**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: GC210 Earth Hazards**

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

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

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

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

**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

### Bulletin description: This course focuses on the study of how the normal physical processes of the Earth concentrate their energies and impact humans and their structures. Earth system processes such as volcanoes, earthquakes, landslides, floods, subsidence, meteorite impacts, and tsunamis will be studied. Techniques for evaluating the risks associated with these hazards is included in the course.

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

The processes of Earth are based mostly upon physics and chemistry. Also, computers and mathematics are integral tools to analyzing data in the science of geology. Students in the GC210 class first learn fundamentals regarding a specific process, and are presented with data, and are expected to formulate hypotheses from their analyses. For example, students must be able to determine the location and magnitude of an earthquake from interpretation and then analysis of seismograph data. Of course, they first learn how to interpret a seismogram and the physics of earthquake wave generation and travel through the Earth. And, for example, students in the class are capable of statistically analyzing historical flood records and determine recurrence intervals, assessing the probabilities of catastrophic events and the risks associated with populating areas prone to those risks. Other topics include volcanoes and mapping hazard zones, landslides and quantification of susceptibility to failure, ground subsidence issues, etc. and in every case, the hazards these events pose to humans.

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, analyze data to arrive at conclusions, and 5) communicate their findings. These tasks are part of both the lecture portion (which includes in-class exercises and quizzes and exams), and a semester-long research project resulting in a term paper (required in the course). The critical thinking component is evaluated in the lecture portion of the course, and the scientific inquiry is evaluated in the exercises and the required research portion of the course culminating in a term paper.

In the lecture portion of GC210 students use the assigned textbook and varied scientific literature (articles and internet sources), 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

Although there is no formal laboratory portion of the course, the scientific inquiry requirement is accomplished by incorporating no fewer than ten hands-on exercises where students make observations, develop questions, and subsequently formulate hypotheses. In all exercises, students will be required to draw conclusions based on thoughtful consideration of their data analyses, and will communicate their findings formally in written form submitted to the instructor (for grading).

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

As a current Division III Natural Science and Math Liberal Studies course, it is offered at a freshman or sophomore level to introduce students to the natural processes of Earth, and the impacts of those processes on human occupation of the planet. No prerequisites are required.

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

GC210 Earth Hazards is required of all Earth Science and Secondary Education Earth Science majors. It is currently a service course to the general University as a Division III Liberal Studies Natural Science and Mathematics, non-lab course. It also serves as an elective and substitute within the department of Earth, Environmental, and Geographical Sciences.

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

In this course I teach about the direct or indirect controls of natural hazards. Also, because human activities can trigger or increase the potential for hazards, our role as individuals and as society in mitigating natural hazards are considered. By the end of the course, students are able to recognize where and why natural hazards occur, their frequency of occurrence, and how their effects can be avoided or minimized to reduce loss of life and cost. They are able to synthesize data using the scientific method, evaluate the data to form hypotheses, and make sound scientific interpretations of their observations. From this class, they learn to make, and encourage others to make, informed economic and political decisions with respect to natural hazards based on scientific fact. It is this logic that was presented to CUP and the Liberal Studies Committee only a few years ago when the course was first introduced. In our exponentially growing population in a global society, students who take this course are prepared to face environmental challenges associated with living on Earth, no matter where they are.

**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.*

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| **DIMENSION** | **WHAT IS BEING ASSESSED** | **PLAN FOR ASSESSMENT** |
| **Evidence** | Assesses quality of information that may be integrated into an argument | Students complete multiple choice/true false and short answer essay questions that verify students familiarity with content presented in class.Students have exercises in which data and information are presented. These are evaluated by use of exercises (weekly) and multiple choice/true false/short answer-essay questions (weekly). Also, a semester-long research paper (tracking disasters that happen during the semester) will be the basis for assessment.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 the form of a written research report. Based on department expectations, combined categories of “proficient” and “exceeds proficiency” shall exceed 70% of students. Student assessment of this dimension will consist of 30% of the overall grade. In-class weekly assignments will require students to assess the quality of information and formulate their arguments accordingly. Such assignments will comprise approximately 10% of the overall grade. The term paper will comprise approximately 20% of the final grade. |
| **Integrate** | Integrates insight and or reasoning with existing understanding to reach informed conclusions and/or understanding | Students evaluate data after learning about processes in class. Students must then present their findings in written and quantitative form. For example, after learning about the methods of calculating probabilities, students estimate the recurrence intervals of various disasters, like flooding, earthquakes, etc. These are evaluated in multiple choice/true false/short answer-essay questions weekly (quizzes) and bi-weekly (exams). The term paper and final exam will be used to assess this dimension.Exams and assignments – 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 will also be assessed by a written research paper 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 research paper, questions on lecture exams on quizzes, and in-class exercises, approximately 20% 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 | Students learn about the scientific method in the first week of class and then employ it throughout the class in exercises. Additionally, students must begin a semester-long research project (disasters happening around the world for the duration of the class) and submit a written report of their findings at the end of the class. Core concepts, theories, and methods of natural Earth hazards 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 hazards 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. However, some group work may be included at the discretion of students in the course. 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.*

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| **DIMENSION** | **WHAT IS BEING ASSESSED** | **PLAN FOR ASSESSMENT** |
| **Research Question** | Develop a manageable and appropriate research question that is tied to testable hypotheses. | In every section of the class (correlative with the 15 chapters of the textbook currently in use), students are presented with data and information regarding physical processes of the Earth, and the potential hazards they pose to human existence. They must evaluate data and formulate a hypothesis. These are evaluated in multiple choice/true false/short answer-essay questions weekly and are of moderate emphasis in the course.Students are presented with a problem (statement) in in-class exercises. The student then must acquire and begin the analysis of pertinent data. Some data may be given to them (not available from other sources) or acquired through research or internet sources. For example, students learn the physics of earthquake waves and how they travel through the Earth. There are multiple sources of real-world data for actual events. Using the knowledge gained through literature and in-class information, with data from seismographs around the world, students interpret actual data, and process it to find the epicenter of the earthquake. The course will include five or more such in-class exercises where individuals or small groups of students will be expected to identify a scientific problem, evaluate what is known about a problem, formulate research questions with regard to the problem, and develop testable hypotheses, given the materials at their disposal. Students will be expected to document and compile their work in a notebook, with individual to be submitted weekly to the instructor, in hard-copy or digital. In addition to these vehicles of assessment, questions regarding the construction of research questions and testable hypotheses may appear on quizzes and exams, where possible. 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 overall grade is approximately 15%. |
| **Methodology/Data Collection** | Select and/or develop appropriate scientific methodologies  | After being presented with data and relevant information (usually spatial information from satellite imagery, maps, and determining probabilities, etc.) students must process that information using quantitative and manual interpretation techniques. These are evaluated in multiple choice/true false/short answer-essay questions weekly, and through the required term paper.Three or more assignments will require students to engage in experimental design to test hypotheses that they have developed. Students must construct experiments using materials presented to them, or developed by the student, and will gather data from these tests. Three or more additional assignments will require that students collect data from experiments developed by the instructor. Formal assessments will include evaluation of students’ assignment 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 final grade is approximately 15%. |
| **Analysis, Results and Presentation** | Collected data is appropriately analyzed and presented | Students analyze all relevant data presented to them, or acquired outside class, arrive at an interpretation, and present results in quantitative and written form. For example, when analyzing flooding, students process not only historical data for probability analysis but spatial information to assess the extent of potential damage in a floodplain. These are evaluated in multiple choice/true false/short answer-essay questions weekly.In each 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). Six or more in-class exercises will require students to analyze data they have collected or that has been presented to them by their 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’ assignment submissions, 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. 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 overall grade is approximately 10%. |
| **Discussion/Conclusions** | Conclusions are linked to evidence and are in the context of scientific limitations and implications. | Students must write a report or statement that includes their interpretation of data and information they processed. Additionally, their understanding of the process or feature is evaluated in written exam questions. These are evaluated in multiple choice/true false/short answer-essay questions weekly, and integrated into a semester-long research report and is of high emphasis in the course.The class 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 assignments 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 flooding data to analyze recurrence intervals (return period), for example), and then analyzed, or from material that has been presented to them by their 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’ assignment 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. 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 overall grade is approximately 25%. |