

Texas A&M University

**Core Curriculum**

*Initial Request for a Course Addition to the Fall 2014 Core Curriculum*

**Foundational Component Area: Life and Physical Sciences**

In the box below, describe how this course meets the Foundational Component Area description for Life and Physical Sciences. Courses in this category focus on describing, explaining, and predicting natural phenomena using the scientific method. Courses involve the understanding of interactions among natural phenomena and the implications of scientific principles on the physical world and on human experiences.

The proposed course must contain all elements of the Foundational Component Area. How does the proposed course specifically address the Foundational Component Area definition above?

CHEM102/112, a lecture/laboratory pair of courses with a mandatory co-registration requirement, are the second in a two-semester sequence that present an introduction to chemistry for students who intend to pursue a degree programs in science or allied fields. These courses focus on intermolecular forces and the properties they engender, chemical thermodynamics and kinetics, equilibrium between phases and between species in solution, and electrochemistry. When time permits, the basics of nuclear chemistry are presented as well. Connections between these concepts and real-life applications in health, environmental science, energy resources, and material science are countless. To name a few examples that are often introduced: freezing point depression is related to the salting of roads in winter; the study of equilibrium is related to ammonia production and the importance to Germany in WWI; automobile catalytic converters and their use in reducing the release of carbon monoxide is discussed; batteries and fuel cells are related to the proposed "hydrogen economy;" and nuclear radiation's application to medical imaging, such as PET scans is introduced. Students achieve their learning objectives by their participation in lectures, lecture demonstrations, videos, individual and team-based problem solving sessions (in class and out), and laboratory experiments. In particular, the laboratory component implements the use of the scientific method to reinforce and provide supplemental information related to lecture topics.

**Core Objectives**

Describe how the proposed course develops the required core objectives below by indicating how each learning objective will be addressed, what specific strategies will be used for each objective and how student learning of each objective will be evaluated.

The proposed course is required to contain each element of the Core Objective.

Critical Thinking (to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information):

The scientific method is the fundamental basis of both lecture and lab. Lectures introduce knowledge derived from historical scientific experiments and how scientific theories have evolved with the need to accommodate new data that revealed the inadequacies of older theories. Lecture exams include questions to assess students' ability to retain fundamental facts of chemistry, for critical thinking, quantitative analysis, and their capacity for synthesizing and integrating information in problem solving. The CHEM112 laboratory course continues the use of pre-lab quizzes to enhance academic and safety preparation. These labs involve more sophisticated data acquisition and analysis than students have yet experienced; they gain experience with spectroscopic and electrochemical measurements in addition to 'wet chemical' techniques associated with study of acids, bases, and equilibrium. The laboratory culminates in a final exam that includes all concepts, calculations, and procedures learned during the semester.

Communication (to include effective development, interpretation and expression of ideas through written, oral and visual communication):

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Students extend their knowledge of chemical vocabulary, now involving description of thermodynamic terms and concepts, reaction rates expressions, terms describing electrochemical apparatus. Both lecture and lab utilize visual communication through the preparation and interpretation of graphs, tables, and figures. Students are required to express quantitative relationships orally and in written mathematical form. In the laboratory, several experiments are dedicated to the manipulation and graphical depiction of scientific data and in the written communication of how the experiments' objectives have been met in the procedures and apparatus used in each experiment. The collaborative nature of the laboratory requires effective oral communication between partners. Lab reports, homework, and exams require students to extend their use this new language.

Empirical and Quantitative Skills (to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions):

CHEM102/112 students are required to manipulate and interpret numerical data in terms of chemical theory when covering most of the the courses' topics. Building on knowledge of bonding learned in Chem 101/111, they are first exposed to a descriptive treatent of intermolecular forces and their influence on the liquid and solid staes of matter. The laws of thermodynamics are given their first overall exposition – both taxing and honing their ability to apply mathematics and physics. In addition to comfort with algebra and functions, students begin to see application of calculus on an occasional basis where pedagogically advantageous. We attempt to strike a balance between the concrete, physical nature of chemistry and the numerical and abstract mathematical tools needed to grasp the breadth of deeper material covered in the second semester of the two-semester sequence. We draw upon and extend students' knowledge of basic physics (e.g., kinetic and potential energy, basic understanding of electrostatics, and heat), Both thermodynamic and chemical kinetic data are discussed in lectures and gathered in the laboratory and subjected to numerical fitting and comparison with expectations/predictions from theory.

Teamwork (to include the ability to consider different points of view and to work effectively with others to support a shared purpose or goal):

Teamwork is an essential part of all laboratory work, since students all work in pairs every week and share all data collected. In the conduct of some experiments, students will work in "pairs of pairs" in the use of shared instrumentation. Students write their own laboratory reports and quickly learn that effective teamwork and communication during the active observational/data-acquisition phase of the experiment is crucial when they must use the data on their own to generate their interpretations and conclusions. Several experiments utilize class data-sharing and collaboration. In a titration experiment, data obtained by each pair of students is collected and collected class data is used guide the class to a "big picture" model system. In a two-week course project the entire class works to prepare a stock supply of modified clay that is then used in adsorption experiments when smaller individual groups test their self-designed experiments. Teamwork is assessed by direct observation of the lab instructor and the assignment of appropriate participation points.

Most instructors use 'clickers' during the lecture periods and collaboration in answering clicker questions is actively encouraged; learning is reinforced when students informally instruct other students (and lessons are learned by all when wrong answers are arrived at collaboratively!) On-line homework allows for meaningful, graded homework exercises – and in this process of active learning student collaboration is certainly allowed, so long as a balance of individual and group effort is maintained.

**Please be aware that instructors should be prepared to submit samples/examples of student work as part of the future course recertification process.**

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