TEACHING AND LEARNING PORTFOLIO

by

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Delta Program in Research, Teaching, and Learning
University of Wisconsin-Madison
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Overview

This portfolio is a display of my professional experiences and personal reflections and goals in teaching and learning. My efforts to learn effective teaching practices and apply them in various settings are documented here with a statement of teaching and learning and specific examples of teaching experiences and professional development, interlaced with comments from peers and students about my teaching style and abilities.

Future goals in teaching and learning

The experiences described in this portfolio demonstrate some of my efforts to continually improve my teaching practice in order to reach as many students as possible and connect them to the material at hand. As described in the following pages, I have been encouraged by students and instructors alike to continue teaching science. Specifically, I would like to either teach science at the introductory college or high school/college preparatory level or be directly involved in science education (curriculum or course development, for example) at those levels. More generally, I will continue to develop my skills in teaching and learning by remaining involved in learning communities, observing teachers in their classrooms and having them observe me, and working on projects committed to improving student learning in science like some of those described below.

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Statement of Teaching and Learning

One of the most important attributes that I bring to the classroom is my broad background and experience in interdisciplinary science. Having studied physics and chemistry as an undergraduate (in addition to taking courses in geology, geography, astronomy, and biochemistry) and completed research experiences in atmospheric chemistry, surface physics, and, most recently, biophysics and nanotechnology, I bring many different perspectives of science and how it applies to our lives to the material I teach. Combining this with my recently acquired understanding of student diversity, learning communities, and teaching-as-research provides a foundation from which I build my teaching practice.

Students in a class often have diverse personal experiences. Tapping into those experiences is one way to promote student learning and enrich the material with examples directly connected to the students. I attempt this by asking questions to students and developing brief surveys at the beginning of a course. If everyone shares their personal experiences with a subject, different views of the same concepts are displayed. Since there are different kinds of learning styles, I see these exercises as a good way to help everyone learn – so everyone can see things from different points of view. I also incorporate some kind of ice-breaker activity or informal gathering (sometimes with free food) at the beginning of my teaching experiences to get to know my students (and to help them get to know each other).

I try to maintain an interactive classroom in my courses. This approach involves brief lectures, group projects, and the use of interactive technology in the classroom. My internship experience described later in this portfolio is a good example of using multimedia learning tools and group laboratory and classroom activities to facilitate learning. I find that a wide variety of learning tools maintains and even enhances student interest in a subject. Outside of class, I try to provide ample accessibility to my students. I allow time before and after class and during office hours or review sessions for students to come to me individually with their questions, comments, and concerns for the course. In the subjects I enjoyed most as a student, I appreciated interacting one-on-one with my professors while working through homework problems, take-home exams, or other projects. Having the teacher as a resource outside of class time is especially valuable to many students.

Ultimately, I want to know how much my students are learning from my teaching. Therefore, I ground all of my activities in the idea of teaching-as-research – using the scientific method to critically assess student learning. For each new activity I develop an assessment tool. Though it is not always 100% successful (as in the internship described below), the process itself of attempting to find out what my students are really learning goes a long way towards refining my teaching style and activities. I have learned about traditional and non-traditional assessment tools and ways of collecting formative and summative feedback from students. Though it sometimes takes an extra investment in time, I find it rewarding and enriching to more fully understand how my students feel about my teaching and what they gain from my courses and teaching experiences.
Delta Certificate in Research, Teaching, and Learning  
(Dated: April 27, 2005)

During my graduate career I was involved in the Delta Program for Research, Teaching, and Learning. A National Science Foundation-sponsored program, Delta is a teaching and learning community including graduate students, post-doctoral researchers, academic staff and faculty across all science, technology, engineering, and math (STEM) disciplines. The program provides courses, focused discussion groups, internships, and other events to promote more effective teaching practices for STEM disciplines in higher education.

My successful completion of the Certificate program includes taking two graduate-level courses, participating in a learning community discussion group for one semester, completing an internship at a local two-year college, and actively participating in discussions on teaching and learning at “roundtable dinners” and other social events sponsored by Delta. A brief description of the major activities is given below with a more detailed description of the internship in the following pages.

Teaching in the College Classroom (graduate course, summer 2003)
- Introduction to college-level teaching, traditional and non-traditional forms of assessment, literature on teaching and learning, learning styles, setting learning goals, critically evaluating student learning
- Implemented course ideas in a micro-teaching experience and developed a teaching and learning philosophy

Effective Teaching with Technology (graduate course, spring 2005)
- Introduction to principles of using technology in the classroom, learning efficacy of tools and assessment of the technology used to improve student learning
- Examples of technology include authoring tools for interactive, web-based learning objects, web-conferencing, tools for distance learning, multimedia databases, and computer modeling and simulations
- Completed semester-long project to implement and evaluate a piece of technology for specific learning outcomes in a course at Madison Area Technical College

Expeditionary Learning (small-group learning community, fall 2003)
- Small-group discussions among faculty, graduate students, and post-docs; explored diversity of students by putting ourselves in their shoes
- Learned how to put course material and assignments in a context that maximizes student learning

Internship (collaboration with Madison Area Technical College, 2004-2005)
- formal practice for developing new curriculum material, implementing it in a classroom, and assessing its impact on student learning
- gained experience in 2-year college environment
- concurrent seminar with other Delta Program interns facilitated understanding of teaching-as-research as it related to individual projects
Delta Program Internship: Fuel Cell Materials Learning Object  
(Dated: September 26, 2005)

Through the summer and fall of 2004 I worked with Dr. Barbara Anderegg and others at Madison Area Technical College (MATC) to develop a learning object about fuel-cell technology. A learning object (LO) is a brief, web-based tutorial designed to convey a “nugget” of information in an interactive manner. I designed an LO about fuel-cell materials technology with content aimed for a freshman-level college or high school course in chemistry or physics. The LO focuses on the fundamental science concepts behind technological issues preventing fuel-cell technology from rapidly becoming part of our economy. The multimedia object may be viewed at: [http://ceret.us/l_objects.htm](http://ceret.us/l_objects.htm) - “Heart of a Fuel Cell”

![Screen-shot of learning object (LO). One can interact with animated figures in order to explore the basic science concepts behind fuel-cell technology. This LO is linked to related objects on other aspects of fuel-cell technology – each conveying a small chunk of knowledge in an interactive manner.]

The LO was first implemented in a chemistry classroom at MATC during a unit on batteries and fuel cells. I was a guest instructor for the entire one-week unit in three sections of the course (~45 students total, 17 hours of class time). The unit included the multimedia learning tools and a new laboratory activity, developed by a colleague at UW-Madison, in which students built and tested their own fuel cells in small groups. Major goals of the project were to see how the LO could be used efficiently by the teacher and how much the students learned by having the extra perspective offered by interactive animation and learning at their own pace. A pre/post quiz assessment tool was used to test student understanding of basic concepts outlined in the LO. This assessment, however, was inconclusive because quiz questions ended up testing not only
material covered in the learning object, but also the lab activity and classroom lectures. This was largely due to timing issues and coordinating the class, lab, and lecture periods combined with the unit being taught in the last week of classes.

Although the results of the quiz were difficult to relate to the project goals, I learned a lot about teaching-as-research (TAR) in practice. Some answers to the quiz questions provided me with unexpected insight into what students were thinking. One of the most important things I learned was that simply attempting a TAR experiment (even if “unsuccessful”) could inform me of student learning.

I learned in the Expeditionary Learning discussion group that a diverse student body can enrich everyone’s learning experience. However, I did not fully use the diversity of students in my MATC classes to enhance learning. Page 12 contains a copy of a peer observation letter that the Internship Program coordinator wrote after observing me during one class session at MATC. He focuses on my experience with diversity and accurately describes my efforts to include all students in learning. Since it was my first time teaching such a course and I was concentrating primarily on the TAR experiment, I did not consider the diversity of my students as much as I would have liked. This is an area in which I can make many improvements for future teaching experiences.

Learning community (LC) is the third major pillar of the Delta Program. During the 2004 classroom experience I noticed that students, when working in small groups around a computer (using the LO), were very engaged in the material. Though using computers for an assignment (offering students the option of completing an assignment individually) might prevent a LC from forming, in this situation it brought students together. This observation shows that using technology can enhance LC if used as part of a small-group activity in a computer lab or classroom (as opposed to leaving the students to complete the activity outside of class with no requirement of working together). It is one that suggests a way to study the effect of technology on LC in my future teaching experiences by measuring the degree of interaction between students and correlating it to specific learning outcomes.

A more rigorous assessment of the same LO was performed in the spring of 2005. Another chemistry instructor at MATC used the LO in his college chemistry classes so a schedule for students to take a pre-quiz, explore the LO, and take a post-quiz was well defined. Access to the tools was controlled by using the Blackboard online learning system. The pre/post quiz assessment is shown on page 7 and the questions were carefully written to address student learning at various levels. We were interested to see if 1) students could simply recall facts about fuel cells from viewing the LO, 2) they had an understanding of basic concepts like how a catalyst works, and 3) they could apply knowledge from the LO to other fields unrelated to fuel cells. The average quiz score from the multiple-choice questions rose from 40% to 80% between the pre and post-quiz and the essay questions identified common misconceptions. In addition, a post-course written evaluation was given to all students asking them to rate their learning gains using the LO technology. Results were similar to the first implementation in 2005: many students enjoyed using the LOs to access information about fuel-cell technology on their own time and at their own pace, but some still preferred the “human interaction” of having the material taught in class.

The internship experience overall was a success for everyone involved. Many students provided feedback that described how they enjoyed the LOs, the regular course
instructors saw the utility of the LOs and used them again in 2005 and encouraged their colleagues to do the same, and a new lab activity was introduced which can also be part of the unit in future courses. I gained experience in the two-year college setting and learned how to deal with various class sizes, lab activities, and student questions. I also learned how to develop lesson plans and adapt my teaching to variables in the classroom (like student participation, technological/computer issues, etc.) Finally, I gained plenty of feedback from students, the course instructors, and an outside observer (in 2004). I learned that it is very important to obtain feedback (both formative and summative) from students in order to really understand what they are learning from the instructor. I documented this feedback and will use it in future teaching experiences to improve my methods.

For more information on the learning objects and laboratory exercises please contact me or refer to:

- [http://ceret.us/l_objects.htm](http://ceret.us/l_objects.htm) (suite of renewable energy learning objects)
- “Measuring Student Learning From a Multimedia Learning Object”, M.J. D’Amato and K.A. Walz (in review, *College Teaching*).

Below is a copy of the pre and post-quiz assessment tool used in April and May 2005 at MATC in two chemistry courses to evaluate student learning from the “Heart of a Fuel Cell” learning object. The pre-quiz consists only of the 9 multiple choice questions. The post-quiz includes an additional four open-ended, essay-style questions.

**Pre/Post-Quiz:**

The purpose of a catalyst in a PEM fuel cell is to: (check all that apply)

**Answer**

- create a more exothermic reaction (increase delta H)
- increase the rate of reaction between O2 gas, H+ ions, and electrons
- provide energy to get the reaction started
- act as enzymes to change the shape of the substrate
- facilitate the production of water by lowering the activation energy (E_a)

What element is commonly used as the catalyst in proton exchange membrane (PEM) fuel cells?

**Answer**

- gold
- silver
- platinum
- iridium

What material is used as a support to make the catalyst in PEM fuel cells more efficient?

**Answer**

- platinum
- carbon
- aluminum
What is one way researchers are trying to reduce the cost of catalysts in PEM fuel cells?

**Answer**
- Replace the catalyst with another metal
- Lower the heat of reaction (ΔH) for hydrogen and oxygen to form water
- Use many nanoparticles of catalyst rather than a solid plate.
- Raise the operating temperature to increase the rate of reactions

Water can reduce the performance of PEM fuel cells because it

**Answer**
- is a product of the reaction and accumulates on the catalyst in excess over time.
- dissolves the catalyst material.
- absorbs heat, cooling the catalyst and making it less efficient.
- prevents CO from being oxidized.

Which of the materials listed below contaminate fuel cells by accumulating on the catalyst surface and limiting performance?

**Answer**
- Water and CO
- CO and CO₂
- Sulfur and platinum
- Water and CO₂

Which of the following is NOT a technological problem for fuel cell durability?

**Answer**
- Fuel cell membranes develop holes over time, reducing the performance of the system.
- Catalysts and other metal components can corrode over time, limiting their performance.
- There are few ways to test long-term properties of fuel cells.
- Fuel cells must withstand thousands of hours of operating time and crash impacts.
- Delivering oxygen and hydrogen in appropriate amounts to the fuel cell membrane assembly has not been achieved.

**Question** The Earth's atmosphere is composed of about 21% Oxygen, 78% Nitrogen, and several other trace gasses. Included in the trace components are small amounts of various gaseous hydrocarbons (such as methane, CH₄, and other carbon-containing molecules). Would CO contamination be a problem if a fuel cell ran exclusively on pure hydrogen fuel (rather than methanol, for example)?

**Answer**
- Yes, CO contamination would still result due to breakdown of the carbon support.
- Yes, CO contamination can result due to impurities in the air supply for the fuel.
- No, pure H₂ fuel is very exothermic. Any CO will be combusted by the fuel cell.
- No, CO cannot form if carbon is not present in the hydrogen supply.
- No, CO contamination would not matter because fuel cells cannot run on pure H₂.

**Question** Catalysts in PEM fuel cells reduce the energy required for oxygen and hydrogen to form water. Which of the following reaction coordinate diagrams best illustrates the presence of a catalyst (dashed line) in an otherwise non-catalyzed reaction (solid line)?

(correct answer is first picture)
ESSAY QUESTIONS (post-quiz only):

**Question** Ken, a very scientific baker, wants to make some super-sugar cookies for an upcoming dinner party. Each cookie is to be coated entirely (top, bottom, and sides -- hence the name "super-sugar cookie") with a thin layer of sugar so it will taste very sweet. If Ken is running low on sugar and doesn't want to go to the store to buy more, which size cookie should he make to conserve sugar: one giant sugar cookie, or ten small sugar cookies made from the same amount of dough? Explain the reasoning behind your answer. What does this problem illustrate about PEM fuel cells?

![Image](image1)

**Question** Catalysts in biology are called enzymes. Lactase, for example, is an enzyme that helps break down lactose sugar (milk sugar) as in the schematic drawing below. Some people are lactose-intolerant so they must avoid normal dairy products because they do not have the ability (enzyme) to break down normal amounts of lactose. The food industry has responded to this by creating some lactose-free dairy products. Large volumes of milk can be treated with the enzyme and lactose can be broken down before packaging.

How is the work of the catalyst in fuel cells similar to that of lactase? How is it different?
**Question** Microelectromechanical systems (MEMS) are very small machines (micrometers in size, see picture below as an example) that can be actuated by electrical pulses. They can be gears, cantilevers, or other mechanical devices and are used in applications such as air bag deployment sensors in automobiles and as digital micromirror devices in projectors. A major problem with some MEMS is that the components (gears, cantilevers, etc.) stick to each other and, once stuck, cannot be moved due to strong surface forces.

Part I. Would making MEMS devices smaller solve this problem? (There are such things as nanoelectromechanical systems (NEMS) being developed.) Why or why not? What else might you want to consider if you are trying to build a NEMS device?

Part II. In order to provide energy to operate MEMS devices a very small power supply is required. You are a R&D scientist for a nanotech company and have been asked to lead a team of technical experts to create microscopic "fuel cells on a chip" to serve this purpose. What are some of the engineering or design issues that you will have to overcome? What type of resources would you need to meet this challenge? What type of individuals would you recruit to help you on your engineering team?

**Question** Nafion, manufactured by DuPont, is the most commonly used membrane material in PEM fuel cells. It is a hydrophobic polymer with the chemical structure shown below.

Part I: What aspect of the molecular structure allows this membrane to exchange protons in a fuel cell? Describe how you think protons can be exchanged through the membrane in an aqueous environment.

Part II: Because of the high cost of the Nafion membrane, many companies are racing to design other alternatives. You are a polymer chemist working for a major fuel cell manufacturer and have been asked to lead a group to create a new membrane. Besides cost and hydrophobicity, what other characteristics are important for the new membrane? How would you measure the performance of your material versus Nafion? Can you describe one or two key sets of experiments that would allow you to determine if your membrane was a superior design?
Internship Peer Observation: Letter from Don Gillian-Daniel, Internship Program Coordinator, after observing my teaching in a chemistry class at MATC

The following is a teaching evaluation of Matt D’Amato for a lecture that he delivered at the Downtown Madison Area Technical College (MATC) campus on Thursday 12/8/04. This was the final class period of the week. In earlier lectures students learned about electrochemical cells/batteries and the basics of hydrogen fuel cells. This group of students also had a laboratory exercise where they made a basic fuel cell and subsequently measured the potential and current. Matt described the lab to me before class began. Students were to have used Matt’s fuel cell learning object outside of class (designing the learning object was Matt’s internship project). The course final exam is next week, so this class serves as a review of the week’s material.

Matt began the class with a post-quiz to assess changes in student understanding of concepts as a result of his teaching. Instead of making this a timed activity, Matt took his cues from when the students appeared to complete the quiz. He also assumed that the students had looked at the learning object prior to this class – from student self-reporting it was not clear that many had done so. After giving an overview of the planned day’s activities, Matt went through the quiz questions to be sure students knew the correct answers. Matt effectively engaged students in the class, calling on some by name, even after less than a week together. Matt had a nice approach to many of the questions—he drew connections between the questions and additional fuel cell topics, he linked questions to concepts in the fuel cell lab activities, and he connected the conversation to other resources students had used during the week (e.g. table of reduction potentials). Although he stopped as soon as a student supplied the correct answer for some questions, Matt did ask for additional suggestions for other questions. This seemed a good way to explore potential student misconceptions. Finally, there were several synthesis/application questions on the quiz that Matt wrote which very effectively asked students to apply their understanding of topics like catalysts and surface area in new contexts.

Matt led a more detailed discussion about the idea of surface to volume ratio—a concept from the learning object that students did not understand. Matt seemed to not understand the questions being asked by one student and input from the regular course instructor was helpful. This would have been a good opportunity for Matt to check in with other students on their understanding (misunderstanding) of a difficult concept.

The remaining class time was structured as small group discussion of topics—a review of the week’s material. The structuring of groups and description of the assignment seemed to take time and could have been more thoroughly prepared in advance. This is particularly important as class time was running short. I participated in a group with two students. One student and I spent some of our time working with the other to clarify a misunderstanding about catalysts. This was an engaging discussion and the lead student had a clear understanding of the topic and was obviously interested in seeing her peer work to a similar understanding. Both students had a clear understanding of the fuel cell lab activity that were to describe (along with the corresponding components in PEM fuel cells).
I liked how Matt built on student answers as he led the discussion during this part of class. For example, in talking about which of three solvents was the preferred fuel type in the lab activity, Matt elaborated by describing the chemistry behind the different fuel types. There were clear connections made between this question and the one my group addressed (the correspondence between components in a PEM fuel cell and the fuel cell made in lab). Matt could have used a question like the one given to our group to scaffold the review for the class, so students would have a common experience (lab activity) to build on as they worked to understand how all of the lecture material fit together. Matt and I ended our debriefing with a discussion of IRB approval and how to publish his internship experiences. I was happy to hear him revisiting the question guiding his project to encompass how one would incorporate a new unit (including learning object) into an existing course.

Matt and I met to talk about his in-class experiences the following week. I asked Matt a series of questions, including the following: 1) How well did it go (the class I observed and the week as a whole)?; 2) What did he hope to accomplish during the week (learning goals for students)?; 3) What can he take from this experience and apply the next time he teaches?; 4) How did he attempt to create an inclusive classroom?; 5) Did he use learning communities?; 6) What changes would he make to his instruction if he planned to teach the material again?

My question about creating an inclusive classroom brought to light an area I feel challenged Matt the most. This came through in several instances—for example, Matt’s consistent use of inclusive language. Several times throughout the class period that I observed Matt made the following type of statement: “I’ll be around to help you guys.” However, the class was an equitable mix of men and women. This also played out in our debriefing discussion. Matt articulated how his approach to teaching about fuel cells was inclusive for different types of learners. However, when asked for more on the topic, Matt commented that the students in his classroom were not all that diverse. A goal of Delta is to have interns like Matt recognize the richness of backgrounds and experiences students have and to think about using this to enrich and enhance learning for all students. One approach that might have worked in Matt’s situation would have been to ask students questions to gauge their prior knowledge about and interest in fuel cells before the lesson. Matt could have then worked individual interest and knowledge into the lesson.

It was very rewarding for me to observe Matt in the classroom, particularly after following the development of the fuel cell learning object. Matt had a natural presence as an instructor. For example, he had clearly established a rapport with the students, even in a brief period of time. His careful attention to integrating topics, with an emphasis on fostering student understanding, was apparent. As mentioned above, the largest area for improvement I observed (from the Delta Internship Program perspective) dealt with creating a truly inclusive classroom. This is a challenging aspect of teaching even for expert instructors and I imagine with Matt’s interest in teaching he will successfully work to improve this.

Don Gillan-Daniel, Ph.D.
Delta Internship Program

4 January 2005
Ways of Knowing Biology” Research Explorations:
Self-Evaluation and Assessment as a Teaching and Learning Experience
(Dated: April 15, 2004)

I was the host of two “research explorations” for freshman undergraduates in a biology course called “Ways of Knowing Biology”. The explorations are intended to expose college students who have not yet committed themselves to studying biology to the variety of research projects on the UW-Madison campus. Much of my graduate work involved studying viruses using tools from physics so I offered to host a tour of the facilities and demonstrate the primary instrument that I worked with. The explorations were offered twice, once each in February and March, 2004. They consisted of a tour for six students through two labs. In the first lab I explained how an atomic force microscope works and showed them how it is used to study surfaces. In the second lab I showed everyone how to perform a cell passage (with their own cells, a fully hands-on demonstration) and explained how cells are used to study viruses.

Below is a reflection on the comments and assessment I received using the “Student Assessment of Learning Gains” (SALGains) instrument available through the Wisconsin Center for Education Research. It is a brief, web-based questionnaire used to obtain feedback from students anonymously. The SALGains instrument was modified for this workshop in order to assess how much the students felt they gained an understanding of atomic force microscopy and virus research. I used three methods to convey information: my lecturing, a hands-on demonstration, and a hand-out packet students could take with them describing the techniques in writing and with pictures. (See Appendix for the complete SALGains questions used in this exploration.) Some comments from the SALGains evaluation are included as well as some forwarded to me by the course project assistant from a separate evaluation implemented by the course director.

February Data Summary:

Four of six students completed the SALGains instrument. My lecturing provided the most help for student learning (5 rating). Hands-on activities (the AFM demo and cell passage) facilitated student learning with an average rating of 4.5. The hand-out packet was the least helpful, but still obtained a 4.0 rating.

Students learned “a lot” (4 rating) about how the AFM is used and the infectious cycle of viruses and how cells are used to study viruses. An average rating of 4.12 was given by students when asked how much their learning would be remembered and carried on to other classes and aspects of life.

The lowest-rated question regarded the students’ understanding of the material as it relates to real-world issues (3.5). Evidently, I need to explain more clearly and give more examples of why people should care about AFM and viruses and how the research I am involved in can be useful for solving real-world problems. This sentiment was echoed in the students’ assessments given to me by the course project assistant.
From the data collected, it is clear that the February workshop was an overall success (students made significant learning gains). However, I aim to improve student learning for the March workshop in several ways. Since the AFM demo was not working well, I will spend more time making sure it is working before the students arrive for the workshop. I think obtaining a real-time image of a calibration grating is useful especially when students themselves can zoom to various parts of the sample. I will talk more about the information in the handout, so it may be more useful to students when they leave, especially regarding the references that I included for further reading. In addition, I will be sure to emphasize the range of applications of AFM work, especially on how we could learn about viruses.

Students’ comments (February):

“My graduate student was very enthusiastic and this helped a great deal. He also got us involved which made it even better. This was not one of my choices, and yet it was very enjoyable.”

“Matt was very enthusiastic about the research he was doing. He made the atmosphere very laid back, and made it very easy to ask him questions. Matt also did not talk down to us, which I think really made a huge difference.”

“I think the only improvement would be to make sure to explain the significance of the experiment in the real world scope. I found it very difficult to make the connection.”

March Data Summary:

Two of six students responded to the SALGains instrument. A different AFM was displayed (because the original one was not available) so it was operating well when the students arrived, performing a real-time scan on a simple substrate I use in my research. From the little feedback on the SALGains instrument, I received a rating of 2 and 4 on the question of understanding the relevance of this research to real-world issues. Though I provided a few more examples in my lecture of how the AFM research helps us understand viruses in real life, I still did not clearly make the connection for all students.

Students’ comments (March):

“Matt -- you seem very knowledgeable of this material. I appreciate your time and effort to making it a learning experience for us all.”

“It would have been fun to see the atomic force microscope scan some actual virus particles, though.”

“I liked learning about what he did and just getting to look around in his lab. I had never been in either the engineering building or the vet building so it was fun to go someplace new. We got to do a hands-on exercise, so that was a good time, and Matt was really nice.”
“Once again, Matt was really open to allowing people to ask questions, and went out of his way to try to get people to do so.”

Summary and Conclusions

The two research explorations were lots of fun to host – I would definitely be open to doing it again. With better samples, I could probably make the AFM demonstration a little more exciting – I felt it did not go as I anticipated. Overall, the demonstrations were successful, the majority of the students enjoyed the demonstrations and hands-on activities – the overwhelming opinion was very positive from the students’ comments. Several of the student comments focused on how I was trying to create a learning community by allowing the students to ask questions and bring their own ideas into the discussion. This was my first experience in actively trying to create an effective learning community and, from student comments, I feel that I was moderately successful.

Appendix: Student Assessment of Learning Gains Instrument Questions

Q1: How much did each of the following aspects of the class help your learning?
   A. The way in which the material was approached
   B. The class activities
      1. AFM demonstration and seeing the components up close
      2. Cell passage
      3. Handout/Take-home packet
      4. My lecturing

Q2: As a result of your work in this class, how well do you think that you now understand each of the following?
   A. What AFM is and how it can be used to study biology
   B. The infectious cycle of viruses and how we can use cell cultures to study viruses

Q4: To what extent did you make gains in any of the following as a result of what you did in this class?
   A. Understanding the main concepts
   B. Understanding how ideas in this class relate to those in other science classes
   C. Understanding the relevance of this field to real world issues
   D. Appreciating this field
   E. Enthusiasm for subject

Q5: How much of the following do you think you will remember and carry with you into other classes or aspects of your life?
   A. Understanding of viruses and their environment
   B. Use of atomic force microscopy to study materials

Q6: [space for extra written comments]
SCALE Partnership K-12 Science Curriculum Development
(Dated: September 26, 2005)

SCALE (System-wide Change for All Learners and Educators) is a partnership committed to developing a new approach to K-12 science and math education in the U.S. A 5-year program funded by the National Science Foundation, SCALE brings together science education researchers, K-12 teachers and administrators from four metropolitan areas across the country, and science, technology, engineering, and math faculty, experts in science content. As a volunteer content advisor for a new 4th grade curriculum unit on electricity and magnetism, I worked with the lead curriculum writer and Madison Metropolitan School District personnel during the winter and spring of 2004-5 to make sure the science content was accurate and understandable for the students, teachers, and administrators. (My contributions to the project are acknowledged by the Madison school district in a letter on the next page.)

This was one of my favorite science outreach projects as a graduate student. I gained experience in communicating difficult scientific concepts to a broad audience. My primary responsibility was to make sure that the fundamentals of electricity and magnetism were being accurately explored by 4th graders in various activities. The curriculum unit was focused on helping the students make connections between the two phenomena, which are often taught independently and with little or no regard to the fact that they are intimately related. I worked closely with the lead curriculum writer and facilitated a lesson on content as it related to the new unit during a one-day professional development workshop for Madison teachers (April 2005).

At the workshop, I learned more about how to create a learning community among teachers (who were my students in this case) by involving the participants in my lesson. When planning the workshop, I and the other facilitators designed periods of time when small groups of participants would work together while we circulated among the groups to encourage peer learning, push participants for accurate content understanding, be available for answering participants’ questions, and informally assess participant learning. In practice, this plan promoted a learning community of teachers who told us they wanted to stay in touch with each other as they began teaching the material in their classrooms.

The other facilitators and I obtained formative and summative feedback about the workshop and were able to identify misconceptions in content and practices in our teaching, which we addressed in a 3-day workshop in June 2005.

The experience working with SCALE helped me to improve my communication skills for science at an elementary level (which is a valuable experience even for science education at other levels). I also learned how K-12 science education can have a broad impact on the future of science and engineering. Participating in the SCALE project is a great example of what keeps me motivated to continue working in science education. In addition, this experience was the first experience which allowed me to bring together all of the ideas learned through the Delta Program (TAR, learning community, and diversity). I actively thought about how the three pillars of the Delta Program could be used in building the unit and the professional development workshops. I shared my ideas.
with the curriculum writer and administrators and the final result was a product where active learning is taking place in 4th grade classrooms (and learning goals are being achieved). I know this because I am now a full-time employee for SCALE and have been able to observe teachers and students using this unit in the classroom. Thus, I am already using the principles of TAR, learning community, and diversity in my first full-time job.
March 18, 2005

Matthew James D’Amato
5029 Sheboygan Avenue, #310
Madison, WI 53705

Dear Matthew

Please accept our sincere appreciation for your contributions of time and expertise in support of the Madison Metropolitan School District (MMSD) professional development on magnetism and electricity. Through your work with district staff, teachers and UW-SCALE immersion developers, you have greatly enriched the quality and accessibility of the science content knowledge of the connections among magnetism and electricity. The collaborative manner in which you offered your services speaks volumes about your sense of purpose and dedication to science as a way of understanding the world and to science education.

A rigorous and sound science education is critical for all children. The world of the future will demand an increasing sophisticated knowledge of scientific principles and applications. MMSD’s vision is to be a district where all students have the academic skills to become independent learners capable of making informed decisions. The primary role of Teaching and Learning—Science Division is to provide curricular materials that will enable students to grasp key ideas in science and provide the professional development for teachers to skillfully instruct using the curriculum. You have joined with our T&L Division in taking a major step towards making our 4th grade physical science curricula both more rigorous and engaging by sharing your wealth of knowledge of electricity, magnetism and engineering with us.

Both Anne and I are deeply impressed with your willingness to give of your time to meet with us prior to the professional development in order to discuss the needs of elementary science teachers so that you could better meet those needs in your contributions. This type of K-12 and higher education collaboration is exemplary in that it models an honest dialogue about very real needs while respecting the expertise of K-12 teachers. MMSD has a long history of effective partnerships with the UW-Madison science community. We are so pleased that you have made your mark in this tradition.

We look forward to working with you again in April when we jointly hold the district-wide professional development with our 4th grade teachers. You will be able to experience for yourself the excitement and enthusiasm of our teachers when they are engaged in inquiry learning for themselves in order to improve their teaching. Additionally, we are convinced you will be proud to be a part of the inspiration for them to teach science more effectively.

Your work with MMSD has certainly been in keeping with the “Wisconsin Idea” – to share and strengthen partnerships and collaboration. You have added your time, knowledge, and skills to extending the resources of the university in service to the children of Wisconsin. The result of your professionalism in our district will endure into the future through improved teacher science content knowledge. The teachers in turn will have greatly improved knowledge and skills to enhance student understanding and appreciation of science for years to come.

Sincerely,

Lisa A. Wachtel
Science Coordinator

Anne Schoenemann
Instructional Resource Teacher