**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 Organic and Biochemistry, CH 109**

**Home Department: Chemistry**

**Department Chair Name and Contact Information** (phone, email): Mark Paulsen (ext 1064, mpaulsen@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

The Catalog describes CH 109 as an “An introduction to the different classes of organic molecules and their reactions which are applicable to biochemistry. Basic biochemical concepts including acid/base chemistry, structure and function of biomolecules and metabolic pathways which are involved in producing energy.” The laboratory portion of the course reinforces concepts taught in lecture in addition to providing practice with mathematical concepts such as plotting data, using calibration curves, and reaction rates. The course consists of 3 hours of lecture and a 2 hour laboratory period each week.

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

**Critical Thinking Outcome**.

**Evaluate**

Throughout the lecture portion of the course the students are presented material in manner that requires them to evaluate information. One example involves understanding the reactivity of carbonyl groups of biologically relevant molecules. Students are presented with typical reactions of carboxylic acids and amides and then learn to predict the reaction outcomes of similar molecules. Also, many concepts are presented in a fundamental manner and students are asked to extrapolate how these same concepts are affected by the environment of the human body, which has a specific temperature and pH range.

**Integrate**

Connecting concepts is a regular feature of lecture and evaluated assignments. For example, after learning about the acidity of carboxylic acids and the basicity of amines, students are asked to integrate both characteristics when dealing with amino acids, which are subunits of proteins and contain both acid and base components. The students also have to evaluate how the body pH will affect the nature of the biological molecule. All of this requires not only a basic understanding of the functional group qualities of biological molecules, but how they behave chemically when next to each other in the same molecule at a specific pH.

**Evidence**

Students in CH 109 assess the quality of information through interactive lecture along with the solution of problems on homework and exams. During the problem solving process, students will be faced with choices which could include which concepts to apply and which pieces of information are required.

**Scientific Inquiry Outcome**

Scientific inquiry is modeled through the lecture component of the course via interactive lectures, homework assignments and in-class examinations as well as in the laboratory.

**Discussion/Conclusions**

For most laboratory experiments students collect data, analyze it via a graph, table, or calculation, and then at the end are asked to draw some conclusions based upon this data. See the **Research Question** section below for examples.

**Analysis, Results, and Presentation:**

In two laboratories students prepare or use a calibration curve. They explore why a calibration curve is needed, how to collect the data, plot it using Excel, and then obtain and use a best-fit line to determine an unknown quantity. Production of good plots (titles, axis labels, and recognizing outliers) is emphasized. Another exercise requires students to practice statistical analysis of data and decide whether any numerical values are true “outliers” and should be discarded. The last laboratory exercise has the students think about forensic DNA analysis and what the current state of DNA technology consists of after reading through several examples of creative and unique uses of DNA profiling. The students orally go through several examples and as a class discuss the pros and cons of such technology.

**Methodology/Data Collection:**

Students don’t routinely develop their own methodology but they do have to figure out how to manage time, and how to physically manipulate equipment in a safe and effective manner. This requires quite a bit of thinking of how to best collect data for analysis. One lab involves a multi-step serial dilution that is complex enough that it forces students to pay attention and organize the set-up and steps well in advance of any pipetting.

**Research Question:**

The short laboratory periods allow only rudimentary research questions to be addressed. In one exercise students measure the amount of acetaminophen in an “unknown” sample, and after achieving the results are asked to speculate on whether the subject would have been poisoned by consuming the amount that was calculated. Although the instructors know the “unknown” concentration the students don’t, so this experiment simulates research as much as possible in a two-hour lab period. In another experiment, students calculate the amount of Calories contained in a specific type of nut through thermochemistry, and then must decide, when the data do not match the vendor’s label, if the experiment has a technical flaw or if the manufacturer is under-estimating the caloric value. This type of analysis is similar to research that might be done as a quality control analyst in the food industry.

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

The majority of the students in CH 109 are pre-nursing students as successful completion of this course is a prerequisite for the nursing program. Most of the students are in either their first or second year of college.

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

See C.

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

Not applicable.

**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 | **Type:** Homework and exams.**Relation to Dimension:** Students must use information correctly to solve problems.**Success Rate:** We expect ~70% of our students will get these evidence questions correct. |
| **Integrate** | Integrates insight and or reasoning with existing understanding to reach informed conclusions and/or understanding | **Type:** Homework and exams.**Relation to Dimension:** Students will combine skills and knowledge learned from solving problems in lecture to solve new problems using the same principles.**Success Rate:** We expect ~70% of our students will get these integration questions correct. |
| **Evaluate** | Evaluates information, ideas, and activities according to established principles and guidelines | **Type:** Homework and exams.**Relation to Dimension:** Students will have to evaluate the problem and determine which chemical principles and problem solving methods should be applied.**Success Rate:** We expect ~70% of our students will get these evaluation questions correct. |

**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. | **Type:** Several laboratory assignments that are somewhat open ended. **Relation to Dimension:** These laboratory assignments will consist of a scenario or case study which students must evaluate using concepts developed in class. Students will be provided with a scenario, and a procedure to use for data collection, and then evaluate what the data show and apply them to the scenario. **Success Rate:** We expect 70% of our students will be able to reach this goal by the end of the semester. |
| **Methodology/Data Collection** | Select and/or develop appropriate scientific methodologies  | **Type:** Several laboratory assignments that are somewhat open ended. **Relation to Dimension:** See above, the students will be responsible for choosing how to implement a proposed procedure. The students will not have time in a two-hour laboratory period to fully develop original procedures, nor do we expect them to at the first year level. **Success Rate:** We expect 70% of our students will be able to reach this goal by the end of the semester. |
| **Analysis, Results and Presentation** | Collected data is appropriately analyzed and presented | **Type:** Several laboratory assignments that are somewhat open ended. **Relation to Dimension:** These laboratory assignments will consist of a scenario or case study which students must evaluate using concepts developed in earlier lab exercises. To formalize the presentation most lab exercises include reporting standard errors. **Success Rate:** We expect 70% of our students will be able to reach this goal by the end of the semester. |
| **Discussion/Conclusions** | Conclusions are linked to evidence and are in the context of scientific limitations and implications. | **Type:** Several laboratory assignments that are somewhat open ended. **Relation to Dimension:** These laboratory assignments will consist of a scenario or case study which students must evaluate using concepts developed in earlier lab exercises. After data analysis is complete, students will determine whether logical conclusions can be reached, and what the % error implies. **Success Rate:** We expect 70% of our students will be able to reach this goal by the end of the semester. |