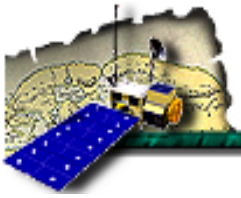

Visit to an Ocean Planet

The Effects of Cleaning Oil Spills

Overview

Students will experiment with different methods of cleaning oil spills. They will monitor the effects of oil and of different cleaning agents on aquatic plants in aquariums.

Concepts

- Oil spills in the ocean have serious impact on the aquatic environment.
- There are a variety of different methods of cleaning oil spills. Unfortunately, some of these methods can cause as much damage to aquatic organisms as the oil itself.

Materials

- Newspaper to cover tables
- Bucket for waste
- Rubber gloves
- 4 Small, clear aquariums with pumps to aerate the water
- Aquarium plant food
- Aquatic plants
- Gravel for the bottom of the aquarium
- Water
- Motor oil or vegetable oil (see Preparation)
- Dish washing detergent
- Sand
- Data sheet

Preparation

Conduct this activity as a class observation that has two distinct parts. During the first part of the experiment, the students need to set up four aquariums with aquatic plants. Three of the aquariums will have oil introduced, while one will remain as the control. During the second part of the experiment, the students will observe the plants in each aquarium and record the effect of the oil and the cleaning agents on the plants. Note that aquarium set up will occur on one day, introduction of plants the next day, and introduction of the oil and cleaning agents on the third day. Subsequent observations are to be made over a period of two weeks. Note: The plants used in this activity are fresh water plants.

Motor oil is very messy, but has a dramatic impact. The difficulty lies in disposing properly of the oil once the lesson is complete. Please make sure that neither you nor your students wash it down the drain when they finish the experiment. The material is disposed of at an authorized motor oil disposal facility. Because of this complexity, you might wish to substitute vegetable oil, which can be washed down the drain, but which may show less dramatic effects.

The week before you plan to begin the experiment, set up an aquarium with all of the plants. This will give the plants a chance to adjust to the aquarium's environment. Use the plant food during this first week. You can order the aquatic plants from a science supply store or purchase them at a pet store that

sells aquarium supplies. Elodea works well in this experiment because it is an excellent oxygenator and grows rapidly. Because it is a bottom rooted plant, it may provide some interesting observations for the spill that is cleaned by sinking it with sand.

Divide your class into four groups and have each group set up one of the aquariums. You might wish to put together an equipment tray for each group of students that includes a small aquarium, aquarium gravel for the bottom, a pump, a small amount of motor oil, gloves for each student, aquatic plants, and labels. One of the trays should have detergent and another should have sand.

You will find a section on the data sheet labeled "Observations and Comments." Have the students use this section to note any changes that they see in the plants and in the oil (for example, if and when bubbles gather on the underside of the oil slick).

PROCEDURE

Engagement

We know that over 700 million gallons of oil spill, leak, or are dumped into the sea each year. This has a major impact on the organisms that live in and near the ocean. Scientists have recently begun to research the effects of cleaning up oil spills. How do we clean oil from the ocean? In this activity, you will observe and record the effects of oil on aquatic plants. You will also examine and document the effects of two different cleaning agents.

Activity

Day 1

Aquarium Set-Up:

1. You will need to set up four small aquariums with water.
   a. Label the first aquarium "#1: Control." Layer the bottom with gravel and add water. Set up the pump and let the aquarium sit for 24 hours before you add the plants.
   b. Set up the next aquarium exactly the same as the first. Once you have turned on the pump, let it sit for 24 hours before you add the plants. Label this one "#2: Oil Spill."
   c. Repeat this procedure with the third aquarium. Label this one "#3: Sand as a Sinking Agent."
   d. Repeat this procedure with the fourth aquarium. Label the fourth aquarium "#4: Detergent as Dispersant."

Day 2

2. After 24 hours, add aquatic plants to each aquarium. Anchor the plants at least one inch into the gravel. Add plant food. You may also want the tops of some plants to reach the water surface. This will show what happens when plants have direct contact with oil. Wait 24 hours before carrying out the experiment portion of the activity.

Day 3

Experiment:

1. After waiting another 24 hours, turn off all the pumps and either remove them or unplug them. Do the following to each aquarium:

#1 Control: Add nothing.
#2 Oil Spill: Add oil to the top and leave alone.
#3 Sand as a Sinking Agent: Add oil to the top. Then drop or sprinkle sand on the oil.
#4 Detergent as a *Dispersant*: Add oil to the top. Then drop detergent on the oil. Stir the water to mix the oil and detergent.

2. Observe the plants in each of the tanks and record your observations on the data sheet. Be sure to note leaf condition and the density of oxygen bubbles on the leaves. Note if different parts of the plants show different responses to conditions.
3. Predict what you think will happen in each aquarium. Make sure that your predictions involve both the oil and the plants.
4. Record observations on the data sheet each day for two weeks. Make sure that you note any unusual conditions on your data sheet.
5. When you have completed your observations, completely clean your aquarium. If you used motor oil, do not dump it down the drain. Ask your teacher for the proper method of disposal.
6. What did you notice happening in each aquarium? How did they differ from one another? What happened to each oil slick that you tried to clean? How did oil affect plants at the water surface? How did each cleaning agent work? Did the cleaning agents affect the plants? If so, how? Did your observations support your predictions? Explain your answer.

Explanation

Scientists estimate that over 700 million gallons of oil end up in the ocean every year, mostly from non-accidental sources.

Sources of Oil Pollution	Millions of Gallons
Big Spills	37
Routine Maintenance	137
Non-Industrial Waste (Used Motor Oil, Oily Road Run-off)	363
Atmospheric Fallout	92
Offshore Drilling	15
Natural Seeps	62

There are a variety of different techniques used to manage spilled, already contained oil. There are absorbents to soak up the oil, sinking agents to remove oil from the surface of the water, chemical dispersants that break down the oil, and oil-degrading microbes that dissolve *hydrocarbons*. Just as biologists monitor the short and long term effects of the oil itself on the marine environment, they must also monitor the effects of these cleaning agents on marine organisms.

Sinking agents—sand, clay, or cement—clump the oil together and then together sink to the seafloor. This affects the animals and plants that live on the ocean floor. Moreover, the natural degradation of the oil is slowed because it is located well below the surface of the water. So the use of sinking agents is now illegal in United States waters.

There are also problems with the widespread use of detergents to disperse the oil on the ocean surface. A large part of the biological degradation from several recent spills have been attributed to the use of these chemical dispersants. Fortunately, today, dispersants are more effective and less toxic than

earlier generations of products. New dispersant options include such things as gelling agents, emulsifiers, elasticizers, and absorbents.

Extension

Further discuss the proper disposal of motor oil. How do the students or their family members dispose of used motor oil? Investigate how authorized motor oil facilities dispose of the oil that they receive.

How might satellites help with oil spill containment and cleaning? Have your students research the use of satellites in monitoring the movement of oil by surface currents to develop an understanding of the most recent methods of containment.

Have your students research the newest methods of cleaning oil spills. You can purchase oil-degrading microbes that have the ability to dissolve hydrocarbons. If possible, have them try several of these methods on their aquatic plants to test their efficacy.

Another option is to set up a second aquarium with plants, add oil, and run an aquarium pump during the class period. This will churn up the oil and has a dramatic impact. Observe the aquarium, including the underside of your oil slick. What affect does the pump's action have on the aquarium environment? Can you think of conditions at sea that might be analogous to this situation? Remember to turn off the pump at the end of the period.

Links to Related CD Activities, Images, and Movies

Activity *Oil Spill*

Vocabulary

dispersant *hydrocarbons*

Source

Long, Jennifer. Orange County Marine Institute Curriculum Series. 1997.

Tank #_____ **Circle One:** **Control Oil Sand Detergent**	**Bubbles present on leaves ?**	**More/less bubbles than day before**	**Leaf Condition (Describe change in Comment)**	**Observations and Comments** **(Example: Leaves are brown on edges and translucent in center)**
Day 1	Yes No	More Less	Same Change	
Day 2	Yes No	More Less	Same Change	
Day 3	Yes No	More Less	Same Change	
Day 4	Yes No	More Less	Same Change	
Day 5	Yes No	More Less	Same Change	
Day 6	Yes No	More Less	Same Change	
Day 7	Yes No	More Less	Same Change	
Day 8	Yes No	More Less	Same Change	
Day 9	Yes No	More Less	Same Change	
Day 10	Yes No	More Less	Same Change	
Day 11	Yes No	More Less	Same Change	
Day 12	Yes No	More Less	Same Change	
Day 13	Yes No	More Less	Same Change	
Day 14	Yes No	More Less	Same Change	