



Fished Out

Grade: 6

Subject Areas:

Life Science, Social Science,
Economics

Skills: modeling,
identifying, observing,
hypothesizing, recording,
problem solving

Duration: 1-2 hours

Connections:
ecology, natural resource
management and planning

Vocabulary

limited

exploit

tragedy

the commons

public lands

private lands

Tragedy of the Commons

extinct

conservation

sustainability

stewardship

Objective:

Students will partially understand what the Tragedy of the Commons means and will model competitive behavior for a limited resource.

Materials

- 1 whole peeled orange
- 6-8 bowls (1 per group)
- 1 straw or spoon per student
- fish crackers or other light weight snack (120 +)
- fish recording sheet (see attached)
- stop watch or clock with a second hand
- pieces of cloth to cover each bowl (optional)

Standards

Strands: Excellence in Environmental Education Guidelines

Strand 1 — Questioning and Analysis: F) Working with models and simulations: Learners understand many of the uses and limitations of models.

Strand 2 — Env. Processes and Systems: 2.3 Humans and their Societies: A)

Individuals and group: Learners understand that how individuals perceive the environment is influenced in part by individual traits and group membership or affiliation **C) Political and economic system:** Learners become more familiar with political and economic systems and how these systems take the environment into consideration. **E) Change and conflict:** Learners understand that human systems change over time and that conflicts sometimes arise over differing and changing viewpoints about the environment.

Strand 2.4—Environment and Society: A) Human/environment interactions:

Learners understand that human-caused changes have consequences for the immediate environment as well as for other places and future times. **C) Resources:** Learners understand that uneven distribution of resources influences their use and perceived value.

Strand 3.2 — Decision-Making and Citizenship Skills: D) Evaluating the results of actions: Learners are able to analyze the effects of their own actions and actions taken by other individuals and groups.

California State Educational Standards:

Life Sciences (Ecology) 5e. Students know the number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition.

LS (Resources) 6b. Students know different natural energy and material resources, including air, soil, rocks, minerals, petroleum, fresh water, wildlife, and forests, and know how to classify them as renewable and nonrenewable.

Background

Resource Overuse

When people share limited resources they have to make choices. The fact that a resource is **limited** means that it will run out eventually if it is not replaced. Many resources can be replaced, if given enough time. History has shown us that typical human nature looks after one's own interests above anyone else's. When resources are shared, however, this attitude poses a problem. The urge to **exploit** resources and therefore, use them up before someone else does, is commonly referred to as the "Tragedy of the Commons".

An in-depth look at the "Tragedy of the Commons" was first expressed by Garrett Hardin an ecologist who wrote an article in 1968 in the prestigious journal Science. In his article, he used the example of many cattlemen raising cows on the same open pasture. Just like all herdsman had done in the past, each cattleman tried to maximize his herd. The more cows he grazed the richer he became. In the past, numbers were kept in check from tribal warfare, poaching, and disease. As social stability became a reality, a **tragedy** unfolded. Each man was compelled to increase his herd without limit in a world that has limits. The net effect was the land became overgrazed and all of the cattlemen (not to mention the land) suffered. To quote Hardin: "Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all".

Understanding this concept has

become increasingly useful as we come closer to the brink of ecological catastrophes in many areas. Tragedy of the commons has led to overgrazing on public lands, overfishing of the oceans, acid rain from the burning of fossil fuels, over-dumping of garbage into the oceans, and an increasing shortages of firewood and drinking water in many parts of the world. Unfortunately these are only some of the ecological disasters we now face as humans push the limits in a limited world.

The **commons** to which Hardin refers are areas covered by either land or

water that are accessible to the public. Common places include our waterways like oceans, rivers and streams. They include national parks, state parks, national forests, wilderness areas, and other government owned lands like those managed by the Bureau of Land Management (BLM). Many people refer to these places as **public lands** as opposed to **private lands**. When someone owns a piece of land it becomes private. Private lands tend to be better protected because there is a sense of ownership or responsibility. The **Tragedy of the Commons** occurs because people take ownership of the benefits from using a resource,

Local Connection

North Coast Fisheries

For over one hundred years, tons of fish have been caught up and down north coast of California every year. North coast fisheries have been an important source of recreation, jobs, and revenue for this remote area of coastline. Both commercial and recreational fishermen regularly enjoy a rich bounty of a variety of fish including rockfish, lingcod, salmon, crab and halibut. Shelter Cove, Eureka and Trinidad are three popular jumping-off points for those that love to ocean fish.

Even though the area from San Francisco bay north to Oregon is one of the richest fisheries in the world, historical data shows a steady decline in many types of fish including salmon, cod and sardines. Potential threats to numbers of fish include overfishing, oil drilling, climate change and water diversion. For the last fifty years, various institutions have been monitoring, assessing and protecting the health and vitality of important marine ecosystems. Today at least four National Marine Sanctuaries have been developed south of San Francisco including the Channel Islands and Monterrey Bay.

Protection of marine habitats and ecosystems, and the fisheries that depend on fish resources, is a difficult yet vital step towards maintaining a productive and sustainable fishery. Fishermen, conservationists and federal agencies agree that a rational, sustainable, and scientifically based management program needs to be implemented in order to preserve this rich resource.

but they don't take ownership of the negative consequences to that resource caused by overconsumption among other things.

The fate of the ocean is a case in point. The ocean has been viewed as the last frontier because of its vastness. As it is sometimes said — we know more about the surface of the moon compared to the surface the ocean. Viewing the ocean as endless has lead to many problems. Now with the help of sonar, GPS, huge nets and high demand, our oceans are rapidly becoming overfished. As carbon dioxide levels continue to increase, the oceans are becoming more acidic in a process called acidification. A slight rise in acidity prevents small microorganisms, vital to ocean food chains, from making calcium carbonate shells causing them to die. Coral reefs are dying due to waters too warm and swarms of plastic garbage have grown to the size of large countries.

Local Tragedy

A Tragedy of the Commons has happened in many places outside of the ocean. At a local level, coho salmon are an example. There are many historical accounts describing times when the coastal rivers of California and elsewhere were packed full of fish including the coho salmon. During seasonal spawning migrations, millions of salmon were driven up stream to the place where they were born. In the past, they were in such high numbers people thought they would never disappear. Both wildlife and people took advantage of this golden opportunity. Animals like bears, eagles and osprey gorged themselves on salmon. Many Native American tribes formed a culture around this seasonal abundance. As more people moved northwest to Humboldt and Mendocino counties,

a successful salmon industry was developed. Men lined up along the banks of rivers and fished until they couldn't carry any more away. Salmon were canned and dried and shipped as far as Europe. Year after year, coho, chinook and other salmon species returned to spawn, and people and wildlife indulged in the bounty.

Today, the coho salmon is near extinction in California. Other local fish species are not far behind including the green sturgeon. Once something is **extinct**, it is gone forever. Habitat destruction is the number one cause of extinction. So what can people do?

Timely Solutions

Many people have turned to conservation to conserve habitat. **Conservation** is planned management that attempts to preserve and protect resources from exploitation, destruction or neglect. By working together, the Tragedy of the Commons can be reduced. Through communication and education, people can counteract the tendency to do the wrong thing. (Apparently every generation needs to be reminded of this, however.) Sustainable land management practices can reduce the risk of exploitation of resources.

Sustainability is harvesting resources at a rate in which they can be replaced. For instance, it may only take 4-5 years for salmon to grow from juveniles to adults. If people weren't allowed to fish every year, salmon could have time to rebound. In order to save the coho salmon and other fish species, people have to obey various laws. Today there are fish limits, season limits and a fishing license requirement. Biologists attempt to count the number of fish

and during lean years, no fishing for salmon is allowed in certain streams. Anyone caught fishing illegally is subject to a steep fine. Averting a tragedy involves restriction to access, reducing consumption, and education among other things. In Whitethorn California for instance, the BLM manages the King Range over 35,000 acres of public land which is available to everyone. Their mission is "... manage the King Range National Conservation Area to conserve one of American's last wild and undeveloped coastal landscapes for the use and enjoyment of present and future generations".

The protection and conservation of our public lands and waterways is up to people. As human population continues to rise, competition for resources increases. If people take responsibility and ownership of "the commons" they become stewards of the land and water. Comprehensive ecological **stewardship** includes the collaboration between scientists, government and citizens to implement sustainable practices that incorporate environmentally responsible and socially acceptable goals and objectives.

Activity: Competing for Fish

Procedure

1. This lesson explores the ways in which people compete for resources. Through participation students will investigate what happens when resources are exploited and extraction of limited resources goes unchecked. Gather the students together and explain to them that they are going to learn about competition for resources in “the commons”.

2. Before the formal activity begins, ask for two volunteers (ideally a male and a female). Have these two students come to the front of the room and give them an orange. Tell the class that these two students represent a married couple. (Give time for laughter, snickering and/or blushing) Tell the couple that there is a limited amount of food and the orange represents all they have to eat. Have them divide the orange up equally so they both have something to eat. Make sure they don't actually eat the orange. Now tell the class that the family has expanded to a family of 4. Add two more volunteers. Have them divide the orange up into quarters. Again, they are not to eat the orange. Repeat this one last time for a family of 8. Have them break the orange up

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- stop watch or clock with a second hand
- pieces of cloth to cover each bowl (optional)

into eighths. The students should be aware of how their proportions changed as population increased.

3. Ask the students questions to learn what they already know about resources and resource allocation. Write down key concepts and terms on the board. It is optional for students to take notes.

4. Allow time for a brief discussion about the availability of resources and what happens when many people are in competition for the same thing. Introduce the concept of “The Tragedy of the Commons” and define important terms not yet discussed. Explain to the class that they are going

to model competition for limited resources. Tell them they will be performing an activity around over-fishing. Have the students hypothesize reasons why over-fishing might occur. Write some of their hypotheses on the board.

5. Overview: In this activity, every person represents a family and every group is competing for fish living in the same pond or stream (a common area). The ponds are only big enough to support 16 fish. Communication cannot occur between families (individual students) and the number of fish will be covered using a cloth so no one knows how many fish there are. Every person needs to catch at least 2 fish or the family will starve. All fish remaining in the pond after a round, can reproduce only one offspring. For example, if 5 fish are left after a round, each fish will reproduce once making 10 fish. The teacher will replenish the fish in each bowl after each round. The students will fish by sucking up a fish cracker using a straw and placing it in a cup. (spoons can be used as an alternative) Have the students record how many fish each “family” caught and how many fish are left after each round. Repeat the procedure 5 times so that every group competes five

- *What happened to each person proportions as more people were added?*
- *How does this model something in the real world?*
- *What types of resources do people compete for?*
- *What do we call the things that people and wildlife use to survive (resources)?*
- *How might the behavior of people change when competition food gets scarce?*
- *What may happen to the environment when resources become scarce?*
- *What types of places are shared by a lot of people? (parks, beaches, etc.)*



Activity: Competing for Fish (cont.)

times. It is important that student don't talk to each other because part of the exercise here is to reveal that communication is key to cooperation.

6. To begin, break the students up into groups of 4 or 5. Explain to them how the activity will work. Time each round, giving only 10-15 seconds of fishing per round. Every group should have a bowl, 16 crackers, and a straw and recording sheet for every student. It will be easier to have everyone start and stop fishing at the same time. This can be done by ringing a bell or shouting out "On your mark; get set, go!" Not talking may be difficult especially if some students are getting frustrated by others actions. Have rules set in place for those students who do talk. Perhaps they automatically starve or move out of the area. After everyone has recorded their results, review and discuss people's actions during the simulation. Note: if any one in a group takes more than two fish, the population of fish is not sustainable. After several rounds, a family may starve because of someone else's behavior.

- *Did anyone in the group take too many fish?*
- *How did this affect everyone else?*
- *Did everyone try and take as many fish as possible? Why or why not?*
- *Did anyone take less fish than they wanted for benefit of the group?*
- *Did any group exploit their resource to the point of starvation?*
- *Did any group harvest fish sustainably? What does this mean?*
- *How would this activity differ if people could talk to each other?*
- *How could people work together to problem solve? What types of things could be done to conserve resources; in this case save numbers of fish?*
- *Who knows of a real world situation where resources are being exploited?*
- *What is the difference between a non-renewable and renewable resource?*
- *Which category do fish belong to? To conclude, have the students write a reflective paragraph.*



Extensions

- Have students research a particular environmental problem facing the world today and develop solutions.
- Invite a local ecologist to come into the classroom and talk about what he or she studies and why it matters.
- Have students role play different characters involved in resource management given a hypothetical situation.
- Use maps to discover what local areas of land are publicly and privately owned.
- Graph the consumption of resources in different areas of the world.
- Have students research an environmental topic that is controversial and write an informed opinion about it.

References

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- Investigating the Tragedy of the Commons, <http://www.classroomearth.org/node/182>
- Kids and Conservation, <http://www.clarkswcd.org/Kids/KidsHome.htm>
- King Range National Conservation Area Draft Resource Management Plan and Draft Environmental Impact Statement, U.S. Department of Interior, BLM, Arcata Office, Jan. 2004
- May-Brett, Jean, Harvesting the Commons, <http://www.lpb.org/education/classroom/ntti/lessons/6mbharvest.html>
- Morton, Kelly, The Tragedy of the Commons, http://alex.state.al.us/lesson_view.php?id=23991, 2010
- National Marine Sanctuaries, <http://sanctuaries.noaa.gov/science/condition/>, 2011

Name: _____

Date: _____

Student Data Table

	# of fish at the beginning of each round	# of fish taken by family 1	# of fish taken by family 2	# of fish taken by family3	# of fish taken by family4	Total fish left after each round
Round 1	_____	_____	_____	_____	_____	_____
Round 2	_____	_____	_____	_____	_____	_____
Round 3	_____	_____	_____	_____	_____	_____
Round 4	_____	_____	_____	_____	_____	_____
Round 5	_____	_____	_____	_____	_____	_____
Total		_____	_____	_____	_____	



Name: _____

Date: _____

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Round 3	_____	_____	_____	_____	_____	_____
Round 4	_____	_____	_____	_____	_____	_____
Round 5	_____	_____	_____	_____	_____	_____
Total		_____	_____	_____	_____	