OUTCOMES ASSESSMENT PLAN
FOR THE CORE CURRICULUM
OFFERED BY THE
DEPARTMENT OF CHEMISTRY & BIOCHEMISTRY

Hypothesis 1. Placement exams can help determine the needs and strengths of incoming 100-level students.

Hypothesis 2. Placement exams can help predict which students are going to experience difficulties in the course and hence need special advising.

Hypothesis 3. Standardized exams may be used to verify student progress as they complete a 100-level sequence.

Rejection of Hypothesis 1. A standardized Chemistry Diagnostic Test (such as the California version of the ACS Chem Ed Exams) will be provided to Chem 105X students in their first week of labs. The scores to questions will be ordered in terms of student performance and the questions categorized to determine students' overall strengths and weaknesses. Categories will include areas such as basic algebra, graphing, visual, high school chemistry basics, terminology, etc. Results from a recent placement exam given for Chem 105 students in the fall 2003 semester are attached as an example.

We will reject hypothesis 1 if we are unable to observe categories where students have strengths or weaknesses. Results from a recent placement exam given for Chem 105X students in the fall 2003 semester, however, suggest that this hypothesis will not be rejected.

Action items for Hypothesis 1. The placement exam will give the instructor and the department an idea of incoming student's strengths and weaknesses. We anticipate that these strengths and weaknesses will change over time and hence the manner in which we deliver our material will need to be modified.

Rejection of Hypothesis 2. At the conclusion of the Chem 105X semester, students scores on their placement exam at the beginning of the semester will be compared with student overall performance (including did the student complete the course). The hypothesis will be rejected (but see below action item) if no useful correlation between placement exam scores and student performance is seen.

Action items for Hypothesis 2. If Hypothesis 2 is rejected, we will consider using alternative placement exams or test if certain types of questions on the existing exam are better predictors of student performance. It should be noted that several book companies are developing diagnostic tests to place students and these may later be adopted in place of ACS standardized exams.

If Hypothesis 2 is confirmed, we will incorporate the results of placement exams as advising tools. In addition, students who perform poorly on the placement exam may be required to show they have the prerequisites for the course (Chem 103X or High School Chemistry). Finally, we will continue to refine our testing to improve the correlation between student progress and placement exam results.

Rejection of Hypothesis 3. Hypothesis 3 will be tested at three different levels: Chem 103X, Chem 105X, and Chem 106X. At the end of the chemistry 103X course, for instance, the standardized 105X chemistry placement exam (see above) will be provided as part of the students' final. The student scores will be analyzed to determine if students doing well in Chem 103X are ready to enter Chem 105X (see hypothesis 2). This is an important assessment because Chem 103X is a course used by many student to prepare for Chem 105X.

The Chem 105X final exam will incorporate questions that reflect those that the student's did poorly on in the placement exam. Students' performance in areas where significant weaknesses were initially seen should show improvement, particularly with those students who perform well in the course.

Chem 106X students will be given an ACS standardized chemistry final exam and students' final grades will be correlated with national distributions to determine if our expectations of students parallel national trends. We expect students who perform well in the course to generally perform well on the final exam compared to national norms.

Action Items. Determining students overall strengths and weaknesses at the start of a core sequence will be used to focus lectures towards areas students are expected to have most difficulty. Students will be explicitly informed that these areas will be emphasized on exams. Through this process, students will receive the mentorship required for them to overcome their deficiencies.

This process at first will be applied to the class as a group and not as individuals. It should be noted that software is being developed by some publishers to allow professors to track student's progress and take corrective actions on an individual basis and that this software may eventually be adopted.

If strong correlations are observed between student success and placement exam results in the Chemistry 105 course, then the department will use the placement exam as part of its advising program to place 105 students. In addition, we will critically examine the records of students who perform poorly on the placement exam to ensure they have the proper prerequisites (Chem 103 or high school chemistry).

Finally, testing of hypothesis 3 will provide information relating students' performance in a class and 1) their ability to compete on standardized national exams (Chem 106X students), 2) the degree to which they mastered "difficult" material (Chem 105X students), and 3) the level of preparedness to continue in subsequent courses (Chem 103X students).

Results from the Fall 2003 Placement Exam

problem	classification	Section 1 correct	Section 1 wrong	Section 2 correct	Section 2 wrong
39	algebra; word problem	53	5	54	
37	algebra; word problem	51	7	50	
35	graph interpretation (best line)	49	9	52	
38	algebra (two equations-two unknowns)	46	12	51	
14	basic chemistry (atomic structure)	46	12	51	
6	basic chemistry (which are gases)	47	11	45	
1	basic chemistry (chemical formula interpretation)	44	14	47	
26	basic chemistry (evaporation of a sugar/water solution)	37	21	45	
7	gas laws (partial pressures)	36	22	42	
42	numbers (ppm, ppb, ppt…)	44	14	41	
27	basic chemistry (like dissolves like)	37	21	41	
43	visual (enantiomers)	26	32	44	
25	105 chemistry (common acids)	38	20	28	
41	105 algebra (scientific notation, exponents, sig figs)	34	24	38	
40	105 algebra (scientific notation, exponents)	27	31	35	
3	105 chemistry (percent composition)	31	27	40	
16	105 chemistry (atomic structure)	31	27	34	
20	105 chemistry (periodic trends)	34	24	37	
15	105 chemistry (molecular geometry)	29	29	30	
22	105 chemistry (periodic trends; metal vs nonmetal)	31	27	33	
32	106 chemistry (kinetics)	33	25	31	
11	105 chemistry (neutralization)	20	38	33	
36	105 chemistry (density)	29	29	26	
12	105 chemistry (balancing chemical reactions)	25	33	24	
23	105 chemistry (atomic size of cations, atoms, anions)	23	35	25	
18	105 chemistry (atomic structure)	26	32	22	
5	105 chemistry (formula of aluminum sulfate)	22	36	24	
17	105 chemistry (molecular geometry)	14	44	27	
21	105 chemistry (formula of Rb2Se)	21	37	20	
8	105 chemistry (phase diagram)	21	37	26	
10	stochiometry	21	37	21	
28	106 chemistry (pH)	23	35	20	
9	105 chemistry (balancing chemical reactions)	21	37	23	
29	105 chemistry (reaction of ammonia and water)	15	43	20	
34	significant figures	10	48	23	
13	stochiometry	11	47	16	
30	stochiometry (molarity)	15	43	18	
19	105 chemistry (polarity)	14	44	18	
4	105 chemistry (mole)	11	47	14	
31	stochiometry	13	45	12	
24	f105 chemistry (lewis dot structure of atoms)	10	48	14	

44	Algebra (word problem PV=nRT)	7	51	11
33	106 chemistry (eq constants)	5	53	10
2	105 chemistry (formula of ionic compound)	5	53	9

OUTCOMES ASSESSMENT PLAN
FOR STUDENTS SEEKING BACCALAUREATE DEGREES
OFFERED IN THE
DEPARTMENT OF CHEMISTRY & BIOCHEMISTRY

Hypothesis. Themes identified by the department (see below) as being important to our overall curriculum are recognized and understood by students in all applicable courses.

I. CHEMISTRY FUNDAMENTALS
- A. SPECTROSCOPY
  - i. ABSORBANCE AND FLUORESCENCE IN ANALYTICAL CHEMISTRY
  - ii. STRUCTURE DETERMINATION
- B. STOCHIOMETRIC CALCULATIONS
- C. KINETIC AND EQUILIBRIUM THEORY
- D. MECHANISMS
- E. INTER AND INTRAMOLECULAR INTERACTIONS

II. TECHNIQUES
- A. CHROMATOGRAPHY (GC, HPLC, TLC, GEL, ELECTROPHORESIS...)
- B. INSTRUMENTATION (IR, NMR, UV/Vis...)
- C. DILUTIONS, EXTRACTIONS
- D. LITERATURE SEARCHES (INCLUDING COMPUTER DATA BASES)

III. EXPERIMENTAL DESIGN
- A. HYPOTHESIS DEVELOPMENT
- B. MULTIVARIATE EXPERIMENTS
- C. RESEARCH TYPE EXPERIMENTS
- D. ERROR ANALYSIS

IV. COMPUTATIONAL CHEMISTRY
- A. HYPERCHEM
  - i. ENERGY MINIMIZATIONS
  - ii. MOLECULAR ORBITAL CONSIDERATIONS (HOMO/LUMO)
  - iii. ELECTRONIC DENSITIES
  - iv. ABSORBANCE SPECTRA (IR AND UV/Vis)
- B. ADVANCED CHEMISTRY DEVELOPMENT (ACD) SOFTWARE

V. PROFESSIONAL SKILLS
- A. GROUP INTERACTIONS
- B. WRITING SKILLS
- C. ORAL SKILLS
- D. ETHICS
- E. SAFE WORKING PRACTICES

VI. CURRENT CHEMICAL ISSUES and HISTORY of CHEMISTRY

Measurement. A questionnaire (attached) will be provided to each class section at the end of the semester asking students if each of the above topics were covered a) not at all, b) occasionally, and c) often.

Rejection of Hypothesis. The hypothesis will be rejected if less than 70 percent of the class does not embrace relevant (see below) themes.

Action Items. It is recognized that some of the departmental themes are not implemental in certain courses and the first action will be to identify those instances. When possible, however, the instructor(s) in charge of a course that students perceive does not address a theme will propose plans to rectify the situation. This may be done by including themes into exam or homework questions, explicitly stating that a lecture topic is covering a departmental theme, or modifying the classroom presentation.

The role of themes throughout our curriculum will be made available to students through syllabi, departmental web page, and posters

The use of themes will be an ongoing process in the department as a means to make the various courses more cohesive from a student's perspective.

The themes identified for the department to incorporate throughout our curriculum will be upgraded on an annual basis and compared with topics suggested by the American Chemical Society.

UAF Chemistry & Biochemistry Student Survey

Course # _____
Semester _____
Year _____

To what extent has this chemistry course at UAF contributed to your knowledge and skills in the following areas:

	Very Much	Some	Not at all
1. Absorbance or Emission Spectroscopy			
2. Structure determination using			
a. Nuclear Magnetic Resonance Spectroscopy			
b. Infra-red Spectroscopy			
c. Mass Spectrometry			
3. Chemical Reactions			
a. Thermodynamics (Free energy, Enthalpy, Entropy)			
b. Kinetics (rate laws, rate constants)			
4. Reaction mechanisms			
a. "electron pushing"			
b. pathways			
c. inter- and intra-molecular interactions			
5. Chromatographic Theory or Practice using			
a. Gas Chromatography			
b. High Performance Liquid Chromatography			
c. Thin Layer and Column Chromatography			
d. Capillary Electrophoresis			

6. “Hands-on” operations of

   a. Nuclear Magnetic Resonance Spectroscopy

   b. Infra-red Spectroscopy

   c. Mass Spectrometry

   d. UV-Visible Spectroscopy

   e. HPLC

   f. Gas Chromatographs

   g. Air sensitive materials

7. Stoichiometric Calculations

8. Literature Searches

   a. SciFinder Scholar/Chemical Abstracts

   b. Use of Chemical Literature in Library

   c. Science Citation Index

9. Experimental Design including

   a. Hypothesis development

   b. Multivariate Experiments

   c. Research Type Experiments

   d. Error Analysis

10. Computational Chemistry

   a. HyperChem including

      i. Energy Minimizations

      ii. Molecular Orbitals (HOMO/LUMO)

      iii. Electronic Densities

      iv. Absorbance Spectra (IR, UV/Vis)

   b. ACD Predictive Software for NMR Analyses

11. Professional Skills including

a. Problem-solving in a Group
b. Writing Skills (lab reports, term papers)
c. Oral Skills (posters, power point presentations)
d. Ethics in Chemistry
e. Safe Working Practices.

12. Current Chemical Issues

13. History of Chemistry

OUTCOMES ASSESSMENT PLAN
FOR STUDENTS SEEKING GRADUATE DEGREES
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Prior to the department chair signing a thesis defense form, all M.S. and Ph.D. students will be asked to participate in a interview with either the department chair or a faculty member chosen by the student. The student will be asked to provide candid answers to questions and will be assured that the their answers will not be placed in their file or provided to their thesis committee without their approval. In general, students will be supplied with a printed copy of these questions prior to the interview. The results will be compiled and discussed at least once each year in a departmental faculty meeting as part of our planning process.

The following questions will be asked. The interviewer at times may ask for follow up questions to clarify points made by the student. As this assessment procedure evolves, however, these questions are expected to be modified, deleted, or augmented with new questions. Questions that have no obvious action item outcomes will be avoided.

1. Were the courses you took in graduate school of high quality? If there were courses you were not happy with, what were they and how could they be improved?
2. Was the range of courses available for you to take sufficient for your needs? Did you find yourself taking a graduate course simply to meet a course credit requirement? What course(s) need to be offered to meet needs of students like you?
3. Was the faculty expertise at UAF sufficient to meet your needs? Did your graduate advisory committee have members with little or no expertise to help you in your progress?
4. Were the instrumental resources at UAF sufficient to meet your needs? Were there experiments you wanted to run but couldn't due to instrument availability? Was instrument maintenance a problem?
5. If a Teaching Assistantship supported you completely or in part, how would you describe the experience? Do you think it was a useful experience or do you view it as a hindrance to graduating in a timely manner? Were the expectations of you reasonable?
6. Were your personal needs met by the amount of support you received through RAs, TAs, or Fellowships? Did you need supplemental income (from family, spouse, side jobs...)? What were your major financial worries (housing, food, school costs...) and would you rank these worries as severe or moderate?
7. Did you generally have a good idea of your responsibilities in setting up committee meetings and having paperwork submitted to the graduate school? Were there any times when deadlines were missed because you were unaware of them?
8. Are there any issues (good or bad) about your graduate experience, the department, or the University that you would like to elaborate on?