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Introduction: My Philosophy of Teaching

"The whole of science is nothing more than a refinement of everyday thinking"
-Albert Einstein

understand |ˌʌndərˈstænd|

verb ( past and past part. -stood )
1 [ trans. ] perceive the intended meaning of (words, a language, or speaker)
• perceive the significance, explanation, or cause of (something)
• be sympathetically or knowledgeably aware of the character or nature of
• interpret or view (something) in a particular way

(Oxford American Dictionary)

Statement of Teaching Philosophy

What constitutes good teaching?

What distinguishes an extraordinary instructor from an ordinary instructor?

While there are as many different excellent teachers as there are personalities, I believe that the key to extraordinary instruction is the pursuit of understanding. Understanding is a complex idea, however, I believe that one of the underlying themes of understanding is a change in vision to include new awareness, perceptions of significances, and interpretations. The core of understanding is the creation of a new framework for viewing the world. True understanding changes how we make decisions and solve problems and provides the framework for further understanding. As a student in high school I experienced such a change in perception. I had had several classes where the mechanics of literary analysis were presented, always as a series of steps without motivation. However, it was not until one of my teachers presented the material in a completely different way that I finally understood. This teacher presented the process as an attempt to defend an idea through presenting evidence and explaining how that evidence supported your idea. As a young scientist this perspective made sense to me, and, for the first time I understood. Because this instructor sought ways to present the material so that students
could understand my appreciation for literature and the humanities has increased and I have learned to enjoy more of the world around me. Because of experiences like this, I have come to believe that extraordinary instruction involves a constant, conscious effort to seek out ways to change perception, and in so doing increase understanding.

With this in mind, effective teaching involves conscious effort to identify desired understandings, and a willingness to seek out ways to achieve them. Good teaching has clear, focused objectives, and materials and presentations should be designed to promote them. I have found that this process is most often evolutionary, rather than revolutionary. It is crucial to take advantage of current research on teaching and learning. Instruction benefits from multiple perspectives. As with scientific investigation, we achieve our objectives faster when we actively study the work of others in developing our own. Similarly, I believe part of excellent teaching results from active study of how the mind works and approaching teaching from the context of current theoretical frameworks about learning and understanding. For example, I approach learning from a constructivist perspective, that new understandings are best build upon prior understandings and therefore make a concerted effort to form connections between new and more familiar material in my teaching.

However, it is also true what works in theory is often more complex in practice. In this respect, the development of understanding is much like a living organism, which must be constantly monitored and evaluated to be successful. This continual assessment of teaching methods (i.e. teaching as research) allows for dynamic adjustment as we teach and provides direction for further development. I believe that assessment of teaching strategies and learning materials can be a very generative process. As frustrating as they may be, learning from past struggles improves us. A critical evaluation of past work can provide inspiration for ideas and provide needed focus for choosing future directions. In fact, some of my most productive and creative moments in teaching have come from assessing my past work, no matter how successful I felt it was. In this teaching portfolio I illustrate my attempts to put this process into action. I have worked to create learning materials and experiences whose goal is to forge and reinforce understanding that are thoughtfully planned, and, once implemented, I am continually working to determine their effectiveness and how they can be improved.
Student Presentations in Biophysical Chemistry

“For me, I’m hoping that a couple hundred years from now, people would no more say, ‘I’m not very good at math,’ than they would say, ‘I’m not very good at reasoning,’ . . . Because that’s all mathematics is; it’s reasoning.”
--Terry Millar

ARTIFACT ONE

In 2007 I participated in a Delta teaching internship where I assessed the effect of using students, instead of teaching assistants, to present problem solutions in the discussion sections of a biophysical chemistry class at the University of Wisconsin-Madison. I had taken the course my first semester as a graduate student and had served as a teaching assistant three times previously. As such, I had seen firsthand the frustration of many of the undergraduate students, who typically have a weaker background in the physical sciences than the graduate students, with learning the material presented in the course. My goal was not just to help them to improve their test scores, but also to have a better experience in the class and see the usefulness of quantitative problem solving in biochemistry. This first artifact includes a series of slides created to summarize the project design and results.
Using Group Presentations in Biophysical Chemistry

Melissa W. Anderson
Delta Internship Presentation

Biophysical Chemistry

• Required course for Biochemistry majors at UW-Madison
• Focuses on general thermodynamics and kinetics, emphasizing applications to biochemical problems
• Students have difficulty transferring understandings developed from the problems sets to the exams
Improving Understanding

- Understanding in the physical sciences requires “a strong understanding of physics concepts” and “a well-developed knowledge structure” (Redish & Steinberg, 1999)
- Cooperative group work has been shown to help in developing these skills (Beichner 2000; Kogut, 1997; Mills et al., 1999; Springer et al., 1999).

Question

Will adding student presentations to discussion sections improve problem-solving skills?
Methods of Assessment

- Maryland Physics Expectation Survey (MPEX)
  - Determines students expectations for learning physics (pre-assessment)
- Student Assessment of Learning Gains (SALG)
  - Determines how effective students perceive aspects of the class (post-assessment)
- Final Student Grades
  - Demonstration of subject mastery (pre-assessment)

MPEX Survey Results

- 565 Students have relatively inexpert expectations for learning physics
- Average expectations for effort expected and coherence of subject matter
- Lower expectations than all other samples for independence and math link

N = 53/122
Qualitative Observations

Students expected to work hard . . .

- Well prepared to present
- Spent many hours on problem sets

But, did not expect to be independent

- Most used the instructor’s answers to the problems, even if the solutions were confusing.
- Were quick to defer questions to the teaching assistant.

Final Grades

- Average grade for all sections and all years is 77 ± 5
- Grades do not depend strongly on choice of TA
- Student presentations had no substantial effect on grades

Melissa W. Anderson • email: mwanderson08@gmail.com
SALG Results

- Students view TA presentations as more helpful than student presentations
- But, students see informal study groups as more helpful than either presentation

N = 34/122
44% from 301
82% expect B or better

Conclusions

- Students do not perceive themselves as independent problem-solvers, resulted in poor quality presentations
- Group presentations not perceived as helpful; but informal group work was perceived as most helpful
- However, student presentations did not influence final grades

Melissa W. Anderson • email: mwanderson08@gmail.com
Future Directions

- What can be done to improve student’s independent problem-solving expectations and skills?
- Would improving student’s perceptions of their ability to be independent improve presentation quality and usefulness?

References

Teaching as Research

Developing and implementing the project taught me a great deal about the practical issues involved in educational research. Not only did I learn about the mechanics of educational research such as dealing with human subjects and IRB review, I also experienced working through some of the challenges of designing a successful experiment, particularly selling new ideas and methods to students. One of the most valuable aspects of this internship project was the information obtained from the Maryland Physics Expectations (MPEX) instrument, which gave me a new perspective on how to approach improving student understandings in quantitative problem solving. The fact that the students perceive themselves as much less independent than average physics students provides a possible explanation for the lackluster reception of the students to using group presentations. Because of this, I am currently working to develop and test ways to improve student’s perceptions of their own independence as a possible way to improve their aptitude for and attitude towards quantitative problem solving.

Learning Communities

As a part of this project, I found that little things, such as learning every student’s name by the second week of class, make a large difference in creating an inclusive atmosphere. I also discovered that, somewhat surprisingly, a sense of independence is an important part of forming a learning community. I had hoped that by having the students present, the barrier between the instructor and the students would be lowered. However, I think that because many of the students continued to perceive themselves as dependent, passive learners they were not able to learn from one another. Consistent with this, in the absence of an authority figure (e.g. informal study groups) the students appeared to learn from and teach one another much more successfully.

In contrast, participation in the Delta Internship Seminar, which included several students I had worked with in the past, was wonderful opportunity to experience a learning community of independent individuals who were also able to work together to support one another with advice regarding our various projects. I especially appreciated the chance to learn more about other problems students were working on, as well as how the graduate experience is both different and similar in other STEM programs.
Learning Through Diversity

Evaluating the project made me realize how differently I approach biophysical chemistry than the students, and how what is effective for me, is not always effective for the students. This experience has given me some ideas for how to adjust my instruction to address audiences with a different backgrounds and learning styles than myself. Additionally, the students in the discussion section were diverse both culturally as well as having a range of different attitudes and background in math and physics. My hope was that by encouraging them to work together and by having them present in groups they would take advantage of on another’s strengths. Since the students did not take the group presentations seriously, I could not tell if this would have been successful. However, I do believe that if the students had been more confident in their ability the diversity of the discussion section, as compared to the student informal study groups where the students tended to work with students of similar backgrounds, would have been a benefit to them. I intend to investigate if this is the case in future implementations of group work.
An Animation of Cellular Respiration

“[A]ll things are made of atoms, and . . . everything that living things do can be understood in terms of the jiggling and wiggling of atoms.”

–Richard Feynman, Lectures on Physics, vol. 1, p.3-6 (1963)

ARTIFACT TWO

My second artifact is a summative report for an animation I designed for Biology 151, a large introductory Biology class in the Spring of 2006, as well as a preliminary analysis of its effectiveness. This animation was my project for the Delta Instructional Material Design class. As part of the class, I worked on a team with a faculty partner and another graduate student to develop materials designed to address a weak spot in the instructor’s class. We worked to develop two different materials, a series of case studies and an animation. My primary focus was on developing an animation as a means to improve student understanding of the molecular and cellular aspects of cellular respiration. To create the animation I took classes in Flash and Illustrator offered by UW-Madison’s Software Training for Students service, and software skills I learned in these classes were not only helpful in creating this animation, but have also allowed me to use animations as an approach for developing other learning materials, such as the vodcasts in artifact four.
Features of Cellular Respiration Animation

Animation begins with a macroscopic perspective to invite connections between macro and microscopic views.

Glucose is shown entering the cell, to illustrate the connection between digestion and cellular respiration.

At the end of each step the end products are graphically summarized to assist in understanding the end products.

Since students are not expected to have a strong organic chemistry background, a simplified molecular notation is used to emphasize the general morphology of the molecules.

Reactions are shown in their cellular context to emphasize the role of the mitochondria in cellular respiration.

The macromolecules and role of the membrane in oxidative phosphorylation are specifically illustrated.

Figure 1: Design features of the cellular respiration animation

Teaching as Research

Teaching as Research was a major theme in the creation and implementation of this project. As a part of the Instructional Materials Design class, we were introduced to a number of resources for finding primary literature in education resource, which we used to look for specific...
misconceptions to address in developing our learning materials. In addition, I was fortunate enough to have my partners, Catherine Carlson and Nihal Ahmad use and assess this animation and the case study during the unit on cellular respiration in fall 2007 as part of a Delta internship project. Before the unit, students were given a multiple-choice pre-assessment, to test for prior content knowledge and expectations. The animation was shown at the beginning of the first day of lecture without annotation or narration and repeated at the end of the second day of the unit, this time with the major metabolic intermediates labeled. Stills from the animation were also used as part of a more traditional Power Point presentation. In addition to the animation, and traditional lecture, students were given a case study to discuss, the design and assessment of which are discussed in greater detail in (Carlson, 2008). At the conclusion of the two-lecture unit on cellular respiration, students were given a post-assessment to assess learning gains, as well as student perceptions of the learning materials. From an analysis of the assessment results, I realized on a more personal and practical level the advantage of linking your assessments to your objectives. The questions on the evaluation about the animation are rather general, in the future I would like to see more specific questions that are in line with my objectives in designing the material.

**Learning Communities**

Because the project was done as a team, the experience gave me some new insight into the role of group dynamics in team projects. In particular, each member of the team had a very different approach to developing solutions to the problem, and I think all of us wanted to get something a little different out of the experience. However, in spite of this, we were able to work together and, for the most part, take advantage of our individual strengths and weaknesses. Additionally, the IMD class, like all of my Delta classes, was a wonderful learning community, it was very refreshing to work with a group of people who were interested in teaching and willing to help and support one another in our goals. I especially benefited from the effort of the instructors to emphasize that the faculty and graduate students were expected to work as equal partners in the development of the learning materials, and in seeing the varying degrees to which each of the groups realized this ideal.
Learning Through Diversity

This project taught me about how diversity affects learning in two separate ways. First, as noted above, working with a diverse group of faculty and students helped me see some of the many different perspectives which exist regarding teaching and learning. Secondly, we designed our learning materials with the intent to address diverse learning styles. In this case, the animation was chosen because it seemed like a good way to address a large part of a diverse audience, many people are visual learners. Similarly, the animation provided both a global and a sequential overview of the process by showing the overall process as it moved through each step. Based on student comments, it does appear that we reached some of our target learning styles through this project.

<table>
<thead>
<tr>
<th>Table 1: Major Topics Addressed in Student Responses to the Question “Please tell us what you liked about the animation”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Response</strong></td>
</tr>
<tr>
<td>Animation was good for visual learning</td>
</tr>
<tr>
<td>Animation helped to</td>
</tr>
<tr>
<td>unify material</td>
</tr>
<tr>
<td>put material in a cellular perspective</td>
</tr>
</tbody>
</table>

a) Cellular perspective was defined as answers that specifically noted that the animation illustrated reactions in the context of their locations in the cell

<table>
<thead>
<tr>
<th>Table 2: Major Topics Addressed in Student Responses to the Question “Please tell us what needs improvement in the animation”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Response</strong></td>
</tr>
<tr>
<td>Animation was played too quickly</td>
</tr>
<tr>
<td>Labels for molecules would/did improve clarity of animation</td>
</tr>
<tr>
<td>Animation would be improved by accompanying verbal explanation</td>
</tr>
<tr>
<td>Animation was acceptable as shown</td>
</tr>
</tbody>
</table>
Table 2: Major Topics Addressed in Student Responses to the Question “Please tell us what needs improvement in the animation”

<table>
<thead>
<tr>
<th>Topic</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding would be improved by viewing animation after presentation of material</td>
<td>8%</td>
</tr>
<tr>
<td>Disliked simplified molecules</td>
<td>4%</td>
</tr>
</tbody>
</table>
Learning From Others

"If you think you have a new idea, it is wise to be sure that Linus Pauling did not publish it twenty years ago"

-Anonymous

ARTIFACT THREE

This summer I had the opportunity to teach Chem 325, which is a Survey of Biochemistry class for nonmajors. In teaching this class I took the opportunity to improve a lot of the methods I had used the previous semester in Chem 407 (see artifact five). In addition, I learned a great deal from the suggestions and course notes of Dr. Sandra Grunwald, who has been teaching the course for the past ten years. Although I was able to apply many of the things that I had previously learned, I think was defined this class was the opportunity to build on the work of someone with more experience than I have. Although I had had the opportunity to learn and share with others during my Delta classes, it was a very different experience to have specific ideas about my class than had been tested and improved with time. Based on the student comments (see table 1), the students also appreciated these features of the class. I especially appreciate the suggestion to print out pictures from the lecture, as a non-visual learner that would not have immediately occurred to me, illustrating the advantage of diverse views in teaching. I intend to in class problems and lecture summaries in future classes.

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Table 1: Student responses to which learning methods were meaningful or enhanced learning on end of class evaluations for Chem 325 Summer 2008

<table>
<thead>
<tr>
<th>Method</th>
<th>% Students Mentioning Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packets of lecture outline and figures</td>
<td>54%</td>
</tr>
<tr>
<td>In class problems done by students</td>
<td>38%</td>
</tr>
<tr>
<td>Instructor Enthusiasm</td>
<td>23%</td>
</tr>
<tr>
<td>Suggested Book Problems</td>
<td>15%</td>
</tr>
<tr>
<td>Instructor Office Hours</td>
<td>15%</td>
</tr>
<tr>
<td>Instructor’s Use of Analogies</td>
<td>15%</td>
</tr>
</tbody>
</table>

*Items in bold were suggested by Dr. Grunwald*
Vodcasts for Introductory Chemistry Laboratories

"In science there is only physics; all the rest is stamp collecting."

-Ernest Rutherford

ARTIFACT FOUR

Artifact three illustrates some of the preliminary design work for some new learning materials I am developing for general chemistry laboratories. Laboratories, particularly in introductory classes, often discourage thinking about the material because the instructions are written out line-by-line. My goal is to develop materials that help students think more critically about the experiments, and their analysis of the resulting data. My previous experience with students has shown me that students, pressed for time, will typically take the viewpoint that the lab can be done without thinking and will miss a valuable opportunity to learn about quantitative and qualitative analysis of experiments. As a first attempt to increase critical reflection, I’ve decided to try using a short videopod cast to be viewed before lecture, in conjunction with a short pre-assessment before each lab and student discussion at the start of class to provide structure for critical thinking.

Teaching as Research

I am using some of the ideas I have found from my previous projects to inform the development of this project. As seen in artifact two, students seem to respond well to visual aids, such as animation. The results of the MPEX survey on senior-level biochemistry students indicate a lack of confidence in their independent problem-solving skills, something that may have resulted from previous experiences in classes such as general chemistry. As chemistry is a very abstract topic, I am hoping that by illustrating the visual components and showing how they link to the concepts and how the concepts are described by the math will give students the perspective they need to improve understanding. In addition, the project incorporates ideas I
have collected from my own study of the literature, and is particularly influenced by the work
done on physics problem solving. Use of these learning materials will include assessment of their
effectiveness, since I have seen how a consciously designed assessment is a crucial part of
determining the effect of learning materials.

Learning Communities

Community plays several roles in this project, to help encourage the students to reflect
on their laboratory experience, I plan to use the animations as a spring board to class discussion.
By requiring the students to view the animation and complete pre-assessment before class
students will be better prepared to participate in discussion as a part of the laboratory class,
rather than being passive participants in a pre-lab lecture. Also, in developing this project, I am
grateful to my colleague Kate Friesen, who has allowed me to observe one of her general
chemistry laboratory sections as I develop ideas and materials for next semester. It has been a
very valuable experience to observe another instructor presenting the same materials and to have
the opportunity to ask questions and get advice about the class.

Learning Through Diversity

In developing this project I have sought to address a diverse group by presenting the
material in multiple ways. Specifically, in addition to the traditional homework questions and lab
overview given in the manual, the course will include visual and audio as well as motion
components from the animation. Students will be expected to participate in a pre-lab discussion,
which I feel will allow the expression of different perspectives regarding the material. Part of the
assessment of this project will involve determining how effective these new materials are at
reaching a diverse student audience.
Table 1: The Four Major Parts of Each Vodcast

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem</td>
<td>Presents each laboratory as a problem or set of problems to be solved</td>
</tr>
<tr>
<td>Plan</td>
<td>Outlines the reasoning process for the methods used in the laboratory, emphasizing the rational design of experiments. The plan is always summarized as a visual flowchart.</td>
</tr>
<tr>
<td>Process</td>
<td>Illustrates important understandings involved in the lab, emphasizes the role of assumptions and potential sources of error in each experiment</td>
</tr>
<tr>
<td>Summary</td>
<td>Repeats the presentation of the plan flowchart and succinctly states the understandings discussed in the process section.</td>
</tr>
</tbody>
</table>

Problem

Determine the identity of three samples

Figure 1: Sample frame from Problem Section
Plan

\[
\text{Density} = \frac{\text{Mass}}{\text{Volume}}
\]

- Wood Block
  - Dimensions \( \rightarrow \) Volume
  - Volume = length \( \times \) height \( \times \) width

- Plastic Cylinder
  - Dimensions \( \rightarrow \) Volume
  - Volume = \((1/2)\pi \times \text{radius}^2 \times \text{length}\)

- Irregular Metal
  - Dimensions \( \rightarrow \) Volume

\[\text{Lesson \#3: Always know where the equation you are using came from!}\]

Process

#3: How close is my model to reality?

- What is true for a solid...
  - Volume = \(N_A \times d^3 \times 1.356\)

- May not be for a gas
  - Volume \(\neq N_A \times d^3 \times 1.356\)

Figure 2: Sample frame from Plan Section

Figure 3: Sample frame from Process Section
Summary
As you do this lab remember...

1. How accurate is my measurement?
2. How close is my sample to what I think I’m measuring?

Figure 4: Sample frame from Section
Designing for Understanding

“What we need are notions, not notations.”

-Gauss

ARTIFACT FIVE

In the Spring semester of 2008, I had the opportunity to teach a Biophysical chemistry class to senior and junior level Biochemistry majors at UW-La Crosse. While I enjoyed working with the students and presenting course material, I found that I was not as successful in helping the students to understand and enjoy the material as I would have like. As such, I have started to re-design the course for future semesters with the intent of strengthening some of its weaknesses.

Teaching as Research

The design of this course relies heavily on the understandings I have developed as a result of both study of the available literature and the results found from my past assessments. For example, in Table 1 I list two of the key issues that need to be addressed based on my previous experience with the course. Below each issue, I have listed methods that I believe will address these issues. One of the most useful tools in making my lectures more clear was the use of the methods described in Understanding by Design by Wiggins & McTighe, which emphasizes the use of clear unifying themes to improve understanding. Table two summarizes the major understandings I plan to emphasize for each unit in the course. I have reorganized the content around three unifying problems, each of which is discussed in the context of the unit’s unifying understandings. Using concrete examples should help students see the application of the major understandings of each unit. To address student’s difficulty with homework problems I have devoted a great deal of time to researching what is known about how students learn to solve quantitative problems. My past experience has shown me that biochemistry students often lack confidence in their own ability to solve quantitative problems (see artifact 1). As such, I have applied many of the principles found in physics education literature to the continued development of this class, and, as seen in Table 2, have introduced a new section of the class that
focuses on the methods of problem solving. My intent with this section is to help students develop greater independence in problem solving and to give them a more robust framework for solving problems.

**Learning Communities**

One of my goals with this course is to create a learning community. The small class size and shared major of the students provides an excellent opportunity for students to form connections with other students with similar interests. Both a survey of the literature and my own experience in teaching biophysical chemistry have shown me that student study groups can become a powerful tool for building learning communities. Thus, as part of the course I will continue to put the students in groups to work together on assignments. Unlike my internship, however, I plan to use the groups to perform assignments without providing written answers. Similarly, I feel strongly that individual interactions between the students and the instructor can be a very effective method for demonstrating problem solving skills if the emphasis is place on helping the student learn to work independently. My goal is to emphasize to the students my role in a coaching, rather than demonstrating problem solving so that they can be active, self-motivated participants in learning and teaching one another.

**Learning Through Diversity**

The redesign will also involve a more diverse approach to the material. I plan to have more visual demonstrations, and to implement some of the methods used in Chem 325 (see artifact five), which the students indicated were helpful in learning. The assessments in the class will also be more diverse, including developing posters, presentations and short papers to supplement the traditional problem sets and examinations. Many of the major assessments will require the students to work together in small groups, as a part of this I plan to use the group assignments as a way for the students to incorporate their own interests into the project (such as in choosing topics for projects) as well as a means to benefit from different perspectives. Also, as I teach the course, I plan to collect student input regarding the things that they find interesting and the careers they would like to pursue, learning more about the goals of the individuals in the class will help me to chose examples that they find interesting and relevant.
<table>
<thead>
<tr>
<th>Table 1: Problems in Biophysical Chemistry Course and Proposed Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Students had difficulty seeing the connections in lecture, felt that lectures were disorganized</td>
</tr>
<tr>
<td>Proposed Solutions</td>
</tr>
<tr>
<td>• Provide students with additional materials to study as a supplement to the lecture notes</td>
</tr>
<tr>
<td>• Provide students with 2–3 clear and succinct unifying ideas per unit</td>
</tr>
<tr>
<td>• Emphasize connections to unifying ideas in lectures and assignments</td>
</tr>
<tr>
<td>II. Students couldn’t see meaning in mathematically based problem sets</td>
</tr>
<tr>
<td>Proposed Solutions</td>
</tr>
<tr>
<td>• Teach students about the importance of metacognition and the use of strategy in problem solving</td>
</tr>
<tr>
<td>• Clearly outline my expectations for how students should approach problem sets</td>
</tr>
<tr>
<td>• Introduce more written interpretation in problems sets</td>
</tr>
</tbody>
</table>
**Table 2: Summary of Units and Corresponding Key Understandings for Revised Biophysical Chemistry Course**

## I. Introduction to Quantitative Problem Solving

Students will learn to think critically about how they solve problems. They will learn how to identify when they are using effective and ineffective problem solving strategies.

<table>
<thead>
<tr>
<th>Key Understandings</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Learning how to solve problems involves making connections between things you already know, some strategies are more effective than others at doing this.</td>
</tr>
<tr>
<td></td>
<td>• Just like other activities, we learn problems solving best when we combine lots of practice with conscious reflection about past performance.</td>
</tr>
</tbody>
</table>

## II. Biological Energetics: Membrane Proteins

The example of moving small molecules and ions across a membrane will be used to demonstrate how the principles of thermodynamics determine the molecular behavior of living systems.

<table>
<thead>
<tr>
<th>Key Understandings</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• The behavior of living systems is governed by the laws of thermodynamics, and this behavior (function) is intimately related to structure</td>
</tr>
<tr>
<td></td>
<td>• Models that use state functions and variables to describe systems are a powerful tool for understanding and predicting behavior and understanding and predicting structure</td>
</tr>
</tbody>
</table>
### III. Equilibrium Phenomena: Hemoglobin

This unit explores the relationship between chemical equilibrium and thermodynamic driving forces using hemoglobin as a classical example.

<table>
<thead>
<tr>
<th>Key Understandings</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Chemical equilibrium concentrations are the result of balancing between different energetic driving forces, changes in the energetics cause shifts in the equilibrium concentrations.</td>
<td></td>
</tr>
<tr>
<td>• We can combine our content and mathematical knowledge to construct models that let us investigate the relationship between driving forces and equilibrium concentrations.</td>
<td></td>
</tr>
</tbody>
</table>
Melissa W. Anderson
1104 Streblow St., Onalaska, WI 54650
Phone: (608)-783-0971  E-mail: mwanderson08@gmail.com
CURRICULUM VITAE

OBJECTIVE

Employment in a tenure-track chemistry or biochemistry position

EDUCATION

May 2008  Ph.D. in Biophysics: University of Wisconsin-Madison
           GPA: 3.85
           Advisor: M. Thomas Record Jr.

           Thesis Title: Thermodynamics of the Unfolding of a 12 Base Pair DNA
                         Duplex and the Interaction of the LacI-DNA Binding Domain with Weak
                         and Strong Operator DNA

April 2002  B.S. in Biochemistry: Brigham Young University
           April 2002
           Minor in Mathematics
           GPA: 3.61

HONORS AND SCHOLARSHIPS

2004-2006  NIH Molecular Biophysics Training Grant Recipient:
2001      Kenneth W. Brighton Chemistry Scholarship:
1999, 2000 Ida Tanner Hamblin Chemistry Scholarship:
2001      Golden Key Honour Society:

TEACHING INTERESTS AND EXPERIENCE

Interests

General Chemistry, Physical Chemistry, Biophysical Chemistry, and Biochemistry

Experience

Jan 2008-present  Associate Lecturer

University of Wisconsin-La Crosse, La Crosse, WI

Chemistry and Biochemistry Laboratory Instructor (present)
  ▪ Present weekly lecture on lab materials
- Develop quizzes and other assignments
- Meet with students during regular office hours

Survey of Biochemistry Instructor (Summer 2008)
- Survey class for nonmajors
- Presented 4 lectures/week
- Met with students during regular office hours

Biophysical Chemistry Instructor (Spring 2008)
- Taught primarily biochemistry majors
- Presented 2 lectures/week
- Met with students during regular office hours and optional discussion section
- Developed entire curriculum for course

Fall 2007  Delta Teaching Internship
University of Wisconsin-Madison, Madison, WI
- Worked in partnership with a faculty partner to improve student instruction in biophysical chemistry through the use of group presentations.

2003-2004, 2006-2007 Teaching Assistant, Biophysical Chemistry,
University of Wisconsin-Madison, Madison, WI
- Course held during fall semester of each year
- Primarily undergraduate biochemistry majors
- Ran 1-2 weekly discussion sections
- Met with students during weekly office hours
- Proctored and graded exams

Summer 2007 Teaching Assistant, Physical Chemistry Laboratory (Chem 567)
University of Wisconsin-Madison, Madison, WI
- Supervised laboratory experiments
- Held oral examinations
- Graded written laboratory reports (2-5 pages each)

Spring 2007  Tutor, Greater University Tutoring Service
University of Wisconsin-Madison, Madison, WI
- Tutored an undergraduate student in introductory biochemistry.
2005-2007  Participant, Delta Program  
University of Wisconsin-Madison, Madison, WI  
• Program designed to improve university instructors  
• Internship project and seminar  
• Coursework in education theories and practice (2 semesters)  
• Participation in a learning community (1 semester)  
• Additional periodic seminars and discussions.

2003-2005  Research Mentor for Undergraduate Students  
University of Wisconsin Madison, Madison, WI  
• Instructed students in use of laboratory equipment and methods  
• Taught students scientific principles and questions involved in projects  
• Read and commented on student manuscripts

1999-2002  Teaching Assistant, BYU Math Lab,  
Brigham Young University, Provo, UT  
• Assisted students with math questions in a drop-in lab environment for college algebra, geometry, calculus I-III, linear algebra, differential equations, and engineering math

RESEARCH INTERESTS AND EXPERIENCE

INTERESTS
Nucleic acid folding transitions, protein-DNA interactions, applications of statistical mechanics to biological problems, improving quantitative reasoning skills in chemistry education

EXPERIENCE

2002-2007  Research Assistant, Lab of Dr. M. Thomas Record  
University of Wisconsin-Madison, Madison, WI

**Thermodynamics of the HPD-Operator Binding Interaction**  
• Studied the binding of the Lac Repressor DNA binding domain to specific DNA sequences as a means to understand the mechanisms of protein-DNA binding and specificity

**Quantification of the Thermodynamics of DNA Duplex Melting**  
• Investigated the various thermodynamic driving forces involved in the formation of duplex DNA using UV-spectroscopic and calorimetric methods.
2001-2002  
*Research Assistant*, Lab of Dr. Roger Kaspar

Brigham Young University, Provo, UT

*Post-transcriptional Regulation of TNF-α by ARE binding protein*

- Worked to obtain a DNA template of the TNF-α gene for in vitro transcription assays

**EXPERIMENTAL TECHNIQUES**

Isothermal titration calorimetry, fluorimetry, UV spectrophotometry, low-pressure column chromatography for protein purification, nitrocellulose filter-binding, PCR, protein and DNA electrophoresis, bacteriological techniques for protein preparation

**PUBLICATIONS**

Anderson, M. W. & Record M. T., Jr. (in preparation) Assessment of the Contribution of DNA Base Unstacking to the Thermodynamics of Melting a 12 Base Pair DNA Duplex

Anderson, M. W., Shkel, I & Record M. T., Jr. (in preparation) Effects of KCl and KGlutamate Concentration on the Thermodynamics of Binding the Lac Repressor Dimeric DNA Binding Domain to a Weak DNA Operator Sequence (SymR): Comparison with NLPB Coulombic Calculations


**POSTERS**


Quantifying Solute-Biopolymer Interactions: Application to Predict or Interpret Solution Effects on Protein and Nucleic Acid Processes- Poster at Biophysical Society 49th Annual Meeting (2005)

**SPECIALIZED SKILLS**

PERL programming, familiar with LINUX/UNIX operating system, Adobe Illustrator, Flash
COMMUNITY SERVICE

2008-present  *Cub Scout Den Leader* (Boy Scouts of America)

BSA Pack 38, Onalaska, WI

- Plan and supervise weekly activities for 4-5 boys, ages 8-10
- Assist in planning and presenting bi-monthly meetings for boys and their families
- Serve as a member of pack committee and assist in planning other pack activities

2005-2007  *Secretary for multi-congregational Young Women’s organization*

Church of Jesus Christ of Latter-Day Saints, Madison, WI

- Assisted in planning and preparation of quarterly activities and service projects for church youth (ages 12-18)
- Helped hold training meetings for congregational youth leaders
- Oversaw the production and distribution of newsletters and other material for organization

2003-2005  *Sunday School Teacher*

Church of Jesus Christ of Latter-Day Saints, Madison, WI

- Taught weekly class on church doctrine to 1-5 students (7-8)
- Assisted at quarterly activities and service projects
- Attended quarterly teacher training sessions

CO-CURRICULAR ACTIVITIES

2001-2002  Member of Y-Chem (ACS affiliate undergraduate organization)

Brigham Young University, Provo, UT

2000-2002  *Guildmistress*, Quill and Sword Music Ensemble

Brigham Young University, Provo, UT

1998-1999  *Member*, Quill and Sword Music Ensemble

Brigham Young University, Provo, UT

1998-2002  *Member*, Quill and Sword, a Medieval History Organization

Brigham Young University, Provo, UT

OTHER INTERESTS

Gardening, Biblical Hebrew, Early Music