CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

LSC Use Only	
Number	LS-7
Action	Approved
Date	12-8-88

UWUCC Use Only	
Number	
Action	
Date	

I. TITLE/AUTHOR OF CHANGE

COURSE/PROGRAM TITLE GS 101-104 Earth Science

DEPARTMENT Geoscience

CONTACT PERSON Connie J. Sutton

II. THIS COURSE IS BEING PROPOSED FOR:

_____ Course Approval Only

_____ Course Approval and Liberal Studies Approval

XXXX Liberal Studies Approval only (course previously has been approved by the University Senate)

III. APPROVALS

Connie J Sutton
Department Curriculum Committee

Department Chairperson

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.]

APPLICATION FOR LIBERAL STUDIES APPROVAL FOR 1989-90

DEPARTMENT: GEOSCIENCE

COURSE: GS 101, 102, 103, 104
EARTH SCIENCE SEQUENCE

LIBERAL STUDIES CATEGORY: NATURAL SCIENCE
BOTH LAB AND NON-LAB OPTIONS

FACULTY COORDINATORS:

CONNIE J. SUTTON, CHAIRPERSON
KAREN ROSE CERCONE
DARLENE S. RICHARDSON
PAUL A. PRINCE
FREDERICK R. PARK

INTRODUCTION

The following information is intended to apply equally to four separately numbered courses: GS 101 (Earth Science: Geology and Oceanography/ lecture), GS 102 (Earth Science: Geology and Oceanography/lab), GS 103 (Earth Science: Astronomy and Meteorology/lecture) and GS 104 (Earth Science: Astronomy and Meteorology/lab). These courses comprise a lecture and laboratory sequence which can be taken in separate parts by Liberal Studies students (as discussed below). Because all of these courses share the same philosophy and many of the same approaches to science education, they have been proposed as a group for provisional approval by the Liberal Studies committee.

I. BASIC INFORMATION

A. Knowledge Area: Natural Sciences: Laboratory Course
B. Regular Approval
C. Substitution for General Education GS 101/102 and 103/104

II. MEETING LIBERAL STUDIES GOALS

A. Intellectual skills

1.) Inquiry & critical analysis: class discussions, test questions and term projects will be used to stimulate critical analysis of geoscience problems such as future projects in the space program. primary

2.) Literacy: reading textbooks, assigned books and journal articles and listening to lectures and seminars sponsored by the

Geoscience Department. secondary

3.) Understanding numerical data: lab exercises will involve manipulation of numerical data such as longitude and latitude, weather parameters, and sizes and distances of the planets. primary

4.) Historical consciousness: in order to understand the breadth and depth of knowledge in science today, an understanding of the process of this growth of knowledge is necessary. The shape of the earth is a basic concept accepted by most today but not in the past. secondary

5.) Scientific inquiry: all aspects of these courses will emphasize application of the scientific method as used in historical research and in current research. Eratosthenes, by using the scientific method, observed the position of the sun and calculated the circumference of the earth in 200 B.C. primary

6.) Values: as involved citizens these students will be asked to made value judgements through voting about many important enviromental concerns as well as space utilization. secondary

B. Acquiring a Body of Knowledge

This is obviously a primary goal of the earth science sequence. To have the student learn concepts which will make him/her an informed and concerned citizen should be the most important goal of every course offered in the Liberal Studies Program.

III. FULFILLMENT OF GENERAL CRITERIA

A. GS 101-104 has traditionally been taught (as a General Education course) in two to three sections by four to six instructors. To ensure equivalency of material and grades, the same instructors teach different parts of the course to all sections (ie. instructors switch mid-semester from one section to another). All students therefore are graded by all instructors during the course of the year. All portions of the course are evaluated using the same number of tests, although format of tests and of additional assignments varies as a function of the material being covered. Our experience has been that our faculty interacts extensively when assigning grades and when preparing syllabi for their sections. Connie J. Sutton has served as coordinator for student registration and grade assignment in the past and will continue to do so in the future.

B. In the sciences, it is often difficult to single out an individual's contribution to a large and evolving theory, particularly in an introductory course. Authors of many modern articles, for example, are often identified only by their first initials, precluding identification by gender or by culture. Furthermore, the objective nature of scientific reasoning by its very nature attempts to eliminate specific gender and culture-related viewpoints in favor of a "universal" reality. Although in practice this may not always be acheived, it is the philosphy which we as scientists must pass

on to our students. In specific cases, however, outstanding contributions made by female or minority scientists are discussed in class. Examples include Henrietta Leavitt (discoverer of variable star periodicity), Jocelyn Bell (discoverer of pulsars), Tanya Atwater (first geologist to propose subduction of an oceanic ridge under California) and Marie Tharp (first mapper of the seafloor). Lectures and test questions will continue to be sensitive to gender balancing in both use of language and selection of examples.

C. Students will be required to read selections from a file on reserve in the main library of current newpaper articles describing national, international and cosmic geoscience issues. These articles will also help give students a cross-cultural perspective on science. In addition, selected papers from scientific journals will be placed on reserve in the library; students will be required to read at least one of these in each quarter of the class. In cases where a book which is not a text book exists which enhances the content of the course (lecture and textbook), it will be assigned as additional reading. At lease one up-to-date, non-text book which enhances the content of the course will also be assigned. An example might be Landprints: On the Magnificient American Landscape by Walter Sullivan, 1984.

D. The Earth Science course sequence was never designed for Geology or Geoscience majors. It is truly an introductory course, encompassing four distinct subdisciplines in the geosciences, and is intended for a general student audience. The stated goal of the course is to produce citizens who can make well-informed decisions on the crucial geoscientific issues they will confront in the twenty-first century.

E. Earth Science will contribute to students' abilities in ways 1,2,5 and 6. Detailed explanations are provided below:

1.) Students will confront major ethical issues in the geosciences by their exposure to actual case histories of natural disasters and environmental problems. In studying the ways in which human activity affects natural earth processes, students will be given the basic tools for understanding future issues affecting the health of our planet.

2.) The laboratory experience in GS 102 and 104 teaches students who take these courses how to define problems analyze data and evaluate possible solutions according to scientific theory. Students are taught to make precise observations on natural samples such as rocks, minerals and fossils; they are given oceanographic and meteorologic data sets to analyze; and forced to confront alternate theories for astronomical observations. In some lab exercises, students do all three things at once. For example, in one oceanography lab, students are given data showing the natural distribution of the toxic chemical mercury in rocks, air and water and are then asked to evaluate whether high levels of mercury in tuna fish truly represent a man-induced pollutant.

5.) Students are given the impetus for continued learning in earth science by being taught to read critically the newspaper articles and scientific papers required in class. In addition, because our science deals so directly with the natural world, students gain a permanent appreciation and understanding of phenomena, such as constellations, weather, landscape and seascape, that they will see throughout their lives.

6.) Again, current issues are involved directly in our teaching of earth science, because we incorporate such events as natural disasters (earthquakes, volcanic eruptions, floods, etc.) and the results of public policy decisions on the landscape (eg, toxic pollution or dam construction), on space exploration (eg, satellite observations of the solar system) or on mineral resources (eg, ocean floor drilling or mining). For earth scientists, what is being studied IS current events and issues - our field is the earth as it exists in reality, not in theory.

IV. FULFILLMENT OF NATURAL SCIENCE CRITERIA

We hope to offer Earth Science as a flexible course for Liberal Studies students. Those students who wish to fulfill their Natural Science requirement by taking two courses, each with labs, may take either or both of our semester pairs (GS 101./102: GS 103/104). Students who prefer to take a one-semester lab course followed by two semester non-lab courses may still utilize the earth science sequence, since they can register in one or both of our lecture classes (GS 101 or GS 103) separately from the lab. We believe this flexibility will serve the greatest number of students in the transition period ahead.

For the ways in which the indivdual sections of Earth Science (Geology, Oceanography, Astonomy and Meteorology) comply with the natural science guidelines, we have attached the course objectives which are handed out to each student in our classes, along with our syllabi. If there are any further questions on this document, please do not hesitate to contact one of us.

V. COURSE SYLLABI - see attachments

VI. Curriculum Committee course approval forms - see attachments

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 in 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 falsity on the basis of reason, that demands evidence for scientific assertions, and yet is tolerant of hypotheses in the absence of contradictory evidence.

CHECK LIST -- NATURAL SCIENCES (Non-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.

Y 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.

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

Y Teach students to formulate and test hypotheses.

Y 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.

Additional Natural Science Criteria which the course should meet:

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

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

Y 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.

GS 101 EARTH SCIENCE GEOLOGY
CLASS OBJECTIVES

During the Geology portion of this class, the material being presented will be aimed at meeting the following objectives. Please keep them in mind as you take notes and study for tests.

1.) By the end of the class, you should understand how scientific hypotheses and theories are created and how they are tested against geologic data to determine their validity.

2.) You should be aware of the earth as an evolving planet whose surface features are determined by interacting physical, chemical and biological systems.

3.) You should know the fundamental concepts of the theory of plate tectonics and realize how this theory accounts for the dynamic processes which occur on the earth's surface and within its interior.

4.) You should be able to describe the different types of rock formations found on earth and explain how each type originates. You should also know what kinds of information can be gathered from the rock record in order to document the entire earth's history.

5.) You should become familiar with earth processes which affect human and activity and vice versa. You should develop an awareness of the scientific problems involved in such activities as construction (ie, floods and landslides); water utilization (ie, dams and water wells) and the exploitation of natural resources (ie, fossil fuels, geothermal energy, ores).

6.) You should know the age of the earth and be able to describe the major stages in its geological evolution. This knowlege should include familiarity with the evolution of life as well as an understanding of the formation and tectonic development of the continents.

7.) You should be able to place geologic events such as volcanic eruptions and earthquakes into their appropriate tectonic context and understand what such processes tell us about the earth.

8.) Finally, you should develop an appreciation for the earth as a constantly changing body whose behavior cannot always be predicted or controlled and whose evolution is being affected in ways we do not entirely understand by the activity of our species.

GS 101-01a - EARTH SCIENCE GEOLOGY SYLLABUS

Professor Karen Rose Cercone
Office: 112 Walsh Hall
Hours: MWF 1-3 pm or by appointment

WEEK	LECTURE TOPIC	READING ASSIGNMENT
1	Hypotheses and theories in earth science; disovering the internal structure of the earth.	(115-9; 145-8)
2	The igneous rocks: classification, occurrence, tectonic significance and controversies over origin.	(20-35)
3	The sedimentary rocks: classification and occurrence; relationship to earth climate and ocean chemistry.	(35-48)
4	The metamorphic rocks: classification and occurrence. Ore deposits: their geologic development and utilization.	(49-55)
5	The theory of plate tectonics: development, evidence, and uses. Types of plate margins and their effects on rock structures.	(126-161)
6	Landscape evolution: landslides, earthquakes floods and the human factor. Water resources.	(119-125) (99-109)
7	The geologic record: age of the earth, rocks as documents of geologic history. the evolution of life and the Gaea hypothesis.	(167-179)

Grading in this half of the course: two hourly exams will be avaraged with grades for each exam adjusted to a mean of 75% so that 90-100% = A; 80-89% = B; 70-79% = C; 60-69% = D and below 60% = F. Grading for the entire course will consist of the average of your geology and oceanography grades. Lecture and lab grades are reported separately and do not affect each other.

Text: R.Foster, GEOLOGY (5th Ed.) Merill Publishing Company.
Additional readings: Articles on file at the Library Reserve Desk. as assigned in class. Information from these readings will be covered on both exams.

GS 102 - 011 EARTH SCIENCE GEOLOGY LAB SYLLABUS

Professor Karen Rose Cercone
Office: 112 Walsh
Hours: MWF 1-3

WEEK	LAB EXERCISE
1	Mineral classification: describe and learn to identify the important rock-forming minerals
2	Rock identification: describe and learn to identify the igneous, sedimentary and metamorphic rocks; determine the genetic relationships between rock types
3	Fossil identification: classify groups of fossils and learn their uses in dating and correlation of rocks
4	Field exercise: using mineral, rock and fossil identification skills developed in previous labs, an actual rock sequence will be described and its geologic history will be reconstructed.
5	Use of topographic maps: reading elevation data and utilizing it to determine suitable locations for vairous types of construction.
6	Use of geologic maps: reading geologic documents and using them to reconstruct geologic histories of various areas.
7	EXAM

Grading for this course consists of 6 lab reports worth 15 points each and a final exam worth 100 points. The exam will be adjusted to a mean of 75 % so that 90-100% = A; 80-89% = B; 70-79% = C; 60-69% = D; and below 60% = F. Geology and oceanography lab grades will be averaged to obtain the final grade for the course.

Text: Earth Science Geology Lab manual, available at Kinko's.

GS 101 Earth Science OCEANOGRAPHY
Lecture Outline

Summer Session: July 1 - July 10, 1987
Dr. D. Richardson
Office: 116 Walsh Hall
Office hours: every class day 3-4 pm

Lecture topics:

Introduction to oceanography: what is it, why we study it, brief history of ocean exploration, coordinate systems, living and non-living marine resources (read Gross, 1985, preface, 1-2, 9-13, 15, 110-111, 151-161)
Ocean basins: bathymetry, physiography, geology, evolution (Gross, 1-8, 15-33)
Properties of seawater: the water molecule, temperature, salinity, density, sound, illumination (Gross, 35-63)
Oceanic circulation: surface and deep, upwelling, downwelling, tides (Gross, 65-81, 88-94)
Coastal (Shoreline) processes: waves and beaches, estuaries (Gross, 83-88, 94-98, 101-113)
Life in the oceans: conditions, diversity (Gross 115-136)
Sediments: sources, distribution, geological and biological processes (139-149, re-read 122-125, 131-136)
Nutrients and pollutants: environmental oceanography

Text: Gross, M.G., 1985, Oceanography, 5th edition and additional readings from scientific journals and newspaper articles will be assigned.
Course assessment:

Examinations contain 2 types of questions: questions designed to encourage you to develop a particular line of reasoning to solve a problem and questions designed to consolidate (synthesize) what you have learned in lectures and readings. Course assessment for GS 101 Oceanog lectures will be based on 2 exams, 7 July and 10 July. Each test is comprised of 60 multiple choice, true-false, matching, etc.-type questions, op-scan computer corrected. The first test will cover material from "Introduction" to "Surface ocean circulation." The second will cover the remainder of the lecture topics. Final assessment for GS 101 (Geol and Oceanog) will be 50% Geol and 50% Oceanog. The grades on each test will be adjusted to a mean = 75% so that $\geq$90% = A, 80-89% = B, 70-79% = C, 60-69% = D, and $\leq$59% = F.

Units:

Although many units are in the International System of Units (i.e. metric) in accordance with contemporary scientific practice, current oceanographic usage retains nautical miles and fathoms for distance and depths. 1 nautical mile = 6080 feet or 1.15 land mile or 1.853 kilometer. 1 fathom = 6 feet or 1.83 meters.

Geology Terms:

You should be familiar with the meaning of the following terms: asthenosphere, basalt, Benioff zone (subduction zone), constructive, destructive, conservative plate margins, continental crust, earthquakes (epicenter, focus, magnitude), faulting and folding of rocks, geological time scale, granite, lithosphere, magma, magnetic anomalies, oceanic crust, plate tectonics, seafloor spreading, sediment transport, sorting, and deposition.

GS 101 Earth Science OCEANOGRAPHY
Objectives

Listed below are the formal objectives for this class. You should read through the list and check your understanding of the material against each objective. It is intimidating to read through these objectives first, but by knowing my objectives for the class you would be able to organize your study time more effectively.

1. You should be able to discuss briefly the oceanographic research that needs to be undertaken in the following fields of study, explaining why such research would be useful, and identifying general methods by which oceanographic data should be collected in each of the following cases:
   a. oceanic circulation
   b. the oceanic crust, including deep-sea sediments
   c. atmosphere, surface waters, life

2. Given data, you would be able to deduce the degree of exploitation of fish in different areas of the oceans and identify the problems involved in predicting potential fish catches and in managing fisheries.

3. You should be able to list the actual and potential physical resources obtainable from within and beneath the oceans, and you would be able to discuss the limitations that govern the exploitation of these resources.

4. You should be able to describe the shape of the ocean basins (including the major physiographic provinces) and explain the importance of this knowledge of the bathymetry of the seafloor.

5. You should be able to describe the major stages in the evolution of an ocean basin and, given suitable data, to determine the stage of evolution of any ocean basin.

6. You should be able to list ways of investigating the structure and composition of the ocean crust.

7. You should be able to explain the physical-chemical-biological parameters (listed below) and describe any important effects that variation in one parameter may have on any of the others.
   a. static physical properties: temperature, salinity, density, transparency, pressure, sound
   b. dynamic physical properties: currents, tides, waves
   c. chemical properties: salinity, dissolved gases, nutrients
   d. biological properties: productivity, diversity
   e. sedimentary properties: processes and products, preservation vs destruction

8. You should be able to describe surface ocean currents and explain, in general terms, their origins.

9. You should be able to describe and explain, in general terms, thermohaline circulation.

10. You should be able to describe and explain, in general terms, tides.

11. You should be able to describe and explain, in general terms, waves and their effects on coastlines.

12. You should understand what controls the amounts of the principal chemical and biological components of the oceans.

13. You should be able to describe and explain, in general terms, the physical, chemical, biological, and sedimentary processes occurring at the boundaries of the ocean system, including
    a. the ocean-atmosphere boundary
    b. the ocean-ocean floor boundary
    c. the ocean-continent (coastal zone) boundary

14. Given examples of a particular coastal area, you would be able to discuss the activities of humans in the coastal zone and describe how such activities relate to a) sediment movement, b) fish and c) pollution.

15. Finally, you should appreciate (and be able to show with examples) that the oceans must be viewed as an interrelated physical, chemical, and biological system and that the sediments deposited in the oceans record changes in that system.

Section 024
Thursday 1:00-3:00

GS 102 EARTH SCIENCE LAB
OCEANOGRAPHY PORTION
FALL 1988

Dr. D. Richardson
Office: 116 Walsh Hall
Office hours: MF 1-2, W 1-4

Schedule of labs:

8 September 1988	Navigation, Plot course changes of R/V IUP Explorer
15 September	Bathymetry: Contouring and Profiling
22 September	Chemical Oceanography: measuring salinity and temperature
29 September	Temperature and Upwelling: Part I of thermoclines and haloclines
6 October	Part II of thermoclines and haloclines, water masses and mixing
13 October	Nutrients and Pollutants
10 October	End-of-course test

Course text:

Richardson, D.S., 1986, Oceanography Lab manual is available at Kinko's (Oakland Avenue). You are expected to read the appropriate lab material before coming to lab.

Course assessment:

The grade in the oceanography portion of GS 102 will be based on a test given on October 10, 1988 and the average of 5 quizzes. The test will count 75% and the average of the quizzes will count 25% to the total grade. The test and quizzes will be OPEN BOOK, short answer, and problem solving on the material covered in the labs. Your final grade in GS 102 will be 50% oceanography and 50% geology. The grade of the oceanography test will be adjusted to a mean = 75% so that $\geq$ 90% = A, 80-89% = B, and so on.

Richardson 88

GS 102 EARTH SCIENCE LAB
OCEANOGRAPHY PORTION
FALL 1988

Course Objectives

1. You should become familiar with the following oceanographic instruments and techniques and you should be able to apply them to solve the appropriate problems.

   navigational aids: parallel ruler, compass rose, latitute and longitude, course, heading, bearing

   bathymetry determinations: precision depth recorder PDR records, contouring and profiling

   salinity and temperature determinations: thermometer, salinometer, refractometer, hydrometer, and use of charts and tables to correct raw data into useable data

   data compilation: plotting of distributions of salinity, temperature, and salinity-temperature both laterally and vertically, use of the T-S diagram

2. You should be able to understand the plotting of thermocline, halocline, and pycnocline and apply these zones to an understanding of oceanic circulation and distribution of life within the oceans and how these physical and biological characteristics of the ocean affect mankind (as specifically related to upwelling and the economics of Peru, for example, in fishing and fertilizer production).

3. You should thoroughly understand and appreciate the use of T-S diagrams in describing water masses of the oceans and how these water masses move both vertically and horizontally.

4. You should understand the intimate relationship between physical and biological systems in the oceans (example, you will explain the distribution of oxygen within the oceans as a function of photosynthesis plus control by temperature of the solubility of gases within a liquid) and how oxidation and reduction in the oceans control the distribution of gases and nutrients within the oceans.

5. You should be able to calculate the residence times of various elements within the ocean and use those calculations to determine the relative abundances of sediment types covering the ocean floors.

6. You should be able to calculate the changes in sea level and ocean volume associated with the most recent episodes of worldwide glaciation and you should be able to judge for yourself whether or not the oceans are in steady state.

7. You will apply the scientific principles which you have learned plus the knowledge of how the oceans operate as physical and chemical systems to evaluate the mercury content of pelagic fish and to determine whether that

mercury content is a man-derived pollutant or whether that mercury content is a natural phenomenon.

8. Finally, you should appreciate that the oceans represent a complex interaction of salty water with atmosphere, living organisms, and ocean floor and each system affects the other in terms of both composition and movement of water.

GS 103 Earth Science ASTRONOMY
Lecture Outline

Spring Session: March 21 - May 4, 1988
Mrs. C. Sutton
Office: 136 Weyandt Hall
Office Hours: see posted hours on office door

Lecture topics:

History: what is astronomy, when and why did it develop, ancient concept and ideas (Chinese, Egyptian, Mayan), Greek astronomers, European Renaissance in astronomy, astrology. pp. 1 - 13.
Earth: motion, time, coordinate systems, seasons. pp. 15 - 21.
Radiation: types and properties, refraction and reflection, spectra and spectroscope telescopes. pp. 37 - 54.
Solar System
- Moon: motion, phases, tides, surface features, history. pp. 23 - 25.
- Space Exploration: manned and unmanned, contributions to society
- Planets: characteristics, similarities and differences with earth and with each other. pp. 57 - 83.
- Minor Members: moons, asteroids, comets, meteors. pp. 64, 69-70, 77 - 81, 85 - 95.
- Sun: interior and atmospheric sections and roles, surface features, effects on earth and man, solar energy. pp. 97 - 104.

Stars:
- General Characteristics: distance, motion, magnitude, size, temperature H-R Diagram. pp. 105 - 112.
- Multiple Stars: binaries, clusters (galactic and globular). pp. 113 - 120
- Life of a Star: birth, main sequence, giant, old age (dwarfs, novae, pulsars, black holes). pp. 120 - 122, 129 - 135.

Galaxies: Milky Way characteristics, classification and characteristics of other galaxies, quasars, theories of the Universe, search for extraterrestrial life pp. 123 - 128, 137 - 152.

Text: Ebbighausen, 1985, Astronomy, 5th edition, and additional readings from science journals and newspaper articles to be assigned.

Course Assessment:
A mid-term and final will be given - each will contain questions which will encourage you to reason through a problem or situation to synthesize what you have learned, as well as containing the normal content oriented questions - each test will be 100 questions in length - will contain multiple choice, true/false, and matching questions - test will be op-scan computer corrected. The first test will cover the material from History through Space Exploration. The second will cover the remainder of the lecture topics. Final assessment for GS 103 (Meteorology and Astronomy) will be 50% Meteor and 50% Astro. The grades on each test will be adjusted to a mean of 75% so that ≥90% = A, 80 - 89% = B, 70 - 79% = C, 60 - 69% = D, and ≤59% = F. Lecture and laboratory grades are reported separately and do not affect each other.

Units

Although many units are in the International System of Units (metric), additional references will be included from the English System to aid the student to adapt to metric. Special astronomy units (Astronomical Unit, light year, parsec) will also be used

Astronomy Terms

You should become familiar during the course with the meanings of the following terms:

geocentric and heliocentric, aphelion and perihelion, rotation and revolution, ecliptic, zodiac, refraction and reflection, planet, star, comet, asteroid, meteorite sidereal time and synodic time, accretion and expulsion, altitude and azimuth, horizonal coordinates, zenith and horizon, equatorial coordinates, right ascension and declination.

GS 103 Earth Science ASTRONOMY
Objectives

Listed below are the formal objectives for this course. This will help correlate lecture/text material and explain how this material can be applied to real life.

1. TSSBAT* describe how, through the study of the history of astronomy, mankind has slowly replaced superstition and fear with facts and knowledge and understanding of the celestial globe.

2. TSSBAT describe the earth's motions and relate them to observations of solar and stellar positions.

3. TSSBAT explain the differences among the various types of radiation and relate their effects on man and the environment, and to understand how the astronomer determines stellar characteristics by studying stellar radiation.

4. TSSBAT explain the differences among the various types of telescopes, how to use them, and how to gather information through their use

5. TSSBAT relate the moon's motion to the apparent phases of the moon, relate the moon's position to the types of tides which are caused, and relate the overall motion of the moon to man's ability to keep track of time

6. TSSBAT relate the present surface lunar features with the past history of the moon.

7. TSSBAT the history of space exploration to its future goals and to list the invaluable contributions made to the welfare of mankind by the space program

8. TSSBAT explain the interior-surface-atmospheric parameters of the various planets and describe any important effects that variations in one of the parameters may have on the others.

9. TSSBAT describe the parts and surface features of our sun and the effects these have on man and his environment and understand the principles behind the use of solar energy.

10. TSSBAT describe each of the following stellar characteristics and explain their interrelationships: distance, magnitude, motion, size, temperature, color, and composition.

11. TSSBAT understand the life of a star including its origin, growth, life, and demise and the differences in these exhibited by various types of stars.

12. TSSBAT describe the physical parameters of the Milky Way including the position of the solar system and relate our galaxy's characteristics to those of other galaxies.

13. TSSBAT list the various ways scientists are searching for clues to determine if there is any other life (extraterrestrial) in the solar system, our galaxy or even other galaxies.

14. TSSBAT describe the latest three theories of cosmology and will begin to assimilate one of them into his or her individual philosophy of life.

15. Finally, TSSBAT will begin to appreciate the beauty andthe complex but orderly arrangement of the universe, to realize man's role in its future, and to begin to formulate a feeling for the purpose of our existence

*TSSBAT = The Student Should Be Able To

GS 104 Earth Science ASTRONOMY
Laboratory Outline

Spring Session. March 21 - May 4, 1988
Mrs C. Sutton
Office. 136 Weyandt Hall
Office Hours: see posted hours on office door

Lab Topics.

Constellations and Stars: history and use of constellations, identification and description of Circumpolar, Winter, and Spring Constellations and the bright stars in these: Weeks 1 & 5.

Seasons: cause of the seasons, view of our sunrise, noon, and sunset positions during during each season, view of the seasons from the North Pole, Arctic Circle, Tropic of Cancer, Equator, and Tropic of Capricorn, explanation of how to determine seasonal parameters (hours of sunlight, efficiency of sunlight) given a location and date. Week 2.

Moon: description of lunar surface features, coordinates used to locate features, phases of the moon, when moon can be seen, plotting lunar positions using stellar coordinates (right ascension and declination), keeping track of time (week, month) with the moon's motion. Week 3

Planets: making a scale model of planet distances from the sun, making a scale model of planets' sizes, plotting positions of Jupiter and earth over a six month period, plotting planetary configurations (such as opposition), ploting the current planetary positions using heliocentric longitudes (making a map of the current picure of the solar system). Week 4.

H-R Diagram: magnitude and classification of stars, plotting stellar characteristics on a chart, describing the different stellar characteristics on various sections of the chart, comparing the sun's characteristics to other stars, surveying characteristics of bright stars and of neighborhood stars. Week 6.

Text: Lab Manual Astronomy by C Sutton, 1988, at Kinko's

Course Assessment:

Each week a ten point quiz will be given on the previous week's lab. These five quizzes (50 point potential) and the 100 point lab final will be used to determine the student's astronomy lab average. The quizzes and final will contain "working" questions - measuring, plotting, determining answers from facts and data. Final assessment for GS 104 (Meteorology and Astronomy Lab) will be 50% Meteor and 50% Astro. The total point score in astro will be adjusted up to a mean of 75% (if necessary) so that ≥ 90% = A, 80 - 89% = B, 70 - 79% = C, 60 - 69% = D, and ≤ 59% = F. Lecture and laboratory grades are reported separately and do not affect each other.

Astronomy Terms:

Constellation, zodiac, ecliptic, celestial meridian, altitude, azimuth, declination, perihelion, aphelion, celestial equator, slanted rays, vertical rays, tilt, heliocentric longitude, opposition, conjunction, quadrature, elongation, crater, maria, sidereal month, synodic month, right ascension, giant star, main sequence star, dwarf star, absolute magnitude, spectral class.

GS 104 Earth Science Lab ASTRONOMY
Objectives

Listed below are formal objectives for this course. You will have some idea of what to expect on the quizzes and test by relating these to the lab exercises assigned.

1. TSSBAT* describe the history and usefullness of constellations.
2. TSSBAT name, describe, and locate 15 - 18 constellations and 12 stars.
3. TSSBAT determine time and directions by viewing the day or night sky.
4. TSSBAT synthesize the concepts related to the seasons to real situations to determine general conditions.
5. TSSBAT plot the motion of the moon on a star chart and determine future positions.
6. TSSBAT describe the phases of the moon and why they occur.
7. TSSBAT describe and locate the five major types of lunar terrain.
8. TSSBAT and calculate compare the earth's size and distance from the sun to those of the other planets.
9. TSSBAT plot current planets' positions and describe important planetary configurations.
10. TSSBAT plot star positions on an H-R Diagram and analyse their stellar characteristics
11. TSSBAT determine the most common variety of star by analysing a representative sampling of our stellar neighborhood.

*TSSBAT = The Student Should Be Able To

GS103 EARTH SCIENCE
METEOROLOGY PORTION
SPRING 1988

Professors Paul Prince/Frederick Park

Outline of topics:

Introduction to meteorology
- Meteorology as a science, brief history of major ideas and theories
- Dimensions and cartesian coordinates
- Eulerian and Lagrangian measurements
- Units of measurement and conversion between units
- Problems in studying meteorology

Composition and structure of the atmosphere
- Permanent and variable gases
- Chemical and thermal structure of the atmosphere
- Meteorological instruments

Radiation
- The electromagnetic spectrum
- Characteristics of solar radiation
- Characteristics of terrestrial radiation
- The radiation laws (Planck's, Kirchoff's, Stefan-Boetzman's, Wiens', Boyle's and Charles Gas Laws)
- Heat budget of the planet
- Heat engine

Humidity and the hydrologic cycle
- Humidity indices (relative humidity, absolute and specific humidity, dew point, and so on)

The adiabatic diagram
- Stable and unstable air
- Using the adiabatic diagram

Pressure and winds
Air masses and fronts
The cyclone
Storm structures: thunderstorms and tornadoes
Circulation of the atmosphere
Air pollution
The Greenhouse Effect
Solar radiation as a source of energy utilized by man
The future: problems and prospects

Text:

Miller and Anthes, 1985, Meteorology, 5th ed. and additional readings from scientific journals and newspaper articles will be assigned.

Course assessment:

You will be responsible for reading all nine chapter of the above text. Exams will be based upon both text and lecture material. Lectures follow textbook chapters in sequence. Lectures will emphasize only certain portions of each chapter. There

will be two examinations: questions are of recall type--short essay--no multiple choice or true-false questions. The exams will be 4-5 pages long and will consist of 15-25 questions. The final exam is comprehensive. You are responsible for all equations and diagrams used in lecture. Quizzes will be given weekly to evaluate both individual and class understanding. These quizzes will include interpretation of diagrams and short answers questions (multiple choice and matching). Your final grade will be based on two tests which count 80%, quizzes which will count 10% and class assignments which will count 10%. No late class assignments will be accepted. If necessary, the grades on the tests will be adjusted to a mean = 75% such that $\geq$ 90% = A, 80-89% = B, 70-79% = C, 60-69% = D, and $\leq$ 59% = F. The final grade in the course will be 50% Meteorology and 50% Astronomy.

GS 103 EARTH SCIENCE
METEOROLOGY PORTION
SPRING 1988

Course Objectives

1. You should be able to briefly discuss the results of past meteorological research and instruments used to determine the following:
   a. composition and structure of the atmosphere
   b. heat budget of the Earth and its atmosphere
   c. air masses and worldwide wind patterns
   d. interactions between air and ocean and climate

2. You should understand how the major meteorological instruments work and what limits their usefulness and precision.

3. You should be able to describe worldwide wind patterns and explain, in general terms, their origin.

4. You should be able to describe air masses, clouds, fronts and the resultant weather patterns.

5. You should appreciate both the science and art of weather forcasting.

6. You should understand what controls the amount of moisture in the air and the different ways in which this moisture condenses or sublimates.

7. You should be able to judge the feasibility of using solar radiation to supply our present and future energy needs.

8. You should understand how man can alter conditions in the atmosphere and thus affect the health of the whole planet (specifically, the Greenhouse Effect and the loss of ozone over polar regions caused in part by chlorofluorocarbons).

9. Finally, you should appreciate (and be able to show with examples) that the atmosphere must be viewed as interrelated physical, chemical, and biological systems with interactions among the cosmos, atmosphere, hydrosphere, lithosphere, and biosphere.

GS 104 EARTH SCIENCE LAB
METEOROLOGY PORTION
SPRING 1988

Prof. Prince, Park

Schedule of Labs:

Lab 1: Meteorological instruments: thermometers (mercury, alcohol, thermister) and different temperature scales, barometer (Fortin and aneroid), anemometer (savonis and Robinson), hygrometer (sling psychrometer, Assman psychrometer, electrical hygrometer, and hair hygrometer), wind vane and actual measurements of temperature, dew point, pressure, wind direction and speed and calculation of relative humidity (use of the psychrometric chart). You will use these instruments to measure the weather parameters of that day. You will also practice converting from one unit of measurement to another (temperature, pressure, wind speed and wind direction).

Lab 2: The classification and identification of clouds (cirrus, cirrostratus, cirrocumulus, altocumulus, altostratus, stratus, stratocumulus, nimbostratus, cumulus, cumulonimbus, lenticular, mammatus, banner, pilus, virga) and their significance in terms of weather. Actual observation of clouds and record of weather. Visit to weather station on roof of Weyandt.

Lab 3: Heat balance and the (mental) construction of a greenhouse to illustrate heat loss and gain by interactions of incoming solar radiation, the Earth's surface, the upper atmosphere, water in its different phases in the atmosphere.

Lab 4: Humidity and the Pseudoadiabatic Chart: relationships between humidity and pressure, relative humidity and mixing ratio, relative and absolute humidity, determination of altitudes of cloud formations for a given environmental lapse rate, calculation of dew points of any parcel of air given its temperature, pressure, and mixing rate, and determination of relative stability of air and the change of stability with increasing or decreasing altitude.

Lab 5: Introduction to weather map: plotting weather information on a map using the international standard symbolic weather station model (you will plot wind direction and speed, type of clouds and amount of sky covered by clouds, temperature and dew point, pressure and pressure change in the past 3 hours, present weather, past weather, amount and time of precipitation) and contour the distribution of pressure (isobars) on a map. You will plot this information on a large weather map which will be used also in lab 6.

Lab 6: Weather map: having plotted the weather information from about 50 weather stations across the contiguous USA you will analyze that weather map by locating the areas of high and low pressure, locating and labelling the appropriate weather fronts, and forecasting the weather based on your interpretation.

Lab 7: End-of-course test.

There is no text for this course. You will be given the necessary information and laboratory sheets in class.

Assessment:

The course assessment will be based on 5 quizzes given at the beginning of lab periods 2-6 and an end-of-course test. The quizzes will be worth 10 points each and will count 25% toward your grade. The test will count 75% toward your grade in the meteorology portion of GS104. Your final grade in GS104 will be 50% Astronomy and 50% Meteorology. If necesssary, the mean on the test will be adjusted to 75% such that $\geq$ 90% - A, 80-89% - B and so on.

GS 104 EARTH SCIENCE II LAB
METEOROLOGY PORTION
SPRING 1988

Course objectives

1. You should be familiar with the following meteorological instruments and techniques and you should be able to apply them to solve the appropriate problems:

   tools of the meteorologist: thermometers, barometers, anemometers and wind vanes, hygrometers

   use of conversion charts

   use of the pseudoadiabatic chart

   understand the symbols used in plotting weather information

2. You should understand the heat budget and how heat is lost and gained on the surface of the Earth.

3. You should understand the interrelationships between humidity and pressure and how these affect our weather.

4. You should be able to plot information on the pseudoadiabatic chart and thus deduce altitude of cloud formation and stable or unstable conditions.

5. You should gain a lifelong appreciation of how the identification of clouds can help you forecast the weather.

6. You should be able to synthesize all the information you have learned to measure in lab and be able to complete a weather map and to understand how to forecast the weather from such knowledge. In addition, you will be expected to completely understand any weather broadcast, for example in newspapers, on television or radio, in both content as well as implication of perhaps dangerous weather conditions.

7. You should gain an appreciation of the uses of solar energy in now and in the future.

8. Finally, you should gain an understanding of how mankind has affected the atmosphere and thus the Earth as a whole.