

IPESL Grant Application
(Initiative to Promote Excellence in Student Learning)
Minnesota State University, Mankato

PROPOSAL COVER PAGE

Title of Project: Implementing, and Assessing New Critical Thinking Curricula for Biology 105W, Introduction to Biology I

Name: Dr. Robert Sorensen and Dr. Marilyn Hart

Are you full-time faculty in 2006-2007?
(fixed-term faculty are not eligible to apply) Yes No

Do you plan to return to MSU in 2007-2008? Yes No

e-mail: robert.sorensen@mnsu.edu; marilyn.hart@mnsu.edu

Campus Address: 242 Trafton Science Center South

Campus Phone: 1280 (Sorensen); 5732 (Hart)

College: CSET

Department: Biological Sciences

Spring Semester Schedule:

List times when available to participate in Learning Communities and workshops.

Mondays: 3-5 10-12

Tuesdays: _____

Wednesdays: 3-5 10-12, 3-5

Thursdays: 10-12 10-12

Fridays: 10-12

Robert E. Sorensen M. Hart
Signature of Applicant

Gregg A. May
Signature of Department Chair/Director/Supervisor

[Signature] 11/27/06
Signature of College Dean/Vice President

Proposal Details

[Please do not use your name(s) in the proposal for purposes of blind review.]

Please address the following in your proposal:

1. Title of Project: Developing, Implementing, and Assessing New Critical Thinking Curricula for Biology 105W, Introduction to Biology I
2. Explain the purpose of your project (e.g., need, project goals or outcomes, significance, affected student population) and include a definition of “critical thinking” as appropriate to your project.
(maximum 250 words)

The development of critical thinking skills is essential to MSU biology students for many reasons. Industry leaders nationwide ask that their entry-level employees be taught thinking skills including creative thinking, problem solving, and reasoning (SCANS, 1992). Seminal educators and scientists emphasize the importance of critical thinking skills, defined in two complementary ways for this project: 1) application, analysis, synthesis, and/or evaluation of concepts (adapted from Bloom, 1950) and 2) as scientific inquiry “that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations and predictions; and communicating result. [It] requires ... use of critical and logical thinking” (NRC, 1996, p. 23). Finally, the current Biology 105W lab and lecture curricula focus on memorization of biology facts and rote verifications. When critical thinking is addressed, students have difficulty with it. Student course evaluations, assessments of students in upper-level biology courses, and the department assessment of critical thinking skills show that our students have not learned these skills.

The goals of this project are to 1) engage students in critical thinking during lecture and lab, 2) develop new curriculum products emphasizing critical thinking (see list under #3 below), and 3) disseminate critical thinking teaching strategies within the biology department, via the IPESL website, and at a professional conference. This project will affect approximately 500 Biology 105W students per academic year.

3. Describe your project and how it will enhance students’ critical thinking through one or more of the following activities:
(maximum of 250 words)
 - development, implementation, and assessment of new instructional or curriculum materials

Development

The project will include development and/or redesign of Biology 105W lectures, labs, and assessments (Summer 2007, with initial planning Spring 2007) in a way that teaches students a uniform strategy for thinking critically and requires them to apply that strategy continuously throughout the biology core course lectures and corresponding labs (Biology 105W, 106, and 211). In addition to curriculum development, the project will include other products emphasizing critical thinking: a research summary of critical thinking strategies for biology lectures and labs, a new non-test assessment and rubric for measuring students' critical thinking skills, and new test items.

Lectures: Ten Biology 105 lectures will be redesigned to include critical thinking during lecture via one of the following methods: student response pad questions, small group questions, case studies, or another research-supported method of teaching critical thinking. The biology content of the course will be evaluated to correspond to the critical thinking component.

Labs: Two new labs will be developed to emphasize critical thinking (scientific inquiry), with additional ones being developed in subsequent years. Instead of having students perform verification labs in which they follow the exact format provided by the instructor, the new labs will utilize a research-based model of teaching scientific inquiry that has been successfully implemented on other college campuses. Students will be required to design, carry out, and write up or present their own experiments.

Implementation and Assessment will occur during Fall 2007 and Spring 2008 as the courses are taught and as described in #4 below.

4. How will you assess the results of your completed project?
(maximum of 150 words)

The effect of the new curricula and implementation will be assessed using student achievement gains on an assessment, student course evaluations, and a professor survey. During Fall 2007, students will complete a critical thinking graded assignment, such as an experiment designed and written up by students or exam questions testing critical thinking, at the beginning of the course and again at the end of the course. Students will also complete course evaluations asking them how much critical thinking they learned during the course. During Spring 2008, professors teaching courses with students who took Biology 105W during Fall 2007 will be surveyed about these students' critical thinking skills compared to those of past students and/or students who did not take Biology 105W during Fall 2007.

5. How will you disseminate your project and its results? (e.g., department colloquium, professional conference, college colloquium, university-wide colloquium, publication, IPESL website)
(maximum of 100 words)

The project's results will be disseminated three ways. We will present the project's critical thinking model and results to all other biology course instructors so they can

build on it in their courses. We will post a brief project description and/or results on the IPESL website. Finally, we will submit a presentation proposal based on the project and its results to a professional conference hosted by an organization such as the Association of Biology Laboratory Educators, the National Biology Teachers' Association, or the National Science Teachers' Association.

6. How will your project support department/university goals?
(maximum of 50 words)

Department goals include engaging students intellectually and fostering skills for life-long learning. This project supports these goals by engaging students in critical thinking that students can use throughout their lives.

References

- Bloom, B. et al. (1950). *A Taxonomy of Educational Objectives: Handbook, 1, The Cognitive Domain*. New York: David McKay.
- National Research Council [NRC]. (1996). *National Science Education Standards*. Washington, DC: National Academies Press.
- Secretary's Commission on Achieving Necessary Skills [SCANS]. (1992). *Learning a Living: A Blueprint for High Performance*. Washington, DC: SCANS, U.S. Department of Labor.

Submit proposals no later than noon, Monday, November 27, 2006, to

Stewart Ross
MH 267
IPESL Project Manager
Mankato, MN 56001

Questions? Contact:

- Dan Cronn-Mills, IPESL Steering Committee, Chair
- John Banschbach, IPESL Steering Committee
- Candace Black, IPESL Steering Committee
- Brandon Cooke, IPESL Steering Committee
- James Rife, IPESL Steering Committee
- Stewart Ross, IPESL Project Manager for Learning Communities
- Tracy Pellett, IPESL Project Manager for Assessment
- Wayne Sharp, IPESL Project Manager for Technology
- Brenda Flannery, IPESL Project Manager

Developing, Implementing, and Assessing New Critical Thinking Curricula for Biology
105W, 106, and 211

Time Budget for Project*

* 1 week of work = 40 hours of work

Hart – Biology 105W

- (2 weeks) develop 5 new lectures including critical thinking for BIOL 105W
- (2 weeks) develop 1 new critical thinking laboratory for BIOL 105W which may take up to 3 lab periods, including selecting and ordering supplies, writing lab manual copy, writing TA notes, etc.
- (1 week) teach and assess new material & attend learning community

Sorensen – Biology 105W

- (2 weeks) develop 5 new lectures including critical thinking for BIOL 105W
- (2 weeks) develop 1 new critical thinking laboratory for BIOL 105W which may take up to 3 lab periods, including selecting and ordering supplies, writing lab manual copy, writing TA notes, etc.
- (1 week) teach and assess new material & attend learning community

Cook – Biology 106

- (2 weeks) develop 5 new lectures including critical thinking for BIOL 106
- (2 weeks) develop 1 new critical thinking laboratory for BIOL 106 which may take up to 3 lab periods, including selecting and ordering supplies, writing lab manual copy, writing TA notes, etc.
- (1 week) teach and assess new material & attend learning community

Mahoney – Biology 106

- (2 weeks) develop 5 new lectures including critical thinking for BIOL 106
- (2 weeks) develop 1 new critical thinking laboratory for BIOL 106 which may take up to 3 lab periods, including selecting and ordering supplies, writing lab manual copy, writing TA notes, etc.
- (1 week) teach and assess new material

Toma – Biology 211

- (1 week) develop at least 3 new lectures including critical thinking for BIOL 211
- (3 weeks) develop a semester of new critical thinking laboratories for BIOL 211, including selecting and ordering supplies, writing lab manual copy, writing TA notes, etc.
- (1 week) teach and assess new material & attend learning community

Lavoie – Assessment Coordinator

- (1 week) research science critical thinking teaching models for lecture & laboratories
- (1 week) develop, pilot, and field test critical thinking pre- and post-assessment for laboratories for all three courses
- (1 week) develop, pilot, and field test grading rubric for laboratory assessment
- (1 week) help develop and pilot critical thinking questions or revisions of old questions for lecture exams for all three courses
- (1 week) analyze results of critical thinking assessments & attend learning community