



TRAGEDY OF THE COMMONS SIMULATION TEACHER LAB TEMPLATE

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Based on a Lab Outline by Wendy Van Norden

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Correlation to Course Description

Although this activity relates to many areas of the course, it most closely connects to the Topic Outline Section III, Renewable and Nonrenewable Resources: Distribution, Ownership, Use and Degradation.

Correlation to National Standards

A. Science As Inquiry. In order to develop an understanding of the "tragedy of the commons" and learn to predict when it can happen, students will have to FORMULATE AND REVISE SCIENTIFIC EXPLANATIONS AND MODELS USING LOGIC AND EVIDENCE.

C. Life Science. Many of the examples that can be applied to this concept underline the INTERDEPENDENCE OF ORGANISMS. Exploitation (overuse) of resources is due to the fact that *increasingly, humans modify ecosystems as a result of population growth, technology, and consumption. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems will be irreversibly affected.*

F. Science in Personal and Social Perspectives. Students will examine POPULATION GROWTH since it is one of the examples of "tragedy of the commons." At its core, this activity is about ownership and management of NATURAL RESOURCES. Students will discuss how *human populations use resources in the environment in order to maintain and improve their existence.* In addition, resource use has effects on ENVIRONMENTAL QUALITY. Finally, to address and try to prevent resource exploitation, students will need to examine SCIENCE AND TECHNOLOGY IN LOCAL, NATIONAL, AND GLOBAL CHALLENGES.

Introduction

The "tragedy of the commons" is one of the most important topics in environmental science. Many resources (e.g., clean air, biodiversity, fresh water) are available to many people, and when resources are *shared* and *limited* (though potentially renewable), they are often exploited. This is due to the fact that the benefit to one person of using more of the resource outweighs the cost to that individual of the resource's overuse. Each person looks out only for his own interests and succumbs to the logic of "If I don't use the resource, then someone else will. I might as well get the benefit." Learning to overcome our natural tendency to overuse common resources is one of the most significant challenges we face in working to improve the environment. Since it can be applied to all areas of environmental science, the presentation of the tragedy of the commons is a logical activity with which to begin an AP Environmental Science course. In completing this activity, students will learn to recognize situations that lead to a tragedy of the commons and how to prevent resource exploitation in these situations.

Materials

- Hershey's Kisses (two bags per group of 16)
- Plastic spoons
- 400 ml beakers
- Fabric sleeves (see directions for making these below)

Suppliers

Any supermarket and fabric store

Safety and Disposal

No hazardous materials, and the "fish" are eaten by the participants.

Group Size

Preferably groups of four, although it can be modified for groups of three to six.

Lab Length

50-65 minutes -- one class period (preferably an extended block) is adequate.

Preparation and Prep Time

To make the sleeves, cut a piece of fabric 5 inches taller than the height of the beaker (approximately 10 inches for a 400 ml beaker), and 1 inch wider than the circumference of the beaker (approximately 11 inches). Wrap the short sides together, and glue the fabric together halfway up the 10-inch side. The sleeve should be sealed around the beaker but flop open covering the top of the beaker.

Total prep time is about 30 minutes.

Teaching Tips

Two possible methods for presenting this activity (depending upon the assessment) are provided. The instructor should choose the template that best serves the needs of the class. The choice will affect the procedure slightly as well as the activities presented below.

Procedure Tips

- I usually use this lab on the first day of school. I don't introduce the "tragedy of the commons" and instead allow the students to learn about it through the activity. In fact, I don't give them the option to read the lab before performing it.
- The first part is set up to encourage exploitation. That is done by prohibiting communication among students and using the sleeves to hide the actions of the students. In addition, since it is the first day of school, students haven't formed strong alliances in the group and are less likely to trust each other.
- Although the activity has time limits assigned to the rounds, there is no need to follow them closely in practice. I usually allow students to pass the "pond" around as many times as they want to.
- I set the "carrying capacity" of the common ponds at 16 and the private ponds at four Kisses (though I don't tell the students this in part 1).
- When using Student Template A, after the first part, I collect and present the results. Usually some groups eliminate their resource after the first round, some maintain it for several generations before eliminating it, and some manage it perfectly from the beginning. It is helpful to show them the variation in strategies and discuss them.
- Before part 2, I allow the students to talk and plan a strategy. The sleeves are removed so that

each fisher can observe the actions of others. The students also know how many fish they are beginning with and how quickly the fish reproduce.

- By the end of the third round in part 2, most groups have learned to maintain their pond. However, I usually mention that the third round will be the "last round." Without fail, most groups remove all of their "fish" at the end of this round. I then continue with a fourth round -- if there aren't any fish left. Their behavior at "the end" provides a good place to begin the discussion of using up a diminishing resource -- "last round" thinking.

Possible Variations

- If time is a constraint, then a large class can be divided into groups, each with different sets of rules: some who can communicate, some who may not, some with only commons ponds, some with only private ponds. In this way, the variety in results can be obtained in one run-through, and differences can be compared across groups.
- If using Student Template B, only give students one page at a time (for each round).
- To add additional unpredictability and reality to the simulation, in part 1, tell the students that the fish will reproduce between rounds, but don't tell them by how much.

Sample Data

- Although the students rotate the "first fisher" position, usually the first fisher takes the most fish. The last fisher usually gets the least.
- The commons pond is often exploited to "extinction" in the first round.
- In the second round, usually both the commons pond and the private ponds are managed well.

Discussion Questions

1. What happened in the first round?

- *The students will usually report that exploitation to extinction occurred.*

2. What led to this result?

- *They wanted the Kisses badly, and students were greedy.*
- *They weren't sure how many fish other people were taking.*
- *They weren't sure how many fish were in the pond, so they didn't know how many they could take.*
- *They couldn't predict how many fish would be left by others, so if the population was going to be exploited, they wanted their share.*
- *They couldn't communicate to plan sustainable resource use.*

3. What changed in the second round (commons pond)?

- *They could communicate.*
- *They knew what was going to happen (learning had taken place).*
- *They agreed to work together.*
- *They had incentive to allow their pond to grow (to maximize the total number of fish each would get in the activity).*

4. What happened with the private pond?

- *They protected their population because they knew that no one else was going to take their fish. There was no competition for the resource.*

5. What kinds of situations lead to a tragedy of the commons?

- *Common, limited, potentially renewable resource*
- *Lack of communication and familiarity between users*
- *Short-term attachment to the resource*
- *No agreed-upon strategy for resource use*

6. What are the solutions to a tragedy of the commons situation?

- *Communication between users*
- *Education about resource use and the dangers of the "tragedy"*
- *Partnership between users*
- *Privatization of the resource if done properly*
- *Long-range thinking -- long-term connection to the resource*
- *Incentives for sustainable resource use*
- *Governmental regulation/laws if fully enforced*

Assessment

Two different student templates are included to correspond to different assessments. Template A is designed to be completed as a lab report. Template B is designed to be completed as a set of in-class data and analysis questions.

Lab Report: Template A

I usually require a formal lab write-up. For more information, see the student lab template. Students' lab reports are evaluated based upon standard lab report requirements and the instructions provided in the student lab template. I require the following format:

- **Introduction:** an introduction to resource use, exploitation, and the tragedy of the commons. Presentation of the goals of the activity.
- **Procedure:** summary of the steps performed.
- **Results:** three data tables, three graphs, and a written summary of trends.
- **Analysis:** a discussion of the results and explanation of the cause of the trends based on an understanding of the tragedy of the commons. Students should incorporate the answers to all of the questions in the student lab template.
- **Conclusion:** a summary of solutions to the tragedy that were learned in the activity. Identification of a specific environmental problem and an application of the general solutions to this specific problem.

In-class Analysis: Template B

- This template provides a discovery experience where the students perform the activity and respond to questions at the same time during the class period. The students do not have access to the content of the second part while the first part is taking place, so there is no anticipation of future changes.
- If this template is used, then the discussion questions above may be omitted.

Other Options

- Have a class discussion only using the questions above and analysis questions as a guide.
- Give the students a primary source article about a tragedy of the commons issue (e.g., over-fishing) and ask them to apply the strategies learned in this activity to the issue.

References/Resources

Hardin, Garret. "The Tragedy of the Commons." *Science* 162 (1968): 1243-48.

Cunningham, W. P., et al. *Environmental Science: A Global Concern*. 7th ed. McGraw-Hill Companies, 2003: 165-66.