OMNIBUS COURSE SYLLABUS
METROPOLITAN STATE COLLEGE
SCHOOL OF LETTERS, ARTS, AND SCIENCES

DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES
PREFIX & COURSE NO. GEL 150
INSTRUCTOR Andrew M. Taylor
SEMESTER OFFERED Fall, 1997

COURSE TITLE  Geology of Red Rocks Park and Vicinity

SEMESTER CREDIT HOURS 1  CONTACT HOURS 15  LAB HOURS* 0

PREREQUISITES/COREQUISITES  None

REQUIRED READING MATERIALS (Title, Author, Publisher, Copyright Date)


VALUATION OF STUDENT PERFORMANCE

Final exam and summary field-trip report.

SPECIFIC (MEASURABLE) STUDENT BEHAVIORAL LEARNING OBJECTIVES

Upon completion of this course the student should be able to:

1. examine selected rock exposures in order to identify and record rock types and to relate rock types to modes of formation;
2. understand regional geologic history on the basis of rock types and sedimentary structures;
3. relate formations and rock types to economic products;
4. recognize the influence of geologic processes on rocks and landforms; and,
5. communicate this knowledge in the form of a geologic report.

DETAILED OUTLINE OF COURSE CONTENT (MAJOR HEADING/SUBTITLES) OR OUTLINE OF FIELD EXPERIENCE/INTERNSHIP (EXPERIENCE, RESPONSIBILITIES AND SUPERVISION)

I.  Classroom lecture
A.  General course objectives
B.  Basic geologic principles and concepts
   a.  Geologic time
   b.  Rock types
   c.  Principles of uniformitarianism, original horizontality, and superposition
   d.  Depositional environments (how rocks were formed)
e. Sedimentary structures
f. Formations
g. Transgressions and regressions (sea-level changes)

C. Presentation of subsequent events
D. Logistics

II. Field lectures (observations and recording of data)
A. Exposed Formations
   a. Geologic age
   b. Rock type(s)
   c. Depositional environments
   d. Economic products
B. Regional geologic history
   a. Pre-Laramide events
   b. Laramide events
   c. Post-Laramide events

III. Course requirements
A. Field-trip exam
B. Summary field-trip report

APPROVAL:
ALL OMNIBUS COURSES: ________________________ DATE: 1/26/97

CHAIR, CURRICULUM COMMITTEE: ________________________
DEPARTMENT CHAIR: ________________________
JEAN, SCHOOL/CENTER: ________________________ 1/24/97
V.P. ACADEMIC AFFAIRS: ________________________ 1/27/97

FIELD EXPERIENCE/INTERNSHIP ONLY:
LOCATION OF INTERNSHIP: ________________________

FACULTY EVALUATION GROUP: ________________________

FIELD SUPERVISOR* ________________________

*APPROVAL BY THE FIELD SUPERVISOR IS REQUIRED, AND MUST BE INDICATED BY THE ORIGINAL SIGNATURE OF THAT SUPERVISOR OF THE SYLLABUS.

(GUIDELINES AS SET FORTH IN THE OMNIBUS COURSE SECTION OF THE CATALOG MUST BE FOLLOWED. AN ACCURATE COPY OF EACH COURSE MUST BE ON FILE IN THE OFFICE OF ACADEMIC AFFAIRS PRIOR TO THE LISTING OF SUCH COURSE IN ANY SEMESTER SCHEDULE.)

CUR #03: JULY 86
ACADEMIC AFFAIRS
REQUEST FOR GENERAL STUDIES DESIGNATION (2012-13)
NATURAL AND PHYSICAL SCIENCES

Please review the Course Selection Criteria for this category for assistance in completing this form, particularly as it relates to the percentages associated with each Student Learning Outcome.

If this course is also being submitted for the Global Diversity Category, check here , and complete and attach the separate Global Diversity General Studies Designation request.

Date: 9-13-2012

School: LAS

Department: EAS

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Course Number</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>GEL</td>
<td>1010</td>
<td>4</td>
</tr>
</tbody>
</table>

Title: Physical Geology

Prerequisite(s): None

Corequisite(s): None

Banner enforced prerequisite(s) and/or corequisite(s): None

Recommended maximum enrollment per section: 25

A. Student Learning Outcomes

Describe the specific ways in which this course addresses each of these Student Learning Outcomes, providing students opportunities to develop the skills and/or acquire the knowledge. Include reference to readings, discussions, lectures, and other pedagogical tools which will be used. See the Criteria Table for examples.

Preface: EAS has developed a Rock/Mineral ID kit (RM ID kit) for students as a pedagogical, educational and professional tool. The kit contains essential tools and geologic samples to be used in laboratory and field settings with a great variety of scientific assessments. Some student learning outcomes depend on the use of the laboratory exercises made possible with this kit.

1. Demonstrate effective use of technologies appropriate to the task and discipline. (10%)

Technology included in the RM ID kit, such as specific gravity measurements, are part of the lab and analytical procedures in this course. Furthermore, students are required to use common office software to apply for research and graphing assignments.
2. Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose. (10%)

When presented with unknown geologic materials or concepts, students are to use appropriate, repeatable tests to verify data reliability. They also may need to data mine outside sources such as but not limited to appropriate internet sites in order to complete projects and/or lab assignments appropriately.

10. Describe how the methods of science are used to generate new knowledge. (30%)

Principles of geologic time and stratigraphy are an excellent tool to develop the concept of generating new science knowledge. As measurements evolved, so did the establishment of geologic time. Here, the activity and concept of using and calculating absolute time are a prime example and course activity.

11. Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline. (25%)

Maps and mapping include symbolic and graphical approaches in deciphering geological systems. Students will be able to use maps and their foundational knowledge to conclude the geology of areas never seen or visited.

19. Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field. (60%)

Students will continually use observations as well as the RM ID kit as appropriate tool to evaluate foundational knowledge. Thus the impact of such tools on the geologic science is learned and observed. Class as well as self-guided field trips are essential in this category.

20. Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses. (10%)

The key to this SLO is the RM ID kit which contains applicable tools. Students are required to frequently use these tools in laboratory settings to verify their hypothesis through appropriate experimental applications.

21. Develop concepts of accuracy, precision, and the role of repeatability in the acquisition of scientific data. (10%)

The RM ID kit includes a proprietary field tool developed by Dr. Uwe Kackstaetter to accurately measure specific gravity with an error of less than 5%. Measuring this property alone follows the laboratory standards of accuracy and precision.
B. Assessment of Student Learning

Identify and describe at least one specific form of assessing student achievement of each Student Learning Outcome which will be a regular part of the course. Include attachments as applicable. A single piece of student work may be used to assess student achievement of more than one Student Learning Outcome. See the Criteria Table for potential data for use in assessment.

1. Demonstrate effective use of technologies appropriate to the task and discipline.

Students are to answer graded i-clicker student response system questions during each class period. They are also to apply appropriate tools and technology during rock and mineral identification exams. See Attachment 1 (Sample Rock Exam). In addition, some lab exercises, such as the earthquake lab are using virtual simulations to hone viable skills in the discipline. See Attachment 2 (Sample Earthquakes Lab).

2. Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose.

The report for the field project requires students to locate appropriate sources to evaluate the data collected on the field trip and support conclusions concerning rock specimens. The analysis of each specimen requires at least three reliable sources. See Attachment 4 (Sample Field Project) and Attachment 6 (Field Project Template).

10. Describe how the methods of science are used to generate new knowledge.

Students will rely on their knowledge of relative time, use index fossils, and calculate absolute time in order to correlate strata. See Attachment 3 (Sample Stratigraphy Lab).

11. Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline.

The appropriate use of such methods is evidently examined during the geohazards unit topic when a laboratory activity in earthquake location and magnitude mitigation has to be evaluated. See Attachment 2 (Sample Earthquakes Lab).

19. Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field.

The rock / mineral or similar project in the course require students to use appropriate analytical tools and observations to derive at interpretations verifying foundational knowledge. Thus true hands-on applications of the scientific method are necessary to be successfully assessed in this area. See Attachment 4 (Sample Field Project).
20. Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses.

An assessment example would be mineral identification, which requires preassessment hypotheses and verification or eliminating of ideas through applying appropriate hands on laboratory tests. See Attachment 4 (Sample Field Project).


Students must measure specific gravity of several minerals. Accuracy and confidence in the method is established by measuring a known sample such as quartz and being able to precisely recreate the established density of 2.65 g/cm³. See Attachment 5 (Sample Density Lab).

C. Conformance with Course Selection Guidelines

Briefly describe how the course meets the course section guidelines:

The course must meet the full requirements of the Student Learning Outcomes, or must be paired with a corequisite lab course that, as a pair complete the outcomes.

Approvals:

[Signatures and dates for Department Curriculum Committee, Department Chair or Program Director, School Curriculum Committee, and Dean or Associate Dean]
METROPOLITAN STATE COLLEGE of DENVER

Chair, General Studies Committee / Date

Associate Vice President, Academic Affairs / Date
School of: LAS
Department: EAS
Prefix & Course Number: GEL1010  Crosslisted With*: ____
Course Title: Physical Geology
Check All That Apply: Required for Major: X Required for Minor: X Specified Elective: ____
Required for Concentration: ____ Elective: X Service Course: ____
Credit Hours: 4 (3+2)
Total Contact Hours per semester (assuming 15-16 week semester):
Lecture 45 Lab 30 Internship ____ Practicum ____ Other (please specify type and hours): ____
Schedule Type(s): B Grading Mode(s): L
Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):
n/a
** NOTE: This information must be included in the course description.
Restrictions (Variable Topics Course): n/a
Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None
Banner Enforced:
Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None
Catalog Course Description:
This course introduces the basic theories, concepts, and assumptions used in geology, utilizing both lecture and laboratory components. It includes earth’s internal systems from core to crust as well as the dynamics of the lithosphere with its processes, products, and effects on the environment. Students will learn to identify common rocks and minerals. A field trip is required. (General Studies - Level II, Natural Science, GT-SCI)
Required Reading and Other Materials will be equivalent to:
APPROVED:

1/2/12

Date

12/13/12

Date

3/12/13

Date

*If crosslisted, attach completed Course Crosslisting Agreement Form

Course Category and Related Student Learning Outcomes:
The following student learning outcomes (SLOs) for this course are prescribed in the General Studies - Natural and Physical Sciences Course Selection Criteria

1. SLO #1: Demonstrate effective use of technologies appropriate to the task and discipline. (10%)
2. SLO #2: Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose. (10%)
3. SLO #10: Describe how the methods of science are used to generate new knowledge. (30%)
4. SLO #11: Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline. (25%)
5. SLO #19: Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field. (60%)
6. SLO #20: Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses. (10%)
7. SLO #21: Develop concepts of accuracy, precision, and the role of repeatability in the acquisition of scientific data. (10%)

Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to

1) discuss and explain the science and common principles of geology
   a) explain relevant terminology in context with geologic theory (SLO #10, #19)
2) describe and identify common rocks and minerals
   a) use appropriate tools, procedures and interpretative technics (SLO #1, #19, #20, #21)
   b) apply knowledge and appropriate procedures to field observations (SLO #1; #19, #20, #21)
3) identify sedimentary, igneous, and metamorphic structures and relate them to geologic processes
   a) translate observations from the field and from samples into applicable explanations of environmental processes and geologic events (SLO #1; #2; #19, #20)
   b) recognize the importance of geologic time in geologic process interpretations (SLO #1; #2; #10; #19, #20)
4) utilize topographic and geologic maps to locate and identify geologic structures and landforms
   a) interpret map date correctly in order to ascertain foundational geomorphological and structural concepts (SLO #2; #11; #19, #20, #21)
5) understand the theory of plate tectonics and how it relates to the distribution of major landforms, geologic hazards, and resources
   a) identify the connection between plate boundaries and... (SLO #2; #11; #19)
      i) mountain building events
ii) geohazard zones
iii) mineral belts
iv) sedimentary basins

6) relate how geologic processes control and influence the environment
   a) examine the impact of geologic systems on human geography (SLO #2; #10; #11; #19)
   b) interpret how geologic processes and events have changed natural systems and cycles over time (SLO #2; #11; #19)

7) discuss the local geology and geologic history using examples from the greater Front Range,
   a) interpret clues in the field coupled with knowledge obtained to discuss local geology (SLO #2; #10; #11; #19, #20, #21)

**Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision)**

I. Minerals
   A. Definition and Basic Chemistry
   B. Basic Crystallography
   C. Physical Properties
   D. Mineral Identification with Practical Application
      1. Hands-on Lab Activities

II. Rocks
   A. Definition and Basic Rock-Forming Minerals
   B. Igneous Systems
      1. Intrusive Igneous Rocks
      2. Extrusive Igneous Rocks
      3. Bowen’s Reaction Series
      4. Classification
      5. Relation to Plate Tectonics
   C. Sedimentary Systems
      1. Weathering and Soils
      2. Sediment Erosion, Transport, and Deposition
      3. Lithification
      4. Basic Depositional Environments
      5. Classification
      6. Relation to Plate Tectonics
   D. Metamorphic Systems
      1. Simplified Metamorphic Mineralogy
      2. Classification
      3. Basic PT Diagrams
      4. Protolith and Barrovian Series
5. Relation to Plate Tectonics
E. Rock Cycle
   1. Relation to Plate Tectonics
   2. Basic Processes
F. Rock Identification with Practical Application
   1. Hands-on Lab Activities

III. Geologic Time
A. Relative Time
   1. Stratigraphic Principles
   2. Practical Applications
B. Absolute Time
   1. Radiometric Dating
   2. Practical Applications
C. Basic Geologic Time Scale and Major Events

IV. Earth Structure
A. Earth Interior
B. Faults and Folds
   1. Basic Stress – Strain relationships
   2. Practical Applications in Geology
C. Relation to Plate Tectonics

V. Geologic Hazards
A. Volcanic Hazards
B. Earthquakes and Tsunamis
C. Mass Wasting

VI. Geomorphology
A. Mountain Building, Isostacy
B. Basic Landforms and Topography
C. Basic Climate Systems
   1. Basic Atmospheric Structure and Circulation
   2. Deserts and Wind
   3. Glaciers and Glaciation
   4. Change in Time
D. Ocean Structure and Processes
   1. Continental Margins
   2. Ocean Bottoms
   3. Ocean Dynamics
E. Fluvial Systems
F. Relation to Plate Tectonics

VII. Resources
A. Minerals
B. Energy
C. Water
VIII. Plate Tectonics
   A. Convergent Boundaries
   B. Divergent Boundaries
   C. Transform Boundaries
   D. Basic Plate Movement
   E. Basic Plate Structure
   F. Introduction to Plate Tectonic Models

Evaluation of Student Performance

1. A minimum of two examinations with applied hands-on laboratory components requiring data acquisition and interpretation
2. One or more traditional examinations (e.g. essay, multiple choice, etc.) and/or quizzes probing the foundational knowledge in the discipline
3. At least three laboratory exercises designed to evaluate correct application of the scientific method by using appropriate technologies, correctly interpreting data and/or validating analytical results
4. A minimum of one major course project and/or paper requiring to draw accurate conclusions by applying foundational knowledge to acquired and verified data using the appropriate methods
5. Additional evaluations may include one or more of the following:
   a. Active participation in the course
   b. Use of simulations or models
   c. Evaluations specific to course field trip(s)
   d. Extracurricular activities
   e. Oral evaluations (one-on-one, group, and/or peer)
   f. Evaluation of power point or poster sessions
GEL1010 Rock Test - Version A

Do NOT write on here! Use scratch paper if you must! Answer only on your scantron! Return test after exam!
PUT THE TEST VERSION ON YOUR SCANTRON!

Multiple Choice (3 pts. ea.)
Identify the choice that best completes the statement or answers the question.

1. Slideshow part of Exam: The vertical igneous band shown in the stratigraphic sequence pictured is best classified as a(n).?
   a. Dike
   b. Batholith
   c. Pluton
   d. Sill
   e. Stock

2. Slideshow part of Exam: Which type of rock is most likely shown in the picture...?
   a. Granite
   b. Conglomerate
   c. Diorite
   d. Schist
   e. Gabbro

3. Slideshow part of Exam: Which would be the right description and environment of formation for the igneous rock shown in the picture?
   a. Aphanitic; Extrusive
   b. Porphyritic; Extrusive
   c. Phaneritic; Extrusive
   d. Aphanitic; Intrusive
   e. Porphyritic; Intrusive

4. Slideshow part of Exam: The pictured valley (yellow arrow) exhibits most likely which rocktype...?
   a. Basalt
   b. Sandstone
   c. Limestone
   d. Conglomerate
   e. Shale
5. Slideshow part of Exam: What is the most likely interpretation of the rock outcrop shown...?
   a. Pahoehoe Lave Flow
   b. Fine grained sedimentary rock deposited in shallow water
   c. Low Grade Metamorphic Rock
   d. Limestone deposit from coral reef environment
   e. Deep Ocean Sediment

6. The difference between lava and magma is that
   a. magma is light in color and lava is dark
   b. magma usually has mafic composition and lava usually has felsic composition
   c. magma is found beneath the Earth’s surface, whereas lava has reached the surface
   d. magma flows more quickly than lava

7. Bombs, ash, and cinders are all examples of
   a. intrusive igneous rocks
   b. hot-spots
   c. volatiles
   d. pyroclastic debris

8. When rock is partially melted, the chemistry of the melt is
   a. more mafic than the original chemistry of the rock that was partially melted
   b. more felsic than the original chemistry of the rock that was partially melted
   c. identical to the original chemistry of the rock that was partially melted
   d. completely unpredictable (it could be more mafic or more felsic)

9. A famous example of hot-spot volcanism occurs at
   a. the Aleutian Islands of Alaska
   b. the Andes Mountains
   c. Hawaii
   d. Mt. St. Helens, Washington

10. Frost wedging, root wedging, and salt wedging are all examples of
    a. erosion
    b. chemical weathering
    c. physical weathering
    d. deposition

11. It is unusual for
    a. ice
    b. water
    c. wind

12. Which environment would most likely produce sedimentary deposits characterized by very well sorted, very well rounded grains that are nearly pure quartz?
    a. river
    b. glacier
    c. beach
    d. alluvial fan

13. Which of the following sedimentary environments would exhibit better sorting in sand size clastic sediments...
    a. Fluvial
    b. Marine

14. The process of high-grade metamorphic rocks being altered to form low-grade metamorphic rocks is termed
    a. foliated
    b. prograde
    c. retrograde
    d. dynamic

15. Metamorphism in rock produced by hot groundwater is termed
    a. Barrovian
    b. Hydrothermal
    c. Blueschist
16. Foliated metamorphic rocks possess
a. leafy plant fossils (ancient foliage)
b. a homogenous texture resulting from randomly oriented grains
c. a planar fabric consisting of mineral grains in preferred orientations or preferred patterns of association (banding)
d. minerals precipitated directly from sea water

17. Which of the following igneous rocks is intrusive?
   a. Basalt
   b. Obsidian
   c. Rhyolite
   d. Granite
   e. Andesite

18. Which of the following igneous rocks could be classified as "intermediate"?
   a. Andesite
   b. Rhyolite
   c. Basalt
   d. A & B are true.
   e. A, B, and C are correct!

19. Which of the following rocks is NOT a metamorphic rock?
   a. Gneiss
   b. Schist
   c. Marble
   d. Limestone
   e. Quartzite

20. Which of the following is NOT a common igneous rock forming mineral?
   a. Quartz
   b. Muscovite Mica
   c. Biotite Mica
   d. Plagioclase Feldspar
   e. None of the above

21. Which of the following rocks is a metamorphic rock?
   a. Granite
   b. Shale
   c. Slate
   d. Limestone
   e. Andesite

22. Name the Barrovian Metamorphic Facies in sequence from Low to High Grade!
   a. Shale, Gneiss, Schist, Slate
   b. Slate, Shale, Schist, Gneiss
   c. Shale, Schist, Slate, Gneiss
   d. Slate, Shale, Schist, Gneiss
   e. Shale, Slate, Gneiss, Schist

23. What is the sequence of deposition when decreasing transport velocities in water for clay, sand, gravel and silt?
   a. Silt, sand, gravel, clay
   b. Clay, sand, gravel, silt

24. Which of the following is/are chemical weathering agents?
   a. Carbon Dioxide
   b. Oxygen
   c. Water
   d. A & B are correct!
   e. A, B, and C are correct!

25. Which of the following sedimentary rocks is indicative of an evaporate deposit, like a dry lakebed in the middle of a desert valley?
   a. Coal
   b. Limestone
   c. Gypsum
   d. Mudstone
   e. Conglomerate

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**PART II: ROCK IDENTIFICATION**

Obtain rock samples as listed in each question from the instructor's desk. Perform all tests necessary to identify & describe the rock. Write question number, rock number & rock name on the back of your scantron. Return rock sample IMMEDIATELY after identification to instructor's desk. You may write down two rock names for ½ credit.

**Short Answer** (Points as indicated for each question)

Do NOT write on here. Answer on BACK OF SCANTRON!

26. Obtain ROCK SAMPLE #1 from the instructor's desk.
   What is the name of the rock? (3pts)

27. Obtain ROCK SAMPLE #5 from the instructor's desk.
   Next to the rock name, give a detailed description of the formation process creating this rock! WARNING! I give minus points for incorrect use of terminology (8pts)

28. Obtain ROCK SAMPLE #9 from the instructor's desk.
   What is the name of the rock? (3pts)

29. Obtain ROCK SAMPLE #13 from the instructor's desk.
   What is the name of the rock? (3pts)

30. Obtain ROCK SAMPLE #17 from the instructor's desk.
   Next to the rock name, give a detailed description of the rock using the correct associated adjectives! WARNING! I give minus points for incorrect use of terminology (8pts)
MULTIPLE CHOICE

1. ANS: A  PTS: 1
2. ANS: B  PTS: 1
3. ANS: E  PTS: 1
4. ANS: C  PTS: 1
5. ANS: B  PTS: 1
6. ANS: C  PTS: 1
7. ANS: D  PTS: 1
8. ANS: B  PTS: 1
9. ANS: C  PTS: 1
10. ANS: C  PTS: 1
11. ANS: C  PTS: 1
12. ANS: C  PTS: 1
13. ANS: B  PTS: 1
14. ANS: C  PTS: 1
15. ANS: B  PTS: 1
16. ANS: C  PTS: 1
17. ANS: D  PTS: 1
18. ANS: A  PTS: 1
19. ANS: D  PTS: 1
20. ANS: E  PTS: 1
21. ANS: C  PTS: 1
22. ANS: D  PTS: 1
23. ANS: E  PTS: 1
24. ANS: E  PTS: 1
25. ANS: C  PTS: 1

26. (Sample ID #1) Granite (3pts)

27. (Sample ID #5) Schist: As heat & pressure increase, shale turns into slate and then into schist at temperatures of about 600°C and a burial depth of roughly 15 to 20 km along the geothermal gradient (3+5=8pts)

28. (Sample ID #9) Limestone (3pts)

29. (Sample ID #13) Quartzite (3pts)

30. (Sample ID #17). Sandstone: medium to fine grained, rounded, sorted, silica cemented, tan colored. (3+5=8pts)
LAB EXERCISE 6 - EARTHQUAKES

Name: _________________________  Course ID: _________________________

During this Lab exercise you will become a seismologist determining the location (Epicenter) and strength (Richter Magnitude) of an earthquake. In order to do this exercise, you need to be familiar on how to interpret a seismogram as shown on the right in figure 5.6. By analyzing seismograms of the same earthquake event from three different geographic locations, you will be able to complete the stated objective.

Materials Needed
• access to the internet
• drawing compass
• ruler / straightedge
• three seismograms (fig. 5.7)
• Locator map (fig. 5.8)
• SP lag time / epicenter distance graph (fig. 5.4)
• blank earthquake nomogram (as shown in fig. 5.5)

Before completing the remainder of this Lab, do the following pre-activity. Log on to the following website:

http://www.sciencecourseware.org/VirtualEarthquake/VQuakeExecute.html

You will be given a set of earthquake choices to investigate:

Start with earthquake 1. San Francisco Area and practice finding the Epicenter location AND the Richter Scale Magnitude.

PART 1
After you think you mastered the skill, chose one of the remaining earthquakes, 2. Southern California, 3. Japan Region, or 4. Mexico, to complete as part of this Lab exercise.

☐ For proof of completion of this first part of your Lab:
   Turn in: Print Out of Web Certificate for selected earthquake presented to you at the end of the activity

PART 2
Establish the Earthquake Epicenter and Magnitude for a distant earthquake given in the three seismograms presented in Figure 5.7. Use a drawing compass to pinpoint the earthquake epicenter on the provided location map (Figure 5.8). Also, use the provided nomogram to identify the earthquake magnitude for ALL 3 seismograms. Next to showing the graphical solution on the map and nomogram, give a written response concerning the location and magnitude in the spaces below:

| Epicenter Location:  
| In the space to the left give a detailed description of the geographic location of the epicenter |

| Earthquake Magnitude:  
| In the space to the left write down the earthquake magnitude with an accuracy of one decimal |
Figure 5.7 - Three station seismograms for CO, CA, and MA
Figure 5.8 - Earthquake epicenter locator map - North America
LAB EXERCISE 7 - EARTHQUAKE DEPTH

Geology - What does the depth of an earthquake tell us?
The list below summarizes the locations & depth of a few earthquakes around 30°S latitude in South America. Use the table below and the attached depth profile to plot the locations and focal depth of earthquakes.

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Day</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Magnitude</th>
<th>Depth (km)</th>
</tr>
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<td>2000</td>
<td>4</td>
<td>23</td>
<td>-28.31</td>
<td>-62.99</td>
<td>7</td>
<td>500</td>
</tr>
<tr>
<td>2001</td>
<td>1</td>
<td>1</td>
<td>-32</td>
<td>-71.54</td>
<td>5.1</td>
<td>82</td>
</tr>
<tr>
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<td>3</td>
<td>31</td>
<td>-29.4</td>
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<td>-71.81</td>
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<td>29</td>
</tr>
<tr>
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<td>5.1</td>
<td>30</td>
</tr>
<tr>
<td>2008</td>
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<td>26</td>
<td>-28.72</td>
<td>-71.43</td>
<td>5</td>
<td>50</td>
</tr>
</tbody>
</table>

After completing this exercise explain in the space below how earthquake depth is related to plate tectonics:
The use of index fossils is advantageous when correlation stratigraphic sections over long distances. Index fossils have a short time span of occurrence and often fall within certain geologic time periods. Figure 7.2 shows a summary of relevant index fossils used in correlation efforts. During this lab exercise you will be using these index fossils (figure 7.2) combined with your knowledge of geochronology to correlate and locate strata over an extended distance. You will also be challenged to decipher the regional geologic history and will learn how strata and geologic time can be traced from one distant location to another.

**MATERIALS**
- drawing pencils with an eraser
- 2 colored pencils (blue & red)
- copies of figures 7.2 and 7.3

**DIRECTIONS**

**STEP 1:** Use the geochemical data from the analysis of unit u, v, w, x, y, z presented in table 7.2 to calculate the absolute times for each of these units. Transfer your calculated times to figure 7.3.

**STEP 2:** Identify the fossils depicted in figure 7.3 by comparing them to the Index Fossil Chart shown in figure 7.2. Write down the fossil name AND appropriate relative geologic time and absolute time span next to the fossils depicted in the rock columns (figure 7.3).

**STEP 3:** Using the geochronological results, the index fossil evidence, the short lithologic descriptors and visual appearance of the strata, connect the layers that appear to be the same using your blue pencil. If there is a facies change or change in lithology over distance, indicate this by a jagged line separating the two strata types in transition as in the example to the right. Also, mark each suspected UNCONFORMITY in your correlation effort with a squiggly line between the strata (see drawing on the right). Use the red pencil to show the changes in time periods across your correlated, stratigraphic sections.

**STEP 4:** Provide a short geologic narrative explaining how these stratigraphic columns came to be and in which particular time sequence. Deduct the environment of deposition if you can. Start with the oldest and move your way upward to the youngest or most recent event.
Figure 7.2 - Index Fossils for geologic time periods (Courtesy of United States Geological Survey)

Table 7.2 - Isotopic geochemical results for various igneous samples associated with Exercise 11

<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
<th>Method</th>
<th>Parent Isotope (mmoles)</th>
<th>Daughter Isotope (mmoles)</th>
<th>Half-Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>rounded basalt pebbles</td>
<td>$^{87}\text{Rb} \to ^{87}\text{Sr}$</td>
<td>13.75</td>
<td>0.10</td>
<td>$48.8 \cdot 10^9$ years</td>
</tr>
<tr>
<td>V</td>
<td>rhyolitic ash layer</td>
<td>$^{235}\text{U} \to ^{207}\text{Pb}$</td>
<td>0.86</td>
<td>0.15</td>
<td>$0.703 \cdot 10^9$ years</td>
</tr>
<tr>
<td>W</td>
<td>rhyolitic ash layer</td>
<td>$^{235}\text{U} \to ^{207}\text{Pb}$</td>
<td>2.24</td>
<td>0.39</td>
<td>$0.703 \cdot 10^9$ years</td>
</tr>
<tr>
<td>X</td>
<td>volcanic breccia ash layer</td>
<td>$^{235}\text{U} \to ^{207}\text{Pb}$</td>
<td>3.99</td>
<td>1.10</td>
<td>$0.703 \cdot 10^9$ years</td>
</tr>
<tr>
<td>Y</td>
<td>rhyolite ash with obsidian</td>
<td>$^{40}\text{K} \to ^{40}\text{Ar}$</td>
<td>44.6</td>
<td>1.6</td>
<td>$1.25 \cdot 10^9$ years</td>
</tr>
<tr>
<td>Z</td>
<td>porphyritic rhyolite ash</td>
<td>$^{238}\text{U} \to ^{206}\text{Pb}$</td>
<td>6.34</td>
<td>0.32</td>
<td>$4.47 \cdot 10^9$ years</td>
</tr>
</tbody>
</table>
Figure 7.3 - STRATIGRAPHIC PROFILE WORKSHEET

NAME: ____________________________

**Outcrop I**

- (A) Coarse Sandstone
- (B) Claystone
- (C) Limestone
- Volcanic Ash Layer (V)
- Sandstone

**Drillcore II**

- (D) Laminated Sandstone
- (E) Limestone
- Volcanic Ash Layer (W)
- (F) Claystone
- Limestone

**Outcrop III**

- (G) Laminated Sandstone
- Volcanic Ash Layer (X)
- (H) Claystone
- Limestone
- Volcanic Ash Layer (Y)
- (I) Coarse Sandstone
- Limestone

- (J) Limestone
- (K) Claystone
- (L) Limestone

- (M) Coarse Sandstone
- (N) Limestone
- (O) Claystone
- (P) Sandstone

- (Q) Limestone
- Volcanic Ash Layer (Z)
- (R) Claystone
- Sandstone

- (S) Sandstone
GEL1010 Physical Geology
Rock-Mineral Field Project

- NOTICE: By accepting & opening this assignment packet you agree to abide by and consent to the
MSCD Field Trip Liability Waiver Regulations (see below for details).

Requirements:
• Your OWN transportation
• Topographic map for each sample showing collecting localities
• Samples must be at least FIST size
• Printable index cards or card stock paper

Outline:
1. During your field trips in the rocky mountains you are required to collect six (6) different rocks and four (4) different minerals of your own choice. Your first step is to identify the collected rocks and minerals correctly and to make sure there are no doubles.
2. To mark your specimens: Put a dot of white-out somewhere on your sample. After drying you can mark your sample on that dot. Or use small sticky labels sold in office supplies stores.
3. You must plot the collection locality of your rocks/minerals on a topographic map to be submitted with your completed collection. Glue map section NEATLY on the back of the index card. (Avoid Elmers = Wrinkles; use glue stick or professional spray glue!)
4. After collection of your samples you are to provide index cards with pertinent information. Make reference to which rock is addressed. These cards MUST be typed using either "printable!" index cards or card stock paper as described in the grading rubric. Information on the card:

<table>
<thead>
<tr>
<th>Collected Specimens</th>
<th>Document</th>
<th>Diagenesis / History</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Six (6) different ROCK specimens which at least one (1) Metamorphic, one (1) Igneous, and one (1) Sedimentary Rock.</td>
<td>Give Correct Name with OBSERVED Mineral Composition. For Sedimentary Rocks ADD grain size and sorting.</td>
<td>Igneous: Formation History &amp; Magma Type, Metamorphic: Formation History &amp; Depth / PT estimation, Sedimentary: Formation Name &amp; Depositional Environment</td>
<td>Print Topographic Location Map with Scale. Mark Sample Location. Give short description of Sample Location.</td>
</tr>
<tr>
<td>Four (4) different MINERAL specimens</td>
<td>Give Correct Name with Chemical Composition and Crystal Form.</td>
<td>Formation of Mineral. How and when did it form!</td>
<td></td>
</tr>
</tbody>
</table>

5. Put your specimens together with the accompanying completed index card into a shoe box.
6. Turn in your box and cards BY THE DEADLINE. Don’t forget to put your name on your work.

#10: Gneiss, a metamorphic rock
Foliated - Quartz, Kspar, Biotite

#7: Shale, a sedimentary rock
Clastic - Very fine grains < 1/256mm

#5: Granite, an igneous rock
Phaneritic - Quartz, K-feldspar, Biotite

#4: Fluorite, a mineral
Calcium Fluoride - Isometric

#1: Calcite, a mineral
Calcium Sulfate - Hexagonal

Diagenesis: Groundwater dissolved limestone from the Ingliside fm. & redeposited in natural crevasses in form of Calcite crystals.

Location: Found along US287, @ Owl Canyon Road cut, about 10 m the North of Ft. Collins, in road cut. In holes & cracks of Ingliside fm.
GEL1010 Physical Geology
Rock-Mineral Field Project

RULES for FULL CREDIT

7.1 RULE 1: Sample MUST be at least FIST SIZE. Small samples must be in FIST SIZE MATRIX.

7.2 RULE 2: NO RIVER PEBBLES = NO ROUNDED or PARTIALLY ROUNDED SAMPLES. Samples must be rough, fresh from original location.

7.3 RULE 3: Sample locations MUST be all different with AT LEAST 1/2 MILE DISTANCE (as the crow flies) between sample locations. You can NOT submit two or more collected samples from the same spot.

7.4 RULE 4: You are not allowed to collect in protected areas such as National or State Parks.

7.5 RULE 5: When submitting your project, your FIRST 4 SAMPLES (Samples 1 - 4) MUST BE MINERALS, SAMPLE 5 must be IGNEOUS; SAMPLE 6 must be METAMORPHIC; SAMPLE 7 must be SEDIMENTARY! Samples 8 - 10 do not matter as long as they are ROCKS, NOT MINERALS!

7.6 RULE 6: When submitting your project, the maps on the back of your index cards MUST BE TOPOGRAPHIC MAPS. No satellite images or road maps allowed.

7.7 RULE 7: Maps MUST show map scale (Bar Scale)

7.8 RULE 8: ABSOLUTELY NO HANDWRITTEN PROJECT MATERIALS ACCEPTED. All project related materials other than the labels on your specimens MUST BE TYPED, including the tables for the extra credit section!!!!

7.9 RULE 9: Index cards must be in sequence held together by a paperclip. NO STAPLES!

7.10 RULE 10: THE WORK MUST BE COMPLETELY YOUR OWN! If your writing is copied by another student you will lose at least 50% of ALL YOUR POINTS!

Common grading rubric:
Answer on a "printable" index card. Your responses must be typed & sorted into an orderly fashion! Each specimen must have its own index card! - Warning: I do reserve the right to refuse acceptance of any disorganized, illegible, incomplete, or shoddy work - Mark each collected sample with a reference number & place into a shoe box, with numbers 1 - 4 being the collected minerals. The 10 accompanying index cards should be clipped together and placed alongside your specimens. Each index card is to describe one sample in your collection.

Minimum Raw Point Deductions for infractions or below standard work for each sample.

Including, but NOT limited to:
Sample to small or rounded: -2pts ea.; Handwritten index card: -4pts ea.; Sloppy work: -3pts ea.; Missing location maps: -4pts ea.; Missing Map Scale: -1pt. ea; Sample within 1/2 mile of another: -4; Mineral & Rock sample numbering out of order: -2pts ea.; Using same printed answers as your buddy: -50% of your project score.

Note: If you want your samples back, clearly mark the outside of your box. Otherwise samples will be donated to MSCD EAS laboratory collections.

1Printable Index Cards for PC or Mac printing are available at various office supply stores. A cheaper solution would be to print on regular card stock paper & then cut out the cards.
# GEL1010 Physical Geology

## Rock-Mineral Field Project

### Project Grading Rubric

<table>
<thead>
<tr>
<th>Name:</th>
<th>Section:</th>
</tr>
</thead>
</table>

The Project consists of 5 individual segments. Each segment is graded on a 10 point grading system as indicated below. These raw points received will be added and then multiplied by three to derive at your final score.

<table>
<thead>
<tr>
<th>Raw Point Distribution:</th>
<th>Segment:</th>
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<tbody>
<tr>
<td>□□□□□□□□□□</td>
<td>11 pts (A+), 10 pts (A), 9 pts (A-), 8 pts (B), 7 pts (C), 6 pts (D), &lt;6 pts (F)</td>
</tr>
<tr>
<td>□ Extra credit for outstanding work</td>
<td>-1 pt for every uncertainty, error, or incomplete;</td>
</tr>
<tr>
<td>□ □ □ □</td>
<td>-1 to 3 pts for quality below other students in course</td>
</tr>
</tbody>
</table>

### Note: A+ summa cum laude (11 pts) are only given for very exceptional & outstanding work rarely seen in a student project! A magna cum laude (10 pts) are reserved for excellent work without any necessary improvement!

<table>
<thead>
<tr>
<th>Segment One: Completed Project Overall</th>
<th>Graded on Professionalism &amp; Neatness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good (what I am looking for): including but not limited to box with lid, Name on outside of box, Title page incl. Name, Class, Section, Date, affixed, A copy of this grading rubric with your name on it, Neatness, Business like print quality on index cards, Electronically prepared, ...</td>
<td></td>
</tr>
<tr>
<td>Bad (point deductions): Cut n’ paste index cards, NO box, missing Name on any or all of the parts, sloppy appearance, stains, handwritten, missing segments, index cards out of order, stapled instead of paperclipped, etc...</td>
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</table>

<table>
<thead>
<tr>
<th>Segment Two: Rock &amp; Mineral Samples</th>
<th>Graded on Correct Order, Numbering, Minimum Size Requirement, Correct Identification, Fresh Samples</th>
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</thead>
<tbody>
<tr>
<td>(#1 - #4 = Minerals; #5 = Igneous; #6 = Metamorphic; #7 = Sedimentary; #8 - #10 = Any other different Rock)</td>
<td>Good (what I am looking for): Fresh sample, First Size, Correct labeling, in order, correctly identified, ...</td>
</tr>
<tr>
<td>Bad (point deductions): Misidentification; Sample too small or rounded; Samples out of order; Samples missing; Samples NOT labeled, Not self collected, etc...</td>
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</table>

<table>
<thead>
<tr>
<th>Segment Three: (Index Card Front): Rock / Mineral Data</th>
<th>Graded on Correctness &amp; Completeness</th>
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</thead>
<tbody>
<tr>
<td>(Minerals: Name, Chem. Formula, Crystal Form, Igneous &amp; Metamorphic: Observed Mineral Composition, Sedimentary: Observed Composition &amp; Grain Size)</td>
<td>Good (what I am looking for): Correctly written / identified sample name PLUS: Minerals MUST include Chemical Formula &amp; Crystal Form; Igneous &amp; Metamorphic MUST include mineral composition AS OBSERVED, Sedimentary MUST include grain size &amp; composition AS OBSERVED, all neatly printed &amp; electronically prepared...</td>
</tr>
<tr>
<td>Bad (point deductions): including but not limited to missing or sloppy / unprofessional work, sloppy cut n’ paste, compositions of samples copied / NOT observed, etc...</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Segment Four: (Index Card Front): Origin / Diagenesis</th>
<th>Graded on Correctness, Language &amp; Neatness</th>
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<tbody>
<tr>
<td>(Available: Transcription done in handwriting, size that matches Box, it is supported by written evidence in form of field notes)</td>
<td>Good (what I am looking for): including but not limited to neatly prepared, professional write-up interpreting observations, use of correct terminology, formation names &amp; nomenclature when applicable, etc...</td>
</tr>
<tr>
<td>Bad (point deductions): including but not limited to missing or sloppy work, poor writing, incomplete, illogical, spelling &amp; grammar errors, etc...</td>
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</table>

<table>
<thead>
<tr>
<th>Segment Five: (Index Card Back): Location Maps &amp; Description</th>
<th>Graded on Quality, Neatness, Evident Fieldtrip activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>(What I am looking for): Neatly reproduced maps with location, Map Scale, Short detailed description, direct print or neatly glued (no wrinkles), index card size match...</td>
<td>Good (what I am looking for): Neatly reproduced maps with location, Map Scale, Short detailed description, direct print or neatly glued (no wrinkles), index card size match...</td>
</tr>
<tr>
<td>Bad (point deductions): including but not limited to missing or sloppy / unprofessional work, hand-drawn, sloppy glue jobs, sloppy cut n’ paste, sample locations within ½ mile, etc...</td>
<td></td>
</tr>
</tbody>
</table>

| Raw Points Total: | |
|------------------| |
| □□□□□□□□□□ | |

<table>
<thead>
<tr>
<th>Grade Points:</th>
<th>Grade:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
</tr>
</tbody>
</table>
LAB EXERCISE 2b - DENSITY

Name: 
Course ID: 

This lab addendum is designed to give you practice and confidence using the pen-scale densimeter system included with the Professional Rock/Mineral Identification Kit. Using a mineral of known density and trying to match the result will help you build skills of proper use with the system.

Materials needed:
- Minerals or materials of known density
- Professional Rock/Mineral Identification Kit (See above for ordering information)
- Some water
- other helpful determinative Mineral ID tables and mineral descriptions

Procedure:

1. **Calibrate the scale:** With only the string attached, the pen-scale should read zero. If it does not, loosen the upper thumb nut, then turn top ring until black line on readout aligns with the zero mark.

2. Use a piece of string or thread and tie a slip knot in one end while clamping the other end of the string to the clip on the Pen Scale. Hold pen scale upright and zero-tare if necessary by using the zero adjustment screw on top of scale.

3. Tie your unknown mineral sample of NO MORE than 10g (preferred around 5g) to the string with the slip knot and weigh sample. Note or record the weight \( W_{\text{string}} \) to 0.1g precisely.

4. Fill a small cup with enough water to completely submerge the sample. Holding the scale upright with the object still attached, lower your tied-on mineral into the water. Neither the object nor string should touch the vessel while measuring and your mineral must be completely immersed. Make sure no major air bubbles are trapped on the sample or the string. Weigh the submerged object and note or record the weight \( W_{\text{submerged}} \) to 0.1g precisely.

5. Either use the equation

\[
SG_{\text{calculated}} = \frac{W_{\text{air}}(g)}{W_{\text{air}}(g) - W_{\text{submerged}}(g)}
\]

and a calculator to compute density OR use the nomographs on the previous pages to establish density.

<table>
<thead>
<tr>
<th>Specimen Name</th>
<th>Measurements &amp; Calculations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz ((\text{SiO}_2))</td>
<td>(SG = \frac{W_{\text{air}}(g)}{W_{\text{air}}(g) - W_{\text{water}}(g)})</td>
</tr>
<tr>
<td>S.G. (= 2.65 \text{ g/cm}^3)</td>
<td></td>
</tr>
<tr>
<td>Galena ((\text{PbS}))</td>
<td>(SG = \frac{W_{\text{air}}(g)}{W_{\text{air}}(g) - W_{\text{water}}(g)})</td>
</tr>
<tr>
<td>S.G. (\approx 7.40 \text{ g/cm}^3)</td>
<td></td>
</tr>
</tbody>
</table>

What is the percent error of your measurement? You should be below ±6%. Use your measurement for quartz according to:

\[
\% \text{ error}_{\text{quartz}} = 100\% - \left( \frac{SG_{\text{your measurement}}}{2.65 \text{ g/cm}^3} \right) \times 100
\]

If your error is greater than ±6%, you MUST REPEAT the part of the experiment that introduced your error until your error margin is acceptable.
Introduction

[Maximal two pages: Describe significance of the assignment in a broad context. Provide a rationale stating specific hypothesis(es) or objective(s), as well as your selection criteria. How where the sample localities chosen? What was the collection procedure? What laboratory tests where performed on the specimens? During what time period where samples collected?]

[Use professional technical writing voice throughout your write-up, therefore AVOID “I”, “us”, “we”, “our”, etc.]
### MINERALS

<table>
<thead>
<tr>
<th>MINERAL NAME</th>
<th>SAMPLE #1</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image_url" alt="Image of MINERAL" /></td>
<td><img src="image_url" alt="Image of YOUR specimen" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>[Chemical Formula]</th>
<th>[Crystal Class]</th>
<th>[Insert Picture of YOUR specimen here! Do NOT copy from other sources]</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Summary of physical mineral parameters, such as hardness, streak, density, etc.: Can be in tabulated or bullet format and may be copied from resource material, AS LONG AS IT IS PROPERLY CITED]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Diagenesis:

[Describe in detail how the mineral formed at the specific sampling location. What is your evidence for your hypothesis? AVOID copying general rock forming descriptions from the literature. Make it specific to the mineral at your location.]

#### Insert map of sample location here

Make sure scale and location marker are included.

#### Short location description, detailed enough to find without map. Longitude - Latitude GPS positions are recommended.

#### Citation:

[A minimum of three viable references used for this particular mineral to be inserted here! Note: Wikipedia is NOT a viable reference]
<table>
<thead>
<tr>
<th>MINERAL NAME</th>
<th>SAMPLE #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Chemical Formula]</td>
<td>[Insert Picture of YOUR specimen here! Do NOT copy from other sources]</td>
</tr>
<tr>
<td>[Crystal Class]</td>
<td></td>
</tr>
</tbody>
</table>

[Summary of physical mineral parameters, such as hardness, streak, density, etc.: Can be in tabulated or bullet format and may be copied from resource material, AS LONG AS IT IS PROPERLY CITED]

Diagenesis:

[Describe in detail how the mineral formed at the specific sampling location. What is your evidence for your hypothesis? AVOID copying general rock forming descriptions from the literature. Make it specific to the mineral at your location.]

[Insert map of sample location here. Make sure scale and location marker are included]

[Short location description, detailed enough to find without map. Longitude - Latitude GPS positions are recommended.]

Citation:

[A minimum of three viable references used for this particular mineral to be inserted here! Note: Wikipedia is NOT a viable reference]
MINERALS

<table>
<thead>
<tr>
<th>MINERAL NAME</th>
<th>SAMPLE #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Chemical Formula]</td>
<td>[Insert Picture of YOUR specimen here! Do NOT copy from other sources]</td>
</tr>
<tr>
<td>[Crystal Class]</td>
<td></td>
</tr>
</tbody>
</table>

[Summary of physical mineral parameters, such as hardness, streak, density, etc.: Can be in tabulated or bullet format and may be copied from resource material, AS LONG AS IT IS PROPERLY CITED]

Diagenesis:

[Describe in detail how the mineral formed at the specific sampling location. What is your evidence for your hypothesis? AVOID copying general rock forming descriptions from the literature. Make it specific to the mineral at your location. ]

[Insert map of sample location here Make sure scale and location marker are included]

[Short location description, detailed enough to find without map. Longitude - Latitude GPS positions are recommended.]

Citation:
[A minimum of three viable references used for this particular mineral to be inserted here! Note: Wikipedia is NOT a viable reference]
**General Course Syllabus for GEL 1010 Physical Geology**

**Spring 2012**

**Sec 001 M W 8:00 - 10:15pm, Sec 003 TR 2:00 - 4:15pm, Rm: SI2008**

**Professor:** Uwe Richard Kackstaetter, Ph.d. (Dr. "K")

**Office Hours:** M T 10:30 - 1:30, W 10:30 - 12:00, other times by appointment

**Office:** SI2014

**Contact:** E-mail: kackstaet@mscd.edu 303-556-3070

**URL:** http://college.earthscienceeducation.net

This syllabus may be modified at any time without prior notice.

**Course Description**

The course studies the materials of the earth, its structure, surface features and the geologic processes involved in its development. It includes laboratory experience. During the class you will learn the basic theories, concepts, and assumptions utilized in geology. Beginning with the study of common minerals, their abundance and formation, we will delve into igneous, sedimentary, and metamorphic rocks and their rock forming processes, sedimentary environments, and continue through theory of plate tectonics, to land forms, maps and map reading, geological structures, finally finishing with geologic hazards such as earthquakes, and the geologic time and history of the earth. Fieldtrip(s) are required for this course, some self-guided.

**Required Materials**

- MSCD EAS (2011), Mineral and Rock Identification Kit, EAS Professional Projects (available through Bookstore)
- i-clicker (ABSOLUTE MUST! YOUR GRADE DEPENDS ON IT) (available through Bookstore)

**Specific (Measurable) Student Behavioral Learning Objectives**

Upon completion of the course the student should be able to:

1. Discuss and explain the science and principles of geology;
2. Describe and identify common rocks and minerals;
3. Comprehend geologic processes and how they create materials of the earth and modify the earth;
4. Understand the theory of plate tectonics and it's relation to the distribution of major landforms;
5. Relate how geologic processes control and influence the environment;
6. Be able to interpret maps, create cross sections and identify common landforms and processes.
7. Identify geologic formations of the front range, environments of deposition and geologic structures.

**Outline of Course Content**

**Major Topics & Subtopics**

I. Elements, Minerals, and Crystals
II. Igneous Rocks (Extrusive [Volcanoes] & Intrusive)
III. Weathering, Transport, Environments of Deposition
IV. Sediments and Sedimentary Rocks
V. Metamorphism, Metamorphic Rocks, and Hydrothermal Rocks
VI. Plate Tectonics & Geologic Structures (Earthquakes)
VII. Geologic Time & History
VIII. Map Reading, Geomorphology, Landform Interpretation

**Grading in Physical Geology**

<table>
<thead>
<tr>
<th>Participation</th>
<th>Max Points</th>
<th>My Points</th>
<th>MY GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineral ID Lecture/Lab Exam</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rock ID Lecture/Lab Exam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geo Time &amp; Correlation Lecture/Lab Exam</td>
<td>400</td>
<td>(100 pts ea. Lowest score dropped)</td>
<td>Keep truck of your grade! Color in Grade Graph to the right! (Don't forget to drop lowest score for Exams)</td>
</tr>
<tr>
<td>Geo. Structure &amp; Map Lecture/Lab Exam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geo. Hazards Lecture/Lab Exam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Online Chapter Quizzes (Ch.5:Minerals; Ch 6,7,8;Rocks; Ch. 9,10:Geohazards; CH 12,13: Geologic Age; Ch.3,4,11: Mountains &amp; Plates; Ch 14,15,19 Resources)</td>
<td>150</td>
<td>(25 pts. ea.)</td>
<td></td>
</tr>
<tr>
<td>Rock / Mineral Project</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMPREHENSIVE FINAL (50 questions) *</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>1000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Students with an average exam score above ≥ 80% and NONE of the exams less than 70% may opt out of the Final Exam. They will receive their exam average times 1.5 as the Comprehensive Final Exam Score.

**FINAL GRADE:**

- A+ = 1000
- A = 950-1000
- A- = 900-949
- B+ = 870-899
- B = 830-869
- B- = 800-829
- C+ = 770-799
- C = 730-769
- C- = 700-729
- D+ = 670-699
- D = 630-669
- D- = 600-629
- F = ≤ 599 points
How does one receive an A+ (over 1000 points) in this class?

Almost all assessments carry extra credit points, therefore more than 100% on assessments is possible. This, however, is most likely reserved for those who are willing to invest heavily and deeply of time and talent into the class! An A+, which I consider "summa cum laude" is usually received by exceptional & outstanding students in the top 1% of my classes.

PARTICIPATION: You are EXPECTED to attend class & labs and PAY ATTENTION in both. Attendance & Student Responses will be tracked using the I-clicker interactive student response system. The timely purchase of the device is REQUIRED in order to earn full participation points (see point distribution below). If you forget your clicker or do not have one (NOT recommended), you MUST sign a special roll in order to receive at least partial credit for attending class (Lowest score of the day minus 10%). Points can NOT be assigned retroactively!!! Students can earn daily points toward their participation grade by responding CORRECTLY to i-clicker questions randomly presented during lectures / labs. I absolutely DESPISE students with less than 80% participation, whining about their grade at the end of the semester. (So, don't even try!). In regards to attendance & class materials: Any handout, any notes, any exam questions discussed will only be given IN CLASS. If you miss class, you are on your own. I do not keep extra copies and NO, I do not have or publish lecture notes for your convenience! (THIS IS NOT AN ONLINE CLASS!)

<table>
<thead>
<tr>
<th>Point Distributions:</th>
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<tbody>
<tr>
<td>15 Week Course meeting</td>
</tr>
<tr>
<td>(a) twice per week: 5pts/day</td>
</tr>
<tr>
<td>(b) once per week: 10pts/day</td>
</tr>
<tr>
<td>10 Week Course meeting</td>
</tr>
<tr>
<td>(a) twice per week: 7.5pts/day</td>
</tr>
<tr>
<td>(b) once per week: 15pts/day</td>
</tr>
<tr>
<td>8 Week Course meeting</td>
</tr>
<tr>
<td>(a) twice per week: 9.4pts/day</td>
</tr>
<tr>
<td>(b) once per week: 18.8 pts/day</td>
</tr>
</tbody>
</table>

ABSENCES: Frankly, registering for this course is equivalent and as serious as you taking a job. I expect from you the same professional courtesies that you would extend toward your employer. As with any employer, you do NOT get paid for missed days, meaning, there are NO participation points awarded if you do not show up for class. Period! However, similarly to the real employment world, I will grant you "sick or leave days" worth a total of 10 participation points, which you may use at your discretion. As with most employment situations, you may cash in your remaining "sick or leave days" for extra credit at the end of the semester. Absences beyond these allotted points will never be awarded anything, no matter the reason, including but not limited to illness, work conflicts, car accidents, booked vacations, etc. 

Exception: Jury-Duty: You must bring official proof of your actual court room duty validated by the court / judge! (No, the little card you get in the mail soliciting you for jury duty does NOT count!)

Note: Nothing in this policy shall require the instructor to reschedule classes, repeat lectures or other ungraded activities or provide ungraded individualized instruction solely for the benefit of students who are unable to attend regularly scheduled classes or activities.

EXAM or TEST MAKE-UP: There is NO make-up for the Final. As far as the 5 lab/lecture exams are concerned, the lowest grade will be dropped. This way you do NOT have to worry about scheduling inconvenient make-ups or that the missing exam will effect your grade @. However, if you miss 2 or more tests, only ONE of the scores will be dropped, the others will still count! 

Exception: Jury-Duty: You must bring official proof of your actual court room duty validated by the court / judge! (No, the little card you get in the mail soliciting you for jury duty does NOT count!)

COMPREHENSIVE FINAL EXAM: Students with an average lab/lecture exam score of above 80% and with NONE of the exams less than 70% may opt out of the Final Exam. If theses qualifications are met, a student must OPT OUT IN WRITING by completing a special form (available online) and attach exam scores as proof. They will then receive their lab/lecture exam average from ALL the exams multiplied by 1.5 as their Comprehensive Final Exam Score. Students who do NOT file this form with all the proof necessary before the final exam MUST TAKE THE FINAL or they will receive a “0” even if they qualify!

Disclaimer: Students who take the final and receive a lower score than their average score computed, can NOT revert back to their average score because it is higher. If you take the Final, you will receive the Final Exam score as your Grade. (No Exceptions!)

ONLINE QUIZZES: These assessments in this course are NOT study guides. They are designed to establish proficiency in understanding the college text material. They are not designed to help you figure out exactly which questions you got wrong and why. You will receive the test score indicating your aptitude in the text material. I will NO longer make individual questions available or go through them in detail, or find a particular test for you to go over, or to give you the questions to take home, etc. If you want to study in order to see how well you do on individual questions, read the textbook intentionally and then work through the practice exercises associated with each chapter.

FIELD TRIPS: To help you identify geologic features in the field, there will be at least one mandatory Saturday field trip. Additional field exercises are devised as self-study tours to be taken at your convenience, therefore avoiding scheduling conflicts. Fieldtrip guides are included in the electronic Lab Manual. They may also be downloaded from my website. For details about this assessment please see the additional handout & field trip guides.

LATE WORK: Since all labs and other assignments are available within the first few weeks of class, I will not accept ANY late work. Please note, this means ANY!!! You had practically the whole semester to complete the exercise(s), so don't blame broken printers, crashed computers, uncooperative emails, sudden work conflicts or bouts of illness the day(s) before or even during the deadline for missing the deadline. Hint: Turn your work in early and there will be NO problems! Since the last deadline is always the last day of your regular scheduled class for the semester, there will be absolutely NOTHING accepted during and after Finals Week! Don't even try!

EXTRA CREDIT: Students may earn extra credit for the LAB exams by doing the lab exercises BEFOREHAND and submitting them by the deadline given. Extra credit for the Rock / Mineral Field Project is included in the project packet. Many exams / assignments also include approx 10% extra credit, giving students the opportunity to earn a high score of 110% (Except take-home or open note
E-MAIL: You may e-mail me any time at hackstae@mscd.edu. In general, I will NOT accept any assignments via e-mail. These must be turned in as hard copies AT THE ALLOTTED DUE DATES!!!!

ACADEMIC INTEGRITY: "As students, faculty, staff and administrators of Metropolitan State University of Denver, it is our responsibility to uphold and maintain an academic environment that furthers scholarly inquiry, creative activity and the application of knowledge. We will not tolerate academic dishonesty. We will demonstrate honesty and integrity in all activities related to our learning and scholarship. We will not plagiarize, fabricate information or data, cheat on tests or exams, steal academic material, or submit work to more than one class without full disclosure."

More Specific: If you copy another students work, both of you, the "copier" and the "copied" will receive 50%. You SHARE THE WORK, YOU DIVIDE THE GRADE!!! If more than one student is involved in the copying, the grade will be prorated accordingly, e.g., 3 students = 33% each, 4 students = 25% each, and so forth! Be especially careful when you work on assignments in a group with other students. (Note: You may share DATA that was collected together, you MAY NOT SHARE WRITE-UPS). The same is true when copying from the internet. Each plagiarized source costs you at a minimum 50% of your assignment grade. (The Internet will get the other 50%)! Any student found involved in academic dishonesty (e.g., cheating on exams, answering i-clicker questions for someone else, copying whole book/internet pages) may receive an "F" for the course grade, and disciplinary action at the college level may be recommended.

I-C LiCKER WARNING: Responding to i-clicker questions for someone else (e.g., by using their i-clicker together with your own) CONSTITUTES ACADEMIC CHEATING (same as cheating on a test or exam). First infraction will most likely involve a stern, public and very embarrassing warning. Second infractions will unceremoniously asked to leave the classroom and academic fraud procedures will be instigated with proper college authorities. Students may receive an F for the course due to academic dishonesty as per student handbook.

CIVILITY: The student code of conduct will be enforced in this class. The short version of the code: Students are expected to assist in maintaining a classroom environment conducive to learning and respectful of the instructor and fellow students. Students have an opportunity to gain from time spent in class. Therefore, students are prohibited from using cell-phones or beepers, text messaging, eating or drinking in class, making offensive remarks, reading newspapers, using their laptop or PDA for class unrelated activities (such as browsing the internet, checking email, watching videos, etc.) or doing other assignments unrelated to the class, sleeping or engaging in any other form of distraction. While you may feel that you are doing it quietly and unobtrusive enough, it does indeed distract other students (as scores of them have reported to me). Inappropriate behavior shall result minimally in a request to cease the behavior and upon continuation despite warnings to leave the class.

ELECTRONIC DEVICES: Put ALL your consumer electronics away (which means they are NOT to be visible, even if you don't use them) including but not limited to cell phones, ipods, MP3 players, headphones, etc. They are NOT to be used at any time during my class. Cell phone calculators are NOT ALLOWED, you must bring a "real" calculator. Personal computers are allowed in class only with approval from the instructor and a written and signed contract. Permission for use of PCs will be immediately revoked for the remainder of the course if a students is found to be engaged in unrelated activities, such as checking e-mail, surfing the web, playing games, etc. Texting, emailing, gaming, listening to music or similar unrelated activities during classtime is not only rude and unprofessional, it is highly annoying to me and the majority of your fellow students. If you are caught you will be unceremoniously asked to leave my class and you will lose any or all participation points for that day. Repeat offenders will face disciplinary action on the college level. You have been warned!

CELL PHONE WARNING: There are NO cell phones allowed in the classroom! PERIOD! If you text or do anything with your cell phone, Dr. K has the right to REMOVE YOU FROM THE CLASS. PERIOD! First infraction will most likely involve a stern, public and very embarrassing warning. Continued infractions will result in a removal from the class and possible failing grades.

STUDENTS WITH DISABILITIES: The Metropolitan State University of Denver is committed to making reasonable accommodations to assist individuals with disabilities in reaching their academic potential. If you have a disability which may impact your performance, attendance, or grades in this class and requesting accommodations, then you must first register with the Access Center, located in the Auraria Library, Suite 116, (303) 556-8387.

The Access Center is the designated department responsible for coordinating accommodations and services for students with disabilities. Accommodations will NOT be granted prior to receipt of your faculty notification letter from the Access Center. Please note that accommodations are never provided retroactively (i.e., prior to the receipt of your letter). Once I have received your official Access Center Faculty Notification Letter, I would be happy to meet with you to discuss your accommodation. All discussions will remain confidential. Further information is available by visiting the Access Center website at http://www.mscd.edu/~access/.

Please be aware that I am unable to grant certain accommodation: My presentations contain copyrighted material and can NOT be printed, copied, transcribed, forwarded or made available electronically or otherwise OUTSIDE OF MY PERSONAL COMPUTER AND CLASSROOM. Solution: Get an excellent notetaker! I also do NOT extend any deadlines on assignments, because (a) all my assignments are given out during the first week of class and (b) my assignment deadlines ARE ALREADY THE EXTENDED ONES, already tailored to the weakest of the weak students and those with disabilities. Solution: Start assignments right away. In this manner I can help you with plenty of time for completion.

"I" Policy: The Incomplete notation is COURTESY OF THE INSTRUCTOR. Instructors are neither required nor obligated to give "Is". However, according to school policy regarding an "I" notation, a student must have completed a major portion of the course requirements (75% minimum) but is unable to complete all of the course requirements due to unusual circumstances, such as


hospitalization. (No, being stressed out, starting assignments too late and being unable to finish them, or going on a cruise during finals week which you booked last year are all NOT considered unusual circumstances). Authorized third party documentation of such unusual circumstances will be absolutely required before an "I" is even taken under consideration. All students found eligible to receive an "I" in the course must complete a contract with the instructor stating specifically by when and how the "I" must be remedied.

IT IS THE STUDEN'TS RESPONSIBILITY TO REMEDY AN "I" AND STAY ON TOP OF IT, NOT THE INSTRUCTOR’S RESPONSIBILITY!!!

OTHER: Students at Metropolitan State University of Denver who because of their sincerely held religious beliefs, are unable to attend classes, take examinations, participate in graded activities or submit graded assignments on particular days shall, without penalty, be excused from such classes and be given a meaningful opportunity to make up such examinations and graded activities or assignments. Advance written notice that the student will be absent for the religious reasons must be given to the instructor during the first two weeks of the semester.

Nothing in the above policy shall require the instructor to reschedule classes, repeat lectures or other ungraded activities or provide ungraded individualized instruction solely for the benefit of students who, for religious reasons, are unable to attend regularly scheduled classes or activities. However, presentations, critiques, conferences, and similar activities involving individual students shall be scheduled to avoid conflicts with such student's religious observances or holidays provided that reasonable advance notice of scheduling conflicts is given to the instructor.

“NC” Policy - all students may request an NC (No credit) notation without faculty approval through the second week of classes. NC notations with faculty approval will only be granted through the sixth week of class. A request for an NC will not be granted after that week.

LAB ASSIGNMENTS: Most Lab assignments carry extra credit for the exams. Please see the extra credit section for details.

LAB TIME: This class requires a lot of lab time. While some time for lab exercises will be given during the assigned course time block, we have created an open lab schedule outside regular class periods. Please look carefully at the posted calendar and sign-up accordingly, if sign-ups are required. Lab spaces are limited and sign-ups will be taken on a first-come, first-served basis. While you may sign-up for several lab times in advance, keeping these times is a crucial commitment. If you miss ANY of your appointments, ALL your future sign-ups will be bumped in favor of other students willing to keep their commitment. You have been warned! Also, be aware that certain labs are only set up during certain times. Missing these labs does not automatically qualify you for a lab make-up at a later date. In fact, these make-ups will be RARELY GRANTED and will need full official documentation of circumstances preventing a student from completing the lab during the assigned time slot. You have been warned again!

LAB RULES: All students working in the lab must sign in, state the purpose of their activities and wear an appropriate name badge identifying you legitimacy to be in the lab. Students must follow instructions of the Lab Assistants and are responsible for thoroughly cleaning their work space and lab equipment used after the completion of the lab exercise. BE AWARE: LAB INFRINGEMENTS CONCERNING EQUIPMENT & CLEAN-UP CARRY MINUS POINTS FOR THE COURSE! ALL students must read and sign the following Liability Waiver:

LAB LIABILITY WAIVER
(1) Students in the course will use analytical & cutting machinery as well as assemble chemical kits for rapid mineral field assay to be taken outside of the classroom. All students participating in such lab activities taught by the Department of Earth and Atmospheric Sciences should be aware that there is always an element of risk involved when working with equipment, machinery and/or chemicals. These risks involve serious injury or death, especially if safety protocols are not followed and/or equipment, machinery, and chemicals are misused. Instructors and/or Lab Personnel will use all reasonable precautions and students need to exercise prudent behavior during such activities, but even then there exists the possibility of an accident or injury. Since many of these activities are to be undertaken in the field and outside of the classroom without the direct supervision of an instructor, students must be alert and aware of possible risks and dangers when using chemicals, equipment, and/or machinery with or without supervision.

(2) Neither the University, nor the instructor, nor any assigned Lab Personnel shall be liable for any damages, including but not limited to injuries, death, loss of property or profits, or incidental, consequential, exemplary, special or other damages that may result from use of chemical, equipment, and/or machinery used in conjunction with or outside the framework of this college course. This condition also expands to the use of procedures and formulations given in LAB texts.

(3) The associated LAB instructions and described analytical procedures are intended for use by mature persons following the safety instructions precisely. Neither the author, nor the instructor, nor the University does accept liability or responsibility for any injury or damage to persons or property incurred by performing the experiments described in the LAB texts, nor for the content of any outside material referred to in class or manual, including linked websites.

(4) EXPLICIT SAFETY RULES & REGULATIONS:
I. Students MUST wear Safety Goggles when working with chemicals or using equipment or machinery.
II. Students MUST read and follow instructions precisely.
III. Students shall NOT misappropriate chemicals, equipment and/or machinery other than its intended and prescribed use.
IV. Students must take care not to ingest, inhale, taste or otherwise orally contact chemicals or reactive products. Students MUST wash hands after each experiment.
V. Some tests may include open flames. Students MUST take precautions in hair and clothing to avoid accidental or intentional contact of persons and property with flames and fire.
VI. Students MUST take care when transporting equipment to avoid spillage and unintended contact with property and persons.

(5) Students who violate any of the above rules, policies and stipulations which are written in this document or implied through instruction and professional laboratory behavior or who fail to conform to directives from the instructor or lab personnel may be immediately dismissed from the course. They may also be subject to a failing grade in the course, be required to withdraw from the course, and be subject to disciplinary action by the University.

(6) All participants MUST SIGN the following LIABILITY WAIVER.

In consideration of my being permitted to participate in this activity, I, the undersigned hereby release and hold harmless the Trustees of the Metropolitan State Universities of Denver, the Earth and Atmospheric Sciences Department, and respective employees, from all claims, losses, damages, or expenses because of property damage or personal or bodily injury incurred or caused by me during or in conjunction with the above mentioned activity or activities. In filling out this form, I acknowledge that I fully understand the risk that is inherent with on and off-campus laboratory procedures and/or equipment and/or machinery use. The undersigned also indicate with their signature that they will follow appropriate safety rules and regulations. Furthermore, I have fully read and understand the department policies and my liability and do accept the restrictions.
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences
Department: Earth and Atmospheric Sciences
CIP Code: 40.0601
Prefix & Course Number: GEL 1020  Crosslisted With*: N/A
Course Title: Geology of Colorado
Check All That Apply: Required for Major:  Required for Minor:  Specified Elective: X
Required for Concentration:  Elective: X  Service Course: 
Credit Hours: 3  (3 + 0)
Total Contact Hours per semester (assuming 15-16 week semester):
  Lecture 45  Lab 0  Internship 0  Practicum 0  Other (please specify type and hours): 0
Schedule Type(s): L  Grading Mode(s): L
Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A
*NOTE: This information must be included in the course description.
Restrictions (Variable Topics Course): N/A
Prerequisite(s): Minimum performance standard scores on reading, writing, and mathematics preassessment placement tests
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None
Banner Enforced:
  Prerequisite(s): None
  Corequisite(s): None
  Prerequisite(s) or Corequisite(s): None
Catalog Course Description: This course introduces the basic theories, concepts, and assumptions used in geology, focusing on the state of Colorado. The major geological provinces; mineral resources; common rock-forming minerals; and sedimentary, igneous, and metamorphic rocks of Colorado are covered. One field trip required. (General Studies - Level II, Natural Science)

APPROVED:

Department Chair OR Program Director  7/17/06

Dean OR Associate Dean  3/6/07

Associate VP, Academic Affairs  9/18/07
Prefix and Course Number: GEL 1020

Required Reading and Other Materials will be equivalent to:


Specific, *Measurable Student Behavioral Learning Objectives*:

Upon completion of this course the student should be able to:
1. discuss and explain the science and principles of geology;
2. describe and identify common rocks and minerals;
3. comprehend geologic processes and how they create materials of the earth and modify the earth;
4. understand the theory of plate tectonics and how it relates to the distribution of major landforms;
5. relate how geologic processes control and influence the environment; and
6. have a basic comprehension of the geology and geologic history of the geologic provinces of the State of Colorado.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Atoms, Elements and Minerals
II. Volcanism and Extrusive Rocks
III. Intrusive Activity and the Origin of Igneous Rocks
IV. Weathering and Soil
V. Sediments and Sedimentary Rocks
VI. Metamorphism, Metamorphic Rocks, and Hydrothermal Rocks
VII. Time and Geology
VIII. Geologic Structures
IX. Plate Tectonics
X. Geology of the Provinces of Colorado
XI. Geologic History of the Provinces of Colorado

Evaluation of Student Performance:

1. At least two examinations
2. Any projects, presentations, or exercises required by the instructor
3. Rocks and minerals exam
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

Prefix & Course Number: GEL 1030 Crosslisted With*: N/A

Course Title: Historical Geology

Banner course title (30 characters): Historical Geology

Check All That Apply: Required for Major: X Required for Minor: X Specified Elective: ___

Required for Concentration: X Elective: X Service Course: ___

To receive Title IV financial aid funds, all institutions of higher education must comply with the federal definition of a credit hour. The Higher Learning Commission requires institutions to maintain policies and procedures for verifying compliance with this definition.

Federal Credit Hour Definition: A credit hour is an amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally-established equivalency that reasonably approximates not less than:
(1) one hour of classroom or direct faculty instruction and a minimum of two hours of out-of-class student work each week for approximately fifteen weeks for one semester or trimester hour of credit, or ten to twelve weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time; or (2) at least an equivalent amount of work as required in paragraph (1) of this definition for other activities as established by an institution, including laboratory work, internships, practica, studio work, and other academic work leading toward the award of credit hours. 34CFR 600.2 (11/1/2010)

Credit Hours: 4 (3 + 2)

Face-to-Face or Equivalent Hours per course:
Lecture 45 Lab 30 Internship 0 Practicum 0 Other (please specify type and hours): 0

Additional Student Work Hours per course: 0

Schedule Type: L Grade Mode: ___

Variable topics umbrella course: No X Yes _ If Yes, number of credit hours allowed

Specified repeatable course: No X Yes

APPROVED:

[Signature]

Date: 9/26/13

Department Chair OR Program Director

[Signature]

Date: 11/5/13

Dean OR Associate Dean

[Signature]

Date: 12/6/13

Associate VP, Academic and Student Affairs

Date

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: GEL 1030

Prerequisite(s): GEL 1010 or permission of instructor  
None (per cover memo)

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:
  Prerequisite(s): GEL 1010
  Corequisite(s): None
  Prerequisite(s) or Corequisite(s): None

Registration restrictions: Level _____ Class _____ Program/Major ____ Student attribute ____

Catalog Course Description: This course presents the origin and history of the Earth as well as the evolution of its life, based on the rock and fossil record. The course also reviews the changing geography of the Earth through geologic time, emphasizing the theory of plate tectonics. A field trip is required. (General Studies - Level II, Natural Science.)

Specific Variable Topics Course Description (if applicable, umbrella course description included above):

Required Reading and Other Materials will be equivalent to:

Specific, Measurable Student Behavioral Learning Objectives:
  1. Understand and discuss the basic geologic concepts used for the interpretation of geologic time;
  2. Understand and explain the basic geologic history of eastern Colorado;
  3. Recall the subdivisions of geologic time;
  4. Describe and identify common minerals and rocks;
  5. Recognize depositional environments on the basis of rock types and fossil assemblages;
  6. Explain the distribution of orogenic belts through time and their relationship to plate tectonics;
  7. Understand the relationship of depositional environments to formation of fossil fuels;
  8. Understand the environmental consequences of fossil-fuel use and exploitation; and
  9. understand basic structural geology, including the interpretation of geologic maps and cross sections.

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision):
  I. Introduction to Historical Geology
  II. Minerals and Rocks
  III. Geologic Time: Concepts and Principles
      A. Uniformitarianism
      B. Steno's Principles
      C. Absolute Geologic Time
  IV. Rocks, Fossils, and Time
      A. Stratigraphy
      B. Fossils and Time
C. Relative Geologic Time

V. Origin and Interpretation of Sedimentary Rocks
   A. Sedimentary Structures
   B. Modern Depositional Environments
   C. Interpretation of Ancient Depositional Environments

VI. Evolution
   A. Concepts
   B. Evidence for Evolution

VII. Plate Tectonics -- A Unifying Theory

VIII. The Origin of the Universe, Solar System, and Planet Earth

IX. Precambrian History
   A. The Archean Eon
   B. The Proterozoic Eon

X. Paleozoic History
   A. Geology of the Early Paleozoic Era
   B. Geology of the Late Paleozoic Era
   C. Life of the Paleozoic Era

XI. Mesozoic History
   A. Geology of the Mesozoic Era
   B. Life of the Mesozoic Era

XII. Cenozoic History
   A. Geology of the Tertiary Period
   B. Life of the Tertiary Period
   C. The Quaternary Period

Evaluation of Student Performance

Examinations
Papers
Projects
Presentations
REQUEST FOR GENERAL STUDIES DESIGNATION (2012-13)
NATURAL AND PHYSICAL SCIENCES

Please review the Course Selection Criteria for this category for assistance in completing this form, particularly as it relates to the percentages associated with each Student Learning Outcome.

If this course is also being submitted for the Global Diversity Category, check here , and complete and attach the separate Global Diversity General Studies Designation request.

Date: 10/4/12

School: LAS

Department: EAS

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Course Number</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>GEL</td>
<td>1150</td>
<td>3</td>
</tr>
</tbody>
</table>

Title: Physical Oceanography

Prerequisite(s): Minimum performance-standard scores on reading, writing, and mathematics preassessment placement tests

Corequisite(s): None

Banner enforced prerequisite(s) and/or corequisite(s): Minimum performance-standard scores on reading, writing, and mathematics preassessment placement tests

Recommended maximum enrollment per section: 35

A. Student Learning Outcomes

Describe the specific ways in which this course addresses each of these Student Learning Outcomes, providing students opportunities to develop the skills and/or acquire the knowledge. Include reference to readings, discussions, lectures, and other pedagogical tools which will be used. See the Criteria Table for examples.

1. Demonstrate effective use of technologies appropriate to the task and discipline. (10%) Oceanic data and conditions will be accessed through the internet throughout the course in lectures and in-class activities. Students will be expected to access notes and assignments via the web. An inquiry-based project requires students to use spreadsheets and other software.
2. Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose. (10%)

One topic in class will be distinguishing between peer-reviewed literature and other types of information sources. The teacher will model for students the proper navigation of the web to find reliable information on ocean tides, currents, and ocean temperatures.

10. Describe how the methods of science are used to generate new knowledge. (30%)

The scientific method will be discussed explicitly early on in the course and referred to throughout the course. The historical development of the discipline of oceanography will provide several examples of how new scientific theories are developed and argued (e.g. plate tectonics).

11. Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline. (25%)

Maps and mapping include symbolic and graphical approaches in deciphering oceanographic systems. Students will be able to use maps and their foundational knowledge to examine parts of the ocean never seen or visited. Maps and charts will be used throughout the course to illustrate concepts and patterns.

19. Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field. (60%)

Throughout the course, students learn the essential vocabulary, descriptions, and concepts which form the foundation of physical oceanography. Students use observations and appropriate calculations to evaluate this foundational knowledge as applied to specific situations. Impacts of oceanic circulation such as coastal flooding, varying weather patterns, transportation, and economic activity provide a deeper meaning to the scientific principles and observed behavior.

20. Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses. (10%)

The scientific method will be discussed explicitly early on in the course and referred to throughout the course. In-class activities will allow students to become fluent in the important steps required in experimentation and inquiry.

21. Develop concepts of accuracy, precision, and the role of repeatability in the acquisition of scientific data. (10%)

Oceanographic data is used throughout the course to demonstrate the physical processes and variability, both temporal and spatial. Maps and charts are analyzed in the context of their accuracy. Maps and mapping include graphical approaches for which accuracy is a limiting factor. Repeatability will be discussed in the context of peer reviewed literature.
B. Assessment of Student Learning

Identify and describe at least one specific form of assessing student achievement of each Student Learning Outcome which will be a regular part of the course. Include attachments as applicable. A single piece of student work may be used to assess student achievement of more than one Student Learning Outcome. See the Criteria Table for potential data for use in assessment.

1. Demonstrate effective use of technologies appropriate to the task and discipline.

The Rumbleometer Project (See Attachment 1) includes organizing and analyzing data in a series of Excel spreadsheets, utilizing calculations of relevant quantities. The project also utilizes software for producing contour maps to solve a case study problem.

2. Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose.

Students are required to use external sources to complete a written assignment on an oceanographic topic. Evaluation of the validity of the sources is a required element. See Attachment 2.

10. Describe how the methods of science are used to generate new knowledge.

Through the Rumbleometer Project, (Attachment 1), students will apply the concepts learned in the class to a realistic example problem, utilizing the appropriate scientific methods.

11. Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline.

The project in Attachment 1 may be used to assess the ability to organize, analyze and interpret data. For example, students use triangulation to identify and display relevant locations.

19. Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field.

Exams may be used to assess how students have mastered the essential knowledge and concepts of the field. The sample exam in Attachment 3 includes several multiple choice questions which require the analytical application of conceptual knowledge to specific locations and situations – not rote memorization. The short essay questions are more explicitly linked to the description of foundational knowledge.

20. Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses.

Through the Rumbleometer Project, (Attachment 1), students will demonstrate mastery of the theory and practice of the scientific method, utilizing the appropriate scientific methods.

The uncertainty and tolerances of errors in the methodology of the experimentation in the Rumbleometer Project (Attachment 1) requires students to evaluate the accuracy of the data, and the implications of the limits on precision.

C. Conformance with Course Selection Guidelines

Briefly describe how the course meets the course section guidelines:

The course must meet the full requirements of the Student Learning Outcomes, or must be paired with a corequisite lab course that, as a pair complete the outcomes.

As described in sections A and B, this course addresses all seven of the category SLOs.

Approvals:

[Signatures and dates]

Department Curriculum Committee / Date

Department Chair or Program Director / Date

School Curriculum Committee / Date

Dean or Associate Dean / Date

Chair, General Studies Committee / Date

Associate Vice President, Academic Affairs / Date
REGULAR COURSE SYLLABUS

Prefix & Course Number: GEL1150

Course Title: Physical Oceanography

Check All That Apply: Required for Major: Required for Minor: Specified Elective:
Required for Concentration: Elective: X Service Course:

Credit Hours: 3 (3+0)

Total Contact Hours per semester (assuming 15-16 week semester):
Lecture 45 Lab Internship ___ Practicum ___ Other (please specify type and hours): ___

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**):
n/a

** NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): n/a

Prerequisite(s): Minimum performance-standard scores on reading, writing, and mathematics preassessment placement tests

Corequisite(s): None

Prerequisite(s) or Corequisite(s): Minimum performance-standard scores on reading, writing, and mathematics preassessment placement tests

Banner Enforced:
Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description:
This introductory course studies the world's oceans, including geographic, geologic and physical features of the ocean basins, and the physical and chemical properties of ocean water. Other major topics include ocean exploration, ocean waves, currents and tides, air-sea interactions, marine ecology, and geologic history. The course emphasizes the use and control of ocean resources and the impact of ocean pollution.

APPROVED:

Department Chair OR Program Director

Dean OR Associate Dean

Associate VP, Academic Affairs

*If crosslisted, attach completed Course Crosslisting Agreement Form
Required Reading and Other Materials will be equivalent to:

Course Category and Related Student Learning Outcomes:
The following student learning outcomes (SLOs) for this course are prescribed in the General Studies - Natural and Physical Sciences Course Selection Criteria

1. SLO #1: Demonstrate effective use of technologies appropriate to the task and discipline. (10%)
2. SLO #2: Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose. (10%)
3. SLO #10: Describe how the methods of science are used to generate new knowledge. (30%)
4. SLO #11: Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline. (25%)
5. SLO #19: Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field. (60%)
6. SLO #20: Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses. (10%)
7. SLO #21: Develop concepts of accuracy, precision, and the role of repeatability in the acquisition of scientific data. (10%)

Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to (format: 1, a, i, ii, etc.):

1) discuss the development of the science of oceanography, including its major breakthroughs (SLO #10, 19)
2) use the scientific method to assess atmospheric processes (SLO #10, 11, 19, 20, 21);
3) relate the physical and chemical characteristics of sea water to the distribution and development to sea organisms (SLO # 10, 11, 19)
4) describe the physical processes and characteristics of ocean circulation including waves, tides, and currents (SLO # 10, 11, 19)
5) define aspects of air-sea interactions and relate atmospheric conditions to oceanic circulation (SLO # 10, 11, 19, 20)
6) define marine resources and relate their distribution to social and economic activity (SLO # 10, 11, 19)
7) evaluate types and sources of marine pollution and the related human impacts (SLO # 10, 11, 19)
8) describe the theory of plate tectonics and how it relates to the distribution of major landforms and ocean basins (SLO # 10, 11, 19)
9) exhibit proficient use of technology by using the internet to locate reliable sources of information about the ocean (SLO # 1, 2)
Detailed Outline of Course Content (Major Topics and Subtopics)

I. The Scientific Method
   A. Scientific Theories and Laws
   B. Scientific Hypothesis

II. History of Oceanography

III. Marine Navigation, Positioning and Sea Travel

IV. Geographic, Geomorphologic and Physical Features of the Ocean Basins
   A. Plate Tectonics and Ocean Basins
   B. Hot spots and their significance
   C. Geology of the Coastal Regions
   D. Marine Sediments

V. The Ocean's role in Earth’s Geologic History

VI. Ocean Water Physical and Chemical Properties
   A. Ice, Water, Vapor
   B. Latent heat and physical energy exchanges
   C. Ocean water chemistry
   D. Chemical species interaction

VII. Air-sea Interaction
   A. Surface Interactions
   B. Solar Energy
   C. Hydrologic Cycle

VIII. Ocean Circulation
   A. Surface Circulation
   B. Vertical Stratification
   C. Oceanic conveyor belt

IX. Waves
   A. Wind-generated Waves
   B. Tsunamis

X. Tides

XI. Marine Environment
   A. Biological Productivity
   B. Biome distribution and life forms

XII. Marine Resources
   A. Types of Resources
   B. Future Potential
   C. Maritime law and resource division of oceans

XIII. Marine Pollution
   A. Sources and distribution
   B. Ocean Acidification
   C. Impacts of Pollution
Evaluation of Student Performance:

1. A minimum of two examinations
2. Exploratory projects employing the scientific method
3. A minimum of one major course project and/or paper requiring to draw accurate conclusions by applying foundational knowledge to acquired and verified data using appropriate methods and appropriate sources of information
GEL1150 - Oceanography

**RUMBLEOMETER PROJECT - GRADING RUBRIC & COVER SHEET**

For complete project go to [http://college.earthscienceeducation.net/OCN/ocnrumble.html](http://college.earthscienceeducation.net/OCN/ocnrumble.html)

<table>
<thead>
<tr>
<th>Name:</th>
<th>Section:</th>
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</table>

The Project consists of 5 individual segments. Each segment is graded on a 10 point grading system as indicate below. These raw points received will be added and then multiplied by three to derive at your final score.

<table>
<thead>
<tr>
<th>Raw Point</th>
<th>Segment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 pts (A+), 10 pts (A), 9 pts (A-), 8 pts (B), 7 pts (C), 6 pts (D), &lt; 6 pts (F)</td>
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</tbody>
</table>

| Distribution: |
| Extra credit for outstanding work |

| Note: A+ summa cum laude (11pts) is only given for very exceptional & outstanding performance rarely seen! A magna cum laude (10pts) is reserved for excellent work without any necessary improvement! |

<table>
<thead>
<tr>
<th>Segment One: Completed Project Overall</th>
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</thead>
<tbody>
<tr>
<td>Raw Points:</td>
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<tr>
<td>Extra credit for outstanding work</td>
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<thead>
<tr>
<th>Segment Two: Locating Earthquake using Triangulation</th>
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<tr>
<td>Raw Points:</td>
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<tr>
<td>Extra credit for outstanding work</td>
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<tr>
<th>Segment Three: Ocean Floor Traverse</th>
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<tbody>
<tr>
<td>Raw Points:</td>
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<tr>
<td>Extra credit for outstanding work</td>
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<thead>
<tr>
<th>Segment Four: Contour Profiling &amp; Map</th>
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<tbody>
<tr>
<td>Create five (5) contour profiles using Contour Profile Worksheets. Can be hand drawn if neat AND orderly. Mark &amp; shade the POST-event profile in Red. Post-event Map: Mark east and west boundaries of new lava flow in red on map roughly following the contour lines, to define boundary and extent of new lava flow</td>
</tr>
<tr>
<td>Raw Points:</td>
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<tr>
<td>Extra credit for outstanding work</td>
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</table>

<table>
<thead>
<tr>
<th>Segment Five: Rumbleometer Data &amp; Conclusion</th>
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<tbody>
<tr>
<td>After plotting data electronically, type a concluding paragraph explaining what happened to the Missing Rumbleometer drawing on ALL the activities.</td>
</tr>
<tr>
<td>Raw Points:</td>
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<td>Extra credit for outstanding work</td>
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<tr>
<th>Grade Points:</th>
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<td>Grade: %</td>
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<td>Grade: %</td>
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</tbody>
</table>

Graded on Professionalism & Neatness

**Good** (what I am looking for): including but not limited to folder, Cover sheet in front, Title page incl. Name, Class, Section, Date. Neatness, Business like print quality, Electronically prepared, ... **Bad** (point deductions): Cut n' paste, Missing Name on any or all of the parts, sloppy appearance, stains, handwritten, missing segments, out of order, etc...

Graded on Triangulation Map & Hydrophone distance calculations

**Good** (what I am looking for): table & calculations in Excel, map showing hydrophone Locations, distance circles, epicenter location, epicenter coordinates, etc... **Bad** (point deductions): Poor drawing; sloppy work; NO long-lat. for epicenter, wrong location, missing circles, etc...

Graded on Correctness & Completeness

**Good** (what I am looking for): Excel Table addressing the following questions: Old or new lava? Lava collapsed or uncollapsed? Hydrothermal Vent present: Old or New? List of observed animal species ... **Bad** (point deductions): including but not limited to missing or sloppy / unprofessional work, not Excel, not enough detail, NOT observed, etc...

Graded on drawing neatness, correctness, completeness

**Good** (what I am looking for): including but not limited to clean cross section and map, ALL 5 sections present, NO errors, color coded differentiating between pre and post event, relying on data... **Bad** (point deductions): including but not limited to missing or sloppy work, incomplete data or map, no color coding, illogical compilation, etc. etc...

Graded on use of Excel, Quality, Neatness, Language

**Good** (what I am looking for): Excel data graphs, professional write-up, logical explanation using ALL the data, detailed, etc... **Bad** (point deductions): including but not limited to missing or sloppy / unprofessional work, hand-drawn, poor grammar / composition, etc...

<table>
<thead>
<tr>
<th>Raw Point Total:</th>
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<td>x3</td>
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</table>

Attachment
Physical Oceanography

Rumbleometer Project

Credits: http://ocn.ucsd.edu/OCN/ocnrumble.html

This activity was adapted from New Millennium Observatory (NeMO), 2006 Educational Curriculum by Ronald Crouse and William Chadwick with assistance from Vicki Osis, William Hanshumaker, Tereza Ahnell, and Jean Marcus.

The project is based on a real-life incident. A sea bottom scientific instrument called a "rumbleometer" was mysteriously lodged onto the ocean floor. While the unit was still operational, communicating with the research vessel above, it could not be retrieved. Something happened on the sea floor and it will be your assignment to solve that mystery.

This assignment is constructed as a PowerPoint presentation, containing 4 activities to be completed by you:

1) Locate an earthquake epicenter - this will tell you where the action was and where to take the ship with ROPOS

2) Record observations during a ROPOS dive - you will look for clues on the seafloor in the area around the rumbleometer

3) Create before-and-after cross-sections of the seafloor - this mapping exercise will show if there have been any changes in seafloor depth since the previous survey was done before the earthquakes

4) Analyze data from the rumbleometer - pressure and temperature data recorded by the instrument will give important information about what happened

Download detailed Grading Rubric Here!

Download the Power Point Exercise BY EITHER CLICKING HERE or on the graphic below!

Common download / view problem: I am clicking on the links and receive an error message or my browser stalls.
You can still download the file by right clicking your mouse and use the "save target as" option.
Oceanography: Research Writing Assignment

Assignment: Choose a specific topic related to
   A) extraction of natural resources from the ocean or the ocean floor,
      or
   B) pollution of the oceans and its impacts
      or
   C) natural hazards and associated impacts

Material for researching this assignment can include web-based resources but should also include at least two references from journal articles and books. All sources must be properly cited and referenced.

Your paper must include recent and historical data (i.e. precipitation, river discharge, temperature, cost of living, change in area of forest or agriculture, etc.) Your data source must be properly referenced.
Your paper must include a map and other appropriate diagrams.

Grading Guidelines:
Required format: 20%
   • 4-6 pages in length, not including figures or bibliographic references. Typed.
     Double spaced or 1.5 space.
   • A Title that refers to the topic being addressed.
   • Properly and consistently referenced sources. Use the citation style appropriate for your discipline, or Chicago Manual of Style as default.

Content: 80%
   • An appropriate topic 10%
   • An abstract that summarizes your paper and your conclusions. 10%
   • An introduction that references information from the assigned reading. 10%
   • Coherent description of the cause and effect of water scarcity for a region 20%
   • A discussion of the environmental, political, and socio-economic outcomes of water scarcity in the region. 20%
   • Comparison with Denver and Colorado. 10%
   • A map and appropriate figures. 10%
   • Spelling, punctuation and grammar. 10%
Multiple Choice (3pts. ea.)
Identify the choice that best completes the statement or answers the question.

1. What causes downwelling?
   a. Increase in ocean water salt content
   b. Decrease in water temperature
   c. Decrease in ocean water density
   d. Both A & B are true.
   e. A, B, and C are true.

2. The general process in which warm fluids rise and cold fluids sink is called ... ?
   a. Connection
   b. Conviction
   c. Convection
   d. Coriolis Effect
   e. Hadley Process

3. Which of the following is/are responsible for major ocean currents?
   a. Wind
   b. Oceanic conveyor belt
   c. Tides
   d. Both A & B
   e. A, B, and C

4. You are vacationing in Texas on the gulf coast. Which tides are you most likely to encounter?
   a. Mixed semidiurnal tides
   b. Neap tides
   c. Diurnal tides
   d. Spring tides
   e. Semidiurnal tides

5. You are in the Atlantic Ocean between Canada and Ireland. The wind is coming from the East. In which direction is the Ekman transport?
   a. South
   b. East
   c. West
   d. North
   e. Southwest

6. Look at the graphic. The wind blows as indicated. Which way does the water surface current move?
   a. North
   b. South
   c. East
   d. West
   e. None of the above

7. Look at the World Map. Where would you expect SINKING ocean water?
   a. Location A
   b. Location B
   c. Location C
   d. A & B are true.
   e. A, B, & C are correct.
a. Big winds generally create big waves.
b. The greater the water surface over which a strong wind can blow, the larger the waves.
c. The longer a strong wind can blow, the larger the waves.
d. Both A and C.
e. A, B and C.

12. The period of a wave is a measure of...
   a. Crest to crest.
   b. Midpoint between trough and crest to top of crest.
   c. Trough to crest.
   d. Midpoint between crests to trough.
   e. Time between successive crests.

13. The wave depicted in the picture most closely resembles...
   a. Airy Waves
   b. Stokes Waves
   c. Solitary Waves
   d. Cnoidal Waves

14. How is a longshore current created?
   a. When waves slam straight onto the shore, causing water molecules to be dispersed sideways.
   b. When wind blows from the coast out into the open ocean.
   c. When waves hit the beach at a highly refracted angle, resulting in sideways net force.
   d. When waves move parallel to the shoreline.
   e. When there are disturbances of alternating shallow and deep sequences along a shoreline, causing water molecules to be deflected.

15. The wave depicted in the picture most closely resembles...
   a. Airy Waves
   b. Stokes Waves
   c. Solitary Waves
   d. Cnoidal Waves

16. The energy distribution within a regular wind generated wave out in the open ocean...
   a. Is equal with depth.
   b. Increases with depth.
   c. Decreases with depth.
   d. First increases, then decreases with depth.
   e. First decreases, than increases with depth.
17. At what earthquake depth would you be concerned about the generation of a tsunami?
   a. ~ 600km
   b. ~ 400km
   c. ~ 200km
   d. ~ 100km
   e. ~ 10km

18. The wave depicted in the picture most closely resembles ...
   a. Airy Waves
   b. Stokes Waves
   c. Solitary Waves
   d. Cnoidal Waves

19. A wave has a wave height of 3 feet. Another wave with a wave height of 3.5 feet crosses the path of the first wave. The trough of the first wave meets the crest of the second wave at the same time. How high is the resulting wave?
   a. 0 feet
   b. 0.5 feet
   c. 3 feet
   d. 3.5 feet
   e. 6.5 feet

20. What is the definition of "period" when talking about waves?
   a. time it takes, in seconds, for a series of wave crests or troughs to pass a fixed position
   b. the length of time wind continues without changing direction or speed
   c. distance between two crests or troughs
   d. the distance wind blows over water
   e. ratio of wave height to wave length

21. Tsunamis are formed by ...
   a. Strong storms, especially in the Pacific.
   b. By wave addition of several superwaves.
   c. By earthquakes most commonly around the "ring of fire".
   d. Both A & B are true.
   e. A, B, and C are correct.

22. What is the definition of "steepness" when talking about waves?
   a. time it takes, in seconds, for a series of wave crests or troughs to pass a fixed position
   b. the length of time wind continues without changing direction or speed
   c. distance between two crests or troughs
   d. the distance wind blows over water
   e. ratio of wave height to wave length

23. You have headlands and bays along a shoreline. Where will the wave energy be the greatest when striking the shore?
   a. Greatest at bays, most dispersed at headlands.
   b. most dispersed at bays, greatest at headlands.
   c. equal along the shore line.
   d. only greatest at headlands when ocean is deep in front of headlands.
   e. only greatest at bays when ocean is deep in front of bays.

24. At what depth is the wave energy negligible in an open ocean wave?
   a. At about 10 to 15 feet.
   b. At 2 times the wave height.
   c. At 20 times the wave height.
   d. At one half of the wave length.
   e. At one twentieth of the wave length.

25. What is the meaning of the name "tsunami"?
   a. tsu means killer and nami means wave
   b. tsu means harbor and nami means killer
   c. tsu means run and nami means away
   d. tsu means huge and nami means wave
   e. tsu means harbor and nami means wave

26. The wave depicted in the picture most closely resembles ...
   a. Airy Waves
   b. Stokes Waves
   c. Solitary Waves
   d. Cnoidal Waves

27. What is the definition of "fetch" when talking about waves?
   a. time it takes, in seconds, for a series of wave crests or troughs to pass a fixed position
   b. the length of time wind continues without changing direction or speed
   c. distance between two crests or troughs
   d. the distance wind blows over water
   e. ratio of wave height to wave length

28. A wave has a wave height of 5 feet at its highest point. Another wave with a wave height of 3 feet crosses the path of the first wave. Both wave high points meet at the same time. How high is the resulting wave?
   a. 2 feet
   b. 3 feet
   c. 5 feet
   d. 8 feet
   e. 15 feet

29. Wave definition for a tsunami is ...
   a. A shallow ocean wave
   b. An intermediate ocean wave
   c. A deep ocean wave
   d. A rogue wave
   e. A superwave
Short Answer / Essay Questions (10 points each)

Answer each question in several complete sentences, emphasizing the important physical processes.

30. Describe how the atmospheric Walker circulation interacts in a feedback loop with the equatorial Pacific ocean circulation to create the coupled ocean-atmosphere states known as ENSO (El Nino/Southern Oscillation).

31. Describe how longshore winds drive the Ekman transport, resulting in coastal upwelling.

32. Describe the causes of equatorial upwelling, starting from knowledge of the latitudinal variation of the Coriolis force.
Course Syllabus for
GEL 1150 - Oceanography
FALL 2011 Sec 003 TR 12:30-1:45pm Rm: NC1130

Professor: Uwe Richard Kackstaetter, Ph.d. (Dr. "K")
Office: ST2014
Office Hours: TR 10:00am-12:00pm, W 12:30pm-3:00pm; Other times by appointment!
Contact: E-mail: kackstaet@mduenver.edu Ph. 303-556-3070
URL: http://college.earthscienceeducation.net

This syllabus may be modified at any time without prior notice.

Course Description
This introductory course studies the world's oceans, including historical explorations, physical & biological processes, energy sources, ocean resources, marine provinces, and geology of ocean basins. The course emphasizes global distribution, use, and control of ocean resources, and ocean pollution. Students should emerge from the class able to understand the global impact of oceans & oceanography. This course should not be confused with marine biology.

Required Materials / Activities
- Thurman and Trujillo, Essentials of Oceanography, 10th edition
- Rumbleometer Project (Download from Instructor website! ...it is large, about 10MB)
- i-clicker

Specific (Measurable) Student Behavioral Learning Objectives
This course is designed to teach oceanographic processes and history. You will hopefully get from the class a basic understanding of the world's oceans, their formation and relative position, geography of sea-floors, and the physics & chemistry of oceanic events. In addition, you will get a grounding in some of the essential themes of oceanography, including:
- the geomorphology of ocean floors & coastlines
- oceans in relation to geologic events
- history of ocean formation and life within
- wave creation, evaluation & interaction
- air-sea interactions
- distribution & development of ocean currents
- ocean water chemistry
- maritime navigation & positioning
- marine biomes & distribution

Outline of Course Content
Major Topics & Subtopics
I. Maritime Navigation, Positioning & Sea-travel
II. Geographic, Geomorphology & Physical Features of Ocean basins
III. Earth's history from an oceanographic standpoint
IV. Ocean & Coastal Sediments, Sediment distribution & Sedimentary Resources
V. Ocean Water Physical Properties & Chemistry
VI. Waves, Currents & Tides
VII. Biome distribution & Life forms

Grading in Oceanography

<table>
<thead>
<tr>
<th>Participation</th>
<th>Max Points</th>
<th>My Points</th>
<th>MY GRADE</th>
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<tr>
<td>Online Chapter Quizzes (25 pts ea.): Ch.2, Ch.3&amp;4, Ch.5, Ch.6&amp;7, Ch.8&amp;9, Ch.10&amp;11</td>
<td>150</td>
<td>150</td>
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<tr>
<td>Ocean Navigation &amp; Exploration Exam</td>
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<td>Ocean Water Chemistry &amp; Physics Exam</td>
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<td>Ocean Seafloor &amp; Sediments Exam</td>
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<tr>
<td>Ocean Marine Life &amp; Geologic History Exam</td>
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<td>Rumbleometer Project</td>
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<tr>
<td>COMPREHENSIVE FINAL (50 questions) *</td>
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<td>TOTAL</td>
<td>1000</td>
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* Students with an average exam score above ≥ 80% and NONE of the exams less than 70% may opt out of the Final Exam. They will receive their exam average times 1.5 as the Comprehensive Final Exam Score.

FINAL GRADE: A+ ≥ 1000 A = 950-1000 A- = 900-949 B+ = 870-899 B = 830-869 B- = 800-829
C+ = 770-799 C = 730-769 C- = 700-729 D+ = 670-699 D = 630-669 D- = 600-629
F = ≤ 599 points

Keep track of your grade! Color in Grade Graph to the right!
(Don't forget to drop lowest score for Tests)
How does one receive an A+ (over 1000 points), in this class?
Almost all assessments carry extra credit points, therefore more than 100% on assessments is possible. This, however, is most likely reserved for those who are willing to invest heavily and deeply of time and talent into the class! An A+, which I consider "summa cum laude" is usually received by exceptional & outstanding students in the top 1% of my classes.

PARTICIPATION: You are EXPECTED to attend class & labs and PAY ATTENTION in both. Attendance & Student Responses will be tracked using the I-clicker interactive student response system. The timely purchase of the device is REQUIRED in order to earn full participation points (see point distribution below). If you forget your clicker or do not have one (NOT recommended), you MUST sign a special roll in order to receive at least partial credit for attending class (Lowest score of the day minus 10%). Points CANNOT be assigned retroactively! Students can earn daily points toward their participation grade by responding CORRECTLY to i-clicker questions randomly presented during lectures / labs. I absolutely DESPISE students with less than 80% participation, whining about their grade at the end of the semester. (So, don’t even try!). In regards to attendance & class materials: Any handout, any notes, any exam questions discussed will only be given IN CLASS. If you miss class, you are on your own. I do not keep extra copies and NO, I do not have or publish lecture notes for your convenience! (THIS IS NOT AN ONLINE CLASS!)

Point Distributions:

- 15 Week Course meeting (a) twice per week: 5pts/day (b) once per week: 10pts/day
- 10 Week Course meeting (a) twice per week: 7.5pts/day (b) once per week: 15pts/day
- 8 Week Course meeting (a) twice per week: 9.4pts/day (b) once per week: 18.8 pts/day

ABSENCES: Frankly, registering for this course is equivalent and as serious as you taking a job. I expect from you the same professional courtesies that you would extend toward your employer. As with any employer, you do NOT get paid for missed days, meaning, there are NO participation points awarded if you do not show up for class. Period! However, similarly to the real employment world, I will grant you “sick or leave days” worth a total of 10 participation points, which you may use at your discretion. As with most employment situations, you may “cash in” your remaining “sick or leave days” for extra credit at the end of the semester. Absences beyond these allotted points will never be awarded anything, no matter the reason, including but not limited to illness, work conflicts, car accidents, booked vacations, etc. Exception: Jury-Duty: You must bring official proof of your actual court room duty validated by the court/judge! (No, the little card you get in the mail soliciting you for jury duty does NOT count!)

Note: Nothing in this policy shall require the instructor to reschedule classes, repeat lectures or other ungraded activities or provide an ungraded individualized instruction solely for the benefit of students who are unable to attend regularly scheduled classes or activities.

EXAM or TEST MAKE-UP: There is NO make-up for the online chapter quizzes, because they can be taken at your convenience. As far as the exams are concerned, the lowest grade will be dropped. If you miss any test, you will receive a “0” and this score will count as your lowest grade. If you miss 2 or more tests, only ONE of the scores will be dropped, the others will still count! The final can NOT be missed at the scheduled day.

COMPREHENSIVE FINAL EXAM: Students with an average lab/lecture exam score of above 80% and with NONE of the exams less than 70% may opt out of the Final Exam. If these qualifications are met, a student must OPT OUT IN WRITING by completing a special form (available online) and attach exam scores as proof. They will then receive their lab/lecture exam average from ALL the exams multiplied by 1.5 as their Comprehensive Final Exam Score. Students who do NOT file this form with all the proof necessary before the final exam MUST TAKE THE FINAL or they will receive a “0” even if they qualify!

Disclaimer: Students who take the final and receive a lower score than their average score computed, can NOT revert back to their average score because it is higher. If you take the Final, you will receive the Final Exam score as your Grade. (No Exceptions!)

RUMBLEOMETER OCEANOGRAPHY PROJECT:
ADAPTED FROM NEW MILLENNIUM OBSERVATORY (NEMO), 2006 EDUCATIONAL CURRICULUM

This assignment is based on a real life incident in the realm of oceanographers. A sea bottom scientific instrument called a "rumbleometer" was mysteriously lodged onto the ocean floor. While the unit was still operational, communicating with the research vessel above, it could not be retrieved. Something happened on the sea floor and it will be your assignment to solve that mystery. The whole assignment is constructed as a Power Point Presentation to be downloaded from my Website!

LATE WORK: Since all labs and other assignments are available within the first few weeks of class, I will not accept ANY late work. Please note, this means ANY!! You had practically the whole semester to complete the exercise(s), so don’t blame broken printers, crashed computers, uncooperative emails, sudden work conflicts or bouts of illness the day(s) before or even during the deadline for missing the deadline. Hint: Turn your work in early and there will be NO problems! Since the last deadline is always the last day of your regular scheduled class for the semester, there will be absolutely NOTHING accepted during and after Finals Week! Don’t even try!

EXTRA CREDIT: Many assessments include extra points (approx. 10%), giving students the opportunity to earn a higher score of up to 110% (Except take-home, online or open note assessments). NO OTHER ADDITIONAL EXTRA CREDIT WILL BE GIVEN. So please DON’T ask.

E-MAIL: You may e-mail me any time at backstage@msudenver.edu. In general, I will NOT accept any assignments via e-mail. These must be turned in as hard copies AT THE ALLOCATED DUE DATES!!!!

ACADEMIC INTEGRITY: As students, faculty, staff and administrators of Metropolitan State University of Denver, it is our
students found eligible to receive an'  

More Specify: If you copy another students work, both of you, the “copter” and the copied will receive 50%. You share the work, you divide the grade!!! If more than one student is involved in the copying, the grade will be prorated accordingly, e.g., 3 students = 33% each, 4 students = 25% each, and so forth! Be especially careful when you work on assignments in a group with other students. (Note: you may share data that was collected together, you may not share write-ups). The same is true when copying from the internet. Each plagiarized source costs you at a minimum 50% of your assignment grade. (The internet will get the other 50%) Any student found involved in academic dishonesty (e.g., cheating on exams, answering i-clicker questions for someone else, copying whole book/ internet pages) may receive an “F” for the course grade, and disciplinary action at the college level may be recommended.

I-Clicker Warning: Responding to i-clicker questions for someone else (e.g., by using their i-clicker together with your own) constitutes academic cheating (same as cheating on a test or exam). First infraction will most likely involve a stern, public, and very embarrassing warning. Second infractions will unceremoniously asked to leave the classroom and academic fraud procedures will be instigated with proper college authorities. Students may receive an F for the course due to academic dishonesty as per student handbook.

Civility: The student code of conduct will be enforced in this class. The short version of the code: Students are expected to assist in maintaining a classroom environment conducive to learning and respectful of the instructor and fellow students. Students have an opportunity to gain from time spent in class. Therefore, students are prohibited from using cell-phones or beepers, text messaging, eating or drinking in class, making offensive remarks, reading newspapers, using their laptop or PDA for class unrelated activities (such as browsing the internet, checking email, watching videos, etc.) or doing other assignments unrelated to the class, sleeping or engaging in any other form of distraction. While you may feel that you are doing it quietly and unobtrusive enough, it does indeed distract other students (as scores of them have reported to me). Inappropriate behavior shall result minimally in a request to cease the behavior and upon continuation despite warnings to leave the class.

Electronic Devices: Put all your consumer electronics away (which means they are NOT to be visible, even if you don’t use them) including but not limited to cell phones, ipods, MP3 players, headphones, etc. They are NOT to be used at any time during my class. Cellular phone calculators are NOT ALLOWED, you must bring a “real” calculator. Personal computers are allowed in class only with approval from the instructor and a signed contract. Permission for use of PC’s will be revoked immediately for the remainder of the course if a student is found to be engaged in unrelated activities, such as checking e-mail, surfing the web, playing games, etc. Texting, emailing, gaming, listening to music or similar unrelated activities during class time is not only rude and unprofessional, it is highly annoying to me and the majority of your fellow students. If you are caught you will be unceremoniously asked to leave my class and you will lose any or all participation points for that day. Repeat offenders will face disciplinary action on the college level. You have been warned.

Cell Phone Warning: There are NO cell phones allowed in the classroom! Period! If you text or do anything with your cell phone, Dr. K has the right to REMOVE YOU FROM THE CLASS, PERIOD! First infraction will most likely involve a stern, public and very embarrassing warning. Continued infractions will result in a removal from the class and possible failing grades.

Students with Disabilities: The Metropolitan State University of Denver is committed to making reasonable accommodations to assist individuals with disabilities in reaching their academic potential. If you have a disability which may impact your performance, attendance, or grades in this class and requesting accommodations, then you must first register with the Access Center, located in the Auraria Library, Suite 116, (303) 556-8387.

The Access Center is the designated department responsible for coordinating accommodations and services for students with disabilities. Accommodations will NOT be granted prior to my receipt of your faculty notification letter from the Access Center. Please note that accommodations are never provided retroactively (i.e., prior to the receipt of your letter). Once I have received your official Access Center Faculty Notification Letter, I would be happy to meet with you to discuss your accommodation. All discussions will remain confidential. Further information is available by visiting the Access Center website at http://www.msudenver.edu/access/.

Please be aware that I am unable to grant certain accommodation: My presentations contain copyrighted material and can NOT be printed, copied, transcribed, forwarded or made available electronically or otherwise outside of my personal computer and classroom. Solution: Get an excellent notetaker! Also do NOT extend any deadlines on assignments, because (a) all my assignments are given out during the first week of class and (b) my assignment deadlines ARE ALREADY THE EXTENDED ONES, already tailored to the weakest of the weak students and those with disabilities. Solution: Start assignments right away. In this manner I can help you with plenty of time for completion.

“F” Policy: The incomplete notation is COURTESY OF THE INSTRUCTOR. Instructors are neither required nor obligated to give “I’s”. However, according to school policy regarding an “F” notation, a student must have completed a majority portion of the course requirements (75% minimum) but is unable to complete all of the course requirements due to unusual circumstances, such as hospitalization, No, being stressed out, starting assignments too late and being unable to finish them, going on a cruise during finals week which you booked last year are all NOT considered unusual circumstances. Authorized third party documentation of such unusual circumstances will be absolutely required before an “F” is even taken under consideration. All students found eligible to receive an “I” in the course must complete a contract with the instructor stating specifically when and how the “I” must be remedied. IT IS THE STUDENTS RESPONSIBILITY TO REMEDY AN “F” AND STAY ON TOP OF IT, NOT THE INSTRUCTOR’S RESPONSIBILITY!!!
**OTHER:** Students at Metropolitan State University of Denver who because of their sincerely held religious beliefs, are unable to attend classes, take examinations, participate in graded activities or submit graded assignments on particular days shall, without penalty, be excused from such classes and be given a meaningful opportunity to make up such examinations and graded activities or assignments. Advance written notice that the student will be absent for the religious reasons must be given to the instructor during the first two weeks of the semester.

Nothing in the above policy shall require the instructor to reschedule classes, repeat lectures or other ungraded activities or provide ungraded individualized instruction solely for the benefit of students who, for religious reasons, are unable to attend regularly scheduled classes or activities. However, presentations, critiques, conferences, and similar activities involving individual students shall be scheduled to avoid conflicts with such student's religious observances or holidays provided that reasonable advance notice of scheduling conflicts is given to the instructor.

“NC” Policy - all students may request an NC (No credit) notation without faculty approval through the second week of classes. NC notations with faculty approval will only be granted through the sixth week of class. A request for an NC will not be granted after that week.
REGULAR COURSE SYLLABUS

SCHOOL: Letters, Arts and Sciences

DEPARTMENT: Earth and Atmospheric Sciences

SEMESTER(S) OFFERED: Fall, every two years

PREFIX & COURSE NUMBER: GEL 1200

COURSE TITLE: Gem and Mineral Collecting in Colorado

CREDIT HOURS: 2 (1 + 2)

CONTACT HOURS: Lecture 15 Lab 30 Internship 0 Practicum 0

RESTRICTIONS (VARIABLE TOPICS COURSES): None

PREREQUISITE(S): None

COREQUISITE(S): The physical ability to endure strenuous hiking at high elevations is necessary.

CATALOG COURSE DESCRIPTION:

This course focuses on the origin, geography, and areas of occurrence of gemstones, as well as the physical mineral properties of gemstones.

REQUIRED READING MATERIALS: (Title, Author, Publisher, Copyright Date)


APPROVED:

Department Chair

Dean

V.P., Academic Affairs

DATE:

2/15/99

2/15/99

DISTRIBUTION: Original to Vice President for Academic Affairs
Copies retained by Dean and Department Chair

Revised 9/94: Academic Affairs-Curriculum-Regular Course Syllabus
(s:\wpform\acadaff\currculm\regsyl.wp)
SPECIFIC (MEASURABLE) STUDENT BEHAVIORAL LEARNING OBJECTIVES:

Upon completion of this course the student should be able to:

1. discuss the history, geography, and occurrence of gemstones and minerals in Colorado;
2. discuss the physical properties of the major gemstones and minerals, including crystal forms;
3. discuss the current extensive treatments of gemstones; and
4. successfully collect gemstones and minerals in Colorado.

OUTLINE OF COURSE CONTENT: (Major Topics and Subtopics)

I. History and Geography of Gemstones and Minerals
II. Physical Properties of Gemstones and Minerals with Laboratory Exercise
   A. Specific gravity
   B. Crystallography
   C. Luster
   D. Brilliance
   E. Dispersion
   F. Refraction
   G. Double refraction
   H. Pleochroism
   I. Inclusions
III. Major Gemstones with Laboratory Exercise
   A. Eeryi
   B. Corundum
   C. Lapis lazuli
   D. Opal
   E. Peridot
   F. Feldspars
   G. Jade
   H. Quartz
   I. Chalcedony
   J. Garnet
   K. Zircon
   L. Spinel
   M. Topaz
   N. Tourmaline
   O. Chrysoberyl
   P. Organic gemstones
   Q. Diamonds
IV. Synthetic Gemstones with Laboratory Exercise
   A. Imitations
   B. Doublets
   C. Triplets
V. Gemstone Treatments with Laboratory Exercise
VI. Field Laboratory with Exercise
EVALUATION OF STUDENT PERFORMANCE:

1. 4 exams
2. 5 laboratory exercises
REGULAR COURSE SYLLABUS

SCHOOL:  Letters, Arts and Sciences
DEPARTMENT:  Earth and Atmospheric Sciences
SEMESTER(S) OFFERED:  Every Semester
PREFIX & COURSE NUMBER:  GEL 1500
COURSE TITLE:  Current Topics in Geology (Variable Topics)
CREDIT HOURS:  1-3  (1-3 + 0)
CONTACT HOURS:  Lecture 15-45 Lab 0 Internship 0 Practicum 0
RESTRICTIONS (VARIABLE TOPICS COURSES):  None
PREREQUISITE(S):  None
COREQUISITE(S):  None
CATALOG COURSE DESCRIPTION:
These courses cover topics of current geologic interest. The course content will vary and the course may be repeated for credit as the course topic changes.

REQUIRED READING MATERIALS:  (Title, Author, Publisher, Copyright Date)
Dependent upon topic under study.

APPROVED:
Department Chair
Dean
V.P., Academic Affairs

DATE:
2/15/93
2/15/97
5/18/99

DISTRIBUTION:  Original to Vice President for Academic Affairs
Copies retained by Dean and Department Chair

Revised 9/94:  Academic Affairs-Curriculum-Regular Course Syllabus
(s:\wpform\acadaff\currculm\regsyl.wp)
SPECIFIC (MEASURABLE) STUDENT BEHAVIORAL LEARNING OBJECTIVES:

Upon completion of this course the student should be able to:

The course content will vary with the topic chosen for current consideration. Therefore, the learning objectives will change also. The general learning objectives will be to study the topic under consideration and determine:

1. What are the parameters and dimensions of the topic?
2. What are the characteristics of the subject?
3. What are the relationships and implications of the topic?
4. What methodology should be applied to the topic?
5. What are the facts relating to the topic?
6. What are the issues raised by the study?
7. What are the alternatives that respond to the issues?

OUTLINE OF COURSE CONTENT: (Major Topics and Subtopics)

The course content will vary with the selection of various topics for consideration. Examples of topics to be considered might include Geology of Caves, Geologic and/or Environmental Investigations of the Green River, Terrestrial Navigation, and Geology of the Great Basin Province.

EVALUATION OF STUDENT PERFORMANCE:

Exams, report(s), and/or project(s), and/or paper(s) dependent upon course topic.
DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES

INSTRUCTOR Frederick E. Welsh

PREFIX & COURSE NO. GEL 150

SEMESTER OFFERED Fall, 1997

COURSE TITLE Canoeing the Canyon Country

SEMESTER CREDIT HOURS 2

CONTACT HOURS 30

LAB HOURS* 0

PREREQUISITES/COREQUISITES None

REQUIRED READING MATERIALS (Title, Author, Publisher, Copyright Date)


EVALUATION OF STUDENT PERFORMANCE

Final exam and summary field-trip report.

SPECIFIC (MEASURABLE) STUDENT BEHAVIORAL LEARNING OBJECTIVES

Upon completion of this course the student should be able to:

1. discuss the geology and geography of Western Colorado (northeastern Colorado Plateau);
2. on the basis of rock types and sedimentary structures, discuss the stratigraphy and geologic history of Western Colorado;
3. relate the stratigraphy and geologic history of Western Colorado to that of the Colorado Front Range;
4. discuss the geomorphic features of Western Colorado and describe the geologic processes responsible for them, especially fluvial processes; and
5. communicate this knowledge in the form of a geologic report.

DETAILED OUTLINE OF COURSE CONTENT (MAJOR HEADING/SUBTITLES) OR OUTLINE OF FIELD EXPERIENCE/INTERNSHIP (EXPERIENCE, RESPONSIBILITIES AND SUPERVISION)

I. Classroom lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      a. Geologic time
      b. Rock cycle and rock types, with emphasis on sedimentary rocks
      c. Principles of uniformitarianism, original horizontality, and superposition
      d. Tectonics
      e. Depositional environments (how rocks were formed)
f. Sedimentary structures  
g. Formations and geologic maps  
C. Regional geographic and geologic settings of Colorado  
D. Stratigraphic columns of Front Range and Western Colorado  
E. Logistics  
II. Field lectures on Colorado River (observations and recordings)  
A. Fluvial processes  
B. Formations  
   a. Geologic age  
   b. Rock type(s)  
   c. Depositional environments  
C. Tectonics  
   a. Folding  
   b. Faulting  
D. Geomorphic features and relationship to weathering and erosional processes  
   a. Plateaus  
   b. Cliffs  
   c. Canyons  
E. Igneous and metamorphic activity of Western Colorado  
F. Regional geologic history of Western Colorado  
   a. Pre-Laramide events  
   b. Laramide events  
   c. Post-Laramide events  

III. Course requirements  
A. Field-trip exam  
B. Summary field-trip report  

APPROVAL:  
ALL OMNIBUS COURSES:  
DATE: 1/23/87  

CHAIR, CURRICULUM COMMITTEE:  
DEPARTMENT CHAIR:  
DEAN, SCHOOL/CENTER:  
V.P. ACADEMIC AFFAIRS:  

FIELD EXPERIENCE/INTERNSHIP ONLY:  
LOCATION OF INTERNSHIP:  
FACULTY EVALUATION GROUP:  
FIELD SUPERVISOR*  

*APPROVAL BY THE FIELD SUPERVISOR IS REQUIRED, AND MUST BE INDICATED BY THE ORIGINAL SIGNATURE OF THAT SUPERVISOR OF THE SYLLABUS.  

(GUIDELINES AS SET FORTH IN THE OMNIBUS COURSE SECTION OF THE CATALOG MUST BE FOLLOWED. AN ACCURATE COPY OF EACH COURSE MUST BE ON FILE IN THE OFFICE OF ACADEMIC AFFAIRS PRIOR TO THE LISTING OF SUCH COURSE IN ANY SEMESTER SCHEDULE.)
OMNIBUS COURSE SYLLABUS
METROPOLITAN STATE COLLEGE
SCHOOL OF LETTERS, ARTS, AND SCIENCES

DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES
INSTRUCTOR James M. Cronoble

PREFIX & COURSE NO. GEL 150
SEMESTER OFFERED Fall, 1997

COURSE TITLE Garden of the Gods--Front Range Geology

SEMESTER CREDIT HOURS 2 CONTACT HOURS 30 LAB HOURS* 15

PREREQUISITES/COREQUISITES None

REQUIRED READING MATERIALS (Title, Author, Publisher, Copyright Date)


VALUATION OF STUDENT PERFORMANCE

Final exam and summary field-trip report.

SPECIFIC (MEASURABLE) STUDENT BEHAVIORAL LEARNING OBJECTIVES

Upon completion of this course the student should be able to:

1. examine selected rock exposures in order to identify and record rock types and to relate rock types to modes of formation;
2. understand regional geologic history on the basis of rock types and sedimentary structures;
3. relate formations and rock types to economic products;
4. recognize the influence of geologic processes on rocks and landforms; and
5. communicate this knowledge in the form of a geologic report.

DETAILED OUTLINE OF COURSE CONTENT (MAJOR HEADING/SUBTITLES) OR OUTLINE OF FIELD EXPERIENCE/INTERNSHIP (EXPERIENCE, RESPONSIBILITIES AND SUPERVISION)

I. Classroom lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      a. Geologic time
      b. Rock types
      c. Rock cycle and plate tectonics
      d. Principles of uniformitarianism, original horizontality, and superposition
      e. Depositional environments (how rocks were formed)
f. Sedimentary structures
g. Formations and facies
h. Transgressions and regressions

C. Logistics

II. Field lectures (observations and recordings)
A. Exposed formations
a. Geologic age
b. Rock type(s)
c. Depositional environments
d. Economic products
B. Regional geologic history
a. Pre-Laramide events
b. Laramide events
c. Post-Laramide events

III. Course requirements
A. Field-trip exam
B. Summary field-trip report

APPROVAL:
ALL OMNIBUS COURSES: 

DATE: 4/23/97

CHAIR, CURRICULUM COMMITTEE: 

DEPARTMENT CHAIR: 

DEAN, SCHOOL/CENTER: 

P. ACADEMIC AFFAIRS: 

FIELD EXPERIENCE/INTERNSHIP ONLY:

LOCATION OF INTERNSHIP:

FACULTY EVALUATION GROUP: 

FIELD SUPERVISOR*

*APPROVAL BY THE FIELD SUPERVISOR IS REQUIRED, AND MUST BE INDICATED BY THE ORIGINAL SIGNATURE OF THAT SUPERVISOR OF THE SYLLABUS.

(GUIDELINES AS SET FORTH IN THE OMNIBUS COURSE SECTION OF THE CATALOG MUST BE FOLLOWED. AN ACCURATE COPY OF EACH COURSE MUST BE ON FILE IN THE OFFICE OF ACADEMIC AFFAIRS PRIOR TO THE LISTING OF SUCH COURSE IN ANY SEMESTER SCHEDULE.)

CUR #03: JULY 86

ACADEMIC AFFAIRS
OMNIBUS COURSE SYLLABUS
METROPOLITAN STATE COLLEGE
SCHOOL OF LETTERS, ARTS, AND SCIENCES

DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES
INSTRUCTOR Robert E. Leitz

PREFIX & COURSE NO. GEL 150

SEMESTER OFFERED Summer, 1997

COURSE TITLE Geology of the Wheeler Geologic Area

SEMESTER CREDIT HOURS 2
CONTACT HOURS 15
LAB HOURS* 30

PREREQUISITES/COREQUISITES None

REQUIRED READING MATERIALS (Title, Author, Publisher, Copyright Date)
Handouts will be provided by professor.
Topographic and geologic maps of the region.

EVALUATION OF STUDENT PERFORMANCE
Final exam and summary field-trip report.

SPECIFIC (MEASURABLE) STUDENT BEHAVIORAL LEARNING OBJECTIVES

Upon completion of this course the student should be able to:

1. describe the geologic structures and characteristics of the San Juan Volcanic Field;
2. observe and describe the volcanic morphology of the San Juan Mountains;
3. compile a reconnaissance geologic map of the volcanic features of the Wheeler area;
4. use a Brunton compass to collect geologic data;
5. locate volcanic landforms on a topographic map;
6. use appropriate pyroclastic terminology to describe the eruptive events at Wheeler;
7. relate the geologic history of the San Juan Mountains to mountain building in Colorado; and
8. describe the effects of chemical and physical weathering on a vitric tuff.

DETAILED OUTLINE OF COURSE CONTENT (MAJOR HEADING/SUBTITLES) OR OUTLINE OF FIELD EXPERIENCE/INTERNSHIP (EXPERIENCE, RESPONSIBILITIES AND SUPERVISION)

I. Classroom Lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      1. Uniformitarianism
      2. Geologic time
      3. Plate tectonics
C. Igneous processes and products
   1. Convergent zones and magma genesis
   2. Divergent zones and magma genesis
   3. Mid-Continent volcanism
   4. Igneous petrology
      a. Field identification techniques
      b. Vocabulary

D. Trip logistics

II. Field Lectures and Exercises
A. Regional geography
B. Regional geology
   1. Previous work
   2. Uplift versus volcanism
C. Pyroclastics and magmaphreatic eruptions
D. Water-pressure effects on magma behavior
E. Devitrification processes
F. Sequence of volcanic events
   1. Pre-eruption geologic setting
   2. Post-eruption modifications
G. Effects of ignimbrite on the environment

III. Course Requirements
A. Field-trip exam
B. Summary field-trip report

APPROVAL:
ALL OMNIBUS COURSES: DATE: 11/14/96

CHAIR, CURRICULUM COMMITTEE: ____________
DEPARTMENT CHAIR: ____________
DEAN, SCHOOL/CENTER: ____________ 12/16/96
V.P. ACADEMIC AFFAIRS: ____________ 12/17/96

FIELD EXPERIENCE/INTERNSHIP ONLY:

LOCATION OF INTERNSHIP: ________________________

FACULTY EVALUATION GROUP: ________________________

FIELD SUPERVISOR* ________________________

*APPROVAL BY THE FIELD SUPERVISOR IS REQUIRED, AND MUST BE INDICATED BY THE ORIGINAL SIGNATURE OF THAT SUPERVISOR OF THE SYLLABUS.

(GUIDELINES AS SET FORTH IN THE OMNIBUS COURSE SECTION OF THE CATALOG MUST BE FOLLOWED. AN ACCURATE COPY OF EACH COURSE MUST BE ON FILE IN THE OFFICE OF ACADEMIC AFFAIRS PRIOR TO THE LISTING OF SUCH COURSE IN ANY SEMESTER SCHEDULE.)

CUR #03: JULY 86
ACADEMIC AFFAIRS
OMNIBUS COURSE SYLLABUS
METROPOLITAN STATE COLLEGE
SCHOOL OF LETTERS, ARTS, AND SCIENCES

DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES
PREFIX & COURSE NO. GEL 150
SEMESTER OFFERED Fall, 1997

COURSE TITLE Geologic and Environmental Hazards--Denver and Vicinity

SEMESTER CREDIT HOURS 2 CONTACT HOURS 30 LAB HOURS* 0

PREREQUISITES/COREQUISITES None

REQUIRED READING MATERIALS (Title, Author, Publisher, Copyright Date)


EVALUATION OF STUDENT PERFORMANCE

Final exam (50%) and summary field-trip report (50%).

SPECIFIC (MEASURABLE) STUDENT BEHAVIORAL LEARNING OBJECTIVES

Upon completion of this course the student should be able to:

1. recognize the geologic and environmental hazards found in proximity to Denver;
2. explain the causes and processes responsible for the geologic and environmental hazards found in proximity to Denver;
3. discuss the remediation of the various hazards found in proximity to Denver; and
4. communicate this knowledge in the form of a geologic report.
DETAILED OUTLINE OF COURSE CONTENT (MAJOR HEADING/SUBTITLES) OR OUTLINE OF FIELD EXPERIENCE/INTERNSHIP (EXPERIENCE, RESPONSIBILITIES AND SUPERVISION)

I. Classroom lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      a. Rock cycle and rock types
      b. Principles of uniformitarianism, original horizontality, and superposition
   C. Types of hazards
      a. Mass wasting, including influencing factors and classification
      b. Subsidence
      c. Swelling clays, including the geology and chemistry of swelling clays as well as remedial construction practices
      d. Flooding
   D. Sanitary landfills
      a. Geologic concerns
      a. Environmental problems
   E. Logistics

II. Field lectures (observations and recordings)
   A. Denver-Arapahoe Disposal Site (Lowry Landfill)
      a. Construction practices
      b. Leachate containment
      c. Hazardous waste remediation
   B. Rocky Mountain Arsenal
      a. Environmental clean-up
      b. Wildlife habitat
   C. Mass wasting
      a. Soil creep
      b. Flows
      c. Slips, including slumps and slides
      d. Falls
      e. Mass wasting remediation
   D. Subsidence
      a. Coal mines
      b. Improper compaction
   E. Swelling clays
      a. Impacts on structures
      b. Remediation of swelling clays utilizing improved construction and landscaping practices
   F. Flooding
      a. Flood frequency
      b. Land use planning

III. Course requirements
   A. Field-trip exam
   B. Summary field-trip report
APPROVAL:
ALL OMNIBUS COURSES:

DATE: 1/23/97

CHAIR, CURRICULUM COMMITTEE: 

DEPARTMENT CHAIR: 

DEAN, SCHOOL/CENTER: 

V.P. ACADEMIC AFFAIRS: 

FIELD EXPERIENCE/INTERNSHIP ONLY:

LOCATION OF INTERNSHIP: 

FACULTY EVALUATION GROUP: 

FIELD SUPERVISOR* 

*APPROVAL BY THE FIELD SUPERVISOR IS REQUIRED, AND MUST BE INDICATED BY THE ORIGINAL SIGNATURE OF THAT SUPERVISOR OF THE SYLLABUS.

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CUR #03: JULY 86

ACADEMIC AFFAIRS
OMNIBUS COURSE SYLLABUS
METROPOLITAN STATE COLLEGE
SCHOOL OF LETTERS, ARTS, AND SCIENCES

DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES
INSTRUCTORS James M. Cronoble and Harold C. Bowker

PREFIX & COURSE NO. GEL 150
SEMESTER OFFERED Fall, 1997

COURSE TITLE Geology of Caves

SEMESTER CREDIT HOURS 1 CONTACT HOURS 15 LAB HOURS* 0

PREREQUISITES/COREQUISITES None

REQUIRED READING MATERIALS (Title, Author, Publisher, Copyright Date)

EVALUATION OF STUDENT PERFORMANCE
Examination

SPECIFIC (MEASURABLE) STUDENT BEHAVIORAL LEARNING OBJECTIVES

Upon completion of this course the student should be able to:

1. discuss the cave regions of the U.S. and major caves of Colorado and New Mexico;
2. discuss the origin of caves, including relationships to rock type, fracture systems, and ground-water chemistry;
3. describe karst topography;
4. discuss the characteristics of caves, including cave temperature, relative humidity, and springs; and
5. discuss the formation of and types of speleothems (cave formations)

DETAILED OUTLINE OF COURSE CONTENT (MAJOR HEADING/SUBTITLES) OR OUTLINE OF FIELD EXPERIENCE/INTERNSHIP (EXPERIENCE, RESPONSIBILITIES AND SUPERVISION)

1. Introduction
   A. Caves as natural laboratories
   B. Cave regions of the U.S.
   C. Caves of Colorado and New Mexico
II. Origin of Caves
   A. Caves in limestone
   B. Influence of water
      a. Ground-water chemistry
      b. Ground-water table
   C. Influence of fractures
   D. Karst
   E. Caves not in limestone

III. Characteristics of Caves
   A. Cave temperature
   B. Relative humidity
   C. Barometric pressure changes
   D. Springs

IV. Speleothems (Cave Formations)
   A. Stalactites and related deposits
   B. Stalagmites and related deposits
   C. Other cave deposits

V. Spelunking Trips/Field Experience

APPROVAL:
ALL OMNIBUS COURSES: DATE: 1/23/97

CHAIR, CURRICULUM COMMITTEE: 
DEPARTMENT CHAIR: 
DEAN, SCHOOL/CENTER: 1/31/97
V.P. ACADEMIC AFFAIRS: 

FIELD EXPERIENCE/INTERNSHIP ONLY:

LOCATION OF INTERNSHIP: 

FACULTY EVALUATION GROUP: 

FIELD SUPERVISOR* 

*APPROVAL BY THE FIELD SUPERVISOR IS REQUIRED, AND MUST BE INDICATED BY THE ORIGINAL SIGNATURE OF THAT SUPERVISOR OF THE SYLLABUS.

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CUR #03: JULY 86
ACADEMIC AFFAIRS
OMNIBUS COURSE SYLLABUS
METROPOLITAN STATE COLLEGE
SCHOOL OF LETTERS, ARTS, AND SCIENCES

DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES INSTRUCTOR Suzanne M. Smaglik

PREFIX & COURSE NO. GEL 150 SEMESTER OFFERED Fall, 1998

COURSE TITLE Geology of the Great Basin Province, Western U.S.

SEMESTER CREDIT HOURS 1 CONTACT HOURS 15 LAB HOURS* 0

PREREQUISITES/COREQUISITES None.

REQUIRED READING MATERIALS (Title, Author, Publisher, Copyright Date)


EVALUATION OF STUDENT PERFORMANCE

Final Exam (50%); class participation (20%); book review (30%).

SPECIFIC (MEASURABLE) STUDENT BEHAVIORAL LEARNING OBJECTIVES
Upon completion of this course, the successful student should be able to:

1. discuss the regional geologic history of the Basin and Range and the Mojave Desert on the basis of rock types, stratigraphy, and tectonic structures;
2. understand the hydrology of the Great Basin, based on the geomorphology and chemistry of ancient lake beds;
3. relate the geologic history of the Great Basin to the tectonic formation of western North America;
4. describe the geomorphic features of the desert and discuss the geological forces by which they were formed; and
5. communicate this knowledge in the form of a critical book review.
DETAILED OUTLINE OF COURSE CONTENT (MAJOR HEADING/SUBTITLES) OR OUTLINE OF FIELD EXPERIENCE/INTERNSHIP (EXPERIENCE, RESPONSIBILITIES AND SUPERVISION)

I. Classroom lectures/discussions
   A. General course objectives
   B. Basic Geologic Principles
      a. Plate Tectonic Theory
      b. Geologic Time
      c. Rocks, Mineral and the Plate Tectonic Rock Cycle
      d. Surface Processes (fluvial and eolian)
      e. Stratigraphy
      f. Regional geology, tectonic structures and geologic maps
   C. Geophysiology of the desert
      a. Desert geomorphology
      b. Ecology of flora and fauna
      c. History of human impact
      d. Preservation and policy
   D. Geologic history and setting of the Great Basin Province
      a. Basin and Range
      b. Death Valley
      c. Owens Valley
      d. Mojave Desert
   E. Hydrology of the Great Basin
   F. Logistics

II. Course requirements
   A. Participation in class discussions and exercises
   B. Critical book review of McPhee or Reisner
   C. In-class final exam

APPROVAL:

ALL OMNIBUS COURSES: 
DATE: 1/24/88

CHAIR, CURRICULUM COMMITTEE: 
DEPARTMENT CHAIR: 
DEAN, SCHOOL/CENTER: 
V.P. ACADEMIC AFFAIRS:

FIELD EXPERIENCE/INTERNSHIP ONLY:
LOCATION OF INTERNSHIP: 

FACULTY EVALUATION GROUP: 

FIELD SUPERVISOR*

*APPROVAL BY THE FIELD SUPERVISOR IS REQUIRED, AND MUST BE INDICATED BY THE ORIGINAL SIGNATURE OF THAT SUPERVISOR OF THE SYLLABUS.

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CUR #03: JULY 86
ACADEMIC AFFAIRS
OMNIBUS COURSE SYLLABUS
METROPOLITAN STATE COLLEGE
SCHOOL OF LETTERS, ARTS, AND SCIENCES

DEPARTMENT OF EARTH AND ATMOSPHERIC SCIENCES
INSTRUCTOR LEITZ
PREFIX & COURSE NO. GEL 150
SEMESTER OFFERED F 1998

COURSE TITLE Terrestrial Navigation

SEMESTER CREDIT HOURS 02
CONTACT HOURS 15
LAB HOURS* 30

PREREQUISITES/COREQUISITES none

REQUIRED READING MATERIALS (Title, Author, Publisher, Copyright Date)
Provided by instructor

EVALUATION OF STUDENT PERFORMANCE
Written Exam 50%
Field Exam 50%

SPECIFIC (MEASURABLE) STUDENT BEHAVIORAL LEARNING OBJECTIVES
Upon completion of this course, the successful student should be able to:

1. plot courses on maps of various scales.
2. convert representative fractions to working units.
3. use a compass for field location.
4. convert magnetic readings to true and vice versa.
5. locate him/herself via map inspection.
6. locate him/herself via resection and triangulation.
7. locate spatial information using Lat./Lon., UTM, and other grids.
8. calculate ETA for various routes.
9. become familiar with the workings of a GPS unit.
10. use GPS for navigation.
11. use a computer to plot GPS course.
I. Topographic maps
   A. Representative fractions and map scales
   B. Contour lines and intervals
   C. Grid systems
      1. Township and range
      2. Lat./Lon.
      3. UTM
      4. State

II. Compasses
   A. Declination – true vs. magnetic headings
   B. Azimuths vs. quadrant readings
   C. Correcting vs. uncorrecting calculations

III. Global Positioning Systems (GPS)
   A. The satellite constellation
   B. Estimated position error
   C. Plotting of Lat./Lon.
   D. Plotting of UTM coordinates

IV. Field exercises
   A. Dead reckoning and position estimation
   B. LOP’s and triangulations
   C. Calculation of ETA and ETE
   D. GPS treasure hunt

V. Computer exercises
   A. Downloading waypoints to a computer
   B. Uploading waypoints to a GPS unit
   C. Converting GPS files to DXF format

APPROVAL:
ALL OMNIBUS COURSES: ___________________________ DATE: 12/1988

CHAIR, CURRICULUM COMMITTEE: ___________________________ DEAN,

DEPARTMENT CHAIR: ___________________________ V.P. ACADEMIC AFFAIRS:

SCHOOL/CENTER: ___________________________ 1/22/88

FIELD EXPERIENCE/INTERNSHIP ONLY:

LOCATION OF INTERNSHIP: ___________________________

FACULTY EVALUATION GROUP: ___________________________

FIELD SUPERVISOR* ___________________________

*APPROVAL BY THE FIELD SUPERVISOR IS REQUIRED, AND MUST BE INDICATED BY THE ORIGINAL SIGNATURE OF THAT SUPERVISOR OF THE SYLLABUS.

(GUIDELINES AS SET FORTH IN THE OMNIBUS COURSE SECTION OF THE CATALOG MUST BE FOLLOWED. AN ACCURATE COPY OF EACH COURSE MUST BE ON FILE IN THE OFFICE OF ACADEMIC AFFAIRS PRIOR TO THE LISTING OF SUCH COURSE IN ANY SEMESTER SCHEDULE.)

CUR 688 7/31/86
REGULAR COURSE SYLLABUS

SCHOOL: Letters, Arts and Sciences

DEPARTMENT: Earth and Atmospheric Sciences

SEMESTER(S) OFFERED: Summer, 1999

PREFIX & COURSE NUMBER: GEL 150

COURSE TITLE: Geology of the Black Hills and Vicinity

CREDIT HOURS: 2 (2 + 0)

CONTACT HOURS: Lecture 30, Lab 0, Internship 0, Practicum 0

RESTRICTIONS (VARIABLE TOPICS COURSES): None

PREREQUISITE(S): None

COREQUISITE(S): None

CATALOG COURSE DESCRIPTION:

This course examines the geology of the scenic Black Hills of South Dakota and surrounding areas in Wyoming and Nebraska. Black Hills history reveals major conflict between resource exploitation and Native American culture. The Black Hills are geologically related to the Rocky Mountains and show unique relationships between intrusive igneous rocks (associated with gold), metamorphosed sediments (associated with gemstones), and uplifted layers (forming limestone caverns). Students learn basic concepts of geology and land use while exploring majestic peaks and spectacular caves. Some strenuous hiking and caving is involved.

REQUIRED READING MATERIALS: (Title, Author, Publisher, Copyright Date)

Field guide provided by instructor.

APPROVED:

Department Chair

Dean

V.P., Academic Affairs

DATE:

4/13/99

4/12/99

9/16/99

DISTRIBUTION: Original to Vice President for Academic Affairs

Copies retained by Dean and Department Chair

Revised 9/94: Academic Affairs-Curriculum-Regular Course Syllabus

(s:\wpform\acadaff\currculum\regsyll.wp)
SPECIFIC(MEASURABLE)STUDENTBEHAVIORALLEARNINGOBJECTIVES:

Upon completion of this course the student should be able to:

1. examine selected rock exposures in order to identify and record rock types and to relate rock types to modes of formation;
2. understand regional geologic history on the basis of rock types and structural features;
3. recognize the influence of geologic processes on rocks and landforms;
4. relate formations and rock types to economic products;
5. understand the land use issues involved in cultural conflicts and resource use; and
6. communicate this knowledge in the form of a geologic report.

OUTLINE OF COURSE CONTENT: (Major Topics and Subtopics)

I. Classroom lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      a. Geologic time
      b. Principles of uniformitarianism, original horizontality, and superposition
      c. Rock types and rock formation
      d. Rock cycle and plate tectonics
      e. Igneous intrusions and metamorphic relationships
      f. Metamorphic grade and facies
      g. Hydrothermal mineralization
   C. Logistics

II. Field lectures (observations and recordings)
   A. Exposed formations
      a. Geologic age
      b. Rock types and relationships
      c. Structural features
      d. Economic products
   B. Regional geologic history
      a. Pre-Laramide events
      b. Laramide events
      c. Post-Laramide events

III. Course requirements
   A. Field-trip exam
   B. Summary field-trip report

EVALUATION OF STUDENT PERFORMANCE:

1. Final exam (60%)
2. Summary field-trip report (40%)
METROPOLITAN STATE COLLEGE OF DENVER
Omnibus Course Syllabus

School of Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences
Instructor: Suzanne M. Smaglik

Prefix and Course Number: GEL 150
Semester offered: Spring, 2000

Course Title: Geology of Death Valley and Beyond

Contact Hours-students: 45
Total Other Hours*: 0
Contact Hours-faculty: 45

Meeting Times/Dates: January 2nd to January 15th, 2000

Grading Mode(s): Letter
Schedule Type(s): Lecture and Field Lecture

Prerequisites/Corequisites: GEL 101 Recommended

Required Reading Materials (author, title, publisher, copyright date):

Fiero, Bill, Geology of the Great Basin, University of Nevada Press, 1986

Evaluation of Student Performance:

Final exam (60%) and Summary field-trip report (40%)

Specific (measurable) Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. discuss the regional geologic history of the Basin and Range and the Mojave Desert on the basis of rock types, stratigraphy, and tectonic structures;
2. understand the hydrology of the Great Basin, based on the geomorphology and chemistry of ancient lake beds;
3. relate the geologic history of the Great Basin to the tectonic formation of western North America;
4. describe the geomorphic features of the desert and discuss the geological forces by which they were formed; and
5. communicate this knowledge in the form of a summary geologic report.
Detailed outline of course content (major topics and subtopics) or outline of field experience/internship (experience, responsibilities and supervision):

I. Field Studies in the Great Basin Province
   A. Basin formations
      a. Geologic age and regional stratigraphy
      b. Rock types and formation processes
      c. Surface processes
      d. Basin and Range tectonics
   B. Basin Hydrology
      a. Fluvial
      b. Groundwater and caves
      c. Evaporation
   C. Desert Geomorphology
      a. Dunes, alluvial fans, pediments, inselburgs, bajadas, and caves
      b. Horst and graben
      c. Faulting and jointing
      d. Associated volcanism
   D. Regional Geologic History
      a. Precambrian events
      b. Paleozoic events
      c. Cenozoic events
   E. Geologic Resources
      a. Metallic ore minerals
      b. Non-metallic minerals
      c. Water

II. Course Requirements
   A. Fourteen-day field trip through the Basin and Range to the Mojave Desert during the first two weeks of January, 2000.
   B. Summary field-trip written report (40%).
   C. Final examination (60%).
Approved - Omnibus course:

[Signature]  9/7/99
Department Chair  Date

[Signature]  9/7/99
Dean of School  Date

Associate Vice President for Academic Affairs  Date

**Approval by the Field Supervisor is required and must be indicated by the original signature of that supervisor on the syllabus.**

Guidelines as set forth in the omnibus course section of the College Catalog must be followed. An accurate copy of each course syllabus must be on file in the Office of Academic Affairs prior to the listing of such course in any semester schedule.
METROPOLITAN STATE COLLEGE OF DENVER
Omnibus Course Syllabus

School of Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences          Instructor: Jerry Morse

Prefix and Course Number: GEL 1500  Semester offered: Fall, 2000

Banner Number (for Academic Affairs use):______________________________

Course Title: Radiation, Radioactivity & Radon

Credit Hours: 2          Contact Hours-students: 30          Total Other Hours*: _____
Contact Hours-faculty: 30

Meeting Times/Dates: Hybrid

Grading Mode(s): L        Schedule Type(s): 6

Prerequisites/Corequisites: None

Required Reading Materials (author, title, publisher, copyright date):

Bartos, Diana S. and Roding, Margaret R., Do You Know Your 3 R’s? Radiation, Radioactivity & Radon, Colorado School of Mines (for Denver Earth Science Project), 1996

Evaluation of Student Performance:

Final Examination

Specific (measurable) Student Behavioral Learning Objectives:

This course is a fundamental course for perspective science teachers, grades 7 through 10. Upon completion of this course students will be able to:
(1) understand what radiation is, including non-ionizing and ionizing radiation, and including the properties of alpha, beta, and gamma radiation;
(2) understand what radioactivity is and what its relationship to rocks, soil, water, and air; and
(3) understand what radon is, how it is concentrated in buildings, testing and mediation techniques, what its effects are on human health.
Detailed outline of course content (major topics and subtopics) or outline of field experience/internship (experience, responsibilities and supervision):

I. What Is Radiation?
   A. Have You Ever Been Exposed To Radiation?
   B. Electromagnetic Radiation Spectrum
   C. What Are The Sources Of Ionizing Radiation?
   D. I Can See Clearly Now! (Cloud Chamber)
   E. Keep Your Distance!
   F. Shields Up!

II. What Is Radioactivity?
   A. Do You Know Where Your Children Are?  
      (Radioactive Decay Series)
   B. Time After Time (A Half-Life Simulation)
   C. Radioactivity In Earth
   D. Radioactivity In Water
   E. What Is Your Personal Ionizing Radiation Dose?

III. What Is Radon?
   A. Life Goes On!
   B. Radon In Your Lungs
   C. Radon: An "Uninvited" Guest!
   D. The 3 R's Trivia Challenge

Approved - Omnibus course:

Department Chair:  
Date: 2/10/00

Dean of School:  
Date: 2/19/00

Associate Vice President for Academic Affairs:  
Date:  

Approved - Field Experience/Internship Only:

Location of Internship

Faculty Evaluation Group:  
Date:  

Field Supervisor**:  
Date:  

**Approval by the Field Supervisor is required and must be indicated by the original signature of that supervisor on the syllabus.
METROPOLITAN STATE COLLEGE OF DENVER
Omnibus Course Syllabus

School of Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences  Instructor: Beth Simmons
Prefix and Course Number: GEG 150E  Semester/year offered: Summer, 2001

Banner Number (for Academic Affairs use): ________  CL: GEL 1505

Course Title: Mining Ghost Towns of Colorado

Credit Hours: 3 + 0  Contact Hours-students: 45  Total Other Hours*: ______
Contact Hours-faculty: 45

Meeting Times/Dates: Five Friday evening classroom lectures (June 1, 8, 15, 22, and 29), 3.5 hours each
Four all-day field lectures (June 2, 9, 16, and 23)

Grading Mode(s): L  Schedule Type(s): L

Prerequisites/Corequisites: GEL 1010 or GEG 1100, or permission of instructor

Required Reading Materials (author, title, publisher, copyright date):
B. Mosch, Alvin, The Lamartine History, 2001 (rough draft).
D. Sampson, Joanna, Walking through History on Marshall Mesa, Boulder Open Space Department, 1995.
F. Selected readings provided by instructor.

Evaluation of Student Performance:
A. Two 100-point examinations, total 200 points
B. Class project (an individual portion of a class research paper on the history of the town site of Freeland in the Trail Run District, Clear Creek County), 200 points
C. Participation in four field-lectures, 25 points each, total 100 points
Specific (measurable) Student Behavioral Learning Objectives: Upon successful completion of this course, students should be able to:

1. identify the major events of gold, coal, and molybdenum discoveries in Colorado by location and time;
2. plot on a map the movement of gold prospectors in the state throughout the late 1800's;
3. explain historical and current settlement patterns of Boulder and Clear Creek Counties;
4. identify 10 major ores, mineral-bearing rocks, and their sources in Colorado;
5. discuss the roles of major players in gold, silver, and coal discovery, transportation, and production and their impacts on the development of Colorado;
6. identify early mining and processing equipment and explain relationships between technology and mining history;
7. explain the relationships between the development of mining, lumber, and cattle ranching and the development of railroads throughout Colorado;
8. explain the relationship of the patterns of railroad development to the beginnings of the tourist industry;
9. explain processes of town site development and dissolution; and
10. conduct a joint research project on the history of a town site.

Detailed outline of course content (major topics and subtopics) or outline of field experience/internship (experience, responsibilities and supervision):

A. History of Gold discoveries in Colorado
   1. Clear Creek County
      a. George Jackson
      b. John Gregory
   2. Boulder County
      a. Aikens – Gold Hill
      b. Langley – Deadwood Diggins

B. Early Transportation by First Settlers
   1. Beasts of burden
   2. Types of wagons, stages
   3. Early trade routes and trails

C. Development of Coal Fields
   1. Marshall Mesa
   2. Rooney Valley
   3. South Park
   4. Importation of miners

D. Development of Supply Towns
   1. Denver and Auraria
      a. William Greenberry Russell – Auraria
      b. Easter party – St. Charles
      c. Larimer – Denver
      d. Sopris - Arapahoe City
      e. Golden and Jackson – Golden City
E. Immigration of Miners
1. Home countries and customs
2. Patterns of settlement
3. Late arrivals

F. Development of Mining Districts
1. Mining laws and claims
2. Ownership of claims

G. Early Placer Deposits and Ore Bodies
1. Spanish Bar
2. Gregory Lode
3. Freeland/Lamartine Veins

H. Mining and Milling Equipment
1. Panning, hydraulics, Arrastras
2. Mill development and construction
   a. Stamp mills, crushers
   b. Smelters
   c. Concentration mills
   d. Mill site claims and development
3. Mining technology
   a. Black powder, dynamite
   b. Ore carts, rail and tram systems
   c. Carbide lamps
   d. Electricity

I. Railroad History – Routes and Roles
1. Colorado and Southern
2. Denver and Rio Grande
3. Colorado Midland
4. Moffat Tunnel
5. Argentine Central
6. Georgetown Loop

J. Military History of State
1. Fremont Surveying party and Gilpin
2. Gunnison Massacre
3. Wm. Bent
4. Sopris in Arapahoe City
5. Colorado National Guard in coal mining history
6. Military role in gold mining strike

K. Group Research Project
### Approved - Omnibus course:

<table>
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<tr>
<th>Department Chair</th>
<th>James M. Corbett</th>
<th>Date</th>
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<tr>
<td>Dean of School</td>
<td>Diane Miller-Harley</td>
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<td>Associate Vice President for Academic Affairs</td>
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beginning [2014] (semester and year).

Approved:

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METROPOLITAN STATE COLLEGE OF DENVER
Omnibus Course Syllabus

School of Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences
Instructor: Beth Simmons

Prefix and Course Number: GEG 150
Semester/year offered: Summer, 2001

Course Title: Volcanic Landforms of Colorado

Credit Hours: 3 + 0
Contact Hours-students: 45
Contact Hours-faculty: 45

Meeting Times/Dates:
Four Friday evening classroom lectures (July 13, 20, 27, and August 3), 3 hours each
Five all-day field lectures (July 14, 21, 28, 29, and August 4)

Grading Mode(s): L
Schedule Type(s): L

Prerequisites/Corequisites: GEL 1010 or GEG 1100, or permission of instructor

Required Reading Materials (author, title, publisher, copyright date):
B. Volcanic information provided by instructor
C. USGS publications
D. Reading and question handouts provided by instructor
E. Information from the Internet and Museum resources

Evaluation of Student Performance:
A. Two 100-point examinations
   1. Before two-day field lecture
   2. Final
B. Four 25-point quizzes, given in field, total of 100 points
C. A 5- to 6-page paper relating the geologic history of a volcanic site in Colorado, 100 points

Specific (measurable) Student Behavioral Learning Objectives: Upon successful completion of this course, students should be able to:
1. identify at least 20 different volcanic rock types and associated minerals;
2. identify the sources of volcanic rock types;
3. identify types of volcanic environments which occurred in Colorado;
4. identify types of plutonic environments in Colorado;
5. identify erosional remnants of volcanic environments on aerial photos and topographic maps;
6. discuss the volcanic history of the Front Range;
7. discuss the volcanic and paleontological history of the Florissant Fossil Beds National Monument; and
8. discuss the volcanic history of the San Juan Mountains and LaGarita Caldera.

Detailed outline of course content (major topics and subtopics) or outline of field experience/internship (experience, responsibilities and supervision):

A. Introduction to the Geological Time Scale
   1. History of the time scale
   2. Times of volcanic activity
B. Classification of igneous rocks and minerals
   1. Magma composition and chemistry
   2. Naming of igneous rocks and origin of rock types
C. Evolution of volcanoes
   1. Hot spot type volcanism
   2. Vent type volcanism
   3. Subduction type volcanism
D. Preservation of and dating volcanic material
   1. Introduction to volcanic processes
   2. Types of dateable minerals
   3. Methods of dating volcanic materials
E. Precambrian volcanism and igneous intrusions
   1. Types of Precambrian volcanics in the Rocky Mountains
   2. Locations of Precambrian landforms and volcanic rocks
   3. Possible origins of Precambrian volcanics
F. Paleozoic volcanism in Colorado
   1. Locations of Paleozoic igneous intrusions and associated volcanic rocks
G. Mesozoic volcanism in Colorado
   1. Plate tectonic activity in Colorado during the Mesozoic
   2. Types and ages of Mesozoic volcanoes and intrusions
   3. Locations of Mesozoic volcanics in western North America
   4. Influence of volcanism on Colorado area
   5. Laramide orogeny in the Rocky Mountains
H. Cenozoic volcanism in Colorado
   1. Tertiary volcanic episodes up to 2 million years ago
   2. Quaternary volcanic episodes and mechanisms during the last 2 million years
I. Field-lecture sites:
   1. Florissant Fossil Beds National Monument
   2. Ruby Mountain at Nathrop
   3. Thirty-nine mile field at Guffey
4. Rio Grande Rift – San Luis Valley
5. Summer Coon Volcano in the San Juan Field
6. Capulin National Monument, New Mexico
7. Curecanti National Recreation Area
8. La Veta Rhyolite dome
9. Spanish Peaks
10. Del Norte Volcanic field
11. Raton Mesa
12. North and South Table Mountain, Golden
13. Finger Rock, Middle Park

J. Summary of volcanism in Colorado

Approved - Omnibus course:

Department Chair

Dean of School

Associate Vice President for Academic Affairs

Approved - Field Experience/Internship Only:

Location of Internship

Faculty Evaluation Group

Field Supervisor**

Guidelines as set forth in the omnibus course section of the Bulletin must be followed. An accurate copy of each course syllabus must be on file in the Office of Academic Affairs prior to the listing of such course in any semester schedule.
COURSE CROSSLISTING AGREEMENT FORM
The Metropolitan State College of Denver

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beginning 2004-10 (semester and year).

Approved:

[Signatures and dates]

Dean

Date

[Signatures and dates]

Dean

Date

Dean

Date

[Signatures and dates]

V. P. for Academic Affairs

Date

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METROPOLITAN STATE COLLEGE OF DENVER
Omnibus Course Syllabus

School of Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences  Instructor: Beth Simmons
Prefix and Course Number: GEL 150  Semester/year offered: Summer, 2002
Banner Number (for Academic Affairs use): 150U

Course Title: Colorado's Volcanic Landforms
Credit Hours: 2 + 0  Contact Hours-students: 30  Total Other Hours*: . . . .
Contact Hours-faculty: 30
Meeting Times/Dates: Classroom lectures (June 6, 13 and July 2), 2 hours each
Four all-day field lectures (June 8, 9, 15, and 16)

Grading Mode(s): L  Schedule Type(s): L

Prerequisites/Corequisites: GEL 101 or GEG 1100, or permission of instructor

Required Reading Materials (author, title, publisher, copyright date):
C. Volcanic information provided by instructor, including reading and question handouts.
D. USGS publications.
E. Information from the Internet and Museum resources.

Evaluation of Student Performance:
A. One 200-point take-home examination
B. Four 25-point quizzes, given in field, total of 100 points
C. A 5- to 6-page paper relating the geologic history of a volcanic site in Colorado, 100 points

Specific (measurable) Student Behavioral Learning Objectives: Upon successful completion of this course, students should be able to:
1. identify at least 10 different volcanic rock types and associated minerals;
2. identify the sources of volcanic rock types;
3. identify types of volcanic environments which occurred in Colorado;
4. identify types of plutonic environments in Colorado;
5. identify erosional remnants of volcanic environments on aerial photos and topographic maps;
6. discuss the volcanic history of the Front Range;
7. discuss the volcanic history of Middle Park, Colorado and the Capulin volcanic area of Southern Colorado and Northern New Mexico; and
8. discuss the volcanic history of the San Juan Mountains and LaGarita Caldera.

Detailed outline of course content (major topics and subtopics) or outline of field experience/internship (experience, responsibilities and supervision):

A. Introduction to the Geological Time Scale
   1. History of the time scale
   2. Times of volcanic activity
B. Classification of igneous rocks and minerals
   1. Magma composition and chemistry
   2. Naming of igneous rocks and origin of rock types
C. Evolution of volcanoes
   1. Hot spot type volcanism
   2. Vent type volcanism
   3. Subduction type volcanism
D. Mesozoic volcanism in Colorado
   1. Plate tectonic activity in Colorado during the Mesozoic
   2. Types and ages of Mesozoic volcanoes and intrusions
   3. Locations of Mesozoic volcanics in western North America
   4. Influence of volcanism on Colorado area
   5. Laramide orogeny in the Rocky Mountains
E. Cenozoic volcanism in Colorado
   1. Tertiary volcanic episodes up to 2 million years ago
   2. Quaternary volcanic episodes and mechanisms during the last 2 million years
F. Field-lecture sites:
   1. Willow Peak
   2. Finger Rock
   3. Hot Sulphur Springs
   4. Middle Park
   5. North and South Table Mountains
   6. Capulin Volcano National Monument and vicinity, New Mexico and Colorado
   7. Spanish Peaks
   8. La Veta Rhyolite Dome
   9. Raton Mesa
G. Summary of volcanism in Colorado
Approved - Omnibus course:

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<tr>
<th>Position</th>
<th>Signature</th>
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<tr>
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Approved - Field Experience/Internship Only:

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<th>Location of Internship</th>
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<td>Faculty Evaluation Group</td>
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COURSE CROSSLISTING AGREEMENT FORM
The Metropolitan State College of Denver

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beginning 2020 (semester and year).

Approved:

\[\text{Department Chair/Institute Director} \quad 10/28/01\]

\[\text{Department Chair/Institute Director} \quad 10/26/01\]

\[\text{Dean} \quad 10-26-01\]

\[\text{Dean} \quad \text{Date}\]

\[\text{V. P. for Academic Affairs} \quad 11-1-01\]

Please forward the completed form to the Office of Academic Affairs for processing and recordkeeping (CN 318, Box 48). It will remain in force until rescinded by one of the parties using the Crosslisting Termination Form.
METROPOLITAN STATE COLLEGE OF DENVER
Omnibus Course Syllabus

School of Letters, Arts, and Sciences

Department: Earth & Atmospheric Sciences
Instructor: Robert Leitz

Prefix and Course Number: GEL 150

Banner Number (for Academic Affairs use):

Course Title: Colorado Wildfires

Credit Hours: 2
Contact Hours-students: 30
Total Other Hours*:
Contact Hours-faculty:

Meeting Times/Dates: Tuesday, and Thursday, July 22 & 24, and Thursday, July 31, 5:30-8:30 PM.
Field lecture: Friday, Saturday, and Sunday, July 25, 26, & 27.

Grading Mode(s): L
Schedule Type(s): L

Prerequisites/Corequisites:
None

Required Reading Materials (author, title, publisher, copyright date):

Handouts provided by instructor.

Evaluation of Student Performance:

Final Exam and summary field-trip report

Specific (measurable) Student Behavioral Learning Objectives:

Upon completion of this course the student will be able to:

1. describe the impact of the 2002 “Big Fish” wildfire on the Flattops Wilderness Area.
2. understand and discuss before and after fire effects on:
   a. lacustrine (lake) environment
   b. fluvial (stream) environment
c. flora and fauna habitats.
d. human habitats.

3. measure and compare rates of erosion in burn versus non-burn regions.
4. compile a reconnaissance burn map.
5. use a Brunton compass to collect and locate data.
6. use a Garmin 12 GPS unit to collect spatial data.
7. collect samples of fire produced hydrophobic soils.
8. discuss economic impact of wildfires.

Detailed outline of course content (major topics and subtopics) or outline of field experience/internship (experience, responsibilities and supervision):

I. Classroom lectures
   A. General course objectives
   B. Basic geologic principles and vocabulary to be used to describe the Flattops region
      i. 1. Uniformitarianism
      ii. 2. Geologic time
      iii. 3. Plate tectonics
      iv. 4. Igneous processes and products
   C. Basic geographic outline of the Flattops/White River Plateau region
   D. Conditions leading to the “Big Fish” wildfire
   E. Field sampling procedures
   F. Field equipment to be used
   G. Trip logistics

II. Field lectures and exercises
   A. Regional geology/geography
   B. Pre-burn/post-burn regional flora/fauna
   C. Pre-burn/post-burn alpine soils
   D. Measuring erosion rates in burn/non-burn areas
   E. Rates of flora recovery
   F. Future wildfire management

III. Course requirements
   A. Field trip exam
   B. Summary field trip report

Approved - Omnibus course:

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<tr>
<th>Department Chair</th>
<th>Date</th>
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<tr>
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<td>1/10/03</td>
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<tr>
<td>Dean of School</td>
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Signature

Linda R. Walker
1/16-03
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beginning Summer, 2003 (semester and year).

Approved:

Department Chair/Institute Director

Date

1/10/03

Department Chair/Institute Director

Date

1/10/03

Dean

Date

1/10/03

V. P. for Academic Affairs

Date

1/16/03

Please forward the completed form to the Office of Academic Affairs for processing and recordkeeping (CN 318, Box 48). It will remain in force until rescinded by one of the parties using the Crosslisting Termination Form.
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 1510 Crosslisted With*: N/A

Course Title: Geology of Red Rocks Park and Vicinity

Check All That Apply: Required for Major: ____  Required for Minor: ____  Specified Elective: ____

Required for Concentration: ____  Elective: X  Service Course: ____

Credit Hours: 1 (1 + 0)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 15  Lab 0  Internship 0  Practicum 0  Other (please specify type and hours): 0

Schedule Type(s): L  Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): GEL 1010 recommended

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:

Prerequisite(s): None

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course examines the geology of Red Rocks Park and vicinity, including rocks formed over a period of approximately two billion years. The geologic history includes Colorado's famous "disappearing" mountain range (the Ancestral Rocky Mountains), evidence of ancient oceans and deserts, dinosaur bones and tracks and the uplift of the modern-day Rocky Mountains. Note: Students cannot take both GEL 1510 and GEL 3530 for credit. (General Studies - Level II, Natural Science)

APPROVED:

Department Chair OR Program Director

[Signature]  [Date]

Dean OR Associate Dean

[Signature]  [Date]

Associate VP, Academic Affairs

[Signature]  [Date]
Prefix and Course Number: GEL 1510

Required Reading and Other Materials will be equivalent to:


Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. examine selected rock exposures in order to identify and record rock types and to relate rock types to modes of formation;
2. understand regional geologic history on the basis of rock types and sedimentary structures;
3. relate formations and rock types to natural resources;
4. understand the environmental consequences of resource use and exploitation;
5. recognize the influence of geologic processes on rocks and landforms; and,
6. communicate this knowledge in the form of a summary field-trip report.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Classroom lecture
   A. General course objectives
   B. Basic geologic principles and concepts
      1. Geologic time
      2. Rock types
      3. Principles of uniformitarianism, original horizontality, and superposition
      4. Depositional environments (how rocks were formed)
      5. Sedimentary structures
      6. Formations
      7. Transgressions and regressions (sea-level changes)
   C. Presentation of subsequent events
   D. Logistics
II. Field lectures (observations and recording of data)
   A. Exposed Formations
      1. Geologic age
      2. Rock type(s)
      3. Depositional environments
      4. Economic products
   B. Regional geologic history
      1. Pre-Laramide events
      2. Laramide events
      3. Post-Laramide events
III. Course requirements
   A. Field-trip exam
   B. Summary field-trip report

Evaluation of Student Performance:

1. Class attendance and participation
2. Final exam and summary field-trip report.
Date: February 25, 1998

School: Letters, Arts and Sciences
Department: Earth and Atmospheric Sciences

Prefix  Course Number  Credit Hours  Contact Hours  CIP Number
GEL  1510  1 (1 + 0)  15  40.0601

Title: Geology of Red Rocks Park and Vicinity (1 + 0)

Prerequisites: None

Corequisites: None

Anticipated number of sections per semester: 1
Recommended maximum enrollment per section: 18

Note: GEL 1510 is taught simultaneously with GEL 3510.

Current Course Status

New course [It has been taught as GEL 1500, a Current Topics in Geology (Variable Topics) course, numerous times.]

Proposed General Studies Designation

Level: II
Category: Natural Science

Proposed Senior Experience Designation

Not Applicable

Proposed Multicultural Designation

Not Applicable
This course, taught numerous times as GEL 1500, Geology of Red Rocks Park and Vicinity, a "Current Topics in Geology (Variable Topics)" course, gives our students the opportunity to experience geology in the Earth's most appropriate classroom, the field. Students learn about geologic concepts, laws, and processes in the pre-trip classroom lectures, but it is critical to allow them to apply their newly-found knowledge to a real geologic situation in the field. In a sense, this field-lecture course is an important continuation/extension of their geologic education. It will give them a glimpse of what geologists can do with, and how they can interpret, information obtained in the field.

This course examines the geology and geologic history west of Denver along the Front Range in the vicinity of Red Rocks Park. By observing and interpreting minerals and rock types, sedimentary structures, and structural geology, students are able to conceptualize and extrapolate what has happened to much of Colorado over the past 2 billion years of geologic time.

Further, the inclusion of this course in General Studies, Level II, Natural Science, will give students the option of a one-credit course to complete their required six credit hours of Natural Science.

Criteria for General Studies—Level II, Natural Science courses:

1. This course utilizes fundamental geologic knowledge and basic methods in the analysis of minerals and rocks, depositional environments, structural geology, and the geologic history of Colorado with special emphasis on the geologic history along the Front Range in the Red Rocks Park area.
2. This course introduces the basic concepts of the formation of rocks and minerals, uniformitarianism, geologic time, plate tectonics, stratigraphy, and structural geology.
3. The science of geology is multidisciplinary in nature. The understanding of basic chemistry is fundamental to our knowledge of the formation of minerals, and hence the formation of rocks, as well as the weathering of rocks and minerals to form solutions and sediments that are eventually deposited as sedimentary rocks. The structure of the earth's interior is based on wave motion (physics), while the interpretation of shallow structures requires knowledge of trigonometry. Uniformitarianism assumes uniformity of the laws of physics through geologic time.
4. Technological change has heightened everyone's awareness of our dependence on natural resources and the need for proper management of geological systems. The application of computers to the generation of maps, diagrams, and reports is making a significant impact on the preparation of written assignments.
5. Because stress on geological resources is increasing, ethical concerns regarding their use and exploitation along the Front Range are addressed. The protection of our environment is always emphasized.
6. This course will strengthen communication skills by use of written assignments and examination essay questions.
7. Critical and logical thinking are required to solve various problems related to the stratigraphy and structural geology in the Red Rocks area.
8. Students must be able to locate, organize, and evaluate course materials and lectures in order to understand the geologic history of Colorado.
9. This course will strengthen quantitative skills, especially in the solving of structural problems.
10. Students will differentiate between speculation, inference, belief, fact, evidence, generalization, theory, and law.
11. Students will interpret and apply the basic laws of geology, as well as formulate and test geologic hypotheses utilizing accurate observations and measurements. They will recognize the limitations, the uncertainty and integrity, of the science of geology.
12. Students will be able to apply the geologic knowledge learned in this course to real-life situations, especially in the disciplines of stratigraphy and structural geology.

Approvals:

[Signatures and dates]
REQUEST FOR GENERAL STUDIES DESIGNATION (2010-11)  
NATURAL AND PHYSICAL SCIENCES

Please review the Course Selection Criteria for this category for assistance in completing this form, particularly as it relates to the percentages associated with each Student Learning Outcome.

If this course is also being submitted for the Global Diversity Category, check here ☐, and complete and attach the separate Global Diversity General Studies Designation request.

Date: August 25, 2011

School: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Course Number</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEL</td>
<td>1510</td>
<td>1</td>
</tr>
</tbody>
</table>

Title: Geology of Red Rocks Park and Vicinity

Prerequisite(s): None; GEL 1010 recommended

Corequisite(s): None

Banner enforced prerequisite(s) and/or corequisite(s): None

Recommended maximum enrollment per section: 20

A. Student Learning Outcomes

Describe the specific ways in which this course addresses each of these Student Learning Outcomes, providing students opportunities to develop the skills and/or acquire the knowledge. Include reference to readings, discussions, lectures, and other pedagogical tools which will be used. See the Criteria Table for examples.

1. Demonstrate effective use of technologies appropriate to the task and discipline. (10%)

   Students will learn to use a Brunton compass to take measurements of strike and dip. Strike and dip measures the attitude of the layers of rocks at a given point in the field and this information can be used to interpret the structural geology of the area under study.

   As a general comment, technological change has heightened everyone’s awareness of our dependence on natural resources and the need for proper management of geological systems. The application of computers to the generation of maps, diagrams, and reports is making a significant impact on the preparation of written assignments.
2. Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose. (10%)

Students must be able to locate, organize, and evaluate course materials and lectures in order to understand the geologic history of Colorado.

Students are required to include in their summary reports at least five references that they utilized in the writing of the report, including websites, in their “Cited References.” The required textbook for the course, A.M. Taylor’s 1995 edition of Guide Book to the Geology of Red Rocks Park and Vicinity, is an excellent source of information on the geology of the Front Range. There are numerous other sources of information available covering different aspects of the geology of Colorado, including A.M. Taylor’s 1999 publication Guide to the Geology of Colorado, as well as the Geologic Atlas of the Rocky Mountain Region published in 1972. All of these publications have extensive bibliographies. Finally, the professor provides additional information that the students can access during and after the field lectures. In reality, while in the field the students record an extraordinary amount of information that is more than enough to write an outstanding field-trip summary.

10. Describe how the methods of science are used to generate new knowledge. (30%)

Students will utilize the scientific method “to solve” a field problem. For example, there is a Cretaceous-aged road cut that exhibits a repeat in the geologic section. The question that is asked is how can you (the student) explain such a repeat? There are at least four hypotheses that are discussed, including the possibilities of folding, faulting, a temporary transgression during the overall regression of the Cretaceous Sea, as well as the original paleogeography of the area. This question cannot be answered on the outcrop because of time restraints; in fact, it would make a good graduate-level thesis problem. The point is the students are required to think about the various possibilities (hypotheses). Obviously, the hypotheses would then have to be tested, and the options for such testing are discussed. Another question that is explored is how would sedimentary rocks deposited in a stream differ from those deposited by the wind? This question requires the students to analyze textures, including grain size, rounding, and sorting, and sedimentary structures, to arrive at an appropriate answer.

11. Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline. (25%)

Students analyze a geologic map of the Golden-Morrison area. Geologic maps are used to interpret the distribution of formations as well as geologic ages of the formation and structural geology.
19. Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field. (60%)

The science of geology is multidisciplinary in nature. For example, the understanding of basic chemistry is fundamental to our knowledge of the formation of minerals and hence the formation of rocks, as well as the weathering of rocks and minerals to form solutions and sediments that are eventually deposited as sedimentary rocks. The structure of the earth's interior is based on wave motion (physics), while the interpretation of shallow structures requires knowledge of trigonometry.

By systematically taking strike and dip measurements and plotting the information on a map, geologists are able to map the structural geology at the surface, the attitude of the rocks, over a large area. If a favorable surface structure is found, e.g., an anticline, it may extend into the subsurface and there may be oil or natural gas trapped in the subsurface.

20. Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses. (10%)

See No. 10 above. Geology is very much an observational science, and the only thing that geologists have to work with to interpret the past is the rocks themselves. This course emphasizes using knowledge to formulate hypotheses. Understanding the variables is necessary to test the hypotheses. The science of geology continues to evolve during human life times; it was only 50 years ago that the hypotheses for the theory of plate tectonics began to tested.

21. Develop concepts of accuracy, precision, and the role of repeatability in the acquisition of scientific data. (10%)

As stated above, geology is very much an observational science. Making accurate observations and taking detailed notes is crucial to the understanding and interpretation of the geology of a particular formation and the geology of a local or regional area. The students are repeatedly told the importance of making accurate observations.

B. Assessment of Student Learning

Identify and describe at least one specific form of assessing student achievement of each Student Learning Outcome which will be a regular part of the course. Include attachments as applicable. A single piece of student work may be used to assess student achievement of more than one Student Learning Outcome. See the Criteria Table for potential data for use in assessment.

1. Demonstrate effective use of technologies appropriate to the task and discipline.

Students are taught how to use a Brunton compass. In groups of two or three students, they show that they are proficient in taking the strike and dip measurements.

2. Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose.
The students are required to obtain at least five sources of information when writing their summary field-trip reports and to include those sources in their “Cited References.” Determining the authenticity, validity, and reliability of such sources is difficult, especially for an inexperienced student and even for the experienced geologist. The students must be able to rely on their professor’s knowledge to assist them with the evaluation of the reliability of outside sources. See Field Report requirements in Attachment 2.

10. Describe how the methods of science are used to generate new knowledge.

Students will interpret and apply the basic principles of geology as well as formulate and test geologic hypotheses utilizing accurate observations and measurements. They will recognize the limitations, the uncertainties, and the integrity of the science of geology.

11. Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline.

Geologic maps are utilized to interpret the distribution of formations, geologic ages of the formations, and structural geology.

19. Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field.

Students will be able to apply the geologic knowledge learned in this course to real-life situations, especially in the disciplines of stratigraphy, structural geology, and environmental geology.

20. Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses.

Students will utilize the scientific method “to solve” a field problem. They will be given a question/problem and they will formulate various hypotheses to test and the problem, including devising methods for testing the hypotheses. See Field Report requirements in Attachment 2.


Making accurate observations and taking detailed notes is crucial to the understanding and interpretation of the geology of a particular formation and the geology of a local or regional area. The students are repeatedly told the importance of making accurate observations. The final examination is based on the information that the students record during the field lectures.
C. Conformance with Course Selection Guidelines

Briefly describe how the course meets the course section guidelines

- The course is a stand-alone course with no corequisite lab. As documented above, the course addresses each of the student learning outcomes.

Approvals:

[Signature]
2/21/12

Department Curriculum Committee / Date

[Signature]
2/21/12

Department Chair or Program Director / Date

[Signature]
2/29/12

School Curriculum Committee / Date

[Signature]
2/29/12

Dean or Associate Dean / Date

[Signature]
2/29/12

Chair, General Studies Committee / Date

[Signature]
3/8/12

Associate Vice President, Academic Affairs / Date
REGULAR COURSE SYLLABUS

GENERAL STUDIES

School of: Letters, Arts and Sciences
Department: Earth and Atmospheric Sciences

Prefix & Course Number: GEL 1520  Crosslisted With*: N/A

Course Title: Garden of the Gods—Front Range Geology

Check All That Apply: Required for Major: _____ Required for Minor: _____ Specified Elective: _____ Required for Concentration: _____ Elective: X Service Course: _____

Credit Hours: 2 (2+0)

Total Contact Hours per semester (assuming 15-16 week semester):
Lecture 30  Lab 0  Internship 0  Practicum 0  Other (please specify type and hours): 0

Schedule Type(s): L  Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**): N/A

** NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): GEL 1010 recommended

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:
Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course examines the geology along the Front Range from Boulder to Colorado Springs through rock exposures covering a span of approximately 1.7 billion years. Basic concepts of geology are applied to the formations exposed along the Front Range. These formations are examined with respect to age, rock type, origin, and economic products. The geologic history includes Colorado’s famous “disappearing” mountain range (the Ancestral Rocky Mountains), evidence of ancient oceans and deserts, dinosaur bones and tracks, and the uplift of the modern-day Rocky Mountains. Notes: Students may not receive credit for both GEL 1510 and GEL 1520. Students cannot enroll in both GEL 1520 and GEL 3520 for credit at the same time.

APPROVED:  

[Signature]
Date 2/11/12

Department Chair OR Program Director  
[Signature]  
Date 3/22/12

Dean OR Associate Dean  
[Signature]  
Date 3/2/12

Associate VP, Academic Affairs  
[Signature]  
Date
Prefix and Course Number:

**Required Reading and Other Materials will be equivalent to:**
Additional course materials will be provided by professor.

**Course Category and Related Student Learning Outcomes:**

1. Demonstrate effective use of technologies appropriate to the task and discipline.

2. Demonstrate the ability to locate sources when information is needed, and to evaluate the authenticity, validity, and reliability of resources applied to a specific purpose.

10. Describe how the methods of science are used to generate new knowledge.

11. Use graphical, symbolic and statistical methods to organize, analyze and interpret data in a manner appropriate to the discipline.

19. Describe the foundational knowledge and impacts of a field of science using analytical tools appropriate to the field.

20. Use knowledge and observations to formulate hypotheses, identify relevant variables and design experiments to test hypotheses.


**Specific, Measurable Student Behavioral Learning Objectives:**
Upon completion of this course the student should be able to:

1. Examine selected rock exposures in order to identify and record rock types and then relate to paleogeography and ultimately their origins (11, 19, 20);

2. Interpret regional geologic history on the basis of rock types and sedimentary structures (1, 2, 19);

3. Relate formations and rock types to natural resources (19);

4. Utilize the scientific method in the analysis of geologic problems (10, 20);

5. Utilize a Brunton compass to measure strike and dip and relate measurements to structure (1, 21);

6. Understand the environmental consequences of resource use and exploitation (19);

7. Relate the influence of geologic processes, including weathering and erosion, on rocks and landforms (2, 19); and,

8. Communicate this acquired knowledge in the form of a summary field-trip report (2, 10, 11, 19).

**Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision):**

I. Classroom lectures
   A. General course objectives
   B. Basic geology
      1. Rock types
      2. Rock cycle, including weathering and erosion
      3. Geologic time
   C. Geologic principles and concepts
      1. Principles of uniformitarianism, original horizontality, and superposition
      2. Scientific method and geology
      3. Brunton compass measurements of strike and dip
      4. Depositional environments (origins of sedimentary rocks)
         a. Rock types
         b. Sedimentary structures
         c. Formations and facies
d. Transgressions and regressions

D. Logistics

II. Field lectures (observations, recording of data, field measurements, and interpretations)
   A. Exposed formations
      1. Geologic age
      2. Formations
      3. Rock type(s)
      4. Depositional environments
      5. Economic products
      6. Structural geology
   B. Regional geologic history
      1. Pre-Laramide events
      2. Laramide events
      3. Post-Laramide events

III. Course requirements
   A. Final exam
   B. Summary field-trip report

Evaluation of Student Performance:
   1. Final examination (50%) and
   2. Summary field-trip report (50%)
Field Report Requirements

1. The report MUST BE TYPED (double-spaced with proper margins) and should consist of 4 to 5 pages minimum of text. Make them as interesting as possible by including properly referenced photographs and figures; these are encouraged because they enhance student learning and the quality of their reports.

2. The report should include, in chronological order from oldest to youngest, the formations discussed, along with their geologic age, rock type(s), mode of formation (depositional environment), and any other pertinent information. These are the subjects that will be discussed during the field trip, and if students take good notes and utilize the textbook, they should have no problems writing their reports or taking the exam.

3. The report must include at least one example of how the scientific method has been used. Identify the hypothesis to be tested, the method you used to test the hypothesis, and evidence which supports the hypothesis.

4. You are required to obtain at least five sources of information (can include the required text) when writing your summary field-trip reports and include those sources your “Cited References.” Any material you obtain from other sources and the Taylor text MUST BE REFERENCED APPROPRIATELY. As per department and college grading polices, plagiarism will result in a failing grade.

5. The report will be due no later than Tuesday, October 4, the same night as the exam. Students should turn in their reports to me the night of the exam in SI 2008. Late reports will result in a progressive grade reduction.
GEOLOGY 1520/3520 – FALL, 2011
GARDEN OF THE GODS--FRONT RANGE GEOLOGY

Dr. James M. Cronoble
303-988-1077 (Home)
303-587-7406 (Cell)
E-mail: jimcronoble@msn.com

Office Hours:
By Appointment Only
CRN: 54920 (GEL 1520)
CRN: 54925 (GEL 3520)

TEXT MATERIAL:


COURSE:

The Front Range area of Colorado is an area of spectacular geology. Students will learn about the geologic history of this part of Colorado which includes rocks created over a span of about 2 billion years. This history includes Colorado's famous "disappearing" mountain ranges, evidence of ancient oceans that moved in and out over the land, dinosaur bones and tracks, and evidence of the rising of the modern-day Rocky Mountains.

The course, Garden of the Gods--Front Range Geology, consists of two 3-hour evening lectures (Monday and Wednesday, September 12 and 14, from 6:00 to 9:00 in SI 2008) and 3 days of field lectures along the Colorado Front Range from Boulder to Colorado Springs (Friday, Saturday, and Sunday, September 16, 17, and 18, from 8:30 a.m. to 4:30). The field-lecture examination is Tuesday, September 27 at 6:00 in SI 2008.

There are no prerequisites for this course for GEL 1520 students. However, students should have an interest in learning about the geology and beauty of the Front Range area.

COURSE OBJECTIVES:

1. To learn the most basic concepts of geology.
2. To acquaint students with the fascinating geology of the Front Range from Boulder to Colorado Springs.
3. To identify the various formations present along the Front Range.
4. To understand the origin of the formations. Students will learn how geologists arrive at interpretations about the origins of rock formations based on field observations.
5. To understand the geologic history of the region.
6. To learn the basic economic products associated with the various formations.

COURSE REQUIREMENTS:

1. Prior to the field trip, the student should review the Appendix in the text. This is especially important for students that do not have any geology background.
2. Students must attend mandatory class and field lectures. If students do not attend the mandatory class and field lectures, they will receive an Incomplete or an "F" depending on the circumstances.
3. Students must take field notes and ask questions for clarification.
4. All students will take a comprehensive exam covering the course objectives on Tuesday, September 27 at 6:00 in SI 2008. The exam will consist of fill-in, true/false, multiple choice, and short essay questions.
5. For GEL 1520 students, the grade on the exam plus a 4- to 5-page summary report will be averaged for their grade in the course. See comments in 6 below regarding the paper.
6. For GEL 3520 students, the grade on the exam plus an upper-division quality, summary report will be averaged for their grade in the course. I expect professional papers from GEL 3520 students. The report MUST BE TYPED (double-spaced with proper margins) and should consist of 8 to 10 pages of text. Make them as interesting as possible by including properly referenced photographs and figures; these are encouraged because they enhance student learning and the quality of their reports.
7. The report should include, in chronological order from oldest to youngest, the formations discussed, along with their geologic age, rock type(s), mode of formation (depositional environment), and any other pertinent information. These are the subjects that will be discussed during the field trip, and if students take good notes and utilize the textbook,
they should have no problems writing their reports or taking the exam.

8. Any material you obtain from other sources, such as Taylor, MUST BE REFERENCED. As per department and college grading polices, plagiarism will result in a failing grade.

9. The report will be due no later than Tuesday, September 27, the same night as the exam. Students should turn in their reports to me the night of the exam in SI 2008. Late reports will result in a progressive grade reduction.

TRANSPORTATION:

During the field lectures, students must arrange their own transportation to a prearranged starting point. However, once at the prearranged point, car-pooling will be required. It is not practical or safe to have a 20-car caravan. Volunteer carpool drivers will be solicited during the class lectures. Each rider should pay the carpool driver the sum of $15.00 for the weekend to defray the cost of gasoline and "wear and tear" on the car.

During the first lecture, all students must read and understand the Field Trip Policies and sign the Liability Waiver. The State of Colorado requires vehicle drivers to have liability insurance coverage.

FIELD LECTURES:

The field lectures include a considerable amount of hiking (physical exertion). Be sure to dress properly, including good hiking shoes or boots. Students should carry drinking water and sun block. Students must prepare sack lunches daily because fast-food stops are not included in the scheduling. Cameras are recommended.

NC POLICY:

A NC may not be granted beyond the last day of classes in a given course. Therefore, the last day a student may request a NC for this course will be Tuesday, September 27. The NC form must be signed by me and turned into the Registrar's Office by 5:00, Tuesday, September 27.

INCOMPLETE POLICY:

To receive an incomplete (I), the student must have performed some work in the course, the amount necessary to be at my discretion. The student will then have one year to finish all requirements for the course. Failure to do so will result in a grade of "F" (automatically assigned by the Registrar). It is the student's responsibility to finish the course requirements in order to prevent receiving an "F".

LEARNING DISABILITIES:

American Disabilities Act Statement:

The Metropolitan State College of Denver is committed to making reasonable accommodations to assist individuals with disabilities in reaching their academic potential. If you have a disability which may impact your performance, attendance, or grades in this class and are requesting accommodations, then you must first register with the Access Center, located in the Auraria Library, Suite 116, 303-556-8387.

The Access Center is the designated department responsible for coordinating accommodations and services for students with disabilities. Accommodations will not be granted prior to my receipt of your faculty notification letter from the Access Center. Please note that accommodations are never provided retroactively (i.e., prior to the receipt of your faculty notification letter). Once I am in receipt of your official Access Center Faculty Notification Letter, I would be happy to meet with you to discuss your accommodations. All discussions will remain confidential. Further information is available by visiting the Access Center website www.mscd.edu/~access.
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 1530  Crosslisted With: N/A

Course Title: Geology of the Colorado Plateau

Check All That Apply: Required for Major: _____ Required for Minor: _____ Specified Elective: _____

Required for Concentration: _____ Elective: X Service Course: _____

Credit Hours: 2 (2+0)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 0 Lab 30 Internship 0 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): Yes

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): None; GEL 1010, GEL 1510, GEL 1520 and/or GEL 1560 are recommended

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:

Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course examines the geology of the eastern Colorado Plateau, including the geology of the Colorado National Monument, Arches National Park and Southern Canyonlands National Parks. Along with basic concepts of geology, the formations exposed in the eastern Colorado Plateau, including their ages, rock types, and origins, are examined. Historical geology and geomorphology come to life in this beautiful, desolate, arid country. Students must be in good physical condition because strenuous hiking is involved, and students must have prior camping experience. Note: Students cannot take both GEL 1530 and GEG 3530 for credit.

APPROVED:

[Signatures]

Department Chair OR Program Director Date

[Signatures]

Dean OR Associate Dean Date

[Signatures]

Associate VP, Academic Affairs Date
Prefix and Course Number:  GEL 1530

Required Reading and Other Materials will be equivalent to:


**Specific, Measurable Student Behavioral Learning Objectives:**

Upon completion of this course the student should be able to:

1. discuss the geology and geography of the Colorado Plateau;
2. discuss the stratigraphy and geologic history of the Colorado Plateau on the basis of rock types and sedimentary structures;
3. relate the stratigraphy and geologic history of the Colorado Plateau to that of the Colorado Front Range;
4. discuss the geomorphic features of the Colorado Plateau and describe the geologic processes responsible for them; and,
5. communicate this knowledge in the form of a summary field-trip report.

**Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):**

I. Classroom lectures  
   A. General course objectives  
   B. Basic geologic principles and concepts  
      1. Geologic time  
      2. Rock cycle and rock types, with emphasis on sedimentary rocks  
      3. Principles of uniformitarianism, original horizontality, and superposition  
      4. Tectonics, including orogenesis and epeirogenesis  
      5. Depositional environments (how rocks were formed)  
      6. Sedimentary structures  
      7. Formations and geologic maps  
   C. Regional geographic and geologic settings of Colorado Plateau  
   D. Stratigraphic column of Colorado Plateau  
   E. Logistics  

II. Field lectures in Colorado Plateau (observations and recordings)  
   A. Plateau formations  
      1. Geologic age  
      2. Rock type(s)  
      3. Depositional environments  
   B. Salt tectonics  
      1. Anticlines  
      2. Faulting and jointing  
   C. Plateau geomorphic features and relationship to weathering and erosional processes  
      1. Plateaus, mesas, buttes, pinnacles, cliffs, and canyons  
      2. Arches and fills  
      3. Needle  
      4. Entrained meanders  
   D. Igneous activity of Colorado Plateau  
   E. Regional geologic history of Colorado Plateau  
      1. Pre-Laramide events  
      2. Laramide events  
      3. Post-Laramide events  

III. Course requirements  
   A. Field-trip exam  
   B. Summary field trip report  

**Evaluation of Student Performance:**

1. Class attendance and participation.  
2. Final exam and summary field-trip report.
METROPOLITAN STATE COLLEGE of DENVER
Office of Academic Affairs

REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 1550 Crosslisted With*: N/A

Course Title: Geology of the Great Sand Dunes National Monument

Check All That Apply: Required for Major: _____ Required for Minor: _____ Specified Elective: _____

Required for Concentration: _____ Elective: X Service Course: _____

Credit Hours: 2 (2 + 0)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 30 Lab 0 Internship 0 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): Yes

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): GEL 1010 recommended

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:
Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course emphasizes the processes and landforms associated with the eolian (wind) and desert environments at the Great Sand Dunes National Monument, located in the San Luis Valley between the San Juan and Sangre de Cristo Mountains. Investigations of the dune fields allow students to identify various types of dunes, as well as damage related to desertification. The relationships of sand source areas, cross bedding, and transport directions are investigated. Note: Students cannot take both GEL 1550 and GEL 3550 for credit.

APPROVED:

Department Chair OR Program Director

Date

Dean OR Associate Dean

Date

Associate VP, Academic Affairs

Date
Prefix and Course Number: GEL 1550

Required Reading and Other Materials will be equivalent to:

No Text.

Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:

1. discuss the igneous nature of Spanish Peaks Area and San Juan Mountains and the igneous/metamorphic nature of Sangre de Cristo Mountains;
2. explain the different types of sand dunes, including factors controlling their shapes;
3. discuss the processes responsible for sand transportation and deposition;
4. discuss the role of wind, streams, climate, and topography on the dune-field location;
5. recognize the impact of sand-dune encroachment on vegetation (desertification);
6. identify the source regions of the sands based on sand composition (San Juans vs. Sangre de Cristos) and sedimentary structures (ripple-mark characteristics and cross bedding);
7. identify alluvial fans and explain their origins; and
8. communicate this knowledge in the form of a summary field-trip report.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Classroom lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      1. Geologic time
      2. Rock types, emphasizing igneous (volcanics and intrusives) and metamorphic rocks and processes
      3. Rock cycle and plate tectonics
      4. Eolian and desert processes
      5. Eolian landforms, including dune types and sedimentary structures
      6. Fluvial landforms, emphasizing alluvial fans
   C. Logistics

II. Field lectures (observations and recordings)
   A. Regional geology
      1. San Juan Mountains
      2. Sangre de Cristo Mountains
      3. San Luis Valley
   B. Sand dunes
      1. Types of dunes
      2. Factors controlling dunes, including wind direction, sand supply, and vegetation
      3. Sand transport and deposition
      4. Role of stream activity
      5. Sand origin (source regions)
   C. Alluvial fans
      1. Landform and origin

III. Course requirements
   A. Field-trip exam
   B. Summary field-trip report

Evaluation of Student Performance:

Class attendance and participation.
Final exam and summary field-trip report.
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 1570 Crosslisted With*: N/A

Course Title: Geology of the Flattops Volcanic Wilderness Area

Check All That Apply: Required for Major: _____ Required for Minor: _____ Specified Elective: _____

Required for Concentration: _____ Elective: X Service Course: _____

Credit Hours: 2 (2 + 0)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 30 Lab 0 Internship 0 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): GEL 1010 recommended

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:
Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course emphasizes the igneous processes and products of the Flattops Wilderness Area of northwestern Colorado. Students study the lava flows exposed in the area and determine their source area. The problems of mid-continent magma genesis and its relationship to plate tectonics are also explored. Note: Students cannot take both GEL 1570 and GEL 3570 for credit.

APPROVED:

Department Chair OR Program Director

Date

Dean OR Associate Dean

Date

Associate VP, Academic Affairs

Date
Prefix and Course Number: GEL 1570

Required Reading and Other Materials will be equivalent to:

Students will be given a detailed field guide and additional course materials developed by the instructor. Topographic and geologic maps of the region.

Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. describe the geologic structures and characteristics of the White River Plateau;
2. observe and describe the volcanic morphology of the White River Uplift;
3. observe and describe the glacial morphology of the White River Uplift;
4. compile a reconnaissance geologic map of the volcanic features in the Wall Lake area;
5. use a Brunton pocket transit to collect geologic data;
6. locate volcanic and glacial landforms on a topographic map;
7. describe the human impact on the Flattops Wilderness Area;
8. discuss the economic potential of the Flattops Wilderness Area; and
9. communicate this knowledge in the form of a summary field-trip report.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Classroom Lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      1. Uniformitarianism
      2. Geologic time
      3. Plate tectonics
   C. Igneous processes and products
      1. Convergent zones and magma genesis
      2. Divergent zones and magma genesis
      3. Mid-Continent volcanism
      4. Igneous petrology
         i. Field identification techniques
         ii. Vocabulary
   D. Trip logistics
II. Field Lectures and Exercises
   A. Regional geography
   B. Regional geology
      1. Previous work
      2. Uplift versus volcanism
   C. Pyroclastics and magmahemetic eruptions
   D. Fissure eruptions and dike alignment
   E. Age relationships of eruptions near Wall Lake
   F. Glacial features and movement
      1. Striations
      2. Moraines
III. Course Requirements
   A. Field-trip exam
   B. Summary field-trip report

Evaluation of Student Performance:

1. Class attendance and participation.
2. Final exam and summary field-trip report.
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 1580 Crosslisted With*: N/A

Course Title: Geology of the Wheeler Geologic Area

Check All That Apply: Required for Major: _____ Required for Minor: _____ Specified Elective: _____

Required for Concentration: _____ Elective: X Service Course: _____

Credit Hours: 2 (2 + 0)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 30 Lab 0 Internship 0 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): GEL 1010 recommended

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:

Prerequisite(s): None

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course emphasizes the igneous processes and products of the Wheeler Geologic Area of southwestern Colorado. Students study the pyroclastic deposits exposed in the area and determine the sequence of events. The problems of mini-continent magma genesis and its relationship to plate tectonics are also explored. Note: Students cannot take both GEL 1580 and GEL 3580 for credit.

APPROVED:

[Signature]
Department Chair OR Program Director 7/17/06

[Signature]
Dean OR Associate Dean 3/6/07

[Signature]
Associate VP, Academic Affairs 9/18/07
Prefix and Course Number: GEL 1580

Required Reading and Other Materials will be equivalent to:

Students will be given a detailed field guide and additional course materials developed by the instructor. Topographic and geologic maps of the region.

Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. describe the geologic structures and characteristics of the San Juan Volcanic Field;
2. observe and describe the volcanic morphology of the San Juan Mountains;
3. compile a reconnaissance geologic map of the volcanic features of the Wheeler area;
4. use a Brunton compass to collect geologic data;
5. locate volcanic landforms on a topographic map;
6. use appropriate pyroclastic terminology to describe the eruptive events at Wheeler;
7. relate the geologic history of the San Juan Mountains to mountain building in Colorado;
8. describe the effects of chemical and physical weathering on a vitric tuff; and
9. communicate this knowledge in the form of a summary field-trip report.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Classroom Lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      1. Uniformitarianism
      2. Geologic time
      3. Plate tectonics
   C. Igneous processes and products
      1. Convergent zones and magma genesis
      2. Divergent zones and magma genesis
      3. Mid-Continent volcanism
      4. Igneous petrology
         a. Field identification techniques
         b. Vocabulary
   D. Trip logistics

II. Field Lectures and Exercises
   A. Regional geography
   B. Regional geology
      1. Previous work
      2. Uplift versus volcanism
   C. Pyroclastics and magmahemetic eruptions
   D. Water-pressure effects on magma behavior
   E. Devitrification processes
   F. Sequence of volcanic events
      1. Pre-eruption geologic setting
      2. Post-eruption modifications
   G. Effects of ignimbrite on the environment

III. Course Requirements
   A. Field-trip exam
   B. Summary field-trip report

Evaluation of Student Performance:

1. Class attendance and participation.
2. Final exam and summary field-trip report.
REGULAR COURSE SYLLABUS

School of Letters, Arts Sciences

Department: Earth and Atmospheric Sciences

Semester(s) Offered: Spring

Prefix & Course Number: GEL 1710

Crosslisted With*: ___

Course Title: Terrestrial Navigation

Credit Hours: 2 (1+2)

Contact Hours: Lecture 15  Lab 30  Internship  ____  Practicum  ____

Schedule Type(s): B  Grading Mode(s): L

Repeat* (Variable topics): ___

*(Pertinent only if the course can be repeated; enter maximum number of hours that can be earned by taking this course.)

Restrictions (Variable Topics Course): ___

Prerequisite(s): None

Banner Enforced Prerequisite(s): ___

Corequisite(s): None

Catalog Course Description:

This course is an introduction to the science of land navigation. Students will use celestial sights, maps, and Global Positioning System (GPS) to locate positions in the field. There are required field exercises.

Required Reading Materials (Title, Author, Publisher, Copyright Date):


GPS 12 Personal Navigator, Garmin Corporation, 1997, or a current equivalent.

APPROVED:

Department Chair/Institute Director

Dean

Associate VP, Academic Affairs

*If crosslisted, attach completed Course Crosslisting Agreement Form
Specific (Measurable) Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to:
1. plot courses on maps of various scales;
2. convert representative fractions to working units;
3. understand celestial positioning;
4. use a compass for field location;
5. convert magnetic readings to true and vice versa;
6. locate him/herself via map inspection;
7. locate him/herself via resection and triangulation;
8. locate spatial information using latitude and longitude, UTM (Universal Transverse Mercator), and other grids;
9. calculate ETA (Estimated Time of Arrival) for various routes;
10. become familiar with the workings of a GPS (Global Positioning System) unit;
11. use GPS for navigation; and
12. use a computer to plot a GPS course.

Detailed Outline Of Course Content (Major Topics and Subtopics) or Outline Of Field Experience/Internship (experience, responsibilities and supervision):

I. Topographic Maps
   A. Representative fractions and map scales
   B. Contour lines and intervals
   C. Grid systems
      1. Township and range
      2. Latitude and longitude
      3. UTM (Universal Transverse Mercator)
      4. State

II. Celestial Positioning
    A. Use of sextant
    B. Role of chronometers
    C. Solar noon sights
    D. Polaris sights

III. Compasses
     A. Declination: True versus magnetic headings
     B. Azimuths versus quadrant readings
     C. Correcting versus uncorrecting calculations

IV. Global Positioning Systems (GPS)
    A. The satellite constellation
    B. Estimated position error
    C. Plotting of latitude and longitude
    D. Plotting of UTM coordinates

V. Field Exercises
   A. Dead reckoning and position estimation
   B. LOP’s (Lines of Position) and triangulations
   C. Calculation of ETA (Estimated Time of Arrival) and ETE (Estimated Time En Route)
   D. GPS treasure hunt

VI. Computer Exercises
   A. Downloading waypoints to a computer
   B. Uploading waypoints to a GPS unit
   C. Converting GPS files to DXF format
Evaluation of Student Performance:
Class Participation
Written Examination
Field Examination
REGULAR COURSE SYLLABUS

School of Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

Semester(s) Offered: Fall

Prefix & Course Number: GEL 2700

Course Title: Introduction to Petroleum Technology

Credit Hours: 3 (2+0)

Contact Hours: Lecture 45  Lab _____ Internship _____ Practicum _____

Schedule Type(s): L  Grading Mode(s): L

Repeat* (Variable topics): ___
*(Pertinent only if the course can be repeated; enter maximum number of hours that can be earned by taking this course.)

Restrictions (Variable Topics Course): ___

Prerequisite(s): GEL 1010

Catalog Course Description: This course looks at the oil industry from the conception of a prospect through to drilling, testing, completion, transportation, marketing, refining, and sales. The course includes a consideration of the role petroleum products play in society, the future of petroleum, and the likely unconventional replacements of petroleum.

Required Reading and Other Materials will be equivalent to (Title, Author, Publisher, Copyright Date):


Supplemental materials to be provided by instructor, including handouts on methods and procedures, as well as articles from relevant sources.

Specific (Measurable) Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to:
1. examine the processes through which hydrocarbons are located, produced, refined and transported;
2. demonstrate knowledge of basic petroleum geology including source, reservoir, trap, seal, migration, and maturation;
3. interpret basic well logs;
4. demonstrate knowledge of the basic theory of geophysical exploration;
5. interpret simple seismic sections;

APPROVED:

[Signature]
Department Chair/Institute Director

[Signature]
Dean

[Signature]
Associate VP, Academic Affairs

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: GEL 2700

6. determine when to use different subsurface examination techniques;
7. demonstrate knowledge of the legal issues related to the drilling of any kind of well;
8. analyze the economics, including the risk factors, involved in resource exploration; and
9. demonstrate knowledge of the basics of refining and marketing of petroleum products.

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship
(experience, responsibilities and supervision):

A. Introduction to the course
   1. Prerequisites
   2. Purpose
   3. Textbook, etc.
   4. Overview
   5. Lab/lecture
   6. Homework
   7. Grading

B. Geology
   1. Subsurface characterization
      a. Well logs as windows to the subsurface
      b. Maps from well logs
         i. Correlation
         ii. Tie to the surface
   2. Structure
   3. Lithology
      a. Clastics
      b. Carbonates
      c. Others
   4. Porosity
   5. Water saturation
   6. Source
   7. Reservoir
   8. Trap
   9. Seal
   10. Migration and maturation

C. Geophysics
   1. Seismic prospecting
      a. Energy sources
      b. Reflection vs. refraction
      c. Acoustics
         i. Basic theory
         ii. Acoustic impedance
         iii. Relationship of bedding to reflections
      d. Travel times
      e. Recording
      f. Seismic sections
   2. Definition of structure
Prefix and Course Number: **GEL 2700**

3. Some indication of fluid contents  
   a. Some indication of fluid movements  
   b. Fluids do not transmit shear  
4. Ground penetrating radar and other shallow devices  

D. Drilling a well  
1. Legal aspects  
   a. Surface and mineral rights  
   b. Right to access  
   c. Problems with increasing urbanization  
      i. People do not understand legalities  
   d. Protecting the ground water  
      i. Casing a well  
      ii. Cementing a well  
2. The drilling prognosis  
3. Cable tools  
4. Rotary tools  
   a. Parts of a rig  
   b. The circulation system  
   c. Cuttings  
   d. Pressure control  
5. Completing a well  
   a. Dry holes  
   b. Producers  
   c. As a water well  

E. Economics of drilling a well  
1. Risk  
   a. One in ten  
   b. Arps-Roberts approach  
2. Time value of money  
3. Return on investment  
4. Rate of return  

F. Transportation  
1. Trucks  
2. Pipelines  

G. Refining  
1. Introduction to petroleum chemistry  
2. The role of hydrogen  
3. The process  

H. Review  

**Evaluation of Student Performance:**  
1. Examinations covering text, class materials, and assigned readings  
2. Homework assignments
REGULAR COURSE SYLLABUS

School of Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

Semester(s) Offered: Spring

Prefix & Course Number: GEL 2710

Course Title: Computer Applications in Earth Sciences

Credit Hours: 3 (2+2)

Contact Hours: Lecture 30  Lab 30  Internship _____  Practicum _____

Schedule Type(s): B  Grading Mode(s): L

Repeat* (Variable topics): _____

*(Pertinent only if the course can be repeated; enter maximum number of hours that can be earned by taking this course.)

Restrictions (Variable Topics Course): _____

Prerequisite(s): GEG 1220, GEL 1010, and CSS 1010 (or CMS 1010), or permission of instructor

Catalog Course Description: This course considers the theory behind contouring clustered subsurface data with the computer and introduces several commonly used mapping and contouring programs. In addition, there is discussion of well log analysis and using borehole data to produce both columnar stratigraphic sections and subsurface cross sections.

Required Reading and Other Materials will be equivalent to (Title, Author, Publisher, Copyright Date):

Supplemental materials to be provided by instructor, including handouts relative to methods and procedures and articles from relevant sources.

Specific (Measurable) Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. discuss the various types of earth science data types;
2. understand how to obtain data from various sources;
3. explain the basic requirements for computer mapping of earth science data;
4. discuss selection of suitable contour mapping algorithms;
5. prepare graphic image files for use in presentations;
6. discuss the basic concept of borehole logging;
7. interpret simple borehole log types;
8. build cross sections from surface and subsurface data with the computer;
9. capture digital images in several ways; and
10. build a multi-source digital presentation on screen and as hard copy.

APPROVED:

Department Chair/Institute Director  

Dean  

Associate VP, Academic Affairs

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: GEL 2710

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision):

A. Introduction to the course
   1. Prerequisites
   2. Purpose
   3. Textbook, etc.
   4. Overview
   5. Lab/lecture
   6. Homework
   7. Grading

B. Introduction to the computer lab
   1. Operating system
   2. Programs
   3. Usernames and passwords
   4. Hours
   5. Care of the equipment
   6. Usage rules

C. Data basics
   1. Data types
      a. Location data
      b. Grid data
      c. Point data
   2. Data organization
      a. Flat
      b. Hierarchical
      c. Network
      d. Relational
         i. Spatial
         ii. Topological

D. Location data
   1. Latitude and longitude
   2. Spheroids
   3. Projections
      a. Mercator
      b. Conic
      c. Others.
   4. Datum Changes
      a. NAD 27
      b. NAD 83
   5. Definition of X, Y, and Z
      a. Cautions
         i. Non linear, non rectangular data
   6. Organization of location data for mapping with the computer
   7. Preparation of base maps
      a. Township and range data
Prefix and Course Number: GEL 2710

b. Digital line graphs
   i. Scales
   ii. Detail

E. Contouring with the computer
   1. Type of contour maps
      a. Topographic
      b. Structure
      c. Isopach
      d. Others
   2. Triangulation
      a. Dulaney triangles
   3. Gridding
      a. Algorithms
      b. Distance weighting
      c. Sector searches
      d. Kriging
         i. Geostatistics
   4. Contour smoothing and when to use it
      a. Bicubic splines and other curve fitting methods

F. Preparation of graphic map files on the computer
   1. Types of graphic image files
      a. Color depth
      b. Sizes
      c. Transferability
   2. Bit maps
      a. Digital elevation models
      b. Photographs
      c. Other image files
      d. Generated from data
         i. Surfer
      e. Combining maps
   3. Compression
      a. Lossless and lossy
      b. When to use it

G. Borehole logging
   1. Application to geologic and environmental work
   2. Concept of subsurface interpretation
      a. Correlation to the surface
   3. Tools and tool responses
   4. Interpretation of tool responses
   5. Preparation of log data files
   6. Presentation of log data files

H. Preparation of Cross sections
   1. Using outcrop descriptions
   2. Using subsurface logs
3. Fence diagrams
4. Simple 3D volumes

I. Digital image capture
1. Screen images
   a. Screen capture
   b. Capture off the web
2. Digital cameras
   a. Resolution
   b. File types
3. Scanning
   a. Color/black and white
   b. Grey scale vs. pure black and white
   c. Resolution
   d. Enlargement/reduction
   e. Suitable file types

J. Geographic Information Systems
1. Purpose and applicability
2. Using GIS data in geologic presentations

K. Preparation of combined illustrations
1. Image files and text
   a. Files sizing
2. PowerPoint for geologic presentations on screen
3. Layout programs
   a. Word processors
   b. Page layout programs
4. Output
   a. Printers
   b. Plotters
      i. Paper sizes
      ii. Resolution
      iii. Memory
      iv. Speed of plotting
5. Service bureaus
   a. File types commonly accepted
   b. Output sizes and costs
   c. Lamination
6. Suitable presentation formats
   a. In school
   b. In business
   c. For professional presentations

L. Review

Evaluation of Student Performance:
1. Examinations covering text, class materials, and assigned readings 60%
2. Laboratory exercises 30%
3. Homework assignments 10%
REGULAR COURSE SYLLABUS

Prefix & Course Number: GEL3050  Crosslisted With*: N/A

Course Title: Introduction to Mineralogy and Optical Mineralogy

Check All That Apply:  Required for Major: _____  Required for Minor: X  Specified Elective: _____
Required for Concentration: X  Elective: X  Service Course: _____

Credit Hours:  4 (3+2)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 45  Lab 30  Internship _____  Practicum _____  Other (please specify type and hours): _____

Schedule Type(s): L  Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned**): N/A

** NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): GEL1010, CHE1800

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:

Prerequisite(s): GEL1010, CHE1800
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description:

This course examines common minerals, their origin, associations within rocks, their basic geochemistry and identification. It includes a discourse in crystallography, as well as methodologies of identification utilizing practical laboratory and field techniques such as hand specimens analysis, chemical methods, X-ray crystallography, and the use of optical microscopy. A field trip is required.

Approved:

Department Chair OR Program Director  Date

Dean OR Associate Dean  Date

Associate VP, Academic Affairs  Date
Required Reading and Other Materials will be equivalent to:

*Mineral / Chemical & ID Kit PLUS previous mineral ID kit from GEL1010

Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to (format: 1, a, i, ii, etc.):

1. Distinguish between mineral specimens using a variety of physical & chemical techniques
2. Collect data by using the XRD as an identification tool;
3. Interpret crystal classes and systems, as well as basic mineral chemistry;
4. Construct thin sections for rock & mineral identification;
5. Apply Bowen’s reaction series to field work;
6. Evaluate thin sections using optical microscopy techniques in order to identify minerals
7. Formulate diageneric processes of mineral formation from thin section observations and in hand sample

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision) (format: I, A, 1, a, etc.):

I. Basic Crystallography
   A. Miller indices
   B. Crystal classes
   C. Physics of crystal growth
   D. Steno’s Law

II. Geochemistry & Minerals
    A. Solid solution series
    B. Mineral groupings according to geochemistry
    C. Bowen’s Reaction series
    D. Solidus and liquidus

III. Physical & Chemical Methods for Mineral Identification
    A. Cleavage
    B. Mohs hardness
    C. Specific gravity
       1. Scales
       2. Pycnometer
    D. Streak
    E. Other physical tests (e.g. fluorescence, magnetism, radioactivity)
    F. Chemical Testing
       1. Solubility
       2. Flame
       3. Fusibility
       4. Microchemical test

IV. XRD & mineral identification
    A. Sample preparation
    B. Physics of x-ray diffraction
    C. Constructive interference
    D. Calculating d-spacings

V. Petrographic Microscopy & Thinsections
    A. Physics of light
    B. Refractory indices
    C. Snell’s law
    D. Critical angle
F. Use and care of the petrographic microscope
G. Optical microscopy techniques and skills

VI. Igneous and metamorphic mineral associations
   A. Common mineral assemblages for igneous rocks
      1. Felsic
      2. Intermediate
      3. Mafic
   B. Common minerals in metamorphic systems
      1. Minerals as P/T indicators
      2. High and low metamorphic minerals

**Evaluation of Student Performance** (format: 1, a, i, ii, etc.):

1. A minimum of two examinations with applied hands-on laboratory components requiring data acquisition, interpretation, and/or correlation
2. One or more traditional examinations (e.g. essay, multiple choice, etc.) and/or quizzes probing the foundational knowledge in the discipline
3. At least three laboratory exercises designed to evaluate correct application of the scientific method by using appropriate technologies, correctly interpreting data and/or validating analytical results
4. A minimum of one major course project and/or paper requiring to draw accurate conclusions by applying foundational knowledge to acquired and verified data using the appropriate methods
5. Additional evaluations may include one or more of the following:
   a. Active participation in the course
   b. Use of simulations or models
   c. Evaluations specific to course field trip(s)
   d. Extracurricular activities
   e. Oral evaluations (one-on-one, group, and/or peer)
   f. Evaluation of power point or poster sessions
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences
Department: Earth and Atmospheric Sciences
Prefix & Course Number: GEL 3060  Crosslisted With*: ___
Course Title: Stratigraphy and Structure
Banner course title (30 characters): Stratigraphy and Structure
Check All That Apply: Required for Major: ___ Required for Minor: X Specified Elective: ___ Required for Concentration: ___ Elective: ___ Service Course: ___

To receive Title IV financial aid funds, all institutions of higher education must comply with the federal definition of a credit hour. The Higher Learning Commission requires institutions to maintain policies and procedures for verifying compliance with this definition.

**Federal Credit Hour Definition:** A credit hour is an amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally-established equivalency that reasonably approximates not less than:

1. one hour of classroom or direct faculty instruction and a minimum of two hours of out-of-class student work each week for approximately fifteen weeks for one semester or trimester hour of credit, or ten to twelve weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time; or
2. at least an equivalent amount of work as required in paragraph (1) of this definition for other activities as established by an institution, including laboratory work, internships, practica, studio work, and other academic work leading toward the award of credit hours. 34CFR 600.2 (11/1/2010)

Credit Hours: 4 (3 + 2)

Face-to-Face or Equivalent Hours per course:
- Lecture: 45  Lab: 30  Internship: ___  Practicum: ___  Other (please specify type and hours): ___

Additional Student Work Hours per course: ___

Schedule Type: L  Grade Mode: L
Variable topics umbrella course: No ___ Yes ___  If Yes, number of credit hours allowed ___

Specified repeatable course: No ___ Yes ___

APPROVED:  

[Signature]
Date  9/26/13

[Signature]
Date  11/2/13

[Signature]
Date  12/6/13

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: GEL 3060

Prerequisite(s): GEL 1010, GEL 3050, and (MTH 1120 or MTH 1400)
Corequisite(s): __________
Prerequisite(s) or Corequisite(s): ______

Banner Enforced:
Prerequisite(s): GEL 1010, GEL 3050, and (MTH 1120 or MTH 1400)
Corequisite(s): ______
Prerequisite(s) or Corequisite(s): ______

Registration restrictions: Level ______ Class ______ Program/Major ______ Student attribute ______

Catalog Course Description:

This course analyzes vertical and horizontal stratigraphic and structural relationships within the Earth's crust. The stratigraphic portion of the course emphasizes transgressive and regressive sequences and unconformity boundaries (sequence stratigraphy) while the structural portion emphasizes three-dimensional relationships found in folded and faulted rocks. Field trips are required.

Specific Variable Topics Course Description (if applicable, umbrella course description included above):

Required Reading and Other Materials will be equivalent to:
Readings will be provided by the instructor

Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to

Upon completion of this course the student should be able to:
1. examine and evaluate the basis for development of the stratigraphic column;
2. assess and debate the stratigraphic code;
3. perform stratigraphic outcrop procedures in the field, from practice;
4. practice the principles and classification techniques of stratigraphic paleontology;
5. analyze both lateral and vertical relationships among lithosomes;
6. examine subsurface stratigraphic data;
7. synthesize facies models;
8. correlate laterally and vertically using lithostratigraphic, biostratigraphic, and timestратigraphic units;
9. prepare stratigraphic maps;
10. conduct a stratigraphic analysis of a specific region/time;
11. analyze structures formed in layered rocks and illustrate by making sequential diagrams;
12. analyze the internal and external features which indicate rock deformation;
13. examine geologic/topographic maps and debate what events have probably transpired;
14. analyze the consequences of the applications of stress under specified conditions to various types of rocks;
15. determine proper stratigraphic succession in deformed rocks if suitable structures are present;
16. analyze and debate with others what relationships exist between orographic features of the earth and their internal construction;
17. examine seismic phenomena;
18. examine the relationships between varieties of igneous phenomena and diastrophism;
19. give specific examples to illustrate 14, 15, and 18 above;
20. solve structural problems using graphic, trigonometric, and stereonet techniques;
21. set up field procedures for structural problems;
22. appraise field relationships between stress vectors and fold and fault patterns; and
23. use Brunton compass to assemble structural data onto topographic map.
Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision)

I. The Stratigraphic Column
   A. Stratigraphic classifications
   B. Stratigraphic Commission
II. Stratigraphic Procedures
    A. Outcrop
    B. Subsurface
III. Stratigraphic Paleontology
     A. Distribution of organisms in space and time
     B. Classifications
IV. Stratigraphic Relationships
    A. Vertical relationships among lithosomes
    B. Lateral relationships among lithosomes
    C. Sedimentary facies
V. Principles of Correlation
   A. Lithostratigraphic units
   B. Biostratigraphic units
   C. Time-stratigraphic units
VI. Stratigraphic Maps
VII. Stratigraphic Analysis
VIII. Principles of Structural Geology
    A. Concepts of stress and strain
    B. Theory of rock failure
    C. Behavior of materials
    D. Folds and faults
    E. Internal deformation
IX. Problem Solving Techniques in Structural Geology
    A. Graphic solutions
    B. Trigonometric solutions
    C. Stereonet solutions
X. Field Sessions
   A. Use of Brunton compass to collect structural data
   B. Use of topographic map as a base map

Evaluation of Student Performance

Projects
Quizzes
Laboratory Exercises
Exams
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

Prefix & Course Number: GEL 3120  Crosslisted With*:

Course Title: Geomorphology

Banner course title (30 characters): Geomorphology

Check All That Apply:  Required for Major:  Required for Minor:  Specified Elective: x

Required for Concentration:  x  Elective:  x  Service Course:  

To receive Title IV financial aid funds, all institutions of higher education must comply with the federal definition of a credit hour. The Higher Learning Commission requires institutions to maintain policies and procedures for verifying compliance with this definition.

Federal Credit Hour Definition: A credit hour is an amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally-established equivalency that reasonably approximates not less than:
(1) one hour of classroom or direct faculty instruction and a minimum of two hours of out-of-class student work each week for approximately fifteen weeks for one semester or trimester hour of credit, or ten to twelve weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time; or (2) at least an equivalent amount of work as required in paragraph (1) of this definition for other activities as established by an institution, including laboratory work, internships, practica, studio work, and other academic work leading toward the award of credit hours. 34CFR 600.2 (11/1/2010)

Credit Hours: 4 (3 + 2)

Face-to-Face or Equivalent Hours per course:

Lecture 45  Lab 30  Internship  Practicum  Other (please specify type and hours):

Additional Student Work Hours per course:  

Schedule Type:  L  Grade Mode:  L

Variable topics umbrella course:  No  Yes  x  If Yes, number of credit hours allowed  

Specified repeatable course:  No  Yes  

APPROVED:

Jason 9/26/13

Debra 11/5/13

Becky 6/6/13

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: GEL 3120

Prerequisite(s): GEL 1010 or GEG 1100
Corequisite(s): __
Prerequisite(s) or Corequisite(s): __

Banner Enforced:
- Prerequisite(s): GEL 1010 or GEG 1100
- Corequisite(s): __
- Prerequisite(s) or Corequisite(s): __

Registration restrictions: Level ___ Class ___ Program/Major ___ Student attribute ___

Catalog Course Description:
This course is a detailed analysis of the Earth’s landforms, including their origins and sequential changes because of internal and surficial processes. Maps and aerial photographs are extensively used for geomorphic interpretations. Field trips are required.

Specific Variable Topics Course Description (if applicable, umbrella course description included above):

Required Reading and Other Materials will be equivalent to:


Specific, *Measurable* Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. use topographic and geologic maps and aerial photographs for the interpretation of geomorphic processes and products;
2. interpret geomorphic processes and products from field observations;
3. predict the behavior of geomorphic agents and processes under varying conditions;
4. relate rock types to landforms and to geomorphic cycles and/or stages of development;
5. compare soil and/or weathered products to landforms and to geomorphic cycles and/or stages of development;
6. relate geologic structures to landforms and to geomorphic cycles and/or stages of development;
7. analyze the relationship of climate to landforms and to geomorphic cycles and/or stages of development;
8. evaluate the significance of various geomorphic processes on land use; and
9. choose, prepare, and present a paper on some aspect of geomorphology.
Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision)

I. The Scope of Geomorphology
   II. Cenozoic Diastrophism and Constructional Processes
   III. Tectonic Landforms
   IV. Volcanoes
   V. Energy Flow in Geomorphic Systems
   VI. Rock Weathering
   VII. Karst
   VIII. Mass Wasting and Hillslope Evolution
   IX. Fluvial Erosion and Transport: River Channels
   X. Fluvial Deposition: Processes and Landforms
   XI. Structural Control of Fluvial Erosion
   XII. Landscape Evolution by Fluvial Processes
   XIII. Arid, Semiarid, and Savanna Landscapes
   XIV. Holocene Processes and Landforms
   XV. Periglacial Morphogenesis
   XVI. Glaciers as Morphogenetic Agents and Landforms
   XVII. Glacial Morphogenesis
   XVIII. Alternating Quaternary Morphogenetic Systems
   XIX. Shore-Zone Processes and Landforms
   XX. Explanatory Description of Coasts

Evaluation of Student Performance
   Exams
   Term Paper
   Presentation
   Projects
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0604

Prefix & Course Number: GEL 3150  Crosslisted With*: N/A

Course Title: Hydrogeology

Check All That Apply: Required for Major: X  Required for Minor:  Specified Elective: X

Required for Concentration: X  Elective: X  Service Course: ___

Credit Hours: 3 (2 + 2)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 30  Lab 30  Internship 0  Practicum 0  Other (please specify type and hours): 0

Schedule Type(s): L  Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): GEL 1010, MTH 1110 and MTH 1120 recommended

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:

Prerequisite(s): None

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course is a practical approach to the study of groundwater flow, with emphasis given to its chemistry, mode of migration, pollution, and relationship to the geologic environment. The course includes methods of exploration, well-log analysis, numerous laboratory exercises and field sampling. A field trip is required.

APPROVED:

[Signature]
Department Chair OR Program Director  Date 7/17/06

[Signature]
Dean OR Associate Dean  Date 3/16/07

[Signature]
Associate VP, Academic Affairs  Date
Prefix and Course Number: GEL 3150

Required Reading and Other Materials will be equivalent to:


Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. interpret the hydrologic cycle;
2. assess the various properties of water;
3. demonstrate a practical approach to the theory of groundwater flow in rocks and wells;
4. evaluate the methods of exploration for groundwater, including geologic and hydrologic;
5. select or choose drilling and testing equipment and monitoring procedures used for groundwater exploitation;
6. analyze geological and geophysical well logs; and
7. analyze the characteristics and occurrences of groundwater in
   a. metamorphic and igneous rocks
   b. volcanic rocks
   c. sedimentary rocks
   d. unconsolidated sediments
   e. regions of climatic extremes

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Water, an Overview
   II. Evaporation and Precipitation
   III. Runoff and Streamflow
   IV. Properties of Aquifers
   V. Principles of Ground-Water Flow
   VI. Soil Moisture and Ground-Water Recharge
   VII. Ground-Water Flow to Wells
   VIII. Regional Ground-Water Flow
   IX. Geology of Ground-Water Occurrence
   X. Water Chemistry
   XI. Water Quality and Ground-Water Contamination
   XII. Ground-Water Development and Management
   XIII. Field Methods

Evaluation of Student Performance:

1. 3 exams
2. Homework problems
3. Laboratory exercises
4. Term paper
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences
Department: Earth and Atmospheric Sciences
Prefix & Course Number: GEL 3420  Crosslisted With*: ______
Course Title: Soil Resources
Banner course title (30 characters): Soil Resources
Check All That Apply:  Required for Major: x  Required for Minor: _____ Specified Elective: x
Required for Concentration: x  Elective: x  Service Course: _____

To receive Title IV financial aid funds, all institutions of higher education must comply with the federal definition of a credit hour. The Higher Learning Commission requires institutions to maintain policies and procedures for verifying compliance with this definition.

**Federal Credit Hour Definition:** A credit hour is an amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally-established equivalency that reasonably approximates not less than:

1. one hour of classroom or direct faculty instruction and a minimum of two hours of out-of-class student work each week for approximately fifteen weeks for one semester or trimester hour of credit, or ten to twelve weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time; or
2. at least an equivalent amount of work as required in paragraph (1) of this definition for other activities as established by an institution, including laboratory work, internships, practica, studio work, and other academic work leading toward the award of credit hours. 34CFR 600.2 (11/1/2010)

Credit Hours: 4 (3 + 2)

Face-to-Face or Equivalent Hours per course:

Lecture 45  Lab 30  Internship ______  Practicum ______  Other (please specify type and hours): ______

Additional Student Work Hours per course: ______

Schedule Type: L  Grade Mode: ______

Variable topics umbrella course: No ______ Yes ______ If Yes, number of credit hours allowed ______

Specified repeatable course: No ______ Yes ______

APPROVED:  

[Signature]  9/26/13

Department Chair OR Program Director

[Signature]  01/06/14

Dean OR Associate Dean

[Signature]  01/06/14

Associate VP, Academic and Student Affairs

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: GEL 3420

Prerequisite(s): ENV 1200 and completion of General Studies
Corequisite(s): ___
Prerequisite(s) or Corequisite(s): ___

Banner Enforced:
Prerequisite(s): ENV 1200 and completion of General Studies
Corequisite(s): ___
Prerequisite(s) or Corequisite(s): ___

Registration restrictions: Level ___ Class ___ Program/Major ___ Student attribute ___

Catalog Course Description:
This course analyzes the materials and processes that combine to produce various soil types. Soil types are examined in relationship to climate, landforms, vegetation, and geology, as well as in relationship to land-use patterns. Required field trips investigate soil mapping techniques.

Specific Variable Topics Course Description (if applicable, umbrella course description included above):

Required Reading and Other Materials will be equivalent to:

Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:

1. examine a soil sample and identify the inorganic components and, in a simple manner, the organic components;
2. analyze what conditions probably governed the formation of a selected soil sample, after examination;
3. assess why certain factors might, or might not, have been involved in the formation of various types of soils;
4. locate and examine on a map examples of major soil groups, such as (a) within climatic zones, where applicable, and (b) within specific regions of the world;
5. choose a soil survey report of the U.S. Department of Agriculture and utilize the map within to predict gross physical properties of the mapped soils;
6. examine surficial and bedrock geologic maps of a local area and analyze what possible soils might be found and make a correlation between the two map types;
7. operate test equipment in the laboratory and in the field to determine prescribed soil characteristics; and
8. portray the results of data collecting, examination, and synthesis in the form of maps and/or charts.
Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision)

I. Physical Aspects of Soil
   A. Soil texture and structure
   B. Permeability and hydraulic conductivity
   C. Color and temperature

II. Soil Water
   A. Soil-water movement
      1. Matrix-potential influence
      2. Gravitational-potential influence
      3. Osmotic-potential influence
   B. Soil-moisture regimes
   C. Soil-water management
   D. Irrigation

III. Soil Chemistry
   A. Cation-exchange capacity
   B. Soil pH
   C. Soil mineralogy
      1. Weathering of silicate minerals
      2. Clay mineralogy

IV. Soil Genesis
   A. Soil-formation factors
      1. Time
      2. Climate
      3. Biotic factor
      4. Parent material
      5. Topography
   B. Human impact of soils

Evaluation of Student Performance

Projects
Quizzes
Laboratory Exercises
Exams
School of: Letters, Arts and Sciences
Department: Earth and Atmospheric Sciences
CIP Code: 40.0601
Prefix & Course Number: GEL 3440 Crosslisted With*: N/A
Course Title: Energy and Mineral Resources
Check All That Apply: Required for Major: _____ Required for Minor: _____ Specified Elective: X
Required for Concentration: X Elective: X Service Course: ______
Credit Hours: 4 (3 + 2)
Total Contact Hours per semester (assuming 15-18 week semester):
Lecture 45 Lab 30 Internship 0 Practicum 0 Other (please specify type and hours): 0
Schedule Type(s): L Grading Mode(s): L
Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A
*NOTE: This information must be included in the course description.
Restrictions (Variable Topics Course): N/A
Prerequisite(s): ENV 1400 and GEL 3050, or permission of instructor
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None
Banner Enforced:
Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None
Catalog Course Description: This course investigates mineral resources and reserves that serve our industrial society. It includes a detailed examination of the origin, physical characteristics, and distribution of mineral resources, including metals and nonmetals, and energy resources, including fossil fuels and alternative energy resources. Field trips are required.

APPROVED:

[Signature]
Date 7/20/06

[Signature]
Date 3/6/07

[Signature]
Date 9/18/07

[Signature]
Date
Prefix and Course Number:  GEL 3440

Required Reading and Other Materials will be equivalent to:


Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:

1. analyze rock and mineral specimens and relate them to energy and mineral resources;
2. analyze the origin, mode of occurrence, and distribution of energy and mineral resources, including why given resources may or may not be generated under specific conditions;
3. predict the location/distribution of given resources, e.g., ore bodies and fossil fuels;
4. compare and contrast courses of action with respect to development and nondevelopment of major resources, including the environmental impact of energy and mineral exploitation;
5. utilize given source material to make economic evaluations of energy and mineral resources;
6. recognize that many energy and mineral resources are nonrenewable and evaluate what may be done to alleviate future shortages; and
7. choose, prepare, and present a paper on some aspect of energy and mineral resources.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Mineral Resources
   A. Our mineral resource crisis
   B. Factors controlling mineral availability
II. Origin of Mineral Deposits
    A. Geologic setting of mineral deposits
    B. Geologic characteristics of mineral deposits
    C. Ore-forming processes
III. Environmental Geochemistry and Mineral Resources
     A. Principles of Environmental Geochemistry
     B. Geochemical cycles and the dynamic nature of global reserves
     C. Assessing and remedying the environmental impact of pollution
IV. Mineral Exploration and Production
    A. Exploration success rates and expenditures
    B. Mineral exploration, personal investments, and you
    C. Mineral exploration methods
    D. Deposit evaluation
    E. Mineral extraction methods
    F. Processing of mineral resources
V. Mineral Economics
   A. Structure of the mineral industry
   B. Profits in the mineral industry
   C. Mineral commodity prices and mineral profits
   D. Mineral taxation and mineral profits
   E. Valuation of mineral deposits
VI. Energy Resources
    A. Fossil fuels
    B. Alternative energy resources
VII. Iron, Steel, and the Ferroalloy Metals
    A. Iron and steel
    B. Ferroalloy metals
VIII. Nonferrous Metals
    A. Light metals
    B. Base metals
    C. Chemical and industrial metals
IX. Precious Metals and Gems
    A. Gold
    B. Silver
C. Platinum-group elements
D. Gems

X. Fertilizer and Chemical Industrial Minerals
   A. Limestone, dolomite, and lime
   B. Phosphate
   C. Salt
   D. Potash
   E. Sulfur
   F. Nitrogen compounds and nitrate
   G. Other agricultural and chemical minerals

XI. Construction and Manufacturing Industrial Minerals
   A. Construction minerals
   B. Fillers, extenders, pigments, and fillers
   C. Glass raw materials
   D. Abrasive and refractory minerals

XII. Global Mineral Reserves and Resources
    A. Reserve and resource estimation methods
    B. Factors that affect the adequacy of world reserves
    C. World reserves and the challenge for the future

Evaluation of Student Performance:

1. Examinations, including laboratory problems
2. Term paper and presentation
3. Class participation
4. Any projects, presentations, or exercises required by the instructor
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 3510 Crosslisted With*: N/A

Course Title: Advanced Geology of Red Rocks Park and Vicinity

Check All That Apply: Required for Major: _____ Required for Minor: _____ Specified Elective: X

Required for Concentration: _____ Elective: X Service Course: _____

Credit Hours: 1 (1 + 0)

Total Contact Hours per semester (assuming 15-16 week semester):

  Lecture 15 Lab 0 Internship 0 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): Nine hours of geography or geology or permission of instructor

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:
  Prerequisite(s): None
  Corequisite(s): None
  Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course requires an analytical approach to the geology of Red Rocks Park and vicinity, including rocks formed over a period of approximately two billion years. The geologic history includes Colorado's famous "disappearing" mountain range (the Ancestral Rocky mountains), evidence of ancient oceans and deserts, dinosaur bones and tracks and the uplift of the modern-day Rocky Mountains. Note: Students cannot take both GEL 1510 and GEL 3510 for credit. (General Studies - Level II, Natural Science).

APPROVED:

[Signature]

Department Chair OR Program Director Date 7/20/06

[Signature]

Dean OR Associate Dean Date 9/18/07

[Signature]

Associate VP, Academic Affairs Date
Prefix and Course Number: GEL 3510

Required Reading and Other Materials will be equivalent to:


Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:

1. analyze rock types of selected rock exposures in order to interpret depositional environments;
2. interpret regional geologic history on the basis of rock types and sedimentary structures;
3. relate formations and rock types to economic products;
4. analyze the significance of geologic processes on rocks and landforms; and
5. set up and solve a geologic problem, and communicate the results in the form of a geologic report.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Classroom lecture
   A. General course objectives
   B. Basic geologic principles and concepts
      1. Geologic time
      2. Rock types
      3. Principles of uniformitarianism, original horizontality, and superposition
      4. Depositional environments (how rocks were formed)
      5. Sedimentary structures
      6. Formations
      7. Transgressions and regressions (sea-level changes)
   C. Presentation of subsequent events
   D. Logistics

II. Field lectures (observations and recording of data)
   A. Exposed Formations
      1. Geologic age
      2. Rock type(s)
      3. Depositional environments
      4. Economic products
   B. Regional geologic history
      1. Pre-Laramide events
      2. Laramide events
      3. Post-Laramide events

III. Course requirements
   A. Field-trip exam
   B. Geologic report, including a comprehensive bibliography

Evaluation of Student Performance:

1. Class attendance and participation
2. Final exam and summary field-trip report.
GENERAL STUDIES, SENIOR EXPERIENCE AND MULTICULTURAL PROPOSAL FORM

(To accompany old and new regular syllabus form and Curriculum Change Proposal forms)

Date: March 29, 1999

School: Letters, Arts and Sciences
Department: Earth and Atmospheric Sciences

Prefix Course Credit Hours Contact CIP Number
Number Hours Hours

GEL 35 10 1 (1 + 0) 15 40.0601

Title: Advanced Geology of Red Rocks Park and Vicinity (1 + 0)

Prerequisites: Nine hours of Geography or Geology, or permission of the instructor

Corequisites: None

Anticipated number of sections per semester: 1
Recommended maximum enrollment per section: 7*

*Note: GEL 3510 is taught simultaneously with GEL 1510.

Current Course Status

New course [It has been taught as GEL 390A, an Advanced Topics in Geology course, numerous times.]

Proposed General Studies Designation

Level: II
Category: Natural Science

Proposed Senior Experience Designation

Not Applicable

Proposed Multicultural Designation

Not Applicable
This course, taught numerous times as GEL 390A, Advanced Geology of Red Rocks Park and Vicinity, an Advanced Topics in Geology course, gives our students the opportunity to experience geology in the Earth's most appropriate classroom, the field. Students use their prior knowledge about geologic concepts, laws, and processes to analyze the formations exposed in the study area, including their ages, rock types, origins, and economic products. They are required to set up and solve a geologic problem using their ability to analyze data collected in the field. This field-lecture course is an important continuation/extension of their geologic education. It will give them a glimpse of what geologists can do with, and how they can interpret, information obtained in the field.

This course examines the geology and geologic history west of Denver along the Front Range in the vicinity of Red Rocks Park. By observing and interpreting minerals and rock types, sedimentary structures, and structural geology, students are able to analyze what has happened to much of Colorado over the past 2 billion years of geologic time.

Further, the inclusion of this course in General Studies, Level II, Natural Science, will give students the option of a one-credit, upper-division course to complete their required six credit hours of Natural Science, an option that does not currently exist.

Criteria for General Studies--Level II, Natural Science courses:

1. This course utilizes fundamental geologic knowledge and basic methods in the analysis of minerals and rocks, depositional environments, structural geology, and the geologic history of Colorado with special emphasis on the geologic history along the Front Range from Boulder to Colorado Springs.

2. This course applies basic concepts related to the formation of rocks and minerals, geologic time, and uniformitarianism, the principles of stratigraphy and structural geology, as well as the theories of original horizontality, superposition, and plate tectonics.

3. The science of geology is multidisciplinary in nature. The understanding of basic chemistry is fundamental to our knowledge of the formation of minerals, and hence the formation of rocks, as well as the weathering of rocks and minerals to form solutions and sediments that are eventually deposited as sedimentary rocks. The structure of the earth's interior is based on wave motion (physics), while the interpretation of shallow structures requires knowledge of trigonometry. Uniformitarianism assumes uniformity of the laws of physics through geologic time.

4. Technological change has heightened everyone's awareness of our dependence on natural resources and the need for proper management of geological systems. The application of computers to the generation of maps, diagrams, and reports is making a significant impact on the preparation of written assignments.

5. Because stress on geological resources is increasing, ethical concerns regarding their use and exploitation along the Front Range are addressed. The protection of our environment is always emphasized.

6. This course will strengthen communication skills by use of written assignments and examination essay questions, as well as oral assignments presented in the field.
7. Critical and logical thinking are required to set up and solve a geologic problem, usually related to the stratigraphy and structural geology along the Front Range.
8. Students must be able to locate, organize, and evaluate course materials and field lectures in order to understand the geologic history of Colorado.
9. This course will strengthen quantitative skills, especially in the solving of stratigraphic and structural problems.
10. Students will differentiate between speculation, inference, belief, fact, evidence, generalization, theory, and law.
11. Students will interpret and apply the basic laws of geology, as well as formulate and test geologic hypotheses utilizing accurate field observations and measurements. They will recognize the limitations, the uncertainty and integrity, of the science of geology.
12. Students will be able to apply the geologic knowledge learned in this course to real-life situations, especially in the disciplines of stratigraphy and structural geology.

Approvals:

[Signatures and dates]

Department Curriculum Committee/Date

[Signatures and dates]

Department Chair/Date

[Signatures and dates]

School Curriculum Committee/Date

[Signatures and dates]

Dean/Date

[Signatures and dates]

Chair, Faculty Senate Curriculum Committee/Date

[Signatures and dates]

Associate Vice President, Academic Affairs/Date
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 3520 Crosslisted With*: N/A

Course Title: Advanced Garden of the Gods—Front Range Geology

Check All That Apply: Required for Major: ____ Required for Minor: ____ Specified Elective: X

Required for Concentration: ____ Elective: X Service Course: ____

Credit Hours: 2 (2 + 0)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 30 Lab 0 Internship 0 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): None

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:

Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course requires an analytical approach to the geology along the Front Range from Boulder to Colorado Springs through rock exposures covering a span of approximately two billion years. Along with basic concepts of geology, the formations exposed along the Front Range, including their age, rock types, origins and economic products, are analyzed within a context of geologic history. Note: Students cannot take both GEL 1520 and GEL 3520 for credit. (General Studies - Level II, natural Science)

APPROVED:

[Signatures]

Department Chair OR Program Director

[Signature] Date

Dean OR Associate Dean

[Signature] Date

Associate VP, Academic Affairs

[Signature] Date
Prefix and Course Number: GEL 3520

Required Reading and Other Materials will be equivalent to:


Specific, *Measurable* Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:

1. analyze rock types of selected rock exposures in order to interpret depositional environments;
2. interpret regional geologic history on the basis of rock types and sedimentary structures;
3. relate formations and rock types to economic products;
4. analyze the significance of geologic processes on rocks and landforms; and
5. set up and solve a geologic problem, and communicate the results in the form of a geologic report.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Classroom lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      1. Geologic time
      2. Rock types
      3. Rock cycle and plate tectonics
      4. Principles of uniformitarianism, original horizontality, and superposition
      5. Depositional environments (how rocks were formed)
      6. Sedimentary structures
      7. Formations and facies
      8. Transgressions and regressions
   C. Logistics

II. Field lectures (observations and recordings)
   A. Exposed formations
      1. Geologic age
      2. Rock type(s)
      3. Depositional environments
      4. Economic products
   B. Regional geologic history
      1. Pre-Laramide events
      2. Laramide events
      3. Post-Laramide events

III. Course requirements
   A. Field-trip exam
   B. Geologic report, including a comprehensive bibliography

Evaluation of Student Performance:

1. Class attendance and participation.
2. Final exam and geologic report.
GENERAL STUDIES, SENIOR EXPERIENCE AND MULTICULTURAL PROPOSAL FORM
(To accompany old and new regular syllabus form and Curriculum Change Proposal forms)

Date: March 29, 1999
School: Letters, Arts and Sciences
Department: Earth and Atmospheric Sciences

<table>
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<th>Prefix</th>
<th>Course Number</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
<th>CIP Number</th>
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<td>3520</td>
<td>2 (2 + 0)</td>
<td>30</td>
<td>40.0601</td>
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Title: Advanced Garden of the Gods-Front Range Geology (2 + 0)

Prerequisites: Nine hours of Geography or Geology, or permission of instructor

Corequisites: None

Anticipated number of sections per semester: 1
Recommended maximum enrollment per section: 7

*Note: GEL 3520 is taught simultaneously with GEL 1520.

Current Course Status
New course [It has been taught as GEL 390F, an Advanced Topics in Geology course, numerous times.]

Proposed General Studies Designation
Level: II
Category: Natural Science

Proposed Senior Experience Designation
Not Applicable

Proposed Multicultural Designation
Not Applicable
This course, taught numerous times as GEL 390F, Advanced Garden of the Gods-Front Range Geology, an Advanced Topics in Geology course, gives our students the opportunity to experience geology in the Earth's most appropriate classroom, the field. Students use their prior knowledge about geologic concepts, laws, and processes to analyze the formations exposed in the study area, including their ages, rock types, origins, and economic products. They are required to set up and solve a geologic problem using their ability to analyze data collected in the field. This field-lecture course is an important continuation/extension of their geologic education. It will give them a glimpse of what geologists can do with, and how they can interpret, information obtained in the field.

This course examines the geology and geologic history along the Front Range from Boulder to Colorado Springs. By observing and interpreting minerals and rock types, sedimentary structures, and structural geology, students are able to analyze what has happened to much of Colorado over the past 2 billion years of geologic time.

Further, the inclusion of this course in General Studies, Level II, Natural Science, will give students the option of a two-credit, upper-division course to complete their required six credit hours of Natural Science, an option that does not currently exist.

Criteria for General Studies--Level II, Natural Science courses:

1. This course utilizes fundamental geologic knowledge and basic methods in the analysis of minerals and rocks, depositional environments, structural geology, and the geologic history of Colorado with special emphasis on the geologic history along the Front Range from Boulder to Colorado Springs.
2. This course applies basic concepts related to the formation of rocks and minerals, geologic time, and uniformitarianism, the principles of stratigraphy and structural geology, as well as the theories of original horizontality, superposition, and plate tectonics.
3. The science of geology is multidisciplinary in nature. The understanding of basic chemistry is fundamental to our knowledge of the formation of minerals, and hence the formation of rocks, as well as the weathering of rocks and minerals to form solutions and sediments that are eventually deposited as sedimentary rocks. The structure of the earth's interior is based on wave motion (physics), while the interpretation of shallow structures requires knowledge of trigonometry. Uniformitarianism assumes uniformity of the laws of physics through geologic time.
4. Technological change has heightened everyone's awareness of our dependence on natural resources and the need for proper management of geological systems. The application of computers to the generation of maps, diagrams, and reports is making a significant impact on the preparation of written assignments.
5. Because stress on geological resources is increasing, ethical concerns regarding their use and exploitation along the Front Range are addressed. The protection of our environment is always emphasized.
6. This course will strengthen communication skills by use of written assignments and examination essay questions, as well as oral assignments presented in the field.
7. Critical and logical thinking are required to set up and solve a geologic problem, usually related to the stratigraphy and structural geology along the Front Range.

8. Students must be able to locate, organize, and evaluate course materials and field lectures in order to understand the geologic history of Colorado.

9. This course will strengthen quantitative skills, especially in the solving of stratigraphic and structural problems.

10. Students will differentiate between speculation, inference, belief, fact, evidence, generalization, theory, and law.

11. Students will interpret and apply the basic laws of geology, as well as formulate and test geologic hypotheses utilizing accurate field observations and measurements. They will recognize the limitations, the uncertainty and integrity, of the science of geology.

12. Students will be able to apply the geologic knowledge learned in this course to real-life situations, especially in the disciplines of stratigraphy and structural geology.

Approvals:

[Signatures and dates]

Department Curriculum Committee/Date

Department Chair/Date

School Curriculum Committee/Date

Dean/Date

Chair, Faculty Senate Curriculum Committee/Date

Associate Vice President, Academic Affairs/Date
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 3530  Crosslisted With*: N/A

Course Title: Advanced Geology of the Colorado Plateau

Check All That Apply:  Required for Major: _____  Required for Minor: _____  Specified Elective: X

Required for Concentration: _____  Elective: X  Service Course: _____

Credit Hours: 2 (2 + 0)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 30  Lab 0  Internship 0  Practicum 0  Other (please specify type and hours): 0

Schedule Type(s): L  Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): nine hours of geography or geology or permission of instructor; GEL 3510, GEL 3520, and/or GEL 3560 recommended

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:
Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course requires an analytical approach to the geology of the eastern Colorado Plateau, including the geology of the Colorado National Monument, Arches National Park, and Northern and Southern Canyonlands National Parks. Along with basic concepts of geology, the formations exposed in the eastern Colorado Plateau, including their ages, rock types and origins, are analyzed. Historical geology and geomorphology come to life in this beautiful, desolate, arid country. Students must be in good physical condition because strenuous hiking is involved, and students must have prior camping experience. Note: Students cannot take both GEG 1530 and GEL 3530 for credit.

APPROVED:

Department Chair OR Program Director

Dean OR Associate Dean

Associate VP, Academic Affairs
Prefix and Course Number: GEL 3530

Required Reading and Other Materials will be equivalent to:


Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. discuss the geology and geography of the Colorado Plateau;
2. interpret the stratigraphy and geologic history of the Colorado Plateau on the basis of rock types and sedimentary structures;
3. compare and contrast the stratigraphy and geologic history of the Colorado Plateau to that of the Colorado Front Range;
4. analyze the geomorphic features of the Colorado Plateau and describe the geologic processes responsible for them; and,
5. communicate this knowledge in the form of a geologic report.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Classroom lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      1. Geologic time
      2. Rock cycle and rock types, with emphasis on sedimentary rocks
      3. Principles of uniformitarianism, original horizontality, and superposition
      4. Tectonics, including orogenesis and epeirogenesis
      5. Depositional environments (how rocks were formed)
      6. Sedimentary structures
      7. Formations and geologic maps
   C. Regional geographic and geologic settings of Colorado Plateau
   D. Stratigraphic column of Colorado Plateau
   E. Logistics

II. Field lectures in Colorado Plateau (observations and recordings)
   A. Plateau formations
      1. Geologic age
      2. Rock type(s)
      3. Depositional environments
   B. Salt tectonics
      1. Anticlines
      2. Faulting and jointing
   C. Plateau geomorphic features and relationship to weathering and erosional processes
      1. Plateaus, mesas, buttes, pinnacles, cliffs, and canyons
      2. Arches and fills
      3. Needles
      4. Entrenched meanders
   D. Igneous activity of Colorado Plateau
   E. Regional geologic history of Colorado Plateau
      1. Pre-Laramide events
      2. Laramide events
      3. Post-Laramide events

II. Course requirements
   A. Field-trip exam
   B. Geologic report, including a comprehensive bibliography

Evaluation of Student Performance:

1. Class attendance and participation.
2. Final exam and geologic report.
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 3550 Crosslisted With*: N/A

Course Title: Advanced Geology of the Great Sand Dunes National Monument

Check All That Apply: Required for Major: ___ Required for Minor: ___ Specified Elective: X Required for Concentration: ___ Elective: X Service Course: ___

Credit Hours: 2 (2+0)

Total Contact Hours per semester (assuming 15-16 week semester):

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Lab</th>
<th>Internship</th>
<th>Practicum</th>
<th>Other (please specify type and hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Schedule Type(s): L   Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): Nine hours of Geography or Geology or permission of instructor

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:

<table>
<thead>
<tr>
<th>Prerequisite(s)</th>
<th>Corequisite(s)</th>
<th>Prerequisite(s) or Corequisite(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Catalog Course Description: This course analyzes the processes and landforms associated with the eolian (wind) and desert environments at the Great Sand Dunes National Monument, located in the San Luis Valley between the San Juan and Sangre de Cristo Mountains. Investigations of the dune fields allow students to identify various types of dunes, as well as damage related to desertification. The relationships of sand source areas, cross bedding, and transport directions are investigated. Note: Students cannot take both GEL 1550 and GEL 3550 for credit.

APPROVED:

Department Chair OR Program Director

Dean OR Associate Dean

Associate VP, Academic Affairs
Prefix and Course Number: GEL 3550

Required Reading and Other Materials will be equivalent to:

No Text.

Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:

1. interpret the igneous nature of Spanish Peaks Area and San Juan Mountains and the igneous/metamorphic nature of Sangre de Cristo Mountains;
2. analyze the different types of sand dunes, including factors controlling their shapes;
3. analyze the processes responsible for sand transportation and deposition;
4. interpret the role of wind, streams, climate, and topography on the dune-field location;
5. evaluate the impact of sand-dune encroachment on vegetation (desertification);
6. interpret the source regions of the sands based on sand composition (San Juans vs. Sangre de Cristos) and sedimentary structures (ripple-mark characteristics and cross bedding);
7. evaluate alluvial fans and explain their origins; and
8. set up and solve a geologic problem, communicating the results in the form of a geologic report.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Classroom lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      1. Geologic time
      2. Rock types, emphasizing igneous (volcanics and intrusives) and metamorphic rocks and processes
      3. Rock cycle and plate tectonics
      4. Eolian and desert processes
      5. Eolian landforms, including dune types and sedimentary structures
      6. Fluvial landforms, emphasizing alluvial fans
   C. Logistics
II. Field lectures (observations and recordings)
   A. Regional geology
      1. San Juan Mountains
      2. Sangre de Cristo Mountains
      3. San Luis Valley
   B. Sand dunes
      1. Types of dunes
      2. Factors controlling dunes, including wind direction, sand supply, and vegetation
      3. Sand transport and deposition
      4. Role of stream activity
      5. Sand origin (source regions)
   C. Alluvial fans
      1. Landform and origin
III. Course requirements
   A. Field-trip exam
   B. Geologic report, including a comprehensive bibliography

Evaluation of Student Performance:

Class attendance and participation.
Final exam and geologic report.
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 3560  Crosslisted With*: N/A

Course Title: Advanced Canoeing the Canyon Country

Check All That Apply: Required for Major:       Required for Minor:       Specified Elective: X
Required for Concentration:    Elective: X  Service Course:  

Credit Hours: 2 (2 + 0)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 30  Lab 0  Internship 0  Practicum 0  Other (please specify type and hours): 0

Schedule Type(s): L  Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): Nine hours of Geography or Geology, or permission of instructor; GEL 3510, GEL 3520, and/or GEL 3530 recommended.

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:
Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course requires and analytical approach to the spectacular geology along a 32-mile stretch of the Colorado River between Fruita, Colorado and Westwater, Utah. Along with basic concepts of geology, the formations exposed in this portion of the eastern Colorado Plateau, including their ages, rock types and origins, are analyzed. Historical geology and geomorphology come to life in this geologic wonderland. Note: Students cannot take both GEL 1560 and GEL 3560 for credit.

APPROVED:

[Signature]

Date 2/13/06

Department Chair OR Program Director

[Signature]

Date 3/6/07

Dean OR Associate Dean

[Signature]

Date 9/18/07

Associate VP, Academic Affairs
Prefix and Course Number: GEL 3560

Required Reading and Other Materials will be equivalent to:

Chronic, H., Williams, F. (2002). Roadside Geology of Colorado. Missoula, MT: Mountain Press Publishing Company. Students will be given a detailed field guide and additional course materials developed by the instructor.

Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. discuss the geology and geography of Western Colorado (northeastern Colorado Plateau);
2. on the basis of rock types and sedimentary structures, interpret the stratigraphy and geologic history of Western Colorado;
3. compare and contrast the stratigraphy and geologic history of Western Colorado to that of the Colorado Front Range;
4. analyze the geomorphic features of Western Colorado and interpret the geologic processes responsible for them, especially fluvial processes; and
5. communicate this knowledge in the form of a geologic report.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Classroom lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      1. Geologic time
      2. Rock cycle and rock types, with emphasis on sedimentary rocks
      3. Principles of uniformitarianism, original horizontality, and superposition
      4. Tectonics
      5. Depositional environments (how rocks were formed)
      6. Sedimentary structures
      7. Formations and geologic maps
   C. Regional geographic and geologic settings of Colorado
   D. Stratigraphic columns of Front Range and Western Colorado
   E. Logistics
II. Field lectures on Colorado River (observations and recordings)
   A. Fluvial processes
   B. Formations
      1. Geologic age
      2. Rock type(s)
      3. Depositional environments
   C. Tectonics
      1. Folding
      2. Faulting
   D. Geomorphic features and relationship to weathering and erosional processes
      1. Plateaus
      2. Cliffs
      3. Canyons
   E. Igneous and metamorphic activity of Western Colorado
   F. Regional geologic history of Western Colorado
      1. Pre-Laramide events
      2. Laramide events
      3. Post-Laramide events
III. Course requirements
   A. Field-trip exam
   B. Geologic report, including a comprehensive bibliography

Evaluation of Student Performance:

1. Class attendance and participation.
2. Final exam and geologic report.
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 3570

Crosslisted With*: N/A

Course Title: Advanced Geology of the Flattops Volcanic Wilderness Area

Check All That Apply: Required for Major: ____ Required for Minor: ____ Specified Elective: X

Required for Concentration: ____ Elective: X Service Course: ____

Credit Hours: 2 (2 + 0)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 30 Lab 0 Internship 0 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): Nine hours of Geography or Geology, or permission of instructor; GEL 3050 recommended

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:

Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course requires an analytical approach to the igneous processes and products of the Flattops Wilderness Area of northwestern Colorado. Students analyze the lava flows exposed in the area to determine their source area. The problems of mid-continent magma genesis and its relationship to plate tectonics are also explored. Note: Students cannot take both GEL 1570 and GEL 3850 for credit.

APPROVED:

Department Chair OR Program Director 7/20/06

Dean OR Associate Dean 3/16/07

Associate VP, Academic Affairs 9/18/07
Prefix and Course Number: GEL 3570

Required Reading and Other Materials will be equivalent to:

Students will be given a detailed field guide and additional course materials developed by the instructor. Topographic and geologic maps of the region.

Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. analyze the geologic structures and characteristics of the White River Plateau;
2. examine and analyze the volcanic morphology of the White River Uplift;
3. examine and analyze the glacial morphology of the White River Uplift;
4. create a reconnaissance geologic map of the volcanic features in the Wall Lake area;
5. collect and interpret geologic data using Brunton compass;
6. analyze volcanic and glacial landforms using a topographic map;
7. evaluate the human impact on the Flattops Wilderness Area;
8. determine the economic potential of the Flattops Wilderness Area; and
9. communicate this knowledge in the form of a geologic report.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Classroom Lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      1. Uniformitarianism
      2. Geologic time
      3. Plate tectonics
   C. Igneous processes and products
      1. Convergent zones and magma genesis
      2. Divergent zones and magma genesis
      3. Mid-Continent volcanism
      4. Igneous petrology
         a. Field identification techniques
         b. Vocabulary
   D. Trip logistics

II. Field Lectures and Exercises
   A. Regional geography
   B. Regional geology
      1. Previous work
      2. Uplift versus volcanism
   C. Pyroclastics and magmaphreatic eruptions
   D. Fissure eruptions and dike alignment
   E. Age relationships of eruptions near Wall Lake
   F. Glacial features and movement
      1. Striations
      2. Moraines

III. Course Requirements
   A. Field-trip exam
   B. Geologic report, including a comprehensive bibliography

Evaluation of Student Performance:

1. Class attendance and participation.
2. Final exam and geologic report.
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 3580 Crosslisted With*: N/A

Course Title: Advanced Geology of the Wheeler Geologic Area

Check All That Apply: Required for Major: ____ Required for Minor: ____ Specified Elective: X

Required for Concentration: ____ Elective: X Service Course: ____

Credit Hours: 2 (2 + 0)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 30 Lab 0 Internship 0 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): Nine hours of Geography or Geology, or permission of instructor; GEL 3050 recommended

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:

Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course requires an analytical approach to the igneous processes and products of the Wheeler Geologic Area of southwestern Colorado. Students analyze the pyroclastic deposits exposed in the area and determine the sequence of events. The problems of mid-continent magma genesis and its relationship to plate tectonics are also explored. Note: Students cannot take both GEL 1580 and GEL 3580 for credit.

APPROVED:

Department Chair OR Program Director

Dean OR Associate Dean

Associate VP, Academic Affairs

7/17/06

12/14/07

9/18/07
Prefix and Course Number:  GEL 3580

Required Reading and Other Materials will be equivalent to:

Students will be given a detailed field guide and additional course materials developed by the instructor. Topographic and geologic maps of the region.

Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. analyze the geologic structures and characteristics of the San Juan Volcanic Field;
2. examine and analyze the volcanic morphology of the San Juan Mountains;
3. create a reconnaissance geologic map of the volcanic features of the Wheeler area;
4. collect and interpret geologic data using a Brunton compass;
5. analyze volcanic landforms using a topographic map;
6. use appropriate pyroclastic terminology to describe the eruptive events at Wheeler;
7. relate the geologic history of the San Juan Mountains to mountain building in Colorado;
8. compare the effects of chemical and physical weathering on a vitric tuff; and
9. communicate this knowledge in the form of a geologic report.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Classroom Lectures
   A. General course objectives
   B. Basic geologic principles and concepts
      1. Uniformitarianism
      2. Geologic time
      3. Plate tectonics
   C. Igneous processes and products
      1. Convergent zones and magma genesis
      2. Divergent zones and magma genesis
      3. Mid-Continent volcanism
      4. Igneous petrology
         a. Field identification techniques
         b. Vocabulary
   D. Trip logistics
II. Field Lectures and Exercises
   A. Regional geography
   B. Regional geology
      1. Previous work
      2. Uplift versus volcanism
   C. Pyroclastics and magmaphreatic eruptions
   D. Water-pressure effects on magma behavior
   E. Devitrification processes
   F. Sequence of volcanic events
      1. Pre-eruption geologic setting
      2. Post-eruption modifications
   G. Effects of ignimbrite on the environment
III. Course Requirements
   A. Field-trip exam
   B. Geologic report, including a comprehensive bibliography

Evaluation of Student Performance:

1. Class attendance and participation.
2. Final exam and geologic report.
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 3590  Crosslisted With*: N/A

Course Title: Advanced Geology of Caves

Check All That Apply: Required for Major: _____ Required for Minor: _____ Specified Elective: X

Required for Concentration: _____ Elective: X Service Course: _____

Credit Hours: 1 (1 + 0)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 15 Lab 0 Internship 0 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): Nine hours of geography or geology or permission of instructor

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:

Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course requires an analytical approach to the origins of caves, including relationships to rock types, fracture systems, and groundwater chemistry, as well as the origin of and types of speleothems (cave formations). The course exposes students to the adventures of spelunking (caving). Note: Students cannot take both GEL 1590 and GEL 3590 for credit.

APPROVED:

[Signatures]

Department Chair OR Program Director

Date

Dean OR Associate Dean

Date

Associate VP, Academic Affairs

Date
Prefix and Course Number: GEL 3590

Required Reading and Other Materials will be equivalent to:


Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:

1. discuss the most basic concepts of geology;
2. compare the geology of different cave regions of the U.S.;
3. analyze the origin of caves, including relationships to rock types, fracture systems, and groundwater chemistry;
4. relate karst topography to caves;
5. relate temperature, relative humidity, and springs to the cave environment; and
6. compare the formation of and types of speleothems (cave formations).

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Introduction
   A. Caves as natural laboratories
   B. Cave regions of the U.S.

II. Origin of Caves
   A. Caves in limestone
   B. Influence of water
      1. Ground-water chemistry
      2. Ground-water table
   C. Influence of fractures
   D. Karst
   E. Caves not in limestone

III. Characteristics of Caves
   A. Cave temperature
   B. Relative humidity
   C. Barometric pressure changes
   D. Springs

IV. Speleothems (Cave Formations)
   A. Stalactites and related deposits
   B. Stalagmites and related deposits
   C. Other cave deposits

V. Spelunking Trips and Equipment

Evaluation of Student Performance:

1. Comprehensive examination covering course content (50%).
2. Research paper (50%).
REGULAR COURSE SYLLABUS

School of Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

Semester(s) Offered: Spring

Prefix & Course Number: GEL 3700 Crosslisted with*: ___

Course Title: Integrated Geotechnology

Credit Hours: 3 (2+2)

Contact Hours: Lecture 30 Lab 30 Internship ___ Practicum ___

Schedule Type(s): B Grading Mode(s): L

Repeat* (Variable topics): ___
*(Pertinent only if the course can be repeated; enter maximum number of hours that can be earned by taking this course.)

Restrictions (Variable Topics Course): ___

Prerequisite(s): GEL 2700 and GEL 2710, or permission of instructor

Catalog Course Description: This course is a continuation of GEL 2700, Introduction to Petroleum Technology, and it emphasizes the integration of the data and methods of petroleum geology and geophysics, land and leasing, and engineering. Students will receive practical experience in gathering and organizing disparate data sets, and in making basic interpretations in the form of reports, maps, and cross sections. The goal is for the student to gain basic understanding of the needs and responsibilities of the professionals that interact with geologists in a corporate and small-company environment.

Required Reading and Other Materials will be equivalent to (Title, Author, Publisher, Copyright Date):

Supplemental materials to be provided by instructor, including handouts on methods and procedures, as well as articles from relevant sources.

Specific (Measurable) Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. prepare basic reports used in petroleum geology and geophysics, land and leasing, and engineering work;
2. construct structure, isopach, and land maps used in petroleum geology and geophysics, land and leasing, and engineering work;
3. construct structural and stratigraphic cross sections used in petroleum geology and geophysics, land and leasing, and engineering work;
4. interpret structure and stratigraphy on seismic sections;

APPROVED: 

[Signatures]

Department Chair/Institute Director Date

Dean Date

Associate VP, Academic Affairs Date

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number:  GEL 3700

5. apply basic petroleum engineering methods; and
6. utilizing skills derived from GEL 2710, Computer Applications in Earth Sciences, to prepare and orally present a term project.

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision):

A. Introduction to Integrated Exploration and Production Companies
   1. The company environment
   2. The role(s) of the geological technician
   3. Interdisciplinary communication
   4. Time and budget restraints

B. Geophysical Interpretations
   1. Seismic theory
   2. Data sources and formats
   3. Synthetic seismograms
   4. Basic seismic interpretation of structure and stratigraphy

C. Land and Leasing
   1. How (and why) companies lease mineral rights
   2. Data sources and formats
   3. Lease take-off maps
   4. Integration with geological maps

D. Engineering Interpretations
   1. Fundamental engineering functions
   2. Data sources and formats
   3. Analyzing decline-curves
   4. Determining volumetric hydrocarbon-in-place
   5. Integrating geological and engineering data

Evaluation of Student Performance:
1. Examinations covering class materials and assigned readings  60%
2. Class participation  10%
3. Semester project and oral presentation  30%
REGULAR COURSE SYLLABUS

School of Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

Semester(s) Offered: Spring

Prefix & Course Number: GBL 3710 Crosslisted with: _____

Course Title: Earth Sciences Data Management

Credit Hours: 3 (2+2)

Contact Hours: Lecture 30 Lab 30 Internship _____ Practicum _____

Schedule Type(s): B Grading Mode(s): L

Repeat* (Variable topics): _____

*(Pertinent only if the course can be repeated; enter maximum number of hours that can be earned by taking this course.)

Restrictions (Variable Topics Course): _____

Prerequisite(s): GBL 2710 or permission of instructor

Catalog Course Description: This course defines the special nature of geological data and shows the various ways to produce databases for information management as well as for extracting mapping and other analysis data. The emphasis is on using commonly available computer data management programs.

Required Reading and Other Materials will be equivalent to (Title, Author, Publisher, Copyright Date):

Supplemental materials to be provided by instructor, including handouts related to methods and procedures and articles from relevant sources.

Specific (Measurable) Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to:
1. analyze and utilize different geologic data types;
2. determine when to use different kinds of data management;
3. appraise suitable data file organization;
4. create flat-file and relational databases with geologic data;
5. understand and discuss data normalization;
6. apply geologic data management in Microsoft Excel and Access;
7. demonstrate knowledge of sources for and be able to obtain geologic data on-line; and
8. prepare a data presentation.

APPROVED:

Department Chair/Institute Director

Date

Dean

Date

Associate VP, Academic Affairs

Date

*If crosslisted, attach completed Course Crosslisting Agreement Form
Prefix and Course Number: GEL 3710

Detailed Outline of Course Content (Major Topics and Subtopics) or Outline of Field Experience/Internship (experience, responsibilities and supervision):

A. Introduction to the course
   1. Prerequisites
   2. Purpose
   3. Textbook, etc.
   4. Overview
   5. Lab/lecture
   6. Homework
   7. Grading

B. Introduction to the computer lab
   1. Operating system
   2. Programs
   3. Usernames and passwords
   4. Hours
   5. Care of the equipment
   6. Usage rules

C. Data basics
   1. Data types
      a. Location data
         i. Grid data
         ii. Point data
   2. Data organization
      a. Flat files
      b. Hierarchical
      c. Network
      d. Relational
         i. Data tables
         ii. Spatial
         iii. Topological
         iv. One to many
   3. When to manage data on the computer
      a. For map and visualization files
      b. For very large data sets
      c. For interaction with colleagues and clients

D. Flat files
   1. Definition
   2. The accountant’s pad
   3. Intro to Microsoft Excel
      a. Organization
      b. Data entry
      c. Simple calculations
      d. Charts
      e. Special effects
   4. Single tables
   5. Rows and columns
      a. Records and fields
Prefix and Course Number: GEL 3710

6. Suitability to purpose
7. Searches and sorts
   a. Cautions
   b. Data handling routines in Excel
8. Data lookup tables
E. Relational databases
1. Theory
   a. Dr. Codd’s invention
   b. SQL
   c. QBE
2. Available programs
   a. Access
   b. Paradox
   c. Oracle
   d. DB2 and others
3. When to use a relational database
4. Introduction to Microsoft Access
   a. Setting up a database file
   b. Objects
      i. Tables
      ii. Queries
      iii. Forms
      iv. Reports
5. Tables
   a. Start with flat files
   b. Tables define depth of database
6. The concept of the key field
   a. How to define a relational key
      i. Sequential numbering
      ii. API numbers
      iii. Permit numbers
      iv. Others
7. Simple relationships
   a. Joins
   b. One to many
   c. Many to one
   d. Referential integrity
8. Normalization
   a. Levels 1 through 5
9. Searches, sorts
10. Queries
11. Reports
12. Cutting and pasting to other programs
13. Introduction to macro definition
Prefix and Course Number: GEL 3710

F. Introduction to Geographic Information Systems
   1. Purpose and applicability
   2. Data organization
      a. Spatial data
      b. The topologic database
   3. GIS data types
      a. Vector
      b. Raster
         i. Data compression

G. Sources of geologic data
   1. Government agencies
      a. USGS, USFS, etc
   2. The internet

H. Presenting geologic data
   1. Charts, forms and reports
   2. Using in a combined format
      a. Intro to the idea of computer cartography

I. Review

Evaluation of Student Performance:
1. Examinations covering text, class materials, and assigned readings 60%
2. Laboratory exercises 30%
3. Homework assignments 10%
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 3920 Crosslisted With*: N/A

Course Title: Directed Study in Geology

Check All That Apply: Required for Major: ____ Required for Minor: ____ Specified Elective: ______

Required for Concentration: ____ Elective: X Service Course: ______

Credit Hours: 2-6 (0 + 4-12)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 0 Lab 60-180 Internship 0 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): Fifteen hours in geology; approval of instructor and department chair

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:
Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course provides an opportunity for upper-division students with a strong background in geology to pursue study in a specific topic of interest and value. The course requires permission of the instructor and chair of the Earth and Atmospheric Sciences Department and frequent meetings between student and instructor.

APPROVED:

[Signature]
Department Chair OR Program Director Date 7/17/06

[Signature]
Dean OR Associate Dean Date 3/16/07

[Signature]
Associate VP, Academic Affairs Date 9/16/07
Prefix and Course Number:  GEL 3920

Required Reading and Other Materials will be equivalent to:

Necessary reading materials will depend upon topic chosen.

Specific, Measurable Student Behavioral Learning Objectives:

The learning objectives of the course are to give upper-division students in Geology an opportunity to pursue a specific topic in Geology to a greater depth of understanding. It allows the student to develop their specific field of interest. It encourages self-discipline and self-motivation. The student works independently to develop their resources which may include library, public agencies, field work, and others. The student meets regularly with instructor for conferences.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

Course content dependent upon topic chosen.

Evaluation of Student Performance:

Students will be evaluated on progress reports, paper(s), and/or project(s) dependent upon topic chosen.
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 4150  Crosslisted With*: N/A

Course Title: Hydrology

Check All That Apply: Required for Major: ___  Required for Minor: ___  Specified Elective: X

Required for Concentration: X  Elective: X  Service Course: ___

Credit Hours: 3 (2 + 2)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 30  Lab 30  Internship 0  Practicum 0  Other (please specify type and hours): 0

Schedule Type(s): L  Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): GEL 3150

Corequisite(s): N/A

Prerequisite(s) or Corequisite(s): N/A

Banner Enforced:

Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course examines surface and subsurface waters with respect to water flow, drainage systems, storage, pollution and environmental relationships. The hydrologic cycle is studied with respect to surface water distribution. This course uses knowledge gained from GEL 3150 (Hydrogeology) in practical applications.

APPROVED:

[Signature]

Department Chair OR Program Director  Date  7/17/06

[Signature]

Dean OR Associate Dean  Date  3/6/07

[Signature]

Associate VP, Academic Affairs  Date  9/16/07
Prefix and Course Number: GEL 4150

Required Reading and Other Materials will be equivalent to:
Topical articles and handouts provided by instructor.

Specific, Measurable Student Behavioral Learning Objectives:
Upon completion of this course the student should be able to:
1. analyze the hydrologic cycle and interpret the relationships between precipitation patterns and surface-water systems;
2. analyze and contrast the relationships between climate and evaporation and transpiration and available surface water;
3. evaluate the factors that affect surface stream flow;
4. analyze the relationships between surface water and ground water;
5. select and differentiate between forms of data available;
6. select forms of data collection, including instrumentation;
7. assess and utilize methods of analysis;
8. collect and utilize raw data to prepare hydrographs, frequency studies, and other types of charts and graphs; and
9. analyze these data to interpret surface-water patterns.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. The Hydrologic Cycle
II. Hydraulics of Ground-Water Flow
III. Flow Nets
IV. Ground-Water Contamination
V. Prediction of Solute Transport and Attenuation
VI. Ground-Water Cleanup
VII. Well Hydraulics
VIII. Analysis of Pumping-Test Data
IX. Precipitation
X. Streamflow
XI. Flood Analysis
XII. Flood Control
XIII. Water Chemistry
XIV. Water Law

Evaluation of Student Performance:
1. 3 exams
2. Term paper
REGULAR COURSE SYLLABUS

School of:  Letters, Arts and Sciences

Department:  Earth and Atmospheric Sciences

CIP Code:  40.0699

Prefix & Course Number:  GEL 4700  Crosslisted With*:  N/A

Course Title:  Subsurface Geology

Check All That Apply:  Required for Major:  ____  Required for Minor:  ____  Specified Elective:  ____

Required for Concentration:  ____  Elective:  X  Service Course:  ____

Credit Hours:  3  (3 + 0)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture  45  Lab  0  Internship  0  Practicum  0  Other (please specify type and hours):  0

Schedule Type(s):  R  Grading Mode(s):  L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*):  N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course):  N/A

Prerequisite(s):  GEL 3700 and GEL 3710, or permission of instructor

Corequisite(s):  None

Prerequisite(s) or Corequisite(s):  None

Banner Enforced:

Prerequisite(s):  None
Corequisite(s):  None
Prerequisite(s) or Corequisite(s):  None

Catalog Course Description: This course guides students through geological interpretation using field observations, well logs, samples, cores, seismic sections, and other indirect methods. The course then teaches the students how to present the interpretations in a meaningful way. Well log and analysis and subsurface mapping use computer methods where they are appropriate.

APPROVED:

Department Chair  OR  Program Director

Dean  OR  Associate Dean

Associate VP, Academic Affairs
Prefix and Course Number: GEL 4700

Required Reading and Other Materials will be equivalent to:

Applied Subsurface Mapping, Tearpock, D. J. and Bischke, R. E., Prntice Hall Publishing Company, 2001. Supplemental materials to be provided by instructor, including handouts related to methods and procedures and articles from relevant sources.

Specific, Measurable Student Behavioral Learning Objectives:

Upon completion of this course the student should be able to:
1. identify and apply the information available from outcrops;
2. recognize the differences between outcrop and subsurface data;
3. correlate and analyze basic well logs;
4. correlate from the outcrop to the subsurface, using well logs, samples, and cores, and vice versa;
5. construct well log cross sections;
6. construct and use different types of subsurface maps;
7. use data from well logs to construct subsurface maps;
8. recognize the value of geophysical and geochemical data; and
9. construct and present a subsurface data project.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

I. Introduction to the course
   A. Prerequisites
   B. Purpose
   C. Textbook, etc.
   D. Overview
   E. Lab/lecture
   F. Homework
   G. Grading

II. Geology
    A. Structure
       1. Strike and dip
       2. Apparent dip
       3. Folds and faults
       4. Fractures
       5. Stress direction analysis
    B. Lithologies
       1. Outcrops
       2. Well samples and cores
    C. Bedding
    D. Fossils
       1. Body
       2. Trace
       3. Environmental interpretation
    E. Stratigraphy
       1. Basic relationships
       2. Sequences
       3. Environmental interpretation

III. Well logs
    A. The curves
    B. Correlation curves
       1. Lithology
    C. Structural analysis
       2. Dip meters
       3. Borehole televewers
    D. Analysis curves
1. Resistivity
   a. Normal
   b. Lateral
2. Porosity
3. Radiation profile
E. Computer methods for well-log analysis

IV. Correlation to the outcrop
   A. Picking tops
   B. Correlations from well to well
   C. Cross sections
      1. Structural
      2. Stratigraphic
   D. Computer methods for building cross sections

V. Subsurface maps
   A. Structure
   B. Isopach
   C. Other iso-maps
   D. Computer mapping

VI. Other types of subsurface information
   A. Geophysics
   B. Geochemistry

VII. Building a presentation
   A. Types of images
   B. Combining logs, sections, and maps into a presentation

VIII. Review

Evaluation of Student Performance:

1. Examinations covering text, class materials, and assigned readings 60%
2. Laboratory exercises 20%
3. Homework assignments 20%
REGULAR COURSE SYLLABUS

School of: Letters, Arts and Sciences

Department: Earth and Atmospheric Sciences

CIP Code: 40.0601

Prefix & Course Number: GEL 4950 Crosslisted With*: N/A

Course Title: Internship in Geology

Check All That Apply: Required for Major: X Required for Minor: ____ Specified Elective: ____

Required for Concentration: ____ Elective: ____ Service Course: ____

Credit Hours: 2-15 (0 + 6-45)

Total Contact Hours per semester (assuming 15-16 week semester):

Lecture 0 Lab 0 Internship 90-675 Practicum 0 Other (please specify type and hours): 0

Schedule Type(s): L Grading Mode(s): L

Variable Topics Courses (list restrictions, including the maximum number of hours that can be earned*): N/A

*NOTE: This information must be included in the course description.

Restrictions (Variable Topics Course): N/A

Prerequisite(s): Land use major with geology emphasis with upper division standing plus 12 upper-division hours in geology and permission of the Chair of the Earth and Atmospheric Sciences Department.

Corequisite(s): None

Prerequisite(s) or Corequisite(s): None

Banner Enforced:
Prerequisite(s): None
Corequisite(s): None
Prerequisite(s) or Corequisite(s): None

Catalog Course Description: This course provides an on-the job internship experience with a geology-related company or agency. The experience must be done under qualified supervision and the auspices of an Earth and Atmospheric Sciences faculty member.

APPROVED:

[Signature]
Date 7/11/06

Department Chair OR Program Director

[Signature]
Date 3/16/07

Dean OR Associate Dean

[Signature]
Date 9/16/07

Associate VP, Academic Affairs Date
Prefix and Course Number: GEL 4950

Required Reading and Other Materials will be equivalent to:

None. Necessary reading materials will be provided by participating company or agency.

Specific, Measurable Student Behavioral Learning Objectives:

This course provides the opportunity for the student to correlate theoretical knowledge with actual practice, under the guidance of an experienced supervisor. Upon completion of this course the student should be able to:

1. to apply, test, and evaluate, under actual working conditions, knowledge gained in the classroom;
2. to acquire practical experience in preparation for employment or career development;
3. to develop an in-depth and broader understanding of decision-making processes in jobs requiring a geologic background; and
4. to develop confidence and a sense of one's own capabilities and needs in the workplace.

Detailed Outline of Course Content (Major Topics and Subtopics or Outline of Field Experience/Internship (experience, responsibilities and supervision)):

A specific job description and work schedule is developed for each placement and is on file in the Department of Earth and Atmospheric Sciences (EAS). A student is expected to work 45 hours for each hour of academic credit granted. On-the-job supervision and training is provided by the company or agency, with overall supervision provided by EAS faculty. The company or agency provides an evaluation of the student's work, which becomes the basis for the grade.

Evaluation of Student Performance:

Students are evaluated by progress reports and consultation with supervisor.