**General Education Course Inclusion Proposal**

**SCIENTIFIC INQUIRY**

*This proposal form is intended for departments proposing a course for inclusion in the Northern Michigan University General Education Program. Courses in a component satisfy both the Critical Thinking and the component learning outcomes. Departments should complete this form and submit it electronically through the General Education SHARE site.*

**Course Name and Number: GC255 Physical Geology**

**Home Department: Department of Earth, Environmental, and Geographical Sciences**

**Department Chair Name and Contact Information** (phone, email): **Dr. Susy Ziegler**, [suziegle@nmu.edu](mailto:suziegle@nmu.edu), 3001NSF, x2500

**Expected frequency of Offering of the course** (e.g. every semester, every fall): **Every Fall, Winter, Summer**

**Official Course Status**: Has this course been approved by CUP and Senate? **YES**

*Courses that have not yet been approved by CUP must be submitted to CUP prior to review by GEC. Note that GEC is able to review courses that are in the process of approval; however, inclusion in the General Education Program is dependent upon Senate and Academic Affairs approval of the course into the overall curriculum.*

**Overview of course** (please attach a current syllabus as well): *Please limit the overview to two pages (not including the syllabus)*

A. Overview of the course content

Physical Geology is the science of the Earth, including minerals and rocks, tectonics, water, and all the processes acting within and on the Earth surface. These include groundwater, glaciers, streamflow, mass wasting, volcanism, earthquakes, oceans and coastal processes and more. The course also includes a component of societal use of, and potential problems with living on and using each materials.

B. Explain why this course satisfies the Component specified and significantly addresses both learning outcomes

Physical Geology is a study of Earth resources and processes, includes spatial analysis of phenomena, and includes the sciences of physics and chemistry. The scientific method is introduced in the Introductory Chapter of the course, and employed throughout the course in weekly discussions and laboratory analyses. Quantitative methods are used throughout the course, and students employ multiple sources of information to make hypotheses regarding Earth processes, physical properties of the Earth, and landform origins.

Students completing the course will be able to 1) understand the scientific processes, 2) valuate the reliability of information regarding scientific topics, 3) formulate ideas with regards to Earth Science topics and communicate them effectively, 4) formulate questions, develop hypotheses, design and perform experiments, analyze data and relate seemingly diverse information to arrive at conclusions. These tasks are part of both the laboratory and the lecture portion of the course. The critical thinking component is evaluated in the lecture portion of the course, and the scientific inquiry is evaluated in the laboratory portion of the course.

In the lecture portion of GC255 students use the assigned textbook and varied scientific literature, and learn how to make informed decisions based on scientific data. They also perform in-class activities that require utilization of critical thinking and inquiry

The laboratory portion of the course meets the scientific inquiry requirements by incorporating no fewer than ten hands-on laboratory exercises where students will make observations, develop questions, and subsequently formulate hypotheses and predictions. In all labs, students will be required to draw conclusions based on thoughtful consideration of their data analyses, and will communicate their findings initially through informal classroom discussions and formally in written form submitted to the instructor (for grading). Students’ will compile their work in laboratory notebooks.

C. Describe the target audience (level, student groups, etc.)

As a 200-level course, it may be taken by all undergraduates. As a current Division III Natural Science lab course, the audience is very diverse. No prerequisite is required.

D. Give information on other roles this course may serve (e.g. University Requirement, required for a major(s), etc.)

In addition to being offered as a Division III Liberal Studies course for decades, it serves as a foundation course for all Earth Science and Secondary Education Earth Science majors. It is a prerequisite for several upper-level Earth Science GC courses.

E. Provide any other information that may be relevant to the review of the course by GEC

Lab exercises in GC255 Physical Geology include activities such as mineral identification, igneous, sedimentary, and metamorphic rock identification, map analysis (topographic) which is used to analyze, quantify, and derive physical attributes and spatial associations of landforms in several later lab exercises, plus quantitative analysis of streamflow, groundwater, coastal, and glacier data and processes, their distribution, and the statistical analysis of historical data. In all labs, data is presented in many forms (tabular data, topographic, spatial, physical properties, etc.), which the student must synthesize into a logical hypothesis and reach a conclusion. The student must then communicate their findings in quantitative, map, tabular, and/or written form.

**PLAN FOR LEARNING OUTCOMES  
CRITICAL THINKING**

*Attainment of the CRITICAL THINKING Learning Outcome is required for courses in this component. There are several dimensions to this learning outcome. Please complete the following Plan for Assessment with information regarding course assignments (type, frequency, importance) that will be used by the department to assess the attainment of students in each of the dimensions of the learning outcome. Type refers to the types of assignments used for assessment such as written work, presentations, etc. Frequency refers to the number of assignments included such as a single paper or multiple papers. Importance refers to the relative emphasis or weight of the assignment to the entire course. For each dimension, please specify the expected success rate for students completing the course that meet the proficiency level and explain your reasoning. Please refer to the Critical Thinking Rubric for more information on student performance/proficiency in this area. Note that courses are expected to meaningfully address all dimensions of the learning outcome.*

|  |  |  |
| --- | --- | --- |
| **DIMENSION** | **WHAT IS BEING ASSESSED** | **PLAN FOR ASSESSMENT** |
| **Evidence** | Assesses quality of information that may be integrated into an argument | Students will study literature related to many Earth Science topics. They will explore different types of information on each these topics and discuss the validity of all reports in group classroom settings. Because Earth Science is always a current news theme, students will compare media reporting with peer-reviewed scientific research and communicate their findings in oral reports. Based on department expectations, combined categories of “proficient” and “exceeds proficiency” shall exceed 70% of students. Student assessment of this dimension will consist of 10% of the lecture grade. In-class lab assignments will require students to assess the quality of information and formulate their arguments accordingly. Such assignments will comprise approximately 10% of the laboratory grade. |
| **Integrate** | Integrates insight and or reasoning with existing understanding to reach informed conclusions and/or understanding | Exams and assignments – including those from the laboratory section - will evaluate the foundational relationship of theory and previous research in drawing conclusions. At least 20% of the questions in these assessment instruments will evaluate the integration of insight or reasoning with existing data to reach informed conclusions. This dimension may also be assessed by written reports that ask students to integrate the material from recent news reports (for example, recent earth hazards such as flooding, earthquakes, volcanic activity, landslides, etc.) with their understanding of earth system processes. Between the paper, questions on lecture exams on quizzes, and laboratory analysis, approximately 40% of the course will deal with integration of information. We expect that 70% of students meet or exceed the proficient standard (grade of “C” or above) on aspects of assessments aimed at this dimension. This is consistent with average grades for all department courses combined. |
| **Evaluate** | Evaluates information, ideas, and activities according to established principles and guidelines | Core concepts, theories, and methods of Earth Science will be included in exams, assignments, and exercises throughout the course. To reach proficiency, students must demonstrate ability to apply concepts, logic and factual information when critically examining Earth materials and processes. Evaluations will require that conclusions and judgments be supported by logic and evidence. Evaluations will draw upon conceptual understanding based upon established scientific principles. Students will be evaluated individually, but some group work may be included entirely within the laboratory section of the course. In the case of group projects, students are also evaluated individually by the instructor with a peer evaluation component. At least 20% of the questions in these assessment instruments will evaluate the integration of insight or reasoning with existing data to reach informed conclusions. We expect 70% or greater student proficiency upon course completion. This is consistent with average grades for all department courses combined. |

**PLAN FOR LEARNING OUTCOMES  
SCIENTIFIC INQUIRY**

*Attainment of the SCIENTIFIC INQUIRY Learning Outcome is required for courses in this component. There are several dimensions to this learning outcome. Please complete the following Plan for Assessment with information regarding course assignments (type, frequency, importance) that will be used by the department to assess the attainment of students in each of the dimensions of the learning outcome. Type refers to the types of assignments used for assessment such as written work, presentations, etc. Frequency refers to the number of assignments included such as a single paper or multiple papers. Importance refers to the relative emphasis or weight of the assignment to the entire course. For each dimension, please specify the expected success rate for students completing the course that meet the proficiency level and explain your reasoning. Please refer to the Rubric for more information on student performance/proficiency in this learning outcome. Note that courses are expected to meaningfully address all dimensions of the learning outcome.*

|  |  |  |
| --- | --- | --- |
| **DIMENSION** | **WHAT IS BEING ASSESSED** | **PLAN FOR ASSESSMENT** |
| **Research Question** | Develop a manageable and appropriate research question that is tied to testable hypotheses. | Students are presented with a problem (statement). The student then must acquire and begin the analysis of pertinent data. For example, in the minerals lab, students first learn of unique physical properties each mineral has, and then must test a set of minerals that need to be identified. Five or more laboratory sessions will include hands-on exercises where individuals or small groups of students will be expected to identify a scientific problem, evaluate what is known about a problem, formulate questions with regard to the problem, and develop testable hypotheses, given the materials at their disposal. Informal assessments will include class discussions and sharing of ideas among student groups. For formal assessment purposes, students will be expected to document and compile their work in a laboratory notebook, to be submitted weekly to the instructor. In addition to these vehicles of assessment, questions regarding the construction of research questions and testable hypotheses will appear on quizzes and/or exams. Based on department expectations, combined categories of “proficient” and “exceeds proficiency” shall exceed 70% of students. The weight of this dimension relative to that of the laboratory grade is approximately 15%. |
| **Methodology/Data Collection** | Select and/or develop appropriate scientific methodologies | Three or more laboratory sessions will require students to engage in experimental design to test hypotheses that they have developed. Students must construct experiments using materials presented in lab, or developed by the student, and will gather data from these tests. Three or more additional laboratory sessions will require that students collect data from experiments developed by the instructor. Informal assessments will include individual and class discussions, and sharing of methodology among individuals and student groups will be encouraged. Formal assessments will include evaluation of students’ laboratory notebook submissions, which will include complete, accurate, and organized records of experimental design, methodology, and data collection for each specific exercise. In addition, questions regarding experimental design, scientific methodology and data collection will appear on quizzes and/or exams. Based on department expectations, combined categories of “proficient” and “exceeds proficiency” shall exceed 70% of students. The weight of this dimension relative to that of the laboratory grade is approximately 15%. |
| **Analysis, Results and Presentation** | Collected data is appropriately analyzed and presented | In each lab assignment, the student must present their results in a written format. In each case, they must explain their rationale as to why the interpretation was reached (e.g. present the evidence based on their interpretation of the data). Ten or more laboratory exercises will require students to analyze data they have collected or that has been presented to them by their lab instructor. Students will compare their results with the hypotheses being tested. Emphasis will be placed on discovery of geographically spatial patterns and trends in data, recognizing anomalies, measuring and evaluating physical properties of materials, and calculating simple descriptive statistics such as mean, standard deviation, mode, recurrence interval, etc. Informal assessments will include individual and class discussions and sharing of analyses and presentation of results among individuals and student groups. Formal assessments will include evaluation of students’ laboratory notebooks, which will include complete, accurate, and organized records of data analysis appropriate to specific exercises. In addition, questions regarding data analysis and results interpretation will appear on quizzes and/or exams given in lab. Based on department expectations, combined categories of “proficient” and “exceeds proficiency” shall exceed 70% of students. The weight of this dimension relative to that of the laboratory grade is approximately 30%. |
| **Discussion/Conclusions** | Conclusions are linked to evidence and are in the context of scientific limitations and implications. | The lab assignments are read and evaluated weekly, and feedback is given, along with a grade for the assignment and suggestions how to improve. Lecture exams are similar but include multiple question formats. All assignments and exams are discussed collectively in class. Six or more laboratory sessions will require students to draw conclusions from the results obtained from either data that they have obtained through experiments or acquired from internet sources (historical streamflow discharge data, for example), and then analyzed, or from material that has been presented to them by their lab instructor. Informal assessments will include individual and class discussions and sharing of conclusions among students in the class, as well as relating results back to possible flaws in experimental design, methodology, human error, and hypothesis generation. Formal assessments will include evaluation of students’ laboratory submissions, which should include presentation of data, analysis, and discussion of results. In these sections, students will be expected to construct cohesive, logical summaries, syntheses and arguments (where appropriate). In addition, questions regarding results interpretation, limitations of current (or provided) methodologies, and implications for future research will appear on quizzes and/or exams given in lab. In addition, assignments in lecture will require students to formulate conclusions based on readings of textbook, alternative sources, and primary literature based on scientific principles. Based on department expectations, combined categories of “proficient” and “exceeds proficiency” shall exceed 70% of students. The weight of this dimension relative to that of the laboratory grade is approximately 25%. |