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Senate App 2/1/00

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CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

I. CONTACT

Contact Person Darlene Richardson/Karen Rose Cercone Phone x 2379

Department Geoscience

II. PROPOSAL TYPE (Check All Appropriate Lines)

COURSE GS 336 Northern Rockies, GS 337 Newfoundland, GS 338 American Southwest
Suggested 20 character title

New Course* _____
Course Number and Full Title

Course Revision GS 336 Geology of the Northern Rockies, GS 337 Geology of Newfoundland, GS 338 Geology of the American Southwest
Course Number and Full Title

Liberal Studies Approval + _____
for new or existing course Course Number and Full Title

Course Deletion _____
Course Number and Full Title

Number and/or Title Change _____
Old Number and/or Full Old Title

New Number and/or Full New Title

Course or Catalog Description Change _____
Course Number and Full Title

PROGRAM: Major Minor Track

New Program* _____
Program Name

Program Revision* _____
Program Name

Program Deletion* _____
Program Name

Title Change _____
Old Program Name

New Program Name

III. Approvals (signatures and date)

Darlene Richardson Department Curriculum Committee
John D. Ed College Curriculum Committee
John D. Ed College Dean
Cheryl Sadler + Director of Liberal Studies (where applicable)
John D. Ed Department Chair
John D. Ed College Dean
Mark St... *Provost (where applicable)

1. New syllabus of record

The “old” and “new” syllabi of record are the same with the exception of the change in prerequisite. The syllabi are found on the following pages.

2. Summary of proposed revision

We propose to change the prerequisite for three of our regional field trips (GS 336, 337, 338) from (current) prerequisite: Permission of instructor to (proposed) prerequisites: at least 14 sh of Geoscience courses and/or permission of instructor. By “and/or” we mean that students must have the permission of the instructor, but that the instructor may waive the 14 sh of Geoscience courses (e.g., a student may have only 11 sh of Geoscience courses).

a: From current catalog description:

GS 336 Geology of the Northern Rockies var-3sh

Prerequisite: Permission of instructor

A field study of the major geologic features and relationships involved in the development of the northern Rocky Mountains. National Park and Monument areas of South Dakota, Wyoming, and Montana are included among the areas investigated. (three weeks, summer only)

To proposed catalog description:

GS 336 Geology of the Northern Rockies var-3sh

Prerequisites: at least 14 sh of Geoscience courses and/or permission of instructor

A field study of the major geologic features and relationships involved in the development of the northern Rocky Mountains. National Park and Monument areas of South Dakota, Wyoming, and Montana are included among the areas investigated. (three weeks, summer only)

b: From current catalog description:

GS 337 Geology of Newfoundland (var-3sh)

Prerequisite: Permission of instructor

A field course designed to utilize the exceptional and diverse geologic features of Newfoundland for instruction of departmental majors and minors in tectonic analysis utilizing sedimentologic, stratigraphic, and paleontologic observations. (three weeks, summer only)

To proposed catalog description:

GS 337 Geology of Newfoundland (var-3sh)

Prerequisite: at least 14 sh of Geoscience courses and/or permission of instructor

A field course designed to utilize the exceptional and diverse geologic features of Newfoundland for instruction of departmental majors and minors in tectonic analysis utilizing sedimentologic, stratigraphic, and paleontologic observations. (three weeks, summer only)

c: From current catalog description:

GS 338 Geology of the American Southwest (var-3sh)

Prerequisite: Permission of instructor

A field study of the major geologic features and relationships exposed in the American Southwest, including the Colorado Plateau, the Rio Grande Rift, Death Valley, and parts of the Southern Rocky Mountains. (three weeks, summer only)

To proposed catalog description:

GS 338 Geology of the American Southwest (var-3sh)

Prerequisite: at least 14 sh of Geoscience courses and/or permission of instructor

A field study of the major geologic features and relationships exposed in the American Southwest, including the Colorado Plateau, the Rio Grande Rift, Death Valley, and parts of the Southern Rocky Mountains. (three weeks, summer only)

3. Justification for change

The Geoscience Department has four regional field trips (GS 336, 337, 338, and 441). We wish to change the prerequisites for GS 336, 337, and 338 to be more in line with the prerequisites for GS 441 (Carbonate Geology-Florida). Typically, students take these regional field trips in the summers between their sophomore and junior years and between their junior and senior years. Even though the course numbers indicate that these courses are intended for juniors (or, at least, after the sophomore year), occasionally we have students attempting to take these courses in the summer between their freshman and sophomore years. To emphasize to students that these field courses are indeed upper level courses, we propose changing the prerequisite to "at least 14 sh of Geoscience courses and/or permission of instructor." These 14 sh hours will typically include GS 121/122 Physical Geology lecture and lab (4 sh), GS 131/132 Historical Geology lecture and lab (4 sh) and two other geoscience courses. Other combinations, particularly for Geoscience education students, might include GS 111/112 Earth Science for Educators I lecture and lab (4 sh), GS 113/114 Earth Science for Educators II lecture and lab (4 sh), and two other geoscience courses.

On these regional field trips it is important that students have not only the disciplinary knowledge to understand what they are observing, but also the maturity to participate in the many field and camping responsibilities that accompany all field experiences.

4. **Old syllabus of record:** same as "new" with exception of change in prerequisites

5. **Liberal Studies course approval:** not applicable

6. **Letters of support:** not required, no other department is affected

"New" and "old" syllabus for GS 336 GEOLOGY OF THE NORTHERN ROCKIES: the only difference between new and old is in the prerequisites (differences in italics):

GS 336 Geology of the Northern Rockies var-3sh

Prerequisites: *at least 14 sh of Geoscience courses and/or* permission of instructor

A field study of the major geologic features and relationships involved in the development of the northern Rocky Mountains. National Park and Monument areas of South Dakota, Wyoming, and Montana are included among the areas investigated. (three weeks, summer only)

GENERAL DESCRIPTION:

The course should appeal to anyone with a basic knowledge of geology who would like to enrich her/his background by studying the geology of a classic region in which the geologic features are spectacularly exposed. Most aspects of geology will be touched on, including rock types and units, fossils, structures, geomorphology-glaciation, economic geology and historical development.

There will be numerous opportunities for photographs of classic geologic features. Some past students report that many of the stops served as excellent field examples of features they had studied only in textbooks before, and some were introduced to classic features and relationships for the first time. Earth Science teachers who were formerly in the course report that their teaching background was greatly enriched, some of the stops serving as whole lesson topics in their classroom teaching framework.

COURSE OBJECTIVES:

- Students will be able to distinguish among the major tectonics events that shaped the structure of the Northern Rockies and how weathering and erosion have subsequently modified them.
- Students will learn how spatial and age relationships of the sedimentary sequences and igneous/metamorphic rock complexes are used to reconstruct the tectonic history of the Rocky Mountains
- Students will learn to recognize geologic features (erosional and depositional) attributable to glacial and periglacial processes.
- Students will learn how to cooperate and contribute as members of a geologic field party engaged in data collection and analysis, facing the physical and psychological challenges of long-term field work under somewhat spartan conditions.

TEXT: None - a manual (no cost) will be given to each student (yours to keep), and supplementary guidebooks and maps will be available on the trip.

TRAVEL, DEPT. EQUIPMENT, AND ACCOMMODATIONS: The course will be taught entirely in the field, with transportation by Geoscience Dept. van(s). Gas and van maintenance costs will be covered by the Dept. (See section on Registration for information on van drivers.) Tents, sleeping pads, and cooking gear are also provided. Accommodations will be tent camping at public, state and national park campgrounds. Most will have hot showers and laundry facilities, but occasionally we may spend nights at more primitive campgrounds. Also, depending on weather, highway conditions, and availability of camping, our schedule may change without notice.

On the long drive to and from the Rockies, we will eat most meals at fast food places. Once in the Rockies region most meals will be from groceries and camp cooking. Camping fees and grocery costs will come from contributions to the trip Kitty. Cooking and clean-up chores will be rotated among the students on the trip.

There will be some time for you to shop and do touristy stuff (but don't complain if we don't stop at every T-shirt store we pass).

COURSE GRADE: The trip will involve various stops at classic geologic sites. At each stop the geology of the site will be introduced and studied, field notes taken, and the route plotted on base maps. The manual and supplementary references will also provide information on each site and for travel between sites. The grade for the course will be based on:

1. 75% - examination given at the end of the course (see attached Itinerary).
2. 25% - participation: attitude, cooperation, attentiveness, performance of responsibilities, and "no whining". Much of the success of the trip depends on these factors. It is very important that you maintain a positive attitude on the trip, perform your duties cooperatively, pitch in and help in chores and responsibilities, and treat people courteously and respectfully.

Grading scale: 90-100% = A, 80-89% = B, 70-79% = C, 60-69% = D, < 60% = F

NECESSARY ITEMS TO BRING:

- **Money:** It is recommended that each student bring a minimum of \$350 for the purchase of food and other incidentals (at least half should be in \$20 travelers checks). At intervals \$20 contributions will be made to the group Kitty for groceries, camping fees, etc.
- **Luggage bag** for clothes, etc. - each student will be limited to one soft duffel-type bag (squashable) - (No hard - cover suitcases allowed).
- **Clothes** - primarily field clothes ("grubbies") - broken-in field boots or sturdy shoes (jogging or walking shoes are generally adequate), warm coat, sweater, and hat, and poncho or raincoat, etc. Blue jeans are recommended, bring shorts also if desired for warm days. It can get quite cool in the Rockies especially at night, so "long johns" or sweat pants and shirt are recommended. Include a hat with brim for sun protection.
- (Laundry facilities are available at or near most campgrounds, so it is not necessary to bring a great many clothes).
- **Sleeping bag** suitable for cold temperatures (generally a bag with at least 4 pounds of synthetic filling is adequate). The Department will provide ensolite sleeping pads.
- **Sun block or zinc oxide**
- **Flashlight and batteries**
- **Toiletries** - towel, soap, etc., in a separate bathroom bag.
- **Pencils, pen, notebook**
- **Knife, fork, spoon, cup**

Optional and desirable Items to Bring:

- **Camera and film.** There will be numerous opportunities for photographs of classic geologic features. Purchasing film prior to the trip should be cheaper than en route.

- Geology equipment that you may have, such as rock pick, hand lens, pen knife, etc. The Dept. can provide some rock picks, and other items of equipment.
- Light day pack or fanny pack for carrying items on day hikes.
- Pillow
- Swimming suit
- Stamps (for post cards)
- Laundry detergent (small container)
- Small sewing kit
- Binoculars
- Insect repellent (Avon Skin-so-soft, though not designed for that purpose, works well)

COURSE OUTLINE: (Summer Session II)

- Day 1. Monday. Walk-in Registration (if necessary) 7 AM-3 PM. Process work/study card if not already done. Class meets 1PM in 104 Walsh. See Dr. Hall during the day to verify you are going and to help make preparations for trip, load vans, etc. Depart IUP by 3:00 p.m. Drive all night, alternating drivers.
2. Tuesday. En route to Badlands National Park, SD. Geology of Badlands. Camp near Badlands
3. Wednesday. Geology of the Black Hills, SD region. Camp in Black Hills
4. Thursday, Geology of the Black Hills - Big Horn Mountains/Basin region, WY. Probably camp at Red Lodge
5. Friday. Geology of the Beartooth Highway and Yellowstone Nat. Park region, MT-WY. Camp at Grant Village
6. Saturday. Geology of Yellowstone and Grand Teton Nat. Park region. Possible short hike in Teton region. Camp at Grant Village
7. Sunday. Geology of Yellowstone National Park - Quake Lake - Butte, MT region. Possibly camp at Butte
8. Monday. Geology of Butte - Helena - Augusta - Sawtooth Range region, and Egg Mountain dinosaur locality. Probably camp at Choteau
9. Tuesday.. Geology of Glacier National Park along Going-To-The-Sun Road. Hike to Hidden Lake Overlook (3 mi total). Camp in West Glacier area
10. Wednesday.. Geology along US 2 - Marias Pass (Lewis Overthrust view) to St. Mary - Many Glacier area. Hike to Grinnell Glacier (10 mile total). Camp in Glacier Nat. Park area.
11. Thursday.. Geology of St. Mary - Chief Mountain region along US Rte. 17 - Canada Rte. 6 to Waterton Lakes National Park, Highway 6/22 to Calgary - Banff region, Camp in Banff-Canmore region.
12. Friday. Geology of Canadian Rockies in Banff-Lake Louise-Icefields Parkway region. Camp in region.
13. Saturday. Geology of Golden - Rocky Mountain Trench region to Kalispell - Flathead Lake - Missoula, MT. Probably camp at Missoula
14. Sunday. Geology of Missoula - Bitterroot Range region and free time in Missoula (home

- of U. of Montana). Camp at Missoula or in Bitterroots.
15. Monday.. Leave for IUP. Geology of Missoula - Butte - Bozeman - Billings - Sheridan - Wall region via I 90.
 16. Tuesday. Wall to Chicago to Cleveland via I 90 and 80
 17. Wednesday. Cleveland to IUP via I-80-90.
 18. Thursday. Clean up equipment, dry tents, prepare for exam.
 19. Friday. Examination.

PUBLICATIONS CARRIED IN THE VANS AND REFERRED TO IN THE MANUAL

1. Geological Highway Map Northern Great Plains Regions, AAPG, by Bennison and Chenowith, 1984.
2. Geological Highway Map Northern Rocky Mountains Region, AAPG, by Renfro and Feray, 1972.
3. Geology of National Parks, Kendall/Hunt Publishing Co., by Harris and Tuttle, 1990.
4. Field Guide The Black Hills, Kendall/Hunt Publishing Co., by Feldman and Heimlich, 1980.
5. Roadside Geology of Wyoming, Mountain Press Publishing Co., by Lageson and Spearing, 1988.
6. Roadside Geology of Montana, Mountain Press Publishing Co., by Alt and Hyndman, 1986.
7. Geology Along Going-to-the-Sun Road Glacier National park, Montana, Glacier Natural History Association, by Raup et al., 1983.

Some copies of other useful books, maps, and articles will also be carried in the vans, such as Roadside Geology of the Yellowstone Country, Mountain Press Publishing Company, by Fritz, 1985.

Special resources required: see list of student equipment/supplies

Bibliography: See above list

"New" and "old" syllabus of record for GS 337 GEOLOGY OF NEWFOUNDLAND: the only difference between old and new syllabus is prerequisites (in italics)

GS 337 Geology of Newfoundland (var-3sh)

Prerequisite: *at least 14 sh of Geoscience courses and/or* permission of instructor

A field course designed to utilize the exceptional and diverse geologic features of Newfoundland for instruction of departmental majors and minors in tectonic analysis utilizing sedimentologic, stratigraphic, and paleontologic observations. (three weeks, summer only)

II. Course Objectives

1. Students will learn to collect physical and fossil data from sedimentary rock exposures and assign the rocks to specific ages and depositional environments.
2. Students will gain experience in observing compositional and textural properties in igneous and metamorphic rock complexes and interpreting the conditions and tectonic settings that produced them.
3. Students will learn how spatial and age relationships of the sedimentary sequences and igneous/metamorphic rock complexes are used to reconstruct the tectonic history of the Appalachian Mountains.
4. Students will learn to recognize geologic features (erosional and depositional) attributable to glacial and periglacial processes.
5. Students will learn how to cooperate and contribute as members of a geologic field party engaged in data collection and analysis, facing the physical and psychological challenges of long-term field work under primitive conditions.

III. Course Outline

This course is a 3-week field study of the island of Newfoundland. Thus, a course outline is an itinerary of field activities. The first day is used for a briefing session, packing and other logistics. Travel to and from Newfoundland requires approximately 1.5 days each way.

Day Activities

- 1 IUP: Registration, packing of camping equipment and personal gear in the vans, shopping to stock coolers with food for first week of trip. Briefing session in the afternoon for an overview of Newfoundland geology, ground rules for the trip, and course policies.
- 2 Travel from IUP to northern Maine or New Brunswick
- 3 Travel to North Sydney, Nova Scotia, Take ferry (5-6 hours) to Port aux Basques, Newfoundland. Examine metamorphic complexes and glacial deposits near Port aux Basques.
- 4 Examine and interpret origin of Hawke Bay Sandstone, Port au Port Group, and St George Group on Port au Port Peninsula.
- 5 Describe and evaluate depositional and tectonic significance of Table Head Group, American Tickle Formation, and overlying chert-mudstone rhythmites in Black Cove, Port au Port Peninsula. Examine the Mississippian "cold seep" marine vent fauna at Aguathuna Quarry.
- 6 Visit Cape Cormorant and Long Point on north and west coast of Port au Port Peninsula to examine and interpret clastic and carbonate successions in those areas.
- 7 Travel north to Blow-me-down Mountain area and examine igneous and metamorphic rock complexes within and below the Bay of Islands ophiolite.
- 8 Travel to Gros Morne National Park to set up base camp for the next four days, stopping in Corner Brook for groceries and other supplies in the morning. Hike up onto Table Mountain (approximately seven miles) to examine peridotite and gabbros at the base of

- the ophiolite sequence.
- 9 Hike (approximately 6 miles) down to coastal exposures of sea floor volcanics at Green Gardens in the morning. Examine limestone-shale rhythmites and faunas of the Cow Head Group at Green Point in the afternoon.
 - 10 Visit exposures of Cow Head Group at Broom Point and at Cow Head in the morning; review session in afternoon; midterm in evening.
 - 11 Free day to allow students to take advantage of Visitor Center and services provided, hike to the top of Gros Morne (second-highest mountain in Newfoundland) or relax in camp.
 - 12 Travel from Gros Morne (stopping for a few exposures in the eastern part of the park) to north-central Newfoundland to examine island arc volcanics along north coast, intrusive igneous rocks in the interior and metamorphics near the Dover Fault.
 - 13 Examine Precambrian sedimentary rocks in the western part of the Avalon Zone; rhythmites, glaciomarine diamictites, and the Precambrian-Cambrian boundary.
 - 14 Examine Middle Cambrian sedimentary rocks with Paradoxites fauna and interpret coarse clastic sequences of the Cape Spear and Signal Hill Groups on the southeastern coast of the Avalon Peninsula.
 - 15 Visit Bell Island in Conception Bay to examine Upper Cambrian and Ordovician sedimentary rocks that contain abundant graptolites, rich trace-fossil assemblages and hematitic ore deposits.
 - 16 Free half-day in St. Johns, Newfoundland for students to visit historic sites, purchase souvenirs, etc. Depart in early afternoon for Port aux Basques.
 - 17 Take ferry from Port aux Basques to northern Nova Scotia. Then continue driving back toward IUP.
 - 18 Complete return trip to IUP. Unpack the vans and prepare for final exam.
 - 19 Study for final (morning); take final (afternoon).

IV. Evaluation Methods

Each student will keep a field notebook that will include daily entries on times and locations (a road log) and field descriptions of the rocks examined on the trip. The field notebook will be collected at the end of the trip and graded for organization, scientific accuracy and completeness. A midterm exam will be given near the middle of the trip (in Gros Morne National Park). A final exam will be given at the end of the trip at IUP. You will also be graded on participation, showing enthusiasm and cooperation, asking and volunteering answers to questions in the field, discussing geology with your classmates and fulfilling your responsibilities in the work to be shared in camp and on the road.

The final grade for this course will be determined as follows:

- 30% Midterm exam (essay)
- 30% Final exam (comprehensive, essay)
- 20% Field notebook.
- 20% Participation

The final point total will be divided by maximum possible points and grades will be assigned on the scale: 90-100%=A; 80-89%=B; 70-79%=C; 60-69%=D; and below 60%=F.

V. Required Textbook, Supplemental Book and Readings

There is no required text but students must purchase a manual describing the rock sequences we will be examining, with an introductory chapter that reviews rock classification and other basic geologic principles. This manual is necessary for properly describing the rocks and is available at Pro-Packet. Each van will carry a "library" of other maps, articles and monographs on Newfoundland geology to supplement the required reading in your manual. You are expected to keep up with assigned readings and to read on your own from material in our "van libraries".

VI. Special Resource Requirements:

Be sure to bring the following in addition to your other personal gear: clothes suited to cool, wet weather including good rain gear; sleeping bag; field boots (already worn in!) and a pair of tennis shoes to give your feet a break; water bottle or canteen; flashlight; rock hammer, hand lens, field notebook, and writing utensils; small day pack for daily use; small first-aid kit with insect repellent, sunscreen, a few adhesive bandages, lip balm, lotion for dry skin (or sunburn), and an ace bandage; toiletries, including a personal bath towel.

VII. Bibliography:

Colman-Sadd, S.P. and Scott, S.A., 1994, Newfoundland and Labrador: traveller's guide to the geology and guidebook to stops of interest: Canada-Newfoundland Cooperation Agreement on Mineral Development, 91 p.

James, N.P. and Stevens, R.K., 1986, Stratigraphy and correlation of the Cambro-Ordovician Cow Head Group, western Newfoundland: Geological Survey of Canada Bulletin 366, 143 p.

James, N.P., Knight, I., Stevens, R.K. and Barnes, C.R., 1988, Sedimentology and paleontology of an Early Paleozoic continental margin, western Newfoundland: Geological Association of Canada Annual Meeting, St. Johns, Field Trip Guidebook B1, 121 p.

King, A.F., 1988, Geology of the Avalon Peninsula, Newfoundland: Newfoundland Department of Mines and Energy, Geological Survey Branch, Map 88-01.

Geological Society of America, DNAG (Decade of North American Geology) Series, Centennial Field Guide 2, Northeastern North America.

This list will be updated each summer the trip is run with other recently-published articles from professional journals in the geosciences (Geological Society of America Bulletin, Geology,

Sedimentology, Palaios).

"New" and "old" syllabus of record for GS 338 GEOLOGY OF THE AMERICAN SOUTHWEST: the only difference between old and new syllabus is prerequisites (in italics)

GS 338 Geology of the American Southwest (var-3sh)

Prerequisite: *at least 14 sh of Geoscience courses and/or* permission of instructor

A field study of the major geologic features and relationships exposed in the American Southwest, including the Colorado Plateau, the Rio Grande Rift, Death Valley, and parts of the Southern Rocky Mountains. (three weeks, summer only)

II. Course Objectives

1. Students will learn to collect physical and fossil data from sedimentary rock exposures and assign the rocks to specific ages and depositional environments.
2. Students will gain experience in observing compositional and textural properties in igneous and metamorphic rock complexes and interpreting the conditions and tectonic settings that produced them.
3. Students will learn how spatial and age relationships of the sedimentary sequences and igneous/metamorphic rock complexes are used to reconstruct the tectonic history of the Colorado Plateau.
4. Students will learn to recognize geologic features (erosional and depositional) attributable to such erosional/depositional processes of rivers, wind, groundwater, and waves..
5. Students will learn how to cooperate and contribute as members of a geologic field party engaged in data collection and analysis, facing the physical and psychological challenges of field work under spartan conditions.

III. Course Outline

This course is a 3-week field study of the American Southwest. Thus, a detailed course outline is an itinerary. A preliminary meeting will be held during the Spring semester to acquaint student with what is expected of them, to hand out information on what to pack, ground rules for behavior on the field trip, medical information form, itinerary, and so on.

Day Program

- 1 Indiana: morning: division of students and faculty into working groups for camping responsibilities and driving; lectures on maintaining a field notebook and short field

- studies which the students will undertake at different stops. Afternoon: meal planning and purchase of food, packing field and camping equipment.
- 2 Indiana to Mammoth, KY: short stops along roadcuts to look at coal cyclothem
 - 3 Mammoth Cave: tour of caverns, study of groundwater dissolution and precipitation; students will compare Mammoth Cave with Carlsbad Caverns; drive to Missouri
 - 4 Missouri to Oklahoma: visits to classic turbidite sequences in the Arbuckle Mountains
 - 5 Oklahoma to West Texas: stops along the way to see important rock formations such as the Paloduro caliche
 - 6 West Texas: McKittrick Canyon (Permian reef complex): 5 mile hike up the canyon from the forereef to the main reef complex; Permian evaporites
 7. West Texas to New Mexico: stops to look at the backreef part of the Permian reef complex, the Raderslide and Castile formations; Carlsbad Caverns; the Rio Grande Rift
 - 8 Carlsbad to Alamogordo: White Sands: gypsum sand dunes; to Santa Fe
 - 9 Santa Fe: free day (laundry, rest, a chance to put the previous 8 days' experiences in perspective)
 - 10 Santa Fe to Los Alamos: volcanic structures of the Jemez Mts.; continue to Shiprock, NM to see erosional remnants and radiating dikes; Nacimiento Fault
 - 11 Shiprock to Canyon de Chelly: 3 mile hike to study Canyon de Chelly eolian sand dunes; Monument Valley--erosional remnants
 - 12 Canyon de Chelly to Petrified Forest: short hikes to study petrified wood and unconformities marked by basal conglomerates; continue to Flagstaff: Sunset Crater
 - 13 Flagstaff to Grand Canyon (South Rim): study of Paleozoic sedimentary rocks, hike into canyon to look at the Precambrian sedimentary, igneous, and metamorphic rocks
 - 14 Grand Canyon--South Rim to North Rim, study of Mesozoic sedimentary rocks of Colorado Plateau
 - 15 Grand Canyon to Page, AZ to Zion, UT: study of outcrops along the way of Paleozoic and Mesozoic sedimentary rocks in the Painted Desert and Vermillion Cliffs (collect fossils); contrast in weathering and erosional styles; tour of the Glen Canyon dam; discussion of environmental impact of coal mining and coal-fired electricity plants; study the sand dunes at Coral Sand Dunes and the Sevier Fault
 - 16 Zion National Park: study eolian cross-bedding in Mesozoic sedimentary rocks (compare with what we saw at Canyon de Chelly); study of weathering of these rocks and fluvial erosional features (entrenched meanders of the Virgin River and hanging valleys)
 - 17 Zion to Death Valley: study of the Death Valley rift; evaporites; landslides and debris flows; playa lakes
 - 18 Death Valley to Hoover Dam to Bryce Canyon: study of Mesozoic and Cenozoic sedimentary rocks, study the sequence of younger sedimentary rocks and what they tell us of the geologic history of this area; different weathering and erosional processes; Bryce to Capitol Reef National Park to Arches National Park: study of primary sedimentary structures and erosional structures
 - 19 Arches to Mesa Verde (visit cave dwellings) to Durango
 - 20 Durango to Indiana, unpack vans, check field equipment, rest, prepare for exam

21 Prepare for exam in morning, exam in afternoon

IV. Evaluation Methods:

The student will keep a daily journal which will cover geological as well as logistical topics. We expect you to record your observations daily. You will also be given quizzes (3 or 4) while we are on the road. The quizzes will be of the short essay type and will cover field observations as well as assigned readings. There will be a final exam when we return to Indiana. This exam will contain short essay and longer essay questions which will ask you to synthesize what you have learned. You will turn in your field notebook after the test and it will be graded. You will also be graded on participation--paying attention, showing cooperation and enthusiasm, asking questions, discussing geology with your colleagues, and fulfilling your camping responsibilities.

Summary of course assessment:

40%	field notebook
10%	quizzes (3 or 4)
30%	final exam
20%	participation

Grading scale: 90-100% = A, 80-89% = B, 70-79% = C, 60-69% = D, < 60% = F

V. Required Textbook, Supplemental Book and Readings

There are no required textbooks, although there will be required readings in the vans (one set of readings, maps, field guides, etc.) in each van. You are expected to keep up with the assigned readings and to read on your own from the materials in our "van libraries." Harris and Tuttle, 1983, *Geology of the National Parks*, 3rd ed. and the AAPG Geological Highway Map of the U.S. Southwest will be helpful. We will have these in the vans also, but you may want to purchase your own copies. You must have a map of the contiguous U.S.

VI. Special Resource Requirements:

Be sure to bring the following in addition to your other personal gear: clothes suited to cool, wet weather including good rain gear; sleeping bag; field boots (already worn in!) and a pair of tennis shoes to give your feet a break; water bottle or canteen; flashlight; rock hammer, hand lens, field notebook, and writing utensils; small day pack for daily use; small first-aid kit with insect repellent, sunscreen, a few adhesive bandages, lip balm, lotion for dry skin (or sunburn), and an ace bandage; toiletries, including a personal bath towel.

VII. Bibliography:

Harris, Ann and Esther Tuttle, 1983, *Geology of National Parks*, 3rd ed.: Kendall-Hunt (Dubuque), 554 p.

Harris, David and Eugene Kiver, 1985, *The Geologic Story of the National Parks and*

Monuments, 4th ed.: Wiley (N.Y.), 464 p.

Geologic maps of states of the Southwest

Many geological guidebooks of the Southwest including:

Chronic, Halka, 1985-1989, Roadside Geology of New Mexico, Roadside Geology of Utah, Roadside Geology of Arizona, Roadside Geology of Colorado: Mountain Press (Missoula, MT), about 150-200 pages each

DNAG (Decade of North American Geology) Guidebooks published in 1987: 6 volumes

Many articles from recent geological journals such as Bulletin of the Geological Society of America, Geology, University of Arizona Notes. This list will be updated each summer the trip is run with other recently-published articles from professional journals in the geosciences.