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**Master Syllabus**

**Course: BIO 499, Capstone Research**

**Cluster 5A, Capstone Study, and 5B, Learning through Engagement**

**Course Overview:**

The Biology capstone course is an in-depth study of a specific topic within a subdiscipline, to be selected by each instructor. Students will study the topic through a combination of readings and guest lectures, then identify a research question for individual study. Each student will produce a professional-style research poster and present it at an undergraduate research symposium. Students will disseminate their research results to a general audience and reflect on the role of biological research in their communities.

Sections will be offered in a 3-hour, once-a-week block and limited to 15 students. Senior standing in the Biology program will be a prerequisite.

**Learning Outcomes:**

Course-Specific Learning Outcomes:

This course is designed to address and assess Biology department program objectives.

Content knowledge

1. Upon completion of the two-year core, Biology majors will understand fundamental concepts related to cellular and molecular biology, organismal biology, ecology, and evolutionary biology.[[1]](#footnote-1)
2. Upon graduation, Biology majors will have in-depth understanding of concepts in one or more sub-disciplines.

Proficiency in analytical and technical skills

Biology majors will be able to

1. Articulate biological questions and formulate hypotheses.
2. Design an experiment to test a hypothesis.[[2]](#footnote-2)
3. Collect and analyze data using appropriate biological research tools and computer software.2
4. Express results in writing, verbally, and graphically.
5. Explain the importance of the results in the context of the original hypothesis.

Fluency in the scientific literature

Biology majors will be able to

1. Read, with critical understanding, current journal articles in at least one field of biology.
2. Communicate, verbally and in writing, the findings of current articles.
3. Evaluate the literature relevant to a biological question.

University Studies Learning Outcomes:

Cluster 5A (Capstone Study)

Upon completion of the capstone study, students will be able to

1. Synthesize the knowledge and skills gained within major courses, independently complete a research‐based project or creative work and integrate the results of both in an open‐ended project or experience (projects within the major are encouraged).
2. Integrate knowledge and principles from the field of study with those of the broader University Studies curriculum.
3. Demonstrate advanced information literacy skills by selecting, evaluating, integrating and documenting information gathered from multiple sources into discipline‐specific writing.
4. Communicate effectively, both orally and in writing, the results of the project or experience.

Cluster 5B (Learning through Engagement)

Upon completion of this requirement, students will be able to

1. Identify the needs and resources of the communities to which they belong.
2. Apply knowledge and skills gained through academic study to real problems and/or opportunities within their communities.
3. Describe the connections between learning on campus and the issues and needs of broader academic, professional or civic communities.
4. Articulate the value of engagement to other members of their communities.

**Examples of Texts and/or Assigned Readings:**

Readings will vary widely by instructor, but will mostly be articles from the primary scientific literature on the course topic.

**Example Assignments:**

To complete the capstone, students must:

1. Complete the Major Field Test in Biology (assessing BIO Objective 1).

Completion of the Major Field Test in Biology will be required in order to pass the capstone course, but scores from the test will in no way affect grades in the course. The test will be administered during class time.

1. Conduct individual research based on an original experimental/observational study OR a review of the literature in a topic, resulting in a professional-style poster OR publication-style manuscript and poster. The research topic will be selected by the student and approved by the instructor. In order to meet the course objectives, literature reviews must address a biological question. Students will demonstrate the broader societal importance of the research question.

Each section of the course will focus on a particular subfield of biology, to be chosen by the instructor. Each instructor will also decide whether students will produce a literature review, conduct research, or have a choice of either option, and whether the final product will be a poster or a paper with a poster. Research projects will need to be selected so that they can be conducted by individual students, either during class time or independently with minimal supervision, and can be completed within a few weeks.

Projects will be assessed with several assignments across the semester (see course outline below): a research proposal, annotated bibliography, first draft of the poster, peer review, and a final poster.

1. Present a poster describing the results of the individual research at a Biology Student Research Symposium. The poster session will be open to the public and will be judged by Biology faculty. In addition, middle school and high school classes will be invited to attend, drawing on an existing network of contacts that already exists within the department. Each student must prepare a 5-minute oral presentation to accompany the poster.
2. Write an essay about their research for a general audience, to be posted to a department-wide blog on undergraduate research. The essay must summarize their independent research; describe their research process; and explain the societal importance of the research question itself, the general research area, or scientific research in general.

A blog showcasing undergraduate research in Biology capstone courses and in other settings (e.g. BIO 440) will be created by the department in collaboration with Instructional Development. The blog will be brought to the attention of local-area high school science teachers each semester through the Southeastern Massachusetts STEM Network and its online newsletter, The Petri Dish. Interested teachers will be encouraged to have students comment on blog posts. The blog will also be linked to the department web site, where it can be seen by prospective students.

1. Write a reflection on what they learned through conducting research, presenting their information in the poster session and on the blog, and seeing other presentations and blog posts. Reflections will demonstrate engagement with each other, the instructor, invited speakers, judges and guests at the poster session, blog readers, and the global community of scientists.

**Mapping to University Studies outcomes:**

Students will need to apply knowledge and skills built across the biology curriculum in order to complete an original research project (A1). To integrate the biological research with the broader curriculum, students must articulate, in their research proposal, final poster and essay, the societal importance of their research question (A2). If the research project is a literature review, students will need to integrate information from many sources. If the project is an experimental or observational study, a literature review will still be a component of the project (A3). The research project will be presented as a poster, with an accompanying oral presentation, and an essay for a general audience (A4).

Students are expected to identify “real” questions in biology and apply their research skills and content knowledge to investigate those questions (B2). By identifying an original research question in the project proposal, students are identifying the needs (unanswered questions) of the professional community of biologists. By identifying the primary literature to address that question, they are identifying the resources provided by and available to that community (B1). The assignments also require students to relate their research topic to the needs of society more generally (B1). They will present their research and explain its importance to a wider audience through the poster session (visiting school students) and the blog (students and the general public) (B3). The final reflection requires students to articulate the value of their engagement with their professional community and with the public (B4).

**Sample Course Outline:**

These are sample semester outlines for a course in which students produce literature reviews as posters, and one in which they conduct an experimental or observational study.

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| Week | Literature review | Study |
| 1 | Lectures: instructor overview of the subfield | Lectures: instructor overview of the subfield |
| 2-4 | Discussion of published research papers (papers selected by instructor, discussions led by students) and/or guest speakers | Discussion of published research papers (papers selected by instructor, discussions led by students) and/or guest speakers |
| 5 | Write research proposal with annotated bibliography | Write research proposal with annotated bibliography |
| 6-7 | Continue library research;  Workshops to discuss progress: groups of students or individuals with instructor | Conduct field/lab research;  Workshops to discuss progress: groups of students or individuals with instructor |
| 8 | Continue library research;  Write first draft of poster and blog post | Continue research;  Write first draft of poster and blog post |
| 9-10 | Workshops; Major Field Test  Complete poster and blog post | Workshops; Major Field Test  Complete poster and blog post |
| 11 | Peer review of posters | Peer review of posters |
| 12 | Revision of posters | Revision of posters |
| 13 | Posters produced | Posters produced |
| 14 | Symposium | Symposium |

1. Although the content is delivered in other courses, this outcome will be assessed in the capstone course. [↑](#footnote-ref-1)
2. These outcomes are also assessed in other courses and may receive less emphasis in this course. [↑](#footnote-ref-2)