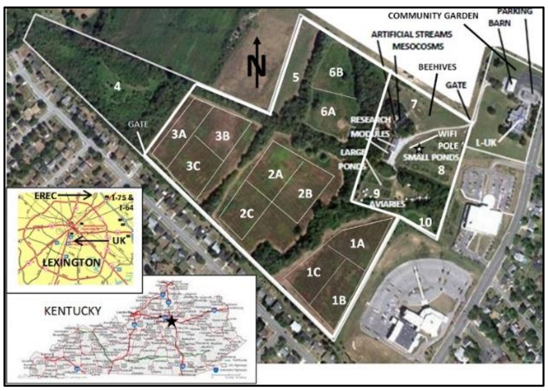
BIO 325 Honors Ecology (BIO 325-001, Fall 2017)

Tuesdays and Thursdays 2:30-5:20 PM at the Ecological Research and Education Center (EREC) 1737 Russell Cave Road (map below). *Bus service will be provided, with buses leaving from behind the Morgan Building at 2:10 PM and returning there before 6:00 PM.*



Ecological Research & Education Center

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General information

This course is an honor senior-level college class. As such, I assume that every student is entering with the writing competencies and biology knowledge as promised by the previous courses required to enroll in this class. However, since these skills have been assessed by various professors as well as tests, there are many kinks in the system. In truth, we are all at various levels of achieving mastery of the written language and biology knowledge. If you are concerned with your particular level of expertise, please see Office Hours for more information and additional skills-based support.

You all enter this classroom with a different sets of skills. In virtue of this fact, I open my office to you as an extension of the classroom, including scheduled virtual meetings and individualized tutoring in the vast areas of academic writing and critical literacy skills.

There is no shame or embarrassment in asking for help, although it is common to feel anxious in approaching one's teacher.

To enter my office and ask for help is an act of bravery. To enter and chat about nothing in particular often leads to new insight. Both are valuable. Both show that you trust me. I promise to respect you and earn that trust through compassionate listening and understanding. As a teacher, I know there is a power unbalance between us. As best I can, I renounce this position. Think of me as human, imperfect and vulnerable just like you.

Class Instructor: **Dr. Philip H. Crowley,** 113 MDR3; 257-1996, pcrowley@uky.edu

Teaching Assistant: **Luc Dunoyer**, 219 THMorgan; luc.dunoyer@uky.edu

Office hours for Luc are Fridays 1-3 PM; office visits with Dr. Crowley can be arranged by e-mail or asking before/after class.

Student Learning Outcomes

By taking this class, students will be able to:

Student Learning Outcomes

- Describe the central principles of ecology;
- Produce hypotheses from a conceptual model;
- Choose appropriate methods and procedures for the rigorous study of ecological systems;
- Evaluate natural phenomenon at large scales of space and time;
- Contrast the relationship between ecology and evolution.

Attendance and Dress Code

Class attendance is a symbol of solidarity with the fellow members of your classroom. Meaningful education requires a shared cultural experience and the readings, writings, discussions, and experiments that take place in this class serve as precisely that. In here, we will practice focus and singleness of mind; I encourage reflection and in acknowledgement of this aim I promise to reserve at least 50% of each class period for student participation and information processing.

Dress appropriately to be outside regardless of weather. No shorts or open-toed shoes are allowed in the lab/classroom under OSHA regulations. Pants must extend down to your shoes for *every* class; hiking boots are preferred.

University Regulations

Students with documented disabilities should notify the instructor at the first class meeting. A Letter of Accommodation from the Disability Resource Center (DRC) is required. Contact information for the DRC: 859-257-2754, drc@uky.edu, http://www.uky.edu/StudentAffairs/DisabilityResourceCenter/.

As students your work is as valuable as the work of any scholar. Hence, we will protect it by monitoring plagiarism of your work in future classes. That means that you cannot plagiarize, cheat, or falsify or misuse academic records; adherence to University policy on these issues will be strictly enforced to protect your intellectual property.

The Code of Student Rights and Responsibilities can be found at http://www.uky.edu/Ombud. See also Senate Rules 6.3.1 at http://www.uky.edu/Faculty/Senate/. In cases where students feel unsure about a question of plagiarism involving their work, they are obliged to consult the instructor before submission.

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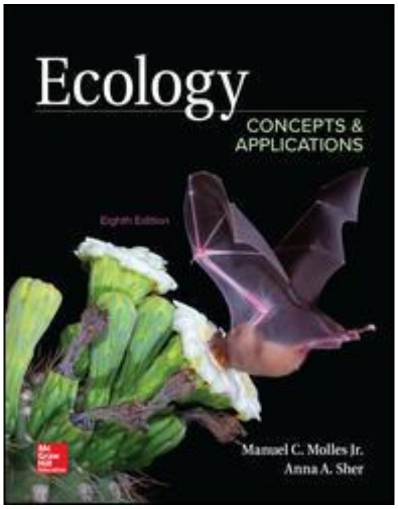
The Text, Course Management, and Scheduling

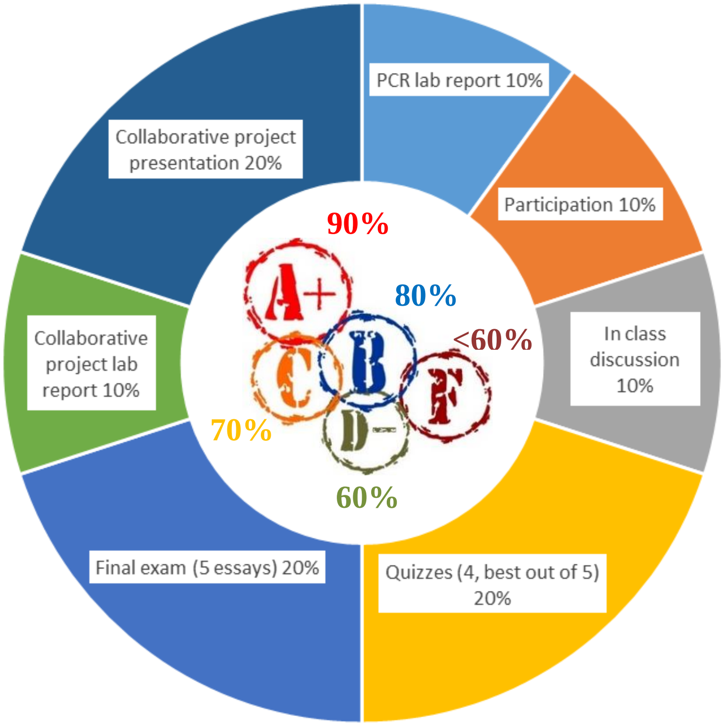


The required text is *Ecology: Concepts and Applications*, 8th *edition*, by Dr. Manuel C. Molles, Jr. (Department of Biology, University of New Mexico). Click on the picture to find the book online. After the initial background reading of chapters 1-3 and 5-6 from the text (assigned in advance to all enrolled students during registration), there will ordinarily be one chapter to read for each session. **Please review these instructions on how to effectively read the textbook.** You don't need to know every little detail before class, you simply need to come prepare for discussion in class.

There will also be manuals to read in preparation for the exercises, a few papers to read from the primary literature, and ten videos to watch throughout the semester. The videos will be the basis for the final exam. Your ability to benefit from the course hinges heavily on preparation for each session and full engagement during the sessions. Class messaging, document access, and record-keeping will be on Canvas. **The schedule of class activities and assignments is at the bottom of this document.**

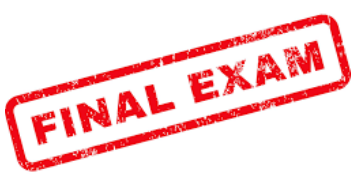
Grading

Since this is a 300-level honors course, an excellent overall performance will produce an A; a solid performance on all work will result in a course grade of B; less-than-solid work will yield a C or below.



Assessments

Over the semester, we will conduct 10 main exercises using an approach that begins with building a conceptual model, from which we derive hypotheses to test; then we design and execute the tests in lab and/or field, analyze the data, and discuss the implications. Finally, we return to the model and update it based on our findings. This is the basic procedure followed by all scientists at work, and you should develop a much deeper understanding of the scientific research process (as well as ecology per se) as a result of this experience. You will be asked to write one page feedback following a one sentence prompt at the end of each exercise.



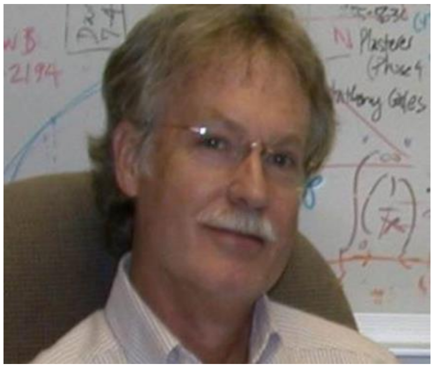
The class final is an enhance version of the exercise feedback. You will be given six one sentence prompts, will have to choose five of them, and write ~750 words for each chosen prompt.

Six quizzes will be conducted along the semester. Quiz 0 will not be graded and the lowest score of the five remaining quizzes will be dropped. These assignments cover the chapters of the textbook.

Two laboratory report will be produced and graded. Although the first report occurs early in the semester, a series of feedback assignments (not graded) will help you stay on track for this report completion while giving you valuable feedback to achieve the best grade possible. **A rubric for this assignment is attached at the end of this document.**

However, the second lab report will be due toward the end of the semester in one submission. This report focuses on the semester long experiment that you will conduct by group of two (we will meet regularly along the semester to allow correct planning, see schedule below). Learning from the first report you will show your progress and will be required to present your research in front of the class during an oral presentation with a PowerPoint support. Feedback will be given on the presentation slides with the opportunity to modify them before the presentation.

Professor and Laboratory Instructor



Professor Philip Crowley is a faculty member in the Department of Biology and is Director of the Ecological Research and Education Center (EREC) field station. He is an evolutionary ecologist who was a geology major as an undergraduate at Rice University in Houston, received an M.S. in Environmental Science & Engineering at Rice and then a Ph.D. in Zoology (focused on ecology) at Michigan State. He has been teaching and conducting research at the University of Kentucky since 1976 and especially enjoys working with undergraduate and graduate-student researchers. His recent teaching assignments include undergraduate and graduate seminars, graduate ecology courses, and BIO 325. His recent research emphasizes the population dynamics, life histories, behavior, and evolution of various plants, insects, crayfish, mammals, birds, amphibians, and fish using lab and field experimentation and mathematical models. He likes to play guitar and Frisbee golf (not simultaneously) and is trying to prove that it's possible to learn French at an advanced age (proof not yet available).

Laboratory Instructor Luc Dunoyer is a French graduate student in biology who wanted to see the world. After his Master's degree in Dijon, France (wine, bread, and cheese country) he decided to cross the Atlantic to see what was on the other side. Now he is a PhD student co-advised by Drs. Ashley Seifert and Jeremy Van Cleve. Luc's personal focus is on interactions between species, behavioral mechanisms, and ecosystem engineering using crayfish in freshwater streams. Contact him if doing a project along these lines would be interesting to you. **Click on my picture to go to my website with more resources for the class.**

Schedule

(V = video, X = exercise, M = manual, C = chapter, P = paper from primary literature)

Date	Theme	Reading/Video
24 Aug R	Course overview: 10 Big Ideas, 10 exercises, 10 papers, 1 project; exams, participation, attendance: grading	V1 Models
	Tour of EREC: What a field station is, facilities, research in progress, sites of class exercises	M12 Excel
	Presentation/discussion: Models, Hypotheses, Induction/Deduction, Tests & Analysis	M13 Design/Stats
	Evolutionary Ecology	
29 Aug T	X1 PCR antibiotic resistance: model/hypotheses, equipment orientation, pipetting	M1 PCR
	PowerPoint on chapters 1-3, 5, and 6	V2 Levels of Organ'n
	Quiz 0 (15 minutes, multiple choice; introducing format, checking familiarity with syllabus; not graded)	C1-3, 5-6
31 Aug R	**Quiz 1** (30 minutes, multiple choice; text chapters 1-3, 5-6)	M11 Report format
	X1: Sample soil and extract DNA	
	PowerPoint overview and discussion of evolutionary ecology and eco-evolutionary dynamics	
	Expectations for class reports and presentations	
5 Sep T	X2 Mosquito dynamics: model/hypotheses, distribute traps, go over methods	C4 Genetics/select'n
	X1: Amplification via thermocycler	M2 Mosquitoes
	PowerPoint on chapter 4 and discussion	
	***Introduction to PCR report due	

Date	Theme	Reading/Video
7 Sep R	X1: Gel and analysis, discussion and interpretation, model redux	
	X2: Trap check (TA), set up for rearing	
	Discuss project group organization and initial ideas for projects (see the end of this document)	
	NetLogo exercises: Bacterial Infection, Bug Hunt Camouflage, Fish-Tank Genetic Drift, Fireflies	
	Feedback X1 (student feedbacks include pros/cons of an exercise and one substantive question on the topic)	
12 Sep T	X2: Initiate 1st rearing, refill traps	C7 Energetics
	X3 Pollination: model/hypotheses, equipment overview, design, conduct study (if weather allows)	V3 Optimization
	Discuss V3 optimization and games	M3 Pollination
	PowerPoint on chapter 7, discussion	
	***Methods and Results for PCR report due	
14 Sep R	X2: Trap check (TA), check rearing chambers	V4 Emergence
	X3: Gather data, analyze, interpret and discuss, model redux	C8 Social rel'ns
	PowerPoint on chapter 8, discussion	P1: Juliano+LPL 2005
	Discuss V4 self-organizing agents, emergence	P2: Koch et al. 2017
	Look at the NetLogo bee model	
	Discuss papers 1 and 2 from primary literature	
	Feedback X3	
	***Deadline for establishing project groups (2-3 members/group)	
	***Full PCR report due (first draft)	

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Date	Theme	Reading/Video
	Populations	
19 Sep T	**Quiz 2** (30 minutes, multiple choice; text chapters 4, 7-8)	C9 Distr'n & abund
	X4 Carbon Footprints: EREC. Overview, model/hypotheses, Excel sheet, gather & dry grass	M4 Carbon footprint
	X2: Refill traps, initiate 2nd rearing	
	PowerPoint on chapter 9, discussion	
	***Notify instructors of potential project topic; feedback on PCR reports returned	
21 Sep R	X2: Check of traps and rearing chambers (TA)	V5 Ecological niche
	X4: Weigh grass; prepare soda-lime jars	C10 Pop'n dynamics
	X4 Carbon Footprints: Yours. Class exercise using internet sources	M4 Carbon footprint
	PowerPoint on chapter 10, discussion	
	***Deadline for first draft of a project proposal *and* final draft of PCR report	
26 Sep T	X2: Refill traps, initiate 3rd rearing	C11 Pop'n growth
	X4: Put soda-lime out in the field	M5 Fruitflies
	X5 Fruitfly Population Dynamics: model/hypotheses, set up study, link to mathematics of population growth	
	PowerPoint on chapter 11, discussion	
	***Feedback on project proposals returned	
28 Sep R	X2: Check rearing chambers (TA)	C12 Life histories
	X4: Retrieve soda-lime jars, put into drying ovens	
	PowerPoint on chapter 12, discussion	
	Work on project proposals and logistics	

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Date	Theme	Reading/Video
3 Oct T	X2: Ongoing ID of adults, data analysis, interpret and discuss (preliminary)	P3: Rebolledo 2017
	X4: Weigh soda-lime to obtain data component 2 (soil respiration)	P4: Dey & Joshi 2013
	X5: Discuss results to date	
	***Final project proposal due	
	Discuss papers 3 and 4 from primary literature	
	Communities	
5 Oct R	**Quiz 3** (30 minutes, multiple choice; text chapters 9-12)	C13 Competition
	X6 Replicated Pond Experiment: Overview, model/hypotheses, design, conduct	M6 Pond study
	PowerPoint on chapter 13, discussion	
	TA takes measurements on Saturday the 7th	
10 Oct T	X2: Ongoing ID of adults, data analysis, interpret and discuss (preliminary)	V6 More models
	X5: Summarize results, discuss patterns and implications for population dynamics	C14 Enemies
	X6: Pond measurements	
	PowerPoint on chapter 14, discussion	
	Feedback X5	
12 Oct R	X6: Pond measurements; analyze data, interpret, discuss	C15 Mutualism
	PowerPoint on chapter 15, discussion	
	PowerPoint on intraguild mutualism	
	Feedback X6	

Date	Theme	Reading/Video
17 Oct T	X7: Succession and Diversity: Overview, model/hypotheses, design	C16 Abund & div'ty
	X2: ID adult mosquitoes, final analysis, interpret results	M7 Succession
	PowerPoint on chapter 16, discussion	
	Feedback X2	
19 Oct R	X7: Conduct sampling, process samples, record data	C20 Succesion/div'y
	Discuss V7 on being an ecologist	V7 Being an ecologist
	PowerPoint on chapter 20, discussion	
24 Oct T	Interactions & community structure	C17 Inter'ns &struc
	X7: Analyze data, interpret, discuss, model redux	P5: Stubble 2017
	PowerPoint on chapter 17	P6: Li & Waller 2017
	Discuss papers 5 and 6 from primary literature	
	Feedback X7	
26 Oct R	**Quiz 4** (30 minutes, multiple choice; text chapters 13-17, 20)	M8 NetLogo primer
	X8: NetLogo Modeling with bees: Overview, model/hypotheses, design, conduct, analyze, interpret, discuss	NetLogo manual:
	Discussion of project progress	BehaviorSpace
31 Oct T	X8: NetLogo Modeling with fruitfly data: Overview, model/hypotheses, code, run, analyze, model redux	NetLogo manual:
	Feedback X8	Tutorials 1-3

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Date	Theme	Reading/Video
2 Nov R	X4: Gather and dry leaves for component 3	C18 Production
	X9: Goldenrods: Overview, model/hypotheses, design, prepare and distribute caterpillars	M9 Goldenrods
	PowerPoint on chapter 18, discussion	
7 Nov T	X4: Weigh leaves	
	X9: Gather data, analyze, interpret, discuss	
	Feedback X9	
	Ecosystems	
9 Nov R	Primary & secondary production	V8 Ecosystems
	Project progress and plans: upload data so far and a one-page explanation of the data, progress and plans	
14 Nov T	Nutrient cycling and retention	C19 Nutrient cycles
	PowerPoint on chapter 19, discussion	P7: Evans et al. 2017
	Discuss papers 7 and 8 from primary literature	P8: Gavazov 2017
	Landscapes to Global	
16 Nov R	Landscape ecology, metapopulations, and metacommunities	C21 Landscape ecol’y
	X10 Metapopulations: beetles, beans and petri dishes in the lab—model, design, conduct	V9 Space/time scales
	PowerPoint on chapter 21, discussion	

Date	Theme	Reading/Video
21 Nov T	Geographical/regional ecology	C22 Regional ecology
	Finish X10: more data, analyze, interpret, and model	V10 HIREC
	X4: Gather and dry honeysuckle for component 4	
	PowerPoint on chapter 22, discussion	
	Feedback X10	
23 Nov R	***Thanksgiving***	
28 Nov T	X4: Weigh honeysuckle; conduct the analysis, interpret, discuss	C23 Global ecology
	Global ecology	M4 Carbon footprint
	PowerPoint on chapter 23	P9: Hindmarch 2017
	Discuss papers 9 and 10 from primary literature	P10: Morley 2017
	Feedback X4	
30 Nov R	**Quiz 5** (30 minutes, multiple choice; text chapters 18-19, 21-23)	
	***Project reports due	
	Presentations of class projects (25 minutes of presentation, 5 minutes for questions)	
5 Dec T	Presentations of class projects	
7 Dec R	Review and class discussion	
12 Dec T	**Final exam** 3:30-5:30 PM (videos: Big Ideas)	

Videos	Exercise (a manual corresponds to each)	Manual (fit exercises + 3 others: 10-12)
V1 Modeling and model-based thinking	X1 PCR antibiotic resistance	M1 PCR
V2 Levels of organization	X2 Mosquito dynamics	M2 Mosquitoes
V3 Optimization and game theory	X3 Pollination	M3 Pollination/refractometer
V4 Emergence and self-organization	X4 Carbon footprints	M4 Carbon footprints
V5 Ecological niche	X5 Fruitfly population dynamics	M5 Fruitflies
V6 More models	X6 Replicated pond experiment	M6 Pond study
V7 Being an ecologist	X7 Succession and diversity	M7 Succession and diversity
V8 Ecosystems	X8 NetLogo modeling	M8 NetLogo primer
V9 Scales of space and time	X9 Goldenrods	M9 Goldenrods
V10 Human-Induced Rapid Environmental Change	X10 Metapopulations	M10 Metapopulations
	M11 Report/presentation format	
	M12 Excel	
	M13 Study design & statistical analysis	

References

1 Juliano, S.A., and L.P. Lounibos. 2005. Ecology of invasive mosquitoes: effects on resident species and on human health. Ecology Letters 8: 558-574.

2 Koch, B.J., B.A. Hungate, and L.B. Price. Food-animal production and the spread of antibiotic resistance: the role of ecology. Frontiers in Ecology and Environment 15: 309-318.

3 Rebolledo-Leiva, R., L. Angulo-Meza, A. Iriarte, and M. C. González-Araya. 2017. Joint carbon footprint assessment and data envelopment analysis for the reduction of greenhouse gas emissions in agriculture production. Science of the Total Environment 593-594: 36-46.

4 Dey, S., and A. Joshi. 2013. Effects of constant immigration on the dynamics and persistence of stable and unstable *Drosophila* populations. Scientific Reports 3: 1405 (7pp)

5 Stubble, K.L., E.P. Zefferman, K.M Wolf, K.J. Vaughn, and T.P. Young. 2017. Outside the envelope: rare events disrupt the relationship between climate factors and species interactions. Ecology 98: 1623-1630.

6 Li, D., and D.M Waller. 2017. Fire exclusion and climate change interact to affect long-term changes in the functional composition of plant communities. Diversity and Distributions 23: 496-506.

7 Evans, R., A.M. Alessi, S. Bird, S.J. McQueen-Mason, N.C. Bruce, and M.A. Brockhurst. 2017. Defining the functional traits that drive bacterial decomposer community productivity. The ISME Journal 11: 1680-1687.

8 Gavazov, K., J. Ingrisch, R. Hasibeder, R.T.E. Mills, A. Buttler, G. Gleixner, J. Pumpanen, and M. Bahn. 2017. Winter ecology of a subalpine grassland: Effects of snow removal on soil respiration, microbial structure and function. Science of the Total Environment 590-591: 316-324.

9 Hindmarch, S., J.E. Elliott, S. Mccann, and P. Levesque. 2017. Habitat use by barn owls across a rural to urban gradient and an assessment of stressors including, habitat loss, rodenticide exposure and road mortality. Landscape and Urban Planning 164: 132-143.

10 Morley, J.W., R.D. Batt, and M.L. Pinsky. 2017. Marine assemblages respond rapidly to winter climate variability. Global Change Biology 23: 2590-2601.

Keys to Be Supplied in Class

1 Flowering plant key (for project X3 Pollination)

2 Aquatic invertebrate keys (for project X6 Replicated Pond Experiment)

1 Terrestrial invertebrate key (for project X7 Succession and Diversity)

1 Morphological plant key (for project X7 Succession and Diversity)

Project Ideas (these are for only if you can't think of something better)

Ant foraging (a kit is available for conducting this)

Dominance hierarchies with crayfish

Fluorometry (photosynthetic efficiency studies)

NetLogo modeling (bees, flies, or new model)

Pollination experiments

Design a citizen science project (based to be collected by non-scientists)

Bird feeder studies (e.g. gradient of predation risk, foraging rates and choice studies)

Rubric example	**No Attempt 0**	**Less-than solid work 50-80**	**Solid work 80-90**	**Excellent work 90-100**
Introduction				
Describe how the study fits into the larger research field = what previous work has identified the question to be addressed?	No broader context is presented.	A broader context is presented, but the study is not placed in that context.	A broader context is presented, and the study is situated in that context. However, the link is not clear or is tenuous and the student fails to convince the reader.	A broader context is presented in which the present study is situated. Moreover, the link is strong and the student convinces the reader of the importance of the concepts linked to the study.
Explain the importance of the study = what gaps in present knowledge will the study fill?	No gap is identified.	A knowledge gap is identified, but not clearly or not convincingly.	A knowledge gap is identified; however, it is not clear how the study will fill that gap.	A knowledge gap is identified and it is clear how the study will fill that gap.
Describe the hypothesis being tested.	No hypotheses presented.	Hypotheses presented, but confusingly.	Hypotheses presented clearly, but the link with the knowledge gap is tenuous.	Hypotheses presented clearly and they address the knowledge gap.
Diagram a simple boxes and arrows model that represents a hypothesis about the key relationships	No diagram is provided.	A tentative diagram is presented.	The diagram contains elements of the broader context, knowledge gap, and hypotheses; however, the structure is unclear or confusing.	The diagram clearly addresses how the hypotheses are related to the broader context and knowledge gap as well as shows which pieces the study is addressing.
Identify the prediction(s) of the hypothesis being tested.	No predictions are provided.	Some predictions are provided, but they do not follow the hypotheses.	Predictions are following hypotheses, but are not clear or justified.	Predictions are following hypotheses, and are clear as well as justified.
Material and Methods				
Provide detailed information on your study organism, including scientific and common species names, where they were collected.	No information provided.	The study organism is vaguely presented.	The study organism is presented, but some information are missing.	Complete presentation of the study organism.
Describe your methods in sufficient detail that someone else could use your description to replicate your experiment and results.	No methods provided.	Methods are vaguely and incompletely presented.	Methods are completely presented, but some parts are confusing and non-replicable.	Methods are completely presented, and all parts are clear as well as replicable.
Mention the statistical tests you used for hypothesis testing.	No statistical test provided.	Some statistical tests are provided, but neither justifiably or convincingly.	Statistical test are provided, but they are not justified or do not allow students to answer their hypotheses.	Statistical test are provided with justification and they allow students to answer their hypotheses.
Results				
Provide graphical summaries of your data and reference those summaries in parentheses after the appropriate text (see example in the next criterion).	No graphics are provided.	Non relevant graphics are presented or relevant graphics are presented, but not referred to in the text and/or are not correctly formatted.	Relevant graphics are presented, but formatting is inappropriate and/or in-text inclusion is incomplete.	Relevant graphics are presented, formatting is appropriate and in-text inclusion is complete.
Provide the complete results of your statistical tests in parentheses after stating a biological result, such as: sample size, degrees of freedom, t-statistics, and p-values (these results could also be in table format).	No results are provided.	Some results are presented, but they are incomplete.	Complete results are presented, but formatting is incorrect and/or there are missing pieces of information about some results.	Complete (all the needed results), exhaustive (no missing pieces), and accurate (no errors) results are presented.
Discussion				
Describe the main conclusions that can be supported by your results.	No conclusions are presented.	Conclusions are presented, but not how they are supported by the results.	Conclusions are presented as well as how the results support them; however, it is done confusingly or non-convincingly.	Clear presentation of conclusions with their supporting results.
Describe alternative explanations for the results or limitations to the study.	No alternative explanations broad up.	Some limitations of the study are broad up, but no alternative explanations are provided (or the other way around).	Study limitations and alternative explanations are provided; however, it is confusing and/or not convincing.	Clear and convincing alternative explanations are provided as well as study limitations.
Generalize findings to other systems (and compare results to any similar studies).	No alternative explanations broad up.	Some other systems are mentioned, but weakly and without justification or context.	Similar and relevant studies are discussed, but the broader context is not present (or the over way around).	Similar and relevant studies are discussed in the student's study context as well as in the broader context. Moreover, there is an effort to generalize the results at hand in that broader context (other systems).
Diagram a new or improved model if your results suggest one	No broader context mentioned.	A diagram is provided, but it is neither new nor improved.	An improved or new diagram is provided; however, the additions or improvements are confusing and/or uncalled for (despite potentially being drawn from the study results).	A clear and justified improved or new diagram is provided. Moreover, the additions or improvements add on our understanding of the study system in light of the study results.