**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: Introductory Biology, BI111**

**Home Department: Biology**

**Department Chair Name and Contact Information** (phone, email): Dr. 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 IN PROGRESS

*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

This course provides an introduction to the major principles central to the big topics in Biology: Biomolecules, Cells, Genes, Ecology and Evolution. The introduction will provide exposure to the rapidly expanding body of scientific knowledge pertaining to living systems, to the foundational theories that explain biological processes, and to the creative and inspiring process of rigorous scientific inquiry.

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

This course design will satisfy both the *Critical Thinking* and the *Scientific Inquiry* learning outcomes as defined by NMU’s General Education requirements. These two learning outcomes can overlap; together they are the foundation of science and scientific advancement. The following is a specific set of learning goals for this course consistent with desired outcomes of the General Education Program. Upon successful completion of this course, a student should be able to:

* Describe the fundamental qualities of the scientific process.
* Define the structure, function and genesis of the major classes of biomolecules.
* Provide a general description of the construction and action of cellular components.
* Describe the basic principles of genetic heredity.
* Give a comprehensive description of the evidence for and scientific fact of evolution.
* Define the basic properties of biological populations, communities and ecosystems.
* Critically evaluate popular accounts of biological phenomena.

In the laboratory portion of the class, students will perform hands-on tasks that provide understandings of the scientific method, the characteristics of macromolecules and cell membranes, genetics, ecology, and evolution. In performing these tasks, students will develop skills with data collection, data analysis, and data presentation. Students will be required to work in teams to complete assigned laboratory activities, will be expected to write formal laboratory reports based upon their laboratory results, and will be required to demonstrate an understanding of the use of the scientific method. At the conclusion of the semester, students will give group presentations on material from the primary literature, demonstrating their understanding of the scientific method.

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

1. Scientific Inquiry – In this module, the process of science is discussed in more detail. Students learn about how to design a quality scientific experiment. Students have the opportunity to practice identifying examples of science and to compare those to examples of pseudoscience, or things that claim to be scientific, but are not.
2. Basic Chemistry of Life – To make sense of how cells work, we must constantly return to their parts (atoms and molecules) and the interactions among them. This is why a clear understanding of some chemistry is essential to understanding how life functions. This unit focuses on the atom. Students learn how atoms combine to form different molecules, making up all the diverse matter in the universe. In this unit, students explore nonliving components of the hierarchy of life.
3. Properties of Biomolecules – There are four classes of biological macromolecules that students study in this course: carbohydrates, lipids, proteins and nucleic acids. In this unit, students use these fundamental building blocks to form the cell, the first level of organization that shows all the characteristics of life.
4. Cell Structure – In this unit, students learn about the cell and all the parts that make it functional. Students also focus on the cell membrane, which is the structure that surrounds the cell and separates its internal environment from the external environment.
5. Cell Reproduction – Cell reproduction provides new cells for growth, the replacement of dead cells, and healing. Cell reproduction it ensures the inheritance of genetic information from parent cell to offspring cell, and it ensures the inheritance of genetic information from one generation to the next. In this unit, students learn about how cells carry out these critical processes. Understanding of the information in this unit will lay the foundation for understanding heredity and molecular genetics.
6. Transmission Genetics – In this unit, students focus on the direct links between genetic information and visible traits. This will help students learn how genetic information can be passed from one generation to the next and how these genes affect the later generation. We will introduce simple examples of traits that are clearly visible and have a direct correlation to genetics.
7. Molecular Genetics – Students learn about the storage, transmission, and expression of genetic information (central dogma of molecular biology), whereby the information content in DNA sequences, called genes, is ultimately converted to a protein. Students look at the structure of genes and genomes and at the interactions between genes and the environment. Finally, students examine how humans are able to manipulate genes through biotechnology.
8. Ecology – Students study the branch of biology that studies life at population and higher levels of organization, emphasizing how groups of living organisms interact with each other and with nonliving factors in their environment.
9. Evolution – Evolution considers how life changes from one generation to the next and how these changes accumulate over very long time scales. Students gain an understanding with analyses that evaluate the relatedness among lineages, how organisms have diversified, and how biodiversity is unified.

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

The target audience for this course is freshmen-level students majoring in one of the Biology majors at NMU.

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

BI111 is a required course for all Biology majors at NMU and serves as a prerequisite for all other required major courses except BI112. BI 111 is also a required course in programs offered by other Departments – Chemistry (Biochemistry, Forensic Biochemistry, and Medicinal Plant Chemistry); Clinical Sciences (Clinical Laboratory Science, Diagnostic Genetics) EEGS (Environmental Science) as well as being a required course for the interdisciplinary Neuroscience major.

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

This course is being proposed for inclusion in the GEC curriculum because of concerns expressed by the administration, not from a grassroots interest on the part of the faculty members of the department. The specific rationale behind the pressure to include BI111 in the GEC curriculum is so BI111-equivalent courses taken by transfer students at other institutions can be used to fulfill GEC requirements.

One of the concerns expressed by Biology faculty about including BI 111 as a general education course is that students may not have enough background to do well in BI 111. We are considering requiring a minimum score on a placement exam to enter BI 111 or requiring that students have completed high school biology or BI 100 before entering BI 111. Any change in the prerequisites would be submitted to CUP.

**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 | This dimension will be assessed by quizzes, exams and assignments, including a summative evaluation at the end of the semester. At least 10% of the questions in these assessment instruments will evaluate application of experimental approaches to the study of biology, including use of data to support arguments. We would like to have all students show mastery, but we believe it reasonable that students who pass the class (>60% across all lecture work and across all lab work) would have demonstrated they meet or exceed the proficiency standard on aspects of assessments aimed at this dimension. |
| **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 about questions in biology. At least 10% of the questions in these assessment instruments will evaluate the integration of insight or reasoning with existing data to reach informed conclusions. We would like to have all students show mastery, but we believe it reasonable that students who pass the class (>60% across all lecture work and across all lab work) would have demonstrated they meet or exceed the proficiency standard on aspects of assessments aimed at this dimension. |
| **Evaluate** | Evaluates information, ideas, and activities according to established principles and guidelines | Core concepts, theories, and techniques biology 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 biological phenomena 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, especially through the laboratory section of the course. At least 10% of the questions in these assessment instruments will evaluate the integration of insight or reasoning with existing data to reach informed conclusions. We would like to have all students show mastery, but we believe it reasonable that students who pass the class (>60% across all lecture work and across all lab work) would have demonstrated they meet or exceed the proficiency standard on aspects of assessments aimed at this dimension. |

**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, laboratory reports and assignments will evaluate students on their ability to apply the scientific method and formulate testable hypotheses. Assessments will be ongoing and will include a summative evaluation at the end of the semester. The department expects 30% 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 60% 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. In laboratories, students evaluate, modify and enact different methods to collect data. Exams and assignments will evaluate students on their ability to apply appropriate methods to acquire data needed to answer specific hypotheses. Laboratory notebooks are collected over the course of the semester and assessed for thoroughness of data Assessments will be ongoing and will include a summative evaluation at the end of the semester. The department expects 30% 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 60% of students meeting or exceeding the proficient standard.  |
| **Analysis, Results and Presentation** | Collected data is appropriately analyzed and presented | This dimension will be assessed by a group presentation in the laboratory portion of the class, and by at least one laboratory report. At the end of the semester, groups of 3-4 students will give oral presentations on one lab assignment. Students are evaluated by the instructor using a standardized rubric and also by their peers. Exams and assignments will evaluate students on their ability to apply appropriate methods to acquire data needed to answer specific hypotheses. Assessments will be ongoing and will include a summative evaluation at the end of the semester. The department expects 30% 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 60% of students meeting or exceeding the proficient standard. The proficiency level is based upon the expectation that all biology students develop a solid ability to collect data, analyze their data, and present their findings to their peers. |
| **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, quizzes and assignments will evaluate students on their ability to draw conclusions on specific hypotheses based upon data and evidence. Assessments will be ongoing and will include a summative evaluation at the end of the semester. The department expects 30% 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 60% of students meeting or exceeding the proficient standard. This proficiency level is based upon the fact that the exams, assignments and quizzes are rigorous and are intended to challenge students to draw inferences and conclusions from the information provided. |