Type of Request:
Renew

Subject code	Course Number	Catalog Year
BIOB	210N	2021-2022

Course Title
Communication of Biology

College/School	Department
Missoula College	Applied Arts and Sciences

Level	Campus	Semesters offered
Undergraduate (U)	Missoula College	Spring, Fall

Does course require a lab?
No

Description & Purpose
BIOB 210N explores topics in biology that have substantial influence on the modern human experience. In spite of the undeniable impact of biological phenomena on our daily lives, there is a troubling disconnect between what scientists discover and what everyday citizens understand. Science as it is communicated in today's world can appear complex, exclusive, and conflicting. This course examines scientific discovery and its dissemination by focusing on general biology topics that affect students' everyday lives and human influences on living systems. The three main purposes of this class are to:

1) Explore current issues in the life sciences that relate to our daily lives.
2) Develop skills interpreting and synthesizing scientific information as it is currently shared.
3) Foster confidence and skills writing about issues in biology to a non-scientist audience.

This course asks students to read, interpret, and synthesize science journal articles. It also examines other modern methods of communicating about science, from news articles to podcasts to videos. Students will scrutinize both the biology content and the communication about science through class discussion and their writing.

BIOB 210N provides Missoula College (MC) students a general education science course without a lab as a complement to the existing science courses at MC, most of which include labs.

Justification / explanation
The course is 200-level and includes the prerequisite of WRIT 101 (or equivalent) as needed for all Intermediate-level writing courses. There are no science prerequisites.

Additional Information (For OCHE Database):

In which MUS Core Category, does this course fit?
Natural Science

Does the course include content regarding cultural heritage of American Indians?
No

Attachments

Syllabus
BIOB 210N course syllabus - SP20.pdf

Other
BIOB 210 Synthesis Paper Instructions.pdf

Criteria

Briefly explain how this course meets the criteria for the group:
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Courses explore a discipline in the natural sciences and demonstrate how the scientific method is used within the discipline to draw scientific conclusions:
This course explores topics in general biology focusing on issues that affect everyday lives. The focus is more specific and demanding of students than a 100-level, introductory biology course, but is nonetheless broad in scope, addressing general themes in biology such as human health and disease, global change, and evolution. The two key distinctions between this general biology course and other introductory biology courses are the emphasis on biology as it relates to modern human experiences and the critical examination of how biological discovery is communicated through literature, media, and other modern means.

Encouraging the development of a deep appreciation for science as a process of exploration is a core component of this course. The purposes of this course are to guide students in an exploration of essential biology content and to critically examine the mechanisms through which scientists communicate their findings. As a consequence, the course asks students to read, summarize, and synthesize refereed science journal articles through several assignments and activities. The process demands attention not only to conclusions, but to the process of investigation as outlined in a journal article's methodology. Although this course does not include a laboratory component, students demonstrate key components of scientific inquiry through their examination of literature and their written syntheses of multiple sources. The process of science as inquiry is explicitly discussed in class lecture and discussion. Lastly, students explore and scrutinize other mechanisms of communicating biology, such as popular magazines, blogs, podcasts, and videos that share the journey of scientific discovery beyond just reporting a set of facts.

Courses address the concept of analytic uncertainty and the rigorous process required to take an idea to a hypothesis and then to a validated scientific theory
The concepts of uncertainty and science as a process are core themes in this course. Students develop skills to recognize, describe, and address uncertainty through oral and written expression of scientific findings. Validation of results is explored through class instruction and interactive activities devoted to interpreting data sets and charts and synthesizing multiple sources. Students focus particular attention to the meaning and value of skepticism and consensus, including how they relate to the development of scientific theories. Reviews of scientific literature and other means of communication are used to reinforce the role of development and testing of hypotheses in scientific inquiry. Assignments and activities ask students to display their understanding of these fundamental features of science through written work.

Lab courses engage students in inquiry-based learning activities where they formulate a hypothesis, design an experiment to test the hypothesis, and collect, interpret, and present the data to support their conclusions.
BIOB 210N does not include a lab.

Student Learning Goals

Briefly explain how this course will meet the applicable learning goals.
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Understand the general principles associated with the discipline(s) studied.
Through completion of this course, students will be able to understand and describe common biological phenomena that relate to their lives, such as human impacts on ecosystems, health and disease, species interactions, and evolution. Students read, summarize, and synthesize primary and secondary sources of recent biological discovery as they relate to course content. Classroom instruction presents core content through lectures and guided class discussion.

Understand the methodology and activities scientists use to gather, validate and interpret data related to natural process
Students read primary sources written by biologists, including the methodology shared by the authors. Other means of science communication, such as podcasts and online articles, include the story of investigation in valid scientific discovery. Focused learning units include interpretation of data and charts, synthesizing multiple sources, and understanding the role of consensus in scientific validity. For example, the topic of invasive species is explored with direct instruction of species identification and ecological impacts followed by student examination of three research papers with particular attention given to methodology and interpreting published data sets.

Detect patterns, draw conclusions, develop conjectures and hypotheses, and test them by appropriate means and experiments.
Developing skills of pattern detection and drawing valid conclusions from data are essential themes in the content of BIOB 210. These goals are met through guided interpretation of published data in literature and conclusions shared through secondary sources such as news articles. The class has no laboratory component, but addresses hypothesis testing in three ways. Firstly, students examine hypothesis testing in published papers and other sources. Secondly, students model hypothesis testing by proposing explanations for biological phenomena to be explored through their research and written work. Lastly, a learning unit focused on citizen science projects models hypothesis testing as a component of quality research.

Understand how scientific laws and theories are verified by quantitative measurement, scientific observation, and logical/critical reasoning.
BIOB 210 guides students to an appreciation of how scientific theories are developed and what they represent in science. Class content distinguishes between hypothesis testing and theory development through direct instruction and class discussion referencing scientific theory in biology, such as evolution, as a model. Critical analysis and synthesis of multiple sources contribute to understanding the value of theory development and its dependence on repeated testing, refinement, and consensus. Connecting these class objectives with the course theme of communication of biology reinforces the value of reliable observation and measurement as presented in diverse readings of scientific research. The connection to scientific theory will be made further with inclusion of broad-reaching works and meta-analyses.

Understand the means by which analytic uncertainty is quantified and expressed in the natural sciences.
Students completing BIOB 210 develop skills describing and appreciating uncertainty in science. Students assess validity using diverse means of communicating about biology. Readings demonstrate quality representations of uncertainty alongside poorly communicated uncertainty for comparison. Topics such as climate change, nutrition, and population biology lend themselves readily to such examination. Although the course does not include direct measurement of natural phenomena, students identify and describe uncertainty as presented in the methods and findings of research papers in their written work.

Learning Outcomes Assesments

How are the learning goals for the General Education Group measured?
Describe how you will determine that students have met each of the General Education Learning Goals. This should include specific examples of assignments, rubrics or test questions that directly measure the General Education learning goals. (See Sample Form) Please attach or provide a web link to relevant assessment materials.

Understand the general principles associated with the discipline(s) studied.
Understanding of biology content is measured in two ways:

1) Weekly quizzes with questions reflecting on readings and class instruction.

Assessment Example 1:
Select the three challenges below that are included in the World Health Organization's list of top threats to human health on Earth:
air pollution organ failure antimicrobial resistance
terrorism homicide pathogens like HIV & influenza

Assessment Example 2:
Which of these is the main concern about the overuse of antibiotics?
a. it can lead to antibiotic-resistant bacteria
b. there will be an antibiotic shortage
c. antibiotics can cause secondary infections
d. antibiotics will get into the water system

2) Students compose the following written work focused on core themes in biology.
a. A summary of a peer-reviewed journal article relevant to class content
b. A community connection project (such as a biology field note for public radio)
c. A synthesis research paper (see attached Assessment Example 3)

Understand the methodology and activities scientists use to gather, validate and interpret data related to natural process.
Understanding scientific methodology and data interpretation is measured in two ways:
1) Weekly quizzes with questions reflecting on readings and class instruction.

Assessment Example 4:
What conclusions are most important to draw from this chart?
(image not included: chart representing growth data for plants under different conditions)
a. Knapweed cannot compete with native fescue & knapweed will soon disappear from Montana.
b. Knapweed competes with native fescue & knapweed exudes chemicals that damage native fescue.
c. Knapweed competes with native fescue & knapweed grows better in Montana soil than in European soil.
d. Knapweed competes with native fescue & knapweed is killed by activated carbon.

2) Summary and interpretation of methodology and data analysis in two written projects:
a. A summary of a peer-reviewed journal article, including methodology
b. A synthesis research paper (see attached Assessment Example 3)

Detect patterns, draw conclusions, develop conjectures and hypotheses, and test them by appropriate means and experiments.
Students will demonstrate their understanding of the scientific method in two ways:
1) Weekly quizzes with questions reflecting on readings and class instruction

Assessment Example 5:
Which of the following changes to the design of this study would most improve the ability to test if the new medication effectively treats ear infections?
a) Create a second group of participants with ear infections who do not use any ear drops
b) Create a second group of participants with ear infections who use 15 drops a day
c) Have participants put ear drops in both their infected ear and healthy ear
d) Have participants use ear drops for only one week

(quizzes are complemented by questions from the Pew Research Center Science Knowledge Quiz)

2) Students address scientific methods and appropriate hypothesis testing in two written projects:
a. A summary of a peer-reviewed journal article relevant to class content
b. A synthesis research paper (see attached Assessment Example 3)

Understand how scientific laws and theories are verified by quantitative measurement, scientific observation, and logical/critical reasoning.
Students understanding of the development and validation of scientific theory is measured in two ways:
1) Demonstrated connection of a focused research topic to broader themes and theories in biology through synthesis of literature in written work (see attached assessment example 3)
2) Instructor observation of active participation in class discussion devoted to verification of findings presented in diverse forms of communication (unquantified but addressed qualitatively in “Assessment Findings” & “Assessment Feedback” below).

Understand the means by which analytic uncertainty is quantified and expressed in the natural sciences.
Student understanding of uncertainty in biology is measured in two ways:
1) Clear expression and analysis of uncertainty in the summary and synthesis of literature in written work (see attached assessment example 3)
2) Instructor observation of active participation in class discussion devoted to uncertainty in biology research and analysis (unquantified but addressed qualitatively in “Assessment Findings” & “Assessment Feedback” below).

General Education Assessment Report

If this information is not yet available, this section must be completed after the next offering (re-submit the entire form with these sections completed by the curriculum deadline). Your course will be granted provisional status until the report is received. Report not required for one-time-only general education offerings.
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Achievement Targets
The desirable level of success is 100%; all students are assumed capable from day one. Expected performance on objective questions is from 75-85% successful. Performance on written work is expected to show 70-80% success in measurable results and reflect genuine understanding of core learning goals through quality, college-level writing.

Assessment Findings (This section is optional. Assessment findings can be reported if they are available.)
Assessment Example 1: Success rate 92%
Assessment Example 2: Success rate 87%
Assessment Example 3 (synthesis research paper):
For learning goal 2: Understand the methodology and activities scientists use to gather, validate and interpret data related to natural process. Success rate 70%
For learning goal 3: Detect patterns, draw conclusions, develop conjectures and hypotheses, and test them by appropriate means and experiments. Success rate 82%
For learning goal 4: Understand how scientific laws and theories are verified by quantitative measurement, scientific observation, and logical/critical reasoning. Success rate 82%
For learning goal 5: Understand the means by which analytic uncertainty is quantified and expressed in the natural sciences. Success rate 78%
Assessment Example 4: 85%
Assessment Example 5: 92%

Qualitative assessments of class discussions:
For learning goal 4: Understand how scientific laws and theories are verified by quantitative measurement, scientific observation, and logical/critical reasoning.
Observation of student discussions, class questions, and reflections supported a high degree of student ability to describe verification of scientific theory. Students collectively understood concepts such as control groups, reduction of bias, and sound methodology in individual research projects and the value of synthesis, replication, and collaboration in the process of broader theory development.
For learning goal 5: Understand the means by which analytic uncertainty is quantified and expressed in the natural sciences.
Observation of student discussions, class questions, and reflections supported a moderate degree of student ability to understand and articulate issues related to scientific uncertainty. Student descriptions of uncertainty often displayed misconceptions that scientific findings are either “truth” or “something no one can know” without recognition of uncertainty as an inherent and quantifiable component of science that does not diminish our interpretation.

Assessment Feedback
Student success in core biology content and understanding of the process of science met or exceeded expectations. The lowest quantifiable metric of success measured was for demonstrated ability to interpret scientists' methods through written work. With anecdotal support from student course evaluation forms and conversations, I suggest that this lower success rate resulted from the very real challenge of understanding the methods sections in most published science papers. Even students who clearly demonstrated an ability to interpret complex data sets and reframe jargon-rich conclusions struggled to accurately summarize scientists' methods. To address this challenge, I propose devoting an instructor-led discussion and low-stakes, interactive activities to methods interpretation. Ungraded practice explaining examples of methodology could benefit student ability and confidence.

BIOB 210N has only been offered once. The spring 2020 group of students was spectacular. This was a class in which everyone was present and engaged on a near-daily basis, where a written assignment often had 100% of students turn in work on time, and where I felt beyond fortunate to be a part of the classroom. I share this to suggest that the moderate-high success rate in measured assessments was a high-performing group of students tempering the reality that a new course always presents numerous opportunities for improvement. In addition to the planned action above, I propose spending the next 2-3 semesters working on the following components of this course:

1) Incorporate learning goals 4 & 5 into more quantifiably measurable outcomes in writing assignments, including the grading rubrics.
2) Deepen the connection between isolated learning units and broader theories in biology.
3) Address the disconnect between the reality of uncertainty in science and the misconception that this signifies meaningless results.
4) Increase low-stakes, interactive activities that provide opportunities to practice the stated goals of the class, such as finding and assessing valid sources, synthesizing resources, and communicating interpretations to non-scientist audiences.

Learning Outcomes

Credits

Credit Hours

Min
-

Max
-

Value
-

Operator
-

Contact Hours

Min
-

Max
-

Value
-

Operator
-

Billing Hours

Min
-

Max
-

Value
-

Operator
-

Lecture Hours

Min
-

Max
-

Value
-

Operator
-

Lab Hours

Min
-

Max
-

Value
-

Operator
-

Other Hours

Min
-

Max
-

Value
-

Operator
-

Academic Progress Hours

Min
-

Max
-

Value
-

Operator
-

Financial Aid Hours

Min
-

Max
-

Value
-

Operator
-

Course Count
-

Repeatable
No

Number Of Repeats
-

Number Of Credits
-

Topics

-

Requisites

No Requisites

Components

-