

11-18-2011

## Achievement Centered Education Program

Eric Malina

*University of Nebraska-Lincoln*, [emalina2@unl.edu](mailto:emalina2@unl.edu)

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Malina, Eric, "Achievement Centered Education Program" (2011). *DBER Speaker Series*. 5.  
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# Achievement Centered Education Program

## Malina's Take on ACE 4

Eric Malina  
Associate Professor of Practice  
Dept. of Chemistry  
emalina2@unl.edu

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## ACE

- New General Education Program (Dec. 2007)
- Focus on Student Learning Outcomes
- Improve education
  - Assessment
  - Faculty reflections
- “ACE places responsibility for the success of the program with the faculty, who create, govern, manage and teach the courses.”
  - From “Hallmarks of ACE” at [ace.unl.edu/aboutace.shtml](http://ace.unl.edu/aboutace.shtml)

See Structural Criteria handout for details

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## ACE Areas

- Skills
    - Writing (ACE 1)
    - Communication (ACE 2)
    - Math / Reasoning (ACE 3)
  - Knowledge
    - Scientific Method (ACE 4)
    - Humanities (ACE 5)
    - Social Sciences (ACE 6)
    - Arts (ACE 7)
  - Responsibilities
    - Ethics / Civics / Stewardship (ACE 8)
    - Diversity (ACE 9)
  - Integrate
    - Generate a creative or scholarly product (ACE 10)
- See Institutional Objectives and Student Learning Outcomes handout

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## ACE Governance

- ACE Subcommittee
  - University Curriculum Committee
  - Review requests
  - Communication to university
  - Remove and/or renew certifications
  - Unanimous vote required

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## ACE Program Assessment

- Instructor
  - Syllabus clearly states ACE outcome and assignment used to assess
  - Provide department with "reasonable sample (at least three)" student products
- Department
  - Reviewing and aggregating samples and summaries
    - Kinds of assessments
    - Student achievement
    - Modifications to improve
  - Providing results and example work to committee
- College
  - Same as department

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## Recertification

- Every 5 years
- Unit must identify
  - How course helps achieve outcome
  - How data helps modify course
  - Any other changes to course since certification

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## Recertification

- Committee's criteria for course
    - Clearly addresses outcome
    - Provides opportunity to develop skills to achieve outcome
    - Provides opportunity to demonstrate outcome
    - Reinforce at least one
      - Writing
      - Oral Communication
      - Visual Literacy
      - Historical Perspectives
      - Mathematics and Statistics
      - Critical Thinking
      - Teamwork
      - Problem Solving
      - Ethics
      - Civics
      - Social Responsibility
      - Global Awareness
      - Human Diversity
    - Assessment data has improved course
    - Department had followed through with responsibilities outlined in the ACE Course Certification Request Form
- See <http://ace.unl.edu/aboutace.shtml> for details

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## Blackboard

- My Organizations
  - ACE Instructors
- ACE Courses
  - Course Tools
    - ACE Sample Submission
      - Upload course syllabus
      - Add evidence samples
      - Add course reflection

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## ACE 4

- [Students will be able to] use scientific methods and knowledge of the natural and physical world to address problems through inquiry, interpretation, analysis, and the making of inferences from data, to determine whether conclusions or solutions are reasonable.

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## ACE 4 Committee & Faculty Learning Community

- Committee
  - Tiffany Heng-Moss
  - Elizabeth Lewis
  - Eric Malina
- Learning Community
  - All ACE 4 instructors

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## Glossary of Terms

- Use scientific methods
- Knowledge
- Inquiry
- Analysis
- Interpretation
- Inferences
- Conclusions and solutions are reasonable

See glossary for details

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## My ACE 4 Journey

- Departmental Syllabus Template
  - Examine ACE 4 meaning
  - Examine ACE 4 assessment
- Scores good at assessing
  - Knowledge
  - Analysis (if designed into exam)
- Scores weak at assessing
  - Use scientific methods
  - Interpretation
  - Inferences
- Scores really can NOT assess
  - Inquiry
  - Conclusions and solutions are reasonable

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## My ACE Journey

- Develop Lab Report
  - Better assessment
    - Use scientific methods
    - Analysis
    - Interpretations
    - Inferences (somewhat)
  - Still lacking good assessment
    - Conclusions and solutions are reasonable
  - Can NOT assess
    - Inquiry
- Rubric modifications to emphasize weak areas

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## My ACE 4 Journey

- New Lab Curriculum
  - Traditional approach
    - Skill building
    - Teaching techniques
  - Inquiry approach
    - More open-ended problems
    - Comparison of techniques
    - Application of skills
  - Develop critical thinking and scientific reasoning skills
  - Assessment covers all areas of ACE 4

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## My ACE 4 Journey

- Department ACE 4 Guru
  - Encourage other faculty
  - Compile department assessment
    - Report to department curriculum committee
  - Improve current practice

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## University of Nebraska-Lincoln

### ACE 4

“[Students will be able to] use *scientific methods* and *knowledge* of the natural and physical world to address problems through *inquiry*, *interpretation*, *analysis*, and the making of *inferences* from data, to determine whether *conclusions or solutions are reasonable*.”

#### Key Terms

*use scientific methods*: demonstrate understanding and/or ability to physical use the tools, skills, and practices appropriate to the discipline that are necessary to conduct scientific investigations

*knowledge*: the scientific concepts (e.g., plate tectonic theory, density, ecosystems) and processes specific to the discipline under study

*inquiry*: the process of formulating appropriate and relevant questions for scientific investigation (referred to as scientific inquiry) (NOTE: Inquiry as an overall process of science would be the culmination of all the terms listed in Learning Outcome #4, thus the focus of the term “inquiry” as a subset within the process would focus on students’ ability to formulate appropriate and relevant questions.)

*analysis*: the processing of data with the appropriate quantitative (which could include statistical means) or qualitative methods (e.g., rich description)

*interpretation*: the making of statements and/or claims supported by available data that help bring meaning to the data

*inferences*: the logical applications and implications of data

*conclusions or solutions are reasonable*: the evaluation of the validity of the experimental conclusions or solutions as supported by the data with reference to other research findings and/or established scientific knowledge

**ACE 4 Reflection**  
**Chemistry 110 – Fall 2010**  
**Eric Malina**

I was only instructor in both Chem 110 courses offered in Fall 2010. Below are my reflections on how my Fall 2010 Chem 110 student did showing ACE Student Learning Outcome #4 (ACE 4).

Exam questions, including the American Chemical Society standardized final exam, show overwhelming evidence of students' ability to use scientific methods and knowledge of the natural and physical world to address problems. My Fall 2010 sections of Chem 110 had average percentiles of 57<sup>th</sup> and 60<sup>th</sup> compared to national norms.

Upon reflection of previous semester's Chem 110 assessment, I designed and implemented a lab practical to help assess ACE 4 specifically. Three written questions and one hands-on task were given to students (see examples). The design was to have...

Question 1 assess the aspect of interpretation of data

Question 2 assess the aspect of determining if conclusions and solutions are reasonable

Question 3 assess the aspect of inferences from data

All three questions assess data analysis

Hands-on task assess use of scientific methods

I planned on assessing student achievement in these areas by looking at average scores on each part; however, TAs who score the students (given grading rubric) and report final scores back to me combined scores for each part into an overall score. Thus, I am not able to assess individual aspects of student achievement on ACE 4.

Looking at overall averages, student success was OK (70% average), but not as high as desired. In general, students demonstrate ACE 4 ability, but TA feedback and looking at the range of scores (standard deviation of 16%) indicates a wide range of student success on ACE 4.

I also asked TAs to copy three reports for me (one good report, one average report, one low scoring report). After examining scores and reports themselves, I concluded that the current rubric has too much emphasis on process of writing the report and not enough about student understanding; therefore, average scores do NOT reflect student abilities with respect to ACE 4. Of the example reports I could read, students are able to show ACE 4 abilities with respect to analysis, interpretation, and inferences of data, and are conclusions or solutions reasonable. The lab reports do not ask student to do inquiry, thus I cannot draw conclusions on students ability in this area.

Future work... Make sure TAs know to report individual scores. Find ways to incorporate more questions like these on exams and find ways to collect those scores for analysis. Also, INQUIRY is VERY tough to incorporate into an assessment. Scoring student questions for appropriateness will require both a good rubric and good TA training.



**ACE 4 Syllabus Template**  
**Department of Chemistry**  
**Taken from Malina's Chem 110 Syllabus – Fall 2011**

**Achievement-Centered Education (ACE) for Chem 110: General Chemistry II**

Chemistry 110 is an Achievement-Centered Education (ACE) course required for UNL graduation. Chem 110 specifically addresses the ACE requirements as follows.

Student Learning Outcome 4. Use scientific methods and knowledge of the natural and physical world to address problems through inquiry, interpretation, analysis, and the making of inferences from data, to determine whether conclusions or solutions are reasonable.

The Student Learning Outcome 4 is embedded in this course through lectures, lecture demonstrations, assignments, and laboratory explorations. Lecture topics address the content knowledge that relates observable phenomena with trends, laws, and theories established through use of the scientific method. Students are taught to see phenomena as vehicles for inquiry into the natural world. Assignments (homework, quizzes) further help students learn to interpret, analyze, and make inferences from data. Students experience multiple ways to arrive at the same conclusions and, therefore, experience ways to determine whether conclusions are reasonable. The laboratory explorations were selected to complement the lecture topics and provide the opportunity for students to engage in guided inquiry of the scientific method.

Student understanding and application of content knowledge is assessed through laboratory reports, personal response system questions, mid-term exams and a final exam. Laboratory reports are used to gauge the students' understanding of the purpose of a testable hypothesis; ability to describe, assess, and analyze the data they collected by identifying appropriate conclusions, relating their findings to the literature, and effectively communicating their findings. Exams consist of problem-based questions about the lecture material and short answer questions. Specific questions from any or all of these assessments can be used to assess students' achievement of Student Learning Outcome 4.

At the end of each academic year, the Chemistry Curriculum Committee will determine the overall student achievement of Student Learning Outcome 4 by analyzing a reasonable sample of students' work (examples: final exam, late-semester laboratory report) each semester. Results will be communicated to appropriate ACE committees (individual student results will be kept anonymous).

Problem solving is the primary skill reinforced by this course. Problem solving is reinforced in multiple aspects of this course (lecture, lab, assignments) through the use of the scientific method to solve chemical problems.



# *Achievement-Centered Education*

UNL's General Education Program

## **Institutional Objectives and Student Learning Outcomes**

Develop intellectual and practical **skills**, including proficiency in written, oral, and visual communication; inquiry techniques; critical and creative thinking; quantitative applications; information assessment; teamwork; and problem-solving.

1. Write texts, in various forms, with an identified purpose, that respond to specific audience needs, incorporate research or existing knowledge, and use applicable documentation and appropriate conventions of format and structure.
2. Demonstrate communication competence in one or more of the following ways: (a) by making oral presentations with supporting materials, (b) by leading and participating in problem-solving teams, (c) by employing a repertoire of communication skills for developing and maintaining professional and personal relationships, or (d) by creating and interpreting visual information.
3. Use mathematical, computational, statistical, or formal reasoning (including reasoning based on principles of logic) to solve problems, draw inferences, and determine reasonableness.

Build **knowledge** of diverse peoples and cultures and of the natural and physical world through the study of mathematics, sciences and technologies, histories, humanities, arts, social sciences, and human diversity.

4. Use scientific methods and knowledge of the natural and physical world to address problems through inquiry, interpretation, analysis, and the making of inferences from data, to determine whether conclusions or solutions are reasonable.
5. Use knowledge, historical perspectives, analysis, interpretation, critical evaluation, and the standards of evidence appropriate to the humanities to address problems and issues.

6. Use knowledge, theories, methods, and historical perspectives appropriate to the social sciences to understand and evaluate human behavior.
7. Use knowledge, theories, or methods appropriate to the arts to understand their context and significance.

Exercise individual and social **responsibilities** through the study of ethical principles and reasoning, application of civic knowledge, interaction with diverse cultures, and engagement with global issues.

8. Explain ethical principles, civics, and stewardship, and their importance to society.
9. Exhibit global awareness or knowledge of human diversity through analysis of an issue.

**Integrate** these abilities and capacities, adapting them to new settings, questions, and responsibilities.

10. Generate a creative or scholarly product that requires broad knowledge, appropriate technical proficiency, information collection, synthesis, interpretation, presentation, and reflection.

*Approved by UNL faculty as of January 2008.*



# *Achievement-Centered Education*

**UNL's General Education Program**

## **Structural Criteria**

Graduates of the University of Nebraska–Lincoln will satisfy the requirements of their majors, their colleges, and the ACE Program.

1. ACE courses are credit-bearing curricular offerings or equivalent documented co-curricular experiences.
2. The ACE program will consist of the equivalent of three credit hours for each of the ten ACE Student Learning Outcomes.
3. Any ACE course approved to satisfy an ACE Student Learning Outcome satisfies that Student Learning Outcome in all undergraduate colleges.
4. Up to three ACE Student Learning Outcomes 4-10 may be satisfied by work in one subject area.
5. ACE Student Learning Outcomes must be satisfied by work in at least three subject areas.
6. Any ACE course may be approved to address a maximum of two ACE Student Learning Outcomes.
7. No ACE course may satisfy more than one ACE Student Learning Outcome in a student's program.
8. If an ACE course addresses two ACE Student Learning Outcomes, the student decides which one of the two Outcomes the course will satisfy in that student's program.
9. Every ACE course will reinforce at least one of the following as appropriate for the discipline and as identified by the department offering the course: Writing, Oral Communication, Visual Literacy, Historical Perspectives, Mathematics and Statistics, Critical Thinking, Teamwork, Problem Solving, Ethics, Civics, Social Responsibility, Global Awareness, or Human Diversity.

*Approved by UNL faculty as of January 2008.*