Annual Assessment Report: Biology

1. Program Assessment Meetings

October 2016: The NMS Division met to discuss who would focus on each of our majors. It was decided that Jackie Schnurr would focus on the BCS major, and the first step would be to develop an assessment plan.

April 20, 2017: Christina Schmidt, Kristy Blake, and Jackie Schnurr met as the Biology major to discuss offering BIOL 130L in Fall, changing BIOL 114L to a 200-level course with BIOL 130L as a prereq because students in BIOL 114L were not making appropriate progress due to the amount of material that needed to be covered in only one course.

May 2, 2017: Chris Bailey, Lindsay Burwell, Christina Schmidt, Kristy Blake, and Jackie Schnurr met to establish a plan for assessment reports and plans, and to share major objectives and course objectives in Google Docs.

May 11, 2017: Chris Bailey, Lindsay Burwell, Christina Schmidt, Kristy Blake, and Jackie Schnurr met to discuss the goals and objectives for each of the majors and what we will focus on for the coming year.

2. & 3. Closing the Loop and Examination of Assessment Data

BMB is now be assessed separately from Biology.

No data to collect.

BCS 403 was combined with the former BCS 301, making a 4-credit Senior Seminar course.

The new course emphasised writing (through the composition of a "research propositional"), oral communication (through two oral presentations), and Life After Wells (through the preparation of a CV/resume and visits by several BCS alumnae). For a detailed assessment of the communication aspects of the course see the 2017 Chemistry Assessment Report.

BIOL 305 was taught as a project-based 3-hour seminar.

The new way of teaching did lead to a higher percentage of A's (30% in 2016 vs 21% in 2014), but the remaining categories remained fairly consistent with 84% of the students getting a C or better in 2014 and 86% in 2016. I concluded that the course was fine either way that it was taught, but that it could be so much valuable to our students if we made some major changes (which we did and it

will be changing to Terrestrial Field Biology in the future).

BIOL 312L was taught with the lab section in the same format as 363, where students will each have a research-based project. Students learned a new method of genome editing called CRISPR and the ethical implications of genome editing was discussed.

The research based aspect of this project turned out extremely well. The students responded very positively to be a part of a larger research collaboration with the Boyce Thompson Institute at Cornell. Michelle Cilia from the Boyce Thompson Institute gave a guest lecturer on her work and how the student's lab projects connected to her research lab. The questions students asked at the end of her talk prompted an interesting and interactive discussion- 75% of students asked questions at the end of her talk.

Students engaged and connected with the project in a stronger way than "regular" course labs. This was mentioned multiple times in person and in course evaluations. 100% of the students fully participated in the research lab, attending each day. 100% passed on short lab question assignments. 100% passed on an exam given at the end of the lab project.

Students explored the ethical aspects of CRIPSR gene editing through discussion, where ~80% of the students participated fully. 100% of students thoughtfully discussed the ethical implications short answer on the exam.

BIOL 330L included a field trip to the cadaver lab at New York Chiropractic College.

There was consistently positive feedback from this activity. All students participated and succeeded (100% passing of organ identification activity) at the activities associated with the field trip . This will continue to be a component of BIOL 330L.

4. Program changes for the upcoming year:

Change BIOL 114L to a 2xx course with a prerequisite of BIOL 130L in order to enhance student preparedness and consequent success in the course. Note: this change will be implemented Fall 2018.

5. Action plan for the upcoming year:

Assessment of how courses in the major are achieving Goal 3 of the major:

Students will communicate scientific work in a clear, coherent manner in both written

and oral form.

Objective 3.1: Students demonstrate effective written communication.

Learning Outcomes: Students use, evaluate, and appropriately cite the scientific literature to communicate the results of scientific investigations in papers and posters.

Specific course assessments:

BIOL 119L: Hemlock and pill bug lab reports (see assignments and rubrics below)

BIOL 130L: Photosynthesis lab report (see assignment and rubric below)

BIOL 304L: Species paper (see assignment and rubric below)

BIOL 363: Manuscript of their research (see assignment and rubric below)

BCS 403: Propositional (see assignment and rubric below)

Objective 3.2: Students demonstrate effective oral communication.

Learning Outcomes: Students orally present the results of their scientific studies to their peers and the public.

Specific course assessments:

BIOL 119L: Hemlock oral presentation (see assignment and rubric below)

BIOL 114L: History of Anatomy and Physiology presentation (see assignment and rubric below)

BIOL 130L: Great Phylum Collection (see assignment and rubric below)

BIOL 304L: Species presentation (see assignment and rubric below)

BIOL 363: Poster presentation (see assignment and rubric below)

BCS 403: Propositional (see assignment and rubric below)

BIOL 119L

Estimation of Abundance in Mobile Animal Populations

Mark-Release-Recapture Methods

Introduction

Estimating abundance of organisms is a fundamental problem in ecology. It is rarely possible to conduct a complete **census** of a population, even of sedentary organisms: The large numbers involved often make such complete counts too time consuming; furthermore, it is often difficult to determine the spatial extent of the population so that all individuals can be counted. One solution is to estimate the **density** (i.e., number of individuals per unit area) of the population by counting the number in each of a sample of small plots, sometimes called **quadrats.** If the extent of the habitat is known, the total number of individuals in the population can then be determined by multiplying the area of the population by its density.

Mobile organisms, such as most animals, may move from plot to plot too rapidly to allow such counting. Moreover, some animals may behave in ways that make them impossible to count: They may be nocturnal or fossorial (burrowing), so that they can't always be seen to be counted. Quadrat or similar methods don't work with such organisms, and one must employ other models of estimation. **Mark-release-recapture methods** are among the most useful for conducting estimates of abundance of populations of mobile organisms. The simplest mark-recapture method is based on what is called the **Lincoln-Petersen Index,** which requires a single episode of marking and releasing animals and a single, later episode of resampling and looking for animals that were previously marked.

Note that both quadrat methods and mark-release-recapture methods give what are called **absolute estimates**, that is, they provide one with a numerical estimate of the size or density of the population (e.g., "there are 247 humpback whales in Baker Sound.") A **relative estimate** allows one to estimate the number of organisms present relative to those present at some other time or place, but doesn't estimate how many are present in either case (e.g., "The density of locusts in our test area is 10 times greater this year than it was last year."). One may achieve such relative estimates by **catch-per-unit-effort methods.** For example, if a group of ecologists spend 5 person-hours in a field netting butterflies and catch 50 butterflies, they have caught them, on average, at a rate of 10 butterflies per person-hour. They have no idea of the total number of butterflies in the population. If, however, the ecologists return to the same site on another day, and net in the same way for, say, 2 hours and catch 40 butterflies, or 20 per person-hour, the ecologists may estimate that the butterflies are twice as abundant on the second day as they were on the first.

It's important to remember that the accuracy of each of these methods depends on its underlying assumptions being met. (Think through what some of the assumptions of quadrat sampling, mark-release-recapture and catch-per-unit-effort methods are.)

Procedure

Mark-Release-Recapture-Estimate

On one occasion, we will capture a sample of organisms of each of two populations we wish to estimate. We will mark each animal we capture with an indelible, but harmless mark, and release it back into the population, keeping careful track of how many were marked. It is important that the animals be treated as gently as possible and that they be given enough time to mix with the population as a whole before the second sampling is conducted.

On a second occasion, probably the next week, we will capture another sample in the same localities. We will count the number of animals in this second sample and note how many of them bear the marks that we applied to the animals captured on the first occasion.

We now have 3 data or pieces of information for each population.

M = number of animals marked on the first occasion

C = number of animals caught on the second occasion

and **R** = number of animals in that second sample found to be marked.

What we want to know is

N = the number of animals in the population.

To help you understand the method, answer the following questions:

In terms of the symbols above, what proportion of the whole population did we mark?

What proportion of the sample of the second occasion was found to be marked?

Note that, if the sample of the second occasion was taken **randomly** with respect to whether an animal is marked or not, the proportion of marked animals in the second sample is equal to the proportion of marked animals in the whole population. This, in fact, is the definition of random sampling.

Write an algebraic expression stating this equality and solve it for **N**, the size of the population and the parameter we wish to estimate.

For this to be an accurate estimator of the population, certain things have to be true; that is, we have made certain assumptions about the population and the behavior of the animals.

Make a list of as many of these assumptions as you can.

Think about ways in which these assumptions may not hold for the populations we're studying.

What are the violations of the assumptions likely to do to the magnitude of our estimate of **N**?

For statistical reasons we need not consider here, we'll use what is called an "unbiased" estimator. It should be similar, but not identical to, the equation you wrote above:

$$N = \frac{M(C+1)}{(R+1)}$$

Like all other measurements made in science, our absolute estimates of population size have a limited degree of precision. The level of precision in our estimate can be expressed by applying **confidence intervals** to them. What a confidence limit tells us is, although it is unlikely that a population is exactly what we estimate it to be, we can say with a given level of confidence—often 95%— that the true population lies between an upper and a lower limit.

In our study, the level of confidence depends on the proportion of the second sample that we found to be marked, or R/C. The higher this proportion, the narrower our confidence interval can be.

Pollack et al. (Pollack, K. H., J. D. Nichols, C. Brown and J. E. Hines. 1990. Statistical inference for capture-recapture experiments. Wildlife Monographs No. 107:1-97.) suggest a method for

estimating confidence intervals for mark-recapture experiments. They begin by calculating a variance for the estimate:

The 95% confidence limits on our estimate of the population can be calculated as

We will calculate a population estimate for the populations we're studying and attach appropriate upper and lower 95% confidence limits around them. On both sampling occasions, we will also keep track of the "sampling effort", i.e., how many "person-hours we spend sampling or how many "trap-hours" the animals were exposed to. We therefore have two opportunities to estimate the **relative density** of each population. These relative estimators should agree with our absolute estimators.

Reporting Results

Write a standard Ecology format (see attached page) research report describing our study. In your discussion, focus on a well-reasoned analysis of the reliability of our study. Is the estimate of population size that we obtain a reasonable one? How likely does it seem that the assumptions you made about the populations were valid? Which of the assumptions underlying the methods were likely to hold and which were not? Did any informal observations you made on the behavior of the animals bear on the reliability of the estimates of population's size? For example, was there evidence that animals were joining or leaving the population between our sampling occasions? How about the effects of our handling of the animals? How might these considerations affect the magnitude of our

estimates? What effects, if any, would they have on our confidence intervals? Are the relative estimates consistent with the absolute estimate, that is, does the population with the largest absolute estimate also have the largest relative estimate? Speculate on what may have caused discrepancies that exist.

References

Krebs, C. J. 1999. Ecological Methodology, 2nd Ed. Addison-Welsley, Menlo Park, CA

To do a lab write up you will basically write up a scientific paper:

1. **Title.** What is the name of your project?
2. **Abstract:** This is an overview of what you did – including the hypothesis, the methods, the results and the conclusion. Think of it as the "cliff notes" of your lab report – it allows people to decide if they want to read your whole paper or not.
3. **Introduction:** This will be a very comprehensive overview of the "problem". What have others found? (Thus, **you should cite other studies in the intro**. In scientific writing, we use the in-text-citing format of (Author year)). How do their results relate to each other? Is there something lacking in what others have done that you needed to research? That should be your question. You will have outlined the problem so well that when you finally get to the question you are asking it will make logical sense to your reader. Also include any expectations about what you thought would happen – your hypothesized answer to the question. If you include this here, in the discussion you can talk about

whether your prediction was upheld!

4. **Methods:** What exact methods did you use? Make sure that you write this section in the past tense. Include everything that you did - in the field, in the lab, and on the computer- INCLUDING THE EQUATIONS YOU USED WITHOUT NUMBERS. Although it may seem strange, statistical analyses are actually only methods that you used to determine if your hypothesis was supported or not. You don't need to include results here, just say, "I performed a t-test to determine if there was a significant difference between…"
5. **Results:** Here is where you present what you found. HERE IS WHERE YOU GIVE THE NUMBERS. Include a graph of the data, if necessary (average together multiple trials, and include error bars so your reader can see how variable the data were). **Don't include raw data** – and that includes t-test results from excel! Refer to the figures in the text when you explain what they mean: "There was a significant difference among my treatments ($P<0.05$); the flowers were on the south side of the gorge (Fig. 1)." That way you tell the reader what is important for them to know – and you point them to the data to see it for themselves. Be very explicit when you discuss what you found – but don't include any conclusions here. At first that seems pretty tricky, but the results are usually fairly dry – "just the facts, ma'am."
6. **Discussion:** In this section you wrap up the whole project. What did you find? What do your results mean? How do they relate to what others have found? Was your hypothesis supported? Why or why not? Again, since you are referring to what others have found you should have citations in the discussion.
7. **Literature Cited:** This is where you put all those citations you used in the introduction and discussion. In the sciences, we use the format:

Author Last Name, First Initial. Year. Title. Journal name. Volume:Pages.

Rubric for the Pill bug lab reports

Title: /2

Abstract:

· Briefly includes a sentence from each paper section /5

Introduction:

- Introduces organism and sets up study /5
- Uses citations /5

Methods:

- Explains in enough detail to repeat project /5
- Statistics used and explained /1

Results:

- Explained in the text /3

Discussion:

- Brought back to organism /2
- Used literature to explain results /5
- Remained positive /3

Literature Cited:

- Format /2

Overall Project:

- Was it understandable? /4

TOTAL: /40

BIOL 119L
Fall 2016

Effects of Eastern Hemlock (*Tsuga canadensis*) on the establishment of interspecific seedlings

INTRODUCTION

Background

Some years ago, ecologists noticed that fewer seedlings and saplings of broadleaved woody species seemed to grow beneath the canopies of Eastern Hemlock trees than beneath the canopies of other species. Since that time, a number of projects have confirmed this pattern, but none have been successful in determining the mechanism by which Eastern Hemlocks inhibit the other species.

Procedure

During this week in lab, we will conduct a brief orientation walk on campus, during which you will observe the spatial distributions of seedlings and saplings relative to Eastern Hemlock trees. We will then collect data to address the question: "Are the densities of seedlings and saplings of woody broadleaved plants lower beneath the canopies of Eastern Hemlock (*Tsuga canadensis*) than beneath those of broadleaved trees?"

To address this question, each group of 3-4 students will sample seedlings and saplings beneath 5 Hemlock and 5 Sugar Maple canopies. So that the physical conditions and seed rain will be as similar as possible between the two canopy types, you should choose your Hemlocks at random, but choose your Maples such than they are the nearest canopy-level ones to each of the 3 Hemlocks. We will identify and count the seedlings and saplings within a 1 x 1 meter quadrat to the southwest of the trunk of each of the trees sampled. There's nothing special about that location, of course. In fact, that's the point: by

choosing the site to sample before we even look at the trees, we reduce the possibility of biasing our results by choosing sample sites on the basis of their seedling density. Within each quadrat, count the total number of seedlings/saplings of woody plants (beech, maple, hemlock, oak, shrubs, etc.) separately. Don't count herbaceous plants like grasses, forbs, mosses, etc.

Use the data collected by all groups in your lab section to test the null hypothesis that the mean density of woody seedlings and saplings does not differ between Hemlocks and Sugar Maples. The alternative hypothesis in this case is directional: mean density of seedlings and saplings is higher beneath Hemlocks than beneath Sugar Maples. So you'll need to do a one-tailed t-test.

Assuming that we find a difference in seedling/sapling density beneath hemlocks and maples in the first part, your group should discuss factors that might be responsible for it. After doing so, your group should propose to test two different working hypotheses to explain the difference. You're free (encouraged!) to come up with other hypotheses, of course, but a few that I can suggest include:

* Light intensity is lower beneath Hemlock canopies, such that germination and/or growth of woody seedlings is inhibited.

* The canopies of Hemlock trees act as "umbrellas" that shed seeds of broadleaved trees to the side, such that areas beneath Hemlock crowns receive fewer colonists.

* Hemlocks alter soil pH in such a way that germination or growth of broadleaved plants are inhibited.

* Hemlocks produce allelochemicals, which either leach from the stems or foliage or are exuded from the roots, and which inhibit either germination or growth, or both.

Each lab group will formally propose 2 different working hypotheses to investigate. Each group will work independently of the others, and write a short proposal that:

1) Presents the statistical analysis and conclusion from the first part of the investigation (the analysis discussed above);

2) Poses two hypotheses about the mode of inhibition (e. g., what is it about Hemlock trees that results in lower densities of other plants near them).

3) Briefly describes a series of experiments or other data collection procedures that you will use to test these hypotheses. Here again, be sure that you state explicitly what sorts of data you'll collect and how you'll analyze them, including statistical

tests, etc;

4) Contains a brief list of materials that you will need to do your study. You can use space in the greenhouse, pH meters, PAR ceptometers (which are fancy light meters often used in photosynthesis labs), and just about anything else within reason.

Be aware that we can't realistically subject maple or other tree seeds from the forest to experiments you might think of to assess the effect of different pH's, soil extracts, etc., since this year's seeds won't germinate until next spring. Instead, if you plan a "bioassay," consider using seeds from a widely available and rapid germinating plant (such as sunflower, alfalfa, or lettuce - all of which are often used in these kinds of experiments).

The calendar of events for this study is as follows:

Week of…

This week: Collect initial data and enter it into an Excel spreadsheet. I'll email it around. Groups will include statistical analyses of initial data in their proposals.

Due Oct 12/13: Proposals due. I'll read through the proposals and make suggestions so you can start collecting data. Although you won't need any literature citations in your proposal, you should probably start looking for them. You will be required to have at least 5 literature citations in this lab report. Use JSTOR, Google Scholar, the library, the list at the end of this handout, etc. I have some available in the lab that you can use also.

Oct 12/13: Return to the field to make more measurements, collect soil, etc. You will be responsible for getting your experiments started and keeping them going. Work out a schedule in your group.

Oct 17: progress report: you'll need to show me your experiments if they're in the greenhouse, or the data you have collected thus far. You can use this lab to finish data collection and do statistical analyses. I'll help you if you have questions.

Nov 14: Group oral presentation of results using PowerPoint (more on this later), and written outline for the presentation (hard copy or electronic copy of the PowerPoint presentation preferred).

Nov 14: Final lab report due, in Ecology format and it must include 5 literature citations. Each student is responsible for their own write-up of the lab!

Rubric for the Hemlock lab reports

Title: /2

Abstract:

· Briefly includes a sentence from each paper section /5

Introduction:

· Sets up question using literature /5
· Hypotheses and expectations explicit /5

Methods:

· Explains in enough detail to repeat project /5
· Statistics used and explained /1

Results:

· Explained in the text /3
· Graphs present and in correct format /2

Discussion:

· Brought back to hypotheses /2
· Used literature to explain results /5
· Remained positive /3

Literature Cited:

· Number of citations /5
· Format /2

Overall Project:

· Was it creative and showed scientific understanding? /10

TOTAL: /55

HEMLOCK PROJECT PRESENTATIONS

Group Members:

(10 pts.) Introduction:_____

- gave necessary background and told why the study was interesting
- clearly stated hypothesis, goal or question

(5 pts.) Methods: _____

· presented adequate detail on how study was conducted (where, how many samples, how determine where to sample, what was measured etc.)

(10 pts.) Results:_____

- clearly described major results
- provided visual aids to illustrate results

(25 pts.) Discussion/interpretation:_____

- described how results related to hypothesis, goal or predictions
- proposed reasonable ecological explanations for patterns
- discussed errors in study *that were likely to influence results*
- discussed the next step, unanswered questions, etc.
- return to context, summary of the study

(25pts.) Delivery:_____

- able to explain work without excessive pauses
- used appropriate language
- appropriate use of visual materials
- **all group members contributed equally**

BIOL 114L

The History of A&P

We will begin about 2,500 years ago and work our way up through time to explore how we have come to know the inner workings of the human body. You will do a short presentation on a key contributor to the field, in which you introduce your subject, explain what they are known for and how they did it, and why their accomplishments are important for our current understanding of human anatomy and physiology. Warning: some of these will be quite gruesome! Early A&P was not for the faint of heart (there's a pun in there somewhere…).

Guidelines:
5 minutes long
At least 3 slides (PowerPoint or similar format)
At least 2 sources (must be cited and/or acknowledged in your presentation)
At least 2 images (1 of your person and 1 example of their work)

Content:
Biographical info (Name, birth-death, occupation, nationality)
What they are known for (some of these folks are known for a lot of different things, focus on the anatomy and physiology aspect)
How they accomplished what they are known for
Why are their accomplishments important to A&P?
An additional fact about your person that you find interesting

Your presentations will be given **in chronological order** in the last four labs of the semester. There will be approximately 6 presentations during each week. Your presentation will be evaluated using the rubric on the next page.

BIOL 114L

Presentation Grading Rubric

The History of A&P

Subject _____ **Name**_____

Points are indicated in parentheses.

_____ (10) **Biographical information.**

_____ Name _____ B-D _____ Nationality _____ Occupation

_____ (15) '**What they're known for.'** Was this clearly explained?

_____ (15) '**How they did it.'** Were their methods described?

_____ (15) '**Why it's important.'** Was the relationship to A&P clearly established?

_____ (15) **Interesting fact.**

_____ (10) **2+ images** _____ Image of subject _____ Image of their work

_____ (10) **2+ sources**. **Were sources cited/acknowledged?**

_____ (5) **Organization and clarity of presentation**

_____ (5) **Did the presentation last for 5 minutes, or was it significantly under/over?**

Time _____ **Did the presenter seem prepared?**

_____ TOTAL (out of 100)

Timeline of Key A&P Contributors

Alcmaeon of Croton (c.500 BC, Greece) – Pioneer of anatomical dissection

Hippocrates of Kos (460-370 BC, Greece) – 'Father of Western Medicine'

Aristotle (384-322 BC, Greece) – Comparative anatomy, developmental biology, humors

Herophilus (aka Herophilos; 335-280 BC, Chalcedon) – 'The First Anatomist'

Aulus Cornelius Celsus (c.25 BC-50 AD, Rome) – *De Medicina* and dermatology

Galen of Pergamon (aka Galen, Claudius Galenus, Claudius Galen; c.130-210 AD, Rome) – Animal dissections and human physiology, humors, circulatory system

Hunayn ibn Ishaq (809-873 AD, Iraq) – *Book of the Ten Treatises of the Eye*

Mondino de Luzzi (aka Mundinus, c. 1270-1326 AD, Italy) – 'Restorer of Anatomy'

Andreas Vesalius (aka Andries van Wesel; 1514-1564 AD, Brussels) – 'Founder of Modern Human Anatomy'

Leonardo da Vinci (1452-1519 AD, Florence) – Anatomical studies and drawings

Paracelsus (aka Philippus Aureolus Theophrastus Bombastus von Hohenheim; 1493-1541 AD, Switzerland) – 'The Father of Toxicology'

William Harvey (1578-1657 AD, England) – systemic circulation, blood and heart

Antonie Van Leeuwenhoek (1632-1723 AD, Netherlands) – 'Father of Microbiology'

Giovanni Battisti Morgagni (1682-1771 AD, Italy) – 'Father of Modern Anatomical Pathology'

Edward Jenner (1749-1823 AD, England) – 'Father of Immunology'

William Beaumont (1785-1853 AD, USA) - 'Father of Gastric Physiology'

Johann Friedrich Meckel (1781-1833 AD, Germany) – Pioneer in teratology

Ignaz Semmelweis (1818-1865 AD, Hungary) – Antiseptic procedures

Henry Gray (1827-1861 AD, England) – *Gray's Anatomy*

Wilhelm Conrad Röntgen (Roentgen; 1845-1923, Germany) – 'Father of Diagnostic Radiography'

Santiago Ramón y Cajal (1852-1934 AD, Spain) – 'Father of Modern Neuroscience'

Karl Landsteiner (1868-1943 AD, Austria) - 'Father of Transfusion Medicine'

Thomas Hunt Morgan (1866-1945 AD, USA) – Chromosomes and heredity

Rosalind Franklin (1920-1958 AD, England) – DNA structure

Some sites to check out:
http://www.famousscientists.org
http://www.historylearningsite.co.uk/history_of_medicine.htm

Biol 130 **Name _____**

Photosynthesis Lab –Library Research Assignment

The purpose of this assignment is to help you to use library resources to explore the effects of carbon dioxide concentration on photosynthesis, in preparation for your laboratory report on this topic. You conducted this experiment two weeks ago, and you asked a question of that you could answer using that experimental design.

What was your question?

What was your hypothesis?

What did you find? Provide an excel graph and a statistical test to *really* answer this question.

In order to provide some background on your study you should search for resources that help to either support or refute your hypothesis and what you found. You will hand this sheet in next lab period and you will use these sources in your lab report that is due the week of March 7 (this is a change from the syllabus because of the snow day last week).

The library at Shippensburg University has created an online tutorial to assist you in this assignment – and we will borrow it! The tutorial will walk you through the steps of effectively using the *Academic Search Complete* database. The tutorial can be found at:
http://libguides.wells.edu/content.php?pid=656065&sid=5464780

After you take the tutorial, fill out this chart:

Topic:	**ÿ Effects of _____ on photosynethsis**

Identify Useful Subject Headings: (list at least six subject headings)

_____ _____

_____ _____

_____ _____

Identify Effects and List Source: (1) List major effects documented in article; (2) be sure to record ALL of the following bibliographic information for each source: Authors (last names, initials), YEAR of publication, Article title, Journal or magazine title, Volume, (Issue), pages.

SOURCE 1

SOURCE 2

SOURCE 3

SOURCE 4

BIOL 130L **Lab write-ups**

When reporting the results of your experiment, the idea is that you need tell your readers why and how you did your experiment, what you found, and what it means! And don't plagiarize! Unsure what that means? Go to https://owl.english.purdue.edu/owl/resource/589/01/ and find out more!

You should have a:

1. **Title. What is the name of your project? Make it descriptive! (2 pts)**
2. **Abstract: This is an overview of what you did – including the general topic, the hypothesis, the methods, the results and the conclusion. Think of it as the "cliff notes" of your lab report – it allows people to decide if they want to read your whole paper or not. (4 pts)**
3. **Introduction: This will be a very comprehensive overview of the "problem". What have others found? (Thus, you should cite other studies in the intro. In scientific writing, we use the in-text-citing format of (Author year)). How do their results relate to each other? Is there something lacking in what others have done that you needed to research? That should be your question. You will have outlined the problem so well that when you finally get to the question you are asking it will make logical sense to your reader. Also include any expectations about what you thought would happen – your hypothesized answer to the question. If you include this here, in the discussion you can talk about whether your prediction was upheld! (5 pts)**
4. **Methods: What exact methods did you use? Make sure that you write this section in the past tense. Include everything that you did - in the lab, and on the computer. Although it may seem strange, statistical analyses are actually only methods that you used to determine if your hypothesis was supported or not. You don't need to include results here, just say, "I performed a t-test to determine if there was a significant difference between…" (5 pts)**
5. **Results: Here is where you present what you found. Include a graph of the data. Don't include raw data – and that includes t-test results from excel! Refer to the figures in the text when**

you explain what they mean: "There was a significant difference among my treatments ($P<0.05$); the disks sank faster in the XX treatment (Fig. 1)." That way you tell the reader what is important for them to know – and you point them to the data to see it for themselves. Be very explicit when you discuss what you found – but don't include any conclusions here. At first that seems pretty tricky, but the results are usually fairly dry – "just the facts, ma'am." (10 pts)

6. **Discussion: In this section you wrap up the whole project. What did you find? What do your results mean? How do they relate to what others have found? Was your hypothesis supported? Why or why not? Again, since you are referring to what others have found you should have citations in the discussion. (5 pts)**
7. **Literature Cited: This is where you put all those citations you used in the introduction and discussion. (4 pts) In the sciences, we use the format:**

Author Last Name, First Initial. Year. Title. Journal (or Publisher). Pages.

Rubric for the Photosynthesis lab reports

Title: /2

Abstract: /5

Introduction:

- **Sets up question using literature /5**
- **Hypotheses and expectations explicit /3**

Methods:

- **Explains in enough detail to repeat project /5**
- **Statistics used and explained /1**

Results:

- **Explained in the text /3**
- **Graphs present and in correct format /2**

Discussion:

- **Brought back to hypotheses /2**
- **Used literature to explain results /5**
- **Remained positive /2**

Literature Cited:

- **Number of citations /3**
- **Format /2**

Overall Project:

- **Was it creative and showed scientific understanding? /10**

TOTAL: /50

BIG PHYLUM COLLECTION

OBJECTIVES: Review the diversity and classification of life by making a collection of organisms found on campus of maximum possible diversity. Review key characters that identify different taxonomic groups. Get outside and observe life.

BACKGROUND: In lecture and lab this semester, we have examined the evolutionary relationships among different types of organisms and what unique derived characters distinguish different taxonomic groups. In this lab, you will review this information to make a collection of organisms on campus.

PROCEDURE: Students will divide into your usual groups we have been working in all semester. In week one (week of April 24th), 1) you should create a master list of all the phyla and subgroups (covered in class) that you think you can find. 2) You should work from this list to create a strategy of how best to collect these organisms on campus using the equipment we have. 3) Collect your organisms this week – to collect an organism, take a photograph! (For microscopic critters, you may need to collect a sample and have us observe it in real life) 4) All organisms need to be labeled with their taxonomic group (including Domain name, Kingdom name, Phylum name, and lower taxonomic name, if necessary). 5) Labels should also include where the specimen was found and when, i.e., type of habitat, location, and date.

During the last lab period (week of May 1) you will make a powerpoint presentation documenting AT LEAST 25 DIFFERENT ORGANISMS FROM AS MANY PHYLA AS YOU CAN FIND! All specimens should be labeled with name and location (see #5 above).

The number of different KINDS of organisms should be tallied AND THE GROUP WITH THE MOST WILL WIN A PRIZE.

BIOL 304L
Species Paper and Presentation Assignment

You will write a 2-part paper on a vertebrate species of your choice. At the end of the semester, you will submit a combined and revised version of the paper. You will do a brief presentation that summarizes your paper in order to share your species with the class.

Part I

- Name
- Physical description
- Food
- Phylogeny and systematics
- Geographic distribution

Part II

- Ecological distribution
- Behavior
- Senses
- Unusual or unique physiology
- Other unusual characteristics

BIOL 304L
Rubric: Species Paper Part I

_____ (4pts) Common name, scientific name, when was it described, who described it, meaning

_____ (12pts) Physical description: scientific terms used, major group, size and shape, color,

integument, unusual structures, sexual dimorphism

_____ (4pts) Types of food, digestive tract

_____ (10pts) Closest relatives - living and extinct (stem group), distinguishing features, fossil record

_____ (5pts) Phylogenetic tree(s)

_____ (4pts) Geographic distribution – native, introduced, variation over time

_____ (1pt) IUCN conservation status

_____ (5pts) In-text citations and list of references – complete and properly formatted

_____ (5pts) Grammar and mechanics – spelling, punctuation, word use, formatting

BIOL 304L
Rubric: Species Paper Part II

_____ (12pts) Ecological distribution – habitat, parameters that limit distribution (food availability, climate, predators and parasites, etc.), seasonal changes and associated specializations, migratory pathways (if applicable)

_____ (12pts) Behavior – locomotion, reproduction, feeding, sociality, parental care, defense, associated physical features

_____ (6pts) Senses – primary senses used, how they are used

_____ (6pts) Unusual or unique physiology – function and biological role

_____ (4pts) Other unusual characteristics

_____ (5pts) In-text citations and list of references – complete and properly formatted

_____ (5pts) Grammar and mechanics – spelling, punctuation, word use, formatting

BIOL 304L
'My Species is Awesome' Presentation Rubric

_____ [1] Common and scientific name

_____ [2] Major group affiliation (eg 'it's a raptor', 'it's a rodent', 'it's a cat', etc.)

_____ [2] Brief description of geographic location and habitat (1-2 sentences)

_____ [5] Interesting/unusual physiology, anatomy and/or behavior

_____ [8] Function and/or biological role of physiology, anatomy and/or behavior

_____ [4] Relevant images and/or videos, with accompanying explanation

_____ [3] Preparation – well organized and clear, length 4-7 minutes

_____ [25] Total

_____ [2] Bonus: Re-name your species

Biol 363 - Project Details

This semester you are charged with a task: to conduct a research project that incorporates parts of both primary and secondary research, in order to discover more about the natural systems that surrounds you. What that means is that I would like you to pick a topic, research it, read the papers, and *from what you have read*, ask a simple question that can be answered with several days of field work. You will then PRESENT your project to the class.

Parts of your lab project:

1. Think of a research project that interests you – and you can work in groups, but each of you is responsible for the write-ups – and I'll expect more from you….
2. Do some literature searches. I would assume you would like to use JSTOR (http://www.jstor.org/search). If you find other papers you would like to use you may need to use interlibrary loan – or head to Mann Library at Cornell.
3. Read and critically think about the papers you find. If you can't find at least 5 papers, pick a different topic. From what you have read, propose a question you can easily answer in the field.
4. Write a proposal about what you are going to do in the field. See below for more details on this.
5. Do what you propose to do in the field, after it is approved by me.
6. Analyze your data, and add it to your proposal in the correct sections. There! You just wrote a well-developed and thought out research project!

How do I write a proposal?

Seems like a silly question, but the ability to write a good proposal is an art. When you are writing grants to perform research you will have to write a good proposal since you are competing with others. The idea is that you need to provide all the background information necessary for your readers to: 1) comprehend what project you would like to undertake, 2) understand why it is important for you to do, and 3) understand that your methods are appropriate. That means that you will have very similar sections in your proposal and the final paper.

You will have a:

1. **Title.** What is the name of your project?
2. **Abstract:** this is usually an overview of what you are proposing to do. There won't be any results, but you can say either what you expect to happen, or why it is important to be doing this project in the long run.
3. **Introduction:** This will be a very comprehensive overview of the "problem". What have others found? How do their results relate to each other? What is the biology of your species? Is there something lacking in what others have done that you NEED to research? And that should be your question. You will have outlined the problem so well that when you finally get to the question you are asking it will make logical sense to your reader.
4. **Methods:** What methods will you use to do your research? Make sure that you write this section in the future tense. "I *will* choose 5 seedlings in light gaps…." Make sure you include everything you plan to do in the field, in the lab, and on the computer. By explicitly stating your statistical analyses it shows your readers you have thought through every part of your project.
5. **Discussion:** In this section you can tell your reader why it is important for you to do the research. It can be a very small section in a proposal, especially since you did such a good job setting up the question in the introduction.

6. **Literature Cited:** This is where you put all those citations you used in the introduction. Make sure that you use the correct *Ecology* format!

Basically, if you write a good proposal you will only need to change a couple of things to complete the final paper. You will add what you found to the abstract, change the future tense to past tense in the Methods, add the Results section and any figures, and explain how your results relate to your question and the work of others in the Discussion.

You are responsible for meeting with me weekly to give me a progress report. I am also here to help you at all stages of your project! This should be a learning experience, and since we all learn best by doing, we're going to do the research! Please see your syllabus for due dates.

Biol 363
Final Paper Rubric (from Karban et al. 2014)

Title: **/ 2**

- **Does it summarize the main result?**

Abstract: **/ 8**

- **Does the abstract tell your story, very concisely?**

Introduction: **/ 20**

- **Does the beginning of your Introduction "hook" the reader by setting the stage for the question(s) your paper answers?**
- **Do you explain and justify your question(s) instead of just extolling the virtues of your study organism?**
- **Do you briefly summarize previous work that informs your current question(s)?**
- **Do you end your Introduction by clearly listing the question(s) your manuscript addresses?**

Methods: **/ 10**

- **Do you briefly explain the relevant natural history of your organisms or study system, if you haven't already included it in the Introduction?**
- **Do you explain your methods thoroughly enough that another ecologist could repeat your experiment, but briefly enough that you're not too wordy?**
- **Do you start the description of each experimental method with a phrase justifying why it was done?**
- **Do you include a brief explanation of each statistical procedure you used?**
- **Do you include only the methods relevant to your overall story?**

Results: **/ 10**

- **Are your results presented in a logical order to help your reader follow your story (not in the order in which you did your experiments, if that is different)?**
- **Does your text inform your readers of your results as much as possible, instead of simply referring them to your figures or tables?**
- **Do you explain your results in biological rather than statistical terms?**
- **Do you present each of your results in terms of your overall story?**

Discussion: **/ 20**

- **Do you restate your main results briefly and interpret them?**
- **Do you generalize to larger ecological concepts where appropriate?**
- **Does the information in your discussion relate to your initial question(s)? Does your story seem cohesive?**
- **Do you hit the reader over the head one last time with your take home question?**

Figures and Tables: **/ 5**

ð Are your figures and tables as simple as possible?

ð Do the titles and captions convey enough information that your reader can understand the meaning without referring to the text?

ð Do your graphs show error bars, if appropriate?

ð Do your scatterplots include a line that describes the best fit, if appropriate?

ð Do you have enough tables and graphs to show your story clearly?

Overall: **/ 25**

ð Is your paper well written and logical?

ð Do you include at least 10 literature citations?

ð Are the citations in the proper Evolution format?

ð Did your project answer an interesting ecological question?

Biol 363

Final Paper Rubric (from Karban et al. 2014)

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Overall: **/ 25**

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ð Do you include at least 10 literature citations?

ð Are the citations in the proper Evolution format?

ð Did your project answer an interesting ecological question?

BCS 403: The Propositional

A major outcome of this course for you will be the composition and presentation of a **4-6 page** (single spaced Times New Roman 12 equivalent) propositional. A typical propositional includes a survey of the current state of the field (both what is known and what might be left to know), followed by a proposal of experiments that would move the field forward. A propositional is similar to a grant proposal, but does not include a budget element.

Your task will be to investigate an area of interest to you, prepare a written background, propose the next questions to be answered in this field, and then design a series of experiments to answer these questions (you will not actually do the experiments in this course, but they should be such that they could be performed by future researchers). The topic you select might be new to you, or might be one you have examined previously.

Propositional Outline: Below is a **general** outline for the work

Part 1: Introduction and Background. What is known in the field? this section should be ~2-3 pgs.
Part 2: Proposition Aims. What is left to know? What specific questions do you propose to answer? What hypotheses do you have? This section will be ~½ - 1 pg
Part 3: Experimental Proposal. How will you answer these questions? In this section you will propose a series of experiments to answer the research questions you propose above. This section will be ~2-3 pgs.

Propositional Timeline:
August 29. Select several potential topics and begin searching out papers in the primary literature covering your topics; recent review articles are particularly helpful at this stage. Come to class with several topics in mind. We will discuss what makes a good propositional. Start to come up with research questions.

September 2. Continue to read the literature concerning your topic(s) and narrow down your choices. Class will consist of small-group peer discussion of potential topics. Be prepared to discuss what topic(s) you have selected and why. Use this discussion to **come to a final decision as to your topic**.

September 5. You will submit your propositional topic to the faculty (*10 points*). Continue reading the literature.

September 9. Select a primary literature paper related to your topic that you will present to your peers (see September 26-October 17 below). Submit a copy of this paper to the faculty. Start reading copies of existing propositionals.

September 12. A discussion of existing propositionals.

September 26. Draft of background section (Part 1) and propositional aims (Part 2) due (*70 points*).

September 26-October 17. Fifteen minute oral presentations of your primary literature paper (*100 points*). For these presentations we will divide the class into two groups. Three students in each group will present on Monday's and two on Friday's.

October 24. Draft of Experimental section (Part 3) due (*70 points*).

October 24-28. Individual meetings with faculty.

November 7-December 2. Ten minute oral propositional presentation (*150 points*) to entire class. If your topic is one you have worked on prior to this course we will anticipate that you will do your presentation earlier

rather than later. An oral presentation of your topic at the Rochester Academy of Sciences may be performed in lieu of a classroom presentation.

December 5. Final propositional paper due (*150 points*).

BCS 403 Propositional Rubric 150 pts

	Exemplary	Above Average	Acceptable	Unacceptable	Pts
Introduction /Background (40)	Engaging and informative. Indicates what is known and not known in the field with support from the literature. Leads to propositional aims. Logically constructed.	Includes relevant information, with some support from the literature. Logically constructed.	Includes relevant information, with little support from the literature. Includes extra material that while related to the propositional may not be necessary.	Includes information with an unclear relationship to the propositional topic. Minimal support from the literature.	
Propositional Aim(s) (20)	Well developed, interesting, novel, and extrapolates from current knowledge. Original thought is clear. Focused on a specific question(s).	Interesting and extrapolates from current knowledge. Original thought is present. Focused on a specific question(s).	Extrapolates from current knowledge. Original thought is unclear and aims are unfocused.	Original thought is unclear and aims are unfocused. Missing or hard to find.	
Experimental (35)	Proposes well designed and feasible experiments; where appropriate includes details of control experiments. Relates experiments to propositional aims. Hypothesizes range of results, interprets predicted results, and knowledge gained. Occurs for each experiment proposed.	Proposes feasible experiments; where appropriate includes details of control experiments. Relates experiments to propositional aims. Hypothesizes range of results, interprets predicted results, and knowledge gained.	Proposes reasonable experiments; control experiments are unclear. Relates experiments to propositional aims. Hypothesizes some results.	Questionable relationship between experiments and propositional aims.	
Significance and Conclusions (15)	Clearly ties together all experiments proposed and their significance to the field. Relates results back to original propositional aims.	Ties together experiments proposed and their significance to the field. Relates results back to original propositional aims.	Included but does not clearly relate significance to field.	Conclusions missing and/or does not relate the significance of results to the field.	
Citation (15)	Consistent and correct.	A few errors.	Multiple errors.	Inconsistent and not correct.	
Overall Composition (25)	Well organized and reads logically. Sentences and paragraphs are well phrased and flow smoothly. The language is professional and appropriate. Almost no errors in punctuation,	Well organized and reads logically. Sentences and paragraphs flow smoothly. The language is professional and appropriate. A few errors in punctuation, capitalization, and spelling.	Problems with organization. Some problems on the sentence and paragraphs level. Some errors in punctuation, capitalization, and spelling	Not organized. Multiple problems on the sentence and paragraphs level. Multiple errors in punctuation, capitalization, and spelling.	

	capitalization, and spelling.				