students as scientists. I have always emphasized the importance of evidence. Many students have coined "evidence" as being Miss Booth's favorite word. Students have learned to view themselves as scientists who must start with a question, find out how to perform an experiment or research, collect data, make claims supported by evidence, and finally present their findings. My students have become accustomed to being required to back up everything they say with scientific evidence. For example, a bonus question on our unit test asked, "What is the most important thing that a scientist must have in order to make a scientific claim? Why is this important?" All but two students answered correctly. Here are a few student responses to the question about evidence:

- ✓ "Evidence, because without it you couldn't prove or know for sure that something is true."
- ✓ " So people believe you."
- ✓ " So you can actually claim it instead of just saying, "I think this is the way it is."

Without evidence, my students constantly tell me that they cannot prove anything. With this real-life approach to teaching science, the *National Research Council (2000)* states, "Students who use inquiry to learn science engage in many of the same activities and thinking processes as scientists who are seeking to expand human knowledge of the natural world(24)." One of my more challenged students once said to me, "I like science because we get to be like scientists and research."

Through inquiry, students have learned to value the importance of accuracy and evidence. During one of our class discussions about our Hay Infusion Lesson, students could not decide which organisms could be found in the hay. One girl said that the Volvox must be present because it "looks like" what she drew on her paper. Another student quickly raised his hand to say that it doesn't matter what she "thinks she knows" because she has to have evidence. After this comment, other students agreed that you must have evidence to prove that something is true.

Because all of my students experience the components of inquiry in our science class on a daily basis, they have become experts on how to find answers to their questions, and how to present them accurately. In the Hay Infusion Lesson, the students were engaged in hands-on learning, as they explored living organisms under a microscope. To continue the inquiry process, the students elaborated their observations, and researched information, taking notes in the computer lab about different types of microorganisms. Students then evaluated the information that they collected from the computer lab with their descriptions of what they witnessed going on under the microscope. Once the students were satisfied with their research, they explained to the class which organisms were in fact present in the hay infusion. Incorporating all aspects of inquiry into science lessons familiarizes students with the real scientific process. As little scientists, my students understand and value the importance of their learning.

Claim 4. Students have self-confidence in science as they see themselves as students of science.

Evidence

Overwhelmingly, I have noticed the quietest students participating in science much more than in any other subject. I believe students have much more self-confidence in their science ability because of the inquiry-based lessons. The reason for this is because these lessons focus around what the student knows and what he/she wants to know. Students have developed an appreciation for the unknown, and instead of being scared of what they don't know, they are excited to ask questions and then find out the answers for themselves. During inquiry lessons, students are the experts, thus creating self-confidence. Here, *The National Research Council (2000)* shares their views on students as science learners:

> Students need to learn to recognize when they understand and when they need more information. They need to be able to know when to ask: What kind of evidence do I need in order to believe particular claims? They are metacognitive; they are aware and capable of monitoring and regulating their thoughts and their knowledge (119).

Through numerous lessons, students have had the chance to investigate a problem, find the answer, and then present their findings to the class. When students are the experts, they feel good about what they have learned and are excited to share their findings.

Noted by Huber (2001), "The Standards define 'full inquiry' as a process in which students pose a productive question; design an investigation directed toward answering that question; carry out the investigation; gathering the applicable data in the process; interpret and document their findings; publish or present their findings in an open forum" (2). As I employ these standards in my daily teaching agenda, I see my students becoming more accountable for their own learning, while I step back and act as more of a facilitator, rather than a teacher with all of the answers. Dispezio explains:

> The teacher takes on an increased role as facilitator of learning and a lesser role as the all-knowing dispenser of knowledge. Students take on much more responsibility for learning and, in the process, acquire lifelong skills applicable in and out of the classroom (2).

In "Inquiry Based Science, What Does It Look Like, (1995), it states that children view themselves as scientists in the process of learning when:

1. They look forward to doing science (Appendix H4)
2. They demonstrate a desire to learn more (Appendix D)

3. They seek to collaborate and work cooperatively with their peers (Appendix H2)
4. They are confident in doing science; they demonstrate a willingness to modify ideas, take risks, and display skepticism. (Appendix I)

I have closely observed as many of my students have experienced a huge increase in confidence and involvement in science over the course of the year. My advisor noted during student invertebrate presentations that, "The children presenting were confident of their knowledge, and creative in their approach. All children participated in presentation. You could tell they had practiced." I witnessed as students who are normally quiet, stood in front of the class, and gave a wonderful presentation about an invertebrate phylum that they had never heard of until a week prior to the presentation. Seamlessly, the students answered questions from the audience with ease. Because they had spent so much time researching, they were fluent with the material. My mentor teacher and I were stunned that the students were able to rattle off facts about their invertebrate without any form of note cards. This was a true sign of the confidence that my students had in themselves as experts of their knowledge. Here, one student verbalizes his feelings about his role in our science classroom, "You used to teach us stuff, but now we get to do hands-on stuff and teach you stuff." This statement clearly states the ownership that students have when participating in inquiry. Here, another normally struggling student shares his improvement in science:

> I used to hate science tests because I thought it was a waste of time at home and at school for like studying and doing boring tests. But now I think they're really easy and they help. You learn about stuff and it helps you later on in life.
>
> (Teacher) When you say that you think they're easy (tests), how are they easy now but they weren't before?
>
> Because I think before I didn't like science that much so I was like "Ok this is stupid, I've had enough of this." But then in the animal unit, I was like, "This is cool," and I

actually listened and paid attention, and I seemed to like it. I studied at home for like five minutes with my dad, and he was like, " 'Todd,' you know this just fine". And then at school I got good grades on my test.

This student reflection is primary evidence that supports my claim about both the improved self-confidence in science, and the ability to succeed in science academically through the inquiry approach. Most of these wonderful reflections were generated during our group Science Talk. In addition to the Science Talk, I have found evidence that my students feel good about their role as scientists in my classroom through test scores, explanations, responses to lessons, student questionnaires, and informal assessments that I make on a daily basis.

***Please refer to Appendix G to view student questionnaires.**

Claim 5. Students have the ability to draw conclusions and make explanations using scientific evidence.

Evidence

My students have proven their scientific knowledge to me in many ways. Through the use of science talks, questionnaires, pre-assessments, post-assessments, tests, and student responses, I have gathered sufficient data that supports the impact of inquiry-driven lessons. These forms of data collection show the conclusions and explanations that students comprehend and express in our everyday science classroom environment. *The Institute for Inquiry(2000)* shares the following guidelines for students to share knowledge through explanations and solutions:

1. Children offer explanations from a "store" of previous knowledge
2. They use investigations to satisfy their own questions.
3. They sort out information and decide what is important.
4. They are willing to revise explanations as they gain new knowledge. (2).

***Please turn to Appendix B to view student evidence.**

Interestingly, during the individual vertebrate report and the group invertebrate project, students were valued as both learners and teachers, which led to greater understanding and interest in the content. These reports support the second statement about student investigations to satisfy their own questions. As one group of students taught, the rest of the class took careful notes, dependent on their classmates to present accurate, meaningful information. During the individual reports, students shared their favorite interesting facts about their animals. Because the students were researching their information on the Internet (statement two), there was an overabundance of information about the invertebrates. The students had to sort through the text, only pulling out the information pertaining to their wonderings, and the required elements stated on the rubric. This sorting corresponds with statement three, which states that the students sort out information, and only use what is important.

Once each invertebrate group had shared all of the information, and the lesson was complete, it was time for our class wrap-up discussion. Here, we make claims supported by evidence and review what we have learned. At this time, students clear up misconceptions that they might have had prior to gaining this new knowledge, as stated in statement four above.

As discussed earlier, students are able to generate explanations based on their realistic engagement with the content. The students proved to me their knowledge that they have gained from the animal unit through many different assessments. Through oral wrap-up discussions, Science Talks, and tests, the children were able to tell me how to classify organisms and why it is important to use a dichotomous key. They were also able to tell me exactly the criterion that is necessary to say that something is an animal. As a question on the unit test, a quiz, and an underlying concept throughout the entire unit, students were knowledgeable about the seven components, and how different animals meet the seven components through their individual attributes. The seven components say that, in order to be classified as an animal, something must eat, inhale oxygen, exhale carbon dioxide, reproduce, digest, expose of waste, and move.

***Refer to page H-3 of the Appendices to read about the hay infusion wrap-up discussion from my reflection journal.**

***Turn to page H-2 of the appendices to view the journal about the science talk.**

***Refer to section C of the Appendices to look at student responses to the seven components question on the unit test.**

Claim 6. Positive behavior emerges naturally with the inquiry approach.

Evidence

Initially, I was worried about the behavior of my students during inquiry-based lessons because the students are often taking part in hand-on activities and are out of their seats. But I was greatly mistaken. Student behavior is best during science class. I have a strong belief that student behavior is most positive during inquiry-based lessons because students are actively engaged, thus never leaving time for them to experience boredom. My advisor made the following observations about student behavior:

- ✓ ”You (meaning the teacher) were always aware of whole class behavior”
- ✓ ”Children were totally engaged, yet calm and focused, and participating.”
- ✓ ”Children worked cooperatively in groups.”

As a teacher, I have learned the importance of “letting go of the reigns.” According to Baker (2002), “Especially during inquiry-based lessons, I am a participant in student exploration, rather than the focus of student attention (1). I move from one group of students to another and I must provide helpful suggestions or probing questions instead of providing answers. As Baker (2002) says,

> Good inquiry-based activities, when properly introduced, increase student interest and motivation, and that greatly reduces classroom control problems. Student motivation shifts from an extrinsic desire for a good grade, which only some students view as possible or even desirable, to an intrinsic one of satisfying a curiosity about nature" (1).

Very few times, I have had students ask for a grade from a report or activity. I do believe that because the teacher's focus is moved away from formally assigning grades, and is shifted toward assessing depth of understanding, the students are extremely affected in a positive manner. Students value their exploration and experimentation science and are truly interested in finding answers to their personal wonderings. Baker states, "Inquiry does mean more noise and activity, but the argument that students are too immature to inquire cannot be accepted." When I went home for the weekend, my parents watched one of the lessons that I had taught. My father was surprised at how loud my students became. He said, "Amy, you have to get control of your class." I then had to defend myself by explaining that noise is a good thing, as it shows that students are actively engaged in their learning. As the video went on, my dad was able to hear the impressive level of questions and explanations that the students were sharing in their small group discussions. Yes, the noise level is often much louder than in traditional classrooms, but the content of the discussions is often amazingly rich with insightful, fifth grade scientific ideas.

I found myself having to give very few cues to manage behavior. The most challenging part of managing behavior was getting the students to stop exploring, and listen for directions. Before each lesson, in order to have less chaos and loss of time, I developed some form a cue with the students. They knew that whenever I did the cue (clapping my hands in a patter), they would stop what they were doing and listen immediately. Very little time had to be devoted to gaining the attention of the class due to these structured cues.

Overall, student behavior was never an issue during my science lessons. My evidence is the lack of attention I had spent away from instructional time to regain behavior. If you look at the student pictures in the back, you will notice that every student is engaged. The engagement viewed in the pictures was not just for the sake of the pictures; the students actually were always actively engaged in learning, thus leading to impeccable behavior.

***Turn to page H- 4 of the Appendices to read about the most explicit behavior management strategies I used before sending my children off to have hands-on interaction with the live animal specimens.**

Claim 7. Visuals and organization are key in student understanding

Evidence

Graphic organizers are an essential aid in the comprehension of content. Preparing visuals for each of my lessons has been a crucial part of my teaching experience. Beginning with the Animal Unit kickoff in January, I wrote down on the white board all of the student wonderings about animals. Because students learn best through using many different modes, I felt it was important for the students to both see and hear what their peers were saying. As I copied these inquiry-based questions onto the board, it was the responsibility of one member from each group to copy down the wonderings so that his/her group could answer them during the animal observation sessions. During the wrap-up lesson, students shared their observations about their animals with the class. Instead of simply verbalizing their answers, I recorded them on a well-organized chart. This chart allowed students to locate the answer to each question in writing, without having to try to remember everything that the students had said.

The introduction to the invertebrate core was packed full of visual organizers for the students to clearly view. I began my presentation by teaching the students about sponges. I even brought in real and artificial sponges for the students to touch, observe, and discuss. By using multiple forms of our senses, students were able to gather a greater understanding that sponges have pores and that they do not weigh very much because they are hollow creatures. I then generated a “KWL” graphic organizer on the board to organize what the students already thought they knew about sponges, what they wanted to know, and finally, what they had learned. This organizer provides very specific categories for data input. At the end of the lesson, students can look back to their initial thoughts about the concept, and see how they developed throughout the lesson, thus leading to greater knowledge. Next, I shared more information by showing a poster that I had created about sponges. As I pointed to the pictures and information that I had written on my poster, I discussed the information in greater detail. The students were able to see the words and hear them, too. After my mock presentation, I asked student to tell me the components of my inquiry-based science lesson. The students told me that I had a funny, interesting introduction, and then I passed around sponges, showed my poster, and asked questions. As the students shared the parts of my project, I made a list on the board, so that everyone would have two avenues to “soak up” the information. Finally, when it was time to explain how the students would construct and share their projects, I used the overhead projector to show a transparency describing the checklist and rubric in detail. I covered up everything on the transparency except for what I was talking about at that moment, because students are overwhelmed easily, and their eyes wonder around the page, which prevents them from devoting their full attention to what I am saying. To support the inquiry stance, Huber (2001) says,

> The (inquiry) strategy involves discrepant events to engage students in direct inquiry; teacher-supported brainstorming activities to facilitate students in planning investigations; effective written job performance aids to provide structure and support; requirements that students provide a product of their research, which usually includes

a class presentation and a graph, and class discussion and writing activities to facilitate students in reflecting on their activities and learning (1).

All of these modes of collecting student evidence were based around deeper understanding and explanation of content, which were evident in the invertebrate group projects.

I provided the students with a mock lesson of how to teach through the inquiry approach. This necessary scaffolding helped lead the students to success when it came time for them to teach the class. This form of direct modeling made an enormous impact in the quality of the student presentations. In my lesson, I had dressed up like a marine biologist and talked with an accent. Two of the seven groups had a theme of a marine biologist in their interesting introduction because I provided them with the audible and visual representation. The student posters were magnificent because students had learned from my poster, thus setting expectations that all groups were able to meet. Due to the representation of scaffolding and visuals within the lessons, all students presented their information clearly and accurately, and the rest of the class was able to learn very effectively.

Along with the importance of visuals comes the necessity for organization by both the teacher and the students. As a teacher, I found it imperative to be very organized because the inquiry-based lessons that I taught demanded many materials, which made organization a key factor in the quality of my lessons. Planning is a crucial part of teaching inquiry-driven lessons. Specific lesson plans create an avenue for the teacher to write down exactly how to organize the materials and how to run each part of the lesson. With well-planned lessons, the students can glide through the materials management because the teacher has already taken care of that aspect of the lesson. When the materials and lessons are well organized, the students are able to focus on their exploration.

***Refer to Appendix H-5 to view my journal about the importance of visuals used during the individual animal reports.**

Claim 8. Reviews and wrap-up discussions lead to greater understanding

Evidence (Unit Test Artifacts)

Wrap-up discussions have become an integral assessment tool that I use in my science classroom on a weekly basis. During these discussions, students pull together their initial wonderings from before the lesson, the answers to their wonderings from after the lessons, and overall claims and evidence that have led to new understandings of content. In order to directly view what the students have taken from my inquiry-based lessons, I recorded their findings, as they share their thoughts through group discussions. For example, after the Hay Infusion Lesson, the students declared that from their evidence, they were able to make the claim that the amoeba, paramecium, and euglena are all present in hay. They supported this claim with substantial evidence; text and hands-on experience observing the hay under the microscopes. In order to assess the depth of understanding, I asked the students to write down all of the claims that they were able to make supported by scientific evidence. After giving the students time to collaborate, I began recording their claims and the supporting evidence. Another way to make sure students are carrying their knowledge forward is to do a mini-review the following day, before beginning the next concept.

*** By turning to page H-3 of the Appendices, you will read about the success of the hay infusion wrap-up discussion.**

*** Refer to section D to read about the explanations the students provided during a Science Talk.**

Claim 9. When students are actively engaged in inquiry-based science, they are more likely to ask questions.

Evidence

Assistant Professor Rick DuVall (2001) of the University of Central Florida, shares his beliefs about student questions;

> For students to ask meaningful questions, teachers must provide time for both wandering (digging in and having experiences) and wondering (trying to figure out what's happening and why (Merriamm 1991.) Teachers should not just rush students into data collection. Instead, teachers should invite children to pose questions, listen carefully to those questions, and structure opportunities for the students to discuss and investigate their own questions (Chaille & Britain, 1997; Galllas, 1995).

Forming wonderings as a science learner is the foundation of the inquiry approach. These wonderings are created by interested students, who want to find out answers to misconceptions or topics that they want to learn more about. Students have learned how to form wonderings in my science classroom by becoming directly engaged in science experiments and explorations. Children are naturally thinking of questions, because the brain strives on knowledge. The tricky part is getting them to recognize the constant questioning that is going on inside their minds. Students also have to value the importance of listening to their inquiring minds. Then, the children must take those questions to the next level, which is inquiry. Through many lessons, I taught students how to ask and think about inquiry-based lessons. I explained that inquiry-driven questions begin with a personal wondering and are thought-provoking questions, not simply a question that can be answered with a yes or a no. During my modeled inquiry lesson about sponges, I asked the students a number of thought-provoking questions such as; "What's the difference between a sea sponge and an artificial sponge?" The students had to use what they already know about sponges to try to answer this question. While the students were making observations about the sponges, they began to wonder if the sponge would come back to life if they were to put it back into water. Interestingly, many students thought that if the sponge was put back into seawater, where it originally lived, that it would come back to life. Other students thought that the sponge would stay dead because if you take a fish out of water it dies, and if you try to put the fish back into the water after it is dead, it will still be dead. This was an example of very in-depth thinking on the part of my fifth graders. The students were able to generate this wondering because they were actually studying the sponge and holding it in their hands.

Ultimately, students always have additional questions and wonderings during our wrap-up discussion. For example, as we were wrapping up the lesson on invertebrates, the students wanted to know how many species of invertebrates existed, and if they could keep invertebrates as pets. They also wondered how something can have both plant and animal characteristics, and how the euglena, amoeba, and paramecium come alive on the hay infusions. I attribute these interests and wonderings to the inquiry-approach, because the students slowly realize that learning never ceases and that there will always be questions that need to be answered, in order to truly understand a certain topic. Since the students were actively engaged in the lessons with invertebrates and vertebrates, they become somewhat attached and internalize what we're studying. The normally abstract content is brought to life for the students in a realistic manner, thus allowing student to physically explore what we are studying. These experiences innately generate student questions and wonderings. With the inquiry approach, the children value their thoughts and are not afraid to ask questions, which are the foundation of inquiry. According to Duval (2001):

> These young people have learned not only to ask, but also to value the question, testing meaning in the world. 'What is the problem, and how might I solve it? The teachers strive to create a learning-centered classroom where all individuals are valued, respected, and supported to meet the rigorous challenges that they confront each day (3).

Many of my struggling students are not normally heavy participators in discussions in our science class. During our animal unit, every student contributed to the discussions and presentations. Students felt empowered during science because they were teaching themselves, focusing on what and how they wanted to learn and how they wanted to organize their data. All of the children were eager to share their individual and group reports.

It was easy to see their excitement and confidence. To agree with Duvall, even though students are not all at the same ability level, each child felt valued, respected, and supported, because everyone was driven to learn for themselves in a learning environment free of judgment and teacher-directed lessons. My newly formed expectations as a teacher of inquiry have moved more towards student exploration than ever before. Students now expect that I will always ask for them to support anything they say with scientific evidence. I often ask my students, “What is the most important thing a scientist must have?” The students know the answer and say, “Evidence!” Throughout the different explorations the students have performed, they have been required to provide evidence for every claim and explanation that they made. This high expectation has led every student to be held accountable for his or her own learning. The students expect to have to prove what they are saying, thus enabling everyone in my classroom to succeed. Here, one of my students expresses her favorite lesson in the animal unit,

> I liked the hay infusion because you actually looked at the microscopic animals. I thought it was really neat how we had to put together all of our evidence to see if we could figure out which ones were actually there in the hay infusion.

The group invertebrate projects brought out a brilliant aspect of inquiry-based questioning, both from the student teachers and from the student audience. Students were required to ask at least five inquiry-based questions that they wanted to have answered during their research. While presenting, the students, who were the teachers for the rest of the class, were required to ask the student audience at least four inquiry-based questions. The students questioned the audience with ease. It was interesting to hear the willingness of the students in the audience to participate. I feel that because their peers were asking the questions, the rest of the class was eager to answer. They felt confident enough to answer, even if they weren’t sure if their answers were correct. I was pleased to see that the student teachers allowed everyone to answer freely, and then finally gave the right answer once everyone had a chance to answer the question. Most interesting was the quality of the questions that the audience generated after the presentations. Normally, if a group of students presents to the class and they ask if there are any questions at the end, at least one person feels bad for the group and asks a “sympathy” question just to make the group feel good. The questions in this case were of a completely different caliber. Each time a group presented, we ran out of time because the students asked so many wonderfully insightful questions at the end of the presentation. It was also incredible to see how many of the questions the presenters were actually able to answer. If the presenters did not know the answer to one of the audience’s questions, they wrote it down and then tried to find the answer for the class. The students were experts, thus leading to a much greater sense of knowledge and confidence. During the presentations, not one student had a note card or anything to read from. Because the students had spent so much time researching their animal, and internalizing the information as the expert, no notes were necessary. Since the students were responsible for their own learning, fully partaking in the inquiry-stance to teaching science became a natural adaptation to our science classroom.

*** Refer to Appendix E for student inquiry-based questions**

Claim 10. Children communicate using a variety of methods.

Evidence

In our science classroom, I feel that in order to accommodate all learning styles, it is important to teach and explore many different modes of sharing information. In order to do this, I must make sure that the children are capable of sharing their data in many different ways. Here are a few ways in which the *Institute for Inquiry (2000)* suggests inquiry is going on in your classroom:

1. Children express ideas in a variety of ways: journals, reporting out, drawing, graphing, charting, etc.

2. They listen, speak, and write about science with parents, teachers, and peers.
3. They use the language of the processes of science.
4. They communicate their level of understanding of concepts that they have developed to date.

My student teaching supervisor has observed many of my science classes, and here she shares what she observes in our science classroom:

- ✔ "Students presenting were knowledgeable about their invertebrates."
- ✔ "Integration of many subjects-science, reading, writing, and speaking skills were all addressed."

I feel that as the teacher, it is very important to teach using many different forms of communication. I expressed my variance in teaching styles throughout the animal unit by using oral, visual, and kinesthetic approaches to teaching children about science. The students received explicit and detailed instructions for projects and activities through both oral and visual explanations. First, I discuss the directions. Often I discuss the directions while showing an overhead transparency, so the students can follow along with what I am saying. I have found that if I pass out directions and explain them while the children are looking at their paper directions, they do not really pay attention to what I am saying. If I pass out the directions after I orally explain what they are to do, the students normally have fewer questions. After I finish giving directions, I have a student repeat them back to me, proving that they understand what they are supposed to do. Kinesthetically, the students have the directions to touch, and can refer back to them whenever needed. I feel that directions are an extremely important aspect of student learning, and they must be delivered in a very clear manner. By using oral, visual, and the kinesthetic approaches to giving directions, I allow my students to meet the necessary criteria to make them successful throughout the lesson.

To focus more on the student aspect of communication, I noticed that students become bored very easily, and get tired of using the same form of communication repeatedly. In order to prevent boredom in my science class, I have realized that my communication expectations must be broad, and I need to employ many different approaches. In order to assess what the students have learned, I held science talks and wrap-up discussions after each lesson, and each unit. Science talks were beneficial because students were involved in a non-structured discussion among their peers about what they had learned throughout the unit. As one student would offer his or her learning about a specific topic, another student would build on that understanding, and the process would repeat itself over and over again. I have found that my students particularly like participating in a science talk because it is informal. They are not required to raise their hands, and they can share all of their feelings about what we're doing in science.

Written explanations are a common way to assess student learning. For example, students wrote a paragraph about how an owl pellet is formed. The written form allows students to formally write down their knowledge. From these written pieces of student work, I was able to assess the depth of their understanding. Another form of written assessment is the animal unit test, which was an exact piece of data that clearly evaluated student learning. Every student is different. Therefore, students take notes differently. I found that note taking came easy for my highest achieving students, while it was more difficult for my lower achieving students. To make sure that everyone had the key information in their notes, I found it helpful after the note-taking session, to have each set of students compare notes, adding information as needed. This peer-collaboration proved to be a helpful tool in getting the students who might have missed some of the important information caught up.

Because some students struggle with the written form of assessment, I often assess students based on their illustrations of content related material. When the students explored what's inside the hay infusion, they had to both take written notes and draw what they saw going on under the microscope. The quality of their drawings and captions was a way for me to assess that they were using the microscopes correctly, because they actually saw moving things that they were able to draw. The details of the student drawings would help the students in the future, when they had to refer back to their drawings in order to scientifically determine which living organisms were present. Many students were sure that the paramecium, euglena, and amoeba were present because the research that they did matched their drawings of the organisms under the microscopes. This was conclusive evidence, which led the students to be positive that the paramecium, euglena, and amoeba were the organisms found in hay infusions. I feel that the oral, written, and illustrative types of assessment are all good choices to use as a teacher, as long the teacher is always using them in different ways, so as to keep the students motivated and interested.

***Refer to Appendix B-1 to view note-taking styles.**

*** Refer to Appendix B-1, B-2, B-3, B4, and B-5 to view written responses.**

*** Refer to Appendix B-4 and B-5 to look at illustrative work.**

Oral presentations became a staple component of the animal unit. Earlier in the unit, when the students completed individual animal reports, they were each required to share three interesting facts that he or she had learned about his or her animal. Most of the students seemed eager to share their information, while a few seemed really nervous. Due to the uncomfortable nature that some students experience when addressing the class, I feel that it is necessary to use many different forms of communication for the students to demonstrate their learning.

Science Talks were yet another manner in which students communicated their learning to both the teacher and the other students. This open and unobtrusive talk is a wonderful way to bring out my more shy students because they feel supported by their classmates as they sit in a cooperative circle. The students are the experts, and it is their turn during the Science Talk to share everything that they have learned, which they seem quite happy and proud to do.

Fantastic invertebrate reports were the conclusion to our animal unit. Students spent about ten days collaborating with their peer groups to successfully complete a project about a phylum of invertebrates.

*** Turn to Appendix I-3, I-4, I-5 to see pictures of students giving oral presentations.**

D. Conclusion and Future Directions

The Animal Unit has not only taught me about the students as inquirers, it has also taught me about my beliefs as a science teacher. Over the past four months, I have seen a transformation in my students that I cannot ignore. Every student has improved in science in one form or another. Students who were already successful in science are now even more engaged, and enjoy science more than before. Those students who were falling behind in science are now at a place where they are much more confident as learners. This is evident through their participation and explanations in our science class. I am fully convinced that the product of inquiry is one that cannot be replaced with any other style, especially when teaching science to children. The natural wonderings that children have serve as the driving theme of inquiry. Students make predictions, form questions, and then do what they call “hands-on activities,” where they are fully engaged in scientific exploration. Seeing a look of self-confidence beaming on the faces of my students reassures me that I am doing something right! I have realized through my inquiry teaching that every student can be successful in science; it is just a matter of finding the avenue that captures the student’s interest. Once the student’s interest has been identified, I feel it is my role to provide that student with the opportunity to succeed based on his/her area of interest. This is why inquiry can work for any student.

After seeing the positive impact that I have had on my students over the past four months, I cannot see myself ever ignoring inquiry as part of my teaching philosophy. When the students are able to make me cry during a Science Talk because of their profound level of comprehension, explanation, and excitement, how can I not continue to teach that way?

Even though teaching through the inquiry approach is very time consuming to plan and implement, the benefits speak for themselves. Beautifully stated, DuVall (2001) sums up the value of inquiry,

> Inquiry-based teaching is not the easiest route a teacher can take. Quite obviously, it is much easier to ask students to read a passage from a science textbook and answer the questions at the end than it is to allow them to generate and test ideas for themselves. However, an over-reliance on transmitting knowledge to students results in those students becoming dependent on others for knowledge and the solution to problems. As our society continues to become increasingly information-based, the need for independent, creative problem-solvers will only continue to increase, as well. We believe that students in inquiry-based classrooms today can become the confident and competent independent readers, writers, and investigators needed for tomorrow (4).

This project has led me in many different directions that I had not predicted. Now that I have found that each of my students is a science lover, and is succeeding, I am looking for new ways to motivate my students in other subjects. I feel that the students would benefit from every science unit having the components of inquiry, but it is a slow process to totally enhance a unit. I believe that, if I had the opportunity, I would like to enhance each of the units that I teach. Because I understand that I may not be teaching in the State College Area School District next year, I hope to carry the inquiry stance with me to whichever district I am teaching in. But how will fellow colleagues feel about the inquiry approach? As I see the impact this unit has had on both the students and myself, do I need to change many other forms of my current teaching style? All of my questions have forced me to closely evaluate my practice as a teacher. I am constantly looking for ways to provide my students with enriching opportunities and extensions that I feel will help them become better-educated children. When teachers, administrators, and professors say that it is time to get out of teaching when you feel you've learned everything, they are definitely correct. I am just beginning my career as a teacher, and I am so excited to learn more about myself as a teacher, to improve for my students, and to see the success that is derived from their motivation to learn. My passion and commitment for the children I teach is my motivation to always do my personal best in order to help each child shine at his or her full potential.

*** Refer to page I-6 to view students engaged while classifying jellybeans using a dichotomous key.**

***Turn to page I-7 to see students analyzing the fingerprints chart from a microscope lesson.**

***Go to pages I-8-I-9 to see me modeling the introductory invertebrate lesson, as I take on the role of "Harriet the Marine Biologist."**

***Go to page I-10 to view a group of students preparing their invertebrate poster for their presentation.**

***Turn to pages I-11-I-15 to look at pictures from the owl pellet lesson and the skull study.**

(Science is much more than the stereotypical mad scientist in a white lab coat!)