

# TEACHING AND LEARNING PORTFOLIO

by

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## Teaching and Learning Philosophy of **Kelly Gorres**

Throughout high school and much of college I never would have answered “teacher” to the question of what I wanted to be when I grew up. I was always interested in the workings of the world around me, and wanted to work in a science or medical field. At the same time, however, I was volunteering as a reading room teacher in elementary classrooms, working as a swimming instructor, and leading a community service project that does science demonstrations. I enjoyed helping others develop new ideas and achieve goals, and through these experiences I decided that teaching was for me. As a biochemistry teacher I aim to provide the tools and environment for students to cultivate their own thoughts, think critically about problems, and be creative in designing solutions. The ultimate goal is to apply these skills to not only scientific quandaries, but in their own life situations.

I believe teaching should be a means by which learners acquire knowledge and skills in a subject area to explore overarching and broad-reaching concepts and phenomena. I believe people have an innate curiosity and desire to understand more about the world around them. I think the job of teachers is to introduce students to new concepts and current understanding which students can integrate into their own experiences. Teachers then create an environment for students to put their knowledge and perspectives into a larger context to turn a set of facts into a deeper understanding for the purposes of analysis and problem solving.

My goals as a teacher are to assist students in developing ideas and to encourage students to continually strive for higher goals. Overall, the best outcomes I can see as a teacher are students becoming independent and confident in their abilities. As a swimming instructor I felt compelled to help my students, but was rewarded to hear students say, “I know how to do it by myself now”. My experiences have translated into the classrooms where I have been a teaching assistant and into discussions with fellow graduate students. The “Oh, now I get it” moment from students I find to be better than any number of A’s on quizzes. Additionally, I value progress in research resulting from me helping another student think through their experimental design problem.

In my experiences, the deepest learning occurs within each student’s own mind. Students learn through building on their own experiences, and so it is important to allow time during a class for students to ponder concepts and place the concepts into the framework of their mind. As a teacher I would promote student learning by having students make connections among the subject material, other courses they have taken, and their own experiences. Learning is a different process for every person, and so as a teacher I will strive to develop individual thinking by encouraging each student to think and share their unique perspectives and original ideas. Many students also learn by active participation. I believe the process of hard work and pondering that leads to discovery and innovation is a unique learning experience, and so laboratory exercises should be incorporated into every class.

I believe the ultimate goal of education is turning students’ thinking from inward to outward. By this I mean getting students to think beyond themselves and to think globally. Collective thinking and applications of knowledge are how much of the world operates. As a teacher I want to create environments for students to use the information that they have taken into their minds and to process their thoughts in order to share their ideas with others and positively impact issues they find compelling. For example, I would like to collaborate with

industries and community service groups to create projects for students. These types of projects require students to integrate many perspectives into their own ideas and draw on many resources and experiences. As a teacher I will challenge students with tasks that draw on analytical skills but are also directed toward broader applications.

As an educator I would like to teach both biochemistry majors and non-majors. I feel it is important for all students to be able to use strong scientific reasoning to make informed decisions as scientists or general citizens. As students leave my classroom I aim to change their intimidation of science into curiosity. Students will be able to transfer the scientific process into logical thinking, approach problems guided by their own creativity and identify new questions and problems. I aspire for my students to develop an inquisitive manner of thinking to question ideas and improve problems they encounter both in science and the greater community.

## **Artifacts of My Teaching Experiences**

The following section consists of items that represent either one of my views or my experiences that have been developed through my teaching experiences and through the Delta program. Each item, or artifact, is accompanied by a reflection that includes a brief explanation of the item and why I feel it characterizes a part of my teaching and learning philosophy.

Artifact 1 is a course syllabus that demonstrates my idea of Student Choice in Learning and addresses the Delta pillar of Learning through Diversity. Artifact 2 contains political cartoons from an activity that I led in a course that emphasized Science–Technology–Society. Artifact 3 is a snapshot from a website that symbolizes my enthusiasm for undergraduate research. Artifacts 2 and 3 mainly point to the Delta pillar of Learning Communities. Finally, Artifact 4 is a summary of a research project I did on classroom learning that demonstrates Delta’s pillar of Teaching-as-Research.

**Artifact 1:** A syllabus that demonstrates my understanding of course design and my idea of **Student Choice in Learning** and also addresses the Delta pillar of Learning through Diversity.

### **Biochemistry 301**

Course number 345345

Fall semester 2010

Course website: [www.wisc.edu/biochem/courses/301](http://www.wisc.edu/biochem/courses/301)

**Instructor:** Kelly Gorres

Office: Science 23

Phone: 2-9874

email: [klgorres@wisc.edu](mailto:klgorres@wisc.edu)

Office hours: M 1-2, T 10-11, F 2-3, by appointment and any time my door is open!

**Course description:** Biochemistry is the study of the molecular basis of life. We will focus on the major classes of molecules that make up living organisms, proteins, nucleic acids, carbohydrates and fatty acids. We will learn what these molecules do, how they interact, and what happens to a cell or organism when they misbehave. We will emphasize the chemical nature of these molecules and reactions that occur in living things.

This course is designed for students majoring in Biochemistry, Biology or Chemistry.

**Location:** Science Building Room 124      **Times:** Monday, Wednesday, Friday 9:00 – 9:50 am

**Prerequisites:** Organic Chemistry, Cell Biology

#### **Learning Goals:**

- Understanding that life is made up of chemical reactions
- Understanding of protein function and regulation
- Understanding of how organisms get energy from food (through reactions)
- Understanding how and why the reactions occur, and how pathways are intertwined—complexity of life
- Figuring out what happens to an organism when a reaction doesn't occur correctly—human medicine, biotechnology, etc.
- Investigating biochemical questions you have
- Knowing where there are resources that provide biochemical information
- Understanding how biochemistry is a part of science as a whole

**Text:** Biochemistry Stryer 5<sup>th</sup> ed. Freeman and Company, New York.

For other perspectives, try other biochemistry textbooks available in the library: Cox and Lehninger, Campbell, Devlin, Voet and Voet, Zubay, and Mathews, van Holde and Ahern.

Biochemistry is closely related to Molecular Biology, Genetics, Bioorganic Chemistry Microbiology, and Immunology. Resources from those courses will also be helpful. I hope you begin to make connections among these courses if you have already taken some, or will make connections when you do.

**Course design:** The course begins with the “Central Dogma of Life”:



The course will touch on many types of biological molecules, but will focus on proteins because DNA and RNA are covered in Molecular Biology. An theme of the course will be pathways in biochemistry. Metabolism, the pathways organisms use to obtain energy, is a fundamental aspect of biochemistry. This course will not emphasize memorization, but will focus on interactions and regulation. Disclaimer: Memorization of metabolism will be useful for standardized exams, such as the GRE or MCAT.

The mode of the course will be to alternate between how nature and how scientists make biological molecules. Class periods will use lecture, student presentations, group discussion and problem-solving. I expect students to have read course material before class. Students are highly encouraged to ask questions. It is your responsibility to keep on schedule; concepts build and pathways get more complex, so keeping on track will make this course easier for you.

**Schedule:** The schedule may change as student learning and interests are taken into account.

Week	Topic	Book Chapters	Assessments	Out-of-class
1	Welcome, Introductions, Review Cell biology and Chemistry of biological molecules	1		Online pre-course survey
2	DNA and RNA	4, 5, 6, (31-33)		Problem set
3	Protein Structure and Function (Protein synthesis)	2, (34)	Quiz 1	
4	Protein folding and Allosteric regulation	16, 7		Vitamin presentation
5	Enzymes	8, 9		
6	Vitamins		Vitamin presentations	
7	Protein Regulation	10		Problem set
8	Metabolism, Energy	17, 30	Exam 1	
9	Carbohydrates, Glycolysis	18, 19		Metabolic disease project
10	Citric Acid Cycle, Oxidative Phosphorylation	20, 21		
11	Photosynthesis	26		
12	Metabolic diseases		Metabolic disease presentations	
13	Membranes	11	Exam 2	
14	Fatty acid metabolism	24		
15	Moving across membranes: Channels and Pumps, Signal Transduction, Protein Targeting	12, 13, 35		



**Assessments:**

Graded assignments will be written work and presentations because these assignments will help you develop important skills that apply to all classes. Short group presentations will be given on a Vitamin and a “Scientist of the Week”. The Metabolic Disease project will require a paper and presentation, both completed individually. Details will be handed out in class.

Vitamin presentation	50
Metabolic disease	100
Scientist of the week presentation will be scheduled the first week of class	30
Article review assignment is due by the end of the semester.	50

A late assignment will lose 10% of its value for each school day (or portion of a day) that it is late.

Homework problems will be available periodically during the course. Problems will not be graded, but will be a useful learning tool and will provide an example for test questions. Attendance in lecture is not mandatory, but exams will be based on material covered in class.

Exams will consist of short answers, problems, and essays. Keep in mind that partial credit can only be given if you **SHOW YOUR WORK/REASONING!** An exam can only be made-up if you miss it due to an officially excused absence and inform me **BEFORE** the exam is missed.

Quiz 1: cell biology, chemistry of biological molecules, DNA and RNA	20 points
Exam 1: Proteins	100 points
Exam 2: Metabolism	100 points
Final exam: will focus on Lipids and Signaling, but will be <b>CUMULATIVE!!!</b>	150 points

**Grading: The University grading policy:**

[www.fpd.finop.umn.edu/groups/senate/documents/policy/gradingpolicy.html](http://www.fpd.finop.umn.edu/groups/senate/documents/policy/gradingpolicy.html)

Letter grades will be determined by the instructor for students individually. Students are encouraged to help each other learn. Grades will be determined by total points earned in the course out of 600 points total available, with 90-100% = A, 80-90% = B, 70-80 % = C, 60-70 % = D, and < 60 % = F, though I reserve the right to lower cutoffs, leading to higher grades.

**Academic Dishonesty:** CHEATING AND PLAGIARISM WILL NOT BE TOLERATED. If I suspect academic dishonesty of any kind, I will set up a meeting with the student(s) involved. The penalty may range from a zero on the assignment or exam to an F for the course. University policy requires me to inform the Chancellor for Student Affairs of the offence and the penalty.

**I am HAPPY to speak with you at any time about how you are doing in this course and EAGER to help you come up with strategies for improvement if needed.**

**Campus resources:**

Tutoring services 608-555-0001  
 Students with disabilities 608-555-0002  
 Counseling 608-555-0003

## Artifact 1 Reflection

I designed this syllabus as part of the Delta course entitled, “International Students, International Faculty”. The course overview states,

“This course is for graduate students and post-docs, both international and domestic, who want to become effective teachers in the global college classroom. We will explore global perspectives on culture, communication, and learning and how these pertain to effective and inclusive teaching. The course will focus on cross-cultural teaching and learning in international context with the goal of enhancing international understanding and perspectives of future faculty. This course is designed to promote the development of skills and habits-of-mind, along with the knowledge base associated with international cultures and high-quality teaching, learning, and assessment.”

I choose to design a course in biochemistry because it is a course I would like to teach. In some ways the syllabus describes a typical biochemistry class, and it contains topics in biochemistry that are I believe are important. The syllabus also describes assignments I would give. These assignments reflect my perspective on teaching that students should be encouraged to pursue their own interests and that communication is a fundamental part of learning. The topics of the assignments are chosen by the students, so that they can find answers to their own questions. I believe having this type of flexibility within a course helps learning for a diverse student population. Also included in the assignments is an emphasis on presentations, both written and oral. This provides opportunities for students to practice communicating science and to share with their peers what they have learned. All students can benefit from hearing about science from a classmate who may have a different perspective which broadens the scope of the course.

**Artifact 2:** Political cartoons from an activity that I led that emphasized **Science–Technology–Society**, which is connected to the Delta pillar of Learning Communities.



Courtesy Mike Lester / The Rome News-Tribune



"YOU DON'T SUPPOSE HE'D BE IMPRESSED WE VOTED FOR AL GORE?"

## Artifact 2 Reflection

I created a lesson on political cartoons for the Biomedical Engineering 601 “Current Issues in Biomedical Engineering” course, which covers tissue engineering, stem cells and gene therapy. These topics, however, are approached through current issues in politics, ethics and science communication. I participated in this course as part of my internship in teaching and learning for the Delta program.

Cartoons illustrate one means by which science is communicated to the public. Bringing political cartoons into the classroom is one way to bridge science and society. The cartoons I used in the lesson addressed a variety of scientific issues. Students were divided into groups to discuss one cartoon and then present that cartoon and lead a group discussion. Students were engaged in the activity. Humor aided the conversation. The message of the cartoon was more obvious in some cartoons than others. Cartoons that were more difficult led to more in depth discussion. The more straightforward cartoons, however, prompted students to share their ideas about what could be added to or changed in the cartoon.

This activity lends itself well to interdisciplinary studies, and could be expanded to incorporate history where cartoons from different time periods are compared and to look at how perceptions change over time. This activity again could include options, where students could choose a cartoon from a group provided by the instructor, or better yet students could delve into the media and find a cartoon of their own, based on a topic that interests them. Going one step further, students could even draw cartoons of their own.

**Artifact 3:** A snapshot from a website that symbolizes my enthusiasm for **Undergraduate Research**, which encompasses to the Delta pillar of Learning Communities.

# Biochemistry

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 Department of Biochemistry  
 433 Babcock Drive  
 Madison, WI 53706-1544  
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## Welcome to our Undergraduate Web Site

Biochemistry is the basic science which has as its goal an explanation of life processes in physical and chemical terms. It deals with the chemical and physical properties of living matter and with the chemical changes occurring in living matter. This includes the properties and chemical changes in genes (DNA) generally referred to as molecular biology.

The major in biochemistry is designed to fit the needs of the student who wishes to terminate his/her training at the B.S. level as well as those students planning on graduate or professional school study. The degree will serve as an excellent background for medical school or veterinary school admission. This major also provides an excellent background for graduate study in biochemistry or other allied fields such as biology, bacteriology, genetics, molecular biology or oncology. The basic requirements for the degree include courses in biology and general, organic, quantitative, and physical chemistry. Depending on his/her particular interest, the student can concentrate on electives in either of these areas to lead to a degree that contains as much chemistry as a chemistry major, or that is more complete in the biological sciences. The Biochemistry Department allows undergraduate majors in the department to continue beyond the sophomore year only if they have maintained a grade point average of at least 2.5 for their first two years.



Many opportunities for laboratory research experience are available on this campus for undergraduate students and such experience is strongly encouraged. Independent study courses and senior theses complement and extend these experiences. Research experience is viewed favorably by employers and admission committees for graduate and professional schools.



Graduates in biochemistry are in demand for interesting jobs as participants in research groups in hospitals, medical schools and academic institutions, as well as a large number of different government laboratories and research institutions. There are many opportunities for biochemists in industries concerned with food processing and drug production and in the various areas of the chemical and petroleum industry.

Any student desiring further information about the degree program in biochemistry should contact

### **Artifact 3 Reflection**

I show the website for the Department of Biochemistry Undergraduates to show my interest in undergraduate education. While pursuing my graduate studies at a major research university, I served as the graduate student representative on the Biochemistry Department Committee for Undergraduates. One of our main jobs was to evaluate applications and to award scholarships for research. Through this experience I was repeatedly reminded how talented and capable undergraduate students are. We always received many more quality applications than scholarships were available. This makes me think that students really are motivated, and that professors and colleges just need to provide the encouragement and opportunities. I circled the links for scholarships and lab/industry opportunities to emphasize how important undergraduate research experiences are.

During my graduate career I also mentored an undergraduate student, Khian Hong Pua. This was a great opportunity for me to think about my research from another perspective, and to communicate my research in a more accessible way. I expanded my view of the project to try to make connections to what Khian was studying in his classes. Perhaps the most valuable conversations we had were when Khian was writing research proposals for scholarships. Khian continuously asked, "What is the significance of this?" During this experience I learned about critiquing writing without rewriting. I also witnessed how beneficial the writing process is to student learning.

## Artifact 4: Teaching-as-Research

*Do students learn technical content in a biomedical engineering course taught through social, political and ethical issues?*

"All (content) is not lost"

Delta Internship Summative Report by Kelly Gorres and Prof. Kristyn Masters

### **Abstract:**

Coursework in science and engineering often lacks study of the social, political, and ethical aspects of topic. Most educators agree that these are important topics for students, both future scientists and future citizens, to think about. One main concern about adding these topics to any course is the fear that course content will have to be sacrificed. The main questions addressed by the research presented herein are "Does presenting a course in biomedical engineering in a social/political/ethical context increase student learning of the broader issues?" and "Do students also learn course content?". This work compares two courses in Biomedical Engineering (BME). One course is traditionally taught, while the other is taught from a science, technology and society (STS) approach. Comparisons were made between students before and after the STS course, and between students in each of the two courses. The major result provides evidence that students in a context-based course do learn the technical content.

### **Introduction:**

There has been a great movement in science education to improve "scientific literacy". AAAS Scientific literacy can be defined as the ability to understand science-related news presented by the media or the ability to form an opinion on a new scientific breakthrough. However defined, this call for science education for the general public most often puts more emphasis on how science relates to society rather than scientific facts. This emphasis is also being brought into the classroom. Science curricula are including interactions among science, technology and society (STS). Course materials are presented in the context of real world issues [1]. While many science and engineering courses often contain "just the facts", more teachers are introducing scientific material through some common topic. By putting technical concepts into a relevant context students can make personal connections. Contextualized learning often takes place in a topic-based context using real world examples and case studies [2].

The effects of context-based courses have been reviewed by Bennett, et al. Students in courses taught by the context-based approach have more positive attitudes toward science classes than conventionally taught courses. The learning of scientific concepts is overall similar when comparing traditional courses with context-based courses, although there is some conflicting data on this topic possibly due to different assessment techniques. Students in context-based courses tended to perform better on evaluations that were also context-based.

The project described herein investigates a biomedical engineering course that incorporates topics not addressed in typical science courses: ethics, science communication, and politics. Scientific research is dependent on funding that is in part determined by politics and public perception of science. Scholars have reasoned that including political arguments in science curricula by discussing real world issues may be the best tool for revolutionizing science education and improving science literacy [3, 4]. Hodson asserts,

“By grounding content in socially and personally relevant contexts, an issues-based approach can provide the motivation that is absent from current abstract, de-contextualized approaches and can form a base for students to construct understanding that is personally relevant, meaningful, and important” [3].

### **Project design:**

The strategy for the project was to compare two courses with some overlapping technical content taught by the same instructor. One class, Biomedical Engineering 510 “Introduction to Tissue Engineering”, was taught in a traditional manner with lectures, literature analysis and laboratory activities. The emphasis in this course was technical content. The other class, Biomedical Engineering 601 “Current Issues in Biomedical Engineering”, was approached from a social/political/ethical perspective. Topics were introduced through these issues and students learned how scientific research is influenced by politics, ethics, and public perception. To demonstrate to the students the diverse community of professionals that are involved in scientific issues, these topics were often introduced by guest speakers that have included Representatives from the WI State Legislature, a U.S. Congresswoman, prominent bioethicists and professional science journalists. The students read articles addressing topics in biomedical engineering found in mass media and technical journals and then participated in discussions and debates, wherein they learned the technical material in order to understand the issue and support their statements. The students were also asked to form opinions and deduce public perceptions in a lesson based on political cartoons. The ultimate goal was to provide students with a solid background in biomedical engineering issues and communication skills that will enable them to be active in the global community.

A pre-course survey gathered student background information and demographics. Students were also asked questions on three topics taught in both courses: tissue engineering, gene therapy, and stem cells. After each unit in the BME 601 course, students were given post-unit quizzes which corresponded to questions in the pre-course survey. Each student response was categorized as either a technical (content) or non-technical (political/ethical/social issue), and scored by the number of responses given in each category.

- What are some of the main challenges facing implementation of tissue engineering strategies?
- What are the biggest obstacles and limitations currently facing gene therapy?
- Please list as many types of gene delivery vectors as you can.
- What are the different types of stem cells that you know of, and how are they different from each other? Please explain briefly.



Assessment of student attitudes toward science and technology was accomplished by using the VOSTS (Views on Science-Technology-Society) survey [5]. The survey was created based on written responses by Canadian high school students, and converted into a multiple-choice format. The number of questions was greatly pared down to decrease survey fatigue and reduce redundancy. A sampling of survey questions and answer choices are included in the Appendix.

Demographic information was also collected to allow for comparisons among different groups of students, such as comparing gender, race, and level of experience (undergraduate versus graduate-level education).

## Results and Discussion:

*Demographics.* There were 29 students in BME 510 course, 16/28 students responding to the survey were undergraduates and 12/28 were graduate students. Twenty students responded as biomedical engineering majors, while seven students were of related majors (mechanical engineering, pharmacology and toxicology, materials science, chemical and biological engineering, and biological system engineering).

The BME 601 course was comprised of 9 undergraduate students and 2 graduate students, 36% male and 64% female, and all biomedical engineering majors. Four of the students marked being partially a minority race.

*Content.* Student learning of biomedical engineering content (technical information) and issues related to science–technology–society (non-technical) was measured by the number and types of responses given by the students to questions given as part of a quiz.

When asked “What are some of the main challenges facing implementation of tissue engineering strategies?”, in a pre-test of students in BME 601 71% gave a response categorized as technical, and 29% gave non-technical (ethical or legal issues or research funding) responses. No post-course data was collected. To the same question in a pre-test, all 29 students in BME 510 gave a technical response. In addition to a technical response, 11/29 (38%) also gave a non-technical responses. No post-course data was collected. Before either course, a larger percentage of students could provide an answer that contained technical information, but only about 1/3 of students in either course thought of non-technical issues.

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Table 1. Number of students that gave technical and non-technical responses/total number of students enrolled to the pre-course question, “What are some of the main challenges facing implementation of tissue engineering strategies?”

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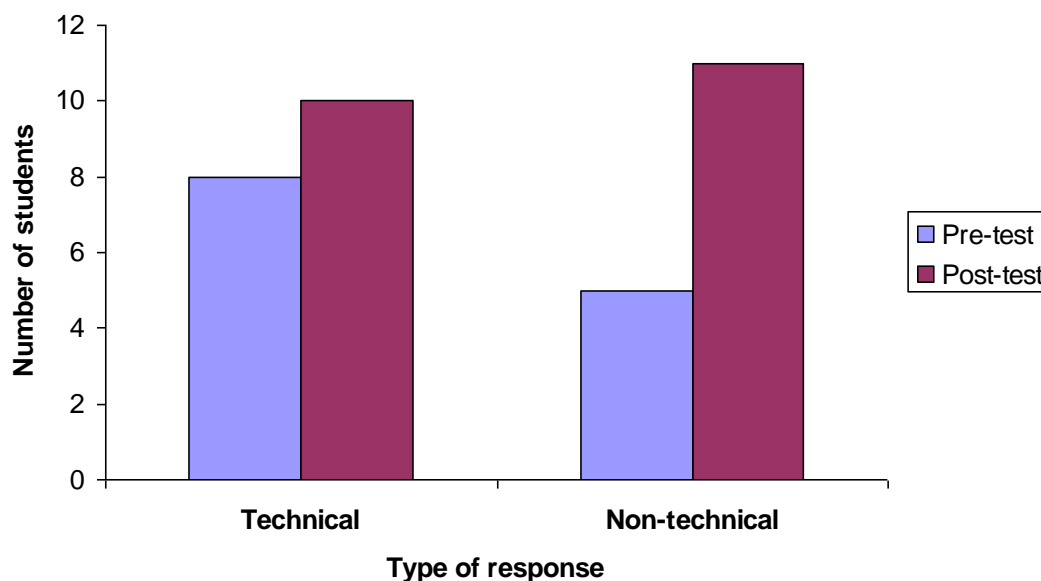
<u>Course</u>	<u>Technical answers</u>	<u>Non-technical answers</u>
Social/Ethical Issues (BME 601)	10/14 (71%)	4/14 (29%)
Technical course (BME 510)	29/29 (100%)	11/29 (38%)

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The breadth of student learning in BME 601 was investigated by looking at both technical and non-technical responses to the question, “What are the biggest obstacles and limitations currently facing gene therapy?” As shown in Figure 1, in the pre-test 8/14 students gave technical responses and 5/14 gave non-technical responses including cost, ethical issues, government regulation, and public perception. In the post-test 10/14 students gave technical

responses and 11/14 gave non-technical responses, most notably including an increase in the number of students who gave an answer categorized as public perception from four to nine. These results demonstrate an increase in student awareness of societal issues.

Figure 1. Non-technical responses from BME 601 students increased from pre-course to post-course when asked, “What are the biggest obstacles and limitations currently facing gene therapy?”.



To further address the amount of content students learn in a context-based course, students in BME 601 were given two technical questions both pre- and post-course. These results are found in Table 2. In the first question, “Please list as many types of gene delivery vectors as you can.” Students gave an average of  $2.0 \pm 2.0$  answers/student with five students giving no response in the pre-test, whereas in the post-test all students gave answers, and there was an average of  $3.8 \pm 1.8$  answers/student. Similar results were observed when students were asked questions about stem cells. In pre-test responses to “What are the different types of stem cells that you know of, and how are they different from each other? Please explain briefly.”, students gave an average of  $2.9 \pm 1.8$  answers/student. In post-test responses to “Please describe three different types/classes of stem cells, focusing on how they are different from each other (i.e. their maturity/potency, their source).”, students gave an average of  $5.0 \pm 1.6$  answers/student. These results provide evidence for student learning of technical content in a course taught by a science–technology–society approach.

Table 2. The technical knowledge, measured by the number of responses given to questions asked about gene delivery or stem cells, increased over the BME 601 course.

	Average number of responses per student	
	Gene delivery	Stem cells
Pre-test	$2.0 \pm 2.0$	$2.9 \pm 1.8$
Post-test	$3.8 \pm 1.8$	$5.0 \pm 1.6$

*Attitudes.* A portion of the VOSTS survey (see Appendix for full questions and multiple-choice responses) was given to the BME 601 students at the beginning of the course. The students' responses to summarized survey statements are given below. Overall, most respondents choose options that included some sort of interaction between scientists and the non-scientific community.

- When asked their position on the statement **A country's politics affect that country's scientists**, 10/11 replied that scientists ARE affected by their country's politics, but the reasons given varied among because of funding (1), policy and money (1), policy (5), and scientists are part of society (5).
- Responses to the statement **We always have to make trade-offs (compromises) between the positive and negative effects of science and technology**, included seven saying there are always tradeoffs, and two saying not always.
- When asked if **More money should be spent on science and technology in the US even though this money will not be available for other things, such as social programs, education, business incentives and lower taxes**, 3 said more money, 5 said spending should be balanced, and 0 said less.
- To the statement "**Community or government agencies should tell scientists what to investigate; otherwise scientists will investigate what is of interest only to them**", 3 students replied government should decide for important public problems otherwise scientists, 3 choose scientists with government advice, and 4 thought solely scientists should decide.
- All 11 students agreed with the statement: **Science and technology offer a great deal of help in resolving such social problems as pollution and overpopulation**, but the answers were divided into Science and technology can certainly help to resolve these problems. (2); Science and technology can help resolve some social problems but not others. (2); Science and technology solve many social problems, but science and technology also cause many of these problems. (3); and It's not a question of science and technology helping, but rather it's a question of people using science and technology wisely. (4).

### **Lessons learned:**

In this project, the assessments using open-ended questions that asked for the limitations or challenges of a technology worked well because they allowed the students to respond without restrictions on the scope of answer and without alluding to any particular problem. The responses were easily classified as technical or non-technical, and comparisons could be made. Enrollment was less than anticipated, which made gender, race, and educational level comparison difficult. Also, some students were in both classes. The data for the second course, BME 601, may be skewed because of these overlapping students.

Based on the results of the VOSTS survey and the pre-course survey, many of the students enrolled in BME 601 were interested and aware of many political, ethical and societal issues in biomedical engineering, which is presumably why they enrolled in the course. To investigate the utility of context-based courses, it may be better to compare courses populated by less advanced students.

## Conclusions:

Biomedical Engineering 601 “Current Issues in Biomedical Engineering” is a course that was designed to provide a setting in which students can discuss social, political, and ethical issues in biomedical engineering, and through those discussions learn the scientific information related to those topics. The main questions focused upon by the research presented herein are “Does presenting a course in biomedical engineering in a social/political/ethical context increase student learning of the broader issues?” and “Do students also learn course content?”. The students enrolled in the course were generally aware of the relationship between scientists and society prior to enrolling in the course, as evidenced in the Views on Science-Technology-Society survey. Prior to the course, student knowledge of technical content on tissue engineering, stem cells, and gene therapy varied, but a comparison of pre- and post-tests showed an overall increase in the number of technical responses given by students, suggesting an increase of technical knowledge. This study provides support for context-based or Science-Technology-Society approached courses, and that technical information typically emphasized in science courses is still learned by students.

## Literature

- 1) Middlecamp CH, Baldwin O. Chemistry, society, and civic engagement (Part 1): The SENCER project. (2006) *J. Chem. Ed.* 83:1301.
- 2) Bennett J, Lubben F, and Hogarth S. A Synthesis of the research evidence on the effects of context-based and STS approaches to science teaching. (2007) *Sci Educ.* 91(3):347-370.
- 3) Hodson D. Time for action: science education for an alternative future. (2003) *Int J Sci Educ.* 25:645-670.
- 4) Hodson D. Going beyond cultural pluralism: Science education for sociopolitical action. (1999) *Sci Educ.* 83:775-796.
- 5) Aikenhead GS and Ryan AG. (1992) The development of a new instrument: “Views on Science-Technology-Society” (VOSTS). *Science Education* 76(5):477-491. Available at: [http://www.usask.ca/education/people/aikenhead/vosts\\_2.pdf](http://www.usask.ca/education/people/aikenhead/vosts_2.pdf)

## **Artifact 4 Reflection**

### **Teaching-as-Research**

The relationship between science and society is often left out of courses in science and technology due to time constraints and the amount of material that needs to be covered. Our goal is to have increase student awareness of political and ethical issues while also learning “scientific information”, with the ultimate goal of more curricula including the broader context of science. We assessed student learning by pre- and post-tests that covered technical and non-technical information. The open-ended questions allowed students to respond with both technical and non-technical answers without alluding to either type of answer. We learned that students did learn both technical and non-technical material over the course of the semester. We would really have liked to compare this data to a more traditionally taught course.

I learned that as a researcher you can never have enough information and feedback from students, but as a teacher you have limit the workload for the students. I think achieving an ideal balance in this regard will be most effective.

### **Learning Community**

The subject matter covered in the course, stem cells and gene therapy, especially the political and ethical aspects, can evoke strong feelings. It was critical for this discussion-based course to have an environment where every student could feel free to ask a question and share their opinions. We encouraged students to participate in debates, including sharing opinions that may not be their own, but that would contribute to the discussion.

Working with a faculty partner was a great experience. It was helpful for me to work with a science professor. I was able to see how educational research can fit into a regular class. I became aware of the challenges associated with doing educational research while meeting departmental requirements, and the challenges and rewards of teaching interdisciplinary topics. Having a faculty partner was useful for gathering resources, sharing ideas, and making the project better.

### **Learning-through-Diversity**

The most obvious groupings within the class were the graduate students versus undergraduate students. I attended a liberal arts college without graduate studies, so this was a unique situation for me. Both groups added to the course. The graduate students conveyed information about current research, and the undergraduate students knew about local issues, such as campus policies and articles in the student newspaper.

Guest speakers brought a great amount of diversity to the course, in their area of expertise, presentation style, and perspective. I think having outside speakers is informative, although I appreciate the difficulties in scheduling and constraining the topic to relevant material. This course also used many forms of mass media, and presented multiple opinions on issues. I think students often shared similar opinions about issues, but still were interested in learning the reasoning of the opposing side, and especially becoming aware of opinions they had not heard before.

## Curriculum vitae of Kelly L. Gorres

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### EDUCATION

Ph.D. in Biochemistry University of Wisconsin–Madison	anticipated Spring 2009
Bachelor of Arts with high distinction and with honors Major in Chemistry, Minor in Biology University of Minnesota, Morris	May 2003

### RESEARCH EXPERIENCE

Graduate Research Assistant University of Wisconsin–Madison Advisor: Prof. Ronald T. Raines	August 2003–present Madison, WI
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- Identified substrate conformational preferences of prolyl 4-hydroxylase
- Developed an assay for prolyl 4-hydroxylase
- Characterized a novel protein disulfide isomerase from *Bacillus subtilis*

Research Technician Internship Beckman Coulter, Inc. Advisor: Dr. Sharyn X. Su	Spring 2006 Chaska, MN
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- Purified and characterized an isoform of Prostate Specific Antigen for clinical diagnostics

National Institutes of Health Study Group Colgate University/National Institutes of Health Advisor: Dr. Carole A. Bewley	Fall 2002 Bethesda, MD
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- Developed trimeric coiled coils derived from HIV-1 Env gp41

Laboratory Technician Internship Minnesota Valley Testing Laboratories, Inc. Advisor: Mr. Dan O'Connell	Summer 2002, 2003 New Ulm, MN
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- Analyzed sugars and vitamins in food samples by HPLC or GC

Research Experience for Undergraduates North Dakota State University Advisor: Prof. Mukund P. Sibi	Summer 2001 Fargo, ND
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- Screened Lewis acid catalysts for *N*-acyl oxazolidinones synthesis

## PUBLICATIONS

**Gorres, K. L.**, Edupuganti, R., Krow, G. R., Raines, R. T. (2008) Conformational preferences for prolyl 4-hydroxylase. *Biochemistry* 47:9447-9455.

**Gorres, K. L.** and Raines, R. T. (2009) Direct and continuous assay for prolyl 4-hydroxylase. *Anal. Biochem.* In press.

Derewenda, U., **Gorres, K. L.**, Raines, R. T., Derewenda, Z. S. (2008) Novel protein from *Bacillus subtilis* with CXC active site motif has disulfide isomerase activity. *Manuscript in preparation.*

## ORAL PRESENTATION

**Gorres, K. L.**, Edupuganti, R., Krow, G. R., Raines, R. T. (2008) Conformational preferences for prolyl 4-hydroxylase. American Society for Biochemistry and Molecular Biology Annual Meeting. San Diego, CA. March 2008.

## POSTER PRESENTATIONS

**Gorres, K. L.**, Derewenda, U., Derewenda, Z. S., Raines, R. T. (2008) *Bacillus subtilis* protein with CXC active site motif has disulfide isomerase activity. Midwest Microbial Pathogenesis Meeting. Madison, WI.

**Gorres, K. L.** and Raines, R. T. (2006) Synthetic Probes for Elucidating the Mechanism of Prolyl 4-Hydroxylase. Midwest Enzyme Chemistry Conference. Evanston, IL.

**Gorres, K. L.** and Raines, R. T. (2005) Genetic Screen for Formation and Recognition of the Collagen Triple Helix. International Chemical Congress of Pacific Basin Societies (Pacifichem). Honolulu, HI.

**Gorres, K. L.**, Louis, J. M., Clore, G. M., Bewley, C. A. (2003) Design and properties of stable trimeric coiled coils derived from the N-helices of HIV-1 Env gp41. 225<sup>th</sup> National Meeting of the American Chemical Society. New Orleans, LA.

**Gorres, K. L.**, Miyabe, H., Sibi, M. P. (2002) Lewis acid mediated conversion of N-acyl oxazolidinones to dihydrooxazolines. 223<sup>rd</sup> National Meeting of the American Chemical Society. Orlando, FL.

## HONORS and AWARDS

NIH Chemistry–Biology Interface Training Program	2004–2007
University of Wisconsin–Madison Vilas Travel Fellowship	2005
University of Minnesota, Morris Scholar of the College Award	2002 and 2003
University of Minnesota, Morris pdf Award for scholarship and service in Chemistry	2003
Barry M. Goldwater Scholarship	2002
University of Minnesota, Morris Andrew Kaufman Scholarship for academic excellence and potential in the natural sciences	2002
University of Minnesota, Morris Presidential Scholarship for leadership and scholastic achievement	1999–2003

## TEACHING EXPERIENCE

- Delta Program for Teaching and Learning internship Spring 2007  
Advisor: Prof. Kristyn Masters
- Assessed student learning in a Current Issues in Biomedical Engineering course compared to an Introduction of Biomedical Engineering course
- University of Wisconsin–Madison Graduate Teaching Assistant Fall 2004, 2005
- Taught and supervised a section of the Biochemical Methods Laboratory course
- University of Minnesota, Morris Undergraduate Teaching Assistant Spring 2003
- Assisted with the Introduction to Research course
- University of Minnesota, Morris Academic Intern 2001–2002
- Led the “Science Sensations Program” that performs and explains chemistry demonstrations in elementary school classrooms and for the public

## REFERENCES

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