

**PROGRAM REVIEW  
Technology and Preparatory Chemistry  
2006-2007**

**Prepared by : Dr. Anu Ganguly**

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## **1. Program Description and Scope**

The program consists of three courses: two of them part of a year long series of "Principles of Chemistry", Chem 106A and 106B and the other, a relatively new course, a semester long "Biochemistry for Health Science and Biotechnology", Chem 109. These courses prepare allied health students for a year long course in general, organic and biochemistry (Chem 106A and B) or a semester long course addressing a similar curricula (Chem 109).

Traditionally students preparing for the allied health majors took a one year sequence called Principles of Chemistry 106A and 106B, one semester of lower division inorganic chemistry and one semester of lower division organic/biochemistry respectively. There is a growing trend among the 2-year and 4-year nursing programs to limit the number of prerequisite units that students are required to complete towards their nursing degree. For the 2-year nursing programs only the first semester, i.e. inorganic chemistry, is a prerequisite of the biology courses along with algebra. Hence the majority of our allied health students at Ohlone College only completed Chem 106A but not Chem 106B. This has been increasingly the case. Our faculty and students have long noticed that Chem 106A was sorely lacking in appropriate and relevant training for allied health. Not only does Chem 106A lack applications to health but also it has heavy emphasis on mathematical minutia, such as lengthy limiting reagent calculations, that lack relevance to nursing.

It is for the reasons mentioned above that, CHEM 109 "Biochemistry for Health Science and Biotechnology" was developed to provide both the allied health students and the biotechnology students appropriate training in chemistry with heavy emphasis on relevant topics in human biology and health. By condensing the needed chemistry into one semester – i.e. the creation of Chem 109, this reduces the total units students are required to take in order to qualify for nursing programs. It increases students' level of skill and knowledge in crucial topics related to their future professions. Students in Chem 106A often questioned "why do we have to learn this?" this was their reaction to the long, laborious calculations – skills that were important to students pursuing a chemistry major but not to students preparing for nursing. Thanks to heavy emphasis on practical applications in Chem 109, the students are much more interested and motivated -- they appreciate the relevance of what is being taught. For example, students are more interested in the metabolism of beer by the liver than they ever were in the endless inorganic substitution reactions from Chem 106A. Students come to appreciate how chemistry forms the basis of enzymes, sugars, protein folding, genetics, maintaining balance among components of the blood, and drug discovery. Chem 106A included very basic lab skills; whereas, Chem 109 has expanded the student hands-on lab experience. Upon completion of Chem 109, students will have confidence mixing and diluting

solutions, using spectrometry to determine concentrations of proteins, creating their own calibration curves, titrations, and performing dosage calculations.

Starting in Summer 2007, Chem 106A will no longer be accepted as a prerequisite to Biol 103A "Anatomy and Physiology" or Biol 106 "Microbiology". Instead, Chem 109 is now the prerequisite for these classes. Nor will Chem 106A satisfy the prerequisite to General Chemistry Chem 101A for the majors track; in its place is a new course Chem 102 "Preparation for General Chemistry". Therefore, Chem 106A will now serve a much more limited purposes: it will still satisfy the GE requirements for a lab science and it will still serve as a prerequisite to Chem 106B for any student seeking a full year of chemistry that meets allied health requirements of some transfer institutions.

It must be noted that we have articulated Chem 109 as a replacement for Chem 106 A and B for CSU East bay, SJSU and SFSU's nursing programs. There are other private schools and other CSU's and UC's that still require the year long Chem106 A and B and no articulation agreements have been made with these schools to accept Chem 109 in the curriculum instead.

In addition, starting Fall of 2007, Chem 109 is being offered in three local area high schools: James Logan High School, Kennedy High School and Newark Memorial High School. This is a initiative of the MST division's NSF funded LAB project, "Learning Alliance for Bioscience" which aims at promoting career pathways starting at the middle and high schools. Currently there are 85 students at those 3 schools enrolled in a year-long version of Ohlone's Biot 105 course, but starting in the Fall 07 they will enroll in Chem 109, again a year-long version of Ohlone's course. Chem 109 will be taught at the high schools by the high school teachers, with course articulation from Ohlone. The high school teachers will be provided support in terms of teacher training, equipment and books, tutoring programs etc. which will be funded by the LAB project. An example of the first in the series of such a training is a Summer Training Institute to be held on June 22nd, 2007 to be hosted by Chemistry/Biology faculty of Ohlone College

## **2. Relationship to Ohlone College Mission and Goals**

The following discussion demonstrates that these curriculum changes are consistent with

- The Mission Statement
- College Core Values
- Strategic College Goals
- ACCJC/WASC Accreditation Standards
- ACCJC/WASC Accreditation Themes

*The program, especially Chem 109, addresses the college Mission Statement “Ohlone College offers instruction for basic skills, career entry, university transfer, economic development, and personal enrichment for all who can benefit from our instruction in an environment where student learning success is highly valued, supported and continually assessed.”*

Chem 106 A and B and Chem109 provides skills necessary to prepare students for careers in the health sciences and biotechnology. Examples of tracks that the courses in the program are required for are Nursing, Respiratory Therapy and Dental Hygiene.

### Chem 109 addresses College Core Values #1, #2 #3 and #4

#### *1. Provide life long learning opportunities for students, college personnel and the community*

The program introduces students to a career track in the health sciences. The students after taking one or more of these courses have the flexibility of choosing several career tracks in the health sciences, not limited to nursing alone. Students may then, depending upon their aptitude, adopt these courses to any track in the health sciences supported by these courses.

#### *2. Open access to higher education and actively reach out to underserved populations*

Chem 109 provides a strong foundation for students from all different backgrounds enabling them to pursue higher education leading to career advancement. In addition, this course is being strategically offered in James Logan High School, Kennedy High School and Newark Memorial High School which have a high representation of economically disadvantaged, underserved and underrepresented populations.

3. *Promote diversity and inclusiveness*

The program reaches out to a variety of student populations in the health professions. In addition to conventional students entering the program, the program also serves a body of students for whom nursing is a second or third profession. The program also serves a population of students and returning adults that are in the process of retooling themselves to fit the local labor market. In addition, the representation of students from the three high schools ensures a high diversity in ethnicity and economically diverse backgrounds.

4. *High standards in our constant pursuit of excellence*

By adding Chem 109 to the chemistry curriculum at Ohlone College we are providing students with more in-depth, relevant, and appropriate training to enable them to succeed in the health sciences and biotechnology. Hands-on lab training is geared at exercises directly applicable to the health science profession.

*Chem 109 addresses the Strategic College Goal #2, #3, #5 and #7*

2. *Learning College Model*

Chem 109 provides more appropriate curriculum. By creating this Chem 109 which is more relevant for students studying allied health sciences and biotechnology, and by creating more appropriate prerequisites to nursing requirements, we enhance greater retention, student success, and ultimately a better educated work force.

3. *Develop strategies to increase proportion of full-time students*

Through the support of the LAB project, Chem 109 is offered in three local area high schools. This enables a career awareness as early as in high school and recruits students for a lucrative career in a health science profession. These students who might have otherwise dropped out of the sciences are now part of Ohlone's program and continue on to Ohlone college to satisfy the rest of the program requirements.

5. *Provide the health, environmental, cultural and economic vitality of the communities served by the district through programs of outreach, community service and partnership ventures.*

The extension the program local high schools is an excellent example of community outreach and partnership ventures.

*7. Increase public and private funds for educational programs, equipment and facilities through entrepreneurial activities, grants and college foundation*

The extension of Chem 109 is a initiative of the NSF funded LAB project which is a component of the highly successful Biotechnology program in our college. This model and extensions/modifications of it has resulted in obtaining several other grants for the program such as Quick-Start grant from the Chancellor's office. In addition, this serves as a model for other new programs such as ChemTech which has been actively involved lately in seeking funding from NSF and other agencies.

*Chem 109 contributes to ACCJC/WASC Accreditation Standards IIA.*

*II. Student Learning Programs/Services*

*A. Instructional Programs*

Chem 109 strengthens Ohlone College's instructional programs because it gives students the specific chemical know-how that is needed in health sciences, biotechnology or other vocational fields with a focus on health, the human body, and curing disease.

### **3. Program Student Learning Outcomes**

#### SLO #1

Students will acquire basic chemistry knowledge and apply them in terms of moles, measurements, concentrations, dilutions, chemical conversions, titrations etc pertaining to the health sciences. Students will also get a basic knowledge of simple organic molecules. Armed with knowledge in chemistry students will gain a comprehensive understanding of classes of biologically important compounds/processes such as carbohydrates, lipids, enzymes, proteins, nucleic acids, metabolic pathways (Kreb's cycle, Glycolysis etc.) and nutrition and body fluids as required by the health professionals.

#### Assessment

The curriculum has been revised to adopt Chem 109 in favor of Chem 106 A and B in order to make it more relevant and applicable to the health sciences. The understanding of topics listed above will be tested in exams and quizzes aimed at problems which are applicable to the biological concepts listed above. Labs will be designed to incorporate a hands-on exercise which is based on a theory taught in the lecture the same week. In addition these materials (or most of them) will be retested and reinforced in other courses in the curriculum such as Biol 103A "Anatomy and Physiology" or Biol 106 "Microbiology". The letter grades and a cumulative GPA in the related courses will be a measure of the level at which these topics are understood.

#### SLO #2

Students will be able to think critically and compare and contrast information from diverse sources. Students will be able to retain and apply information from course to course.

#### Assessment

Students will be able to organize information from a variety of sources and organize them in charts, essays, lab reports in different formats. Students should be able to relate new and old information. At the completion of Chem 109 and Biol 103A and 106, the Lab Final and Exam Final will emphasize heavily on common topics and understanding of these common topics. The dissemination team has identified these topics to be carbohydrates, lipids, enzymes, proteins, nucleic acids, metabolic pathways, nutrition and body fluids.

SLO #3

Students will gain proficiency in enquiry-based lab and problem solving skills and demonstrate the ability to conduct scientific investigations by suspending preliminary judgments drawing conclusions only from observable and testable data.

Assessment

The lab curriculum is being expanded to introduce new labs beyond the scope of the textbook. In addition, new instructional handouts are being supplemented in other existing labs which have additional questions embedded in them that are required to be answered in order to get a lab grade. Such labs will strongly emphasize an inquiry - based approach. Questions answered correctly showing proficiency in enquiry based skills and the ability to comprehend and integrate fundamental concepts of scientific knowledge in chemistry will carry more points.

SLO #4

Students will demonstrate proficiency in the use a variety of instruments required in the program.

Assessment

The students are required to use basic lab equipments such as Ph meters, titration apparatus, spectrophotometers, melting point apparatus etc. They are also required to be proficient in lab station set-up which require setting up constant temperature baths, vacuum filtration, product purification etc. The grading of labs will incorporate points to reflect these techniques. These will be awarded based on the instructors observation of the students and their skills and will be part of the lab grade. The correct use of instruments will be tested again on a Lab Final Exam.

SLO #5

Students will be able to apply scientific and mathematical principles and utilize appropriate scientific techniques including information and data analysis technology.

Assessment

The students should be able to collect, analyze and graphically represent data in order to compute their lab findings. They should be able to use table and graph formats. In the Lab Final examination, at least one graphing exercise will be selected for

evaluation. In relevant courses in Biology such as Biol 103A and 106 these skills will be retested and incorporated in the grading system.

#### SLO #6

Students will have knowledge of the range of careers in chemistry and the ability to apply scientific concepts, principles and techniques in a professional scientific setting.

#### Assessment

This SLO will be tested through tracking of student internships. Our students are often employed in internships and work-study positions in hospitals, doctors offices and as dental and hygiene assistants. By tracking the success and performance of our students in these positions through direct feedback from employers and supervisors we will establish a student performance database and at the same time identify areas of curriculum that need improvement.

#### SLO#7

Students will be proficient in laboratory safety, record keeping and lab procedures and protocols.

#### Assessment

Since this will be the only one time that the students are required to take a chemistry course in the curriculum, it is important that they are fully conversant on lab safety and are trained to use lab coats, goggles and gloves in the labs. Instruction in chemical safety is introduced at the beginning of all classes in Chem 106 A&B and Chem 109. It is expected that students retain common laboratory safety guidelines at the end of the program. This is especially important because most of the safety procedures in chemistry are common to biology, nursing and other science - based careers. A safety quiz will be incorporated in the Lab Final and will be tested in every chemistry course and should be strongly emphasized in related biology courses as well.

## **5. Assessment of the program through review of the Teaching Learning Process**

A part of the data obtained for the program was directly gathered from the students by conducting a survey of Chem 106-B students enrolled in the program (Spring 2007, Instructor: Dr. Anu Ganguly). These students had completed 106-A and had already taken or were concurrently enrolled in Biol 103A “Anatomy and Physiology” or Biol 106 “Microbiology”.

The data was in the form of a questionnaire where the students were asked to address the following information:

- List their proposed major:

This gives us an idea of the variety of health related disciplines that require these courses

- Universities they were applying to:

Since Chem 106A&B are in the process of being phased out, this gives us an idea of which institutions still require these courses and identify institutions with whom we should establish articulation regarding Chem 109.

- Relevance of topics related to their major or in subsequent courses in the program:

This allows us to establish firmly common topics in the program and in other courses that depend on the program. At the same time, this identifies topics that are not as relevant could be taught at the expense of other relevant topics which are not enforced enough in other courses due to time and other constraints.

Based on the student polls, input from the LAPSI tutor and feedback from other faculty in the team the following needs were identified in the program:

**Needs # 1**

*Based on the data collected from the poll, institutions listed below (second table) need to be contacted in order to set up course articulation for Chem 109.*

| <b>Institutions not requiring Chem 106 A&amp;B or accepting Chem 109 in their programs</b> |
|--|
| Ohlone College   |
| San Jose State University  |
| CSU East Bay   |
| San Francisco State University   |
| CSU Chico  |
| CSU Long Beach   |
| San Diego State University   |

| <b>Universities requiring Chem 106 A&amp;B in their program.<br/>Articulation of Chem 109 needed for these institutions</b> |
|---|
| Sonoma State University   |
| Sacramento State University   |
| Fresno State University   |
| Samuel Merritt College  |
| UCLA  |
| CSU Fresno  |
| University of San Francisco   |
| College of San Mateo  |
| Evergreen Valley College  |
| Grossmount College  |
| San Diego City College  |
| Yuba college  |

Disclaimer: The institutions listed in this survey may not reflect a complete list. There may be other institutions in the area/state which may or may not accept Chem 109 at this time.

## **Needs # 2**

*Based on the findings summarized below, the curriculum should be revised and adjusted to incorporate and address these concerns*

The students and the LAPSI tutor for the course (Alpana Bhatnagar, Spring 2007) were polled on the relevance of topics emphasized in the program and to identify problem areas in the curriculum. The following findings were discovered in terms of curriculum and program alignment which needs to be addressed:

1. General chemistry concepts such as atoms and molecules, bonding, acids and bases and pH need to be covered in depth and a lot more rigorously in the chemistry courses. These concepts are required in Bio 103 (A&B), Bio 106 and Bio 130. These topics need to be reinforced in Chem 106A and Chem 109 with the aim of applying these principles to biological examples.
2. Study of organic chemistry should be kept at a minimum level and to a extent that is only required for the understanding the biochemistry of molecules in subsequent chapters. The course time to be devoted to more biology/biochemistry based concepts.
3. Chem 106-B serves as a prerequisite for Bio 106. However, students often take these courses in the reverse order. This causes difficulties in grasping concepts such as Kreb's cycle and Glycolysis etc. in Bio 106 where these topics are covered at a rapid pace with the understanding that the students have already covered the material in Chem 106-B or Chem 109. The order of courses to be taken must be reinforced by academic counselors.
4. Biological, cycles such as Kreb's cycle, Glycolysis should be covered early on in Chem 106-B and Chem 109. This enables the students to get a solid grasp on these vitally important topics, rather than rushing through them at the end, which is the way they are structured in most textbooks. In addition, these bio cycles should be reinforced in Bio 103 A&B and Bio 130 as these are important topics for the program and need to be addressed multiple times to enable better retention of material.
5. Chapters on Nutrition may be underemphasized (in case of time constraints) to emphasize other important topics such as bio cycles, acids and bases etc. This is in light of the fact that most students have to take a nutrition course which covers the material in great depth and detail.

### **Needs # 3**

#### *Need to hire a full-time faculty to teach health related Chemistry courses*

In 2007 there were approximately 100 students enrolled in Chem 109, but by Spring of 2008 there will be 350 students enrolled in Chem 109. Prior to Summer 2007 there was only one instructor teaching Chem 109 but by Summer 2008 there will be at least 3 instructors teaching this course. Besides, Chem 109 is being offered in three area high schools whose curriculum has to be coordinated with Ohlone's and teacher training to be provided at these schools to ensure smooth articulation.

The program is being challenged to find experienced committed teachers who possess strong grasp of chemistry as well as biology and biotechnology. We feel the hiring of an additional full time instructor with these qualifications would greatly strengthen the program. Currently all the Chem 109 and Chem 106A courses are taught by adjunct instructors. While talented and dedicated, it is difficult for them to fully invest their time and energy in the development of Ohlone's program while also teaching at other colleges and campuses. Therefore, it is the hope of the chemistry department at Ohlone that a full-time position could be created with the unique skills to teach applied/allied health/biotech chemistry courses.

### **Needs # 4**

#### *Need of a Centralized Science Center for the sharing of lab personnel and resources.*

Currently science laboratories are spread across campus in three different buildings. There is urgent need to consolidate all the laboratories one centralized science center with laboratory staff on hand, should the need arise. This would greatly save precious resources of time and supply due to much more efficient use of equipment, consumable reagents, and supplies.

Having a central science center would greatly increase the safety of the students and the instructors. Engineering and physics labs pose serious risk even in the best of circumstances as there is no lab technician available for these programs.. But this risk is increased when the teacher is isolated and overextended. If anything goes wrong, there is no back-up assistance. To make matters worse, many of the instructors are part time instructors that have little or no time to spend assembling or disassembling the laboratory equipment, much less repair it if it breaks. Often the instructor is all by herself late at night. Most of the courses in this program are offered at night. These problems would be remedied if all the sciences were consolidated into one central science center. Round-the-clock availability of lab technicians would be then possible. Instructors could focus on curriculum development and improved teaching strategies instead of devoting their time to lab set-up and take-down. And most importantly, if an accident occurs there would be a lab technician available in an emergency.

## **7. Review and Dissemination Team**

### **Team Leader and preparer of program Review Document**

Dr. Anu Ganguly  
Associate Professor of Chemistry  
Ohlone College

### **Other members**

Dr. Ron Quinta  
Dean, Math Science and Engineering  
Ohlone College

Prof. Yvette Niccolls  
Professor of Chemistry  
Ohlone College

Prof Peggy Kauffman  
Professor of Biology  
Ohlone College

Frank Hoang  
Instructor: Chem 109  
Ohlone College

Joe Zermano  
Coordinator, LAB Project  
Ohlone College

Ms. Alpana Bhatnagar  
LAPSI Tutor: Chem 106-B and Bio 103-A (Fall 2006 and Spring 2007)  
Ohlone College

Students of Chem 106-B (Spring 2007)  
Ohlone College