WILL THERE BE ENOUGH (1 HOUR)

In this activity students will play a simple game designed to simulate the situation known as "the tragedy of the commons." Students will later work together in groups to craft rules for sharing resources so that those resources are not overused.

OVERVIEW

Topic: Tragedy of the Commons

Real-World Science Topics:

- An exploration of the relationship between people and their environment.
- An exploration of the how people regulate their use of resources.

Objective

Students will play a game in order to model how and why people have to work together in order to prevent overuse or destruction of natural resources.

Materials Needed for Student Activity

Materials Needed for Each Group of Students

- Pencils (100 per group of 4 students)
- Rewards: Photocopied paper money, stickers, etc.

Teacher Preparation

Count pencils into groups of 10, ready for quick distribution during the game.

WILL THERE BE ENOUGH (1 HOUR)

Standards Met

NATIONAL SCIENCE STANDARDS ADDRESSED

CONTENT STANDARD A: Science as Inquiry Students:

- Think critically and logically to develop the relationships between evidence and explanations.

CONTENT STANDARD C: Life Science

- Will understand that humans depend on their natural and constructed environments.
- Humans change environments in ways that can be either beneficial or detrimental for themselves and other organisms.

NATIONAL MATH STANDARDS ADDRESSED

- Problem Solving: Apply and adapt a variety of appropriate strategies to solve problems.

NATIONAL TECHNOLOGY STANDARDS ADDRESSED

- Use models and simulations to explore complex systems and issues.

Sources

National Science Teachers Association

http://books.nap.edu/html/nses/overview.html#content

National Council of Teachers of Mathematics

http://standards.nctm.org/document

National Educational Technology Standards

http://cnets.iste.org/currstands/cstands-netss.html

STEPS FOR *WILL THERE BE ENOUGH*

1. **Warm-up Activity:** Display one pack of 12 pencils. Prompt the students, 'What would happen if these were the only pencils available for us to use for the rest of the school year?' Allow students to discuss and chart their ideas in a 'Problem and Solution' T-chart. Be sure to highlight examples of rules about cooperation and sharing of resources. Explain to students that humans sometimes have to work together to prevent a shortage of resources, and in some cases there is already a shortage. At this point you may wish to provide background knowledge with books or images.

2. Explain to students that they will play a game to show how and why such shortages happen. Explain that when humans collect resources to make money, they sometimes take too much, even if it means there will no longer be enough resources for others.

3. Explain to students that during the game, our pencils will represent lumber from trees. Ask students, "How do humans use trees?" Chart student ideas and provide background knowledge when needed.

4. Break students into groups of 4. Then explain the following rules:

   - Each group starts with 50 pencil "logs."
   - You get one reward for every 10 pencil "logs" you pick up.
   - To continue to the next round, you have to earn at least one reward.
   - Each round will last 15 seconds.
   - At the end of each round, the 'forest' will only partially grow back. I will double the number of pencils available after each round.
   - Goal: Which group can last the most rounds without running out of pencil 'logs?'

5. At the end of each round, have the students count the number of pencils each student has picked up, and the banker will hand out rewards. (You may wish to omit the rewards as a modification for K-1 students.) Ask any students who did not earn at least one reward to stand up and join the 'gallery' for the next round. Students in the 'gallery' will watch the continuing rounds and should still participate in group discussions.

6. Before starting the next round, allow time for the group to discuss the outcome. Ask, "Did every member have enough pencils?" "What can we do during the next round to make sure we don't run out?" After students have discussed, explain that the number of available 'trees' (pencils) will double, representing the portion of the forest that grows back. Give new pencils to each group, doubling the number of pencils remaining.

7. Students will participate in 5 rounds. Have students record the number of remaining pencils after each round. Most groups will run out of pencils before the end of the game. After the end of the game, prompt students to reflect on how the shortage of pencils developed.

8. Play the game again. This time explain that a new lumber law has been created and each player can only take 5 pencils per round. Once again, have students record the number of remaining pencils after each round. After the conclusion of the second game, allow students to evaluate the new law. Challenge students to propose an alternate solution to the pencil shortage prompting, "How can we get rewards without running out of pencils?" Play the game one more time, this time allowing each group to use their own 'laws.'

9. **Wrap-up Activity:** Discuss the results of the game, have each group share their 'laws' and evaluate the outcomes. You can then have students create rules for sharing resources in the classroom.

Water Cycle Extension Activity

As an extension, have students create informational posters about the importance of preserving natural resources.

What is the tragedy of the commons?

In the past, many towns had commons, or areas in town where townspeople could allow their animals to graze. In 1968, a scientist named Garrett Hardin published a paper describing how it was inevitable that common but limited resources, such as fresh grass for grazing, would be overused by people who could profit from them. In the grazing example, each farmer gained more money for each sheep he could raise on the commons. When the grass ran out, farmers with one sheep and farmers with 20 sheep were equally unable to feed their sheep. However, a farmer with 20 sheep made more profit than a farmer with fewer sheep. This is why it is called a tragedy: because those who have the foresight to try to preserve the common resource lose the most, while those who most actively destroy the resource gain the most.

What can be done about the tragedy of the commons?

There are generally two accepted solutions to the tragedy of the commons. The first is to make the resource a private commodity instead of a common one.
The second solution is to regulate the use of the commons. This solution would allow farmers only a limited number of animals on the commons.

What are some modern examples of the tragedy of the commons?

There are many examples of the tragedy of the commons.

- Fishing and whaling are common examples, since the oceans and their contents are common resources. To combat overfishing, nations enact rules allowing only a certain number of fish to be caught during a certain period of time. International agreements govern areas of the ocean that are outside the borders of a nation.

Air and water pollution are also examples of the tragedy of the commons. In these examples, fresh water and clean air are the finite resources. The polluter uses them by dumping the pollution into the water or air. If there are no rules against such action, then it is more profitable to pollute than to clean up the pollution. The population in general pays for the pollution, while the polluter derives more profit from each widget he or she makes, and therefore pollutes more. Efforts to curtail pollution usually entail laws limiting the amount of pollution the polluter can put into the water or air.

Modeling the Tragedy of Commons

Record the number of available pencils after each round:
Student responses should reflect accurate records of available pencils after each round.

Reflection

Which rules helped your group still have pencils left over at the end of the game?
Sample response: We had pencils left over when we were only allowed to take 5 pencils.

Which rules helped the members of your group get the largest number of rewards?
Sample response: We were able to get the most rewards when we took 3 pencils during the first 2 rounds.

Was it possible for everyone in your group to get rewards without the group running out of pencils?
Sample response: We could all get rewards as long as we work together, follow directions and not take too many pencils.

How can humans share and save our natural resources? Include drawings in your explanation.
Student responses can show humans recycling, sharing resources, working together to make new laws etc.

Sample response: I can use both sides of my papers before I throw them away or recycle them. This way I am using less paper, and there will be more trees for other humans to use.

Name:

Date:

Modeling the Tragedy of Commons

Record the number of available pencils after each round:

Game #1	Number of Pencils Left
Round #1	
Round #2	
Round #3	
Round #4	
Round #5	

Rule: Students may take only 5 pencils per round.

Game #2	Number of Pencils Left
Round #1	
Round #2	
Round #3	
Round #4	
Round #5	

Rule:_____

Game #3	Number of Pencils Left
Round #1	
Round #2	
Round #3	
Round #4	
Round #5	

Reflection

Which rules helped your group still have pencils left over at the end of the game?

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Which rules helped the members of your group get the largest number of rewards?

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Was it possible for everyone in your group to get rewards without the group running out of pencils?

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How can humans share and save our natural resources? Draw and write your explanation.