**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: Introduction to Cell and Molecular Biology, BI218**

**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

*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 structure and function of the basic unit of life – the cell. The lecture portion of the course covers the molecular basis of cell structure and function, with a particular focus on DNA structure, DNA replication, chromosome structure, gene organization, RNA transcription, protein translation, control of gene expression, cell membranes, membrane transport, metabolism, and cell signaling. In the laboratory portion of the class, students will develop basic molecular biology skills including micropipetting, gel electrophoresis, Polymerase Chain Reaction (PCR), and recombinant DNA techniques. 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 laboratory exercises, demonstrating their understanding of the scientific method along with the central tenets of cell and molecular biology.

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. Each of the main sections of this course include observational, correlational, and experimental studies to address the focal topics in cell and molecular biology.

This course addresses the *Critical Thinking* learning outcome in multiple ways. Some exam questions and in-lecture clicker questions require students to integrate information that they have learned previously to answer novel questions about an experiment or biological process. Students write a term paper that requires them to critically evaluate articles from the popular press on topics related to cell and molecular biology (genetically modified organisms, disease risk, anti-oxidants, etc.) based on what they have learned in the course. This gives them valuable experience in analyzing the information content of an article, and in questioning the reliability of information sources that may appear superficially reliable, but less accurate upon more detailed scrutiny.

Similarly, this course addresses the *Scientific Inquiry* learning outcome in multiple ways. Themes of experimental design and hypothesis testing are regularly emphasized in the lecture portion of the course, particularly in discussions of topics such as the classic series of experiments that established that DNA was the carrier of genetic information. As this course is currently taught, the laboratory portion of the class makes up 50% of the course grade. In the laboratory portion of the course, all of the dimensions of the *Scientific Inquiry* learning objective are addressed, from developing a research question and hypotheses, collecting data and performing experiments, analyzing and presenting results, and making inferences and drawing conclusions based on those results. Students complete two lab reports, a final project, and a class presentation on their project in the lab section.

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

The target audience for this course is sophomore-level students majoring in one of the Biology majors at NMU. The prerequisite course work for enrollment in this course includes a year of freshman chemistry (CH 111 & CH 112) as well as and a semester of freshman biology (BI 111).

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

BI218 is a required course for all Biology majors at NMU and serves as a prerequisite for another required major course, Genetics (BI312).

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 | This dimension will be assessed by ongoing quizzes, exams and assignments, including a summative evaluation at the end of the semester. At least 20% of the questions in these assessment instruments will evaluate application of experimental approaches to the study of cell and molecular biology, including use of data to support arguments. Students will also evaluate popular press articles covering topics in cell and molecular biology, based on the material that they learn in the course. Between these different assessments, ~25% of the course will involve evaluation of evidence. We would like to have all students show mastery, but we believe it reasonable to expect a mean of 65% of students meeting or exceeding 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. |
| **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 cell and molecular biology. 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 term papers that ask students to integrate the material from popular news reports (genetically modified organisms, genetic risks of disease, effects of antioxidants, etc.) with their understanding of basic cellular processes. Between the paper, questions on lecture exams on quizzes, and a lab project to research a gene in detail, ~30% of the course will deal with integration of information. We would like to have all students show mastery, but we believe it reasonable to expect a mean of 65% of students meeting or exceeding 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 cell and molecular 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 cellular 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. In the case of group projects, students are also evaluated individually by the instructor and via peer evaluations. 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 65% or greater student proficiency upon course completion. 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. 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. | 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. Between lecture and laboratory assessments, this dimension will comprise ~20% of the course. 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.  |
| **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 at the end of the semester and assessed for thoroughness of data. Between lecture and laboratory assessments, this dimension will comprise ~20% of the course. 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 | This dimension will be assessed by lab reports (2), a final lab project, and a group presentation on this project in the laboratory portion of the class. 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. Forms of analyses in cell and molecular biology will also be addressed in the lecture portion of the course. Between lecture and laboratory assessments, this dimension will comprise ~25% of the course. 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. 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. Between lecture and laboratory assessments, this dimension will comprise ~40% of the course. 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. 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. |