Apoha the O'opu
Simulation Activity

GRADE LEVEL:
4-6

DURATION:
2 classes
40-50 mins

SUBJECT AREAS:
Science

Standard 1:
SCIENTIFIC INVESTIGATION:
Discover, invent and investigate using the skills necessary to engage in the scientific process

Standard 2:
NATURE OF SCIENCE: Understand that science, technology, and society are interrelated

Standard 8:
Forces that Shape the Earth:
Describe how slow processes sometimes shape and reshape the surface of the Earth

Through a simulation activity, students will apply cause and effect relationships to water pollution in a stream. They will also recognize varied uses of water and the importance of clean water in our daily lives. To do this activity, share the story of Apoha as written below. At the end of each section, simulate pollution by adding items to the jar of water. Discussion on the effects of the pollutants can be done after each item is added or at the completion of Apoha's story.

(This lesson plan is adapted from Chilton-Stringham, Patricia and Wolanin, Jan (1991). National Science Teachers Association, Karen K. Lind (Eds.) Water, Stones, and Fossil Bones (pp. 54-57).
http://www.arvindguptatoys.com/arvindgupta/cesi-1.pdf

OBJECTIVE(S):

- Develop an understanding of specific terms introduced in this lesson.
- Identify what were Apoha's challenges in his journey upstream.
- Determine how these challenges could affect the outcome of his journey.
- Express correlation of experiment to nature and how it can affect marine life in the streams and oceans? (cause and effect worksheet attached can also be used for this)
- Students will think about what they do in their daily lives to influence water quality & become EVERYDAY CLEANWATER HEROES

MATERIALS:

A sponge (or a gummy worm)
A LARGE jar with water in it
String/fishing line
Pencil
Soil
Brown sugar
Syrup
Paper dots
Soapy water
Red food coloring
Green food coloring

GLOSSARY OF TERMS:

- DECOMPOSITION: (decompose) to break down organic matter or (of organic matter) to be broken down physically and chemically by bacterial or fungal action; rot

- ESTUARY: An estuary is a body of water formed where freshwater from rivers and streams flows into the ocean, mixing with the seawater. In Hawaiian this is called a muliwai.

- EROSION: Wearing away of the ground surface as a result of action by wind and/or water.

- FERTILIZER: a substance (such as manure or a special chemical) that is added to soil to help the growth of plants

- HAZARDOUS WASTE: is waste that poses substantial or potential threats to public health or the environment.

- NUTRIENT: Food, or any nourishing substance assimilated by an organism, and required for growth, repair, and normal metabolism

- NON-POINT SOURCE POLLUTION: Pollution that does not come from a single, identifiable point but from a number of points that are spread out and difficult to

identify and control. Includes materials that wash from roofs, streets, yards, driveways, sidewalks as well as from agriculture, erosion, and construction.

- POLLUTANTS: Any waste, cooking or fuel oil, waste milk, waste juice, pesticide, paint, solvent, radioactive waste, hazardous substance, sewage, dredged spoils, chemical waste, rock, sand, biocide, toxic substance, construction waste and material, and soil sediment.

- SEDIMENT: Sediment includes particles of sand, clay, silt, and other substances that settle at the bottom of a body of water.

- STEWARDSHIP: the conducting, supervising, or managing of something; especially: the careful and responsible management of something entrusted to one's care….*stewardship* of natural resources

- STORMWATER: Storm water suggests large quantities of water (from rain, flooding) at any one given time.

ACTIVITY:

Read the following aloud to the student or have students take turns reading each section (some excerpts taken from the book "The Journey Home"):

Suggested variations on presenting the lesson:

- Enlarged copy of each part of the script, laminated to card stock, for students reading the script. It helps to highlight the reading part in one color and the doing part in another.
- A copy for each child, which allows them to follow along as the simulation takes place.
- For children below third grade or with limited reading ability, either read the script for them, or present it through story telling.

1. Apoha the o´opu has traveled all around the sea and now it is time for him to return up stream. As Apoha begins his travels it begins to rain heavily. The storm water from the rain begins to wash sediment into the estuary. (*Muliwai*-pool near mouth of a stream-translation source: Mary Kawena Pukui)

- Dump sediment (soil) into Apoha jar
- Ask the students. "How is Apoha? What happened to the water when the rain fell? What do you think might happen to Apoha as a result?

2. Apoha makes it through but it was very difficult to move forward (Ho´o mua) through the estuary (muliwai) due to all the sediment and other trash (*opala*) that filled the stream mouth. Apoha, determined to return home continues his journey up stream. As he maintains his course he comes upon fresh green lawns with people driving around in little cars with no windows. He realizes he is now near a golf course. Some fertilizer from the golf course and lawns has washed into the stream awhile back. Fertilizer from the golf course also makes the plants in the stream grow very fast and thick. Eventually the stream could not provide the plants in the stream with all the nutrients they needed, and so they died and are starting to decay. Their decomposition is using up some of Apoha's oxygen.

- Place brown sugar in Apoha's jar
- How is Apoha? What do you feel is happening to him? How could you help him?

3. Apoha makes it past the golf course and now finds he is swimming beside a large parking lot. Some cars parked on it are leaking oil. The rain is washing the oil into the stream below.

- Pour pancake syrup into Apoha's jar.
- How is Apoha? What do you feel is happening to him? How could you help him?

4. Apoha now swims past the city park. Some picnickers didn't throw their opala (trash) into the garbage can. The wind is blowing it into the stream.

- Sprinkle paper dots into Apoha's jar.
- How is Apoha? How does this affect Apoha's journey up stream?

5. A cement factory is located downstream from the city park. Although regulations limit the amount of chemical pollution factories are allowed to dump into the stream, the factory owners are not abiding by them.

- Pour warm soapy water into Apoha's jar.
- How is Apoha? What do think the soapy water represents?

6. Due to the earlier heavy rain. Untreated wastewater spilled into the stream after a sewer pipe overflowed.

- Squirt two drops of red food coloring into Apoha's jar.
- How is Apoha?

7. Finally, Apoha swims past where some hazardous waste is being stored. Rusty barrels of toxic chemicals are leaking. The rain is washing these poisons into the stream.

- For each leaking barrel, squeeze one drop of green food coloring into Apoha's jar.
- How is Apoha?

8. Summary discussion
    a. What happened to Apoha on his journey?
    b. What were some of the ways you could help Apoha?
    c. What is stewardship? Where the places Apoha encountered examples of stewardship? Why/why not?
    d. How could they be better stewards? How can you be a steward for our environment?

TEACHER'S NOTES

Lesson step #	Related Standard #	Topics of discussion
1	8	Erosion and how overtime this process reshapes the earth creating valleys, etc.
2	1	Encourage inventive ideas to restore oxygen for Apoha or limit fertilizer in the stream
3	2	Society's increase in vehicle use and impacts on Apoha's stream
4	2	Non-point source pollution, how trash comes from various locations and society's increased use of disposable packaging has affected the amount of trash in streams and ocean impacting life there
5	1 & 2	Point source pollution, how chemicals coming from factory are a single location for pollution, encourage ideas on how to investigate the amount for regulation and propose consequences for breaking the rules
6	1 & 2	Wastewater, where does it come from and where does it go (house to treatment plant), what is meant by a spill (overflow or break in pipes leading from house to treatment plant, unintentional discharge to streams/oceans), is this non-point source or point source pollution
7	1 & 2	Hazardous waste, why do toxic chemicals exist, how are they used, how do you think they should be disposed (encourage inventive ideas)

EXTENSION ACTIVITY:

- Create a visual cause and effect of Apoha's travels using attached worksheet Describe to students:

  A *cause* is something that makes something else happen. Out of two events, it is the event that happens first.

  To determine the cause, ask the question "Why did it happen?"

  An *effect* is what happens as a result of the cause. Of two related events, it's the one that happens second or last. To determine the effect, ask the question "What happened?"

ONLINE RESOURCES:

- Background information on o'opu:
  http://hbs.bishopmuseum.org/good-bad/oopu-full.html
- 'The Journey Home' e-book:
  http://cleanwaterhonolulu.com/storm/journey/
- Various other Hawaii themed water quality activities:
  http://cleanwaterhonolulu.com/storm/learning_center/students.html
- World Water Monitoring Challenge:
  http://cleanwaterhonolulu.com/storm/learning_center/world_water_monitoring_day.html
- Various other lesson plans, booklets and other resources on topic of water:
  http://www.projectwet.org/teach-and-learn
- Interactive learning site 'Discover Water – The Role of Water in Our Lives:
  http://www.discoverwater.org/

CAUSE AND EFFECT OF APOHA'S TRAVELS WORKSHEET

Name_____ Date_____

Directions:

Using the activity Apoha the O´opu IDENTIFY the types of pollution described throughout the story by checking off the correct cause. Was the pollution caused by HUMANS or NATURE? Once you identify the cause, what is the effect of this pollution on streams? How does pollution impact the stream and water quality? Briefly describe your answer in the space provided below.

What	Cause		Effect
Specific Action	Human	Nature	Impact on water Quality
Soil & trash from storm water makes stream mouth dirty	X	X	The storm water washes soil and trash into the stream mouth creating obstacles for the o´opu as he tries to return up stream