I. TITLE: BIO 320: Biological Inquiry and Analysis

II. CATALOG DESCRIPTION: An inquiry-based introduction to concepts in biology. Research-oriented activities will emphasize the skills and attitudes necessary for understanding and conducting scientific inquiry.

III. PURPOSE: To learn basic concepts in biology and experience science as a process of active inquiry, thereby providing a solid framework for further study in the discipline.

IV. COURSE OBJECTIVES:

Students shall be able to:

1. design and conduct experiments that address testable hypotheses,
2. analyze scientific data and draw valid conclusions,
3. critically evaluate scientific information,
4. communicate scientific information effectively using a variety of media,
5. demonstrate understanding of the skills and attitudes necessary for effective teamwork,
6. use computers and other modern technology to conduct and report scientific research,
7. apply basic concepts in biology to solving problems,
8. demonstrate understanding of the theory of evolution and related concepts,
9. demonstrate awareness of the significance of biology (and other sciences) to themselves and society, and
10. distinguish between science and non-science.

V. CONTENT OUTLINE: The course is organized into three modules with each module serving as a stepping stone to more in-depth involvement in scientific inquiry and understanding of evolution. In module I you will focus on the history of biology, learning what is science and what it is not, and the study of science (i.e. biology) as a process of inquiry. In module II students move to applying their understanding of science through more extensive scientific inquiry and applications to the study of evolution. In module III, you will focus more fully on change in organisms over time and the concepts of natural selection and adaptation. You will also apply your research skills to a community-service project.

VI. INSTRUCTIONAL ACTIVITIES: The class meets twice weekly. Research-oriented activities will be emphasized during the three-hour meeting each week. During these activities you will propose, design, conduct, and evaluate scientific studies. The second weekly meeting will consist of an assembly (activity/discussion period) during
which you will develop larger, more theoretical knowledge structures that stem from your hands-on experiences, synthesize and formulate relationships between important ideas, and learn concepts and theories specifically related to the process of evolution.

The assemblies for module I will focus on understanding science as a process of inquiry. In the hands-on periods, you will examine different ways of knowing by conducting a simple directed investigation, writing a scientific proposal, and writing a draft paper that will be peer reviewed. In module II, the assemblies will focus on change in living organisms over time. During the hands-on investigations, you will study responses of organisms within the broader context of ecology. As research teams, you will develop a research question that you will then pursue in the field for the next four weeks. Teams will present their investigations in the form of a scientific paper that will then be evaluated by their peers. In the assemblies of module III, you will continue to study and make presentations about change in living organisms over time. The emphasis in the hands-on periods will be investigation of biological issues that are of importance to a local community. You will work as research teams to pose scientific questions of your own, state testable hypotheses, conduct a directed investigation, analyze data, and as teams, present your research as a poster that will be evaluated by faculty and your peers.

**Important Note about Cooperative Learning:** In this course, we will use cooperative learning approaches. Your accomplishments will depend greatly upon your team participation and individual effort. We will use cooperative learning strategies to help you learn to work together in order to maximize your own and each other's learning. If you are unfamiliar with cooperative learning, please review the material for students at: [http://www.wcer.wisc.edu/nise/cl1/CL/doingcl/hints.htm](http://www.wcer.wisc.edu/nise/cl1/CL/doingcl/hints.htm)

**VII. FIELD, CLINICAL, AND LABORATORY EXPERIENCES:** You will work extensively in the laboratory and field. The activities will incorporate use of modern technology (e.g., computers, data loggers, and sensors). In addition, all students are required to attend a minimum of four Department of Biology research seminars. Seminar announcements will be posted in hallways in Blackburn Science Building and the new Biology Building. For each seminar, you are to provide your Professor with a one page typed summary in which you 1) state the purpose of the research conducted, 2) give a brief explanation the scientific methods used, 3) state the conclusions resulting from the research, and 4) give your impression of the quality of the presentation (i.e., explain what you thought was well presented and what was not well presented). Summaries are due the week following a seminar presentation.

**IMPORTANT NOTE:** Appropriate conduct when attending seminars. You are expected to be courteous and attentive during seminars. Do not begin packing your notebooks or leaving your seat until the seminar is finished, even if the seminar runs over-time. Do not talk with colleagues during a seminar. Do not walk in front of the speaker if you enter the seminar room after the seminar has begun. Remember that most seminar speakers are professionals who are visiting the campus for the first time. Your actions will establish an impression of the quality of student that attends MSU. Rude or discourteous behavior will not be tolerated.
VIII. RESOURCES: You will be provided with access to modern equipment for all classroom and field activities.

IX. GRADING:

Grades for all components of the course are assigned as follows:

- > 89% A - unusual ability and distinctive performance
- 80-89% B - articulate, above average performance
- 70-79% C - satisfactory performance
- 60-69% D - passing work, below standard
- <60% E - work not acceptable for passing credit

Grading will be based on written papers, assessments of your knowledge and understanding, results of peer evaluations, student presentations, and participation in class activities. Your success in cooperating as a research team will also be evaluated throughout the course. On some assignments, group grades may be part of your individual grade. Criteria for earning group points will be explained to you as you conduct the team activities. Points for a number of assignments will be based on rubrics. Be sure to review the appropriate rubric for each assignment: rubrics.

All assignments are due on the assigned due date. Required work that is turned in late will be penalized 10% per day late. The only exception to this policy is in the event of a medical or other emergency or an approved university event (e.g., authorized sports events). Written documentation must be provided in evidence of such an emergency. Final exams can only be taken at their scheduled time.

X. ATTENDANCE POLICY: You are expected to attend all scheduled course activities. Because of the nature and structure of the class, attendance is vital to your success in the course.

XI. ACADEMIC HONESTY POLICY: Cheating, plagiarism (submitting another person's material as one's own, or doing work for another person which will receive academic credit) are all impermissible. This includes the use of unauthorized books, notebooks, or other sources in order to secure or give help during an assignment, the unauthorized copying of examinations, assignments, reports, or term papers, or the presentation of unacknowledged material as if it were your own work. It is students' responsibility to determine whether or not a particular source of information is or is not authorized for use in the course. If substantial evidence exists for a violation of this policy, the student(s) involved will receive a grade of 'E' for the course and a written explanation will be included in his/her academic file and a copy sent to the chair of the department in which the student is a major. Disciplinary action may be taken beyond the academic discipline that the instructor administers in the course itself.

XII. TEXT AND REFERENCES:


XIII. PREREQUISITES: Students are expected to be enrolled in BIO 115 when enrolled in BIO 116.

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INFORMATION ON CORE CONTENT STANDARDS FOR GRADES 8 THROUGH 11 COVERED IN BIOLOGICAL INQUIRY AND ANALYSIS (BIO116) FOR SECONDARY EDUCATION IN BIOLOGY MAJORS

Core Content

- **SC-H-3.2.2.** Behavioral responses to internal changes and external stimuli can be innate or learned. Responses to external stimuli can result from interactions with the organism's own species and/or other species, as well as environmental changes.

- **SC-H-3.2.3.** The broad patterns of behavior exhibited by organisms have changed over time through natural selection to ensure reproductive success. Organisms often live in unpredictable environments, so their behavioral responses must be flexible enough to deal with uncertainty and change. Behaviors often have an adaptive logic.

- **SC-H-3.3.3.** Changes in DNA (mutations) occur spontaneously at low rates. Some of these changes make no difference to the organism, whereas others can change cells and organisms. Only mutations in germ cells have the potential to create the variation that changes an organism's future offspring.

- **SC-H-3.4.1.** Species change over time. Biological change over time is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and
recombination of genes, (3) a finite supply of the resources required for life, and (4) natural selection. The consequences of change over time provide a scientific explanation for the fossil record of ancient life forms and for the striking molecular similarities observed among the diverse species of living organisms.

- **SC-H-3.4.2.** The great diversity of organisms is the result of more than 3.5 billion years of biological change over time that has filled every available niche with life forms. The millions of different species of plants, animals, and microorganisms that live on Earth today are related by descent from common ancestors.

- **SC-H-3.4.3.** Biological classifications are based on how organisms are related. Organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their relationships. Species is the most fundamental unit of classification. Different species are classified by the comparison and analysis of their internal and external structures and the similarity of their chemical processes.

- **SC-H-3.5.5.** Human beings live within the world's ecosystems. Human activities can deliberately or inadvertently alter the dynamics in ecosystems. These activities can threaten current and future global stability and, if not addressed, ecosystems can be irreversibly affected.

- **SC-H-2.1A.** Formulate testable hypotheses and demonstrate the logical connections between the scientific concepts guiding a hypothesis and the design of an experiment.

- **SC-H-2.1B.** Use equipment, tools, techniques, technology, and mathematics to improve scientific investigations and communications.

- **SC-H-2.1C.** Use evidence, logic, and scientific knowledge to develop and revise scientific explanations and models.

- **SC-H-2.1D.** Design and conduct different kinds of scientific investigations.

- **SC-H-2.1E.** Communicate and defend the designs, procedures, observations, and results of scientific investigations.
• **SC-H-2.1F.** Review and analyze scientific investigations and explanations of other investigators, including peers.

• **SC-H-2.1H.** Analyze the role science plays in everyday life and compare different careers in science; recognize that scientific knowledge comes from empirical standards, logical arguments, and skepticism, and is subject to change as new evidence becomes available; and investigate advances in science and technology that have important and long-lasting effects on science and society.

**PRAXIS Biology Content Knowledge**

• Scientific methodology: scientific methods, process skills, facts, concepts, models, commonly shared scientific ideals, and history and philosophy

• Mathematics, measurements, and data manipulation:
  - measurement and notation systems
  - data collection, manipulation, interpretation, and presentation, including tables, graphs, charts, and error analysis

**PRAXIS Biology Content Essays**

Evolution and Ecology

• Data analysis, experimental design, and investigation questions evaluate examinees’ ability to design experiments that test simple hypotheses, analyze and interpret data, suggest demonstrations that illustrate concepts, and propose investigations within a specific content area.

• Concepts, models, and systems questions evaluate examinees’ ability to use scientific knowledge to formulate major concepts, to understand model use and limitations and to communicate the process by which scientists create and use models, and to understand the interacting components of a functional biological system.