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

**PROPOSAL COVER PAGE**

Title of Project: Using Application and Problem Solving Exercises to Enhance  
Critical Thinking Skills and Learning in an Allied Health Chemistry Course

Name: Theresa A. Salerno

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

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

e-mail: [theresa.salerno@mnsu.edu](mailto:theresa.salerno@mnsu.edu)

Campus Address: Department of Chemistry and Geology 242 North Trafton

Campus Phone: 389-5273

College: Science, Engineering, and Technology

Department: Chemistry and Geology

Spring Semester Schedule:

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

Mondays: 8-9:50, 11-12:50, 2-4:50

Tuesdays: (not a good day)

Wednesdays: 11-12:50, 3-4:50

Thursdays: 8-9:50

Fridays: 12-12:50, 3-4:50

Dr. Theresa A. Salerno  
Signature of Applicant

Bruce Lusk  
Signature of Department Chair/Director/Supervisor

[Signature]  
Signature of College Dean/Vice President

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## Using Application and Problem Solving Exercises to Enhance Critical Thinking Skills and Learning in an Allied Health Chemistry Course

### *Purpose of the project:*

The purpose of this project is to enhance student learning through the development of application and problem solving exercises which increase comprehension, information literacy, communication, and critical thinking skills. The target audience is the spring Chemistry 111 class, four sections of approximately 100 pre-nursing, pre-dental hygiene, pre-athletic training, and dietetic majors. Many of these students struggle in the course because of inadequate skill preparation in high school. They don't read carefully, can't package and apply key concepts, and can't express their arguments because of poor writing skills. One goal of this proposed project is to provide weekly exercises to develop these skills.

A second goal is to develop critical thinking skills using problem solving exercises. Critical thinking has multiple definitions but usually involves a written argument based on careful reflection of the evidence. The process involves several steps: identification of the problem, finding relevant information, recognizing relationships and multiple issues, and communicating an argument after careful reflection of the facts (Halx and Reybold 295). Scientific critical thinking is based on understanding of content including concepts and experimental evidence. However, the process must also include the understanding of the limitations of scientific studies and the consideration of societal and ethical issues. It is difficult for students to develop critical thinking without first improving foundation skills of reading comprehension, writing, and information literacy. Students with strong critical thinking skills are more successful in demanding courses and more successful in their careers.

### *Description of the project*

In this proposed course enhancement, weekly application assignments and five unit problem solving exercises will be developed. Students will work in pairs to draft a weekly study outline which will list and apply key concepts. Students will be given links on D2L to reliable sources of chemistry information like PubChem and *Chemical and Engineering News*. Students will research chemistry information and apply it in the context of the summarized weekly learning outcomes.

An example is given below for unit 1. Students will add detailed note summaries and will apply learned concepts to assigned topic applications.

<b>Application Topics</b>	<b>Student Learning Outcomes</b>
<i>Week 1: Sport drinks and toothpaste (identify a minimum of four active ingredients)</i>	Review inorganic ions Atoms vs. ions Covalent vs. ionic bonds Learn key functional groups and organic classes What are the functions of the key chemicals?
<i>Week 2: CFCs and HCFCs Goretex</i>	Learn hydrocarbon naming rules Distinguish between substitution and addition reactions Learn rules for physical properties Why did HCFCs replace CFCs?
<i>Week 3: Fuels- hydrocarbons and ethanol</i>	Learn aromatic structure and naming Learn alcohol naming rules Learn alcohol reactions Learn oxidation schemes

In each unit, students will be given a related problem solving exercise. In unit 1, the question will be:

*Is E85 a better fuel than regular unleaded gasoline? Your argument should consider all aspects of the issue and should be based on fact and at least one scientific study. You are encouraged to communicate with others but this should be your argument.*

### ***Assessment***

Although the literature acknowledges the use of critical thinking assessment tests like the Watson-Glaser Critical Thinking Appraisal, it also supports rubrics which are more specific to the project goals. To assess impact of the project on student learning, quiz and exam scores from the spring 2006 and spring 2007 classes will be compared. This approach has its limitations since the student population is different. My assessment for critical thinking skills will be based on a modification of a rubric successfully used by Washington State University's Critical Thinking Project (Kelly-Riley 6).

Identifies the problem and issues embedded within and clearly states them
Finds reliable sources of information and develops a personal opinion
Identifies other perspectives (argument is not one-sided) (considers limitations, other issues)
Identifies other issues including ethical or societal issues
Makes an argument (conclusions) based on fact/ is critical of limitations in the scientific study

### *Dissemination*

Given the time constraints of the IPESL funding, sharing of project successes and failures and proposed improvements are essential to promoting future critical thinking and student success. The dissemination will occur at three levels. Insight will be shared with middle and high school teachers in STEM forums. Design and assessment will be discussed among science faculty colleagues in the college who teach core courses for allied health students. Finally, projects will be shared with other MNSCU faculty and thus other MNSCU students through an IPESL website.

### *Department/ University Goals*

Enhancing quality undergraduate education is both a department and university goal. Although practicing critical thinking is painful for students and time intensive for faculty, critical thinking and the foundation skills of reading comprehension, writing, and information literacy are essential elements of a quality undergraduate education.

### *Works Cited*

Halx, Mark D. and Reybold, L. Earle "A Pedagogy of Force: Faculty Perspectives of Critical Thinking Capacity in Undergraduate Students." The Journal of General Education 54 (2005): 293-315 .

Kelly-Riley, Diane "Washington State University Critical Thinking Project: Student Learning Outcomes Through Faculty Practice." Assessment Update 15 (2003): 5-7,14.