**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:** Biological Science, BI 100

**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

**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 is designed for the general student and focuses on content which supports topics which are germane to the issues a person will likely encounter such as health, disease, environmental issues, and energy. Content includes cell biology, health, genetics, ecology and evolution.

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

This course is designed to ensure that students 1) understand and can use the scientific processes, 2) are able to evaluate the reliability of information around scientific topics, 3) are able to formulate and express ideas with regards to biological topics, 4) can formulate questions, develop hypotheses, design and perform experiments, analyze data and synthesize information to express conclusions. These tasks are part of both the laboratory and the lecture portion of the course. However, for the purpose of this evaluation we are centering the critical thinking component in the lecture portion and the scientific inquiry in the laboratory portion of the course.

In the lecture portion of BI 100 students analyze primary literature, make informed decisions based on scientific data, perform in-class activities that utilize both critical thinking and inquiry skills such as:

* Computer-based or hands-on simulations such as those available through HHMI Biointeractive where they determine through analysis of fossils the evolution of a fish.
* Small group discussions in small groups which are then shared with the entire class over topics such as alternative energy or DNA fingerprinting in crime solving.
* Answering higher-level critical thinking questions with clickers.

The laboratory portion of the course meets the scientific inquiry requirements by incorporating no fewer than two hands-on laboratory exercises where students will make observations, develop questions, and subsequently formulate hypotheses and predictions. Given materials at their disposal, students will design methods to test their hypotheses, and will be expected to carry out these experiments. Data generated will be analyzed, and the results summarized and presented to the class. In at least two additional sessions, students will perform analyses of instructor-provided data sets, and will present their results to their peers. In these four-plus lab sessions, and in at least two more, students will be required to draw conclusions based on thoughtful consideration of the results of their data analyses, and will reflect on them both in classroom discussions and in written form. Students’ will document their work in laboratory notebooks and written assignments.

C. Describe the target audience (level, student groups, etc.) BI 100 is designed for the general student population and does not count toward a biology degree. It is also approved as a laboratory science course for the graduation requirements. There are no prerequisites for the course.

D. Give information on other roles this course may serve (e.g. University Requirement, required for a major(s), etc.) BI 100 is required for a major in social work. In several other subject areas it is a course that is one of an approved list such as elementary education integrated science minors may select it or BI 111.

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

**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 will explore primary literature related to one or more topics studied, some of which may be controversial. They will explore different types of information on these topics and assess the accuracy of reports. They will compare media and personal information with that which is the result of valid scientific research. They will demonstrate this analysis through assignments such as a brief literature review on with a summary statement. 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 lab, students will be presented with supporting and refuting evidence for various topics in biology that may be of national or global importance, such as embryonic stem cell research or human population growth. In-class group assignments will require students to assess the quality of this 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 | Students are able to use a collection of scientific resources to synthesize a summary of findings. ~~An assignment for this would be for students to~~ Students select or are assigned a relatively narrow topic and collect pertinent, reliable research articles then use these to formulate a summary synthesis which is written up and presented in class. As an example, currently students collect data on their own diet and compare these data with research-based recommendations such as the FDA food pyramid or the Harvard Plate, create a graphic and reflect on their findings. In addition, exam questions will require students to formulate conclusions based on given information and the knowledge gained through lecture and readings. Based on department expectations, combined categories of “proficient” and “exceeds proficiency” shall exceed 70% of students. The student assessment of this dimension will comprise 20% of the lecture grade. As mentioned above, in laboratory, students will examine various topics in biology that may be of national or global importance, such as embryonic stem cell research or human population growth. In-class group assignments will require students to examine their preconceived ideas and personal ethics in light of the scientific evidence presented, and to ultimately construct informed conclusions. Such assignments will comprise approximately 10% of the laboratory grade. |
| **Evaluate** | Evaluates information, ideas, and activities according to established principles and guidelines | The students will be able to express opinions by explaining the science behind a topic and defending their position using valid resources either as separate assignments or as essay questions on exams. This may be done as an assignment, in class or homework; or as essay questions on tests. Examples may be GMOs, stem cell research, immunization, genetic sequencing to determine whether someone carries genes for disease, etc. Topics will change as time goes on to fit what is most pertinent at the time. 70% of the students will demonstrate proficiency of this dimension by written argument either as part of exams or as separate assignments. An example of a question might be “After reading the chapter and completing other assignments on genetically modified organisms, discuss your opinion on the use of GMOs. You should explain the science behind genetic modification and use reliable resources to defend your position.” In addition, much of the content in the course is assessed through exams or otherwise at an application or higher level. For example, questions concerning genetic outcomes given new (to the student) scenarios will be analyzed and reported on. Based on department expectations, combined categories of “proficient” and “exceeds proficiency” shall exceed 70% of students. The student assessment of this dimension will comprise 20% or more of the lecture grade. |

**PLAN FOR LEARNING OUTCOMES
SCIENTIFIC INQUIRY**

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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. | Two or more laboratory sessions will include hands-on exercises where 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 research ideas among student groups. For formal assessment purposes, students will be expected to document their work in a laboratory notebook. In addition, questions regarding the construction of research questions and testable hypotheses 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 15%. |
| **Methodology/Data Collection** | Select and/or develop appropriate scientific methodologies  | Two 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 at their disposal, and will gather data from these tests. Two or more additional laboratory sessions will require that students collect data from instructor-planned experiments. Informal assessments will include class discussions and sharing of methodology among student groups. Formal assessments will include evaluation of students’ laboratory notebooks, which should include complete, accurate, and organized records of experimental design, methods, and data collection, appropriate to specific exercises. In addition, questions regarding experimental design, scientific methodology and data collection 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 15%.  |
| **Analysis, Results and Presentation** | Collected data is appropriately analyzed and presented | Four 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 patterns and trends in data, recognizing outliers, and calculating simple descriptive statistics such as means. Informal assessments will include class discussions and sharing of analyses and presentation of results among student groups. Formal assessments will include evaluation of students’ laboratory notebooks, which should 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. | Six or more laboratory sessions will require students to draw conclusions from the results obtained from either data that they have analyzed, or that has been presented to them in materials presented to them by their lab instructor (e.g. documentary films). Informal assessments will include class discussions and sharing of conclusions among student groups, as well as relating results back to possible flaws in experimental design and hypothesis generation. Formal assessments will include evaluation of students’ laboratory notebooks, which should include Conclusions and Future Directions headings. 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%. |