**General Education Course Inclusion Proposal**

**SCIENTIFIC INQUIRY**

*Note: In revising this document, I deleted some sections and inserted revised ones, changing the structure of the document. I left out the deletions, as it made this version difficult to read. If you’d like to see a version with the deleted sections in strike-through, let me know.*

*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:** BI 210 Principles of Ecology

**Home Department:** Biology

**Department Chair Name and Contact Information** (phone, email): John Rebers, 227-1585 jrebers@nmu.edu

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

**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)*

1. Overview of the course content

Each of the main sections of this course include observational, correlational, and experimental studies to address the following topics in ecology:

* Populations and Communities: how are they maintained, how they interact with each other and the abiotic environment, and the factors influencing their change over time.
* Coping with Environmental Variation: a discussion of the ways that animals and plants have adapted to environmental variation and the impact the adaptation has on abundance and distribution of organisms.
* Evolution and Ecology: the linkages and feedbacks between evolution and ecological interactions and the evidence behind these relationships.
* Competition: organisms often compete for biotic and abiotic resources and these relationships often influence their abundance and distribution.
* Herbivory, Predation, and Parasitism
* Global Ecology: anthropogenic alterations of nutrients and deposition of pollutants can cause significant change in ecosystems and influence the future of humankind.
* Production, Nutrient Supply and Cycling: specific nutrients play pivotal roles in the structure of ecosystems and the distribution and abundance of populations. Their movements through ecosystems can structure communities.

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

This course is designed to satisfy both the *Critical Thinking* and the *Scientific Inquiry* learning outcomes as defined by NMU’s General Education requirements. Please note that these two learning outcomes can overlap; together they are the foundation of science and scientific advancement. (Note that the percentages given for assessment of each dimension in the “Plan for Learning Outcomes” below add up to more than 100%.)

This course meets the *critical thinking* component by engaging students in asking questions about the fundamental of ecology, assessing information from a variety of sources, and synthesizing this information. In particular, time is spent in this course on defining “scientific literature”, and teaching students how to identify it, search it, and use it. Students will also spend time comparing information in the literature to research questions that they work to address in the lab portion of the class.

This course meets the *scientific inquiry* component by requiring students to think about, in detail, the process of designing a scientific study. This includes identifying a research question, developing appropriate methods of collecting and analyzing data, and using the data analysis and scientific literature to synthesize this information and place it in a larger context. Students will study examples of this process in lecture, and actually engage in this process in the laboratory section.

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

This is a sophomore-senior level course that has BI 111 and BI 112 as course prerequisites, and will fulfill a General Education requirement. The majority of students in the course are Biology majors, with some Environmental Science majors.

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

This course is required for all Biology majors, Fisheries and Wildlife Management majors, and Environmental Science majors. It is also a laboratory class.

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

The course enrollment in recent past has been about 135 students in the Fall and 105 students in the Winter semesters. It has most recently been taught by two members of the Biology faculty who supervise 4-6 laboratory sections and an equal number of graduate teaching assistants. Some types of exercises and assessments (engaging with the scientific literature, writing papers, etc.) are impractical to do in the lecture section due to the large enrollment and single lecture instructor. In many cases, these assessments have been moved to the (smaller) lab section of the class, even if they are not strictly “lab” activities. Note that the lab section is responsible for ~40% of the course grade, due to this division, even though the lab is technically only 25% of the credit hours for this 4-credit course.

**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 | Exams and assignments will evaluate students on the application of scientific approaches to the study of ecology, including use of data and previous research to support arguments. This dimension will be assessed by having students evaluate scientific research in the lecture portion of the course, and in the lab by having students find scientific literature, evaluate it, and use it in writing a scientific paper. A lab exercise is included focusing specifically on identifying scientific literature, and differences between primary and secondary literature. Assessments will include lecture exams, a library exercise on the use of primary literature, and papers and lab reports that require use of the scientific literature. Between lecture and laboratory sections, 20-30% of the course will address this dimension. The department expects 35 % exceeding proficient (B- and above) + 30% proficient upon course completion. While we would like to have all students show mastery, we believe it reasonable to expect a mean of about 65% of students meeting or exceeding the proficient standard.  |
| **Integrate** | Integrates insight and or reasoning with existing understanding to reach informed conclusions and/or understanding | Exams and assignments will emphasize the foundational relationship of theory and previous research in drawing conclusions about questions in ecology. Assessments will include 3-4 lecture exams and two laboratory exams as well as assignments in the laboratory. Between lecture and laboratory sections, 20-30% of the course will address this dimension. We expects 65% or greater student proficiency upon course completion. While we would like to have all students show mastery, we believe it reasonable to expect a mean of about 65% of students meeting or exceeding the proficient standard.  |
| **Evaluate** | Evaluates information, ideas, and activities according to established principles and guidelines | Core concepts, theories, and methods of ecology 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 ecological questions and processes. Evaluations will require that conclusions and judgments be supported by logic and evidence. Opinion in the absence of evidence or conceptual foundations will not meet the standard of proficiency regarding critical thinking. Students will be evaluated mostly individually, but some group work will be included. Between lecture and laboratory sections, ~30% of the course will address this dimension. We expect 65% or greater student proficiency upon course completion. While we would like to have all students show mastery, we believe it reasonable to expect a mean of about 65% of students meeting or exceeding the proficient standard.  |

**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. | Lectures and laboratories will embed examples of biologists using the scientific method to create research that tests scientific hypotheses. Exams and assignments will evaluate students on their ability to apply the scientific method and formulate testable hypotheses. At least two assessments in the laboratory portion of the class will address the development of a research question, for a minimum of ~10% of the course addressing this dimension. The department expects 35 % exceeding proficient (B- and above) + 30% proficient upon course completion. While we would like to have all students show mastery, we believe it reasonable to expect a mean of about 65% of students meeting or exceeding the proficient standard.  |
| **Methodology/Data Collection** | Select and/or develop appropriate scientific methodologies  | Lectures and laboratories will embed examples of biologists using the scientific method to create research that tests scientific hypotheses. Exams and assignments will evaluate students on their ability to apply appropriate methods to acquire data needed to answer specific hypotheses. Case studies will be covered in lecture, and the methodologies addressed. Methodology and data collection will also be a focus of the laboratory section. Between lecture and laboratory sections, 20-30% of the course will address this dimension. Assessments will be ongoing and will include a summative evaluation at the end of the semester. The department expects 35 % exceeding proficient (B- and above) + 30% proficient upon course completion. We would like to have all students show mastery, but we believe it reasonable to expect a mean of about 65% of students meeting or exceeding the proficient standard.  |
| **Analysis, Results and Presentation** | Collected data is appropriately analyzed and presented | Lectures and laboratories will incorporate examples of how biologists analyze and present data. There will be a particular focus on this dimension on the laboratory section of the class, where students be required to collect and analyze their own data during multiple exercises. Lab exams and assignments will evaluate students on their ability to acquire data, analyze it appropriately and present data in coherent and meaningful ways. Between the lecture and laboratory sections, 20-30% of the course will address this dimension. Assessments will be ongoing and will include a summative evaluation at the end of the semester. The department expects 35 % exceeding proficient (B- and above) + 30% proficient upon course completion. We would like to have all students show mastery, but we believe it reasonable to expect a mean of about 65% of students meeting or exceeding the proficient standard.  |
| **Discussion/Conclusions** | Conclusions are linked to evidence and are in the context of scientific limitations and implications. | Lectures and laboratories will include information on how biologists base conclusions on evidence with full recognition of strengths, limitations, and conclusions of their experimental design and quality of data in their deliberations. Exams and assignments will evaluate students on their ability to draw conclusions on specific hypotheses based upon data and evidence. Between the lecture and laboratory sections, ~40% of the course will address this dimension. Assessments will be ongoing and will include a summative evaluation at the end of the semester. The department expects 35 % exceeding proficient (B- and above) + 30% proficient upon course completion. We would like to have all students show mastery, but we believe it reasonable to expect a mean of about 65% of students meeting or exceeding the proficient standard.  |