

## Insights into Student Development of Case Studies

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*As a SCN New Case Fellow, for the past two years I have been helping undergraduates write their own case studies. In this feature, I will describe the project that I have developed and highlight some of its most important aspects.*

### ***The Context***

I teach a large course (~200 students per semester) called Foundations of Ecology and Evolution. Two years ago, when I was developing an honors version of this course, I became involved with the Science Case Net (SCN) program. At that time, I decided that one way I would make the experience in my honors course unique was to incorporate case studies throughout the class and to challenge the students to write their own cases. With the help of Kipp Herreid, my mentor in the New Case Fellow program, I designed a semester long project to help my students write their own cases. The details below are based on what I have learned while developing and implementing this project over the past two years.

### ***The General Design***

The case study project is introduced on the first day of class. I use cases as a ways to teach the material throughout the course. About 1/3 of the way into the course, the students begin their own case studies by brainstorming potential topics. My honors course has 32 students and they develop their cases in groups of four students. Below I outline the major steps of the project.

### **Part 1: Topic Selection**

- ★ Each group submits 3 potential topics
- ★ Suggested places to look for topics include Science Daily, NYTimes Science section, and NPR Science Fridays
- ★ After submission each group meets with instructor for 20-minutes

### **Part 2: Individual Essay**

- ★ Students divide their topic into 4 subtopics
- ★ Each student researches a subtopic and writes a short research paper on that topic (~2pgs single spaced)
- ★ Each student collects at least 4 sources for their case

### **Part 3: Initial Plan**

- ★ Each group develops two potential stories to introduce their case
- ★ Students identify major learning goals for their cases
- ★ Students develop outlines of the major sections of their case studies

### **Part 4: Rough Draft**

- ★ Each group turns in an ungraded rough draft
- ★ The draft includes teaching notes
- ★ Although this is ungraded, students are told that the more complete their cases are at this stage the more feedback they will be able to receive for their final version

### **Part 5: Final Version**

- ★ Students submit a final versions of their cases along with teaching notes
- ★ Each member of the group evaluates the group using the combined self/peer evaluation form

### **Part 6: Presentation**

- ★ Each group has 20 minutes to introduce their case and then teach one or two parts of their case to the class
- ★ Students receive feedback on their cases from their peers

In the following section I will focus on what I believe is the hardest step, **“Step 1: Choosing a Topic”**, and I will discuss tips that I have learned while working through this process. If you want a more thorough discussion of each step of having students write a case study, I recommend the following article by Annie Prud’homme-Genereux that was recently published in The Journal of College Science Teaching. Our methods are very similar and the article goes into great detail describing each step of the process.

Prud’homme-Genereux, A. 2015. Case Study: A Step-by-Step Guide to Students Writing Case Studies (and Tools for Novice Case Authors). Journal of College Science Teaching 44 (6) 57-61.

### **Step 1: Choosing a Topic**

One of the most exciting yet challenging parts of this project is having the students choose their own topics. I do not provide any list or suggestions before they begin, so as not to limit their ideas. Each group must turn in three potential topics and the only rule I have is that the topics must somehow relate to ecology and/or evolution. I suggest that their topics might come from experiences they have had in life, topics they have touched on in other courses that they might want to explore further, news articles, or scientific research that they might be conducting (many of these students are already working in a lab on campus somewhere). I direct them to several news sources where they might find interesting articles to get them excited including: NPR's Science Friday, Science Daily, NYTimes Science section, Wired Science, and New Scientist. Once the students submit their potential topics, the hard part (for the instructor) is to help direct their case without taking over their ideas.

### **Here are a few submitted topics from my students:**

#### A) Resistance to Antibiotics

The era of antibiotics began in 1929 with the discovery of Penicillin by Alexander Fleming. Since that discovery, antibiotics have become used widely, but over the years due to their constant overuse to cure bacterial infections, some have become less potent since some bacteria have become resistant to them. In our case study, we would focus on the role of bacterial evolution in making antibiotics ineffective treatment methods. In particular, we want to focus on the evolution of either *Streptococcus pneumoniae* or MRSA.

#### B) Arabidopsis plant defense

In a recent study, the Arabidopsis plant was tested for its defenses against four different bugs eating it. These defense mechanisms are genetically implanted in the plants. When monitoring the plants while they were attacked by bugs, the research team noted that about 10% of the genes in the plant was actively responding; 2,778 genes. The research team also noticed a different response from the Arabidopsis plant when it was attacked by different species of bugs. In fact, even when attacked by bugs that had the same method of feeding, the plant's response was different depending on what was *most* effective against that species.

#### C) Overfishing

Overfishing first initiated in the 1800s. Increased fishing practices began as the world required a more affordable and convenient way to incorporate protein into their diets. Through these practices, many species of fish have been obliterated. According to predictions, if overfishing carries on at the same rapid rate, fishing will ultimately come to an end in 2048 due to the depletion of fish populations. In our case study, we wish to examine the effects of the depleted fish populations due to overfishing on the ocean and aquatic ecosystems. In addition, we would like to observe the reasons for overfishing and how it has had a direct effect on ocean ecosystems through time.

As you can see none of these are ready to be cases yet. It is my job to try to help the students develop their ideas into interesting cases. To do this, I first do a little bit of research myself on their proposed topics. One of the major goals of my research is to try to see what the latest and most exciting findings are in these areas. Once I have done my research, I brainstorm before I meet with each group of students, trying to determine how each topic they submitted might be transformed into a case.

My meeting with each group is a discussion. The purpose is not for me to tell them what to do, but instead for me to give them advice on their topics, and help them as a group to decide which topic they are most interested in pursuing. I usually start off my meetings by asking the group to explain which topic they are most excited about and why. If they are solidly set on one topic, then we spend the rest of the meeting discussing how to make that topic work. If there is more than one topic that interests them we talk about the pros and cons of each. Since they are writing the case, as a group they decide which topic to pursue and how.

One major aspect that I help the students with is the **scope** of their proposed topic. Above, both topics A and C are rather broad, and over time will need to be narrowed down, but topic B is quite specific. At this stage, I want the students to think broadly, so for topic B I suggested that if they continued with this as a topic they would need to make it broader, and I provided a few different suggestions of ways that they might expand their scope.

The second major issue that we discuss is how they will start **conducting their research**. After students pick topics, the next step of the project is for them to write an individual essay. The idea with this essay is to encourage each student do a little research, so that they become an expert on a distinct subtopic. Then, when they come back together, each group member will be able to add something new to their case.

To help facilitate this, we discuss how they might be able break up their proposed topic into different parts. For example, when I met with the group that proposed Topic C (Overfishing), together we determined that they could write about the following different subtopics:

- 1) Why we care about fish? (both ecologically and economically)
- 2) Current threats to fish
- 3) Impact of fishing on the evolution of fish
- 4) Current strategies for protecting fisheries.

These divisions were the product of my own knowledge of fisheries and what the students knew about fisheries. Specifically one student had been really excited about how overfishing might be causing microevolution in fish populations, so we made sure to include that as a subtopic.

In the end, the case that the group wrote focused exclusively on the impact of fishing on the evolution of the Atlantic cod. The final product incorporated into the case was some information on the ecological and economic value of cod, and the threats to the cod fishery.

Throughout this process my students have come up with topics that I would have never arrived at myself. For example, I have had cases on biomimicry, cancer resistant mole rats, the evolution of human brain size, and sexual conflict.

## Got Cancer? Better Consult a Mole Rat

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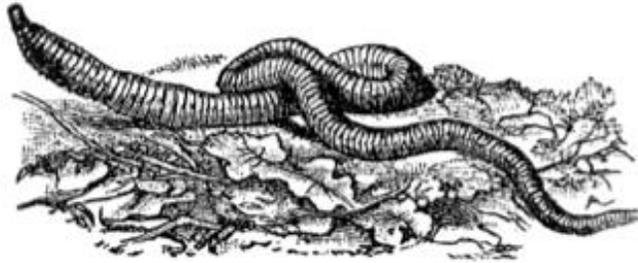
## YELLOWSTONE: THE MYSTERY OF GREY WOLVES



BIO 2054 - Foundations of Ecology and Evolution

## Sharkskin Biomimicry

by  
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### Vital Roles of Decomposers

#### Part I - Ewwwwwwwwww! (i.e. earthworms)

Aarav's Garden Journal

February 26th, 2007

Hi my name is Aarav and today our teacher told us that Big kids from college are coming! Recess time will be SO much funner when the Big kids come. They are bringing with them lots of flowers and dirt and we get to take care of it. We are going to have OUR own community garden!!! Today our teacher taught us about all kinds of flowers in the ecosystem and why dirt is important. We also learned that the flowers need lots of water and lots of help from the big yellow SUN.

Aarav's Garden Journal

March 1, 2007

Our teacher lied! She said water and sunlight should be fine but our plants aren't growing. I got mad but then i asked one of the Big kids who said that adding worms should do the trick.... EW.

Homework Assignment #1:

- 1) What limits plant growth?
- 2) What is a decomposer? List some decomposers (minimum of 3) that you have encountered.
- 3) Hypothesize whether or not worms will help Aarav's community garden (explain).

Example cases written by my students.

## **Tips**

Here are a few suggestions I have for one planning to try similar project with their students.

1) Peer assessment – Even with only eight groups, trying to provide feedback on the cases is very time consuming. Peer assessment can help everyone involved develop better cases. Specifically, having students in one group grade another group's rough draft provides feedback to the latter and helps the former get ideas on how to improve their own case.

2) Self-reflection – As with any group project, I have run into issues with getting ALL students involved in a group project. The individual essay helps, but after the students produce a rough draft I also require a peer/self-reflection. In which each student must rate their group members, and comment on how the process is going. In addition, they have to rate their own contribution to the group and discuss concrete ideas on how to become more involved in the project. This encourages my students to become more involved because they know that I care that all people are participating. It is important that this is done early enough so they can change their behavior and get involved in the group.

3) Structure – I limit my students to writing cases only in the interrupted case study format. Since this project is open ended in terms of topic, I find that having a defined structure helps the students. I use cases in this format the most in my course, and have found that my students are most comfortable writing these types of cases.

4) Topic Exclusion – Sometimes students end up gravitating towards familiar topics: antibiotic resistance, GMOs, Yellowstone wolves, etc. Next semester I plan to make certain topics off-limits. This is so that I find the material more interesting, and so that their cases are more original.

5) Time – Implementing student-written cases is a huge time commitment. It is worth it, but make sure to factor in the time it will take to give the students feedback. They need lots of direction because it is unlikely that they have written anything like this before.



Group presentations provided an opportunity for students to explain the setup of their case study and the role of class participation.

### **Student Feedback**

I asked the students for feedback on the case study project and here are a few responses:

*"Writing the case study rather than the big final paper certainly helped me in learning more about a specific topic in Ecology or Evolution. My case study was on the topic of decomposers. Not only did this case study help me gain a better understanding on the subject, but it also enabled me to break it down into fundamental concepts in order to teach the rest of the class."*

*"One of my favorite things about this class was the case study. Taking a unique topic and dividing it, and then bringing all our thoughts together was a completely different experience for me. I definitely learned a lot about my part of the case study and the case study as a whole with its relation in ecology and evolution. The individual essay helped us become experts in our own individual topic and the case study helped us bring information onto the table and make connections."*

*"The case study helped me find my own weaknesses, in terms of biology. I do not think I would have had this much insight if I was writing a research paper instead."*

I received comments from 27 of my 32 students. Of these comments 26 enjoyed the case study project and felt it helped them learn the topic. There was one student who did not like it as much and said he/she would have preferred to have written a final paper instead. Overall, my experience having students write cases has been very positive.

Writing cases helps students build content knowledge and develop skills in interpreting scientific literature, working in groups, explaining complex scientific topics in writing and orally, and it allows them to explore a topic in which they are interested.