

CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

LSC Use Only
Number LS-66
Action _____
Date _____

UWUCC Use Only
Number _____
Action _____
Date _____

I. TITLE/AUTHOR OF CHANGE

COURSE/PROGRAM TITLE SC 106 Physical Science II
DEPARTMENT Chemistry
CONTACT PERSON Dr. Frank Ballas Phone X2360 (Main office)

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

A. D. Christian
Department Curriculum Committee
Douglas W. Ross
College Curriculum Committee

M. A. S. 12/29/88
Department Chairperson
John H. ...
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 _____ Semester/Year to be implemented _____ Date to be published in Catalog _____
to UWUCC _____

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
- 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?

- 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? yes no

If so, which General Education course(s)? SC 106 Physical Science II

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. | <u> X </u> | <u> </u> |
| 2. Literacy--writing, reading, speaking, listening | <u> X </u> | <u> </u> |
| 3. Understanding numerical data | <u> X </u> | <u> </u> |
| 4. Historical consciousness | <u> </u> | <u> X </u> |
| 5. Scientific inquiry | <u> X </u> | <u> </u> |
| 6. Values (ethical mode of thinking or application of ethical perception) | <u> </u> | <u> X </u> |
| 7. Aesthetic mode of thinking | <u> </u> | <u> X </u> |

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 | <u> </u> | <u> X </u> |
| 2. Use of computing technology | <u> </u> | <u> X </u> |

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 strengths 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 responsibility 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.").

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.
- 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.
- 4. Recognize creativity and engage in creative thinking.
- 5. Continue learning even after the completion of their formal education.
- 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:

- 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.
- Suggest the major intellectual questions/problems which interest practitioners of a discipline and explore critically the important theories and principles presented by the discipline.
- Allow students to understand and apply the methods of inquiry and vocabulary commonly used in the discipline.
- 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:

- Examine a body of knowledge of natural science that will contribute to an understanding of the natural world.
- Provide an understanding of the development of natural science theories and their modification.
- Teach students to formulate and test hypotheses.
- 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:

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

- Encourage an appreciation of the complex interrelationship of natural science with the life of the individual.
- Develop in students the abilities necessary to cope with the consequences of natural science in the modern world.
- 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.

LIBERAL STUDIES COURSE APPROVAL

The Chemistry Department submits SC 106 - Physical Science II as a Natural Science Laboratory Course.

PART I - BASIC INFORMATION

- A. We are proposing SC 106 - Physical Science II along with SC 105 - Physical Science I of the Physics Department as a two-semester natural science sequence, with a laboratory in each course.
- B. We are requesting regular approval for SC 106 - Physical Science II.
- C. During the transition from General Education to Liberal Studies, SC 106 should be listed as an approved substitute for the current General Education course, SC 106.

PART II - WHICH LIBERAL STUDIES GOALS WILL YOUR COURSE MEET?

A. Intellectual Skills and Modes of Thinking:

1. These are major goals met by SC 106 - a course in environmental and consumer chemistry that includes the development of student skills allowing recognition of chemically related global and national problems. Methods used for data collection needed for proper decision making is first presented as lecture introductions. After development of basic chemical skills in the lecture portion of the course, laboratory exercises dealing with these major chemical issues are completed. For instance, in the cigarette smoke analysis exercise, a major global health concern is carefully investigated with students using cigarettes of their own, of family members or friends.
2. Scientific literacy is developed in the following manner. Written homework assignments provide some writing experience. The attached syllabus describes the reading and writing assignment dealing with a major non-text work of non-fiction. Students are encouraged to read the newspaper which then serves as a reference for class discussions concerning environmental and consumer issues. Our students are introduced to and encouraged to subscribe to environmental publications (e.g. "National Wildlife").
3. Understanding numerical data is a primary course goal. All but one laboratory exercise has a quantitative result as its primary objective. Collection of data is done using state-of-the-art equipment, appropriate to the laboratory exercise. In the course lecture component, calculations are used to illustrate major concepts (e.g. air pollution control) that require a quantitative result in order to achieve proper decision-making. Quantitative skills needed are taught at the proper time, throughout the course, by all instructors.
5. Scientific inquiry begins with a historical development of chemistry as a science. Major concepts (e.g. atomic structure, bonding, and radioactivity) are developed for use as background in order to investigate the role of chemistry in major issues of national and global concern. Laboratory exercises dealing with these major concerns are used to collect data in order to illustrate society's eventual solution of these problems.

- B. Acquiring a Body of Knowledge or Understanding Essential to an Educated Person
This is a primary goal of SC 106. The student soon realizes that decisions leading to any positive solution to the above listed concerns requires a large body of data, facts and information. SC 106 advances the educated person's data collection skills and knowledge, thereby permitting their input towards a solution of these problems.

PART III - DOES YOUR COURSE MEET THE GENERAL CRITERIA FOR LIBERAL STUDIES?

- A. The Chemistry Department will continue to use the following strategies to assure that basic equivalency exists: All sections use the same course syllabus in order to coordinate the lecture content with the laboratory experience. The equivalency of course content is achieved by use of the same textbook and laboratory manual in all sections. Meetings with the course staff and course coordinator help to insure uniform evaluation and content degree-of-difficulty among sections. Grade distribution information is shared by all instructors with the course coordinator.
- B. The attached syllabus indicates that SC 106 includes perspectives and contributions of ethnic and racial minorities and of women wherever appropriate.
- C. Course Reading Requirement - See attached syllabus.
- D. SC 106 is intended for a general non-science student audience. No previous chemical knowledge is assumed. Our primary objective is to develop the chemical skills and knowledge needed to deal with major chemically related concerns and to appreciate and preserve the chemical aspects of our planet. The student is asked to realize that they must take part in the solutions to these problems. The course keeps current by attempting to answer such questions as: Does the hot summer of 1988 indicate that the Greenhouse Effect is here? No other course in the Chemistry Department deals with such issues.
- E. 1. SC 106 confronts the major environmental issues of our time. Ethical questions are often at the forefront. For instance, in our work with air pollution, the fact that the U.S. is a major polluter of Canada is illustrated using U.S. EPA and Environment Canada data. The Canadian film "Acid Rain-Requiem or Recovery" is used to present much of Canada's chemical data, as well as presenting their political, social and esthetic views on this issue.
2. Defining and analyzing problems, framing questions, evaluating available data to pose solutions in which choice is possible are major goals of this course. Both lecture and laboratory components of the course are constantly working towards achievement of these goals.
3. Communicating knowledge and exchange of ideas is achieved by lecture and laboratory discussion, in writing laboratory reports and by completion of written homework assignments. A bulletin board in the hallway between the two laboratory rooms displays current topics using information collected by instructors and students. The major reading-writing component (see syllabus) will also contribute to the development of student skills in this area of expertise.
4. The student first recognizes creativity in science "greats" of the past. He/she learns to engage in creative thinking by becoming part of the science experience participating in the laboratory experience. By collecting data

dealing with major concerns the student becomes confident in his/her ability to make the decisions leading to the solution of these concerns.

5. Students in SC 106 eventually realize that the solution to many of the complex environmental concerns (e.g. the Greenhouse Effect) may require a lifetime to achieve. SC 106 begins their long-term contribution to the solution of these problems.
6. Our students develop that understanding that solutions of concerns (e.g. the conservation of Earth's resources) depends on many interacting forces - chemical, economic, social and political. They are encouraged to develop and use their skills in order to be able to contribute positively to these forces. As instructors, we encourage our students to become involved in the solution to these problems in specific ways (e.g. by voting and by use of letter writing campaigns to our U.S. senators to attempt to encourage positive "acid rain" legislation.

COURSE SYLLABUS

I. CATALOG DESCRIPTION

4 credits
3 lecture hours
2 laboratory hours

SC 106 PHYSICAL SCIENCE II

A basic course in environmental and consumer chemistry for the non-science major. High school chemistry is not a prerequisite. Major topics include man's use and abuse of soil, water, air and energy resources, global food production and hunger, the nuclear industry and the threat of nuclear war. Consumer topics include vitamins and nutrition, food additives, pesticides, and drugs.

II. COURSE OBJECTIVES

1. The student shall understand the major discoveries and concerns in the history of chemistry. Individuals responsible for these discoveries include Lavoisier, Proust, Dalton, Rutherford, Geiger, Curie, Bohr, Einstein, Pauling and Carson.
2. The student will develop scientific methods, including quantitative aspects, that lead to the best solutions to major environmental, consumer and health problems.
3. The student will understand the political, economic and social forces that impact the solution of the major environmental, consumer and health concerns.
4. The student will realize that major chemically related problems require their long term commitment of time and resources needed to achieve solutions to these concerns.

III. COURSE OUTLINE (The Lecture Component)

A. The Major Outside Reading-Writing Component

1. By the third week of the course, each student will select a major work to be read. The work will be selected from a list of 3-6 titles proposed by the instructor and purchased by the student in the Coop Bookstore. Examples of titles an instructor might propose are: "Silent Spring" by R. Carson; "Bread for the World" by A. Simon; "I'll Winds"; "Pollution's Toll on Trees and Crops" by World Resources Institute Publications.
2. By the end of the tenth week of the course each student will complete a five page written report on the work selected.
3. The final exam will include one specific essay question (10% of the final exam) for each of the proposed titles, with each student answering the question for his/her chosen title.

B. Lecture Topics (3 lectures)

1. Chemistry as a science
 - a. Measurement

- d. Scientific method
 - c. The nature of matter - mixtures and pure substances
 - d. Parameters measured - energy, mass, temperature, and density
 - e. Risk - benefit analysis
2. Atoms (5 lectures)
- a. Atoms: The Greek Idea
 - b. Lavoisier: The Law of Conservation of Mass
 - c. Proust: The Law of Definite Proportions
 - d. Dalton: Atomic Theory
 - e. The periodic table
 - f. X-rays and radioactivity - Rontgen, Becquerel and Curie
 - g. Nuclear structure - Rutherford and Geiger
 - h. Electronic structure - Bohr and Schrodinger
 - i. Electronic configurations - periodic table
3. Nuclear Chemistry (4 lectures)
- a. Isotopes
 - b. Natural radioactivity modes
 - c. Half-life
 - d. Use of radioisotopes in medicine and in the home
 - e. Radon gas as a health threat
 - f. Nuclear weapons, war, the arm race, SDI, nuclear winter and arms control
4. Chemical Bonding (3 lectures)
- a. Stable electron configurations
 - b. Ionic and covalent compounds
 - c. Molecular shape vs. properties
 - d. Valence Rules using environmentally significant molecules
5. Names, Formulas and Equations (3 lectures)
- a. Common simple ions
 - b. Binary ionic compounds
 - c. Polyatomic ions
 - d. Chemical equations - collection of quantitative data for acid rain control.
6. Acids and Bases (3 lectures)
- a. Acids and bases - properties
 - b. pH scale
 - c. Antacids
 - d. The mine acid-acid rain problem
7. Organic chemistry (5 lectures)
- a. Nonrenewable-renewable resources
 - b. Alkanes - the petroleum industry
 - c. Alkenes - plastics and the garbage problem
 - d. Aromatic compounds - tobacco smoking - cancer and the addictive effects of nicotine
 - e. Alcohol - the booze problem
 - f. Functional groups - esters, aldehydes, ketones, carboxylic acids, amines and DNA

8. Water as a Resource (4 lectures)
 - a. Water - its properties
 - b. Water cycle
 - c. Major pollutants
 - d. Ecological cycles
 - e. Groundwater contamination
 - f. Wastewater treatment
 - g. Municipal water purification

9. Air as a Resource (4 lectures)
 - a. Properties of the atmosphere
 - b. Nitrogen and the oxygen - carbon dioxide cycle
 - c. London type smog - characteristics and control
 - d. Los Angeles type smog - characteristics and control
 - e. Ozone layer - chlorofluorocarbons
 - f. Pollution Standards Index
 - g. The Greenhouse Effect

10. Energy Resources (4 lectures)
 - a. Fossil fuels - coal, natural gas and petroleum
 - b. Products from petroleum
 - c. Limitations of the fossil fuel industry
 - d. Alternative sources - fusion, solar, geothermal, wind and coal gasification
 - e. Your role in fuel conservation - the auto and in the home
 - f. Home construction and retrofitting leading to full efficiency

11. Soil as a Resource and Food Production (2 lectures)
 - a. Essential soil minerals - analysis
 - b. Fertilizers
 - c. Insect control
 - d. Biological magnification of pesticides
 - e. Biological insect control
 - f. Grow your own food - the home garden
 - g. Problems in the U.S. food delivery system

12. Food Additives (2 lectures)
 - a. Esters
 - b. Flavor enhancers
 - c. Preservatives
 - d. Antioxidants
 - e. Colors
 - f. Artificial sweeteners
 - g. Vitamins and minerals
 - h. The GRAS list

As time permits, other topics would include drugs, household chemicals and cosmetics.

IV. COURSE OUTLINE (Laboratory Component)

A. Laboratory exercises - the schedule (one exercise per week)

1. Direct Observation - a study of physical vs. chemical change.

2. Paper Chromatography - a study of mixtures - develops the skill of working with small quantities, observation of minute differences, begins student quantitative skills.
3. Percentage of Weight of Oxygen in a Compound - exercise on the Law of Definite Proportions - a cornerstone of chemistry - develops manipulative skills - use of the balance.
4. Percentage of Oxygen in Air - the beginning of the understanding of the properties and pollution of the atmosphere.
5. Gram Molecular Weight of Gases - the concept of the mole, the work of Avogadro, understanding the gas phase of matter.
6. Radioactivity - Half-Life - modes of decay, determination of the half-life of a short lived radioisotope, radioisotopes in our home, use of modern instruments.
7. Volumetric Analysis - analysis of acidic coal mine drainage - a major water pollution problem, a slide show of mine sites enhances the laboratory exercise.
8. Neutralizing Capacity of Antacid Tablets - a study of the most economically efficient compounds with pertinent medical information.
9. Analysis of Cigarette Smoke - a study of the addictive and health effects of tobacco/pot smoking. Students use minute samples at the limit of mass measurement (0.1 mg). After the exercise, a number of smokers are able to quit the habit. Supplemental information is provided to our students by the American Lung Association.
10. Water Hardness - a study of the mineral content of student's home water samples - the exercise enhances the student's appreciation of our water resource.
11. Iron in Acidic Mine Drainage - a study of the mine acid problem - students also measure the iron content of their home water samples.
12. Phosphorus Analysis in Detergents - an exercise dealing with a major water pollution problem - excessive plant nutrients in natural waters (e.g. Lake Erie).
13. Nitrite in Hot Dogs - Luncheon Meats - an exercise dealing with nitrite - one of the few food additives capable of inducing cancer - data is collected to allow decisions on which ones to purchase and consume.

V. EVALUATION METHODS

The final course grade will be determined as follows, allowing for small differences among individual instructors.

50% Exams. Three exams, including the final, consisting of multiple choice, matching, completion, essay and calculation questions.

10% Quizzes. Announced and unannounced quizzes dealing with textbook assignments.

10-15%. Major Reading Report. Each student will submit a five page paper dealing with a selected major reading.

25-30% Laboratory Component. From laboratory reports and quizzes.

~~VI. Required Textbooks, Supplemental Books and Readings~~

~~Textbook: Hill, J.W. Chemistry for Changing Times, Macmillan Publishing Company, New York, 1988.~~

~~Lab Manual: Ballas, F; Fazio, F; Zambotti, G; Costa, J.; Physical Science with Environmental and Consumer Applications, Kendall/Hunt Publishing Company, Dubuque, Iowa, 1989.~~

VII. BIBLIOGRAPHY: Selected representative journals and readings

National Wildlife, published by the National Wildlife Federation, Vienna, Virginia.

Environmental Science and Technology, published by the American Chemical Society, Washington, D.C.

Chemical and Engineering News, published by the American Chemical Society, Washington, D.C.

Journal of Chemical Education, published by the American Chemical Society, Washington, D.C.