Standard One: Knowledge of Subject Matter

The teacher understands the central concepts, tools of inquiry and structures of the discipline he or she teaches and can create learning experiences that make these aspects of subject matter meaningful for students.

My growth and progress toward meeting Standard 1:

In my undergraduate years at Carleton College I fulfilled all the requirements of the biology major. However, I understand that this alone does not mean that I have full knowledge of all the subject matter in the field of biology. In my major I focused primarily on energetics and genetics as they apply to biological systems. As I began teaching I realized that my knowledge of biology at such a detailed level may be necessary to fully understand the concepts, but such details can actually get in the way of effectively teaching the relevant information. One of the most difficult things I did during my first weeks of teaching was learn science on a new level using new words and different concepts.

One of the reasons that I have always been interested in science on a molecular level is because I could relate it to my body. I was a fairly successful competitive swimmer in college and I loved the subjects that I could apply directly to my swimming. In Human Physiology I learned how the body's energy systems work and I used that to enhance my practices. In Biochemistry I learned how to most efficiently fuel my body and in Anatomy I learned the names of all the parts that hurt so badly. The molecular side of science often seems very irrelevant to high school and middle school students, however, I think relating these complicated processes of biology to something students are interested in is important to making the information meaningful. By relating this information to athletics it is easy to grab the attention of many of the students that would not otherwise be interested. Nearly every child has had some sort of athletic experience in their life, whether they are the star track athlete or the physical education student struggling to finish the twelve minute run, they will be able to relate the information to some form of previous experience.

Another way to help students relate the abstract concepts of science to something a little more relevant is to find news articles discussing the topics. I found that this was especially useful when teaching genetics because it seems that you can pick up the newspaper on any day of the week and find an article relating to what you are teaching. Often science is a completely different world to young students, by showing them that science really shows up in every day life, they can see that it is important and not dismiss it as the topic that nobody understands anyway. In addition, using recent articles helps to keep the curriculum up-to-date. Especially in science it seems that the textbooks are obsolete by the time they're printed, let alone ten years down the road when they're finally replaced. While teaching my unit on genetics I was able to pick out where the textbook was lacking and/or wrong and supplement by using recent news articles.

One more way to help students understand complex systems and structures is the use of models. Using models is absolutely necessary in teaching science. Many of concepts students must learn are things that can not be seen. Having to visualize abstract processes

makes learning science especially difficult for younger students. For example, to teach seventh graders about the structure of DNA, I had each student make a simple paper model that represented a piece of the giant molecule. They were able to use their model to see how certain nucleotides pair together and how the molecule could be replicated. When using models, however, it is important to take time to help the students realize that models are not exact replicas and that they are only tools to help them learn. In my classes we did this by discussing what DNA would be like if it was really as big as our model. The students did some figuring and discovered that the DNA of one chromosome would stretch all the way to Wal-Mart. Perhaps this helped them put the model into perspective.

In addition to learning some tricks of the trade, such as which models to use, during student teaching I learned a lot about how to apply my detailed knowledge of biology to the classroom. One of the most difficult things I found was trying to determine which pieces of information are relevant to what the students need to know and how to teach it in such a way that it is appropriate for the age level. I find that it is easy to get wrapped up in trying to do a number of activities to help students understand the concepts. It seems that every textbook comes with a pile of worksheets and activities to supplement the lessons. Here it is important for teachers to know when to say when. Every class will reach a point of diminishing returns if the teacher tries to incorporate all the possible activities. While student teaching I learned that it is necessary to evaluate each activity and determine what the students would get out of it before implementing it into my lessons. Also to determine if the students would be able to make the necessary connections to the material they had learned to make the activity a learning experience rather than an arts and crafts lesson. All too often people make the mistake of making science "hands-on" rather than "minds-on"; it is important to realize that if students aren't able to make the connection to science, nothing valuable will be gained from the activity.

Evidence to support my knowledge of Standard 1:
My knowledge of biology culminated for my senior thesis, which I have included in my portfolio. This piece demonstrates my ability to comprehend primary literature and apply what I have learned in order to explore new concepts. The content of the paper is an example of the detailed level at which I had previously learned biology. One of the most difficult things I did as a student teacher was to move from this level and begin to explain things at a level more understandable to seventh graders.

Second, I have included my laboratory notebook from my introductory biology class. I like this piece for two reasons. First of all, it shows the broad range of topics that are covered in an introductory biology class. To be an expert in all areas is very difficult, yet this is what is expected of life science teachers. Another challenge I have faced is reviewing a number of these concepts that I learned only in my first year of college in order to teach them to my classes. Second, this notebook demonstrates how my ability to take notes and keep a record of my lab explorations improved over the course of the

class. This skill is used in all science disciplines and can also be applied to other areas of teaching such as self evaluation and action research.

My last two pieces of evidence are lesson plans that I developed for my seventh grade life science classes specifically to add interest and relevance to their respective units. The first is a lesson that I used to wrap up a unit on genetics. I found six short articles that discussed recent developments in genetics. The students did a jigsaw activity where each group received an article to read and discuss. After a short period of time the students chose one member to report their findings to the rest of the class and relate it to what we had learned in the unit. The second lesson was used to introduce the controversy surrounding the theory of evolution. I knew that some students would object to learning human evolution and would have plenty to say about the topic. My intention was to use this one day to let them voice their opinions and learn a little more about what the theories are about before covering them in more detail. The lesson was based on a number of questions such as "how old is the universe?" "How old is the human race?" Etc. We discussed each question and the answers given by different groups. Finally I ended the lesson with a debriefing period where I discussed the meaning of the evolution as a theory, what we teach as scientists and why we teach it that way.

My goals to further achieve Standard 1:
Unfortunately, my great interest in the energetics and genetics portions of biology left little time for the areas of form and function. I think biology has one of the widest ranges of subject area of all the disciplines. Even though I went to a liberal arts college and was required to take classes in many areas of biology, I only scraped the surface in some of those areas. Now that I have graduated I am beginning to see where I am lacking and I am taking interest in some of those topics. One of my ongoing goals is to continue to strengthen my knowledge of biology by learning more about the areas where I am not as strong and to keep updated on all other aspects of the ever-changing world of science. During my job with the department of agriculture during the summer of 2001, I began to expand my knowledge in the areas of entomology and botany. Additionally, I was primarily in charge of planning lessons for the Ecology class I taught at West Central Area High School. While student teaching in Discovery Middle school I taught evolution and classification, two more areas outside of my main focus.

One thing I participated in during my student teaching but was not able to follow up on was the development of an interdisciplinary unit. As part of a "True Team" the teachers I worked with were able to meet on a daily basis to discuss among other things their curricula. This enabled them to align with other classes and teach similar things at the same time. Taking this a step further, they were working on assembling an interdisciplinary unit that would be covered in the four major subject areas. Unfortunately, I was not able to participate in the actual unit, but I was a part of much of the planning and I am anxious to find out how it worked. Eventually I would like to participate in the development and implication of an interdisciplinary unit. I can see that it would be quite difficult in a large school without the support of the True Team, but would be very possible in a smaller school. Either way, I hope to give this method of instruction a try.

Every science teacher bends the curriculum a bit to focus on his or her strong areas. I'm sure I'll do quite a bit of this especially in my first years of teaching. Eventually though I would like to take more classes and acquire more experience in some of the areas of biology I have not mastered so that I can better present this information to my students. Also, as I apply for jobs I am realizing that many biology majors teach more that just life science, many have to teach other science disciplines as well. I hope to take more classes outside of the life science discipline, especially in earth science and physics, to prepare myself for the possibility that I will be teaching in another discipline. Gaining knowledge of other disciplines will also help me to prepare my students for other science classes they'll take so that hopefully my class will be helpful in preparing them to succeed later in school. Finally, I believe that one hasn't truly mastered something until one can teach it to someone else. As a teacher I plan on continuing to master new aspects of the biology discipline.