TEACHING ECOLOGY USING A WRITING INTENSIVE, RESEARCH-BASED, COLLABORATIVE LEARNING APPROACH

Javier Monzón, Pepperdine University

INTRODUCTORY ESSAY

Introduction to Ecology is an upper-division, writing intensive course in the Biology major at a small, private, Christian university. The course is required for all students majoring in Biology and is offered once per year, usually in the fall semester. It is a 4-credit course with lecture and laboratory components. The class meets for lecture in three 1-hour periods and for lab in one 3-hour period. There are usually two laboratory sections, each capped at 16 students.

An intentional emphasis on collaborative learning and the research process permeates the course, consistent with a nation-wide vision for undergraduate biology education (AAAS 2011). The collaborative tenor of the course creates a class environment that is cooperative, not competitive, thus promoting greater retention and mastery of material and more positive attitudes toward the learning experience (Humphreys et al. 1982, Schinske and Tanner 2014). Facilitating authentic ecological research experiences with unknown outcomes ensures that students learn the process of ecology, not just the end result of previous ecological studies. By conducting research, students graduate from being passive consumers of knowledge and become active creators of knowledge. Furthermore, conducting research challenges students to apply, analyze, create, and evaluate information, thereby activating the highest levels of cognition (Crowe et al. 2008).

The emphasis on writing, research, and collaboration is reflected in the grading scheme. Laboratory writing assignments, which represent 50% of the total grade, are intended to help students improve the skills associated with the research process, starting with the first step of the scientific method – making observations – and ending with the last step of the scientific method – communicating results. An additional 10% of the grade is calculated from in-class group writing activities (during the lecture sessions) that challenge students with a real-life ecological research scenario. Thus, 60% of a student's grade is from writing assignments, most of which are completed in groups; the remaining 40% of a student's grade is calculated from four exams of the lecture material. Below, I provide my thoughts on the design of the syllabus and details on four types of writing assignments.

SYLLABUS DESIGN

There is only one opportunity to make a first impression. In college courses, the syllabus contributes to that opportunity, setting the tone for the course and communicating what the professor is like (Thompson 2007, Fink 2012). Being a form of communication, the syllabus must effectively convey critical information to the primary audience – the students. Today's students regularly consume multimedia that richly integrates graphics and text. Hence, the traditional black-and-white text-based syllabus is contrary to students' preferences for graphics-rich content (Mocek 2017). In fact, Mocek (2017) empirically demonstrated that black-and-white and color graphics in syllabi have a statistically significant long-term benefit on students' retention of course information. I design my syllabi with my own or royalty-free pictures and icons, and with colorful graphs and tables. I strive for simplicity, adding URL links to webpages where students can read institutional policies more thoroughly, instead of copying them onto the syllabus.

I also omit the details and rubrics of assignments and prefer to distribute those during the semester when the assignments are first presented.

IN-CLASS GROUP ACTIVITIES

On most weeks, I teach content on the first two days of class, employing traditional lecturing punctuated by brief think-pair-share discussions, computational problems, or videos. For the third-class meeting of the week, I assign an article reading from the primary literature to provide further content, which students will need to draw upon for a period-long, active-learning group activity. The idea is to challenge the students to integrate what they learn from lecture and a recent scientific article and apply it to a real-life ecological issue. Some timely topics include the impacts of climate change on species in protected areas (Monzón et al. 2011), the connection between invasive predators and amphibian declines worldwide (Kats and Ferrer 2003), the effects of habitat fragmentation on the dispersal of carnivores (Janecka et al. 2016), and the colonization of New York City by eastern coyotes (Nagy et al. 2017). Many of the ten activities require the group of students to quickly formulate a hypothesis and design a study to test it. Below is an example of a group activity and its rubric (Appendix 1). Students would have had to read the assigned paper prior to class to engage meaningfully in the activity. In theory, an individual may fail to do the preparatory reading and still obtain a high grade from the work of others in the group. However, I have observed that students do not want to embarrass themselves in front of their peers by coming to these activities unprepared.

To execute the group activities efficiently, I randomly assign students to groups of three to four. I display the group assignments on the screen before class begins, so students sort into the groups as soon as they enter the classroom. At the very beginning of the class period I display the prompt, i.e., the scenario and the instructions. Students use their laptops and Google Docs and begin writing collaboratively. After allowing the students to grapple with the activity for about five minutes, I walk around the classroom from group to group, listening in on their conversations, observing what they're typing, and offering some guidance if it appears it is needed. These student-centered activities incentivize class attendance, help students interact with ideas to construct meaning, and literally transform me from the "sage on the stage" to "guide on the side" (King 1993).

FIELD REFLECTIONS

The university campus is nestled in the foothills of a mountain range in coastal California. This physical setting provides numerous opportunities to explore the ecology of many very different ecosystems that are in close proximity, such as oak woodlands, chaparral, salt marshes, sandy beaches, rocky intertidal pools, and the urban environment. I take students on four field trips during lab on the first four weeks of the semester. During these field trips, I teach techniques commonly used in ecological field research, but I also permit about one hour of free time for students to explore and make ecological observations. Students then have one week to submit an individual field reflection in which they describe three ecological observations or questions they may be interested in investigating through a research project and an explanation of how one of those observations or questions has been already addressed in the primary scientific literature (Appendix 2).

I have observed that, with the expectation of the field reflection assignment, students remain focused during their free time of exploration. I watch students staring contemplatively at a mountainside to make observations of large-scale ecological phenomena, such as drought-induced dieback of the vegetation. I also watch students break open decaying logs with childish curiosity to make small-scale observations of termites and centipedes. One practical consideration of this instructional approach is that students should explore the field site in small groups, at least in pairs, to promote peer-to-peer dialogue and ensure their safety. Another practical matter is that field reflections must be evaluated expeditiously. I have learned that my rapid feedback to students is important for them to improve their writing and meet the expectations of the assignment which is repeated weekly four times.

RESEARCH PROPOSAL AND UPDATES

After four field trips with their corresponding field reflections, a typical class of 30 students has amassed 360 ecological questions or observations that may be further investigated in a research project. I spend three weeks discussing aspects of experimental design and data analysis. I also teach them the conventions of appropriately citing sources and how to use bibliographic software in preparation for the group research proposal, their first large writing assignment. Self-selected groups of 3 to 4 students form organically based on their research interests and relationships. As a group, students must submit a research proposal that includes an introduction that summarizes the topic and identifies information gaps, a clearly articulated research question and scientific hypothesis, a detailed description of materials and methods required, a plan for the statistical analysis of data, and a list of cited references (Appendix 3).

This is another assignment that needs rapid assessment. Any inadequacies in study design must be addressed and any materials not immediately available must be purchased so that students may commence their projects. Once I approve the project and students have the materials they need, they are on their own. They are free to attend the lab period or not, if their project demands they work in the field off campus (e.g., at the beach because they are investigating a shore bird) or at a time not congruent with the scheduled lab period (e.g., at night because they are investigating a nocturnal creature). Thus, I remain apprised of the students' progress through two research updates. In the first update, students are asked to describe how and why any methods changed from their initial proposal (because they inevitably always do) and report preliminary results in the form of a data table or figure (Appendix 4). In the second update, students are asked to provide a more complete set of results, make a good-faith effort at analyzing their data statistically, and make preliminary conclusions based on those analyses (Appendix 5).

RESEARCH PRESENTATIONS

During the final week of classes, I spend 30 to 40 minutes with each research group to examine the details of their project, assist them with quantitative data analysis, and guide them in planning their final poster and oral presentations. We discuss principles and conventions of scientific communication. Although the research poster is a weighty group writing assignment, it is not a lengthy writing assignment. Students are expected to design and present a poster that succinctly highlights their research hypothesis, methods, results, and conclusions, as is typically done in professional scientific conferences (Appendix 6). Thus, students learn not only the content of science, but also the practice of science.

The first time I implemented this group research approach to teaching ecology, I did not assign any research updates between approving the projects and seeing the final presentations. There were some disappointing surprises. Since then, I implemented the two group research updates described above, which resulted in an improvement in the quality of student research. The average grade for the final poster and oral presentations was 85% in 2015 when no research updates were required; after implementing research updates, the average grade increased to 92.5% in 2016 and 91% in 2017. This is an important improvement because the final poster and oral presentation is the weightiest assignment in the course, representing 20% of a student's grade.

The student groups give their final research presentations during the Ecology Grand Finale, a symposium-style gathering on the week of final exams. The Ecology Grand Finale is inspired from the idea that a semester of learning ought to end with an epic, memorable learning experience, not with a boring, written exam taken in silence and secrecy (Crider 2015). Student groups have 15 minutes each to give an oral presentation of their research while their poster is digitally projected onto a screen (this way, there is no need to physically print the posters). This format puts the students on the spotlight for the few minutes while they present their research, but then allows them to enjoy the rest of the final experience, learning about the discoveries of their peers, even those in the other lab section. The course grand finale is then a celebration of learning, not of what students learned from their professor, but of what all – students and professor – learned from the students' disciplined investigation of nature.

REFERENCES

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SYLLABUS

INTRODUCTION TO ECOLOGY

BIOL 311

COURSE DESCRIPTION

This course introduces the student to the basic concepts of ecology, which is the scientific study of the distribution and abundance of organisms and of the interactions between organisms and their environment. Topics covered include population dynamics, community structure, ecosystems, competition, predation, and conservation. Field trips are required. **This is a Writing Intensive course that emphasizes collaborative learning and conducting authentic research.**

Instructor information

Dr. Javier Monzón

Office: RAC 132

☎: 310-506-4478

✉: javier.monzon@pepperdine.edu

Office hours: M, T, TH, 10-11 am or by appointment

Class meetings

Lecture:

M, T, TH 9:00 am – 9:50 am

@ TAC 180

Laboratory:

T or W 2:00 pm – 4:50 pm

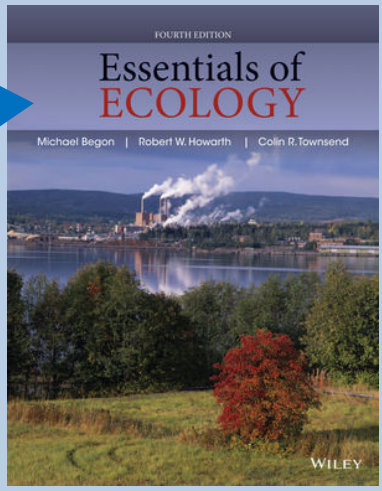
@ KSC 360

Regular attendance is

COURSE MATERIALS

Essentials of Ecology

4th edition, 2014. Begon, Howarth, and Townsend.



STUDENTS WILL

- **demonstrate understanding** of the basic concepts in ecology and the underlying evolutionary processes associated with the formation of populations, communities, and ecosystems
- **gain first-hand knowledge**, through field trips and an examination of the scientific literature, of how ecology relates to local and global environmental issues
- **design, implement, and present** an original research project in ecology that specifically addresses hypotheses derived from observations of local ecological systems
- **collaborate in teams** to learn techniques in field ecology, conduct authentic research, and apply ecological principles to real-life scenarios

RELATION TO PEPPERDINE UNIVERSITY'S MISSION

Many local to global problems in society are ecological in nature. Therefore, literacy and fluency in the science of ecology will prepare students for lives of **purpose, service, and leadership**.

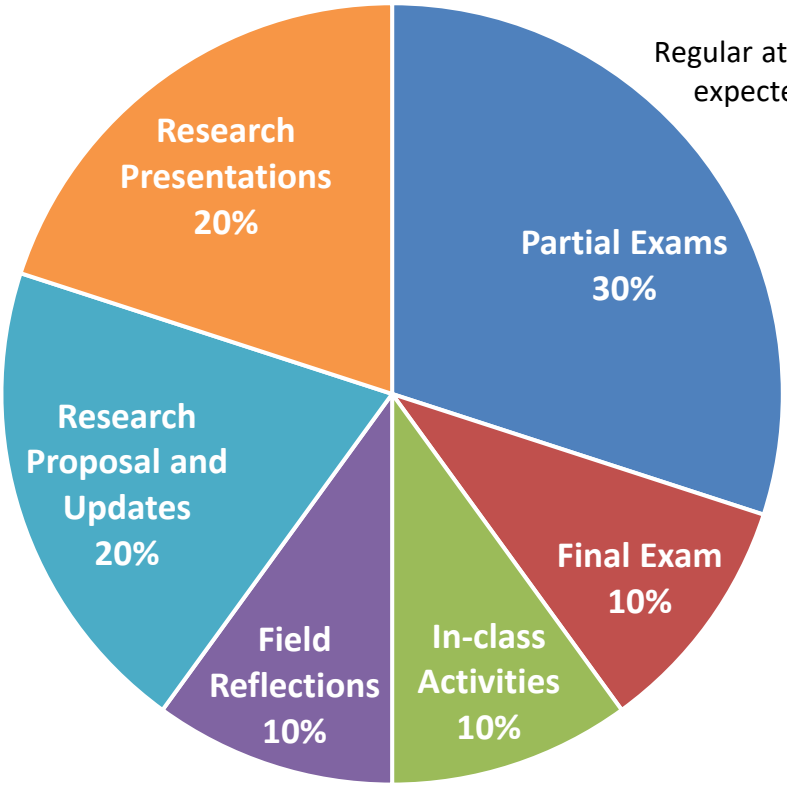
Food For Thought

Is biblical wisdom defined, in part, by one's understanding of nature?

"God gave Solomon wisdom and very great insight, and a breadth of understanding as measureless as the sand on the seashore.... He spoke about plant life, from the cedar of Lebanon to the hyssop that grows out of walls. He also spoke about animals and birds, reptiles and fish. From all nations people came to listen to Solomon's wisdom, sent by all the kings of the world, who had heard of his wisdom."

1 Kings 4: 29-34

COURSE STRUCTURE AND GRADING



Regular attendance to lecture and lab sessions is expected to obtain a passing grade.

> 94	A
90-94	A-
87-90	B+
83-87	B
80-83	B-
77-80	C+
73-77	C
70-73	C-
67-70	D+
63-67	D
60-63	D-
< 60	F

LECTURE

There will be regular in-class group activities related to the lecture's content and assigned readings of primary scientific literature. These active-learning exercises are designed to challenge you to collaboratively integrate and apply your knowledge to real-life ecological scenarios. Many of the ten activities require you to quickly formulate a hypothesis and design a study to test it. I will randomly assign students to groups of three to four and will display the group assignments on the screen before class begins. It is imperative that you arrive on time so you may sort into groups as soon as you enter the classroom and have the entire period to work together.

There will be three partial exams and a final cumulative exam. Exams will include multiple choice, short answer, and long answer questions. The exams are not simply focused on repeating factual information but give you a chance to integrate and apply various issues discussed in class. You cannot make up exams or in-class activities following unexcused absences.

LABORATORY

Our university campus is nestled in the foothills of the Santa Monica Mountains. This physical setting provides numerous opportunities to explore the ecology of many very different ecosystems that are in close proximity, such as oak woodlands, chaparral, salt marshes, sandy beaches, rocky intertidal pools, and the urban environment.

We will go on four field trips during lab on the first four weeks of the semester. During these field trips, you will learn techniques commonly used in ecological field research. You will also have about one hour of free time to explore and make ecological observations. These trips are essential to meet the learning objectives of the course; hence, attendance is required. You should be prepared to go outside: dress appropriately, wear proper footwear, bring water and sunscreen, etc. It is important that you always explore the field site in small groups, at least in pairs, to promote peer-to-peer dialogue and ensure your safety. Following each field trip, you will have one week to submit an individual field reflection, in which you describe three ecological observations or questions that you may be interested in investigating through a research project and an explanation of how one of those observations or questions has been already addressed in the primary scientific literature.

After the four field trips, you will work in groups to identify a suitable research topic. Each group must submit a research proposal and conduct the research throughout the rest of the semester. Groups will submit two updates after initiating the research but before the final project is due. Each group will present the final results of the project in a poster and oral presentation.

Detailed instructions and rubrics for the field reflections, research proposal, updates, poster, and oral presentation will be available in Courses.

This course intentionally emphasizes collaborative learning to promote greater retention and mastery of material.

See Humphreys et al. 1982. Effects of cooperative, competitive, and individualistic learning on students' achievement in science class. *Journal of Research in Science Teaching* 19, 351-356.

MOBILE DEVICES

The use of personal electronic devices in lecture is permitted only to enhance your learning (e.g., accessing Courses or material on the web relevant to ecology). The use of personal electronic devices in lab is encouraged to take photographs or make observations of the living world; we will use mobile apps to assist in field work.

COURSE EVALUATIONS

Online course evaluations are conducted for all Seaver courses at the end of each semester. I value your feedback, so please fill out a course evaluation.

ACADEMIC INTEGRITY

Students must adhere to the Code of Academic Integrity found in the Student Handbook. Please visit http://seaver.pepperdine.edu/academics/academic-support/integrity for a description of violations of academic integrity and consequences of such violations.

INTELLECTUAL PROPERTY

Course materials prepared by the instructor, including lectures and exams, are the property of the instructor. Students may not make photographic, video, or audio recording of lectures and review sessions without the consent of the instructor. Students may not sell course materials and notes or make any commercial use of them.

STUDENTS WITH DISABILITIES

Any student with a documented disability (chronic medical, physical, learning, psychological) needing academic accommodations should contact the Office of Student Accessibility (OSA) as early in the semester as possible. All discussions will remain confidential.

Tyler Campus Center (TCC) room 264

310-506-6500

www.pepperdine.edu/student-accessibility

TENTATIVE SCHEDULE

Week	Lecture	Lab
1	Chapter 1 - Ecology and how to do it	Field trip 1
2	Chapter 2 - Ecology's evolutionary backdrop ***Group Activity 1***	No labs scheduled this week ***Field Reflection 1 due***
3	Chapter 3 - Physical conditions and the availability of resources ***Group Activity 2***	Field trip 2
4	Chapter 4 - Climate and the world's biomes ***Group Activity 3***	Field trip 3 ***Field Reflection 2 due***
5	Chapter 5 - Birth, death, and movement ***Group Activity 4***	Field trip 4 ***Field Reflection 3 due***
6	***Exam 1 on Chapters 1-5*** Chapter 6 - Interspecific competition	Experimental design and narrowing down research projects based on field trip observations ***Field Reflection 4 due***
7	Chapter 7 - Predation, grazing, and disease ***Group Activity 5***	Discussion of research proposals
8	Chapter 8 - Molecular and evolutionary ecology ***Group Activity 6***	***Research Proposal due***
9	Chapter 9 - From populations to communities ***Group Activity 7***	Initiate research projects
10	Chapter 10 - Patterns in species richness ***Group Activity 8***	Continue research projects
11	***Exam 2 on Chapters 6-10*** Chapter 11 - The flux of energy and matter through ecosystems	Continue research projects
12	Chapter 12 - Global biogeochemical cycles and their alteration by humans ***Group Activity 9***	Continue research projects ***Research Update 1 due***
13	Chapter 13 - Conservation ecology ***Group Activity 10***	Continue research projects
14	Chapter 14 - The ecology of human population growth, disease, and food supply	Analyze research data ***Research Update 2 due***
15	Review for exams ***Exam 3 on Chapters 11-14 on Tuesday*** ***Final cumulative exam on Thursday***	Analyze research data and prepare posters
Grand finale and research project presentations: Monday, December 11, 7:30-10:00 am		

APPENDIX 1: GROUP ACTIVITY 1

DESIGN A STUDY!

You deployed wildlife cameras in various urban parks of New York City. In one park, you obtained photographic evidence of a pair of coyote adults and 8 coyote pups. This represents the very first evidence that coyotes are breeding in Queens, an area of New York City that is in an island connected to other areas by bridges and tunnels.

As a group, write a mini research proposal that includes the following:

1. Introduction that summarizes what is known about this animal and why its appearance in Queens represents a unique research opportunity in one area of ecology
2. Hypothesis to be tested
3. Description of the methods that will be used to test the hypothesis
4. Description of how the data will be analyzed
5. Citation of one reference from the primary literature

CATEGORY	*Meets* CRITERIA (2 PTS)	NEARLY MEETS CRITERIA (1 PT)	DOES NOT MEET CRITERIA (0 PTS)
Introduction 2 pts	Clearly summarizes what is known about the animal and why it is a unique research opportunity in ecology	Lacks detail about the animal, fails to explain the importance of the observation to future ecological research	Poorly written or disorganized introduction
Hypothesis 2 pts	Clearly states the hypothesis to be tested	Scientific hypothesis is vague or unclear	Unscientific idea that is not testable
Methods 2 pts	Clearly describes the study design and methods that will be used	Some areas of study design are lacking in detail	Vital information on study design is lacking
Data analysis 2 pts	Clearly describes how data will be collected and analyzed	Some areas of data analysis are lacking in detail	Vital information on data analysis is lacking
Reference 2 pts	Full citation is present in proper format	Citation is not complete	Citation is absent
Total 10 points			

APPENDIX 2: FIELD REFLECTION

Following each field trip, you will submit a field reflection, which includes (1) header information (your name, location visited, date of field trip, and partner(s); (2) three ecological observations or questions you may be interested in investigating later in the semester; (3) the full citation of a peer-reviewed scientific article that addresses one of your three observations/questions; and (4) a one-paragraph explanation of how the cited article relates to your observation/question and helps you better understand the topic or methodology. Your observations/questions and article must be unique and not redundant with those of your partners.

CATEGORY	ACCURATELY MEETS/EXCEEDS CRITERIA (5 PTS)	SATISFACTORILY MEETS CRITERIA (4 PTS)	NEARLY MEETS CRITERIA (3 PTS)	DOES NOT MEET CRITERIA (1-2 PTS)
Observation 1 5 pts	Observation demonstrates keenness and is suitable for ecological investigation in one semester	Observation does not lend itself to ecological investigation during a semester	Observation is too obvious or not suitable for investigation	Observation is not ecological
Observation 2 5 pts	Observation demonstrates keenness and is suitable for ecological investigation in one semester	Observation does not lend itself to ecological investigation during a semester	Observation is too obvious or not suitable for investigation	Observation is not ecological
Observation 3 5 pts	Observation demonstrates keenness and is suitable for ecological investigation in one semester	Observation does not lend itself to ecological investigation during a semester	Observation is too obvious or not suitable for investigation	Observation is not ecological
Reference 5 pts	Full citation is present in proper format	Citation is missing an important element	Citation is missing more than one important elements	
Explanation of referenced article 5 pts	Clearly relates article to observation and demonstrates keen understanding of the topic	Relates article to observation, but only superficially	Relationship between article and observation is unclear	Article is not related to any observation
Total 25 points				

APPENDIX 3: GROUP RESEARCH PROPOSAL

You will work in groups to identify a suitable research topic. Each group must submit a research proposal and conduct the research throughout the rest of the semester. As a group, write a research proposal that includes the following:

1. Introduction that summarizes what is known and not known about the topic from the primary literature. Cite primary sources.
2. Research question and hypothesis to be tested. Be specific.
3. Description of the methods that will be used to test the hypothesis. Be specific. What data will you collect? Will you have controls? Will you have replicates?
4. List of materials necessary to implement the proposed methods. Be very specific.
5. Description of how the data will be analyzed. What statistical test will you conduct? What is the null hypothesis?
6. Citation of three references from the primary scientific literature. Use proper and consistent format.

CATEGORY	MEETS CRITERIA	NEARLY MEETS CRITERIA	DOES NOT MEET CRITERIA
Introduction 20 pts	Clearly identifies the topic, summarizes what is known, cites sources 16-20 pts	The primary topic is identified but lacks detail, lacks citations 11-15 pts	Poorly written or disorganized, lacks citations 1-10 pts
Hypothesis 20 pts	Clearly articulates research question and states the hypothesis to be tested 16-20 pts	Scientific question and hypothesis are vague or unclear 11-15 pts	Poorly written or disorganized, unscientific idea that is not testable 1-10 pts
Methods 20 pts	Specifically describes the study design and methods that are appropriate 16-20 pts	Some areas of study design are lacking in detail, or methods are inappropriate 11-15 pts	Vital information on study design is lacking 1-10 pts
Materials 10 pts	Provides a complete list of materials necessary to implement the project 6-10 pts	List appears to be incomplete for proposed methods 1-5 pts	
Data analysis 20 pts	Clearly describes how data will be analyzed and interpreted 16-20 pts	Some areas of data analysis are lacking in detail 11-15 pts	Vital information on data analysis is lacking 1-10 pts
References 10 pts	Full citations of 3 references are present in proper format 6-10 pts	Less than 3 citations, or citations are not complete or not in proper format 1-5 pts	
Total 100 points			

APPENDIX 4: GROUP RESEARCH UPDATE 1

THIS RESEARCH UPDATE FOCUSES ON METHODS AND PRELIMINARY RESULTS.

1. Describe how your methods have changed from your initial proposal.
   - Which new method(s) are you including? Why?
   - Which method(s) are you discarding? Why?
   - Which method(s) are you modifying? How and why?
2. Report your preliminary results in at least one table or one figure. Describe your results in one or two paragraphs. No formal data analyses are needed, but describe trends that you observe in the data.

CATEGORY	ACCURATELY MEETS/EXCEEDS CRITERIA	SATISFACTORILY MEETS CRITERIA	NEARLY MEETS CRITERIA	DOES NOT MEET CRITERIA
Methods 10 pts	Specifically describes changes to the study design and methods that are appropriate, explains how and why changes were made 9-10 pts	Explains how the study design and methods were changed, but not the reasons for the changes 7-8 pts	Some changes of study design are lacking in detail, or new methods are inappropriate 5-6 pts	Vital information on changes to study design is lacking 1-4 pts
Results figure or table 5 pts	Results are presented in at least one table or figure that is clear and organized 5 pts	Results are presented in at least one table or figure, but elements necessary to interpret results are missing 4 pts	Results are presented in at least one table or figure that is inappropriate for the type of data 3 pts	Results are presented in at least one table or figure that is inappropriate for the type of data, and the data are sloppy and inconsistent 1-2 pts
Results text 5 pts	Description of results is clear and consistent with the data presented 5 pts	Description of results is unclear but seems consistent with the data presented 4 pts	Description of results is clear but not consistent with the data presented 3 pts	Description of results is unclear and seems not consistent with the data presented 1-2 pts
Total 20 pts				

APPENDIX 5: GROUP RESEARCH UPDATE 2

THIS RESEARCH UPDATE FOCUSES ON RESULTS AND PRELIMINARY CONCLUSIONS.

1. Summarize your results in at least one table or one figure. This should be a different or an updated table or figure from that presented in Group Research Update 1.
2. Analyze your data. Describe the statistical analysis and the output of the analysis.
3. Describe your results, including results of statistical tests, in one paragraph.
4. Interpret your results in one paragraph. What do you conclude from your current results? What are the broader implications of your results (e.g., for conservation)? What are the limitations of your study? Cite one additional peer-reviewed article that was not cited in your Group Research Proposal or Group Research Update 1.

CATEGORY	ACCURATELY MEETS/EXCEEDS CRITERIA	SATISFACTORILY MEETS CRITERIA	NEARLY MEETS CRITERIA	DOES NOT MEET CRITERIA
Results figure or table 5 pts	Results are presented in at least one table or figure that is clear and organized 5 pts	Results are presented in at least one table or figure, but elements necessary to interpret results are missing 4 pts	Results are presented in at least one table or figure that is inappropriate for the type of data 3 pts	Results are presented in at least one table or figure that is inappropriate for the type of data, and the data are sloppy and inconsistent 1-2 pts
Data analysis 5 pts	The analysis is appropriate for the type of data, and the output of the analysis is clear 5 pts	The analysis is appropriate for the type of data, but the output of the analysis is unclear (e.g., no P-value) 4 pts	The output of the analysis is clear, but the analysis is inappropriate for the type of data 3 pts	The analysis is inappropriate for the type of data, and the output of the analysis is unclear 1-2 pts
Results text 5 pts	Description of results is clear and consistent with the data presented 5 pts	Description of results is unclear but seems consistent with the data presented 4 pts	Description of results is clear but not consistent with the data presented 3 pts	Description of results is unclear and seems not consistent with the data presented 1-2 pts
Conclusions 5 pts	Interpretation of results is sound and is placed in a broader context using at least one properly cited reference 5 pts	Interpretation of results is sound but is not placed in a broader context using at least one properly cited reference 4 pts	Interpretation of results is overreaching but is placed in a broader context using at least one properly cited reference 3 pts	Interpretation of results is overreaching and is not placed in a broader context using at least one properly cited reference 1-2 pts
Total **20 pts**				

APPENDIX 6: GROUP RESEARCH POSTER AND ORAL PRESENTATION

In your groups, create a poster based on your original research. You will project (not print) the poster and present it orally to the rest of the class. Design your poster in PowerPoint with the following dimensions: 36" height × 48" width. Refer to the Poster Preparation Guidelines in the www.sccur.org/guidelines.html webpage for helpful advice. Prepare your presentation to be no longer than 10 minutes. There will be about 3 minutes of Q&A after each oral presentation.

CRITERIA FOR POSTER AND ORAL PRESENTATIONS:

TITLE AREA

a) title properly conveys the subject of research and is legible based on poster size
b) names of authors and affiliations are included and are legible

ABSTRACT

a) clearly presents a brief description of the problem and describes hypothesis
b) briefly describes experimental procedure and results
c) is no longer than 250 words

INTRODUCTION

a) provides an overview of the general topic
b) adequately cites literature supporting the thesis
c) adequately introduces the question or hypothesis that is relevant to the general topic
d) includes a summary statement of how the hypothesis was tested

MATERIALS AND METHODS

a) describes an experimental/observational/modeling approach that is adequate for testing the hypothesis or addressing the question
b) the materials and methods are communicated such that the study is repeatable
c) includes proper controls and replications
d) adequately describes sampling procedures
e) adequately describes data analysis procedures

RESULTS

a) clearly presents results in tables and figures relevant to question
b) statistical tests are adequate and performed correctly

DISCUSSION

a) results are properly addressed and interpreted
b) integrates new results with those of previous studies, citing appropriate literature
c) original question or hypothesis is answered

LITERATURE CITED

a) literature cited is relevant to the topic
b) contains a minimum of 5 primary references

Appearance and Writing

a) poster is visually appealing
b) text is free of spelling and grammatical errors
c) text is large enough
d) uses proper and consistent format for the literature cited in the text and reference section

Oral Presentation

a) all group members play an active role in the oral presentation
b) presenters display an understanding of the general topic, hypotheses tested, methods used, results presented, and conclusions
c) presenters satisfactorily answer questions about their research
d) presenters reflect on what they learned about the scientific method
e) presentation was no longer than 15 minutes

Project title: _____

Group members: _____

CATEGORY	ACCURATELY MEETS/EXCEEDS CRITERIA	SATISFACTORILY MEETS CRITERIA	NEARLY MEETS CRITERIA	DOES NOT MEET CRITERIA	POINTS
Title area 10 pts	10 pts	8-9 pts	6-7 pts	1-5 pts	
Comments:					
Abstract 20 pts	19-20 pts	16-18 pts	11-15 pts	1-10 pts	
Comments:					
Introduction 20 pts	19-20 pts	16-18 pts	11-15 pts	1-10 pts	
Comments:					
Materials and Methods 30 pts	28-30 pts	24-27 pts	16-24 pts	1-15 pts	
Comments:					
Results 30 pts	28-30 pts	24-27 pts	16-24 pts	1-15 pts	
Comments:					
Discussion 30 pts	28-30 pts	24-27 pts	16-24 pts	1-15 pts	
Comments:					
Literature Cited 10 pts	10 pts	8-9 pts	6-7 pts	1-5 pts	
Comments:					
Appearance 10 pts	10 pts	8-9 pts	6-7 pts	1-5 pts	
Comments:					
Oral Presentation 40 pts	36-40 pts	31-35 pts	21-30 pts	1-20 pts	
Comments:					
Total 200 pts					