Title: Sheen-Oil-Mousse

By Jane Middleton

Theme: Oil undergoes changes in marine ecosystems.

Objectives:
- Students will examine the basic characteristics of oil.
- Students will identify the changes oil undergoes once it is spilled.

Duration: 60-90 minutes

Age Range: 6^{th}-12^{th} Grade

Materials:
- 1 cubic centimeter 10W-40 motor oil or crude oil
- 1 quart sea water
- Hand whisk or egg beater
- 1 large bowl
- Eye dropper
- Graduated cylinder
- 2 bowls, 6" in diameter
- 1 large flat pan or tray
- 4 seabird feathers
- 4 small rocks
- 1 oil absorbent pad
- Rulers
- Pens or pencils
- Paper
- Calculators
- State or U.S. map with scale

Background:

When oil is spilled, it begins to change both physically and chemically. Some amount of the lighter, volatile compounds turn to gas and disperse in the air. The remainder of the toxic oil usually spreads out from the main slick as fingers of very thin, iridescent sheen on the surface of the water. This layer of sheen can be deadly to seabirds and other marine life that spend time on the surface.

As oil on the surface is agitated by wind and begins to weather, it changes. Within about two weeks it begins to form mousse: a thick, gel-like mixture of oil, air, and water. Media images of birds and other animals covered with mousse and heavy crude oil may leave the impression that this thick oil is the problem following an oil spill. This simple experiment demonstrates that even a small amount of oil in a sheen can be deadly.

Preparation:

Set up this activity outside if possible where there is good ventilation.   The tools and kitchen supplies used in this activity should not be used for food ever again.

Introduction:

Remind students that oil is toxic; they should not try to inhale large amounts of the volatile compounds and should avoiding touching the oil. Ask them if they have encountered oil outside of the classroom. Where? What did it look like? Could they smell it? Explain that when oil enters the environment, some of it turns to gas and rises into the air. These gasses are responsible for the scent associated with oil spills or an open container of oil. The heavier components of oil then interact with water, wind, and waves to form either a sheen or thick mousse.

Activities & Procedures:

Pour a layer of salt water about 1 inch deep into each of the bowls. Have a student use the eyedropper to drop a single drop of motor oil onto the surface of the water in one of the bowls. Examine the sheen that forms.

Have a different student dip two feathers into the bowl of plain saltwater as the control. Remove the feathers and place them on top of each other in a well-ventilated or sunny spot to dry. Then have someone else dip two new feathers into the bowl containing the oil sheen. Remove the feathers. Can anyone see the oil? Place the feathers on top of each other next to the control feathers to dry.   Save the oiled saltwater and move on to the next steps as the feathers dry.

Demonstrate the way oil leaking from a tanker, pipeline, or drilling rig spreads out to form a slick on the surface of the water by pouring a layer of sea water into the large, flat tray and dropping a cubic centimeter of oil on to the water's surface.

Have students compute the area in centimeters of the slick that forms. Then compute the area of a slick that could be formed by a liter of oil – just multiply by 1000. The *Exxon Valdez* Oil Spill was measured in gallons. There are 3.785 liters in one gallon, so students can calculate the size of a slick formed by one gallon of oil simply by multiplying the slick formed by a liter times 3.785. Approximately 11,000 gallons of oil were spilled in the *Exxon Valdez* Oil Spill, so have students multiply by 11 million. Finally, students can convert the slick size to square centimeters – divide their answer by 929 (1 square foot = 929 square centimeters) and then divide by 27,900,000 (1 square mile = 27,900,900 square feet). Record this final number as a projection of the slick size for an 11,000,000 gallon oil spill. Here is a review of these steps:

Area of slick formed by cubic centimeter of oil:	______________ cm^2
	X 1000
Predicted area of slick formed by liter of oil:	______________ cm^2
	X 3.785
Predicted area of slick formed by gallon of oil:	______________ cm^2
	X 11,000,000
Predicted area of slick formed by 11 million gallons of oil (cm^2):	______________ cm^2
	÷ 929
Predicted area of slick formed by 11 million gallons of oil (ft^2):	______________ $feet^2$
	÷ 27,900,000
Predicted area of slick formed by 11 million gallons of oil (mi^2):	______________ $miles^2$

Provide students with copies of a local or U.S. map. Have students identify the scale of the map. Calculate the scaled size of the projected slick (divide the projected slick size in square miles by the scale mile:inch or mile:centimeter). Have students color a scaled oil spill on the map. What areas would be oiled?

Take the oiled water from previous experiments and pour into a large bowl. Mix with an egg beater for at least twenty minutes. While this is happening, revisit the feathers. What happened? Did both sets of feathers dry at the same rate? Are any of the feathers matted together? Discuss how even a tiny amount of oil may cause bird feathers to mat together. In this condition, feathers cannot be fluffed for warmth and birds may die of hypothermia.

After twenty minutes, skim of the froth of oily mousse that forms. Have students measure it. Is it more or less than the amount of oil that was poured into the bowl (1 cubic centimeter of oil plus one drop of oil went into the bowl)? What happens to an oil slick at sea that is agitated by high winds and strong seas for 2 weeks or more? That is what happened to the *Exxon Valdez* oil in the Gulf of Alaska, and it formed mousse. Thick foamy mousse blew ashore and remained in the intertidal areas. This has also been a concern in more recent oil spills. Blow and pour some of the mousse onto a few dry rocks to illustrate how it clings to shore rather than washing back out to sea. Save the oiled water for "Critter Clean Up" activity.

Begin a discussion or have students write about the potential effects of mousse on intertidal life:

- What happens to animals such as chitons, snails, and limpets which normally crawl across the surface of the rocks looking for food? Do you think they can remain attached and move with gooey mousse covering the rocks?
- Barnacles attach themselves to rocks and reach their fragile legs out to capture food from the water. What happens to the barnacles if they are covered with mousse?
- Clams and mussels filter food out of the water by pulling water into their siphons? What would happen if they were covered with mousse?
- Many shorebirds and ducks feed on barnacles, clams, and mussels. What happens to these birds if their foods are covered in mousse?
- There are many kinds of crabs which live on the shore. Crabs breathe by means of gills, which are located just under the top shell. What will happen if mousse gets in their gills?
- Many people harvest chitons, snails, limpets, clams, mussels, crabs, or birds. How would people be affected by mousse?

Wrap-Up

Ask students if they have ever seen oil in the water. Discuss sources of small amounts of oil pollution, such as fuel oil spills or oily bilge water on recreation and commercial boats, as well as oil leaks on land from cars, trucks, ATVs, etc. How can these sorts of small spills be prevented? Follow-up with a trip to the harbor or a large parking lot to look for evidence of tiny oil spills and learn more about prevention.

This activity pairs very well with "Critter Clean Up."

Evaluation:

Check student computations for completeness and accurate work. Assess the map for accuracy, and observe student cooperation during group work and contributions during discussion. Student answers about the effects of mousse on marine life can serve as a formative assessment.

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Science As Inquiry and Process: Students develop an understanding of the processes and applications of scientific inquiry.

SA1
Students develop an understanding of the processes of science used to investigate problems, design and conduct repeatable scientific investigations, and defend scientific arguments

The student demonstrates an understanding of the processes of science by:

[6, 7, 8, 9] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating

Concepts of Physical Science: Students develop an understanding of the concepts, models, theories, universal principles, and facts that explain the physical world.

SB3
Students develop an understanding of the interactions between matter and energy, including physical, chemical, and nuclear changes, and the effects of these interactions on physical systems.

The student demonstrates an understanding of the interactions between matter and energy and the effects of these interactions on systems by:

[6] SB3.1 recognizing that most substances can exist as a solid, liquid, or gas depending on temperature

[7] SB3.1 recognizing that most substances can exist as a solid, liquid, or gas depending on the motion of their particles