

University of Wisconsin-Whitewater
Curriculum Proposal Form #3

New Course

Effective Term: 2083 (Summer 2008)

Subject Area - Course Number: **Biology 451/651**

(See Note #1 below)

Cross-listing: **Geology 451**

Course Title: (Limited to 65 characters) Natural History of Yellowstone NP and the Upper Great Plains

25-Character Abbreviation: Nat. Hist. YNP & UGP

Sponsor(s): Drs. George Clokey, Ellen Davis, Bruce Eshelman and Rex Hanger

Department(s): BIOLOGY; GEOGRPY/GEOLGY

College(s): Letters and Sciences

Consultation took place: NA Yes (list departments and attach consultation sheet)
Departments:

Programs Affected: none

Is paperwork complete for those programs? (Use "Form 2" for Catalog & Academic Report updates)

NA Yes will be at future meeting

Prerequisites: Biology 120 or 141 or consent of instructor

Grade Basis: Conventional Letter S/NC or Pass/Fail

Course will be offered: Part of Load Above Load
 On Campus Off Campus - Location Yellowstone NP

College: Letters and Sciences **Dept/Area(s):** BIOLOGY; GEOLGY

Instructor: George Clokey

Note: If the course is dual-listed, instructor must be a member of Grad Faculty.

Check if the Course is to Meet Any of the Following:

Computer Requirement Writing Requirement
 Diversity General Education Option: Select one:

Note: For the Gen Ed option, the proposal should address how this course relates to specific core courses, meets the goals of General Education in providing breadth, and incorporates scholarship in the appropriate field relating to women and gender.

Credit/Contact Hours: (per semester)

Total lab hours: 100 Total lecture hours: 60
Number of credits: 3 Total contact hours: 160

Can course be taken more than once for credit? (Repeatability)

No Yes If "Yes", answer the following questions:

No of times in major:
No of times in degree:

No of credits in major:
No of credits in degree:

Proposal Information: (Procedures can be found at <http://acadaff.uww.edu/Handbook/Procedures-Form3.htm>)

Course justification: Understanding the development and use of natural resources and wilderness areas requires knowledge of basic scientific principles. Fieldwork is crucial to learning these principles and necessary for Ecology, Geology and other field science majors. Further, an informed citizen can best contribute in decisions related to the future of public lands. This course will prepare students for more advanced course in geology and biology. It will also provide a strong field foundation for teachers of K-12 science classes. It has been taught 7 times since 1996 as Biology 491/691 and was cross listed in 2007 as Geology 491. We would like to make it a permanent course.

Relationship to program assessment objectives: This course advances the following department mission goals:

- 1) Offer up-to-date courses relevant to the needs of modern Biology and Geology
- 2) Prepare students for post-baccalaureate programs and success in a competitive job market
- 3) Contribute to the targeted Emphases of majors by providing a knowledge base and developing skills

The course offers current, relevant material to undergraduates in the field of geology, biology and natural history. The instructors for the course continually introduce new subjects and seek researchers and workers in the field to present timely issues. There is a nucleus of topics taught each year that address the basic techniques of field research. The field work prepares the students for our undergraduate research program, gives them an advantage for admission into highly competitive post-baccalaureate programs and aids in their employability. The practical field skills, knowledge base and critical thinking skills acquired in this course provide the basis for students to take more advanced courses in their Emphases. The Department of Biological Sciences is also instituting a practical, out of classroom experience for majors. This course would satisfy that requirement.

Budgetary impact:Self sustained. All costs including salary are integrated in course fees. For 2007 the total budget for the course was ca. \$44,000 and the cost per student for 20 students was \$2200. This course will only be offered during the summer term.

Course description: (50 word limit) This is an introductory, multi-disciplinary, summer field course open to all. It is held at Yellowstone Natl. Park and locations in route. Students will learn field methods, geology, ecology and natural history. It is suitable for biology and geology majors and anyone interested in field science or natural history.

If dual listed, list graduate level requirements for the following:

1. **Content** (e.g., What are additional presentation/project requirements?) Graduate students will be expected to explore the course and readings at greater depth than undergraduates during discussion. They will also be expected to participate in class discussion more frequently than undergraduates. Graduates will be expected to have a more complete field collection both in specimens and descriptions of specimens.
2. **Intensity** (e.g., How are the processes and standards of evaluation different for graduates and undergraduates?) In general graduate students will be expected to demonstrate standards that reflect greater intellectual intensity and rigor in all aspects of the course. In class participation and during written exams they will be graded with this in mind. They will be expected to have a notebook that is more extensive than undergraduates. When appropriate they will be expected to be leaders in group activities.
3. **Self-Directed** (e.g., How are research expectations differ for graduates and undergraduates?) Graduate students will organize and present to the class a lecture or activity. The topic will be agreed upon by the student and instructors during the pre-lectures and will be of about 2 hours in length. This presentation will be prepared before the field part of the course commences. It will demonstrate self-directed learning, outside research and an extensive depth of understanding.

Course objectives and tentative course syllabus: Course objectives and tentative course syllabus: Students will participate in fieldwork in ecology, geology and natural history. They will also explore some of the philosophies of conservation being applied to the regions of study. Students will:

- 1) acquire a working knowledge of field geologic and ecologic techniques including but not limited to: data recording, use of GPS and maps, stream and lake sampling, vegetation and tree sampling, trapping grid design, handling of trapped mammals and use of dichotomous keys
- 2) acquire a working knowledge of field equipment including but not limited to: GPS, water chemistry, water sampling devices, trapping equipment, vegetation sampling devices such as increment corers and "throw squares", atmospheric sampling devices, USGS maps, field radios

- 3) learn to identify minerals, rocks and animals using keys and field guides
- 4) learn basic petrology, mineralogy and geomorphology of the regions we visit
- 5) learn the unique ecologies of the regions we visit
- 6) learn basic statistical methods for analysis of the data we collect
- 7) learn of about resource acquisition, e.g. mining, forestry, and the impact that this has on the environment and people of the region
- 8) learn safety in field study

SYLLBUS (proposed for 2008)

Instructors: Drs. George Clokey, Bruce Eshelman and Rex Hanger

Office Hours: In the evening, after class, by appointment only (appointments are required since we are in our motel rooms).

Instructor contact information: Since this is a field course you will be in contact with us in the field. When not in the field you can set up an appointment for non-urgent business or come to our motel rooms at any time for urgent problems (please knock). If you need to contact us prior to the start of the course or after the course has finished contact us (Dr. Clokey 262-472-5140, clokeyg@uww.edu; Dr. Eshelman 262-472-5136, eshelimab@uww.edu or Dr. Hanger 262-472-5258, hangerr@uww.edu).

Title: Natural History of Yellowstone Natl. Park and the Upper Great Plains (Nat. Hist. YNP & UGP)

Dept. Prefix: BIOLOGY 451/651 (grad credit for Biology only) or GEOLGY 451 (no grad credit offered for Geology)

Prerequisites: Biology 120 or 141 or consent of instructor

Course Textbook: "Mountain Time", Schullery, P. (handed out at 1st meeting), "Dictionary of Geologic Terms", 3rd Ed., Bates and Jackson (UWW bookstore) or other dictionary of geologic terms.

Course Objectives: The course is designed to provide a foundation in the techniques of field biology and geology. It will also provide the student opportunities to make field collections for later study. We will introduce the student to the geology, ecology and natural history of the upper Great Plains, the Black Hills and the Yellowstone region. This is an introductory course open to all. This course is suitable for biology and geology majors and anyone with an interest in the sites covered.

Attendance Policy: Attendance is mandatory at all times for all activities. This is a field course and you are required to participate in everything we do. Attendance will be part of your grade and missing anything may lower your grade. We can only accommodate absence for illness or injury occurring during the course; there will be no absence for University sponsored events since we are too far away from the University. If you are injured or ill you must inform the instructor immediately. We will then transport you to medical facilities as appropriate.

Grading Policy: A, 90% and up; B, 80 –89%; C, 70 – 79%; D 60 – 69%. There will not be a curve, and there is no extra credit.

Undergraduate Grading List* (BIOLOGY 491 or GEOLGY 491):

- 1) 2 Lecture exams: **20% each**
- 2) 2 Practical exams: **10% each**
- 3) Note book: **20%**
- 4) Field collections: **5%**
- 5) Class participation: **15%**

Graduate Grading List* (BIOLOGY 651 only):

- 1) You will be graded as the Undergraduate Grading List above but you will be graded at a higher standard than that expected from an undergraduate (see "Content" and "Intensity" below). The total from the Undergraduate Grading List will be **80%** of your final grade.
- 2) You will be expected to accomplish an extra assignment as listed below under "Self-directed Study". The total from the extra assignment will be **20%** of your final grade.

1) Content: Graduate students will be expected to explore the course and readings at greater depth than undergraduates during discussion (see 5 in "Undergraduate Grading List" above). They will also be expected to participate in class discussion more frequently than undergraduates. Graduates will be expected to have a more complete field collection both in specimens and descriptions of specimens (see 4 in "Undergraduate Grading List" above).

2) Intensity: In general graduate students will be expected to demonstrate standards that reflect greater intellectual intensity and rigor in all aspects of the course. In class participation (see 5 in "Undergraduate Grading List" above) and during written exams (see 1 in "Undergraduate Grading List" above) they will be graded with this in mind. They will be expected to have a notebook that is more extensive than

undergraduates (see 3 in "Undergraduate Grading List" above). When appropriate they will be expected to be leaders in group activities.

3) Self-directed Study: Graduate students will organize and present to the class a lecture or activity. The topic will be agreed upon by the student and instructors during the pre-lectures and will be of about 2 hours in length. This presentation will be prepared before the field part of the course commences. It will demonstrate self-directed learning, outside research and an extensive depth of understanding.

* For more on grading please see the "Evaluation and Reading" below.

The University of Wisconsin-Whitewater is dedicated to a safe, supportive and non-discriminatory learning environment. It is the responsibility of all undergraduate and graduate students to familiarize themselves with University policies regarding Special Accommodations, Academic Misconduct, Religious Beliefs Accommodation, Discrimination and Absence for University Sponsored Events (for details please refer to the Schedule of Classes; the "Rights and Responsibilities" section of the Undergraduate Catalog; the Academic Requirements and Policies and the Facilities and Services sections of the Graduate Catalog; and the "Student Academic Disciplinary Procedures (UWS Chapter 14); and the "Student Nonacademic Disciplinary Procedures" (UWS Chapter 17)).

This is a field course that requires moderate physical activity to participate in all aspects of the course. We will be going on hikes at 11,000 ft. elevation, hikes that cover rough, rocky terrain and hikes over areas where there are no trails. Students will be expected to ford and wade in small streams, climb steep hills and in general work in rugged environment. The course can not be conducted otherwise. For a complete grade students must participate in all activities.

Course Calendar (tentative for 2008):

This is a field course and as such field events will determine to a degree what will be taught. We plan to teach numerous basic concepts but we will also rely on opportunities as they present themselves. We may not cover the topic on the day listed but we will cover all of the topics listed. **At any time during the course you will be expected to participate in discussions and answer questions on previously presented material or material from the reading. You will be graded on your response. For more detail see "Grading Policy" above and the "Evaluation and Reading" handout.**

Mon, Aug. 4: Discussion of WI and MN biomes, geology, unique vegetation and climate change. As we travel we will point out and discuss formation and significance of the unique features of Wisconsin geology including: the pre-Cambrian Baraboo Hills, late Wisconsin Episode glacial features and Cambrian and Ordovician outcrops and structure. We will talk about folding, metamorphism, depositional environments and geomorphology. We will discuss large scale climatic influences such as air circulation cells and the effects of mountain ranges on rainfall. As we progress from east to west we will point out changes in vegetation brought about by these climatic changes. As opportunity presents we will discuss unique biomes of the region such as oak savannas and unique fauna and their adaptations. Any rock, geologic formation, plant or animal that we point out or sample will be expected to be recorded in the student's field notebook. This applies throughout the course.

Tue, Aug. 5: During the AM we will travel across North Dakota. We will continue the study of climatic changes and discuss both natural vegetation changes and agricultural changes dictated by the climate change. We will discuss the mid states flyway for migratory water fowl and cover how land use has impacted this resource. We will stop at Theodore Roosevelt National Park and discuss the formations of the badland topography including: deposition of the easily eroded Cenozoic formations, sources of the bedrock (Eocene volcanism and erosion from the Rock Mt. orogeny). As opportunity presents we will discuss unique biomes of the region such as tall and short grass prairies, prairie pot holes and unique fauna and their adaptations. Since we will be traveling along the route of Lewis and Clark we also will hold discussions on the settling of the region and point out land marks such as Pompey's Pillars. We will be on site @ Glendive MT, in the PM, (See Aug 6 for specifics). Basic use of GPS will be taught so that students can locate specimen collection sites. The instructor will cover USGS quadrangle maps briefly (more extensive instruction will be given later).

Wed, Aug. 6: Glendive, MT base. We'll work in the field all day. Depending on arrangements with the rangers of Makoshika State Park we will tour the park Tue PM or some time on Wed. During the tour we will discuss extreme desert habitats and point out adaptations that flora and fauna have that allow them to survive this environment. We will cover Cretaceous depositional environments such as point bars, channel deposition and cross bedding. Students will be able to view a hadrosaur skeleton *in situ*. During the middle of the day we'll go to the Yellowstone River. We will collect hand specimens for analysis. Possible specimens include: petrified wood, Cenozoic vegetation fossils, coal and agates. We will tie in the current depositional patterns found on the river with the Cretaceous deposits found at Makoshika. The river site is at an irrigation dam and we will discuss the impact of water use especially as it relates to the endangered paddle fish population threatened by that use. We'll introduce various stream sampling devices, flow meters and collection nets. We will do basic water chemistry (water will be

studied at several sites during the trip). During the rest of the day we'll look for fossil (dinosaurs, ammonites, shrimp and clams), study the stratigraphy of the Pierre Shale, Fox Hills Sandstone, Hell Creek Shale and Fort Union Shale formations and look at desert biomes. During this time we will be working in an active oilfield. We will discuss structural formations of oil fields and use of this resource. We will cover paleo-environments and how one can analyze them. We'll compare fossil forms to modern forms and discuss evolution. If we are able to find shrimp borrows we will discuss "fossilized behavior".

Thu, Aug. 7: AM at Glendive (see Aug 6), travel to Spearfish SD in PM. In Spearfish we will listen to Dr. Jace Decory on the importance of the Black Hills to American Indians. Dr. Decory is a medicine woman of the Lakota Sioux and will also discuss native medicine and the uses of plants found in the region. Dinner will be with Dr. Decory.

Fri, Aug. 8: We will visit Spearfish Canyon, Jewel Cave, the Pacer Corp. White Elephant feldspar mine and various road cut. At Spearfish Canyon we will look at the rock formations that the Canyon was formed from. We will discuss why the Black Hills is such a unique environment and why the forests are so prevalent in the hills vs. the surrounding plains. We will look at the micro environment of Bridal Veil Falls and discuss the impact that gold mining has had on Spearfish Creek. In Jewel Cave we will learn of the conditions that produce caves and cave formations. We will discuss the impact that tourism has had on the resource itself (a problem that is recurrent in many of the sites we visit). At the Pacer Corp. feldspar mine we will discuss formation of pegmatites and why they are economical important. We will discuss both high and low grade metamorphic processes and some of the minerals that form from them at the various road cuts we visit. Specimens will be collected at the mine and road cuts. If time permits we may stop at Mt. Rushmore and discuss the conflict that the development of the Black Hills has generated with resource preservation and also on the American Indian culture specifically religion).

Sat, Aug. 9: We will travel across eastern Wyoming, the Big Horn Mountains and the desert basin of the Big Horn River. We will pass through Gillette WY and see several coal surface mines and oil field. We will discuss land reclamation and the problems associated with strip mines. We will stop for specimens and discuss the formation of some of the outcrops. During the trip we will observe land use practices and discuss problems with over irrigation and over grazing and their impact on vegetation and fauna of the region. When we arrive at the K-Z we will tour the surrounding region for orientation. We will establish a trapping grid for small mammals in the PM. This trapping grid will be the basis for the major field project for the course. We will conduct a capture/recapture study and analyze the data using various statistical methods. We will also engage in other sampling techniques in common use.

Sun, Aug. 10: There will be a hike around the K-Z to observe plant communities, local geology and biomes and the effects of forest fires on the ecosystems. We will learn how to use GPS, read USGS quadrangle maps and determine position by compass and GPS. Students will be required to verify the location of the trapping grid, locate their position and participate in a "treasure hunt" using the GPS, compass and USGS maps. We will learn several sampling techniques for vegetation including, tree coring, random throw squares and "distance to nearest neighbor" and the information that can be gathered from each type of technique (again applicable statistical techniques will be applied to the data).

Mon, Aug. 11: Stream ecology will be discussed. We will take a trip to Sunlight Basin, in the Absaroka Mountains to examine different stream orders, stream ecology and stream invertebrates. We will expand on the use of sampling devices used at the Yellowstone River in Glendive, discussing their appropriate uses and limitations. Comparison of the structure and ecology between high order streams and low order streams (Yellowstone River vs. Sunlight Creek) will be analyzed. We will introduce and use dichotomous keys to identify stream invertebrates. Will also take a look at White Mt., a volcanic neck with intricate structure, and interpret the sequence of geologic events. In Sunlight basin there are several interesting landforms and geologic features (terminal moraines, ice rafted boulders, striations, entrenched valley, spring line). We will discuss their formation and significance. We'll look for trace fossils and study the Paleozoic rock column from Cambrian to Permian. We will view the uplifted block of the Beartooth plateau.

Tue, Aug. 12: We'll leave the K-Z (ca. 4:30 am) to be on site in Lamar Valley at 6:00 am. Dr. Jim Halfpenny will talk on carnivore ecology of YNP and the reintroduction of wolves. This is an all day exercise with Dr. Halfpenny and he will be conducting the study. He is an expert on large mammals and conducts research in the park. We will learn various field techniques for studying large carnivores and interpreting their behavior. We will learn tracking techniques and their interpretations. We'll try to view wolves (we have seen a pack every year we have been there) and any other large mammal we can find (coyote, pronghorn, bison, bear, etc.).

Wed, Aug. 13: We will visit several sites associated with the New World mine. This mine was a moderate source of gold in the early 1900. It has been reclaimed to some degree but there is still significant disturbance. The topics are mining and human impact. Exercises include: 1) discussion of the impact of the gold mines in the area, 2) observation of reclamation efforts, 3) mineral collection at tailing pile, 4) comparison of mined and non mined areas (ecology, diversity, and water chemistry).

The 1st test will be held at the K-Z after dinner. It will consist of short essay, a few multiple choice and true false and a practical section. Any specimens collected up to this point are fair game on the practical. We will collect your field notebook and view your collections for grading.

Thu, Aug. 14: We will cross the Beartooth Mountains to Rock Creek overlook to study alpine glacial processes and high altitude ecology. We'll stop at Beartooth Lake for landslides and the ecologic disturbance they cause and at Beartooth Pass for tundra biomes and permafrost geology. We will view adaptations that the various plants have that allow them to survive in the harsh environments found at elevation. We will see unique micro ecosystems such as "pink snow".

Fri, Aug. 15: We will view the Grand Canyon of the Yellowstone and the Tower Falls basalt flows. We will discuss how the Canyon formed and why Yellowstone Falls is located where it is. We will see effects of hot springs on geology and ecology. We will discuss the 3 caldera events that shaped Yellowstone. We will look at a basaltic lava flow and see paleosols. We will take a hike in the forest and meadows at Mt. Washburn and Cascade Lake to study these two major ecosystems. We will also examine areas for fire destruction and recovery and discuss the adaptations that allow the flora and fauna to survive periodic fires. Ecologic succession will be explained and viewed.

Sat, Aug. 16: We will travel into the Beartooth Mountains. We'll examine the Devonian river channel at Beartooth Lake and view the delta cross-section and unconformity. We will hike from Clay Butte fire tower to Devonian fish fossil sites. We will also study alpine forests and the changing life zones that occur with altitude. We will examine a basaltic dike and discuss how crystals form from melts, contact metamorphism and igneous events.

Sun, Aug. 17: Free day, We'll offer a van to Cody for museum (Buffalo Bill Museum, Whitney Gallery of Western Art, Plains Indian Museum, Cody Firearms Museum and Draper Natural History Museum), Cody Rodeo, etc. Cody has many unique educational opportunities and the museums are excellent. There are also horseback trips and fishing offered by the K-Z. All extra expenses are the responsibility of the student.

Mon, Aug. 18: We will travel to Yellowstone National Park (YNP) to study the two major types of geothermal features found in the Park. These are represented by Norris Geyser basin and Mammoth Hot Springs. We will study fumaroles, hot springs, mud pots, geysers, travertine terraces and sinter deposits. We will explore the unique micro environment created by the geothermal features and discuss the thermophilic bacteria and algae that live in these extreme environments. We will also stop at Obsidian Cliffs and the Golden Gate lava flows and continue to explore the volcanic activity that produced the Park. While in YNP we will observe the flora and fauna.

Tue, Aug. 19: Travel in the region to observe geology, natural history and ecology. We may visit sites that we did not have enough time for previously. Students will be expected to answer questions on all aspects of the region. The questions will be part of your evaluation (i.e. this is a verbal test).

Wed, Aug. 20: Leave K-Z in AM and drive to Devils Tower WY, then Hulett WY. We will cover the desert climates again and cross through the Big Horn Mountains via a different route. We will tour Devils Tower and discuss the formation of this feature. There are several unique Cretaceous fossils that we will study. We will look at a lower elevation pine forest and compare it to the higher elevation forests near Yellowstone. There are several unique microclimates that we will examine and we will observe behavior of a prairie dog community. During travel students may review via radio.

Thu, Aug. 21: Leave Hulett travel to Mitchell with a stop along the White River for fossil collection from the Pierre Shale. During travel students may review via radio.

The 2nd test will be held at the motel. It is the same format as Test 1. Although the exam is not designed as a comprehensive exam there may be concepts and information that span both the 1st and 2nd exam. Any specimen collected from the 1st exam up to this point is fair game on the practical. We will collect your field notebook and view your collections for grading.

Fri, Aug. 22: Leave Mitchell in AM arrive UWW PM, we'll stop along the way for contact calls for your ride.

EVALUATION AND READING

Course Evaluation:

- 1) Attendance at the preparatory class (pre-course meeting) is required.
- 2) There will be 2 formal exams combined with 2 practical exams; one set about half-way through the course the other at the end.
- 3) Compilation of a comprehensive field notebook (see "Notebook" below) will be required of the students.
- 4) Field questions: Identification and interpretation test of flora, fauna and geology of the study areas will be given during the trip from time to time. It is imperative that the student stay current with the information given. In other words if we tell you or show you something it is fair game for us to ask you about it later.

- 5) Students will compile plant, rock and mineral collections of the study areas. The collections will be evaluated for completeness and used as an aid to the students for testing the student's natural history knowledge of the study areas on practical exams and field exams. We will instruct the students as to what may be lawfully collected.
- 6) All students are expected to participate in the field data collection exercises.
- 7) The students will be asked to discuss and apply information from the assigned readings in the context of fieldwork activities. We will also ask questions and hold discussions in the field on ecology, geology and paleontology. Participation in discussions on the philosophical issues involved in conservation will be expected of all students. Students will be judged on both the amount and relevance of their participation.
- 8) For graduate requirements: 1) graduate students are expected to participate in discussion much more than undergraduates, show greater depth of understanding during the exams and have more extensive field notes and collections, 2) graduate students are asked to present a section of the course on a topic of their choosing. The presentation must be at least 4 hours long and cover the topic in detail. The topic will be decided upon at the pre-course meeting.

Readings

- 1) For reference, students are required to have a dictionary of geologic terms. We suggest "Dictionary of Geologic Terms", 3rd Ed., Bates and Jackson. It is available at the UWW Bookstore.
- 2) Students are required to read "Mountain Time", Schullery before the class begins. It will be handed out at the pre-course meeting. *

Preparatory class (pre-course meeting) will be held to:

- 1) explain the objectives of the course
- 2) evaluate the background of the students
- 3) lecture on some of the principles of ecology, conservation, natural history, geology and paleontology that are relevant to the field work
- 4) demonstrate certain equipment and field techniques
- 5) explain evaluations and tests
- 6) set up travel arrangements
- 7) hand out "Mountain Time"
- 8) discuss safety issues, sample collection procedures, rules and regulations

Notebook:

- 1) It must be bound and quad-rule. You must purchase this notebook (UWW book store).
- 2) In the notebook, you will record on a daily basis: a log documenting activities, comments, specimens and features. This notebook is an important study guide and reference. It will count as part of your grade, so do a good job. Write it so that you can: find the same spot again, know what you found and know what was important or unique about the find. The sections of the notebook are as follows:
 - 1) Table of contents: The table of contents will allow anyone to easily find the various sections of the notebook.
 - 2) Log: The log will be a description of the day's events and any important comments and notes that you wish to make. In this section you will also list your samples such as rocks, plants, animals etc. and you will refer to a more complete description of the finds in the appropriate section as listed in #4 below.
 - 3) Four sections containing field notes on samples (animals, plants, rocks and formations): The specific sections on samples will contain notes as listed below. Each entry should be segregated as to section (Sample sections are: Animal, Plant, Rock or Formation). Each entry in a section should be numbered so that you can refer to it in the log section (e.g. We found an emu today (see Animal 12)). Sample sections and necessary data are as follows (an entry may not include all of the information but you should attempt to collect as much data as possible):
 - a) Field notes on Animals
 - i) species
 - ii) date, time of day, exact location from GPS if possible
 - iii) weather
 - iv) habitat including other animals and plants associated with animal
 - v) behavior
 - vi) comments and drawings
 - b) Field notes on Plants
 - i) species
 - ii) date, exact location from GPS if possible
 - iii) soil type and general gross climactic features
 - iv) habitat including other plants and animals associated with plant
 - v) comments and drawings

- c) Field notes on Rocks
 - i) rock type
 - ii) date, exact location from GPS if possible
 - iii) stratigraphy, lithology, mineralogy
 - iv) fossil type and species, paleo-ecology
 - v) comments and drawings
 - d) Field notes on Formations
 - i) formation type
 - ii) date, time of day, exact location from GPS if possible
 - iii) how it formed, paleo-ecology
 - iv) relationship to other formations, both contiguous and distant
 - v) impact on biosphere
 - vi) comments and drawings
- 3) We will be checking the log part of the notebook and sample sections. If you want to write other personal stuff, do so at the end of the notebook. The log section should be a "scientific document". With all this in mind think about arrainging it before you start so it is not a mess.

Bibliography: (Key or essential references only. Normally the bibliography should be no more than one or two pages in length.)

- 1) Alt, D. and D. Hyndman; 1986; *Roadside Geology of Montana*; Mountain Press Pub., Missoula, MT
- 2) Bates, R.L. and Julia. A. Jackson; 1976; *Dictionary of Geologic Terms*; 3rd ed.; Anchor Press/Doubleday, Garden City, NY
- 3) Bioscience, 1989, 39 (10), entire issue
- 4) Blackstone, D.L., Jr., 1988, *Travelers Guide to the Geology of Wyoming*; Bulletin # 67, The Geological Survey of Wyoming, Laramie, WY
- 5) Blevins, W.; 1989; *Roadside History of Yellowstone Park*; Mountain Press, Missoula MT
- 6) Brock; 1978; *Thermophilic Microorganisms and Life at High Temperatures*; Wm. C. Brown, Dubuque, IA
- 7) Brookfield, M.; 2005; *Principles of Stratigraphy*; Blackwell Publishing, Malden, MA
- 8) Courtney, B. and J. Zimmerman; 1978; *Wildflowers and Weeds*; Simon & Schuster, New York, NY
- 9) Craighead J. F. Craighead and R. Davis: 1991; *Rocky Mountain Wildflowers*; Houghton Mifflin Co., Boston, MA
- 10) Despain, D. et al.; 1986; *Wildlife in Transition*; Roberts Rinehart, Inc. Pub., Boulder, CO
- 11) Fastovsky, D.E.; 1990; *Sedimentology of the Hell Creek Formation*; Geol. Soc. Amer., Special Paper 247:541
- 12) Feldman, R.M. and R.A. Heimlich; 1980; *The Black Hills*; Kendall/Hunt Pub., Dubuque, IA
- 13) Fritz, W.J.; 1985; *Roadside Geology of the Yellowstone Country*; Mountain Press Pub., Missoula, MT
- 14) Gries, P.; 1996; *Roadside Geology of South Dakota*; Mountain Press Pub., Missoula, MT
- 15) Halfpenny, J.; 2003; *Yellowstone Wolves*; Riverbend Pub.; Helena, MT
- 16) Halfpenny, J.; 2007; *Yellowstone Bears*; Riverbend Pub.; Helena, MT
- 17) Harvey, H, R. Tracy and B. Owens; 2006; *Petrology Igneous, Sedimentary, and Metamorphic*; 3rd ed.; W. H. Freeman and Company, New York, NY
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Notes:

1. Contact the Registrar's Office (x1570) for available course numbers. A list of subject areas can be found at <http://acadaff.uww.edu/Handbook/SubjectAreas.html>
2. The 15 and 25 character abbreviations may be edited for consistency and clarity.
3. Please submit electronically when approved at the college level - signature sheet to follow in hard copy.