KELP SAILORS FOR THE SEA

KIDS ENVIRONMENTAL LESSON PLANS

This lesson developed by:

New England Aquarium

The Dirty Water Challenge

Overview:
This is a fun activity that teaches students about their environment in an engaging and practical way. Inquiry and discussion is embedded within the practical-students have to design, plan and then build their own design of water filter. Students are exposed to important concepts from a variety of scientific disciplines, including how the water cycle works, and the principles behind water filtering.

Ocean Literacy Principles:

1. The Earth has one big ocean with many features
2. The ocean and life in the ocean shape the features of Earth
6. The ocean and humans are inextricably interconnected
7. The ocean is largely unexplored

Key Concepts:
The scientific method is used to introduce students to the concept of "being scientists" and solving a problem with inquiry and well-thought out process. Students are also given the chance to discuss their ideas of water conservation and water use.

Materials:

- paper cups
- sand
- gravel
- coffee filters
- napkins
- aluminum foil
- large container to hold "dirty water"

The Dirty Water Challenge (cont.)

Set-up Prior to Activity:
Build the "mystery filter". The mystery filter is made up of two or three paper cups with small holes in the bottom for drainage. Place a coffee filter in the first cup. Place this cup into a second that is covered with sand at the bottom, and place this into a third cup filled with a small layer of gravel. (You can fill the cups in a different order or with different materials as you have available). Experience has shown that it is best not to put too much filtering material in each beaker (one or two centimeters of filtering material is usually sufficient); otherwise it simply soaks up all the water that you pour in, or the water takes too long to filter through to the bottom. Cover the filter completely with aluminum foil so that students cannot see how the filters work or what they are made of. In addition, mix up some tap or other clear water with soil to make it "dirty" water.

Duration:
This activity can be done all at once, or over several days:

- 30 Minutes for demonstration
- 30 Minutes for testing filter materials
- 30 Minutes to build new filters
- 30 Minutes to test new filters and discuss

Physical Activity:
Low

Background:

Activity:
The teacher stands in front of the students and holds the filter above a clear plastic container. One student is invited to pour in some dirty water, made by mixing a liberal amount of soil into tap water. After several minutes, water should begin to drip through the layers in the cups and start dripping into the clear container at the bottom. After passing through the filtering layers, the water should be noticeably cleaner than when it was poured in. Do not pour all the dirty water in so the class can compare what the water looks like before and after.

During the demonstration, pose questions to the students that force them to think about what they are seeing:

- Where do you think dirty water could come from?
- What do you think will happen to the dirty water?
- Why would you want to make it clean?

Perhaps students will mention water use in their homes, or precipitation falling onto the ground. Students may mention that water should be made clean again so it can be reused.
Finish the demonstration by asking the students to design, test and make their own filters based on the mystery filter they have seen in action. These will be tested at the end of the lesson to see which group made the most effective water filter. The objectives of the lesson are for students to test different materials and combinations of materials to discover their filtering ability and use this knowledge to

The Dirty Water Challenge (cont.)

design and build their own water filters.

Making and Testing Water Filters:

1. Provide each group of two or three students with paper cups, filter paper, sand, gravel of different sizes and a large supply of dirty water (fill a bucket full to be sure to have enough). The groups should determine the following:
    - Which materials filter most effectively?
    - Which combination of materials, and in what order, produces the most effective filter?
2. Explain to students that in a good experimental design they should test each material on its own before beginning to test several materials together. If students simply mix lots of filtering materials together they won't know which one is the most effective or which is best suited for removing certain substances. Only after sufficient testing should the group go on to produce their final filter. You can promote this by simply going around the groups and prompting them with: "Which material filters best?" "What happens if you use two materials to filter the water?" "Which layers of material work best?"
3. The hint "Why don't you use less materials?" can be used to hinder frustration if the filters don't work as well as students expect. Sand can cause a problem, as it tends to run through the holes at the bottom of the cup easily. One solution (thought of by a group of students) is to place a piece of filter paper in the bottom of the cup first.
4. When the groups have tried a number of combinations and have a good idea how each of the different filtering materials work, they can start making their final filters. This testing period typically takes 30-45 minutes but can be varied to the ability of the group, their enthusiasm, and how much time is available.
5. The design of the final filter may vary between groups. Some will use a sequence of cups, each with a separate filtering material. Others may use a single cup and place several layers of material within it. Other groups may use a combination of these, or something completely different. Let students experiment and decide themselves what they want the filters to look like. It is more important that each group can explain why it believes its filter to be the best design, rather than that all groups have identical filters. This activity will require good communication between members of the same group, so this is also a chance to place sailing teams together to practice their communication skills off the water.

Final Test:

1. At the end of the lesson, when every group has produced a filter they are happy with, test the filters to see which ones are the most effective. This is best done by collecting all filters in a long row at the front of the class, with clear containers to collect the filtered water beneath them (you can use cut up empty water bottles, or clear cups, or glasses).
2. Ask the students: Which filter do you think will be best, and why? Encourage a debate or discussion based on how each material works at removing various pieces of debris or particulate.
3. To test the filters, pour a small amount (about a half cup) of dirty water into each filter and wait until they fill the clear empty containers beneath them. When all have filtered, as the students which ones were the most effective and produced the cleanest water.

The Dirty Water Challenge (cont.)

Discussion:

- What problems did you encounter while making filters? (Some problems include filters becoming blocked with material, or filtering taking too long)
- How could you improve the filters? (bigger filters, different size gravel, etc.)
- What happens to the water you use in your every day life? Does it get filtered? How/ Where?
- Do you know any natural filters? What happens to rainwater? Where does it go and how does it get there?
- Connect this experience to the Water Cycle, noting that water slowly seeps through sand and rock in the earth to become part of underground aquifers or feed into streams.
- Did the filters truly get the water "clean"? (Although filtering makes water appear less dirty, it will not remove all the dirt. Additionally, there can be other substances in the water that cannot be seen, such as microscopic bacteria, toxic runoff or salt in the ocean water.)
- Why do some of these unseen materials not get filtered out? (They are either too small to be caught by the filter, or are saturated into the water and need to be removed by some other method, such as distillation).

At the end of the lesson, reveal how the mystery filter was made and let them compare it to their own designs. Remember that it is more important for the students to use logical, scientific steps to build their filters than to create the best filter. Extend this activity by using water testing kits (available at aquarium supply or science supply stores) to test the unseen properties of the water. You can also test how different sources of water vary in quality.