Please attach/submit additional documents as needed to fully complete each section of the form.

I. COURSE INFORMATION

Department: Geosciences
Course Number: GEO 104N

Course Title: Introduction to Environmental Geology Laboratory
Lab Status: With Lab
Type of Request: New

Rationale: The development of a freshman-level general education lecture course in Environmental Geology (GEO 103N) with a companion laboratory course (GEO 104N) will provide students access to an applied, broadly based introductory Geoscience course sequence that focuses on Earth-human interactions. Our existing GEO 101N/102N sequence (Introduction to Physical Geology/Laboratory) focuses on Earth materials and processes. GEO 104N, a 1 credit laboratory course, provides a basic introduction to the principles of environmental geology and focuses on the development of elementary scientific skills through a set of formal laboratory exercises, assigned reading material, and discussions that explore human interactions with the Earth’s natural physical systems. No prerequisites are required.

These proposed new classes will provide a core course sequence for Geosciences students who have a strong interest in water science and the environment. This request to add GEO 104N Introduction to Environmental Geology Laboratory (as well as GEO 103N Introduction to Environmental Geology) is part of a continuing departmental effort to (1) provide consistent instruction in a broad range of geoscience principles to all interested students; (2) optimize undergraduate course offerings; (3) better balance instructional offerings between the department’s two focus/research areas: water science and solid earth science; and (4) present courses that offer innovative and forward-looking content.

These two courses will serve as part of one of two general introductory foundation course options available to undergraduates who elect to complete a major or minor in Geosciences. Students can elect to take either the GEO 103N/104N or the GEO 101N/102N sequence plus GEO 211 for a total of 8 credits. Students need complete only one of the lower division core options as part of their BS degree major or minor requirements, maintaining the credits required for the major at 62 and minor at 18.

If course has not changed since the last review and is taught by the same tenure-track faculty member, you may skip sections III-V.

JUSTIFICATION FOR COURSE LEVEL

Normally, general education courses will not carry pre-requisites, will carry at least 3 credits, and will be numbered at the 100-200 level. If the course has more than one pre-requisite, carries fewer than three credits, or is upper division (numbered at the 300 level or above), provide rationale for exception(s).

This 1 credit laboratory course is designed to be the companion course for the proposed new lecture class 'Introduction to Environmental Geology', GEO103N. As such, GEO104N will provides a basic introduction to the study of environmental geology through a set of formal laboratory exercises, assigned reading material, and class discussions. No prerequisites are required.
**ADDITIONAL INFORMATION (FOR OCHE DATABASE):**

In which **MUS Core Category**, does this course fit? Natural Sciences

Does the course include content regarding cultural heritage of American Indians? No

**II. ENDORSEMENT / APPROVALS**

* Instructor: Marc S. Hendrix
  
  Signature _______________________ Date____________
  
  Phone / Email: 406-544-0780/marc.hendrix@umontana.edu

Program Chair: James R. Staub
  
  Signature _______________________ Date____________

Dean: Christopher Comer
  
  Signature _______________________ Date____________

*Form must be completed by the instructor who will be teaching the course. If the instructor of the course changes before the next review, the new instructor must be provided with a copy of the form prior to teaching the course.

**III. DESCRIPTION AND PURPOSE**

**GEO104N – Introduction to Environmental Geology Laboratory** is a new general education course offering that utilizes a series of laboratory exercises to explore Earth’s natural geologic systems and the interactions between these and humans. The course is designed to be the companion laboratory to GEO103N (Introduction to Environmental Geology) and will provide a broad introduction to Earth’s geological processes, the timeframes over which they operate, and the techniques utilized to understand and measure Earth processes in the context of their impact on humans. Selected topics that will be covered include estimating earthquake magnitude and location, volcanism and recognition of volcanic hazards, landslides and other forms of mass movement, coastal erosion, industrial water pollution, and climate.

This course differs substantially from GEO102 (Introduction to Physical Geology Lab) in that it emphasizes the quantification and understanding of Earth processes and how these impact human activities, rather than focusing solely on the processes themselves. As an introductory applied geoscience lab course, GEO104N will provide students with the tools to recognize Earth’s materials and understand geologic processes in the context of the impact of these processes on humans. This lab course directly addresses numerous topics that will be of direct concern to humans seeking to live sustainably in Earth’s dynamic geologic environment.

**IV. CRITERIA**

**BRIEFLY EXPLAIN HOW THIS COURSE MEETS THE CRITERIA FOR THE GROUP.**

1. Courses explore a discipline in the natural sciences and demonstrate how the scientific method is used within the discipline to draw scientific conclusions:

   Environmental geology is the application of geologic analysis to problems involving interactions between humans and the Earth. The scientific method is the framework through which course topics are explored on a weekly basis. Each weekly exercise involves an introduction, hypothesis building and testing, data collection by the student, and analysis, interpretation, and formulation of conclusions. For example, in the exercises on landslides and avalanches, students will be introduced to the dynamics and aftermath of snow avalanches, then be required to investigate a set of satellite images to map avalanche pathways in an area of ongoing human activities.

2. Courses address the concept of analytic uncertainty and the rigorous process required to take an idea to a hypothesis and then to a validated scientific theory:
The concept of analytic uncertainty will be a part of each weekly exercise and is addressed directly and deliberately in the third week’s exercise on measurements, basic calculations and conversions, and graphs.

3. Lab courses engage students in inquiry-based learning activities where they formulate a hypothesis, design an experiment to test the hypothesis, and collect, interpret, and present the data to support their conclusions:

   Each week’s exercise will involve the formulation of one or more hypotheses, the development of an experimental design, execution of the design, data collection, analysis, and interpretation of results in the context of the original hypothesis. For example, in the first week’s lab, students will be provided with roughly a dozen important rock-forming minerals and their properties and must formulate a hypothesis for the identification of each mineral, design a set of experiments to test that hypothesis, execute the experiments and collect the critical data, analyze the results, and formulate conclusions, returning to revise the original hypothesis if needed.

V. STUDENT LEARNING GOALS

BRIEFLY EXPLAIN HOW THIS COURSE WILL MEET THE APPLICABLE LEARNING GOALS.

1. Understand the general principles associated with the discipline(s) studied.

   Students will be introduced to the course content through weekly assigned reading, class discussion, and weekly exercises using the published laboratory text.

2. Understand the methodology and activities scientists use to gather, validate and interpret data related to natural process.

   Students will be introduced to a wide variety of scientific methods used to measure Earth’s processes at multiple time frames that include the historic and geologic. For example, the first lab exercise on earthquakes (week 6) will require that students examine multiple seismic records from a single event and from these estimate seismic intensity and locate earthquake epicenter. Similarly, in other topics covered in this class, students will be introduced to a variety of methods for quantifying environmental changes that result from geologic processes and they will be required to use these methods to investigate real examples of such change.

3. Detect patterns, draw conclusions, develop conjectures and hypotheses, and test them by appropriate means and experiments.

   Students will undertake these scientifically-framed activities through each week’s laboratory. For example, we will explore relationships among magma chemistry, volcanic explosivity and landforms, and volcanic hazards and we will use this information to formulate a risk analysis for humans living near two very different active volcanoes: Mount Rainier and the Island of Hawaii.

4. Understand how scientific laws and theories are verified by quantitative measurement, scientific observation, and logical/critical reasoning.

   Students will explore the application of scientific reasoning, including hypothesis-testing through measurement and interpretation to environmental geology. A specific example is that in week 14, students will map mercury and chromium concentration data from the uppermost 2-3 cm of lake sediment in Lakes Erie from 1971 and 1997/98, analyze the results, and derive conclusions regarding the changing source of contaminants and success of pollution mitigation efforts between the two sampling periods.

5. Understand the means by which analytic uncertainty is quantified and expressed in the natural sciences.

   Analytic uncertainty is introduced as a stand-alone topic in week 3, the laboratory focusing on measurements, basic calculations and conversions, and graphs in the context of environmental geology. In addition, analytic uncertainty is incorporated into each
weekly laboratory in the context of the specific measurement types utilized for that week's project. For example, in discussions of heavy metals pollution, analytic uncertainty associated with measurements of contaminations in soil and water samples will be explored. Similarly, in the lab exercise on earthquakes, students will investigate analytic uncertainty in the context of epicenter location and estimation of seismic intensity.

VI. ASSESSMENT

A. HOW ARE THE LEARNING GOALS FOR THE GENERAL EDUCATION GROUP MEASURED?
Describe how you will determine that students have met each of the General Education Learning Goals. This should include specific examples of assignments, rubrics or test questions that directly measure the General Education learning goals. (See Example)
Please attach or provide a web link to relevant assessment materials.

6. Understand the general principles associated with the discipline(s) studied.

The general principles covered in this class will be assessed in two ways:
1.) At the beginning of the semester, students will be asked to complete a questionnaire focusing on basic concepts covered in class. The same questionnaire will be given to the students during the final day of class as part of the class evaluations. The difference in results from pre-to post-class will form part of the course summative assessment.

2.) Prior to and following each weekly lab, the students will be asked to answer a brief set of questions designed to evaluate the success of the lab towards increasing student understanding of and skills pertaining to that week's topic.

7. Understand the methodology and activities scientists use to gather, validate and interpret data related to natural process.

The scientific method and its application to natural processes will be addressed in the context of environmental geology. Specific examples include: a) during week 5, students will investigate the May 18 and May 25 1980 eruptions of Mt. St. Helens through aerial photography, topographic maps, LIDAR imagery, and tephra isopach maps. b) during week 7, the class will investigate the 1989 Loma Prieta Earthquake by analyzing regional seismicity maps and cross-sections, isoseismic maps, seismic hazard maps, and comparisons of artificial fill types and their locations with vertical seismic velocities.

Student understanding and retention of the scientific methods used in environmental geology will be assessed through the pre-and post-class environmental geology questionnaire and the weekly pre- and post-lab questionnaire.

8. Detect patterns, draw conclusions, develop conjectures and hypotheses, and test them by appropriate means and experiments.

Pattern detection and integration into hypothesis-testing will be covered through a wide variety of class topics. For example, relationships among volcanic landforms, magma chemistry, and resulting hazards will be covered in two separate laboratories (weeks 4 and 5).

Both of these specific examples as well as all other class topics will be assessed through the pre- and post-class environmental geology questionnaire and the weekly pre- and post-lab questionnaire.

9. Understand how scientific laws and theories are verified by quantitative measurement, scientific observation, and logical/critical reasoning.

Each laboratory exercise will involve the implementation of scientific theories by quantitative measurement, scientific observation, and critical reasoning. For example, in week 15, students will investigate the problem of groundwater overdraft and saltwater intrusion through the critical evaluation of groundwater altitude maps and their changes through time, and through analysis of dissolved solids concentration model results. Students also will explore various conceptualized engineering solutions to saltwater intrusion.
Assessment pertaining to how well students are retaining class material on the scientific process will be measured through the pre- and post-class questionnaires and the weekly pre- and post-lab questionnaires.

10. Understand the means by which analytic uncertainty is quantified and expressed in the natural sciences.

A wide variety of measurement units will be introduced and discussed in this class in the context of scientific measurements involved in this lab course. Specific examples include the measurement of earthquake intensity, the measurement of pollutants, the rates of coastal erosion, flood prediction models, and volcanic hazards risk.

The concept of analytic uncertainty in environmental geology will be assessed through the pre- and post-class questionnaires and the weekly pre- and post-lab questionnaires.

A General Education Assessment Report will be due on a four-year rotating cycle. You will be notified in advance of the due date. This will serve to fulfill the University’s accreditation requirements to assess general education and will provide an opportunity to connect with your colleagues across campus and share teaching strategies. Items VI.B-D will be helpful in compiling the report.

B. ACHIEVEMENT TARGETS

[This section is optional. Achievement targets can be reported if they have been established.]

Describe the desirable level of performance for your students, and the percentage of students you expected to achieve this:

1. Pre- vs. post-class questionnaires: I anticipate a 75% improvement rate between the pre- and post-class questionnaires.

2. Pre- and post-lab questionnaires: I anticipate that the pre- vs. post-lab questionnaires will yield an aggregate average improvement of 80%.

C. ASSESSMENT FINDINGS

[This section is optional. Assessment findings can be reported if they are available.]

What were the results/findings, and what is your interpretation/analysis of the data? (Please be detailed, using specific numbers/percentages when possible. Qualitative discussion of themes provided in student feedback can also be reported. Do NOT use course grades or overall scores on a test/essay. The most useful data indicates where students’ performance was stronger and where it was weaker. Feel free to attach charts/tables if desired.)

D. ASSESSMENT FEEDBACK

[This section is optional. Assessment feedback can be reported if it is available.]

Given your students’ performance the last time the course was offered, how will you modify the course to enhance learning? You can also address how the course could be improved, and what changes in the course content or pedagogy you plan to make, based upon on the findings. Please include a time frame for the changes.

VII. SYLLABUS AND SUBMISSION

Please submit syllabus in a separate file with the completed and signed form to the Faculty Senate Office, UH 221. The learning goals for the Natural Science Group must be included on the syllabus. An electronic copy of the original signed form is acceptable.