I. DEPARTMENTAL MISSION, GOALS, AND HISTORY

Mission (adopted 27 March 2006). The mission of the Department of Chemistry includes, first, the general education of students in the liberal arts and sciences and, second, the preparation of students professionally for participation in the scientific and technical workforce both in and out of the laboratory.

Goals. The *Liberal Arts and Sciences Goals* listed below apply to all of our students, while the *Professional Training Goals* apply to students taking our service courses and to students taking courses designed for the various chemistry majors.

Liberal Arts and Sciences Goals. The Department of Chemistry strives to foster in students an appreciation and awareness of the beauty, power, utility, and limitations of the discipline of Chemistry. Successful students will be able to demonstrate:

(1) an understanding of what chemistry reveals about the nature of physical reality;
(2) proficiency in abstract reasoning;
(3) sound abilities in written and oral communications;
(4) an understanding and use of physical and mathematical models;
(5) an understanding of the relationship of experimental observation to chemical theory and knowledge;
(6) proficiency in spatial perception; and
(7) ability as critical independent thinkers.

Professional Training Goals. The Department of Chemistry strives to provide a theoretical and practical background in chemistry, as well as to equip students with a sound academic foundation and the appropriate laboratory training for undertaking graduate studies and employment in chemistry. Students will be able to demonstrate:

(8) the chemical knowledge and skills needed in chemistry as well as in other disciplines;
(9) proficiency and skill in performing laboratory techniques and in making and interpreting laboratory observations; and
(10) an understanding of the theory and operation of fundamental modern laboratory instruments.

History. Ten years ago, in 1998, the Department of Chemistry boasted **nine** full-time tenure-track or tenured faculty members (Borgers, Clark, Davis, Hanson, Hennings, Lasko, Schineller, Wood, and Zoellner), one half-time tenured faculty member (Paselk, also half-time Chair), as well as **four** part-time temporary lecturers (Codispoti, Golden, Martinez, Price). Currently, there are **eight** tenure-track or tenured faculty members (Golden, Hurst, Lasko, Paselk, Schineller, J. A. Smith, J. R. Smith, and Wayman), one one-quarter time tenured faculty member (Zoellner, also three-quarter time Chair), **one** full-time three-year appointment lecturer (Martinez), and **three** part-time temporary lecturers (Brenneman, Ehrlich, and Tinseth). Thus, over ten years of increasing enrollments, escalating demands upon the time of faculty members, and decreasing facilities, the department has managed to cling to a barely adequate staff with which to teach the courses necessary for the curriculum.

Staffing has been a chronic problem with the department: Nearly every fall semester finds the department searching for temporary faculty to teach unassigned courses. Within the last four years, before the beginning of the fall semester, the faculty shortfall has been as large as 23 units – the equivalent of nearly two full-time faculty members – only a handful of days before the first day of classes. The lack of a large population base in Humboldt County has always exacerbated the problem of finding qualified temporary faculty members to teach chemistry, and has emphasized the need for tenure-track and tenured faculty members to be hired even in the face of the need to assure flexibility by maintaining a significant percentage of temporary faculty members.

While six faculty members have retired (one of the six is currently a FERP member) since 1998, only five new faculty members have been hired: Wayman in 2000 (organic), J. R. Smith in 2001 (organic), Golden in 2001 (physical), Hurst in 2006 (analytical and environmental), and J. A. Smith in 2008 (physical and atmospheric). These new faculty members maintain undergraduate research programs along with their teaching and service duties, as do most of the current, "old-guard" faculty members. While heavy teaching loads often may seem to preclude much in the way of research, these faculty members have developed innovative methods to foster research with enthusiastic undergraduate students.

The recent hire of J. A. Smith, whose scholarly pursuits lie in the area of atmospheric chemistry, will specifically help the Department of Chemistry expand into this new (to us) area of chemistry. Not only will his research be centered in the area of atmospheric chemistry, but he will initiate two new courses, CHEM 370, Global Climate Change, and CHEM 470, Atmospheric Chemistry, in the chemistry curriculum. Thus, other hires were made primarily to replace the expertise of retired or retiring faculty members. The most recent hire of J. A. Smith moves the Department of Chemistry into a new area having the potential for many novel external collaborative efforts, such as with NOAA and other environmental entities, in addition to J. A. Smith's physical chemistry expertise. However, the hire of J. A. Smith will still leave the Department of Chemistry with fewer faculty members than are reasonably required to properly carry out teaching in the five traditional areas of chemistry: analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry.

The Department maintains three permanent staff positions: A full-time Stockroom Manager (Fraser), a half-time Biochemistry Stockroom Assistant (Arvidson), and a full-time Administrative Assistant (Comella) split half-time with the Department of Chemistry and half-time with the Department of Physics and Astronomy.

The position of Chair of the Department of Chemistry has traditionally been a part-time appointment, as befits a relatively small department. However, since AY 2004/2005, as the result of an administrative decision by the Dean of the College of Natural Resources and Sciences, the Chair of the Department of Chemistry has also served as the Chair of the Department of Physics and Astronomy. This dual appointment totals a three-quarter time appointment during the academic year and a one-quarter time appointment during the two month summer session.

The Department of Chemistry is housed in Science A, now an aging, sub-standard building with many short-comings in its infrastructure. However, the department maintains a fairly high level of quality instrumentation, as is appropriate to a field of study that has become increasingly computer- and instrumentation-driven. Recent acquisitions include a JEOL Fourier-transform, multinuclear, variable-temperature, 300 MHz nuclear magnetic spectrometer which will be primarily used in organic and inorganic chemistry laboratories, and a Hewlett-Packard diode-array ultraviolet-visible spectrometer used primarily in biochemistry and analytical chemistry laboratories. The department also supports a Computational Chemistry Laboratory for teaching and research which houses modern research-quality computational software and hardware.

II. DEPARTMENTAL FACULTY AND STAFF

Chemistry Dept Instructors -- AY Average Count of Appointments facpos_CHEM report generated: 22-FEB-08						
Appt Category	**AY 02/03**	**AY 03/04**	**AY 04/05**	**AY 05/06**	**AY 06/07**	**AY 07/08**
Lecturer	3	3	5	4	5	7
Assist Prof	2	2	2	2	1	1
Assoc Prof	2	2	2	1	3	1
Professor	4	5	3	5	5	5
Volunteer	0	1	1	0	0	0
Total	**11**	**13**	**13**	**12**	**14**	**13**

Currently, for the AY 2008/2009, the headcount for the Department of Chemistry is **four** lecturers, **two** assistant professors, **three** associate professors, **four** professors, and **one** FERP professor, for a current headcount total of **fourteen** faculty members. However, as can be seen below, the actual number of faculty members based on FTEF is significantly smaller than the totals above.

Chemistry AY average FTEF (time base totals) facpos_CHEM report generated: 22-FEB-08						
Appt Category	**AY 02/03**	**AY 03/04**	**AY 04/05**	**AY 05/06**	**AY 06/07**	**AY 07/08**
Lecturer	2.64	1.83	3.37	2.67	3.60	3.97
Assist Prof	2.00	2.00	2.00	2.00	1.00	1.00
Assoc Prof	2.00	2.00	2.00	1.00	3.00	1.00
Professor	3.50	4.50	3.00	5.00	4.50	4.50
Volunteer	.00	.06	.04	.00	.00	.00
Total	**10.14**	**10.39**	**10.40**	**10.67**	**12.10**	**10.47**

Despite increases in the total number of student credit units offered and in the number of chemistry majors in the department, the number of full-time equivalent faculty members in the Department of Chemistry has remained nearly constant at slightly more than ten.

Chemistry department release/assigned time **facpos_CHEM report generated: 22-FEB-08**						
Assignment Description	**AY 02/03**	**AY 03/04**	**AY 04/05**	**AY 05/06**	**AY 06/07**	**AY 07/08**
Excess Enrollment (=>75)	.10	.20	.49	.48	.39	.16
New Preparations	.00	.00	.03	.00	.30	.03
Special Instructional Programs	.16	.11	.29	.27	.24	.06
Instructional Experiment Innovation/Research	.00	.00	.02	.00	.00	.06
Advising Responsibilities	.03	.00	.00	.00	.00	.00
Instructionally-Related Committee Assignments	.00	.33	.40	.10	.20	.15
Department Chair AY, Leaders/Dir.	.36	.36	.36	.36	.48	.36
Department Chair - 12mo	.13	.13	.13	.20	.20	.13
Total	**.77**	**1.13**	**1.71**	**1.40**	**1.80**	**.95**

The tenured and tenure-track faculty members in the Department of Chemistry have an agreement of long-standing with the Dean of the College of Natural Resources and Sciences with respect to assigned time for large lectures (which appears in the table as "excess enrollment") and to assigned time for the coordination of multiple laboratory instructors (which appears in the table as "special instructional programs"). This agreement specifically refers to the physical chemistry courses (CHEM 361 and 362, first and second semester Physical Chemistry, and CHEM 363, the associated laboratory as well as CHEM 364, Introductory Physical Chemistry, and CHEM 367, the associated laboratory) and their enrollments. These courses and laboratories are fundamental upper division graduation requirements for all chemistry majors, but the courses often have enrollments of less than ten students. Thus, in order to be allowed to offer these courses each year and to keep chemistry majors properly on track for graduation, the tenured and tenure-track faculty members of the Department of Chemistry as a whole have agreed to accept the assigned time for large lectures and for the coordination of multiple laboratory instructors as an **overload** above and beyond their normal twelve-unit teaching load each semester.

Current Personnel

Name	Position	Description of Specialty and Key Contributions
ARVIDSON, Ryan	HT IST I	**Biochemistry Stockroom Technician.** Current position description on file in Human Resources.
BRENNEMAN, Edward M.	PT Lecturer	**General Chemistry.** Instructor for CHEM 107 and 109 laboratory sections.
COMELLA, Mary	HT ASC I	**Administrative Support Coordinator.** Full-time total position; half time for the Department of Chemistry and half-time for the Department of Physics and Astronomy. Current position description on file in Human Resources.
EHRLICH, Andrew C.	PT Lecturer	**General Chemistry.** Instructor for CHEM 107, 109, and 110 laboratory sections and for CHEM 109 discussion sections.
FRASER, William S.	FT IST III	**Stockroom Manager.** Current position description on file in Human Resources.
GOLDEN, William G.	Professor	**Physical Chemistry and General Chemistry.** Instructor for CHEM 107, 109, 110, 305, 340, 361, 362, 363, 364, 367, and 450. Research interests include green energy storage (fuel cell and lithium ion battery) technologies and electrocatalysis projects in collaboration with researchers at the University of California – Davis, as well as projects dealing with the adsorption of molecules on surfaces, with all projects involving undergraduate researchers. Academic advisor for Chemistry and Environmental Science majors.
HURST, Matthew P.	Assistant Professor	**Analytical Chemistry, Environmental Chemistry, and General Chemistry.** Instructor for CHEM 109, 110, 341, 433, 441, and 450, and SCI 331. Research interests include trace metal speciation in natural waters, marine biogeochemistry, and local water quality issues, with undergraduate research projects focused on metal speciation and nutrient distributions in Humboldt Bay and the Arcata Marsh. On-going collaborative projects with the Institute of Marine Sciences at the University of California – Santa Cruz enhance these efforts. Academic advisor for Chemistry majors.
LASKO, Carol L.	Professor	**Analytical Chemistry and General Chemistry.** Instructor for CHEM 107, 109, 308, 341, 433, and 441. Research interests focus on the use of biopolymers to adsorb heavy metals from aqueous environments and have involved undergraduate students as collaborators and co-authors. Academic advisor for Chemistry majors.
MARTINEZ, Ralph A.	FT 3-year Lecturer	**General Chemistry.** Instructor for CHEM 107 and 117 lecture sections, CHEM 107, 109, 110, and 328 laboratory sections, for CHEM 109 discussion sections, and for SCI 331. Academic advisor for Undeclared majors.
(continued)		

SCHINELLER, Jeffrey B.	Associate Professor	**Biochemistry and General Chemistry.** Instructor for CHEM 109, 321, 322, 323, 328, 429, 431, 432, 438, and 485. Research interests include the application of bio-organic chemistry, biochemistry, and proteomics methods to the study of chemical communication (quorum sensing) in systems of bacteria so as to design new antibiotics, and the development of new biochemistry laboratory and discussion exercises. Academic advisor for Chemistry and Biochemistry majors.
SMITH, Jamison A.	Assistant Professor	**Physical Chemistry, Atmospheric Chemistry, and General Chemistry.** Instructor for CHEM 109, 367, and 370. Research interests on surface science as applied to atmospheric chemistry and on computational atmospheric modeling. Academic advisor for Chemistry majors.
SMITH, Joshua R.	Associate Professor	**Organic Chemistry and General Chemistry.** Instructor for CHEM 109, 305, 321, 322, 328, 421, 450, and 485, and SCI 331. Research interests include physical organometallic chemistry, molecular electronics, and new laboratory experiments for undergraduate courses, with all projects involving undergraduate students. National and international collaborations enhance many of the projects. Academic advisor for Chemistry and Undeclared majors.
PASELK, Richard A.	Professor	**Biochemistry and General Chemistry.** Instructor for CHEM 107, 109, 110, 328, 431, 432, 438, 451, 485, and SCI 331. Current scholarship focuses on undergraduate chemistry education (*e.g.*, CSU-wide Transforming Course Design team member, HSU Faculty Development Committee, *etc.*), history of scientific instruments, and designing and implementing physical and virtual (web-based) museum exhibits at HSU. Academic advisor for Chemistry, Biochemistry, Environmental Toxicology, and Environmental Science majors.
	Curator	**Curator and Webmaster.** HSU Scientific Instrument Museum and **Associate Curator and Webmaster**, HSU Natural History Museum.
TINSETH, Glenn R.	PT Lecturer	**General Chemistry and Physical Chemistry.** Instructor for CHEM 107, 109, and 110 laboratory sections and for CHEM 109 discussion sections.
WAYMAN, Kjirsten A.	Associate Professor	**Organic Chemistry and General Chemistry.** Instructor for CHEM 107, 109, 321, 322, 323, 328, 421, 422, and 485, and SCI 331. Research interests include organic synthesis and methodology, natural products extraction, isolation, and characterization, and the development of new undergraduate organic laboratory experiments, with all projects involving undergraduate researchers. Collaborations with scientists at the University of Otago (New Zealand) have been established to investigate plant extracts. Academic advisor for Chemistry majors.
(continued)		

WOOD, William F.	Professor (0.50 FERP)	**Organic Chemistry and General Chemistry.** Instructor for CHEM 107, 321, 322, 323, and 328. Supervisor for the departmental Mass Spectrometer facilities. Undergraduate research director for research in the field of chemical ecology, with on-going collaborations with researchers at the University of California – Berkeley and the Smithsonian National Zoological Park. Currently teaching during the Spring semesters only.
ZOELLNER, Robert W.	Professor	**Inorganic Chemistry, Computational Chemistry, and General Chemistry.** Instructor for CHEM 107, 109, 110, 321, 330, 410, and 485. Supervisor, coordinator, and system administrator for the departmental Computational Chemistry Laboratory. Undergraduate research director for computational chemistry research projects; on-going collaborations with researchers at Newcastle University (England). Academic advisor for Chemistry majors.
	Chair	**Chair**, Department of Chemistry, and **Chair**, Department of Physics and Astronomy, both since Fall 2004.

III. RECRUITMENT AND RETENTION

Recruitment. The Department of Chemistry enthusiastically participates in the standard recruitment projects: Fall Admissions Day, Spring Preview, HOP, and HOOP. While the department does not itself have any special programs specifically aimed at the recruitment of new majors, it has recently completed the design and printing of a new, modern departmental brochure for use by recruiters and others interested in the programs of the Department of Chemistry. In addition, the department has recently commissioned a poster display to be designed and constructed for the annual Department of Chemistry presentation for Fall Admissions Day and for Spring Preview.

The B.S. degree in Chemistry and the options to the B.S. degree in Biochemistry and in Environmental Toxicology are currently certified by the American Chemical Society as meeting the requirements for professional training as established by that professional society.

Scholarships. The department currently boasts one endowed scholarship fund which generally accounts for two scholarships annually under two scholarship categories. These scholarships are the Humboldt Chemistry Research Scholarship and the Humboldt Chemistry Scholarship, the former to give support to undergraduate chemistry research students and the latter a more general scholastically-based scholarship for an undergraduate chemistry major.

Retention. The lower-division five-unit course CHEM 109 (first semester General Chemistry) is a "gateway" course for many students who are not chemistry majors. As such, the course is a required course or a recommended elective for many of the majors or options in Biology, Botany, Zoology, Environmental Resources Engineering, Environmental Science, Geology, Oceanography, Physics, and Wildland Soils Science, among others. Because of the ubiquity of CHEM 109 in a variety of science major programs, many in-coming first-year students take this course during their first semester at HSU.

General Chemistry is a rigorous and demanding course, even for well-prepared students. The course has for many years been taught in the delivery mode of three nominal one-hour lecture sessions and two nominal three-hour laboratory sessions each week, for a total of nine contact hours each week for the students taking the course. This heavy "in-class" contact requirement, along with the recommended "out-of-class" study time of between fourteen and twenty-one hours per week (calculated as two to three times the student-to-faculty contact hours for the course) has meant that the "failure" rate (the percentage of "D" and "F" grades) in the course has been as high as 45%, paralleling national norms.

When observed over many years, these high failure rates have been seen to be *independent* of the instructor of the course, and *independent* of the number of positive or negative comments in the student evaluations of the instructor of the course. Historically, many students have had to repeat CHEM 109 two or three times before earning a passing ("C–" or better) grade! Obviously, doing poorly in a five-unit course, especially during a student's first semester of college, will have a significantly detrimental effect on the retention of that student.

The reasons for poor performance in CHEM 109 can be traced to a variety of causes, including poor preparation in mathematics, inadequate study skills, and the difficulty inherent in taking a five-unit course during a student's first semester of college. However, the general feeling was that the situation could be improved with a change in the mode of delivery of the course to give the students in the course additional problem-solving assistance in a smaller group setting. Thus, the mode of delivery was changed to eliminate one laboratory session each week and replace that session with a nominal one-hour discussion session each week (while maintaining the five-unit nature of the course). Such a change meant a complete revision of the laboratory portion of the course as well as the development of protocols and plans for the newly-instituted discussion sessions. However, after instituting this change during the Fall 2007 semester, the "failure" rate (the percentages of "D" and "F" grades earned) immediately decreased, in some instances down to less than 20%, well below the failure rate nationally! These numbers appear to be sustained in subsequent semesters.

The change in the mode of delivery of CHEM 109 was made even though the change would of necessity reduce the number of hours of hands-on laboratory work for each student. In chemistry, laboratory work is absolutely essential to the ultimate success of the student, whether in graduate or professional school, or in an industrial setting. The Department of Chemistry has always emphasized the student-centered, laboratory-intensive nature of its programs. However, in the case of CHEM 109, it was concluded that the need for better retention of students out-weighed the need for laboratory experience in this narrowly-defined case. (After all, the students cannot experience the laboratory-intensive nature of the chemistry programs if the students do not pass CHEM 109!) Thus, the sacrifice of some laboratory experiences for additional problem-solving and individual instructor-student contact was considered to be essential, and, so far, has been successful.

In addition to the revision of mode of delivery for CHEM 109, Professor Richard A. Paselk is one of a half-dozen CSU faculty members currently serving on the CSU-wide Transforming Course Design program (http://transform.csuprojects.org/) for introductory chemistry courses. The goal of this program is to improve the delivery of introductory/general chemistry system wide so as to improve the student success rate and, subsequently, student retention.

IV. LEARNING, CURRICULUM, AND ASSESSMENT

The following table details the relationship of **departmental learner outcomes** to courses in the Department of Chemistry: A “1” indicates “low intensity” in which the learner outcome is included implicitly or occasionally; a “2” indicates “medium intensity” in which the learner outcome is an explicit focus or theme; and a “3” indicates “high intensity” in which the learner outcome is the main purpose of the course.

	Outcome 1	**Outcome 2**	**Outcome 3**	**Outcome 4**	**Outcome 5**	**Outcome 6**	**Outcome 7**	**Outcome 8**	**Outcome 9**	**Outcome 10**
Course	Chemistry & nature of physical reality	Abstract reasoning	Written & oral communication	Physical & mathematical. models	Relationship of observation to theory	Spatial perception	Critical independent thinking	Chemical knowledge & skills	Laboratory technique & observation	Instrument theory & operation
CHEM 104	1	1	1	1	1	1	1			
CHEM 107	1	1	1	1	1	1	1	1	1	1
CHEM 109	1	1	1	1	1	1	1	1	1	1
CHEM 110	1	1	1	1	2	1	2	2	1	1
CHEM 117	1	1	1	1	1	1	1	1		
CHEM 199	**(a)**	**(a)**	**(a)**	**(a)**	**(a)**	**(a)**	**(a)**	**(a)**	**(a)**	**(a)**
CHEM 305	1	1	1	1	1	1	1	1		
CHEM 308	2	1	1		2		1			
CHEM 321	2	2	1	2	3	2-3	2	3	2	2
CHEM 322	2	2	1	2	3	2-3	2	3	2	2
CHEM 323							2	3	2	3
CHEM 328	1	1	1	1	1	2	1	2	2	2
CHEM 330	3	3	2	3	3	3	3	2		2
CHEM 340	2	3	2	3	3	2	3	2		2
CHEM 341	2	2	2	2	3	1	3	3	3	2
CHEM 361	3	3	2	3	3	2	3	2		
CHEM 362	3	3	2	3	3	2	3	2		

(continued)	**Outcome 1**	**Outcome 2**	**Outcome 3**	**Outcome 4**	**Outcome 5**	**Outcome 6**	**Outcome 7**	**Outcome 8**	**Outcome 9**	**Outcome 10**
Course	Chemistry & nature of physical reality	Abstract reasoning	Written & oral communication	Physical & mathematical. models	Relationship of observation to theory	Spatial perception	Critical independent thinking	Chemical knowledge & skills	Laboratory technique & observation	Instrument theory & operation
CHEM 363	3	3	3	3	3	2	3	3	3	3
CHEM 364	2	2	2	2	2	2	2	2	2	2
CHEM 367	2	2	2	2	2	2	2	2	2	2
CHEM 399	**(b)**	**(b)**	**(b)**	**(b)**	**(b)**	**(b)**	**(b)**	**(b)**	**(b)**	**(b)**
CHEM 410	3	3	3	3	3	3	3	3	3	2
CHEM 421	3	3	2	2	3	2	3	3		
CHEM 422	3	3	3	2	3	2	3	3	3	2
CHEM 429	2	2	2	2	2	2	2	2		
CHEM 431	3	3	3	3	3	3	3	3	3	3
CHEM 432	3	3	3	3	3	3	3	3	3	3
CHEM 433	2	2	3	2	3	2	3	3	3	3
CHEM 438	3	3	2	2	3	2	3	3		
CHEM 438L	3	2	3	2	3	2	3	3	3	2
CHEM 441	3	3	3	2	3	2	3	3	3	3
CHEM 450	3	2	3	2	3	2	3	2		
CHEM 451	3	2	3	2	3	2	3	2		
CHEM 480	**(c)**	**(c)**	**(c)**	**(c)**	**(c)**	**(c)**	**(c)**	**(c)**	**(c)**	**(c)**
CHEM 485			3	3			3	3		
CHEM 495	**(d)**	**(d)**	**(d)**	**(d)**	**(d)**	**(d)**	**(d)**	**(d)**	**(d)**	**(d)**
CHEM 499	**(d)**	**(d)**	**(d)**	**(d)**	**(d)**	**(d)**	**(d)**	**(d)**	**(d)**	**(d)**

Footnotes to table above: (a) This course is a supplemental instruction course designed to provide additional study and problem-solving assistance to students in a particular course; the level of outcomes for CHEM 199 will correspond to those of the course with which it is associated. **(b)** This is a directed study course designed to provide instruction for transfer students whose prior course work is not equivalent to corresponding local courses; the level of outcomes for CHEM 399 will correspond to those of the course with which it is associated. **(c)** This is a selected topics course. The level of outcomes for CHEM 480 will depend upon the instructor and the topic chosen for the specific course offering. **(d)** These are undergraduate research (CHEM 495) and directed study (CHEM 499) courses; the level of outcomes will depend upon the research project or program of study chosen.

The following table details the relationship of **HSU learner outcomes** to courses in the Department of Chemistry: A "1" indicates "low intensity" in which the learner outcome is included implicitly or occasionally; a "2" indicates "medium intensity" in which the learner outcome is an explicit focus or theme; and a "3" indicates "high intensity" in which the learner outcome is the main purpose of the course

		Outcome 1	**Outcome 2**	**Outcome 4**	**Outcome 5**	**Outcome 6**	**Outcome 7**
Course	**GE category**	Oral & written communication	Critical & creative thinking; information acquisition & application	Appreciation for & engagement with diversity	Preparation for career success	Responsibility for lifelong learning & setting goals	Social justice, environmental responsibility, economic improvement
CHEM 104	LD-B-PhysU		1				1
CHEM 107	LD-B-PhysU		1				1
CHEM 109	LD-B-PhysU		1				1
CHEM 110			2				1
CHEM 117							
CHEM 199							
CHEM 305	UD-B	1	1				1
CHEM 308	UD-B	1	1	1			
CHEM 321		2	3		2		2
CHEM 322		2	3		2		2
CHEM 323			3		2		
CHDM 328		2	2		1		1
CHEM 330		2	2				
CHEM 340			2				

(continued)		Outcome 1	Outcome 2	Outcome 4	Outcome 5	Outcome 6	Outcome 7
Course	**GE category**	Oral & written communication	Critical & creative thinking; information acquisition & application	Appreciation for & engagement with diversity	Preparation for career success	Responsibility for lifelong learning & setting goals	Social justice, environmental responsibility, economic improvement
CHEM 341		2	2				
CHEM 361			2		2		
CHEM 362			2		2		
CHEM 363		2	2		2		
CHEM 364			2		2		
CHEM 367		2	2		2		
CHEM 399							
CHEM 410		2	2		2		1
CHEM 421		2					
CHEM 422			2				
CHEM 429		2	2		2		
CHEM 431		2	3		2		
CHEM 432		3	3		3		
CHEM 433		2	2		2		
CHEM 438		2	2		2		
CHEM 438L		2	2		2		
CHEM 441		2	2		2		
CHEM 450		2	2				2
CHEM 451		2	2				2
CHEM 480							
CHEM 485		3	3		2	1	

(continued)		**Outcome 1**	**Outcome 2**	**Outcome 4**	**Outcome 5**	**Outcome 6**	**Outcome 7**
Course	**GE category**	Oral & written communication	Critical & creative thinking; information acquisition & application	Appreciation for & engagement with diversity	Preparation for career success	Responsibility for lifelong learning & setting goals	Social justice, environmental responsibility, economic improvement
CHEM 495		3	3		3	2	
CHEM 499		3	3		3		3

ASSESSMENT

The Department of Chemistry has met all of the seven benchmarks set by the Assessment Coordinator, and is current in all assessment reports.

Assessment Cycle. The Department of Chemistry assesses its goals over a four-year assessment cycle. Every year at least two goals will be assessed.

Year One: Goals 3, 5 and 9
Year Two: Goals 1, 2, and 8
Year Three: Goals 4 and 6
Year Four: Goals 7 and 10

Year One, Goal 3: ... sound abilities in written and oral communications. This goal was assessed through the analysis of two independent sets of evidence: upper division laboratory reports from CHEM 363 (Physical Chemistry Laboratory) and from the laboratory portions of CHEM 410 (Inorganic Chemistry) and CHEM 433 (Principles of Chromatography), and from faculty analyses of senior seminar presentations in CHEM 485 (Seminar in Chemistry).

The laboratory reports demonstrate that upper division students in chemistry courses initially have some difficulty in constructing laboratory reports that meet scientific standards for writing, that is, having the proper writing style (third person passive) and the properly level of formality. However, feedback from the instructors in these courses on how to improve the reports followed by significant amounts of re-writing by the students results in greatly improved laboratory reports as the course progresses through the semester. Later examples of these laboratory reports demonstrate that the students had taken the comments and criticisms of the instructors to heart and have developed their writing styles to fit more closely the demands of scientific written communication. Thus, based upon the evidence provided, the goal of developing sound abilities in scientific written communication is being appropriately met.

The senior seminar course was recently changed from a one-unit credit/no credit course required for graduation to a graded course (still required for graduation), and is considered a capstone course for majors in chemistry. The change in grade mode was made both to emphasize for the students the importance of the seminar and to allow the faculty members to recommend a letter grade rather than simply recommend credit/no credit, since the latter requires only a grade of “C–” to receive a grade of “CR”. In this course, students are required to present a seminar to the department (all faculty members and the students in the course must attend, and, as the seminar is advertised to the campus, other students and members of the community often attend) of approximately 45 minutes in length, followed by a question and answer period, on a topic directly related to the broad field of chemistry. During these seminars, both the students in the course and the faculty members attending the seminar carefully critique the student presentation for style, for the relationship of the seminar to the field of chemistry and the amount of chemistry included in the seminar, and for the ability of the student to answer questions. The comments by the faculty members are transcribed anonymously and returned to all students to use to improve their seminars.

Careful analyses of the faculty comments on the student seminars indicates that while there is a broad range of speaking ability among majors in chemistry, most chemistry majors demonstrate the ability to present well-constructed, well-organized seminars in a professional manner, and are able to answer questions with good facility. Thus, based upon the evidence provided and examined, the goal of developing sound abilities in scientific oral communication is being appropriately met.

Year One, Goal 5: ... an understanding of the relationship of experimental observation to chemical theory and knowledge. In Spring 2007, CHEM 109 (first semester General Chemistry) students were evaluated to determine how well Goal 5 was met. Goal 5 connects the theoretical information students learn in lecture and during independent studies with the experimental and hands-on experience the students gain in the laboratory. This goal was assessed during a regularly-scheduled quiz with three questions related to the concept of chemical equilibrium and Le Chatelier's Principle. The quiz was given after the students had taken part in a three-hour laboratory experience in which the students investigated chemical equilibria by making predictions, mixing chemicals, observing the results, and deriving conclusions concerning the shifts in the equilibria. The results showed that, on average, 53% of the three quiz questions were answered correctly. This number is in line with the overall average student score in the class, and indicated that students have difficulty connecting experimental experiences to concepts learned in lecture and study.

This evaluation can be, and will be, improved. In the laboratory chemical equilibrium exercise, all of the chemical equilibria were aqueous ionic solutions, but the quiz questions used to evaluate this goal were exclusively related to gas-phase equilibria examples. If the evaluation questions were a combination of gas-phase and aqueous ionic solution examples, the numbers would likely improve and would more accurately reflect the ability of the students to make the connections between experimental and theoretical information.

Year One, Goal 9: ... proficiency and skill in performing laboratory techniques and in making and interpreting laboratory observations. The assessment of Goal 9 was carried out in the CHEM

110 (second semester General Chemistry) laboratory. Students in that laboratory complete an analysis of ions in aqueous solution during an eleven-week period. The students work independently with minimal help from the instructor, and their grades are based upon the number of ions correctly identified in their unknown solutions. The success of each student is dependent on the ability of the individual student to work independently, follow written instructions carefully, and work with hazardous chemicals safely. These skills are required for students who wish to continue in the chemistry field as graduate students or professional scientists.

During Spring 2007, the ion analysis scores for 67 students were compiled. The average percentage correct score for those 67 students was 80%. Based on these data, the assessment committee concluded that an 80%-successful score indicates successful performance by the students in the laboratory, and that the goal was met. Further assessment in subsequent cycles to investigate the scores on unknown samples as the semester progresses may be of value.

Is the assessment tool an adequate tool for measuring this goal? As stated in the assessment results, the skills required to succeed in the CHEM 110 laboratory are required for students who wish to continue in the chemistry field as graduate students or professional scientists. Thus, the assessment committee concludes that this assessment tool is satisfactory, and does not find any reason to change the assessment tool or the goal.

Year Two, Goal 1: ... an understanding of what chemistry reveals about the nature of physical reality. This goal has two subordinate, explanatory goals: (1) Students will be able to distinguish between chemical and physical processes and identify examples of each, and (2) students will be able to name the different states of matter and identify examples of each in their environment. This goal was assessed in the final examination of CHEM 107 (Fundamentals of Chemistry) during the Fall 2007 semester. The following final examination questions were used to determine the extent of student knowledge of the topics described for this goal:

(1) (4 points) Name each of the following conversions:
- **(a)** liquid to solid
- **(b)** solid to gas

(2) (4 points) What is the state of matter described by each statement below?
- **(a)** Particles are independent of each other.
- **(b)** The least compressible of all the states of matter.

(3) (6 points) Indicate whether the following are chemical or physical changes.
- **(a)** Evaporation
- **(b)** Neutralization
- **(c)** Turning a solid cube of copper into a wire

In the Fall 2007 semester, 101 students who took the CHEM 107 final examination responded to the three questions listed above. The results for those students are listed in the box below. The average total score for these three questions was 12.65/14, or an average of 90.38% for the students who responded to these questions.

14 points	61 students
12 points	20 students
10 points	15 students
8 points	4 students
6 points	0 students
4 points	0 students
2 points	1 student
0 points	0 students

Goal number one, a "liberal arts and sciences" goal, was assessed through evidence from CHEM 107 (Fundamentals of Chemistry), a General Education and service course of the Department of Chemistry for liberal arts and sciences majors. The data indicate that the students in this course exhibited an average success rate of more than 90% in responses to the questions that related directly to this goal, and that this goal was satisfactorily met.

Year Two, Goal 2: ... proficiency in abstract reasoning. This goal was interpreted to mean that students will be able to use abstract mathematical methods to solve representative chemistry problems. During the Fall 2007 semester, students in CHEM 109, the first semester of the two-semester general chemistry sequence, were asked to use a mathematical equation to find the final energy level of an electron in a hydrogen atom when light of a certain wavelength was emitted from that atom. In a different version of the same question, students were asked to find the value of the wavelength of light emitted when an electron relaxed from a higher to a lower energy level. These problems require that the students understand the connection between the mathematical equation and the energy level model of the hydrogen atom.

Students (n = 107) in the CHEM 109 course were given the question during a midterm examination. The average score on the question was 6.1/10, which correlated well with the overall average of 63/100 on that examination. Furthermore, even when students did not receive full credit for the question because of mathematical or calculator errors, 85/107 students were able to evaluate the question and use the correct equation to begin answering the question. Use of this question to assess the goal appears to be a good indicator of student ability to use relatively complex mathematical methods to solve a chemistry problem.

Year Two, Goal 8: ... the chemical knowledge and skills needed in chemistry as well as in other disciplines. Goal number eight was addressed in CHEM 431, the first semester of the two-semester biochemistry course. The question chosen was one in which the students were asked to apply and integrate aspects of their knowledge of biochemistry into a biological context. The specific question had three parts and was asked on final examination for the course final. The three-part question is reproduced in the box below.

> **(a)** Under what conditions will "ketone bodies" be formed in the liver?
> **(b)** What is the biological "purpose" for forming ketone bodies?
> **(c)** Explain the statement, "Ketone bodies give the liver overall control of fatty acid metabolism."

The student success on this question was significantly better than the overall success of the students on the final examination itself: The students scored an average of 69% on the question above versus an overall average of 54% on the final examination, indicating that the goal was achieved for this example. However, it is recommended that when goal eight is next scheduled to be assessed, the Assessment Committee consider the possibility that a different question be constructed, if this goal is again assessed in CHEM 431, in order to broaden the confidence in this goal, and to consider the options for assessing this goal in other advanced courses as well.

Year Three (current), Goal 4: ... an understanding and use of physical and mathematical models.

Year Three (current), Goal 6: ... proficiency in spatial perception. These two goals will be assessed in CHEM 340 (Symbolic Computation in the Sciences), CHEM 322 (the second semester of Organic Chemistry), and CHEM 109 (the first semester of General Chemistry).