CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

LSC Use Only	
Number	25-64
Action	
Date	

UWUCC Use Only	
Number	
Action	
Date	

I. TITLE/AUTHOR OF CHANGE
COURSE/PROGRAM TITLE CH 111, 112
DEPARTMENT Chemistry
CONTACT PERSON Dr. John C. Woolcock

II. THIS COURSE IS BEING PROPOSED FOR:
____ Course Approval Only
____ Course Approval and Liberal Studies Approval
_X_ Liberal Studies Approval only (course previously has been approved by the University Senate)

III. APPROVALS

Department Curriculum Committee

Department Chairperson 12/20/88

College Curriculum Committee

College Dean*

Director of Liberal Studies
(where applicable)

Provost
(where applicable)

*College Dean must consult with Provost before approving curriculum changes. Approval by College Dean indicates that the proposed change is consistent with long range planning documents, that all requests for resources made as part of the proposal can be met, and that the proposal has the support of the university administration.

IV. TIMETABLE

Date Submitted
to LSC _____
to UWUCC _____

Semester/Year to be implemented _____

Date to be published in Catalog _____

Revised 5/88

[Attach remaining parts of proposal to this form.]

LIBERAL STUDIES COURSE APPROVAL FORM

About this form: Use this form only if you wish to have a course included for Liberal Studies credit. The form is intended to assist you in developing your course to meet the university's Criteria for Liberal Studies, and to arrange your proposal in a standard order for consideration by the LSC and the UWUCC. If you have questions, contact the Liberal Studies Office, 353 Sutton Hall; telephone, 357-5715.

Do not use this form for technical, professional, or pre-professional courses or for remedial courses, none of which is eligible for Liberal Studies. Do not use this form for sections of the synthesis course or for writing-intensive sections; different forms will be available for those.

PART I. BASIC INFORMATION

A. For which category(ies) are you proposing the course? Check all that apply.

LEARNING SKILLS

____ First English Composition Course
____ Second English Composition Course
____ Mathematics

KNOWLEDGE AREAS

____ Humanities: History
____ Humanities: Philosophy/Religious Studies
____ Humanities: Literature
____ Fine Arts
__X__ Natural Sciences: Laboratory Course
____ Natural Sciences: Non-laboratory Course
____ Social Sciences
____ Health and Wellness
____ Non-Western Cultures
____ Liberal Studies Elective

B. Are you requesting regular or provisional approval for this course?

__X__ **Regular** ____ **Provisional** (limitations apply, see instructions)

C. During the transition from General Education to Liberal Studies, should this course be listed as an approved substitute for a current General Education course, thus allowing it to meet any remaining General Education needs? __X__ **yes** ____ **no**

If so, which General Education course(s)? CH 111 112

PART II. WHICH LIBERAL STUDIES GOALS WILL YOUR COURSE MEET? Check all that apply and attach an explanation.

All Liberal Studies courses must contribute to at least one of these goals; most will meet more than one. As you check them off, please indicate whether you consider them to be primary or secondary goals of the course. [For example, a history course might assume "historical consciousness" and "acquiring a body of knowledge" as its primary goals, but it might also enhance inquiry skills or literacy or library skills.] Keep in mind that no single course is expected to shoulder all by itself the responsibility for meeting these goals; our work is supported and enhanced by that of our colleagues teaching other courses.

	Primary	Secondary
A. Intellectual Skills and Modes of Thinking:		
1. Inquiry, abstract logical thinking, critical analysis, synthesis, decision making, and other aspects of the critical process.	X	
2. Literacy--writing, reading, speaking, listening		X
3. Understanding numerical data	X	
4. Historical consciousness		
5. Scientific inquiry	X	
6. Values (ethical mode of thinking or application of ethical perception)		
7. Aesthetic mode of thinking		
B. Acquiring a Body of Knowledge or Understanding Essential to an Educated Person	X	
C. Understanding the Physical Nature of Human Beings		X
D. Certain Collateral Skills:		
1. Use of the library		X
2. Use of computing technology		X

CONCERN #1: that you provide the missing elaboration of Part II for the CH 111-112 course.

In order to answer, in general terms, how CH 111-112 will meet the liberal studies goals as requested in Part II of the Liberal Studies form I have included a paraphrased version of selected chapters (1 and 5) from the book "The Success Manual for General Chemistry" by Kean and Middlecamp. This book is provided in the Co-Op Store as the optional study guide for CH 111-112. This is followed by a more specific explanation of why certain items on p. 2 of the Liberal Studies form have been checked.

There are five important characteristics of the subject of chemistry and each requires a unique study approach in order to assure a student's success in this course. First, chemistry is abstract. Because of this, models and other visual devices are used to create mental pictures of molecules which are too tiny to actually see. Students must be able to understand the models and how they are "connected" to reality. For this reason the second characteristic: "chemistry is a simplified version of the real world" is particularly important. Students must use care in trying to relate everyday experiences to chemistry. For example, although one can relate dilution of chemical solutions to the preparation of orange juice from a concentrate, other analogies do not work since orange juice is really a suspension and not a solution. Thus, students must look for differences as well as similarities to understand the models chemists use and how they are related to "everyday life."

A third characteristic of chemistry is that it connects macroscopic and microscopic views of matter. Since we observe macroscopic behavior of substances in the laboratory and then infer or deduce what might be happening at the molecular level, thus, the models that have been learned are applied in new situations to explain observed properties. This is one place where the laboratory or demonstrations done in lecture can be extremely effective.

A fourth characteristic of chemistry is that the content is sequential and builds rapidly. Thus, the student who falls behind or lacks a strong motivation to learn falls behind and performs poorly. To be successful, a student must literally study chemistry every day and carefully evaluate his mistakes and correct them as they occur.

Finally, there are a number of types of chemical content each of which requires a slightly different study technique. Within each major topic presented in lecture and lab are chemical facts, concepts, rules and problems. These are roughly analogous to letters, words, sentences and paragraphs in the English language. A student must master each level, beginning with facts, before going on to the next. To completely understand a topic, the student must progress through and complete each of these levels. Chemical facts (the names of compounds or elements, descriptions of the color or appearance of the materials, etc.) can only be learned by memorization. On the other hand chemical "concepts" are single words or phrases that stand for a complex chemical idea. These are mastered best by identifying their essential characteristics and being able to recognize examples and non-examples of the concept. These are terms such as "molecule", "atom", etc. Rules are generalizations that relate concepts to each other and are mastered by identifying the relationships between the concepts that creates the rule.

Another important part of learning chemical "rules" is knowing when and when not to apply it, particularly in new situations. Rules can be verbal such as "like electrical charges repel one another" or mathematical such as Boyles' Law: PxV=k. The last cateogry of chemistry content is that it is often called the "word problem." Problems of this type describe a specific situation and then ask the student to find new information about it.

PART III. DOES YOUR COURSE MEET THE GENERAL CRITERIA FOR LIBERAL STUDIES? Please attach answers to these questions.

A. If this is a multiple-section, multiple-instructor course, there should be a basic equivalency (though not necessarily uniformity) among the sections in such things as objectives, content, assignments, and evaluation. Note: this should not be interpreted to mean that all professors must make the same assignments or teach the same way; departments are encouraged to develop their courses to allow the flexibility which contributes to imaginative, committed teaching and capitalizes on the streangths of individual faculty.

What are the strategies that your department will use to assure that basic equivalency exists? Examples might be the establishment of departmental guidelines, assignment of repsonsibility to a coordinating committee, exchange and discussion of individual instructor syllabi, periodic meetings among instructors, etc.

B. Liberal Studies courses must include the perspectives and contributions of ethnic and racial minorities and of women wherever appropriate to the subject matter. **If your attached syllabus does not make explicit that the course meets this criterion, please append an explanation of how it will.**

C. Liberal Studies courses must require the reading and use by students of at least one, but preferably more, substantial works of fiction or nonfiction (as distinguished from textbooks, anthologies, workbooks, or manuals). **Your attached syllabus must make explicit that the course meets this criterion.**

[The only exception is for courses whose primary purpose is the development of higher level quantitative skills: such courses are encouraged to include such reading, but are not expected to do so at the expense of other course objectives. If you are exercising this exception, please justify here.]

D. If this is an introductory course intended for a general student audience, it should be designed to reflect the reality that it may well be the only formal college instruction these students will have in that discipline, instead of being designed as the first course in a major sequence. That is, it should introduce the discipline to students rather than introduce students into the discipline. If this is such an introductory course, **how is it different from what is provided for beginning majors?**

January 31, 1989

Subject: Response to Questions Raised by the Liberal Studies Committee

To: Dr. Charles Cashdollar, Director
Liberal Studies Program

From: Dr. Neil J. Asting, Chairperson
Department of Chemistry

In response to your memo dated January 20, 1989 which listed four areas of concern identified at the January 19 meeting of the University-wide Liberal Studies Committee, I would like to provide you with the following information.

Concern #2: that you provide stronger, more complete answers to III-b relating to gender and minorities. This we believe, was also a request of your College committee:

In general, the concepts which are the foundation for chemistry and that are covered in CH 113/114, CH 111/112, and CH 101/102 were developed during a time when women and minorities were not significantly represented in the scientific community. During the last 25 years or so, this pattern has changed dramatically and contributions from these groups are now an important part of modern chemistry. However, given the vertical nature (ie., sequential, one concept building upon another) of the science of chemistry, it would be impossible to introduce contributions from this group to freshmen students. Simply, freshmen would not possess the background to comprehend the significance of the advanced studies produced by this group of chemists. Of course, we take special care to inform all students, especially those that have an aptitude for science, of the limitless opportunities that are available to everyone today in the science of chemistry.

The faculty in the department feel that chemistry is an abstract science and issues dealing with gender and/or minorities are really not appropriate and, in fact, would detract from the subject. While we may discuss concepts such as Charles' Law, Plank's Constant or the Curie Law of paramagnetic susceptibility, we do not discuss Charles, Plank or Curie as persons. Individuals; male, female or minorities, are simply identified as scientists (we try only to use last names) who have made contributions to the area of Chemistry. Gender or race is immaterial. Our goal to focus only on the actual science of chemistry itself also extends to assignments and evaluation instruments. Problems or exam questions are never constructed using he/she or him/her. When it is necessary to refer to a person, words such as "student", "chemist", "you", etc. are used. Most often we even by-pass these terms. Usually, homework problems or exam questions are constructed without reference to anyone (ie., "calculate the number of grams of sodium hydroxide required to prepare 250 milliliters of a 0.35 molar solution.").

Concern #4: that for the three proposals requesting an exemption from the booklenght reading requirement, you provide brief, written answers to the following questions:

Question (4a): What is the level of mathematical skills required and practiced in each course?

Answer (4a.1): CH 113/114, Concepts in Chemistry

The freshman chemistry majors that take these courses are required to become proficient with or in some cases learn for the first time the following:

#1. Manipulation of algebraic type expressions (simple to complex)
#2. logarithms (common and natural)
#3. antilogarithms
#4. exponential functions
#5. quadratic equations
#6. "word" type chemical problems which require the student to read, understand, analyze and then formulate solutions which in some cases require multiple steps
#7. dimensional analysis
#8. chemical data analysis via construction of graphs
#9. significant figures
#10. scientific (exponential) notation
#11. conversion of non-linear equations into linear forms
#12. the significance of the terms: dependent variable, independent variable, slope & intercept and how these quantities relate to mathematical equations which describe natural chemical phenomena
#13. The use of commercial software to process and graph laboratory data.

Answer (4a.2): CH 111/112, General Chemistry

The vast majority of students that take this sequence are science majors (Biology, Geoscience, Physics, Medical Technology, Pre-med, Pre-vet, Pre-engineering, etc.). These students are also expected to become proficient with or in some cases learn for the first time the same basic mathematical concepts and skills outlined above for CH 113/114. The main differences are in lecture (slightly less coverage and intensity), lack of computer equipment for processing laboratory data, and laboratory experiments that are scientifically (and mathematically) less challenging than those used in the major's course. Overall however, CH 111/112 and CH 113/114 are very similar and are equated when changes in major occur.

Answer (4a.3): CH 101/102, College Chemistry

The majority of students who take these courses are from the College of Human Ecology and Health Sciences although students from other colleges will occasionally enroll. The students in this

sequence are required to become proficient with or in many cases learn for the first time the following:

#1. Manipulation of simple algebraic type expressions
#2. "word" type chemical problems which require the student to read, understand, analyze and then formulate solutions
#3. dimensional analysis
#4. chemical data analysis
#5. significant figures
#6. scientific (exponential) notation

Question (4b): What is the frequency and form of assignments and/or activities involving quantification

Answer (4b.1): CH 113/114, Concepts in Chemistry

The freshman chemistry majors receive a large dose of assignments in which all of the activities cited in (1a) above play a very large part. Specifically, activities involving mathematics occurs both in the laboratory (about 12 experiments & corresponding laboratory reports, and 6-8 quizzes per semester) and in the lecture portion of these courses (lecture discussions, 8-10 homework assignments per semester, 6-8 quizzes per semester, 3 hour exams per semester and a comprehensive final exam). Although exact frequencies are difficult to determine, it is estimated that there is about 60% involvement in quantification activities in the laboratory and about 50% involvement in the lecture.

Answer (4b.2): CH 111/112, General Chemistry

As noted above, CH 111/112 is quite similar to the CH 113/114 sequence and the students taking these courses are also exposed to a considerable amount of applied mathematics. Specifically, activities involving mathematics occurs both in the laboratory (about 12 experiments & corresponding laboratory reports, and 6-10 quizzes per semester) and in the lecture portion of these courses (lecture discussions, 8-10 homework assignments per semester, 6-8 quizzes per semester, 3 hour exams per semester and a comprehensive final exam). However, as noted in (1b) above, the experiments chosen for General Chemistry tend to to less challenging than those used in CH 113/114. Thus the frequency of activities involving quantification in the laboratory is somewhat less than that for the major's course. We estimate that there is about 50% involvement in these activities in the laboratory but still about 50% involvement in the lecture.

Answer (4b.3): CH 101/102, College Chemistry

The exposure to activities involving quantification occurs both in the laboratory (experiments, lab reports and lab quizzes) and in

the lecture portion of these courses (interactive lecture discussions, homework assignments, quizzes, hour exams and a final exam). Although exact frequencies are difficult to determine, it is estimated that there is about 40% involvement in quantification activities in the laboratory and about 33% involvement in the lecture.

Question (4c): What part does this quantitative work play in the evaluation/grading of students

Answer (4c.1): CH 113/114, Concepts in Chemistry

As indicated above, the amount of instruction and assignments that the freshman chemistry majors receive regarding the application mathematics to solve chemical problems is very large. It would be difficult to ascertain exactly how much quantitative work plays in the determination of grades for students. However, the bottom line is that if a student doesn't master these skills, they will not be able to obtain passing scores on assignments (see 2a) and exams and quizzes. Failure for the entire course must occur.

Answer (4c.2): CH 111/112, General Chemistry

As in (3a) above. Students who fail to master the applied mathematical skills taught in these courses will be unable to obtain passing scores. Failure of the entire course is the only possible outcome.

Answer (4c.3): CH 101/102, College Chemistry

It would be difficult to ascertain exactly how much quantitative work plays in the determination of grades for students. However, students who fail to master these skills, will have a difficult time obtaining passing scores on the assignments noted above (see 2c) and, hence, failure for the entire course is likely.

E. The Liberal Studies Criteria indicate six ways in which all courses should contribute to students' abilities. **To which of the six will your course contribute? Check all that apply and attach an explanation.**

____ 1. Confront the major ethical issues which pertain to the subject matter; realize that although "suspended judgment" is a necessity of intellectual inquiry, one cannot live forever in suspension; and make ethical choices and take responsibility for them.

__X__ 2. Define and analyze problems, frame questions, evaluate available solutions, and make choices

____ 3. Communicate knowledge and exchange ideas by various forms of expression, in most cases writing and speaking.

__X__ 4. Recognize creativity and engage in creative thinking.

__X__ 5. Continue learning even after the completion of their formal education.

__X__ 6. Recognize relationships between what is being studied and current issues, thoughts, institutions, and/or events.

PART IV. DOES YOUR COURSE MEET THE CRITERIA FOR THE CURRICULUM CATEGORY IN WHICH IT IS TO BE LISTED?

Each curriculum category has its own set of specific criteria in addition to those generally applicable. The LSC provides copies of these criteria arranged in a convenient check-list format which you can mark off appropriately and include with your proposal. **The attached syllabus should indicate how your course meets each criterion you check. If it does not do so explicitly, please attach an explanation.**

CHECK LIST -- NATURAL SCIENCES (Laboratory)

Knowledge Area Criteria which the course must meet:

X Treat concepts, themes, and events in sufficient depth to enable students to appreciate the complexity, history, and current implications of what is being studied; and not be merely cursory coverages of lists of topics.

X Suggest the major intellectual questions/problems which interest practitioners of a discipline and explore critically the important theories and principles presented by the discipline.

X Allow students to understand and apply the methods of inquiry and vocabulary commonly used in the discipline.

X Encourage students to use and enhance, wherever possible, the composition and mathematics skills built in the Skill Areas of Liberal Studies.

Natural Science Criteria which the course must meet:

X Examine a body of knowledge of natural science that will contribute to an understanding of the natural world.

X Provide an understanding of the development of natural science theories and their modification.

X Teach students to formulate and test hypotheses.

X Provide an understanding of some of the "great moments" in the history of natural science and the individuals, including women and minorities, responsible for them.

Natural Science Laboratory Criteria which the course must meet:

X Provide students with opportunities to learn and apply data-gathering techniques.

X Provide students with opportunities to develop skills in making accurate observations, in formulating concise and appropriate descriptions of natural phenomena, and in producing meaningful systems of classification for natural objects.

X Provide students with opportunities to apply theories to practice in the the working world of science.

Additional Natural Science Criteria which the course should meet:

X Encourage an appreciation of the complex interrelationship of natural science with the life of the individual.

X Develop in students the abilities necessary to cope with the consequences of natural science in the modern world.

X Develop an inquiring attitude consistent with the tenets of natural science, an attitude that is willing to expose fallacy on the basis of reason, that demands evidence for scientific assertions, and yet is tolerant of hypotheses in the absence of contradictory evidence.

COURSE SYLLABUS

I. CATALOG DESCRIPTION

CH 111, 112 (Consecutive) 4 credits each (3 C, 3 L)

GENERAL CHEMISTRY I AND II

Prerequisites: CH 111 prerequisite of CH 112

CH 111: Lecture-discussion of principles of chemistry, including theory and applications. The lab illustrates principles discussed. Topics discussed include scientific measurements, simple definitions and concepts, the mole, stoichiometry, gas laws, electronic structure of the atom, bonding, thermochemistry and descriptive chemistry of the elements.

CH 112: Continuation of General Chemistry I. Topics discussed include the solid and liquid state, solutions, kinetics, equilibria, acids and bases, solubility equilibria, thermodynamics, electrochemistry, and descriptive chemistry of the elements.

II. COURSE OBJECTIVES

The students are expected to understand the basic principles of chemistry and the scientific method of inquiry. They will also gain an appreciation of the significance of chemistry in everyday life.

III. DETAILED COURSE OUTLINE

General Chemistry is a multi-section course taught by a team of instructors. However, it is always coordinated so that students receive exposure to the same series of lecture topics and the same experiments. These topics are:

CHEMISTRY 111

1. Chemistry as a Quantitative Science — 4 lectures
   Development of modern chemistry, experiment-theory, units of measurements.

2. Description of Matter — 4 lectures
   Early atomic theory, symbols, formulas, chemical equations. Atomic mass scale. Periodic table of the elements.

3. Chemical Calculations — 4 lectures
   The mole concept. Molecular weight, formula weight, stoichiometry.

4. Reactions in Aqueous Solution — 4 lectures
   Electrolytes, acids, bases, salts.
   Types of reactions and stoichiometric calculations.

5. The Gaseous State — 4 lectures
   The laws of gases: Boyle's, Charles', Avogadro's, and Dalton's laws.
   The ideal gas, the kinetic molecular theory.

6. Thermochemistry — 4 lectures
   Heats of reaction and their measurement. Calorimetry. Hess' law of thermochemistry. Enthalpies of formation.

7. Structure of the Atom — 4 lectures
Discovery of electron and nucleus. Atomic models: Rutherford's model, Bohr's model. Atomic mechanics. Quantum numbers and atomic orbitals.

8. Electronic Structure of the Atom — 4 lectures
Electron spin and Pauli principle. Electron configuration. Orbital diagrams. Periodicity of the elements. Brief description of the main group elements.

9. Ionic and Covalent Bonds — 4 lectures
Description of ionic bond. Electron configuration of ions, ionic radii. Description of covalent bond, polar covalent bond, electronegativity. Lewis structures, octet rule, delocalized bonding and resonance.

10. Molecular Geometry and Directional Bonding — 4 lectures
Electron pair repulsion theory and molecular-orbital theory. Dipole moments and molecular geometry.

CHEMISTRY 112

1. States of Matter: Liquids and Solids — 4 lectures
Phase transitions. Phase diagrams. Properties of liquids and solids.

2. Solutions — 4 lectures
Types of solution. The solution process and colligative properties.

3. Reaction Kinetics — 5 lectures
Reaction rates. Reaction orders. Activation energy and the collision theory.

4. Chemical Equilibrium — 5 lectures
The description of equilibrium and equilibrium constant. The conditions of chemical reactions and the position of equilibrium. LeChatelieu principle.

5. Acid-Base Concepts — 4 lectures
Arrhenius, Bronsted-Lowry, and Lewis concept of acids and bases. Strength of acid-bases and self-ionization of water.

6. Acid-Base Equilibria — 4 lectures
Acid-base ionizations. Equilibrium constants. Titration curves. Hydrolysis of salts.

7. Solubility and Complex-Ion Equilibria — 4 lectures
The solubility product constant. Common ion effect. Precipitation calculations. Complex-ion formation, complex-ion formation and solubility. Qualitative analysis of metal ions.

8. Chemical Thermodynamics — 4 lectures
The law of the conservation of energy (first law). The second law and entropy, free energy and spontaneity. Equilibrium calculations.

9. Electrochemistry — 5 lectures

Electrochemical cells and electrolytic cells, electromotive force, electrode potentials. Equilibrium constants from electromotive forces. The laws of electrolysis.

IV. EVALUATION METHODS

The evaluation method consists of quizzes, hourly exams, grading of weekly lab reports and the final exam. Normally the lecture grade determines three-fourths of the final grade, the lab grade determines one-fourth. The final exam grade usually contributes 25-30% to the lecture grade and the hourly exams plus quizzes contribute the rest. The lab grade is made of report grades and quiz grades.

V. READING MATERIAL

Students are expected to study from the required textbook and lab "modules" (see below). They are also encouraged to use supplementary materials such as books of exercises and occasionally articles in non-specialized journals.

The textbook selection is made by common agreement between the teaching instructors.

With respect to content, general chemistry textbooks usually vary little from each other but the General Chemistry Committee has nevertheless agreed to switch textbooks every three to four years (or sooner, if necessary). This allows for renewal and adjustment to the needs of students.

The laboratory part of the course is made up of approximately 26 experiments (13 each semester) that are intended to provide practical illustrations of the concepts taught in lecture. In order to insure essential flexibility and facilitate broader faculty participation in the construction of the lab program, we have made use of "modular" lab experiments purchased from Chemical Education Resources or especially prepared by some of the teaching faculty. These "modules" contain all the information necessary to complete a particular lab experiment including background information on the concept under study, pre-lab questions, the experiment procedure and data analysis and post-lab questions.

VI. SPECIAL RESOURCE REQUIREMENTS

To reinforce the classroom teaching individual instructors use occasionally films, slides and tapes that are available in our film library as well as classroom demonstrations. Also available to the students are a number of computer-based tutorials that provide primarily drill-and-practice on such topics as chemical nomenclature, balancing chemical reactions, calculation of pH, etc. These programs are available in the department during normal working hours on an Apple computer reserved exclusively for student use. It is well to remember, however, that the laboratory always remains the main source of reinforcement and practical learning of the concepts taught in this course.

VII. BIBLIOGRAPHY

The textbooks that have been used in lecture for the last few years are the following:

1) Darrell D. Ebbing, General Chemistry (2nd ed.); Houghton Mifflin Co., Boston, Mass. (1987).

2) Raymond Chang, Chemistry (2nd ed.); Random House, New York (1984).

3) W.H. Nebergall, H.F. Holtzclaw, Jr., W.R. Robinson General Chemistry (6th ed.); D.C. Heath and Co., Lexington, Mass. (1980).

4) C.W. Keenan, D.C. Kleinfelter, J.H. Wood, General College Chemistry; Harper & Row, New York (1980).

The titles of the experiments that were used in the Fall 1988 are as follows:

1. Lab safety, exponential notation of numbers, significant digits, logarithms, graphing of data.
2. Mass and volume measurements, density of solids and liquids
3. Observation and interpretation of chemical change, chem. formulas and equations
4. Reactions in aqueous solutions
5. Acid base titrations
6. Boyle's law
7. Atomic weight of a metal
8. Molecular weight of a volatile liquid
9. Thermochemistry I, calorimeter constant determination
10. Thermochemistry II, enthalpy of hydration
11. Spectrum of atomic hydrogen
12. Periodic properties of the elements
13. Molecular structure and VSEPR Theory

Also in the Spring of 1988 we made use of the following experiments:

1. Preparation of a standard sodium hydroxide solution, titration of a hydrochloric acid solution with sodium hydroxide
2. Evaluations of commercial antacids
3. Water hardness
4. Determination of molecular weight by freezing point depression
5. Formaldehyde clock reaction
6. Equilibrium
7. Spectrophotometric analysis of permanganate solutions
8. Determination of the equilibrium constant for $FeSCN^{+2}$
9. Determination of acid, dissociation constant by titrimetry, the pH meter
10. A study of pH, dissociation hydrolysis and buffers
11. An introduction to the qualitative analysis of a group of cations
12. Electrochemical cells and reduction potentials, electrolysis

LIBERAL STUDIES COURSE APPROVAL FORM

PART III (Attachment)

A. In order to insure, among other things, basic equivalency in the course the Department has established the General Chemistry Committee and the position of Laboratory Coordinator.

The Committee decides on the selection of the class textbooks, the topics to be taught and the overall grading policies to follow, especially in the laboratory. The Laboratory Coordinator is responsible for scheduling, ordering of supplies and the numerous practical details of the operation of a multi-section lab.

Though there exists among the instructors variations in the style of teaching there is sufficient uniformity in the topics that are covered to allow for a smooth transfer of students between sections during the transition from CH 111 to CH 112.

B. Perspectives and contributions of minorities are included wherever appropriate; unfortunately, most of the concepts that are covered were developed during a time when such groups were not significantly represented in the scientific community. The students are informed that this is changing, albeit slowly, and that there are real opportunities available for members of these groups in chemistry today.

C. The main task which students in an introductory course face is the comprehension of the important ideas and their application in concrete laboratory situations. For this reason students are encouraged to try to increase their comprehension with theoretical and practical exercises and occasionally with additional readings in non-specialized journals such as the Journal of Chemical Education, Chemistry Today, etc. Anything more than that would seem to be unrealistic since the topics ordinarily covered in a typical class rarely exceed three-fourths of the material that is given in the textbook. Aside from this, it is important to understand that in natural sciences and math learning is accomplished primarily with practical and theoretical exercises.

D. Chemistry 111-112 has been offered as a General Education elective and as a course designed to satisfy the chemistry requirements of students in areas such as biology, geo-science, etc. It does not differ significantly from the introductory course for beginning chemistry majors in the breadth of topics, but nevertheless it is less vigorous in the treatment of these topics and less demanding on the students.

E. In a chemistry course students are expected to learn the concepts of chemistry and the way in which they are interrelated. This type of learning necessitates first of all the application and development of logical thinking which is manifested in the way in which we ask questions, look for answers and evaluate alternatives. We have reasons to hope that the learning skills the students acquire in this course stimulate their interest for further studies and, at any rate, increase their capacities to function as educated citizens in the numerous areas in which chemistry affects their lives.