# Civic Responsibility Curriculum Infusion Pilot Project

*"Teaching the Science of Living Systems through Civic Engagement"*

Dr. Jeffrey Miller, Biology Professor, Estrella Mountain Community College

## I. Contact Information

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## II. Instructor Biography

*Instructional Background and Experience*

| | |
|---|---|
| 2000-2007 | Taught upper-level Cell Biology course at the University of Minnesota |
| 2006-2007 | Taught non-majors Nutrition course at Minneapolis Community and Technical College |
| 2007-present | Teach two sections (lecture and lab) of Bio100 (general biology for non-majors) and one section of Bio202 (Human Anatomy and Physiology) at Estrella Mountain Community College |

As outlined above, I have been teaching biology full-time for 12 years, the last five at Estrella Mountain Community College (EMCC). My teaching experience has ranged from teaching an upper-level Cell Biology course at a large University to teaching an introductory biology class for non-majors at EMCC. Through these experiences and other professional development opportunities, I have learned and now utilize a variety of pedagogical methods, including active learning, inquiry-based learning, and modeling, in my courses. These methods are student-centered and are designed to engage students in the course material and invite them to be active participants in the discovery process. In addition, I focus on making connections with students in the classroom in order to facilitate student learning and establish relationships necessary to effectively guide students through their college experience.

*Current Course Load*

Bio100: 2 sections (lecture + lab) 10.8 load hours
Bio202: 1 section (lecture + lab) 5.4 load hours

## III. Course Overview

The course I propose to modify is **Bio100**, an introductory course for non-majors that explores fundamental principles in biology and methods of scientific inquiry. Bio100 is a high-demand course taken by students with diverse academic goals who are typically seeking a SQ general education course with an accompanying lab. Enrollment data for Bio100 at EMCC is listed below:

| | **Spring 2011** | **Fall 2011** | **Spring 2012** |
|---|---|---|---|
| **Bio100 enrollment** | 193 | 163 | 186 |

MCCD course competencies include investigation of (i) the cellular and molecular basis of life, (ii) cellular respiration and metabolism, (iii) reproduction and genetics, and (iv) relationships between organisms in biological systems and evolution. While these competencies provide students with a broad overview of biology, the extraordinary pace of changes in the science of biology have spurred calls for reforming undergraduate science education. This effort has been lead at the national level by the American Association for the Advancement of Science (AAAS) and the National Science Foundation (NSF), which initiated a series of discussions among science educators and administrators that resulted in recommendations to place more emphasis on the development of competencies such as integrative problem-solving and quantitative skills, as well as application of knowledge to relevant societal challenges. For non-major students in particular one must think about the need to teach future teachers, poets, business professionals, politicians, school board members, and parents. Therefore, successful science education must take into account not only the content but also the interdisciplinary nature of the science of biology and the diversity of skills and knowledge that will be required to successfully relate biological concepts to solving real-life problems. By meeting these goals, educators can stimulate student's natural curiosity to learn about the living world and help students develop a solid foundation of scientific literacy necessary for meeting the challenges of our rapidly changing world.

## IV. Infusion Statement

*"Innovation in the life science will be the major driver of meeting four major societal challenges: challenges of climate, challenges of food, challenges of energy, and challenges of health."*

*- Phillip A. Sharp, Ph.D.*
*Professor, Massachusetts Institute of Technology*
*Nobel Prize Laureate*

The science of biology touches all of us. Breakthrough discoveries, from genomics to neurosciences to the effects of climate change on the Earth's ecosystems, have pushed the boundaries of the traditional biology discipline, while new technologies have allowed researchers to investigate questions we never thought possible. This extraordinary

change in the science of biology has thrust the field into the public domain as biologists investigate questions with great importance for human health and the environment. Because the science of biology intersects many societal challenges, scientists and non-scientists alike must be able to make connections from seemingly disparate bits of information, as well as be able to understand and evaluate scientific evidence to make informed decisions about biology-related problems.

Entry-level biology courses, such as Bio100, serve as the first and often the only opportunity to introduce students to scientific inquiry and the use of scientific evidence in addressing personal, social, and civic challenges. Thus, it is essential that courses such as Bio100 reflect the changing needs of our students to provide them with a strong foundation of biological knowledge and the integrative problem-solving skills and global perspective necessary to address relevant societal challenges. *In this proposal, I will outline reforms to the Bio100 curriculum that will facilitate investigation of societal challenges related to biology and enhance development of students' civic responsibility.* The goal of these changes is to use student-centered pedagogies and complex and often unsolved problems of civic consequence to foster greater student engagement and invite students to become active participants in the discovery process. As a result, students are expected to gain scientific literacy and a diverse set of skills and knowledge that will help them successfully integrate scientific perspectives to inform their own worldview. This approach makes science more real, accessible, useful, and civically important.

### *Civic Responsibility Objectives*

The proposed Bio100 curriculum will incorporate civic and public policy issues and promote development of civic engagement skills by addressing the following objectives:

1) Students will engage in learning opportunities that focus on community issues and be equipped with evaluative and analytical skills needed to address civic matters.

2) Students will examine issues of ethics, social responsibility, and individual accountability related to the course content.

The proposed curriculum still addresses MCCCD competencies and, therefore, provides students with a strong foundation of biological knowledge. However, the revised curriculum places much more emphasis on the development of integrative problem-solving and quantitative skills, and application of biological knowledge to relevant personal, civic, and public policy challenges. The issue of Nutrition will be a starting point for changes to the curriculum, but in the future I would like to develop additional course materials and establish college and community partners that can facilitate service learning activities to support the development of civic skills.

*Civic Issue: Nutrition*

Nutritional science is the study of metabolism and the physiological responses of the body to diet. Given the central role of nutrition in our lives, this topic has immediate relevance and importance to students. When studying the food we eat, it rapidly becomes evident that our food choices are shaped by personal preferences, tradition, the food industry, advertising, and government policy. In addition, our eating choices affect not only our personal health but also public health policies that must deal with the increasing number of individuals suffering from nutrition-related illnesses such as heart disease and diabetes. Thus, the study of nutrition provides an excellent opportunity to bring together science with civic issues related to food production and consumption and public health.

The civic engagement issues addressed in this unit will focus on the public health crisis and environmental costs that our nation, and increasingly many others in the world, are facing. Issues I propose to address include: (i) food labeling, (ii) diet trends and recommendations, (iii) diet-related diseases (iv) social and economic costs of the American diet, and (v) agricultural issues such as water quality, impacts of fertilizers and pesticides on food safety and the environment, and industrialization of food production.

The importance of individual nutrition for societal well-being, and ultimately, global health, will be emphasized, but questions about the dividing line between individual and societal responsibility will also be discussed. For example, each individual is in control of the choices they make that affect their health, but when the individual is placed in a "toxic food environment" that negatively impacts individual choice and health, what societal action is possible to reverse the public health trends we are facing? What should be the government's role in regulating or implementing those actions? The involvement of the government in issues as personal as what food we eat may raise concerns about the potential overreach of government regulation in our lives. To avoid "taking sides" on this issue, discussions will focus on how scientific data can inform us about the problems and provide clues for finding solutions. In addition, subjects such as childhood obesity can be used to bridge ideological differences and find common ground. No matter what one's position is on government regulation, we are all concerned with the well being of our children. These lessons can help students develop evaluative and analytical skills required to solve complex and unresolved civic problems.

Examination of the civic issues will facilitate learning of the following general principles of biology: (i) molecular and cellular biology (biology of carbohydrates, proteins, and fats and their relation to cell structure and function), (ii) photosynthesis, cellular respiration, and metabolism (how plants make food, how our bodies digest food, how our bodies use food to produce cellular energy, and how our bodies control weight), and (iii) genetics (how our genes affect nutrition, weight, and health). Each of these topics fulfills a MCCCD course competency for Bio100.

## V. Course Enhancement Proposal

### *Research on instructional practices and policy issues relevant to the course*

In order to develop the proposed Bio100 curriculum, I will perform research into inquiry-based and student-centered pedagogies that can be used to successfully infuse civic engagement into the course. I currently utilize a variety of active-learning strategies in my classroom, but know that bringing a greater emphasis on civic challenges will require me to switch gears from teaching science to teaching basic science through complex and unresolved public issues. This change will require defining new student learning outcomes and then finding the best strategies to accomplish these goals. The primary resources I will use in my research are described below, but I will also investigate other relevant resources that can help inform my choices of instructional practices and policy issues to use in the reformed curriculum.

I will utilize a number of sources in my research efforts but will focus my initial research on instructional practices and policy issues laid out by the Science Education for New Civic Engagement and Responsibilities (SENCER) community. The SENCER community is comprised of more than 2000 educators and administrators who are working to redefine how science is taught at the undergraduate level. The SENCER approach builds on the recommendations made in the National Academy of Sciences reports *"How People Learn"* and *"Knowing What Students Know: The Science and Design of Educational Assessment"* and helps make science real and useful to students. The SENCER website (see www.sencer.net) contains many useful course materials (including model courses), assessment tools, and research data evaluating the impact of the SENCER approach on student learning. Thus, the SENCER community will be an invaluable resource for developing instructional strategies and course materials.

A second resource I will utilize in my research is the *"Vision and Change in Undergraduate Biology Education"* report produced by AAAS and NSF. This report, prepared by faculty, scientists, and administrators, is a call to action for biology educators to reform undergraduate biology curriculum to meet the needs and challenges faced by our students. I attended the Vision and Change meeting in Washington D.C. in the summer of 2009 and participated in work to define and develop a set of best practices in biology education. This meeting marked an important step in the development of my approach towards biology education and my commitment to align my instructional strategies with an understanding of how we learn. I will research and incorporate recommendations from the report, the Vision and Change website (see www.visionandchange.org) as well as from members of the community of educators into the revised curriculum.

***Potential new projects, assignments, activities and reading materials***

A key ideal of the proposed curriculum is that students will learn basic biological principles through their engagement with public issues. Thus, I will need to identify or develop new projects, activities, and identify new reading materials that will help connect current and unresolved issues to the basic science. As a starting point, I will research the SENCER model courses (see sencer.net/Resources/models.cfm) for ideas I can use or adapt to meet my instructional goals. A second resource I use is the Learning Network blog published by the *New York Times* (learning.blogs.nytimes.com). The Learning Network houses a series of lesson plans connected to current events. I will also use my research findings to develop new materials as necessary. Several examples of these materials are outlined below.

*Project #1: Nutrition Roadblock and Diet Analysis*

In order for students to gain knowledge about their eating choices and the impact of these choices on personal health I will have students perform a three-part nutritional assessment project. In this project, students will begin by performing a self-assessment exercise in which they will write about their biggest roadblock to living a healthy life. Next, they will keep a detailed 3-day food and activity log and use SuperTracker (see choosemyplate.gov/supertracker) to calculate their actual nutrient intake and energy use. They will then evaluate how well their habits match their needs and write an essay describing their strengths and weaknesses. Finally, they will write a set of personal "food rules" for themselves, which they can follow to help overcome their roadblock and any identified dietary or activity-related challenges. The students will be asked to share their "food rules" with the class and discuss the benefits of these rules for healthy living. An extension to this project will be for the class to discuss how poor diet and low activity contribute to public health issues including obesity and obesity-related illnesses such as diabetes and heart disease. Through this project, students will learn how individual choices affect their health and how their choices fit into larger issues of public health.

*Project #2: Diabetes*

Diabetes mellitus refers to illness caused by the body's inability to regulate blood glucose levels due to changes in the production or function of the hormone insulin. Diabetes currently affects over 25 million Americans (8.3% of the population) and the number of affected individuals is expected to rise dramatically in the future. Type 2 diabetes, which comprises 90% of all cases, is strongly linked to obesity triggered by improper nutrition and inactivity. The Centers for Disease Control and Prevention estimates that diabetes costs the U.S. economy $174 billion in direct medical costs and indirect costs related to disability, work loss, and premature mortality. On a personal level, medical costs for a person with diabetes are two times higher than the costs for people without diabetes. Finally, diabetes disproportionately affects minority and immigrant communities in the U.S. with high numbers of the American Indian, African American, and Hispanic/Latino American communities suffering from the disease.

Thus, the need to reduce the prevalence of cases in America will take cooperation among scientists, policy makers, and educators. Together, these facts make Diabetes an ideal issue for students to connect biology to complex and important civic challenges.

Potential projects and activities include the use of case studies to help students learn about the biology of blood glucose regulation and how defects in insulin signaling cause diabetes. In this activity, students will perform urinalysis on simulated urine samples to gain insights about the etiology and symptoms associated with the disease. Case studies are useful tools because they help personalize the issue to see how diabetes affects people in the real-life scenarios. In addition, case studies utilize an inquiry-based approach that helps students see how science is done, use analytical and quantitative skills to evaluate data, and draw conclusions based on scientific evidence.

Potential reading assignments include a series of articles published by the *New York Times* chronicling the diabetes crises from a number of perspectives including how it disproportionately affects minority communities. These articles can provide a foundation for understanding the affects of diabetes on individuals as well as local, regional, and national communities.

*Proposed reading and multimedia materials*

Through my efforts to reform my biology curriculum from an emphasis on traditional content to an emphasis on the relevance of the content to my student's lives, I have come to realize that standard textbooks are incompatible with teaching science through the lens of civic responsibility. Thus, I have not utilized a textbook in my class for several years. However, students do learn from reading and I do utilize a variety of sources of reading materials to highlight specific learning goals. In order to fully infuse civic responsibility into my class I will need to find and employ additional reading materials into the course. As mentioned above, I will take advantage of articles on current topics and issues published in leading newspapers such as the *New York Times*, magazines such as *Scientific American*, and scientific journals such as *Nature* and *Science*. In addition, I will evaluate the idea of having students purchase and read several books that explore issues related to the course. These books include *"In Defense of Food: An Eater's Manifesto"* and *"Food Rules"* by Michael Pollan. I am also interested in evaluating the usefulness of *"Thinking in Systems"* by Donella Meadows, which offers insights into problems solving on individual and global scales. Finally, I plan to develop a set of materials related to the movie "*Food Inc.*", which explores issues related to food production from farm to supermarket. Assignments associated with the readings will include a reading blog where students will be required to answer questions about the reading and provide reflections on it.

*Other proposed assignments, projects, activities, and readings*

As time permits, or for future classes, I plan to identify or develop projects and activities that explore additional topics related to nutrition including: (i) the biochemistry of food (calories, carbohydrates, fats, proteins, macro, and micronutrients), (ii) metabolism (digestion, cellular respiration, and endocrine homeostasis), (iii) nutrition and disease (exercise, body weight, blood pressure, and cardiovascular health), (iv) quantitative analyses (percentages, conversion rates, and statistical analyses), (v) psychology (body image, behavior, and eating disorders), (vi) sociology (food traditions, consumer choices, and marketing), and (vii) political science (government policies and food industry practices) so that students can connect the biology to cultural, economic and, social cultural factors.

### *Instructional resources to be developed or identified*

An important component of the proposed curriculum reforms is to disseminate the new materials to colleagues and gain feedback from colleagues. Thus, I plan to develop my materials in a format that can be easily adapted by other faculty. This will include developing both teacher notes and student worksheets and making these materials freely accessible to other interested faculty. To facilitate this process, I will work with the Information Technology staff at EMCC to develop a webpage that can house the materials. On this page, I will also include links to outside sources of instructional materials and resources relevant to the civic engagement project. I will also develop a number of web-based materials in Blackboard, which can be shared with interested faculty.

### *Evaluation and assessment tools to gauge the impact or success of the new instructional methods*

The impact and success of the new civic engagement curriculum will be assessed using a variety of strategies. Good assessment starts with good goal setting. Thus, I will first develop a set of learning outcomes that I want students to achieve during the course. Once these goals are established I will develop a set of t assessments to measure student progress towards these goals. The types of tests and assessments I plan to utilize to measure student success are briefly described below:

*Formative Assessments*

I will use a variety of formative assessment strategies to gauge student learning and the effectiveness of the instructional strategies and course materials. These assessments will include a number of tools described in *"Classroom Assessment Techniques"* by Angelo and Cross. For example, I will utilize *"One minute papers"* in which students address two questions that can judge student interest, relevance, attitudes, analysis or

conceptual connections as well as points of confusion. Possible questions for the one minute paper include: "What was the most important point made in class today", "What was the most persuasive or convincing argument (or counterargument) that you heard expressed in today's discussion?" and "What unanswered question do you still have?"

*Just-In-Time Teaching*
Some of the formative assessment will be accomplished using "Just-In-Time Teaching" (see jittdl.physics.iupui.edu/jitt), which primarily uses web-based study assignments that are completed prior to class. The instructor uses these tools to fine tune classroom lessons to match students' needs. Examples of these types of assessments include "WarmUps", which are a set of questions completed prior to class, and "Good For's", which help students connect material to the real world.

*Learning Journals*
Students will be required to keep a "Learning Journal" in which they write and/or diagram a summary of the concepts and ideas discussed in each class period. The entries into the journal must be written in their own words and must be completed outside of class. Journals will be randomly collected six times throughout the semester and graded for content and completeness. The journals provide an excellent study aid for students, compelling students to stay on top of the material, and will allow me to identify areas where students are having difficulties.

*Summative Assessments*

*SENCER Rubric*
I plan to utilize the SENCER rubric (sencer.net/Assessment/assessmenttools.cfm) to assess the effectiveness of the civic engagement curriculum. The rubric provides a tool for evaluating course materials such as readings, assignments, projects, journals, and tests as well as identifying student interests and motives, the context and issues to be discussed, and content and learning goals to be taught to.

*Exams*
Unit exams and a cumulative final exam will be used to evaluate student learning of basic biological concepts. These exams will contain a blend of multiple choice and short answer/essay questions, focusing on biological concepts and problem-solving and will reflect several levels of Bloom's taxonomy.

*Final Project*
I plan to develop a public health project that will serve as a capstone activity for assessing the integrative learning aspects of the course. The project will ask students

working in groups of 3 or 4, to prepare a presentation exploring a nutrition-related issue from both biological and public health perspectives.

*Student Assessment of Learning Gains*

The Student Assessment of Learning Gains (SALG; salgsite.org) is an on-line survey developed by SENCER that asks students to rate how much specific activities, such as lectures, discussions, or labs, helped their learning. The assessment tool also asks students to report on their science skills and interests, as well as the civic activities in which they engage. The SALG survey is conducted near the beginning, middle, and end of the course. The primary purpose of the SALG is to provide instructors with feedback to improve their teaching, but it also provides a snapshot of student skills and attitudes at the beginning and end of courses, allowing instructors to gauge the effectiveness of their instruction in specific areas. I have used SALG surveys for a number of semesters and find the information provided by the assessment to be highly valuable in evaluating the effectiveness of my instructional strategies and student attitudes about their own learning.