Students will be introduced to the concept of sustainability and reflect on their environmental footprint.

5-12 30-45 minutes

- Goldfish, M&Ms, or other small snack item.
- Tragedy of the Commons worksheet (provided)
- Environmental quiz worksheet (provided)

The word sustain means to maintain something. Therefore, the concept of sustainability is based around the idea that we must maintain and manage natural resources in a way which meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainable practices can be incorporated into your everyday life. One method is to reduce our consumption of water, energy, and materials. This might mean taking shorter showers, driving less, or even eating less meat.

Another sustainable practice is to reuse items or materials instead of purchasing or extracting new materials. Using a refillable water bottle instead of a single-use plastic bottle is one example.

Recycling is a process in which old materials are repurposed or used to make something new. Recycled paper and plastic bottles often go to factories to be broken down and remade into new paper or containers.

Activity 1:
1. Purchase a package of goldfish, another small snack, or items that could be used as tokens in a game. You may need up to 56 fish per each group of 4 students.
2. Print copy of the “Tragedy of the Commons” double-sided worksheet for each student

Activity 2:
1. Print a copy of the environmental quiz for each student.
2. Fold the bottom of the quiz back so that students can not see the scoring rubric when initially handed the quiz.
ACTIVITY 1: SUSTAINABILITY GAME

1. This game will teach students about the importance of sustainability and an environmental concept called “tragedy of the commons.” (See step 8 and recommended websites for a detailed definition.)

2. Assign students groups, with 4 students in each group. Each group represents a village. The village's only food source is fish from a small lake that holds up to 16 fish. Place 16 “fish” in the center of each group. You can use any small snack such as goldfish, M&Ms, marshmallows, etc. TELL STUDENTS NOT TO EAT ANY UNTIL YOU SAY THE ACTIVITY IS OVER!

3. Tell students that once a year they have the opportunity to collect fish from the lake. Each student may take between 1-4 fish and should record their catch on the data sheet provided. Students should also not talk or discuss with their neighbors how many fish they plan to take.

4. Inform students of the following implications: If you take 1 fish your family will starve. If you take 2 fish your family survives. If you take more than 2 fish you can sell the extra for a profit.

5. After each student in the group takes their desired amount of fish, the year has ended. At the start of each new year the fish in the lake reproduce. The teacher should double the amount of fish in each group’s lake to simulate reproduction. Not every group may be receiving the same amount of new fish. For example, a group that has 8 fish left should be given 8 more for a total of 16, but a group with only 4 fish left should only receive 4 more.

6. Continue playing the game for 5 years (5 rounds). Make sure students are recording the amount of fish they catch, the group catches, and the number of fish present after reproduction.

7. After the game is complete, have students discuss and answer the questions on the back of the datasheet with their group, or discuss as a whole class.

8. If groups were living sustainably (only taking what they need) then the lake would keep a stable fish population. Once individuals begin consuming resources beyond basic need, this compromises the ability for everyone else to continue acquiring enough resources. This phenomena is known as the tragedy of the commons. Shared natural resources like fish, coal, or trees, are susceptible to rapid decline when human consumption (or demand) outweighs the rate at which nature resources replenish (supply). Some resources, such as crude oil, takes thousands of years to form in the earth. A resource that takes longer than a human lifetime to replenish is known as a nonrenewable resource.

9. Optional: conclude the lesson and transition into activity 2 by showing students the short video, “What is sustainability?” which is listed on page 3 under “recommended websites.”

ACTIVITY 2: RECOGNIZING ECO-LIFESTYLE CHANGES

1. Conserving resources is one way we can live more environmentally friendly. Usually when we think about sustainability or being eco-friendly, we refer to the terms reduce, reuse, and recycle. Spend a minute defining the 3 R’s if students are not familiar.
PROCEDURE CON’T

2. Give students a few minutes to independently fill out the environmental conservation quiz and calculate their score.

3. Afterwards, have students flip their paper over and pair up with a partner to make a list of additional things they do or could do in their everyday life to be more environmentally friendly.

4. Lastly, have students share out lists with the entire class. (Tip: have students add any additional actions mentioned by peers to their lists using a different color pen!)

5. Give students time to look over their answers to the conservation quiz, as well as the list made in class. Have students circle one thing they can pledge to begin doing (that they currently do not do). Consider a classroom pledge poster for all students to sign with their commitments.

RECOMMENDED BOOKS

Generation Green: The Ultimate Teen Guide to Living an Eco-Friendly Life by Linda and Tosh Sivertsen

World Without Fish by Mark Kurlansky

Reduce, Reuse, Recycle: An Easy Household Guide by Nicky Scott

RECOMMENDED WEBSITES

Video: What is Sustainability? (10 mins)
https://www.youtube.com/watch?v=rmQby7adocM

Tragedy of the Commons Explanations
https://kids.kiddle.co/Tragedy_of_the_commons
http://encyclopedia.kids.net.au/page/tr/Tragedy_of_the_commons

Sustainability Lessons Clearinghouse
http://www.greeneducationfoundation.org

Green Schools Alliance
https://www.greenschoolsalliance.org
**VOCABULARY**

**Carbon footprint:** A measure of CO$_2$ emissions that results from an individual’s various activities which produces CO$_2$ during a given time period.

**Conservation:** The use of natural resources in a way that ensures their continuing availability to future generations; the wise use or protection of natural resources.

**Consumer:** A person or thing that eats, purchases, or uses something.

**Finite resource:** Also called a nonrenewable resource; a resource that does not renew itself at a sufficient rate for sustainable economic extraction in human time-frames. Examples include, coal, crude oil, natural gas, rocks, and minerals.

**Natural resource:** A material that is naturally occurring, not produced by humans. Examples include water, grass, soil, rocks, animals, crude oil.

**Nonrenewable resource:** Also called a finite resource; a resource that does not renew itself at a sufficient rate for sustainable economic extraction in human time-frames. Examples include, coal, crude oil, natural gas, rocks, and minerals.

**Overharvest:** Also called overexploitation; using or consuming a resource at a rate that is unsustainable, given their natural rates of replenishment. The term applies to natural resources such as wild medicinal plants, grazing pastures, game animals, fish stocks, forests, and water aquifers.

**Pollution:** Contamination of soil, water, or atmosphere by discharge of harmful substances.

**Population:** The number of a particular species in a defined area.

**Preservation:** Protection that emphasizes nonconsumptive values and uses; to keep in a perfect or unaltered condition.

**Recycle:** The act of processing used or abandoned materials for use in creating new products.

**Reduce:** Using less of something

**Reuse:** When an item is used more than once, typically for the same function.

**Renewable resource:** A resource that is replaceable when properly conserved and has the capacity to renew itself within human time-frames. Examples include, plants, animals, solar energy.

**Supply and demand:** the amount available of an item vs the amount that is desired by the consumers.

**Sustainability:** meeting the needs of the present without compromising the ability for future generations to meet their own needs. A sustainable lifestyle involves limiting one’s impact on the environment and consumption of natural resources so that there will be sufficient materials and a healthy planet for all people in the future. Also referred to as sustainable development.

**STANDARDS**

**COMMON CORE ELA**
- Speaking and Listening
- Literacy in Technical Subjects
- Literacy in Science
- Writing Standards

**COMMON CORE MATH**
- Number System
- Quantities
- Ratios & Proportional Relationships

**NYC K-8 SCIENCE & SOCIAL STUDIES SCOPE & SEQUENCE**
- Humans in their Environment
- Needs & Tradeoffs
- Earth Materials

**NEXT GENERATION SCIENCE STANDARDS**
- 5. Earth and Human Activity
- MS: Human Impacts
- MS: Earth Systems
- HS: Human Sustainability
- HS: Earth and Human Activity
NAME__________________________________________

Tragedy of the Commons
Imagine you live in a small village. The only food source comes from the fish in a small lake, known as the “commons.” Once a year you will get the chance to fish. Each time you may take between 1 and 4 fish. You may NOT discuss with your community (group members) how many fish you plan to take.

Use the table to record the following data for each year (round):
- Number of fish in the lake before fishing, but after reproduction.
- Number of fish you catch.
- Total number of fish caught by the community.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>NUMBER OF FISH IN THE LAKE (after reproduction)</th>
<th>NUMBER OF FISH YOU CAUGHT THIS YEAR</th>
<th>TOTAL NUMBER OF FISH CAUGHT BY EVERYONE THIS YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. How many people in your group took more than 2 fish in one year?

2. How did taking more than 2 fish impact the fisher? How did it impact the rest of the community?

3. Did anyone reduce the number of fish they caught over time? Why or why not?

4. If your community played the game a second time, what would you do differently to maintain a stable population of fish in the lake?

5. Can you think of any other “commons,” or resources that people must share. What problems usually arise?

6. What are some possible solutions to managing one of the problems you listed above?
1. How many people in your group took more than 2 fish in one year?
   
   Answers vary

2. How did taking more than 2 fish impact the fisher? How did it impact the rest of the community?
   
   It is each person’s best interest to take as many fish as possible. The more they take, the more they can sell. There is no immediate consequence to the fisher for taking more. Because of this, however, there might not be enough fish available for the other community members to survive the year. As people continue to consume more, the demand for the resource further outweighs the supply (the rate of reproduction), and every individual in the community will eventually suffer because the population of fish will diminish to zero.

3. Did anyone minimize the number of fish they caught over time? Why or why not?
   
   Answers will vary. Some students may have realized that the fish population was decreasing too much or that there would not be enough fish to go around. Reasons students may not have decreased their overconsumption include: belief that resources are infinite, desire to maximize profit, there was no immediate negative impact on them for taking more.

4. If your community played the game a second time, what would you do differently to maintain a stable population of fish in the lake?
   
   Each person should only take 2 fish each year. If even one person takes one additional fish, it will cause a slow yearly decline of the fish population.

5. Can you think of any other “commons,” or resources that people must share. What problems usually arise?
   
   Possible answers may include, overharvesting of resources such as plants, animals, and fossil fuels; polluting waterways, land, and air; population growth; wasting unnecessary water and electricity; traffic congestion in a city.

6. What are some possible solutions to managing one of the problems you listed above?
   
   Setting limits on consumption; creating laws that hold people responsible for harm done to a shared amenity or the negative impact forced upon others; finding alternative resources to use that are inexhaustible (i.e. coal vs wind).
How does your family/household use energy and water?
Answer the following questions honestly to help identify ways you could do more to conserve resources.

<table>
<thead>
<tr>
<th>ENVIRONMENTAL CONSERVATION QUIZ</th>
<th>Always/ Mostly</th>
<th>Sometimes/ Usually</th>
<th>Rarely/ Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>We use fluorescent (CFL) lightbulbs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We turn off lights, computers, televisions, radios, games, etc. when they are not being used.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We turn the surge protector or power strip off when the electronics are not in use, and we unplug cell phone chargers when not in use.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>We turn the heat/ air conditioner off when we are not at home and turn down while we are sleeping.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We open curtains to let the light &amp; warmth from the sun in or close them to keep the heat out and keep the house cool.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>We use rechargeable batteries.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Our windows and doors are well sealed and there are no drafts.</td>
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<td></td>
</tr>
<tr>
<td>We use energy-saving settings on our computer, TV, and household appliances.</td>
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<td></td>
</tr>
<tr>
<td>When possible we hang clothes to dry, instead of using dryers.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>We run the washer, dryer, and dishwasher only when we have a full load.</td>
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<td></td>
<td></td>
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<tr>
<td>We use a microwave or toaster oven for cooking small amounts instead of the oven.</td>
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<td></td>
</tr>
<tr>
<td>We have a low-flow showerhead or toilet.</td>
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</tr>
<tr>
<td>We turn off the water while brushing our teeth.</td>
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<tr>
<td>The faucets are in working order (no drips or leaks).</td>
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<td></td>
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<tr>
<td>We use a fan instead of an air-conditioner.</td>
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<td></td>
</tr>
</tbody>
</table>

**Calculate Your Score**

Count up the number of tallies in each column above and multiply by the corresponding points below to get your total conservation score.

- Always/ Mostly = 2 points
- Usually/ Sometimes = 1 points
- Rarely/ Never= 0 points

My Score: ____________

**A Conservation Score of:**

- 24-34: Excellent!
- 15–23: Good
- Less than 15: Needs Improvement