# General Education Assessment and Review Form – Natural Science (Group XI, N) 5/15

Please attach/ submit additional documents as needed to fully complete each section of the form.

## I. Course Information

Department: **Chemistry and Biochemistry** Course Number: **CHMY 141**  
Course Title: **College Chemistry**

Lab Status: **X**  With Lab Without Lab   
  
Type of Request: New One-time Only **X** Renew \* Change Remove  
Rationale: **This is a core course in the curriculum** **and serves as a foundation for** **many students.**

\*If course has not changed since the last review and is taught by the same tenure-track faculty member, you may skip sections III-V.

### justification for course level

Normally, general education courses will not carry pre-requisites, will carry at least 3 credits, and will be numbered at the 100-200 level.If the course has more than one pre-requisite, carries fewer than three credits, or is upper division (numbered at the 300 level or above), provide rationale for exception(s).  
**Not applicable**

## II. Endorsement / Approvals

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\* Instructor: Signature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_  
 Phone / Email:   
Program Chair: Signature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_  
Dean: Signature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_

\*Form must be completed by the instructor who will be teaching the course. If the instructor of the course changes before the next review, the new instructor must be provided with a copy of the form prior to teaching the course.

## iii. Description and Purpose

General Education courses must be introductory and foundational within the offering department or within the General Education Group. They must emphasize breadth, context, and connectedness; and relate course content to students’ future lives: See Preamble

We follow the standard curriculum in the United States, as suggested by the American Chemical Society. This is the first semester of a two-semester sequence. The sequence provides an introduction to the principles of physical and inorganic chemistry appropriate for the level of knowledge necessary for students who plan on majoring in the health sciences, engineering, or the sciences. A major theme of the course is to introduce you to the chemist's view of the universe, with an emphasis on making connections between the macroscopic and the particulate levels of matter.

## iv. Criteria

Briefly explain how this course meets the criteria for the group.

1. Courses explore a discipline in the natural sciences and demonstrate how the scientific method is used within the discipline to draw scientific conclusions:

**The scientific method is addressed throughout the course. For example, the first lesson is titled "What is Science?", and it follows the discovery of oxygen as an example of the application of the scientific method. It is also addressed in the inquiry-based laboratory portion of the course.**

1. Courses address the concept of analytic uncertainty and the rigorous process required to take an idea to a hypothesis and then to a validated scientific theory;   
     
   **We introduce uncertainty in measurement in Section 2.2, "How is Uncertainty in Measurement Expressed?" This thread is followed throughout the course, as is the scientific method. These issues are also addressed in the inquiry-based laboratory portion of the course.**
2. Lab courses engage students in inquiry-based learning activities where they formulate a hypothesis, design an experiment to test the hypothesis, and collect, interpret, and present the data to support their conclusions.

**The laboratory portion of the course truly embraces this criterion because it is based in inquiry. The title of the lab manual is Inquiries into Chemistry. The lab curriculum includes a mix of guided inquiry and open inquiry. Guided inquiry exercises guide students through data collection, leaving data analysis and drawing conclusions to the student. Open inquiry exercises require students to work through the entire process listed in this criterion without guidance.**

## v. Student Learning Goals

Briefly explain how this course will meet the applicable learning goals.

1. Understand the general principles associated with the discipline(s) studied;   
   We follow the standard curriculum in the United States, as suggested by the American Chemical Society. We use the first-term general chemistry exam produced by the American Chemical Society as the final exam, and each semester, one or more students has scored in the 100th percentile nationally, and the average is typically in the 70-80th percentile range.
2. Understand the methodology and activities scientists use to gather, validate and interpret data related to natural processes;  
     
   The scientific method is addressed throughout the course. The general pattern used in the textbook and in lecture is a data-to-concepts sequence. It is also addressed in the inquiry-based laboratory portion of the course.
3. Detect patterns, draw conclusions, develop conjectures and hypotheses, and test them by appropriate means and experiments;

The scientific method is addressed throughout the course. The general pattern used in the textbook and in lecture is a data-to-concepts sequence. It is also addressed in the inquiry-based laboratory portion of the course.

1. Understand how scientific laws and theories are verified by quantitative measurement, scientific observation, and logical/critical reasoning; and

The scientific method is addressed throughout the course. The general pattern used in the textbook and in lecture is a data-to-concepts sequence. It is also addressed in the inquiry-based laboratory portion of the course.

1. Understand the means by which analytic uncertainty is quantified and expressed in the natural sciences.  
     
   We introduce uncertainty in measurement early in the course, and this thread is followed throughout the course, as is the scientific method. These issues are also addressed in the inquiry-based laboratory portion of the course.

## vi. Assessment

A. How are the learning goals above measured? Describe the measurement(s) used, such as a rubric or specific test questions that directly measure the General Education learning goals. Please attach or provide a web link to the rubric, test questions, or other measurements used.

**Course**

**Five pretests, described below, were administered in the first two weeks of the 16-week first-semester course during the regularly-scheduled laboratory meeting. Ten points (of 1000 course points) of the laboratory points were assigned to pretest participation. The time allotted for administration of each instrument was based on experience with administering the instruments in the previous academic year, and it was sufficient for what we observed as allowing every student to finish completely and without time pressure. The first-semester posttest, also described below, was administered during the scheduled final examination period in the 16th week of the Autumn semester. The academic-year-posttest will be administered during the scheduled final examination period in the 16th week of the Spring semester.**

**Instruments:**

**Pretests:**

1. **Knowledge of topics associated with alternate conceptions: Chemistry Concepts Inventory (CCI)**
2. **Intelligence: Raven Standard Progressive Matrices–Plus Version (SPM+)**
3. **Scientific Reasoning Ability: Classroom Test of Scientific Reasoning (CTSR)**
4. **Proportional Reasoning Ability: Paper and Pencil Balance Beam Task (PPBBT)**
5. **Attitude Toward Chemistry: Attitude toward the Subject of Chemistry Inventory (Version 2) (ASCI V2)**

**Posttests:**

1. **American Chemical Society Division of Chemical Education First Term General Chemistry Examination, Form 2009 (ACS 1st)**
2. **American Chemical Society Division of Chemical Education General Chemistry Examination, Form 2013 (ACS AY)**

**Laboratory:**

1. **The first survey (Week 8) was a list of ten questions that students have to decide if the question was a legitimate question that could be tested by direct observation and/or gathering of data.**
2. **The second survey was given a scientific question from which students had to develop a hypothesis.**

**A General Education Assessment Report will be due on a four-year rotating cycle.** You will be notified in advance of the due date. This will serve to fulfill the University’s accreditation requirements to assess general education and will provide an opportunity to connect with your colleagues across campus and share teaching strategies. Items VI.B- D will be helpful in compiling the report.

### B. AChievement targets

[This section is optional. Achievement targets can be reported if they have been established.]

Describe the desirable level of performance for your students, and the percentage of students you expected to achieve this:

**The mean score on the nationally-standardized final should be at or above the national mean.**

### C. Assessment Findings

[This section is optional. Assessment findings can be reported if they are available.]

**What were the results/findings, and what is your interpretation/analysis of the data?** (Please be detailed, using specific numbers/percentages when possible. Qualitative discussion of themes provided in student feedback can also be reported. Do NOT use course grades or overall scores on a test/essay. The most useful data indicates where students’ performance was stronger and where it was weaker. Feel free to attach charts/tables if desired.)

**Laboratory:**

**1. Scientific Question Analysis**

**Rubric:**

**3 = a well written question that can be tested via by experimentation and data gathering**

**1 = written question but not pertintent or worded properly**

**0 = Can not develop a question in any sense**

**Results:**

**Out of 101 students only twelve scored less than perfect with just three students scoring less than seven out of ten. Overall students with some minimal example showing and discussion are able to grasp how to formulate a question that could be tested with experiments and collection of data.**

**2. Hypothesis Development**

**Rubric:**

**5 = Exceeds Expectations**

**Hypothesis resembles one that would be posed by a practicing scientist. Clear connection between research question, hypothesis, and predicted outcome of experiment.  Hypothesis is causal.**

**4 = Meets Expectations**

**Hypothesis is at the level expected for a student in general chemistry. Clear connection between research question, hypothesis, and predicted outcome of experiment. Hypothesis may be descriptive or statistical.**

**3 = Nearing Expectations**

**Hypothesis has a minor flaw. Could be missing one logical connection between research question, hypothesis, and predicted outcome of experiment. Hypothesis may be causal, descriptive or statistical.**

**2 = Inadequate**

**Hypothesis has a major flaw. Could be missing one ore more logical connections between research question, hypothesis, and predicted outcome of experiment. Hypothesis may be causal, descriptive or statistical.**

**1 = Poor**

**Statement given is not a scientific hypothesis. Statement may be a predicted outcome, has logical flaws, or demonstrates a scientific misconception.**

**0 = Did not Complete by Due Date**

**Results:**

**Scores varied from 0-3. Out of the 60 students that completed the exercise five students scored a 3.0, and twenty students had average scores from 2-2.5 while the rest were 1.0 and below. Developing a hypothesis is a difficult endeavor for students. This survey was done on a beginning group of chem 141 students who tried their first hypothesis exercise after a preliminary discussion about scientific question and hypothesis. In comparison, students in the chem 143 series who have completed several projects in an open inquiry format in which they must develop a science question, followed by a hypothesis, experimental design, data collection, results/conclusion and finally a presentation have increased their ability to formulate a hypothesis. This part of the data is qualitative since we have not tested this group but just by formal lab report and oral presentation methods. These students have done better to some degree as expected with an extra semester of work and more projects but are far from the level of mastering a developed hypothesis.**

### D. Assessment Feedback

[This section is optional. Assessment feedback can be reported if it is available.]

Given your students’ performance the last time the course was offered, how will you modify the course to enhance learning? You can also address how the course could be improved, and what changes in the course content or pedagogy you plan to make, based upon on the findings. Please include a timeframe for the changes.  
 **1. Development of scientific reasoning skills.**

**We cannot report on gains in scientific reasoning skills until after the posttest is administered.**

**2. Development of content knowledge.**

**The first-semester course content knowledge goal indicates that students are learning more content than the national average. Our average of 47.7 (SD = 12.1) favorably compares with the national average of 37.13 (SD = 11.39). Our average student is about one standard deviation above the nation’s average student. This translates to the average student scoring in approximately the 68th percentile nationally. Thus, we do not plan to make major changes to the lecture and workshop curriculum.**

**3. Development of understanding of the nature of science.**

**No students met or exceeded expectations of the ability to develop a scientific hypothesis. We are very concerned with this result. The course coordinator and the laboratory coordinator will initiate work on an action plan in Summer 2015.**

## vii. Syllabus and Submission

Please submit syllabus in a separate file with the completed and signed form to the Faculty Senate Office, UH 221. The learning goals for the Natural Science Group must be included on the syllabus. An electronic copy of the original signed form is acceptable.