The Refinement of a Junior High Science Teacher

By

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Where I Started

I can still remember sitting in my science education classes while taking my undergraduate classes. My professor was always talking about inquiry this and inquiry that and all of these *E's* that were cycling. It took a while for me to understand what my professor was trying to get us to understand, but when I did, it struck me like a ton of bricks. I thought, "Why would someone not use the 5Es to set up a lesson?" It seemed to make so much sense to me. Every lesson I made for a field experience or for my professors was done in line with the 5E Instructional Model. The five Es are engage, explore, explain, elaborate, and evaluate. The instructional model was developed by the Biological Science Curriculum Study (BSCS) in the 1980's. By the time I was student teaching I knew I was going to be this amazing science teacher who was engaging every student with the best inquiry lessons ever. I maintained the use of the 5E during student teaching and the false sense of my teaching effectiveness.

I started working at a junior high school the next fall and went into the over- whelmed survival mode that every new teacher goes through at the beginning of the first year. Doing whatever it takes to get through the day sometimes leads to habits that are not always good for a teacher in the long run. The classroom environment and management is one of the areas new teachers struggle with the most and can lead to trouble. I found myself in the *wanna be cool* part of being a teacher my first year, and I started losing the classes because I was trying to be too cool. I reflected back after that first year and thought my management style needs to be more firm.

This completely went against what I had always told my friend during college, that teaching science should be controlled chaos. She always thought I was crazy and science should be rows, notes, a lab, and tests. At the time, for lack of a better term, I thought science was better learned *playing*. The controlled chaos is what I kept preaching to my friend every time we had a methods class and were building lesson plans. I even used *controlled chaos* in job interviews, papers for college, and that is how I went about trying to plan my lessons during field experiences.

I later received an electronic mail message from that friend thanking me for the idea of controlled chaos and how she finally had to let go of control of her class and it made her classes so much better. The sad thing is I was not taking my own advice. During the same time period, I reined in the control of my class. If I was going to be this stronger classroom manager, then I needed to cut back on partner and group work. The one good thing that came from groups and partners was talking. The more control I wanted, the more notes and book work I used to help with the control. Class was moving far away from the controlled chaos. I did become an effective classroom manager, but I do not think it had anything to do with the curriculum. I asked a teacher who was about to retire why it was that I never heard him yelling. He told me he learned to see a problem before it ever became an issue and had the ability to stop the problems before they became problems. Knowing this now, I would say my excuse for a lack of inquiry being classroom management is pretty weak.

The cycle of notes, worksheets, and tests continued for several years. It was not until I decided to go back and get my masters degree that I started to bring myself back to disequilibrium. I knew my friend had received his masters from Colorado College (CC), and he told me how cost effective his masters had been along with the outstanding classes he was taking. I noticed him trying to do some different activities, and we had had discussions about notebooks during the same time. I had been to the National Science Teachers Association (NSTA) convention in Denver and had seen a 30 minute seminar about science notebooks and decided this was something I was going to start in my class. Obviously a 30 minute session about notebooks had made me an expert. After more deliberations with friends and family, I decided to scrap my previous plans for my masters degree which involved either counseling or administration. Having watched both of these positions the last six years I think I made the correct decision. The counselors are glorified secretaries, and administrators do not always seem to be having much fun.

I signed up for the graduate program and needed to write an essay to get into the CC program. Before being accepted into the program, I knew I was in need of a change.

Flow of the paper

The following paper chronicles the journey I followed through the CC MAT program. The program consisted of two summer institutes, seminar classes during the school year in conjunction with the institutes and two STEP3 classes.

The STEP3 classes canceled out a third summer. Within in these classes science content was used to help teachers become stronger in the pedagogical areas. Action research was a component of each summer institute. Several different teaching tools were touched upon in class and I will discuss in this paper.

I start with my entrance essay into the program. The essay explains where I was as a teacher before the program and my motivation for being in the program. After the essay I discuss the first summer institute. During this section I follow the activities of the professor and how they align with the 5E instructional model. As this section progresses you will find me moving between the activities of the class and reflection of these activities in regard to my own classroom and teaching. The field research and summer refinement from the first summer follow the section about first summer institute. Next I write about changes in my school and how they will affect me as a teacher and how I used the degree program to cope with changes to my school. The section becomes a reflection on myself and dealing with the change in a positive nature and what I can do for children. The next fifteen pages discuss many of the different teaching tools the program has emphasized and the instructors have modeled. These include notebooks, grouping, and debriefing, learning targets, leadership and an action research pertaining to the use of notebooks as a way to bridge the gap between block class periods. The action research connects the use of notebooks and one of the major difficulties mentioned in the reflection paper. The next section of the paper includes the second STEP3 class and emphasizes the teacher's use of

inquiry and questioning. The matter into mountains section is followed by the second summers institute on cosmology and related curriculum refinement. Action research on using different teaching styles accompanies these sections and I finish the paper with a section about inquiry. The inquiry section is a capstone of all the other section in my degree program getting me from the teacher I was in the following entrance essay to leading seventh grades on a full inquiry investigation.

Entrance Essay

A 0-9 record is very tough for me to stomach, but it is posted on the wall in my office to see every day. That was the record of my JV football team the first year I was the offensive coordinator.

The first thing I had to do was look at myself and figure out what I needed to do as a coach to make the team better. People can point fingers at many different factors which may have been out of my control, but, in the end, the final decisions stop with me. This failure, as I painfully put it, has been driving me as a coach ever since. It pushes me to work harder to gain the knowledge and experience needed to teach and put my players in a position to be successful, not only in football, but also in life.

I see a very similar correlation between the classroom and the gridiron. As a whole, I would not call myself a failure in the classroom, but I know I have failed some of my students. I have students who have done well in my class, but the same outcome would have been true with any teacher. There are students

for whom I know I have made a personal impact. Because of me, they are more knowledgeable people and have a greater understanding of science. These are the ones teachers can hang their hat on and keep us coming back to class. The failures are the ones who keep me up at night, much like the game that got away.

The ones that got away are what drive me to get better as a coach, along with pushing me to be a better classroom teacher. It is that same drive that pushed me to enter the Integrating Natural Science (INS) Masters of Arts in Teaching (MAT) at CC. The program seemed like a great way to use my classroom as a tool to improve myself as an educator.

I remember thinking right out of college how great a teacher I was going to be and all of the great lessons I would make. All of the students would want to be in my class and want to learn, and it was going to be awesome. Then, I did my student teaching, and I realized my first couple years were going to be an education for the teacher as well as the students. Just as some of the best football knowledge I have learned was during the middle of a game, I am hoping my on the job training, along with the MAT program, will make a great impact on my ability to change my failures into successes.

I am a competitive person and admitting failure is hard. Knowing I have not been doing the best I can for students is the one thing that really drove me back to get my masters degree.

First Summer- Chemistry of Fire

As my journey through the MAT program continued I was sitting in Olin Hall on the CC Campus the first day of class trying to figure out how we were going to have an entire class based on The Chemistry of Fire. The first summer I sat through an institute, it was not long before I realized I had gotten pretty far off the track as far as what I should be doing in the classroom. The time spent working through cycles of the 5E with the professor made me feel like a pretty bad teacher. We were reviewing some chemistry I already knew, but the instructor was going much deeper on some content and filling in holes in other places. It was great. To make it even better, I was having fun while I was learning. We were making observations, taking measurements, and making our own experiments. I started wondering if my students have this much fun.

I had experience with the 5E Instructional Model, so when we started talking about the pedagogy the instructor was using with the class I had one of those light bulb moments. The concept map we made as a group was an engagement and a way to assess prior knowledge of the class. I always thought I did a pretty good job with engagement activities in my own teaching. Even when I am notes and worksheet heavy, I do make an effort to engage my class on the lesson ahead. The concept map about fire was interesting because different people see a topic like fire in so many different ways. I am not a huge fan of the concept map because my brain does not always seem to work in that fashion. This is a teaching strategy I really need to work on implementing more with my students. Even though I am not a big fan of the concept map, it does not

mean my students might not gain from using one in class. I need to connect with many different learning styles in my classroom. The concept map is a way for many different students with different learning styles to arrange information to fit their understanding. A leader in the field of concept mapping, Joseph Novak tells us, “Knowledge is constructed. The construction of new knowledge begins with our observations of events or objects through the concepts we already possess” (Novak, 1984 p.4). I have many students who spend much of class drawing and doodling, the concept map is a great way for them to use a skill they like for content they may not. “Concept mapping can be a creative activity and may help to foster creativity” (Novak, 1984 p.17). Concept maps always seem like a great idea while I am sitting in class or at a conference, but the actual implementation in the classroom is tough. Concept maps are one of those activities I sometime seem to just forget. After the fact I think about different parts of a lesson which might have been good to use a concept map. The year goes by and the next time I teach that same concept I do not remember until afterward. Doing a better job keeping notes about changes for an activity would be a good way to help fix the problem of forgetting about concept maps.

The next activity during the summer institute was the observation of a candle. I have never really thought about a candle with this much detail. The observations a person can make of a simple lit and unlit candle were incredible to me after reflecting on the activity. It made me wonder if sometimes we try and make lessons too complex when something simple is a better use of time. Several other things became apparent with this activity. Getting students to be

descriptive is difficult. I think this is a skill my students lack. Trying to explain how something looks seems like it could be very simple, but when you really try and explain candle wax, it is tough. How thorough someone is when making observations is another skill students need. I have students who are only willing to write down four or five observations when 20 could be made easily. Is it laziness or an inability to make observations? I am guessing a little bit of each.

The types of observation, qualitative and quantitative, being made are also an important concept to understand. Knowing the difference between qualitative and quantitative observations can really help students when they are struggling to make observations. We need students who can distinguish between an observation which is more qualitative versus one where everyone makes a similar quantitative measurement. Students need to show they can take measurements for quantitative observations and form inferences about an object for a qualitative observation. One of the tricks the professor was playing on us was that she was trying to spark our interest in the candle. The instructor wanted us to question a characteristic or observation of the candle so we could then go and test the question on our own. Some adults and definitely students can have trouble forming a question about something a simple as a candle, many people will think “How could I ever have a question about burning wax?”

This moves us into the third activity during the summer institute. I classify it as an explore step of the 5E while the candle observation was another engagement to me. Some might argue for it being an explore. In this case I think both people can be right; it might depend on how you are defining some of

the steps. The explore activity had us working in groups to answer a testable question we designed on our own. Getting adults to agree on what question to test can be just as tough as getting students to form a testable question. The connection between good observations and a testable question is key. Sparking the interest of a student is most of the battle to arrive at a testable question. A student-originated question gives more buy-in and typically higher quality work when student interest is driving the work. My group tested how the diameter of the candle affected the burn rate of the candle. Like many experiments, we came up with decent results but enough variance to make the results inconclusive. The good thing about inconclusive results is that it will typically lead to better science than results we were expecting. Had we been in a different setting or had more time we could have taken our results and formed a new question to test. This is where a true science class should be able to go, but it is hard to do based on many educational constraints. The biggest of these constraints is just getting through the curriculum we feel is driving everything we are doing in our classrooms.

The nice part of a good explore activity is that we are typically able to get students into disequilibrium. From a student standpoint this is annoying because no one wants to have the feeling of not understanding, but from a teacher's point of view it is remarkable. We feel this way because we now know that learning is capable of occurring. A sprinkling of some notes on vocabulary a teacher might be trying to define as a class can be of much help at this point in the cycle. The significant thing about a learning cycle is that a teacher has the freedom take a

lesson in many different directions. The direction is driven by the needs of the students. We can go back and do another explore because we need to develop more questions about a concept. We can move on to an explain activity where students can show they are making progress on the concepts we are learning. Students show understanding by being able to represent the concepts to be learned. A more advanced example of the *explain* is when students are able to explain the concept to other students. In the summer class we cycled back to another explore activity and then a few more notes. Notes directly from the teacher can be the explain section of the 5E.

There is a difference between trying to have students discover a concept on their own and just giving them the information. As teachers we do not want to make it too easy and just hand them all of the information. Students will not always internalize something they have not had to work to learn, but we also have to be careful to not put so much on students they get discouraged and quit. It is hard to change the minds of 13 year olds who have made up their minds about not being smart enough to find an answer. The explain has to be done well, because we can either get students eager to learn, wanting more and taking them to an elaboration or we spend large amounts of time we do not have trying to get them back. The elaboration takes a concept the students are beginning to grasp and challenges the students to deepen their conceptual understanding through new experiences.

An elaboration can be arduous if students have not formed an adequate grasp on the concepts. If a teacher finds students are not ready for the

elaboration, the beauty of a learning cycle is the ability to go back to another explore or explain activity until the students are feeling comfortable. The *explain* can be student-driven or teacher-driven based on the needs of the class. I really like this because it allows me to add bits and pieces of the concept with out completely giving the information away. It is still best if students can derive the concept on their own, but sometimes a gentle nudge is needed.

The last part of the 5E model is the evaluation. During the institute we performed several evaluations but none as big as the final Portrait of a Candle. This performance assessment took different activities in which we had participated all summer and summed them up into one final evaluation. We started with several prompts guiding us on what we needed to answer. The first part was to do an observation activity and gain as much information about the candle. This included quantitative measurements of mass, temperature, volume, density, and height. I used water displacement to find the volume, and temperature was very scientific with a thermometer inserted in the wax. The next observations taken were qualitative using the five senses. Sorry, no tasting allowed. Observations were made while the candle was unlit and again while the candle was lit. The second part was conducting a small experiment using the candles. I built a small calorimeter to determine the caloric output of the candle. I heated 100mL of water for ten minutes and measured the temperature change compared to the mass of candle that burned. The science notebooks containing our observations and experiment were handed in with the final product. The second part of Portrait of a Candle, a three part written response, was driven by

writing prompts from the instructor. The first section of part two was a written description of the observations I had taken earlier along with a labeled drawing of the candle. This more or less described all the characteristics of my candle along with a visual. The second written part of the evaluation was an explanation about how a candle actually works. I started from the top of the candle before it was lit and worked my way through the chemistry of the burning candle. This is a very interesting way to be evaluated on a concept. It forces us to really show that we understand the information. We had to include and underline certain vocabulary words that were part of our key learning concepts. The third and final part of the written evaluation was like an elaboration. We were given a list of words to use to explain the candle as a system. After looking at this evaluation nearly two years later I can remember exactly the activities and information we were learning. This is an amazing way to evaluate students, there is no multiple choice for them to guess. Students have to clearly put their thoughts together in a neat and organized way.

I remember back to how long it took me to write the final evaluation and tried comparing it to my classroom as a teacher. I know this was for a graduate class and the expectations should be higher for graduate students than for my eighth grade science students. I get stuck with the fact that we had 12 people in the class and it took the professor a while to get the evaluations graded. I have 160 seventh and eighth graders; one evaluation to 80 students in one grade would take an exorbitant amount of time to grade effectively. Time for grading is a common theme that has arisen during my time working on my master's degree.

Hayman Fire Research

A part of my master's degree I really enjoyed was working with CC biologist learning plant physiology. Part of the summer institute consisted of time spent with several of the CC biology faculty and research being conducted at the Hayman fire location. Before we went to the field we spent time with the science behind how a forest fire can grow and die. We also spent time learning plant physiology and how fire impacts the reproduction of plants. Instruction during plant physiology was more of a traditional lecture giving us a very quick understanding of how plants function in different environments and conditions. Very little inquiry was involved, but, after having taken a four credit plant physiology class during my undergraduate degree, it was amazing what I started to remember. This was a perfect example of how one's brain is learning and storing information, but I would have never been able to remember any of the information without that small lecture. Brain researcher Hardiman says "true learning occurs best when teachers require students not merely to acquire knowledge but to use it actively and meaningfully in real-world contexts" (Hardiman, 2005, p.71). Memory recall is an interesting topic; I can vividly remember my junior high science classes and the activities we did in the class. I remember little of my high school science classes where we read the book and answered questions. There was a point in my undergraduate degree and more so when I first started teaching that I realized my junior high science teacher was very much an inquiry-based teacher. I believe there is a high correlation

between his inquiry-based teaching and my ability to remember the content and activities 15 years later.

Recalling my experiences makes me think of my own classroom and how my current students or former students will remember science 15 years from now. Students come back and ask me about some memorable activities we used in class, but I have also spent time with text books and vocabulary questions. Trying to find the balance between the two is burdensome and I am still working on it.

Back to the summer class. The biologists also took us to the burn area where I was completely amazed at what I saw. The devastation was scary and something I had never experienced before, but the succession that was occurring where the old pines had once been and now were charred twigs was amazing. I had always taught about succession and how new soils or plants start over, but I had never really seen it with my own eyes. The first stop outside Woodland Park was meant for observations only. I had to get over my awe and really start looking at the ground and what was growing. The color in the burn areas was very vibrant. The wild flowers which are normally choked out and lose the battle for resources were in higher density compared to non-burned land. Young grasses and some trees had started growing without fighting the old trees. The biggest and fastest growing plants were the weeds. They are normally tougher and grow faster and will take over an area until other native plants are able to get a foothold in the ecosystem. We stopped at several places to do more observing. Comparisons were huge. We were able to start to see the difference

between an area where the fire had been really hot and other places where burning had happened but with less ferocity. The big difference in these places was the different stages of the succession process. A much larger variety of plants was seen at the areas with the hottest fire.

This is where I struggle with education and the state it is in. I should be able to take all of my students to see these same areas and do the same kinds of activities as I did, but problems of money and time always seem to interfere. During the CC class my partner and I, with my ideas of good education, were able to set up our own experiment in the field. We tested the amount of scat of different animals compared to the populations of animal dispersed shrubs, shrubs whose seed is spread by the waste of animals. The field study we conducted is something junior high or high school students could feasibly do and would be a great experience for them. I need to try and do this more with the resources available to me outside on our own school ground. The experience I had at the Hayman fire burn area is something I will never forget, and being able to provide the same opportunity for my students would be invaluable to student learning.

The curriculum refinement from the first summer was a struggle for me because I was now spending time with some of the national documents on what experts think our students should be learning, and a giant battle began within me that still has not been resolved. It made me question what I had been teaching the last four years and if I was really giving students the quality education they really needed.

First Summer Refinement

My father always taught me the importance of having a quality pair of shoes and a good set of tires. "It doesn't matter how good something looks. If you can't get down the road then it doesn't matter." I have always taken that statement to heart when buying shoes and tires for my family. I believe that statement also holds true when talking about the classroom. Without a strong knowledge base, students always struggle building additional knowledge required to be successful in future science classes and life.

This is where I falter in my classroom. After taking an in-depth look at the curriculum I am teaching my eighth grade science students, I have come to the conclusion that I have the triangle of science knowledge upside down. The large quantity of material I am pushing my students through in a short period of time is comparable to a good portion of a first year high school chemistry class. The basic concepts they should be getting are being brushed over in an attempt to teach the higher level material. The first summer curriculum refinement is meant to bring the triangle of science knowledge back on a firm base with an addition of more inquiry learning.

There has been this ongoing battle with myself, since I began teaching, over what I should be teaching. There is a part of me that is caught in an earlier time, and thinks "I don't need standards to tell me what to do. I know what students need. The state of Colorado does not know what 8th grade students need. I know they need a well rounded chemistry curriculum."

The state based most of what they say from what the American Association for the Advancement of Science (AAAS) and other scholarly groups have deemed necessary for students (AAAS, 2001, n.p.). I pretty much always win this battle with myself. Obviously in my four years of teaching I know more than people like Paul. A biased feeling such as this is often brought on by the fact that most people really do not like being told what to do or what they are doing is wrong. One of the reasons why I have formed this opinion is based on my students. I have a large percent of students in my classes who may never take a chemistry class again. I have this intrinsic desire to make students into well-rounded contributing citizens in a society that is moving more toward how well we can perform on a standardized test and less worried about carrying on an intelligent conversation. Motivation for teaching the higher level chemistry comes in several different forms. One of the forms is an arrogance to show someone, not sure who, I can teach high school chemistry. I am making the world better one students at a time with the amazing chemistry content. Another form of motivation for teaching the higher level material is pushing students to use their brains in more difficult content. Higher level thinking skills and pushing students to be better thinkers drives my heavier content for students. I feel these two types of motivation are similar in the form of making better students, but different because one is student centered and one is selfish on my part.

Along with making students well-rounded citizens, I feel it is my duty to facilitate critical thinking skills for our students. The desire to have students confront tough problems has pushed me toward giving the students higher level

thinking problems to solve. The higher level problems are sometimes confused with more difficult content. I would like to think of this pushing as an extension of the content being covered. Many students come to me without the ability or the desire to challenge themselves with higher level thinking skills. Many students have been spoon fed the material so much they are unwilling to attack a harder concept. Marzano asks the question, “Are students mentally ready for the higher level questions” (Marzano, 2001, p.47)? or are they just showing a lack of gumption because of the aforementioned spoon feeding. If they are struggling because they have not reached this level of thinking, then I need to do my best to help keep them on track. “A student must be challenged with a concept before they will be able to reach the next level of thinking” (Bloom, 1984, p.128). Students will not magically move from concrete to formal thinking. Piaget's suggestion, that cognitive performance cannot be attained unless cognitive readiness is brought about by maturation and environmental stimuli, has been instrumental in determining the structure of educational curricula. These students are typically great because they want to learn, they are trying really hard, but the brain is not ready. The student with the lack of ambition is much more frustrating because teachers know the student can understand the problem. Students simply refuse to think due to factors over which we may or may not have control. At this point we need to be ready to think creatively and motivate the students. Searching for a new angle with which to reach the unmotivated will tax us much more than trying to bring along someone who just does not understand content.

The lack of ambition is very relatable to athletics. As a coach I have seen many athletes who have all the talent in the world but refuse to work hard because they think they are already good enough. On the other side I have students with little athletic ability, but they work so hard they are able to reach or surpass the same level as the more talented athlete. This is a point where we as coaches and teachers need to be very careful. We can easily lose the natural athlete because he gets frustrated and quits, or he might step up and become great. In this situation, the playing field and the classroom are no different.

Motivation is a place where inquiry can be a very effective tool. The ownership a student takes in their own knowledge is a stronger tool for us as teachers than any concept map or notebook. There is a point where we are limited by a student's intrinsic motivation, but if we are able to use inquiry to get students asking their own questions, half the battle is won. Most people want the feeling of being in charge and making their own decisions. Inquiry gives students the chance for independence on their way through a problem instead of being forced to answer questions in which they have no ownership.

This is where the fight between my desire for a student to learn and the student's desire sometimes butt heads. What is my motivation for them to learn? Money? I get paid if they learn about density or if they have no clue. Test scores? There are so many factors which play into test scores, I put little time into judging myself on a test students are taking. What other profession holds us accountable for what a 13 year old can accomplish on a couple of hour long tests? Sally may be really sick that day, broke up with her boyfriend, or watched

mom and dad in a physical altercation before school. *I am sure this student is really worried about her test*. I think the biggest motivation I have as a teacher is doing what is right and knowing I am doing the best possible for the students. This may seem like somewhat of a subjective situation, but the hope is that I have been trained to know what is best for students. There is an interesting irony here when a congressman is writing legislation telling me what to do when he or she has never spent a day in my shoes. I have never tried to tell my mechanic or my doctor how they should do their job. This idea of motivation and moving students toward being higher level thinkers is a conflict I am sure I will continue to fight until I am no longer in the classroom.

The standardized test, when used as a tool to see if schools are performing has great intentions, but the final outcome of the effect on students, teachers, and schools seems to be missing the mark. The trouble with the test is that a great deal of money, public opinion, and governmental red tape are tied to how well Sally does on one week of testing during one part of the year. Let us not forget the before mentioned situations that may have an impact on Sally's test performance even though she might know the material

I referenced earlier about how my class seemed like a semester of high school chemistry crammed into five to six weeks. The rate at which material is covered has a great impact on the way a class is organized. We are going to disregard the level at which the material is taught and solely discuss the time frame during which content is taught. Because of the standardized test, a teacher has a set amount of information to be covered so students are

considered prepared. The wide range of information and the randomness of the questions make for a large amount of information in a short period of time. Teachers can be overwhelmed trying to prepare students. It is this time versus amount of information issue where the dilemma for the teacher can be found. The first option for a teacher is to try to cover as much information as quickly as possible with the hope students will be able to recall some of the random factual information on the test. The second option is to teach the basic information very well, giving the students a deep understanding of the concepts. The third option would be to teach a few basic concepts well and guess what to teach from the rest of the curriculum. All of these options have pros and cons. The first option may do well if you are cramming for the test. This class *might* have good scores, but long term retention via the last second memorization (cramming) method is unreliable. Option two should give students a great foundation for science, but remember, big brother is still watching. The district is going to want to know why certain students did not know what the endoplasmic reticulum's job was when asked on the multiple choice test. The third option should be very effective. However the problem is the test is so hit and miss about what is covered a teacher would have to be very lucky to guess what the test is going to ask each year. My hope is that by introducing more inquiry into my lessons, students will become more efficient learners. By making class more inquiry-based, students have more invested, because they are answering more questions that they formulated. This bigger investment allows me to delve deeper into the learning process while also injecting the other parts of the curriculum as we go.

The last issue I would like to address is how the MAT class has done a very good job of making me look introspectively at myself and how I have been using inquiry in the classroom. The strong pre-service training I received was very inquiry-based, and I had several great examples of inquiry from field experience teachers. I think my downfall in inquiry started with my student teaching. I was going to have a nationally recognized high school chemistry teacher for the first part of my experience, but she had to decline because she thought she was going to be taking a leave to work with NSTA. My first student teaching experience was with a great guy who had been selling insurance two years earlier and somehow had enough science to be a high school chemistry teacher. In hindsight, I look back at that experience and think I was probably as good a teacher as he was at the time. My second experience was in a very rough school in south Omaha where the two teachers with whom I worked closest had been teaching for many years and hated the world. These two teachers knew their content, but seemed more interested in their side jobs and just *controlled the animals* while at school. The gentleman I was working with had the idea that if we could come up with a worksheet we were in good shape. Also he kept me on a close leash and just wanted me to copy what he had done first hour.

Once I was in my current job, great ambitions turned into day to day survival. If my co-workers had Power Point notes and a worksheet for the day, that sounded good to me. I was not coaching at the time, but I was very inefficient at using plan time. I am now very good at managing class and time,

but I also coach three sports which takes all of my after school time along with many nights and weekends. The point is not to give excuses, but to show where I am weak and use that as a way to make myself stronger. Arnold Schwarzenegger once said about how he kept making himself a stronger bodybuilder; “The best way to make yourself stronger is to look into a mirror and really look at yourself to see what you do not like. If you keep looking at it and seeing it, then you will force yourself to fix the problem.” (Schwarzenegger, 1984, p.27) Now Arnold was talking about his triceps and oblique muscles, but I think that analogy fits very well with how I am trying to see myself as a teacher and what this assignment is pushing me to learn.

I decided to figure out what I was teaching, what I was supposed to be teaching, and see if I could get those two to match up a little better. The first step was to sit down with *The ATLAS* for a few hours while we were at the BACA, and write down everything the experts thought middle level teachers should be teaching (AAAS, 2001, p.36). I compared this with the Benchmarks and found they were very similar. After this process I had a revelation when I realized nearly-everything the experts thought I should be teaching was not even close to what I was teaching. I felt better thinking I was over shooting and hopefully challenging students and not dumbing down the curriculum. Next I wrote down everything I considered in my chemistry curriculum (Glencoe, 2005, pp.402-418). The state standards were next and that feeling of needing to trash everything I do came flooding back. A meeting with two of my instructors ensued, and I was brought back to ease knowing that I could and should teach *MOST* of my

curriculum but a different approach was needed. The new approach was to take several major topics, which were geared toward the standards and strengthen them with an inquiry approach (CDE, 2007, n.p.). Aligning the lessons more with the standards and getting the triangle flipped right side over so we were building a stronger base was the next step. I wanted to give the students a better understanding of the higher level thinking skill I pride myself on, along with hopefully making better preparations for the Colorado Student Assessment Program (CSAP). Balancing chemical equations in an example of a topic I would spend a large amount of time on during class and was over the level at which most of my students are capable. I justified teaching the concept as a way to push the more gifted students. I was giving the equations to all of my students and expecting them to do well on assessments. In the future balancing equations is a concept which will be left for the more advanced students to use as a possible elaboration.

The work I did during the first summer was very much an eye opening experience. I had scoffed in my younger years at the idea of someone telling me what to teach in my classroom. I have now come to understand the importance of using national and local documents to help drive my instruction. I plan to use this experience to help in job searches if the need arises, to help my co-workers and myself, fix any issues we are having with curriculum and standardized testing, and last use these documents as a way to check and balance myself as a teacher.

Since the first summer module work in the MAT program the state of Colorado has changed the academic standards of science. This change has led to an even bigger change by our district. The state moved the concept of the atom to the sixth grade level. This topic is too abstract for most concrete learners at the middle levels. AAAS in the publication of Benchmarks for Science Literacy tells us “Atomic theory powerfully explains many phenomena, but it demands imagination and the joining of several lines of evidence. Students must know about the properties of materials and their combinations, changes of state, effects of temperature, behavior of large collections of pieces, the construction of items from parts, and even the desirability of nice, simple explanations. All of these elements should be introduced in middle school so the unifying idea of atoms can begin by the end of 8th grade” (AAAS, 1993, p.75). Why the state thinks they are smarter than the rest of the scientific community I do not know. AAAS also states “Bringing atomic and molecular theory into earlier grades is a great temptation, but most students are not ready to understand atomic theory before adolescence” (AAAS, 1993. p.75). The group of faculty in my district who set up the curriculum calendar have gone against the standards set by the state and moved the atomic theory concepts back to eight grade. While analyzing the new standards and trying to match what we are teaching with the new schedule my district has adopted for the junior highs, my co-workers and I are having trouble being able to get the amount of material covered in the amount of time we now have. Middle level science has lost classroom time throughout the entire district because of a schedule change.

The first summer refinement was the catalyst of me changing as a teacher. The young arrogant teacher who can not be told what to do and scoffs at a staff development is now working in changing the entire content me and my department teach. The first summer helped me understand how the national documents and material my district gives out can be an important tool. The first summer refinement made me understand more about the abilities of my students and the level I need to be teaching. I do not want to lower my standards, but may need to make sure I am setting a better foundation for the students. More specifically I dropped some of the chemistry concepts I have been teaching my students. Balancing equations has moved from an activity I fought with all of my students, to an extension activity for my high performers who need to be pushed. Our department is moving towards using more inquiry to teach the content instead of teaching content and throwing a few inquiry activities in on the side. One of our biggest goals is to get students with better overall science thinking abilities.

STEP3 Reflection Paper

The following section is a reflection paper about myself and changes going occurring in my school at the time of the assignment. The original assignment was to extend a curriculum modification, but having completed several modifications during my time in the program I asked to write about some changes and difficulties I was facing. I wanted to use the reflection

paper as a way to work myself through several of the difficulties I was facing with the changes in my classroom and work toward solutions to the difficulties. This paper made me look at myself an classroom to see what I could be doing differently to make my classroom more conducive to learning for the students. The paper was written during the year between the two summer institutes as part of a STEP3 class in congruence with my program.

The new school year brought with it an entirely new schedule. Not only has the amount of time we spend in each period changed, but we also no longer see the students daily. The time change has been from a 50 minute period to an 82 minute block each day. The English and math teachers see their students everyday for 82 minutes, but science and social studies teachers see their students every other day for 82 minutes. The inequality really had me unhappy for a longtime. We were now expected to continue to raise CSAP and SCANTRON (scantron tests are district wide assessments purchased to test growth during the year) test scores while losing time.

Once I got over the inequality (deal with it or get a new job), I found some good qualities in seeing students every other day. Planning one subject a day does make the day to day load slightly easier. Not having to see some students daily also makes dealing with the behavior issues a little more tolerable. Lab-set up for one class compared to multiple classes is also a plus. The extended period has helped with lab time and allowing activities more time to be completed. I did have trouble wrapping up activities in the past, and it is now

less of an issue. These may seem like a pretty good list of reasons to like a schedule, but the reasons for not liking the schedule are much more troubling.

The every-other-day schedule has led to several situations that I have not had to experience in the past. One of the first problems I encountered was the trouble learning names. This may sound funny, but the amount of time between seeing students can be three days and even more with holidays. It took me several more weeks to learn names and this hurts classroom management and rapport with students. It seems like I get better buy-in from students when they know I know their names. If we were to take the issue with names and apply it to any type of activity or concept the students may be having a hard time with during class, we now understand why the retention of concepts is poor. This leads to more time spent reviewing during each class, and this takes away from the time needed to advance students.

The district has purchased more standardized assessments for students to take periodically during the year. This steals several blocked periods from an already stripped schedule for science students. These large block interruptions are what cause a lack of rhythm while teaching, one of my biggest struggles with the new schedule. The long layoffs make lessons choppier. In the past I could say we will continue with this tomorrow, but now it may be four days until we get back to work. The students do not remember, I do not always remember, and any flow is lost from one day to the next. Each day ends up being like an island. Getting the previous block and next block to be congruent is difficult. Some lessons need several days, while others are not big enough to fit the block, but

then I am left with insufficient time for a new topic yet too much to not feel like I am wasting.

The longer periods are nice for some activities, but, honestly, they are too long. As the adult in the class I have trouble keeping my own attention for that length of time. We need to keep the activities moving and changing so it is not an issue.

There has been an attitude change in the school with regard to which classes students are putting the most effort and attention. The science teachers and social studies teachers have all been seeing a drastic drop in completed homework. Students are feeling having math every day compared to science every other day makes math more important. Students tell me directly about math being more important. I also know some students are less organized with class every other day. Because of this change in attitude I have students trying to use my class to finish math and language homework while they are not completing science.

Another part of this issue is CDE changing state standards. This has led us to teaching different concepts with different age groups. The provided curriculum from the district no longer matches with the age groups. We are not able to check out text books, and I think the lack of a text book gives teachers a lack of credibility with the students.

One of the last struggles I have is pacing for activities and having enough different activities to keep students engaged. I know how much time was needed in the old system but I have trouble pushing activities through that should happen

faster but I think they are strung out because of an overall feeling of more time meaning less push. I am 100% to blame for many of these issues but this is why I am trying to lay them out and create solutions to my problems.

I took all of these problems and tried to attack them with a couple of solutions discussed later. Some of the issues like the extra testing I have zero control over, but I do have control over the day before and the day after. I am in the process of trying to make a system for connecting the classes so the large gaps are not interfering with the rhythm and flow of the concepts. One part of the solution centers on the use of notebooks. I am using this idea as part of my action research which centered on notebooks as a bridge between class periods. Students are taking time at the end of each class and doing some kind of writing prompt about what was learned that day and asking any questions they might still have over the information. Students use the prompt from the previous day as the beginning of the next class. A second part of the solution that works along with the notebook use is trying to plan lessons so they do not start and end on the same day. I try to end and start a new topic during the middle of class, so we are forced to revisit the topic from one block to the next.

As with most students who are not used to notebooks, and doing reflections, I struggle with students writing about what they learned or did in a day. Some of them are just so uninterested in writing that teachers have the normal issues, but when I have them write about what they still want to know or are still unsure of this leads to better conversations the next class. The ownership of finding knowledge THEY want to know is key.

Notebooks

The Chemistry of Smell STEP3 course was based around learning chemistry from the main concept of smell. The class was heavily centered on the use of notebooks. Researcher Klentschy said, “The science notebook is more than a record of data that students collect, facts students learn, and procedures students conduct. It is also a record of students’ questions, predictions, claims linked to evidence, conclusions, and reflections” (Klentschy, 2005, P.24)

Should they be a fact book or a reflective piece for their learning in class? I know the answer to this question, but the implementation is tough. I have been working to introduce notebooks into my class for the past several years. I am doing well with the structure of the notebook, as students are filling out the table of contents, pages are numbered, and no pages are torn from the notebooks. The structure of the notebook is important for several reasons. Making connections between different concepts throughout a course is a higher level skill assisted by the table of contents. Once a notebook starts getting filled these connections are made much easier by knowing page numbers and using a table of contents. If students have information about the states of matter and later time is spent on different types of precipitation, a note can be made in the table of contents showing the connection. If a large amount of time has passed between these two topics, the table of contents saves students from spending time searching through pages. Connections between past and current lessons are

where students and I can make improvements in our classroom. When we finish with a concept, often it is as if it does not exist anymore. Sometimes I say, “Remember when we talked about.....,” but we never go back into the notebook and ask students to find the lessons we covered. The curriculum I teach lends itself to this problem because we skip around to different topics and they do not always build upon each other. Some topics do build on each other, and we need to make those connections.

Notebooks are a place where students write notes and take lab notes which I would argue is one of their functions. Notebooks allow students to maintain a consistent place to compile what is happening in class. I also like to use the bound composition notebooks because they are sturdy and less likely to lose pages. I have had trouble in the past with students losing lose leaf paper and using many different notebooks to keep science information. To combat this I turned to notebooks and began storing them in our classroom so I spend less time with students forgetting them in their lockers and losing the notebooks. In years past students compiled all vocabulary words in the back of the notebook and worked my way forward. The idea was to have all vocabulary words together and students would not have to spend time digging through the notebook to find vocabulary words. Is that not what the table of contents is designed?

This year I decided to have students keep the vocabulary with the current notes and labs of the chapter being studied. In the place of the vocabulary, at the back of the notebook, I moved the daily focus questions, used as a starter for

the day, to the back of the notebook so students had a consistent place for writing starters. In the past I asked students to keep track on a single sheet of paper with the focus questions for an entire week and hand them in on Friday for weekly participation grade. This was some what of a nightmare asking middle school students who have trouble knowing what day and time it is, let alone keeping track of a single sheet of paper for a week. The nice part about the method was grading was simple and fast. Now I have to collect notebooks and as mentioned earlier about the new schedule, I do not have a consistent numbers of days with students each week. The new schedule has also raised the total number of students I have considerably and made grading that much more time consuming. The trade off for helping students be more organized and keeping class more efficient created a grading problem for myself. I like having the focus questions in the back of the notebook, so I need to create a better system for grading these questions.

Once again…Should they be a fact book or a reflective piece for their learning in class? I always start out with great intentions of having students reflect as part of their classroom activities, but I am not doing as good a job as I would like. The reflections that students make are one of the most important parts of the notebook. These reflections allow students to form more of their own ideas about a topic and ask questions which can lead them to greater comprehension. Reflections also put more of the job of learning on students and less on my ability to lecture and write up notes and worksheets for the students. The reflections move students to more of a personal buy-in and the feeling of

learning gain. More work from students and less direct feeding puts students on the path toward learning. My intentions at the beginning of the year tend to fall back into old habits by the middle of the year. In my defense, I have been better and better each of the last two years not falling into old habits, and feel this is an area of my class I will continue to improve. I need to continue to improve because I know what research has shown is best for students. In a study conducted by the STEP-uP program, a standard deviation of 1.8 was found between test classes with low implementation of notebooks compared to classes with high levels of proper notebook implementation. Two of the major points for proper implementation were student reflections and students generated questions. **(CITE PAULS STEP-uP STUDY NOTE SURE HOW),** and I would be doing students a disservice by not getting better. Knowing I tend to slide later in the year, I formulated my second action research question to happen during a time I tend to slide.

Action Research

My actual research question was: Will students perform better on the human body final when notebooks have been used to close the time gap between every other day class periods?

My research stemmed from the retention of information problem I was having with students because of the large time gap between each period. I wanted to find a way for my students to be able to have less disconnect between each class period.

I teach three block classes each day and decided to use my seventh grade students as my test group. They took a human body final (they take again at the end of the unit) as a pretest. Retaking the final at the end of the study provided quantitative results for my research. Qualitative differences were observed during the study and compared to the control class along with the same students in the previous semester. Two of my classes had the independent variable applied while a third class acted as the control group.

The applied independent variable was the use of a notebook at the end and beginning of each class. The end of one class ended with a reflection meant to spur conversation and activities during the next class. Students wrote on a prompt given at the end of each class. This prompt was based on the lesson for that day and what we might be leading into the next day. I wanted students to write about any questions they had with the material. The next step was to use the questions to structure the focus for the next class period. These class periods can be as many as three to four days later. During the following class I used the responses from students as a lead in to what we were covering during that class period.

Scores from pretest and post test were compared and the growth for each student tested was calculated. These numbers were averaged together for the class and the classes were compared. Class 1 had an average change of 28.4 points, class 2 had an average change of 28.6 points and the control group had an average change of 28.2 points. The results of the action research were mixed. I did not find a quantitative difference of the growth of scores on the

assessment. The biggest difference I found was the ability of the class to engage in discussion about the activities from the previous class. This could be related to the grouping of students socially, the period I teach the students, and differences in how I teach from one class to the next. Before giving the final assessment I would have been sure the students in the test class would show more growth. The type of assessment was based on how I have been teaching in the past and did not reflect the different use of notebooks. In the future I will continue using the strategy to help my block classes remain more cohesive between days.

Learning Targets

The Chemistry of Smells class opened my eyes to the use of learning targets. The main ideas of a topic covered in class are written in a way students can show you their level of knowledge. In the classroom I give students a chart with the learning targets listed and next to each target is several boxes for students to mark the different levels of undestanding of the learning target. The students can mark if they, “don”t know this”, “kinda get this”, “know this”, could teach this”. The students place themselves on a continuum, based on their current level of understanding. I like how this is used as a measure of prior knowledge to help drive instruction, and students have a concrete way to track progress on the main concepts they are expected to learn. Many students found a sense of accomplishment by being able to move across the table from “don’t know this” to “know this” to “could teach this”.

My colleagues and I plan to use the district curriculum calendar, state standards, and national science documents to write learning targets for our curriculum. We plan to use learning targets to set up common assessments for our department. My co-workers and I are bad about teaching a topic for a while and then deciding it is time for a test and writing a test to match what has been taught. The targets we are forming are based on the district curriculum calendar which is based on the state standards. We are writing the targets in student friendly language so students do not have to fight through the complex verbiage. The next for our department will be using t he learning targets to write assessment for our students which will test the content, skills, and processes written into the learning targets. Our department is looking to write the tests in a manner which causes the students to apply the information in their science notebooks for answers to tests, not just looking the up random facts. This will make the notebooks more important to the students and make the checking of the notebooks less important. This will lead to instruction which hopefully fits the model we are striving for as a department

Student data from standardized tests and district assessments will be driving more and more of our classroom instruction, teacher evaluation, and teacher compensation in the future. We need to ensure we as a department are working on an even playing field. I do not want the district comparing my students with students from another class if we are not working with similar learning targets and assessments.

One part of the Chemistry of Smells class was how the instructor had students use their notebooks as part of taking the assessments. The assessments were written in a way so notebooks were useful and helped lead students to an answer. My notebooks tend to be a little more like answer books than I would prefer, but I have not taken the time to write assessments or different activities in class that would lead students to this better use of the notebook. I really enjoyed how the class forced me to arrive at answers and not lead me step by step through the cookie cutter lab, or have a list of notes just waiting for a quiz. I need to force myself out of my comfort zone of giving facts. Structuring quizzes and other assessments in a way students are forced to depend on the notebook will give me more leverage with the students and put the work of learning back on the students.

Grouping

The Chemistry of Smells also did a great job of bringing me out of my comfort zone about group work. I have become less of a fan of group work, mostly from a management standpoint, as I have taught longer. There is often too much talking and time off task when students are grouped. I think I have been trying to counteract the copying and one person doing the work I observed earlier in my teaching career. The more I think about it, the great work I found in Smells was happening while we were working in groups. This reflection reminds me I need to bring my students back to working in groups. I know we were adults working in the groups, but I was able to learn a great amount from my

group mates. The classroom management and cheating all falls back on me, as the adult in charge of the class. If I want them active and engaged, then I need to have lessons set up to keep the students engaged. The simple fact that students are not stuck working by themselves on an activity they might not find interesting makes the classroom that much more conducive to learning. I can think about myself working on the farm as a kid when I had a daunting task to do by myself. I hated it. I worked much less effectively by myself. Work was much easier when I could work with another person. This is leading me to loosen the reins and bring the controlled chaos back into my classroom.

The control also shows itself in different forms when it comes to grading notebooks. I think grading is the primary reason I have not been able to implement other activities which would be beneficial. When I add or think about adding another piece to my notebooks the part of me that balks the most is the part knowing I will have to grade 160 notebooks and the task seems so daunting I keep the books as simple as possible for my own personal reasons. The biggest complaint from teachers, and many times the largest excuse used, is time. Everyone has families, and many teachers coach or have clubs or help with activities after school. I can not use the time complaint fairly because everyone else has the same problem, so the problem has to lie within me. I want to know how people check notebooks effectively. If as a department we are able to get assessment to a point where the notebook is needed to pass assessments then the need to grade might works its self out and there will be no need to grade. This is the answer which I struggle with the most but probably makes the

most sense is when I am told not to check the notebook but allow it to be a tool for the students. My biggest predicament is how I get an uninterested 13 year old to keep a notebook up to date without accountability. Having assessments based on a well kept notebook would help accountability. I keep coming back to the use of the notebook on assessment. I want students to love putting in information and thought provoking entries into a black and white book of little meaning to most people, but they do not care unless there is something in it for them or at least something to loose if they do not. I collect all of the books, but get frustrated by the pile of work I have given myself and time away from family. I tried grading the notebooks in class, but it took most of a period to do justice to really looking them over and giving the all important feed back.

Without feedback are we really doing the students any good by just checking for completion? This is a trap I find myself falling into all of the time so I can give students a grade. The loss of class time had forced me to ask myself if using most of a period to look at notebooks was good use of time. I could stagger the collection of the notebooks. This is a method I have yet to try, but then do I end up changing my instruction with the class I am checking if I do not get their notebooks back in time

Debriefing

The Chemistry of Smells also showed me the importance of debriefing a topic when we are finishing an activity. I tend to tie up the loose ends of an activity, and I always make sure the relevance of the topic is made clear to the

students. I did a poor job debriefing in the past because the 50 minute class period was not enough time to get an activity finished and have time to have students report out on what they learned or had questions. I would say I would talk about the topic more the next day, but then I just kept charging ahead and really missed out on some of the most important parts of an activity. One of the good parts of the new schedule has been the availability of time during a period to have a final discussion. Grading the debriefing may be an effective way off getting students involved. If I was to give participation points for discussions the students may feel more of a need to join the conversation. A step I need to take in the future with debriefing is to have students lead the discussion and less of me talking and asking questions. Giving students different media in which to present information helps students get experience beyond the science classroom. Being able to stand in front of one's peers and speak publicly is tough for many adults but it can be learned with practice. I was a very shy person until I was hired as a resident assistant (RA) during college.

Leadership

The skills I learned as an RA have been critical to my development as a teacher and a coach. I once read a chapter from a book written by Pete Carroll, the former national championship coach at the University of Southern California and current head coach of the Seattle Seahawks. Coach Carroll said, "We live in a society that celebrates executives, coaches, and other leaders yet does not put high value on teaching as a profession. But any successful leader will tell you

that leading and teaching go hand in hand. You can't be a great leader if you're not a great teacher." (Carroll, 2010, p. 127) I was forced into a position of leadership when I was in charge of 50 young men some older than me while I was in college. I had to become effective at communication in many different forms. Facilitating one-on-one relationships as well as leading an entire group were skills I learned as an RA which have become essential to my abilities as a teacher and a coach. I went into teaching with the idea it was a good way to become a coach, but I forgot about coaching during college and even spent a year teaching without getting into coaching. I now coach high school and middle level sports during the year and the connections between teaching abilities in the classroom and the ability to get information across on the field are very similar. I feel my abilities as a coach and my abilities as a teacher are growing together. Learning a good teaching skill is making my ability to coach better, and coaching techniques help my abilities in the classroom. Ten years ago I would be honest if I told you I did not think I was a natural leader and I still might not be the natural leader to whom people are drawn, but I have developed into a leader who is used to taking over a task and getting a job done. This was evident on our first trip to the CC cabin when we were working on the teams' courses as a group. I tend to sit back for a while and listen to the people who are just loud, pipe up, and try leading. After I decided I could get the task accomplished, I just took over and people listened. We were able to finish many of the group activities under my leadership, to a point where I was asked to stop leading so other people were forced to step up. I do not mention this to brag because I know I am far from

being the greatest leader, but I should show how a shy kid who could barely speak in front of a group can now lead groups of adults, sports teams, and students successfully. I attribute much of this to being forced into a position of leadership.

I like to put students in my class in leadership positions along with my student athletes. The more exposure they have to positions of leadership the better off they will be when they come into these opportunities where they have to lead for important reasons. A seventh grade science classroom and a football field are fairly safe places to start to learn leadership and communication skills. I had people give me opportunities to learn leadership and communications skills, so I feel it is my duty to *pay it forward* in the classroom as well as during sports competitions. The students we have now are the bosses and leaders of the future, I feel it is my duty as a teacher and coach to try and mold students into fine young adults.

My time in the MAT program has made me feel comfortable in mentoring young adults interested in teaching. Two students from the local high school teacher cadet program have spent several weeks in my class observing and eventually teaching lessons. I have also started mentoring a friend who is working through a nontraditional online licensure program. She is learning educational theory and supposed to get a full time teaching placement at the same time. She is currently a substitute in our district without actually training or field experience. I am hoping to begin teaching her the 5E Instructional Model

along with the beginning of inquiry-based teaching. These experiences are leading me toward working with pre-service teachers in the future.

Matter into Mountains

One of the most enjoyable classes I took as part of my MAT program was the week spent figuring how matter turned into mountains. The class started with several days around the Pikes Peak area tracing different formations of the rock record during the past 75,000,000 years. The notebook I have for this class is far different than the notebook I had for other classes. The notebook for this class is dirty, crumpled pages, messy hand writing, sweat drops, and bad organization. The book represents one of the best examples of inquiry I have ever experienced. I spent a week crawling around on rocks, digging in roadside ditches, and not being given a straight answer by my instructor. There were many people in the class who were used to getting immediate feed back whenever they had a question, and in the world of Google we are getting used to this luxury. Being forced to use our brains and figure out answers on our own was such an eye opening experience for me as a teacher acting as a student. I felt great accomplishment when my group or I was able to think of answers. It made me want to answer all of my students' questions with a question. I think the strength of the instructor was his ability to lead us toward the goal of the investigation, but never giving us an answer. This is a skill I feel I use pretty well with my students. I find many of my students asking why questions and less question about how. The professor did a great job of doing what the National

Research Council (NRC) says about questioning: "Students often ask why questions. In the context of school science, many of these questions can be changed into how questions and thus lend themselves to scientific inquiry" (NRC, 2000, as cited in BSCS, 2006, p.20).

In a one-on-one situation when a student asks me a question, I feel I do a good job asking them probing questions to keep them working toward the goal of the activity. I need to make sure I am turning the why questions into how questions. I think I have a lot of work to do when it comes to setting up the activity and having a good question set at the beginning of the activity. One way I think I could make this better would be to spend more time going through an activity on my own before the students attempt the activity. This will give me better insight into the problems that may occur and may allow myself better preparation for the students.

A final task while we were still in Colorado Springs was to use the prior information we had learned about the different rock formations and decide what an unknown formation may be at a different location. To accomplish finding the unknown we used our notebooks and any other information we had collected prior to seeing the unknown.

A majority of this information was collected with observations and comparisons of the different types of rocks. We used field glasses, nails, fingernails, and our tongues. We were looking for differences in grain size, minerals, biomaterial, some color differences, and hardness of many substances. We started being able to tell the difference between different types and

formations of sediments and how those might compare to the different types of sedimentary rocks we were seeing. There was a wide range of prior knowledge in the class. In the class were some people like myself who had a pretty good earth science background, some people had actually taken the class before, and some people had zero formal training in earth sciences. The way the class was formatted all of the different levels of learners were able to come away with different levels of knowledge. Some of the people who had very limited levels of beginning knowledge were able to come away with an understanding of the different rock types and their formations from the class. Inquiry allows students to learn at their own level while still learning the same concepts. The investigation into these rock types by the beginners gave them success seeing the difference between the different types and telling them apart

I already knew the different types of rocks and formations and was able to come away with a deeper understanding of what differentiates the different rock types. I had a deeper understanding of not just how the rocks formed but how the formation of one type of rock affected the formation of another type of rock. I came away with a much better understanding of the geology of the area, and I will be able to give my students a better understanding of the geological formation of the Pikes Peak area. The class spent several days traveling to the Spanish Peaks in southern Colorado and the volcanic areas outside of Raton in New Mexico. The formations we studied in Colorado Springs focused more on the sedimentary rock formations and how the landscape would have looked and changed in the past. The Spanish Peaks area was more dedicated to the

formation of metamorphic rocks and the function of mountain building. The Capulain volcano outside of Raton and the surrounding areas focused on the formation of igneous rocks. One of the more interesting parts was how most of the areas had all three rocks types and we were able to compare and match up rock types from one area with the same formation 200 miles away. I was able to start seeing the story of the formation of the southern Colorado and northern New Mexico region. When taking a class with a group of teachers, often they want to show how smart they are and all of the vocabulary words they know. It tended to be a problem for the instructor who was trying to get us to learn content without using all of the vocabulary words to teach our students in the classroom. This is a skill I go back and forth with myself. Do I teach the vocabulary and then try to apply the words to an activity or do I have the students perform an activity and then allow them to apply the related vocabulary? I think the latter is the trick to a good inquiry-based lesson. Putting students into disequilibrium with an investigation of their own is key to being able to guide the students to understanding. The instructor of Matter into Mountains was able to do a fantastic job of driving us nearly to insanity or possible thoughts of violence toward him because of the unrelenting ability to ask us more questions than he ever answered. Lucky for him the multitude of questions he asked nearly always led to an answer of the goal we were trying to accomplish.

I wish I could give students the field experience I had with Matter into Mountains class. In a perfect world I would load up a group of students and head to a local example of the topic we are studying. I can honestly say I learned

more in that five day class than I learned in a month of geology in college. The system seems broken to me when I teach students about rock types from a book, tubs of rocks, and pictures when I am ten minutes from the same information as it is found in nature. The students in my school live right next to a geologic gold mine of learning, and very few of them have spent time hiking or exploring the mountains. Classroom time, money, and the constant worry about performance on standardized testing have completely ended field trips in my school district.

Second Summer- Cosmology

The loss of field trips and other resources presents an even more difficult task of giving students real life examples of content. A place I would like to take my students is the observatory on the CC campus. During the cosmology institute during my second summer, we did laboratory work with the telescope in the CC observatory. The class centered on the formation of the universe and all which makes up the universe. It was an interesting mix of chemistry, physics, and mass confusion once we started discussing theoretical physics. We started with a brief history lesson of cosmology and discussed how many different civilizations have created myths which have been a driving force behind political and social aspects of their cultures. The use of stories about the heavens has become less of a driving force in our society and more of a children's activity. The society we live in has become dependent upon reality television for

entertainment and taking people with zero talent or ability and making them famous. The change in what is important to us as a society makes me wonder if the lessons taught to children by the elders in a past civilization might be a good plan for our current society. Parents seem to have lost a sense of what is really important about life. I see how my students act and treat each other. It makes me wonder where we changed so much as a society and made actions which are being modeled on television acceptable for every day life.

The class progressed with more history but now the history centered on some of the fathers of astronomy. Some of the early physicists and astronomers had a tough job trying to prove abstract ideas to people unable to understand or choose not to understand like The Church. I can relate this to modern teaching. It is interesting and aggravating how beliefs can actually drive what is taught in schools. There are some modern ideas which science has more than enough evidence, but some idealists feel it is their job to force what should be taught in a public school. I have always wanted someone to let me decide what I want to understand and I have always made it a point to allow my students form their own opinions. I want to be open minded about what I am teaching. It is students' right not to be forced to believe, but I think it is important for students to learn to think critically and with an open mind before they form an opinion on a subject. I touch on evolution in my class and have had to touch on the subject more because the new Colorado Academic Standards call for evolution to be taught in the classroom. I feel as if I have to preface myself in regards to different opinions

before I begin any of these discussions, and I find students become very engaged and normally want more information.

I enjoyed the time we spent talking about Newtonian Physics. This is very much a comfort zone for me. I like discussing how objects which are resting stay at rest until a force acts upon the object. It is very concrete, and students seem to understand Newton's laws. I am able to set up experiments for students so they can see how force acting on a mass will cause the mass to accelerate in the direction of the applied force. One of the simplest things I do is have students bounce balls off the walls and floor. The force a student applies to a bouncy ball has an equal but opposite reaction, and middle level students can understand the concept. I enjoyed the concrete feeling of the first week of the class. The chapter per day we covered was a fair amount of work, but I had a pretty good base in much of the science we were covering so I did not feel too overwhelmed like some of my classmates who only thought Newton was hit by the apple. Little did I know I was about to get hit by a ton of bricks. We continued our hurried journey through several years worth of college-level sciences, my own background keeping me afloat. The heavy content and new vocabulary began to take its toll when we passed into an area of science for which I have a more limited back ground. I have had astronomy classes and enjoy studying the topic, but the reading and questions made it hard for me to sleep at night because I ended up doing all of my sleeping while I was trying to do my homework. A few demonstrations once in a while helped keep me interested and the explanations from someone with a better understanding than myself also was a benefit, but

demonstrations were not enough to save me from the deluge of math which was about to take over my world.

I do not love math nor would I consider myself bad at math, but the number of constants and variables caused me to really question my abilities. I have the ability to understand many of the concepts the instructor was trying to teach, but I was helpless when it came to understanding the math. My pencil was flying and equations were getting thrown down on the paper, but I could barely keep up with what was being said and what was being written. I wanted special and general relativity to make sense in three days, but there was no way. Looking back at the chapters of the book we studied, did I really come away with new knowledge? The answer would be yes for the early chapters where I already had a basic back ground. I was able to expand upon what I already knew, but where the information was new to me or mostly new I have very little understanding about what we were to have learned. This can all be related back to my classroom. The cosmology class did one thing for me which I think every teacher needs. We all need a reminder every few years of what learning requires of us.

I think every teacher needs to be reminded of what it is like to be a student, and not just a successful student but a student who is struggling or failing. This is the position I was put in for the first time in a long time. The last time I felt lost and was struggling as much was during my undergraduate work in an upper level chemistry class. The vocabulary and mostly the math was like learning a whole new language. The speed we were taking the content in made

processing nearly impossible. I found myself stopping and wondering if my students felt this way and if they did I really felt ashamed for how I had let those students slip through the cracks.

I need to be able to take the feeling of being lost and apply it to my class. One way I could cut down how I was feeling for my students would be to monitor more closely the level of understanding compared to the amount of new content I am giving the students. A skill I have always liked using but fail to use it enough is the *ticket out of the door*. The small two or three question quiz we give students as they walk out the door is a very simple way to gauge the understanding of the class. This allows me to differentiate my instruction. I leave fewer students behind because I need to get to the next chapter. Another way I may be able to help students feel more successful is change the way I deal with vocabulary in class. This is a tough problem for me, because I feel vocabulary is very important. Are learning the processes of science more important? The reading level of the text book comes into play, because the book seems to be written at a higher level than many of my students. We spend a large amount of class time trying to sound out words we are trying to understand. Even if I were to use inquiry to teach a concept, the students still need to be able to learn the vocabulary attached to the concept. The current science CSAP test is a perfect example. In my opinion, the test had fewer questions which were basic recall, but many of the questions were written in a way the student needed to know very specific vocabulary to have a chance at a correct answer. For this reason, I still like having students define vocabulary words. One way to help the vocabulary

dilemma is pairing down the words I ask students to learn. I could spend more time on words I consider to be most vital and rely less on the text book as a crutch for what words are most important. Does the publisher really know which words my students need to know?

Another common problem is when the instructor says the dreaded phrase: “Are there any questions?” The blank looks being given off by over half the class should answer this question. Also it has become common understanding in an academic situation not to ask questions. They, incorrect as it maybe, fear being labeled as “that guy” who holds up class and asked all the dumb questions when half the time most people are unwilling to admit “that guy” was right to ask the questions and over half the class wondered the same things he asked. This can be put back on the students, but as educators we need to know the situation exists. We need to have a better mechanism to initiate conversation and dialogue about the topics in question. We need to push students out of their comfort area and safe silence. Taking students out of a situation where they need to speak in front of large groups will help, but, public speaking is a skill we need to build. Students can ask questions in small groups. Students place notes on a question wall with sticky notes and then answer the questions. Students from different groups can answer questions by the other groups.

One last idea I have for helping students get past the feeling of being buried is putting more emphasis on smaller chunks of content. Students need to feel successful more often. For example, I had trouble getting started with this paper because I have never written anything of this magnitude. Now that I got

going, it has been easier to write on a night when I know I am close to getting finished. The first few days of writing where I only had a few pages felt like I was pushing a boulder up a giant hill. I need to realize my students feel the same way about some assignments I am assigning. I gave my students an essay about the digestive system. I wanted students to write in first person as a morsel of food making the journey through the digestive tract. My objective was for the activity to be a culminating project on our study of the digestive system. The students needed to describe to me the organs and how each of those organs affected the food. I also had a list of vocabulary words they needed to incorporate. I wanted students to use skills from language arts class to write a plan, a rough draft which was to be peer or parent reviewed, and a final copy in ink or typed. Many students hate writing, so I really pushed how much fun they could make this assignment and hopefully the quality science understanding followed. I gave students some class time and then reminded them of the due date. Would I have better quality work and less missing work if I allotted more small chunks of time over an extended period of time? I do not know the answer to this question, but I feel it would make a great action research question.

The feeling of being buried alive by mountains of classroom material can make or break a student who may not be the most motivated student in class for whatever reason. I think it is our duty as teachers to find the line between piling on so much work students find it easier to just give up instead of pushing forward. In a class where material builds upon itself this can be very destructive. I also think teachers need to be able to maintain the rigor in a class because

students can also tell when a class is not being taken seriously. They will start treating the class with the same amount of respect as the teacher is giving. The level of rigor in a class also helps maintain classroom management; when students are challenged and engaged they maintain a much higher level of discipline.

The level of discipline in a class can also get lost if many of the students are bored. In the cosmology class I did not fight this problem on a regular basis, but coming from a motivated adult, I was not a great example. From my own stand point there were a few times I tuned out the instructor and drew football plays in my notebook. This happened when I realized I was lost and had very little chance of getting caught up. Personally I did not get bored because I entertained myself, but the idea of many of my students sitting in front of me probably feeling the same way was a tough reality for me. I can think of many times when I am doing a great job of disseminating information which is obviously important to 13 year olds but have to redirect students who are drawing or whispering to a friend. The reality is these students are uninterested and bored. Once a student has reached this point no amount of antics in front of the class does much good in getting the students back. I might just as well save my breath because no amount of learning is going to occur.

I used to think if students are not learning what I think they are supposed to be learning, it was their fault. I talked about the information; the student just did not try hard enough to learn the information. It was not until I was sitting in a coaches meeting and we were discussing why our football team was not able to

accomplish a certain task that I completely realized we teachers need to look at ourselves. My head coach told me if my running backs are not using the correct footwork on an inside zone play, it is my fault. He knows I have taught the footwork because he has watched and heard me teaching the footwork. The problem with saying I have taught the footwork and the athlete can not learn it is not going to help win games. The athlete can learn the footwork; I need to figure a way to teach the footwork so he can understand. What works for one athlete does not always work for another. As coaches we are the adults in the positions we are because we know more than a 15 year old knows. We are getting paid to make sure the athlete knows what we know. During the middle of a game, the athlete does need to know what the coaches know. If only the coaches know, all the knowledge in the world is not going to win the game. I have been able to relate much of what I learned about coaching back to the classroom. I can walk around a class and read questions on a test my students are taking and know all the answers. It does not do the students a bit of good for me to know the answers if I have not been able to teach the students the answers.

Action Research

How I teach my students the answers and how they learn processes has become important in the past several years. I have been looking for my seventh graders to get a better understanding of the human body. I wanted my students to have a good understanding of how the systems of the body worked together. I

wanted them to leave my class knowing why they have their body systems and how each one is dependent upon the rest.

My actual research question was: Will students perform better on the human body final when taught with a macro to micro system compared to a micro to macro?

My action research was based on how different approaches to teaching the same material might change students' understanding. I used what I call the macro to micro *vs* micro to macro approach. What I mean by "micro" is working from the different organs to the larger systems and how they work together. The "macro" approach starts at the system level; how organs work together and then works down to the specific organ level. By drawing interest in how systems work, interest in the organs involved might be a natural result. If I could get students wanting to know more about the organs, they may be more interested in learning instead of memorizing organs and systems like they have done in the past.

My study was split between my two classes of seventh graders. Each class was given the same pretest on the same day while also taking the same test as the post test on the same day. I tried to use a more inquiry-based approach with the second period class and adhered to my past book and lecture for the micro to macro class. I added a graphic organizer to compare how the students understood the relationship between systems. I had students draw on a chalk outline all the different organs and systems. This happened as part of the pre-test and post-test. This tool could be used to help differentiate for some

learners. The actual scores from the pre and post tests were the only data I used. I evaluated at other natural breaks subjectively.

I randomly chose 15 people from each class because there was a large difference in the number of students in each class. I calculated a delta for each student by subtracting the pretest score from the post test score. I averaged the delta for all of the students in each class to calculate an overall delta for the class. I also looked over the other two parts of the test, though they were not analyzed mathematically. I did use them for checking understanding.

There was only a difference of .2 between the deltas of each class. First hour (less inquiry) actually had a very small advantage to second period. This difference is so minimal that had a different person been randomly selected, my data could have easily been changed. I did not find from the test that the macro to micro approach worked better, I also found that it probably did not hurt the students either. Looking at the graphic organizer, I was able to see a difference in the two classes. Period two did show slightly better understanding on the graphic organizers. I can attribute that to activities that were more similar to the graphic organizer being done by period two. I felt the second period class enjoyed the activities we did more than period one. The difference in interest level between the two classes was driven by the different activities period two was able to experience. Period two had more activities that were partner or group based. More time was spent on how systems worked and less time on what each system contained. I used less rote memorization with period two compared to period one.

As a class, period one had more of the higher level students and it would be interesting to see if I switched how I taught each group if they would react differently. In six years of teaching I have learned some of the higher level students are not always higher level thinkers. They are good at school work. They are motivated to do work and know how to play the game of school. They are normally pretty good at memorizing lists of facts. Students who are normally less interested in the memorization of information many times do well with actives needing to use their brain, just not always where reading and writing is involved. Students who despise reading and writing are many times better problem solvers and more willing to think outside the box than students who are good at playing school; being able to act like you are learning, but not comprehend the information. Students who think outside the box and are the problem solvers need to be the reason for change in education. These students are getting left behind in school because they are unable and sometimes unwilling to learn in the current educational setting of lectures and tests. A move to a more inquiry approach will give these students a better chance of success. The motivated students are more likely to adapt to an inquiry approach because they are going to be successful in school no matter how the teacher teachers.

Second Summer Refinement

It is very sad when money becomes the real driving force behind change in education. One would think what is best for students would be the real driving force, but we know that is not true. It is also interesting to me that money

became the driving force behind why I chose my topic for curriculum refinement. I work in a district with very little bondable value due to a lack of business and industry. Large capital improvement projects are very difficult. This lack of capital improvement keeps the district from building a new elementary building which is needed in the south eastern part of the district. This space issue in the elementary grades along with a couple of thinner grades in the middle levels has led the district to move sixth grade to the junior high schools. The new class for which I prepared the curriculum was made up entirely of sixth graders. This was a grade I had never taught so there was some learning that will needed to happen on development levels, classroom management, and curriculum. I knew there was only one year between sixth and the seventh graders I am currently teaching. I do feel this is an age where major changes are happening to the students and there was a wider range of growth and development, compared to seventh and eighth graders.

Money is driving the curriculum development in my district. Our district has said they are working hard with the state to be able to get large amounts of grant money. To get this grant money, we had to show we were doing something innovative. The innovation came in the form of a modified block schedule and the incorporation of more intervention time for students. Where I came in to play was the schedule had all study halls removed so now we needed to have places for the students to be during the 41 minute blocks of time. The core class block is 82 minutes long. The elective blocks are 41 minutes long. The administration asked us to come up with innovative electives. Money comes

into play again because the reason for administration wanting innovative electives is so our school looks more appealing to students and they want to come to our school over other junior highs. This is not a bad reason, just a fact that is based on money, FTE, etc. I taught a Physics Olympics class. I gave students a challenge and they designed a way to meet the goal. I taught this class every day for one semester. The same time period was to be more plan time the other semester. Two school counselors approached me with a favor to ask. For an extra .1 of my salary I will teach a second elective. Another teacher was going to teach an ecology class, but because they had such good numbers, they needed another section. Once again this is not a bad class to be teaching but I found the way I ended up teaching the class interesting.

When deciding what I was going to teach, because ecology is a very general term, I headed to the *Atlas* and *Benchmarks* to see about age appropriate material. It became more and more apparent that I needed to be more aware of the content level and the age of my students (AAAS, 1993, p.117). I also spent time with the new state academic standards to show the class was aligned with state curriculum. Most importantly I gathered my team mates together, and we had a good discussion about the vision of our department and how we were going to use my elective as a way to supplement the sixth grade science teacher and the rest of us who are teaching the seventh and eighth graders. The class was an elective, and I wanted to make the class fun for me and the students. I wanted to see how I teach when I am less worried about “getting to chapter 23 in the blue text”. I hoped to see if I can practice

using a more inquiry approach when there is less pressure in regard to standardized testing. I had several long term projects planned that would show changes over time. The class will have several different components going on at the same time. I wanted to have a long term and short term parts of the class. The long term part of the class involved observations over time of a small ecosystem outside the school down by the ditch. The second long term activity was a student generated study with tests of fast growing plant seeds. The third long term activity was maintaining a decomposition experiment for observations and questioning over the period of the semester. These activities were not going to be checked daily. Mixed in with these long term activities I wanted to take smaller pieces of what they were seeing in the long term and build smaller activities to elaborate on some of these concepts. I had an idea about what I wanted students to learn during the smaller sessions, but I hoped it would become more student-driven if they started asking questions and running in a different direction. If they were more interested in a topic which still fits with the overall plan, I did not have a problem with changing gears and going in a different direction. I hoped I would get more buy-in from students if the topic was their decision and not mine.

It was a goal of mine to make the scientific process the basis for the use of the notebook. I wanted questions to be asked, investigations to be made, hypotheses formed, hypotheses tested and conclusions formed. As a department we used to spend time teaching scientific method. In the future we plan to incorporate the scientific process into all activities. I feel this will give us

an advantage of time and a better application if the students use the basic format for all activities. I have been poor in the past at concluding activities and bringing everything together. Without a need to “get to chapter 23 in the blue text”, I will ensure I take the extra day for a conclusion, as long as I am getting the real meaning from the activities.

Students tend to have expectations of how classes are supposed to run. I was told by a co-worker who taught a class like this, from a management stand point I have to be careful with the line between being a “class” and “hangout time.” The key was setting clear objectives for what is to be accomplished and have meaningful follow-through when objectives are not met. The two main goals I had for this class were what gave me my overall vision for the class. One was student-centered and one was teacher-centered. For the student goal, I wanted the students to exit the class with a better ability to think critically about a situation and create meaningful questions and finding the answer to those questions. Basic memorization questions have their place but they do not show a students ability to take a concept they learned and apply the concept to a new situation. I wanted my students to take the questions they were answering during an explore and help one another solve higher level problems. These problems were supplied by the teacher or even better by the students. This should have lead to a better overall understanding and application of scientific processes. The topic of ecology was the guide toward this goal. My teacher-related goal was like I stated before, breaking the crutch of the text book and worksheet from my daily classroom activities and put less of the knowledge-

building on myself and more of the knowledge-building upon the students. The following is an outline of the activities I planned to use as the structure toward reaching my two main goals for the ecology class.

I formulated the brain storm list to help guide instruction before I planned the activities. I based my brain storm on several sources; from a more academic standpoint I referenced the *Atlas* and *Benchmarks*. I compared what they said to the curriculum calendar our district teachers formed based on the state standards. I also looked at the new state standards, but it seems as if the state and the scientific community do not always agree. I do feel our district representatives from each building did match what the scientific community said fairly closely. The brain storm list does seem fairly extensive but I was also trying to build a list for the whole semester.

Scientific Process and Experimentation Targets

- The use of a constant in an experiment
- The use of variables in an experiment
- The purpose of the control in an experiment
- Writing a hypothesis in the “if-then-because” form
- Communicating the conclusion of an experiment

Content

- Importance of photosynthesis to plants and animals
- The inputs and outputs of photosynthesis
- Three symbiotic relationships

- How energy travels from one organism to another
- The effect of environmental conditions on organisms
- How populations change
- Predator/Prey relationships
- Cycles
    - Water
    - Carbon
    - Nitrogen

Examples of learning targets based off the brain storm list.

-Describe how energy travels from one organism to the next.

-Use your understanding of the water cycle to describe the journey of a water molecule across the continent.

-Discuss the role of sunlight in photosynthesis.

The long term activities were meant to be used as a basis for most of the other activities in the class. I wanted question formulation and hypotheses to be drawn from these activities.

My hope was, the long term activities would act as engagements for learning cycles to be built from those activities. I wanted students to move into disequilibrium from something they saw and wanted to know more about or why something is the way it is. I could have tried try to plan these wonderful cycles with loops inside loops of wonderful 5E magic. After teaching the class, maybe I

should have, but I was hoping the student's interests might be able to drive this class more than me planning it out to the letter in the middle of July. I wanted to have a good foundation of avenues I could take the students if they were not doing a good job of driving the instruction

The next four paragraphs outline what I wanted the class to do when building this class, but what I wanted to accomplish and what actually happened are not the same. Later I will explain more about what actually happened in class. **The following are taken directly from my own preparation for the class and assignment for the MAT program.**

The first long term activity will consist of students choosing an area of habitat in the open space next to the school. Students will start by taking observations and making a detailed drawing of their habitat. The long term aspect will be the weekly observations made for changes over the semester. The observation of the students will hopefully lead to questions and possibly a hypothesis about what changes will take place over the semester. Are there tests we can make based on the allotted time and resources? What do we find in our habitat and how do the different organisms affect each other? What will a change in the weather do to our habitat? What happens if we remove organism "X" from the habitat? This activity will have a culminating project of showing change over time. I would love to be able to show more change, spring to winter, instead of just fall to winter; but the other long term activities should help cover the growth of and decomposition of organisms. I see a problem being if a student chooses a very barren area with little to no organisms. A way to fix this

problem would be to ask the student to choose a different area, or the student could dig down into the soil and look for organisms. Other problems areas could be weather and human disruption.

The second long term activity will be conducting experiments with fast growing plants. This is where I am hoping to give the students a chance to conduct a really meaningful experiment and learn about the use of variables, constants, and a control. I want students to understand basic photosynthesis. I hope students will take observations outside and apply these to plants in a controlled environment. During this process I may also have students observe the germination of seeds, not just the growth out of the ground. Watching seeds germinate on a wet paper towels may lead to more testable ideas when we actually plant seeds. I may even have some of the students plant the germinating seeds. We have a small solarium along with a small bank of grow lights so experiments with tropisms of plants are possible. I hope the students will compare light to no light, different amounts of water, soil types, etc. I want the students to decide what they are going to test and see if we have the ability to understand "fair" in an experiment. My job is to then try and take the idea of "fair" and build upon it in to variables, controls, and constants.

The third long term experiment for my class is a decomposition experiment. I have several different types I might use, and I may try several to have more way for comparison for the students. I want the students to see the full circle of life and death of different organisms and to see how the dead ones are important to the growth and life of new and other organisms.

The learning targets I mentioned before will be imbedded into the above activities. Smaller spin-off activities will specifically attack one or more of the learning targets. I am not going to try and specifically say when or where I would use the other activities because it depends greatly on the prior knowledge of the students and how they are progressing with the other activities.

Assessment of the class was done in several ways. Students recorded their learning in their notebooks. To satisfy the people in the world who demand tests, I threw in a few small written quizzes. Concrete numbers of questions answered properly or incorrectly can be more understandable for some parents compared to what maybe thought of as a subjective score on a notebook activity. The notebooks were the main source of assessment along with projects completed outside of the notebook. I wanted scientific thought spelled out in the notebook, but I needed to do a better job of communicating this expectation to the students. If I teach this class again in the future I will need to make better use of a scoring rubric. The rubric would give the less organized sixth graders more structure for completing assignments.

The ecology class was very enjoyable to teach once I was able to let go of a few pre conceived idea I had going into the class. The management style needed with sixth graders at the end of the day is much different than the management of seventh and eighth graders. I also had to get used to the 41 minutes of class, which turned in 37 minutes once bells were added. Herding 28 sixth graders outside is not as easy as one might think. I do have a renewed respect for elementary teachers.

One aspect of the class I feel went well was the weekly drawings of the area of the creek we chose. At the end of the class we were able to put them together in a book format and really have a good discussion of how the area changed, why the area changed and how might these changes affect the rest of the ecosystem of the creek bed. The students seemed excited about the weekly hike and chance to work outside. There are definite differences in students ability to draw and this activity allowed the good artists who might not always shine in the classroom a chance to really succeed. The second activity I feel went well for the students was a culmination project for the end of the semester. I was looking for the students to incorporate the content they learned into an ecosystem they created. The class was given a list of ecology concepts which needed to be used as the basis for their ecosystem. Food chains, populations, habitats, predator/prey situations, producers, consumers, are examples of what students were expected to show an understanding of with the final project. I wanted drawings of the organisms, food chains and food webs to help show the energy flow in their ecosystem and an explanation of how the whole ecosystem worked together. A third project I feel went well was growing of beans to see the process of germination. Students checked and drew the development of their seeds daily. We were able to start looking at the different parts of the seed and how the germinating seed changes. I did not try and take sixth graders into the depth my plant physiology teacher took college students. I was able to give the students a basic understanding of plant growth.

There were aspects of the class which did not go well and I would need to change if I were to teach the class again. The activity using the fast growing plant and inquiry investigations did not happen because I was leaving it for when the weather was colder and we were lest able to go outside. Problem with the plan was it stayed nice for so long and I forgot to use the seeds until too late and by the time I remembered we would not have had time to get any good use before the end of the semester. Along with this activity I wanted to incorporate some open inquiry investigations, but feel into the normal trap of young learners not being trained in inquiry and not being able to handle a lack of structure. I needed to ease the students into the open inquiry more gradually. If I was able to keep these students into the second semester I feel our investigations would have gained strength and the conclusions students were drawing would have been more sophisticated. The higher level questioning skills and further investigations could have begun. The class was more cookie cutter overall then I had originally imagined, but the ability and development of the younger students played a stronger role than imagined.

Inquiry

The next great idea in science. Where does it come from? Someone had to discover the next great idea. A problem or a question sitting there waiting to be answered by someone with the desire and ability to try. Desire is individual, only the person working on the problem can control desire. Ability is something a teacher can give to a student. The understanding of scientific processes can be

molded and nurtured in a student. I would be willing to bet few of the great scientific break throughs of the past hundred years occurred during an enthralling lecture. My guess is most great inventions and explanations of problems happened by trial and error in a lab or garage. Science educator Mark Windschitl says “These explanations come from the process of developing models and hypotheses and then testing them against evidence derived from observation and experiment “(as edited in Luft, et al, 2008, p.2). Fostering the next generation of inventors can best be done with a strong inquiry-based education.

I have been slowly transforming my classroom into an inquiry-based classroom. A success with my seventh graders was the gummi bear diffusion lab. I finished the human body unit and was looking for a way to transition to a cell unit. A co-worker told me of a lab she used and I decided to give it a try. I had two goals in mind for the lab. The students were to get an understanding of diffusion. I wanted a lab where students completed an activity based on prior knowledge and used their observations as a way for “Learner poses a question” (NRC, 2000, p. 29) from Table 2-6. Their own questions were used for a student driven investigation. Our focus question for the day asked students to describe how they thought the blood was able to pick up and drop off oxygen. The question stumped many of the students but did lead to a lively discussion on how this may have happened. I had the students think-pair-share, which seemed to bring out more responses than the original individual question. I like how science educator Page Keeley explains using prior knowledge in the class room. “Drawing out the initial ideas students have developed through their prior

experiences, intuition, and encounters with familiar phenomena provides a starting point from which the teacher can design instruction that will build from students‘ ideas” (Keeley, 2008, p. 20). After the discussion seemed to come to a halt at how the “transfer” between cells occurred, the class moved onto the exploration activity. All students set up an investigation seeing how gummi bears were affected while sitting in water, salt water, sugar water, and a control that I provided. I gave students a testable question, they formed hypothesis and organized the investigation in their notebooks. I asked them to take observations with the five senses over a period of 20 minutes. The students experienced a small amount of change and good natured bantering about different hypotheses occurred. Students were asked to form predictions for the bears based on the 48 hour period until they would see them again. The next class period I asked students to complete collecting data, analyze the data they collected and form conclusions for their individual hypotheses. As a whole group, the class concluded the water was probably the reason for the change in the gummi bears. This conclusion leads to more questions for students to answer.

The NRC says “Scientifically oriented questions center on objects, organisms, and events in the natural world; they connect to the science concepts described in the content standards” (NRC, 2000, as cited in BSCS, 2006, p.20).

I asked students to form some questions on their own they might be interested in investigating. In their groups they decided on a testable question, formed their own hypotheses, and provided a procedure for me to approve. Once the students’ procedures were approved they carried out their own

investigations, collected data, analyzed data, formed conclusions, and reported out to the class. The reporting out of an investigation is an essential feature of inquiry as the NRC states. "Having students share their explanations provides others the opportunity to ask questions, examine evidence, identify faulty reasoning, point out statements that go beyond the evidence, and suggest alternative explanations for the same observations (NRC, 2000, as cited in BSCS, 2006, p.24).

These activities fall on different parts of Table 2-6, Essential Features of Classroom Inquiry and Their Variations. The first explore activity is on the more teacher directed portion of the chart. "Learner guided in process of formulating explanation from evidence...learner engages in question provided by teacher" (NRC, 2000, p. 29). In contrast the same essential feature for the second part of the activity is more on the student directed portion. "Learner formulates explanation after summarizing evidence...learner poses a question" (NRC, 2000, p. 29).

I was able to take seventh graders and set them out mostly on their own with an investigation. It has taken a good portion of the year to get the students to a point where I felt comfortable letting them loose on such an activity. One of the biggest differences I noticed was when I listened in on conversations. The level to which the students were engaged has not been matched all year for such long periods of time. Students who normally groan when given a task were no longer acting like they were too cool for science. Some of the students had trouble controlling variables as mentioned in the National Science Education

Standards. “Middle-school students might have trouble identifying variables and controlling more than one variable in an experiment” The NRC also states “Students also might have difficulties understanding the influence of different variables in an experiment” (NRC, 1996, p.143). Students wanted to include many different liquids and different types of gummies in their investigations. It took several pointed questions to get the students to realize they would have a hard time forming a conclusion based on the multiple variables driving the investigation.

In the end

The instructional model began my journey in the education field and more specifically the 5E. I plan to continue the use of the 5E instructional model and try branching out from the 5E. Instructional models are explained very well where Bybee is cited in Inquiry and the National Science Standards. “An instructional model incorporates the features of inquiry into a sequence of experiences designed to challenge the students’ current conceptions and provide time and opportunities for reconstruction, or learning, to occur” (Bybee as cited in NRC, 2000, p. 34). The past two years have been a great restart for me as a teacher and a person. The MAT program has forced me to take a look at myself as an educator and the field of education as a whole. I have begun to forge my own identity as an inquiry teacher and opinions on how education needs to progress in the future. I am here to make a change for the future inventors and make a Refinement of a Junior High Science teacher.

References

American Association for the Advancement of Science (AAAS). (1993). *Benchmarks for science literacy*. New York: Oxford University Press.

AAAS and NSTA. (2001). *Atlas of science literacy*. Washington, DC: AAAS.

Bloom, B. S., Krathwohl, D. R., & Masia, B. B. (1984). *Taxonomy of educational objectives: The classification of educational goals*. New York: Longman.

Biological Science Curriculum Study. (2006). *Why Does Inquiry Matter?* Dubugue, Iowa. Kendall/Hunt

Carroll, P. (2010). *Win forever*. New York: Penquin Group.

Colorado Department of Education (CDE). (2007). Colorado Academic Standard. Denver,CO. CDE.

Glencoe. (2005). *Science* (Level Blue). The McGraw-Hill Companies.

Hardiman, M. M. (2005). *Conecting brain research with effective teaching.* Lantham, Maryland. Rowman & Littlefield Education.

Keeley, P. (2008). *SCIENCE formative assessment*. United States of America: National Science Teachers Association.

Klentschy, M. As Cited in *Science and Children.* (November/December,2005) Science Notebook Essentials.

Luft, J.,Bell, R.L.,& Gess-Newsome, J. (Ed.) (2008). *Science as inquiry in the secondary setting*. Arlington,Virginia. NSTA.

Marzano, R. J. (2001). *Designing a new taxonomy of educational objectives*. Thousand Oaks, Calif.: Corwin Press.

National Research Council (NRC). (1996). *National science education standards: Observe, interact, change, learn*. Washington, DC: National Academy Press.

National Research Council (NRC).. (2000). *Inquiry and the national science education standards: A guide for teaching and learning*. Washington, D.C.: National Academy Press.

Schwarzenegger, A. (1993). *Arnold: The education of a bodybuilder*. Chicago, Illinois. Simon & Schuster.