



COURSE DESCRIPTION

This course is the first in a two-course sequence emphasizing biological discovery and the synthesis of knowledge and skill from previous courses. The capstone experience focuses on the application of the scientific method through the design, execution, analysis, and presentation of an in-depth scientific study. This course will center on the production of a formal research proposal for an original, in-depth scientific study to be completed during the second semester in collaboration with a faculty research advisor.

INSTRUCTORS	Dr. Ann Throckmorton	Dr. Joshua Corrette-Bennett
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LECTURE 8:10 – 9:10 Tuesday, Thursday 150 Hoyt Science Center

Attendance in lecture is expected. Because a large part of your grade in the course will be based on participation, your success is strongly dependent on your presence in class. Therefore, you should make an effort to be present at all class sessions. Absence may be excused for personal emergencies or health-related problems. If you miss class, it is your responsibility to contact us and to obtain information and assignments that were given during your absence. Any missed group work must be made up on an individual basis and will be graded on an individual basis.

COURSE OBJECTIVES

1. To demonstrate the excitement and possibilities inherent in the study of the natural world and to show how curiosity should be focused in a methodical manner in order to make novel contributions to the field of biology;
2. To prepare students to participate and initiate individual research during their senior year. This includes:
 - a) Selecting a faculty research advisor and initiating discussion with them in order to identify a research project within that faculty member's field of expertise;
 - b) Using appropriate literature and other resources to identify an interesting question that contributes to a greater, or new, understanding within the field, and identifying the significance of the topic;
 - c) Formulating hypotheses, selecting appropriate experimental methodology, and identifying a suitable model system with which to study their question;
 - d) Completing a pilot project to assess the feasibility of the research;
 - e) Writing a comprehensive research proposal in an appropriate scientific style; and
 - f) Presenting a proposal to faculty and peers for constructive criticism.
3. To provide an opportunity for students to enhance their scientific literacy, including, but not limited to locating, reading, reviewing, evaluating, and interpreting literature related to current concepts, theories, and ideas in their selected field of biology;
4. To continue to develop qualitative and quantitative reasoning skills required for scientific inquiry, data analysis, and interpretation;
5. To strengthen communication and problem-solving skills.

COURSE CONTENT

Participation: You will be expected to participate in all class discussions, particularly student presentations. Participation includes, but is not limited to asking questions and offering insights and suggestions to your peers. Attendance alone is not enough to gain participation points.

Paper presentation: Students will work in pairs, with each student presenting information from one secondary and one primary research article pertaining to their capstone topic to the rest of the class, in a clear, informative, and critical style, focusing on one or two key figures. Students should also identify questions and hypotheses proposed in the paper and discuss the importance of the results. Presentations will be 20 minutes long (the contributions of each student should be fairly equal). Prior to the presentation, the students will provide the instructors with their Powerpoint and a one page outline of what they presented and a list of sources used.

Team paper/presentation review: Students who are not presenting a paper will be asked to work in teams of two to review the papers being presented by other students. For each presentation, each team will write down a list of specific questions that pertain to the presentation but were left unanswered.

Question summary: Each student will identify two questions that they wish to investigate during the fall semester research project (Bio 602). This is the first step in doing scientific research. The questions will be based on discussions with a supervisor, an initial review of relevant literature, and original ideas. The questions should push the envelope of current understanding within the selected field. The summary must also include a signature from the supervisor, confirming that they have approved the questions.

Initial Literature List: Each student will perform a cursory review of relevant literature and submit a list of 30 articles (full citation) that appear to have some relevance to their project.

Annotated bibliography: Students are expected to obtain, read, evaluate and then select at least 11 articles, of which two to five must be secondary, that adequately discuss the background to your proposed project. The annotated bibliography will contain a summary of the information gained from each article, highlighting its aims and hypotheses, the experiments, results, and conclusions. All of these articles must be listed in the bibliography of your final proposal, so choose them wisely.

Draft of the research proposal: Having identified two questions, students will write a draft of their research proposal, following the provided guidelines and including all of the sections outlined in the guidelines. Drafts must be submitted by the due date; drafts that are late will not be accepted and the student will receive a 0 for that assignment.

Pilot study: Students must perform pilot studies to determine whether their proposed methodology is feasible, manageable, and reproducible. It is not unusual for experiments to fail the first time. When that happens, the researcher must change their methods or even change their project. Very few grant-awarding bodies will fund a research proposal without some preliminary data that shows the chosen methods are working. Each student will be write a report of their pilot study explaining what they did, what they found, what they concluded about the feasibility of their study, and what needs to be changed about their proposed methodology.

Research symposium: Students will be expected to attend the Westminster Undergraduate Research Symposium on April 24th and write a summary about two of the oral presentations. Each student must choose a talk that is scientific in nature; the presenter must have done their research in the department of biology, chemistry, or physics. The student will write a one-page, critical summary of their research and seminar.

Revised proposal: Following the pilot study, you will be given an opportunity to revise and/or correct your proposal, incorporating any changes you or your supervisor wish to make.

Proposal presentation: Each student will make a formal PowerPoint™ presentation of their research proposal and pilot study to peers and select faculty (which will include the faculty advisor).

GRADING

Grades will be based on the above criteria, weighted as follows:

Participation	75 points
Application for research	50 points
Advisor & question summary	25 points
Paper presentation	50 points
Team paper reviews (team grade)	50 points
Preliminary literature list	25 points
Annotated bibliography	75 points
Draft of the research proposal	200 points
Pilot study summary	50 points
Research symposium summary	25 points
Revised proposal	300 points
Proposal & pilot project presentation	75 points
Total	1000 points

Your final grade in the course will be based on the following scale:

Above 93%: A	87% - 90%: B+	77% - 80%: C+	67% - 70%: D+	below 60%: F
90% - 93%: A-	83% - 87%: B	73% - 77%: C	63% - 67%: D	
	80% - 83%: B-	70% - 73%: C-	60% - 63%: D-	

POLICY ON EXAMS AND ASSIGNMENTS

All assignments must be turned in by 4:00 p.m. on the day that they are due (unless the student is absent the day that the assignment is due and has a valid excuse). Points will be subtracted from assignments turned in late. Occasionally, assignments may be due in class, but instructors will let students know ahead of time if this happens.

Almost all assignments will be submitted electronically to the Assignments folder on the course R: drive: When a file is saved to the R: drive, the name of the file must contain your name and a description of what it contains (e.g., the name of the file could be "Smith Annotated Bibliography"). Once you have saved something to the Assignments folder you will be unable to retrieve it, open it, or delete it. NOTE: Assignments will not be accepted by e-mail except for extenuating circumstances.

All electronic assignments will be returned to you in your personal folder inside the Assignments folder of the r-drive. Only you and the instructors will have access to that folder, so your work and the grades that you receive will be absolutely confidential.

ACADEMIC INTEGRITY

Academic integrity is central to the purpose and pursuit of any academic community. The issue of academic integrity is taken very seriously at Westminster. Students are expected to abide by the College Policy on Academic Integrity. The policy can be found at:

http://www.westminster.edu/acad/pdf/undergrad_catalog/current.pdf

“Academic dishonesty is a profound violation of this expected code of behavior. It can take several forms, including, but not limited to, plagiarism, cheating, purposely altering the work of another (without that person’s permission), misrepresentation of attendance in class or at a College event, misrepresentation of work, facts or experimental results, unauthorized use of or intentional intrusion into another’s computer files and/or programs, intentional damage to a computer system, unauthorized use of library materials and privileges, or engaging in any activity which attempts to alter or harm another’s academic standing.”

Academic integrity is particularly important when dealing with scientific writing. We encourage students to work together and discuss their assignments, but written assignments must be the student’s own work. Quotes, data or ideas taken from another source must cite that source fully and correctly, even if paraphrased. If a student doesn’t understand how to do this, they are expected to seek help from one of the instructors. Work that is not the student’s own, i.e., anything copied from an external source, a classmate, or class material, is considered plagiarized and will receive a score of zero. Note: plagiarism includes extensive, unnecessary quoting from another source, even if it is cited. More than one incident of plagiarism may result in failure of the course. If in doubt – ask.

In the case of your research project, if your question, ideas, experiments or data are not your own and have been previously published by someone else, or if you interfere with others’ research or if you fabricate, falsify or modify your data, you will receive an F for the course. These violations of academic integrity amount to scientific fraud and merit a severe penalty.

COURSE SCHEDULE (subject to revision)

Date	Topic / Reading	Assignments
Jan 21	Introduction to the course	
Jan 26	Presentations by biology faculty	
Jan 28	Presentations by biology faculty	List of possible research advisors
Feb 2	Research and presentation of secondary sources	Applications (2) for research positions
Feb 4	Research and presentation of primary sources	
Feb 9	Information literacy resources	Confirmation of capstone advisor and question summary due
Feb 11	Citing sources; creating an annotated bibliography	
Feb 16	Proposals – Literature search; reading; writing; troubleshooting	Initial literature list due
Feb 18	Research papers – presentation & review	
Feb 23	Research papers – presentation & review	
Feb 25	Research papers – presentation & review	
Mar 2	Research papers – presentation & review	Team paper/ presentation review
Mar 4	Proposals – Literature search; reading; writing; Troubleshooting	
Mar 5	Pilot study discussions	Annotated bibliography due
Mar 9	<i>Spring Break – No Classes</i>	
Mar 11		
Mar 16	<i>Spring Break – No Classes</i>	
Mar 18	Begin pilot studies	
Mar 23	Ordering supplies; chemical safety	Proposal draft due
Mar 25	Animal care and use; microscopy	
Mar 30	Study/experimental design	
Apr 1	Data analysis and presentation	
Apr 6	Pilot studies – class discussion, problem-solving, proposal feedback	Animal care proposal due (for students working with vertebrates)

Apr 8	Pilot studies – problem-solving, proposal feedback	
Apr 13	Pilot studies – class discussion, problem-solving, proposal feedback	
Apr 15	Pilot studies – class discussion, problem-solving, proposal feedback	
Apr 20	Pilot studies – class discussion, problem-solving	Pilot study summary due
Apr 22	Evaluation of scientific presentations- form and content	
April 24/25	Attend Undergraduate Research Symposium	
Apr 27	Consultations regarding proposal	Symposium summary due
Apr 29	Presentations of Pilot study and Proposal	Revised proposal due
May 4	Presentations of pilot study and research proposal	
May 6	Presentations of pilot study and research proposal	
May 11	Reading day	
May 12 8–10:30 am	Final period Presentations of pilot study and research proposal	