Part 1: Degree Programs and Mission for this Academic Unit:

Students majoring in chemistry will be provided with a sound and comprehensive grasp of the basic principles of chemistry and the practical laboratory skills necessary for the range of professional careers into which they enter. The students will have a thorough knowledge of content and related problem-solving skills that will enable them to succeed in graduate or professional school or in entry-level employment in a chemically oriented position. The importance of research as part of chemical education is recognized and the chemistry faculty encourages majors to participate in undergraduate research and present their results at professional meetings.

Part 1: Degree Programs
Northwestern Oklahoma State University offers a baccalaureate degree in chemistry. The chemistry faculty and the head of the Department of Natural Sciences are responsible for the assessment of the program.
Part 2: The Assessment of the Basic Use of Computers

Students majoring in chemistry will be required to use a computer to: write laboratory reports, research various topics, complete Internet assignments and perform mathematical manipulations such as graphing, data analysis and calculations of error analysis.
Form B: ASSESSMENT PLAN
Goals, Methods for Measurement, Criteria for Success

Natural Sciences
(Department)

Chemistry
(Degree Area)

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(Form Completed By)  Fall 2006-Spring 2007
Report for Academic Year

Program/Student Outcome Goal #1
Content Knowledge - General Chemistry
As a result of majoring in chemistry, students will be able to demonstrate knowledge of atomic and molecular structure, nomenclature, stoichiometry, chemical bonding, states of matter, solutions, acids and bases, thermochemistry, gas laws, kinetics, equilibrium, thermodynamics, electrochemistry, and nuclear chemistry. The knowledge will form the foundation for later courses.

Assessment Methodology #1 for Goal #1
Standardized Exam

Description of Methodology
The American Chemical Society (ACS) publishes standardized, nationally normed, exams for each semester of the introductory chemistry course. The ACS standardized exam will be given as the final at the end of the Fall and Spring semesters respectively after a student completes each sequence of General Chemical I and II. The results for each student will be kept on file in the Department and the compilation of these results will be used to assess the knowledge of general chemical principles acquired by the students.

Criteria for success: For Goal #1 to be considered successful, 75% of the students enrolled in General Chemistry will meet the following criteria. A student receiving an A in General Chemistry should answer at least the number of questions* (see below) correctly that correspond to the 50th percentile of the nationally normed standardized ACS final. A student receiving a B should score answer a minimum of seven less that the above number corresponding to the 50th percentile (based on difference of 10% of problems), and a C student would be expected to answer correctly at least 14 less than the number corresponding to the 50th percentile.
* The chemistry program at NWOSU is not ACS accredited and our students are not able to answer all of the questions in each of the ACS standardized exams because not all ACS topics in chemistry are taught. Therefore, some questions are removed from the exam to more fairly assess student performance in chemistry courses taught at NWOSU. Given this constraint, the ACS raw grades should be scaled using the formula below:

$$\text{Equivalent} = \frac{\text{ACS raw score}}{\text{ACS score}} \times \frac{(\text{total # of question in exam})}{(\text{actual # of questions given})}$$

This formula scales the raw ACS scores to an equivalent ACS score that is based on an exam (the ACS exam specifically) containing a total number of 70 questions. This is a valid scaling method to evaluate students’ understanding of what was actually taught in our classes as long as the testing time is an appropriately scaled length of that prescribed by the ACS.

Assessment Methodology #2 for Goal #1
Syllabi Review

**Description of Methodology**
The syllabi for General Chemistry (1115 and 1215) will be reviewed to make sure the adequate material is being taught for the students to have a basic working knowledge of general chemistry.

**Criteria for success:** Goal #1 will be successful if the topics in the Goal #1 are taught during the year-long chemical principles sequence.

RESULTS FOR THIS METHODOLOGY WILL BE REPORTED ANNUALLY.

Program/Student Outcome Goal # 2
Content Knowledge-Organic Chemistry
Students majoring in chemistry will be able to demonstrate knowledge about the chemistry of organic compounds including spectroscopy, nomenclature, functional groups, reactions, mechanisms and stereochemistry. The knowledge of organic chemistry acquired will provide the essential background needed for graduate or a pre-professional school as well as chemical employment.

Assessment Methodology #1 for Goal #2
Standardized Exam

**Description of Methodology**
The American Chemical Society (ACS) publishes a standardized, nationally normed, exam for a year-long organic chemistry course. The ACS standardized exam will be given as the final at the end of 4115 Organic Chemistry II. The results for each student will be kept on file in the Department and the compilation of these results will be used to assess the knowledge of organic chemistry acquired by the students.

**Criteria for success:** For Goal #2 to be considered successful, 75% of the students enrolled in Organic Chemistry will meet the following criteria. A student receiving an A in the final semester of organic chemistry should answer at least the number of questions correctly that correspond to the 50th percentile of the nationally normed standardized ACS final. A student receiving a B should score answer a minimum of seven less that the above number corresponding to the 50th percentile, and a C student would be expected to answer correctly at least 14 less than the number corresponding to the 50th percentile.

**Assessment Methodology #2 for Goal #2**

**Syllabi Review**

**Description of Methodology**
The syllabi for organic chemistry (3115 and 4115) will be reviewed to make sure the adequate material is being taught for the students to have a basic working knowledge of organic chemistry.

**Criteria for success:** Goal #2 will be successful if the topics in the Goal #2 are taught during the year-long organic chemistry sequence.

**Program/Student Outcome Goal #3**

**Content Knowledge - Analytical Chemistry**
As a result of majoring in chemistry, students will be familiar with the principles of chemical stoichiometry and equilibrium, gravimetric and volumetric analysis, optical and electrochemical methods, and quantitative and qualitative analysis. The students will be knowledgeable of simple instrumental methods and separation techniques required as background for graduate school or employment in an industrial setting.

**Assessment Methodology #1 for Goal #3**

**Standardized Exam**

**Description of Methodology**
The American Chemical Society (ACS) publishes a standardized, nationally normed, exam for analytical chemistry. An ACS standardized exam will be given as the final in Classical Chemical Analysis (3015) and Instrumental Chemical Analysis (3025). The results for each student will be kept on file in the Department and the compilation of these results will
be used to assess the knowledge of analytical chemistry acquired by the students.

**Criteria for success:** For Goal #3 to be considered successful, 75% of the students enrolled in both semesters of the analytical chemistry course sequence will meet the following criteria. A student receiving an A in each of the corresponding classes of analytical chemistry should answer at least the number of questions* correctly that correspond to the 50th percentile of the nationally normed standardized ACS final. A student receiving a B should score at least six less that the above number corresponding to the 50th percentile, and a C student would be expected to answer correctly at least 12 less than the number corresponding to the 50th percentile.

* The chemistry program at NWOSU is not ACS accredited and our students are not able to answer all of the questions in each of the ACS standardized exams because not all ACS topics in chemistry are taught. Therefore, some questions are removed from the exam to more fairly assess student performance in chemistry courses taught at NWOSU. Given this constraint, the ACS raw grades should be scaled using the formula below:

\[
\text{Equivalent} = \frac{\text{ACS raw score}}{\text{ACS score}} \times \left( \frac{\text{total # of questions in exam}}{\text{actual # of questions given}} \right)
\]

This formula scales the raw ACS scores to an equivalent ACS score that is based on an exam (the ACS exam specifically) containing a total number of 50 questions. This is a valid scaling method to evaluate students’ understanding of what was actually taught in our classes as long as the testing time is an appropriately scaled length of that prescribed by the ACS.

RESULTS FOR THIS METHODOLOGY WILL BE REPORTED BIENNALLY.

**Assessment Methodology #2 for Goal #3**
Syllabi Review

**Description of Methodology**
The syllabi for Classical Chemical Analysis (3015) and Instrumental Chemical Analysis (3025) will be reviewed to make sure the adequate material is being taught for the students to have a basic working knowledge of analytical chemistry.

**Criteria for success:** Goal #3 will be successful if the topics in the Goal #3 are being taught to the students.
RESULTS FOR THIS METHODOLOGY WILL BE REPORTED BIENNIALLY.

Program/Student Outcome Goal # 4
Content Knowledge - Physical Chemistry
The student will obtain knowledge and skills of physical chemistry including chemical thermodynamics, chemical kinetics and introductory quantum mechanics as well as some topics selected from: electrochemistry, polymer chemistry, spectroscopy, statistical thermodynamics and surface chemistry.

Assessment Methodology #1 for Goal #4
Standardized Exam

Description of Methodology
The American Chemical Society (ACS) publishes standardized, nationally normed, exams for both semesters of physical chemistry. The ACS standardized exam will be given as the final in both the Fall and Spring semester respectively after a student completes Physical Chemistry I and II (4355 and 4365). The results for each student will be kept on file in the Department and the compilation of these results will be used to assess the knowledge of physical chemistry acquired by the students.

Criteria for success: For Goal #4 to be considered successful, 75% of the students enrolled in both semesters of the physical chemistry course sequence will meet the following criteria. A student receiving an A in each of the corresponding classes of physical chemistry should answer at least the number of questions* correctly that correspond to the 50th percentile of the nationally normed standardized ACS final. A student receiving a B should score answer a minimum of six less that the above number corresponding to the 50th percentile, and a C student would be expected to answer correctly at least 12 less than the number corresponding to the 50th percentile.

* The chemistry program at NWOSU is not ACS accredited and our students are not able to answer all of the questions in each of the ACS standardized exams because not all ACS topics in chemistry are taught. Therefore, some questions are removed from the exam to more fairly assess student performance in chemistry courses taught at NWOSU. Given this constraint, the ACS raw grades should be scaled using the formula below:

\[
\text{Equivalent} = \frac{\text{ACS raw score}}{\text{ACS score}} \times \frac{\text{total # of question in exam}}{\text{actual # of questions given}}
\]

This formula scales the raw ACS scores to an equivalent ACS score that is based on an exam (the ACS exam specifically) containing a total number of 40 questions. This is a valid scaling method to evaluate students’
understanding of what was actually taught in our classes as long as the testing time is an appropriately scaled length of that prescribed by the ACS.

Assessment Methodology #2 for Goal #4
Syllabi Review

Description of Methodology
The syllabi for Physical Chemistry I (4355) and Physical Chemistry II (4365) will be reviewed to make sure the adequate material is being taught for the students to have a basic working knowledge of physical chemistry.

Criteria for success: Goal #4 will be successful if the topics in the Goal #4 are being taught to the students.

RESULTS FOR THIS METHODOLOGY WILL BE REPORTED BIENNIALY.

Program/Student Outcome Goal # 5
Practical Laboratory Skills
As a result of obtaining a baccalaureate degree in chemistry, the student will have laboratory experience in the synthesis and characterization of inorganic and organic compounds. The students will be familiar with various separation techniques such as recrystallization, various forms of chromatographic separations, distillation, and extraction. The student will also have knowledge of the principles of chemical analyses and instrumental methods including: the application of statistics to data, gravimetry, titrimetry, optical spectroscopy, and selected electrochemical methods.

Assessment Methodology #1 for Goal #5
Laboratory Skills

Description of Methodology
Each student will be required to perform labs in general chemistry, organic chemistry, analytical chemistry, and physical chemistry. The labs must be completed before credit in a given course can be earned.

Criteria for Success
Goal #5 will be successful, if 80% of the students complete each lab with a passing grade.

RESULTS FOR THIS METHODOLOGY WILL BE REPORTED ANNUALLY.

Assessment Methodology #2 for Goal #5
Alumni Survey
Description of Methodology
A short alumni survey will be sent to past chemistry majors to assess how they felt the laboratory skills they obtained while at NWOSU prepared them for their current position.

Criteria for Success: A ranking of satisfactory or excellent from the majority of those completing the survey will be the criteria for the student gaining practical laboratory skills.

RESULTS FOR THIS METHODOLOGY WILL BE REPORTED ANNUALLY.

Program/Student Outcome Goal #6
Computer Use
As a result of obtaining a baccalaureate degree in chemistry, the student will have acquired skills in the basic use of a computer. Skill will be developed in: word processing, data manipulation and analysis, on-line searching, and data collection using interfaced equipment.

Assessment Methodology #1 for Goal #6
Laboratory Reports

Description of Methodology
The students will be required to write their own laboratory reports giving them experience in word processing and data manipulation.

Criteria for Success: If a laboratory report that has been generated by a word processing program is turned in for grade evaluation. A passing grade on 80% of the assignments will be considered successful.

RESULTS FOR THIS METHODOLOGY WILL BE REPORTED ANNUALLY.

Assessment Methodology #2 for Goal #6
Class Assignments

Description of Methodology
Students will be required to write term papers in which they will have to use the internet for on-line searching and data collection. They will then be required to type the report giving them experience in word processing and data manipulation.
**Program/Student Outcome Goal # 7**

**Communication Skills**

Students will be able to communicate the results of experimental investigations in the form of written and oral reports.

**Assessment Methodology #1 for Goal #7**

**Written Laboratory Reports**

**Description of Methodology**

Students will be required to write laboratory reports for experiments conducted in chemical principles, organic chemistry, chemical analysis, and physical chemistry.

**Criteria for Success:** A passing grade on 80% of the lab reports will be considered successful.

**RESULTS FOR THIS METHODOLOGY WILL BE REPORTED ANNUALLY.**

**Assessment Methodology #2 for Goal #7**

**Oral Presentations**

**Description of Methodology**

Students will be required to give an oral presentation on an instrumental chemical analysis technique or an organic compound with significant medical importance.

**Criteria for Success:** A passing grade on 80% of the assignments will be considered successful.

**RESULTS FOR THIS METHODOLOGY WILL BE REPORTED ANNUALLY.**

**Program/Student Outcome Goal # 8**

**Problem-Solving Skills**

Students will have the ability to examine a problem, collect relevant data, determine a solution for the problem, and assess the significance of their solution.
Assessment Methodology #1 for Goal #8

Course Performance

Description of Methodology
The graded material in the lecture portion of all classes consists of questions and problems designed to assess the students understanding of key chemical concepts and their ability to use this information to solve problems. Thus, assessment of problem solving skills can be directly correlated with course performance.

Criteria for Success: Goal #8 will be considered successful if 80% of the students receive a passing grade in each course.

RESULTS FOR THIS METHODOLOGY WILL BE REPORTED ANNUALLY.

Assessment Methodology #2 for Goal #8

Alumni Survey

Description of Methodology
A short alumni survey will be sent to past chemistry graduates three years after they graduated to assess how they felt their chemistry problem solving skills they developed while at NWOSU prepared them for their current position.

Criteria for Success: A ranking of satisfactory or excellent from the majority of those completing the survey will be the criteria for the student gaining adequate problem solving skills.

RESULTS FOR THIS METHODOLOGY WILL BE REPORTED ANNUALLY.

Program/Student Outcome Goal #9

Anecdotal Student Review of Chemistry Program
Senior students graduating with a chemistry degree during the assessment period will be allowed to express their opinions about their chemistry education at NWOSU in the form of exit surveys and informal panel discussions with chemistry faculty on Assessment Day.

Assessment Methodology #1 for Goal #9

Exit Surveys

Description of Methodology
An exit survey will be designed and administered by the Chair or non-chemistry science faculty to senior chemistry students during their last
semester or on Assessment Day. Student comments will be kept confidential until all final grades are administered and the student has graduated so the student will feel comfortable answering questions honestly and frankly. Questions will cover their opinions of facilities, structure of classes and labs, career advisement at NWOSU and their future postgraduate career plans, whether they feel they obtained satisfactory laboratory and problem-solving skills and open suggestions for improvement. After the student graduate, chemistry faculty may then view and use student’s written survey comments.

Criteria for Success: Goal #9 will be considered successful if 75% of the student respondents feel they have received a satisfactory chemistry education.

RESULTS FOR THIS METHODOLOGY WILL BE REPORTED ANNUALLY.

Assessment Methodology #2 for Goal # 9
Informal Panel Discussion

Description of Methodology
Informal panel discussions with graduating chemistry seniors and a panel of chemistry faculty and the Chair or a non-chemistry science faculty member will take place during the student’s last semester on during Assessment Day at NWOSU. Having a non-chemistry science faculty member on the panel will decrease biases in reporting and evaluating student responses. Students will also be reassured that their opinions will not be used in a punitive fashion for their class grades and only are to be used to improve the chemistry program. Free discussions between graduating seniors and faculty panel members will allow students to express their opinions firsthand to faculty. Chemistry faculty will construct panel questions and topics and use these same or similar questions each year for graduating chemistry students. An advantage to this tool to the written survey is that topic areas can be expanded and explored directly with the student as needed.

Criteria for Success: Goal #9 will be considered successful if 75% of the student respondents feel they have received a satisfactory chemistry education.

RESULTS FOR THIS METHODOLOGY WILL BE REPORTED ANNUALLY.