

In-Touch Science: Chemistry & Environment

Contents

3 Introducing the Program

- 3 Welcoming All Children
- 4 What's in Each Session
- 7 A Way of Teaching and Learning
- 8 Encouraging Conversation
- 10 "I Wonder..." Statements
- 11 Organizing Supplies
- 13 Monitoring Success
- 14 A Preprogram Activity



15 Session 1: Dispersion: Swirling Colors • Cleaning Up an Oil Spill

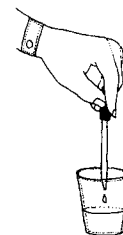
31 Session 2: Chemical Concentrations: What's the Strength? • How Polluted Is It?



47 Session 3: Chemical Bonds and Physical Properties: Making Gloop • Polymers—How Can We Use Them?

63 Session 4: Dissolving: What Dissolves and What Doesn't? • Water Treatment—Cleaning It Up

79 Session 5: Acids, Bases, and Buffers: Pink? Green? Or in Between? • Forever Purple?



95 Resources and Management

- 97 Checklist for Assembling Supply Kits
- 99 Checklist for Assembling Supply Kits to Loan
- 101 Guide to Ordering Supplies
- 103 Parent Letter
- 105 Model Release
- 107 Evaluation Form
- 109 Glossary
- 111 References





Swirling Colors

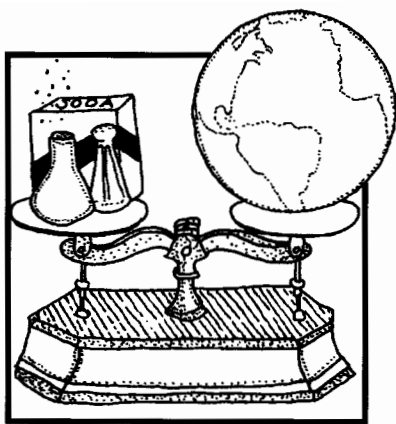


Cleaning Up an Oil Spill



Dispersion





Session 1

Dispersion

These two activities introduce the idea of dispersion. When you shake oil and vinegar to make salad dressing, the oil and vinegar disperse; each liquid temporarily scatters, causing them to mix together rather than remain in separate layers. But given a chance to settle, the layers of oil and vinegar will quickly reappear. Children are encouraged to think about how dispersion occurs and whether it is helpful in environmental cleanup operations.

In Activity 1A, *Swirling Colors*, children observe dispersion by adding detergent to milk, which causes fat droplets and other tiny particles to disperse, or scatter.



In Activity 1B, *Cleaning Up an Oil Spill*, they try cleaning up a miniature oil spill and decide under what circumstances we might want dispersion to occur.

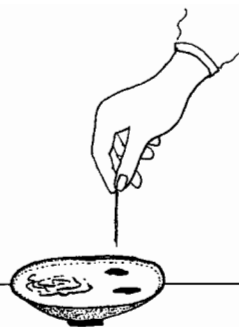


Session at a Glance

- Leader's Guide, pages 18, 24
- Special Hint, pages 18, 24
- Science: Behind the Scenes, pages 19, 25
- Supplies and Preparation, pages 20, 26
- Focus, pages 21, 27
- Activity, pages 21, 27
- Transition or Closure, pages 22, 28
- A Step Beyond, pages 23, 29

Activity 1A

Swirling Colors



Leader's Guide

What's the point?

Children observe dispersion in colorful milk solutions and experiment to see what household chemicals cause such dispersion to occur. They find that detergents and soaps make the milk colors swirl and also help you to wash oil off your hands. Washing with soap causes oils and fats to break into small droplets that become dispersed in water like the colors do in the milk solutions.

For additional information, read Science: Behind the Scenes (page 19).

What's the plan?

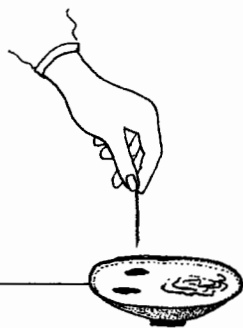
1. Read the activity (page 21).
2. Gather the supplies (page 20).
3. Try the activity.
4. Note special hint (below).

What's my role?

- Guide the children through the activity by doing the procedures with them.
- Encourage conversation about what they are doing and observing. Use the conversation questions as a guide, not a script to be followed.
- Listen for and summarize "I wonder..." statements the children make during the activity. (See "I wonder..." statements, page 10, Monitoring Success, page 13, and Evaluation Form, page 107.)
- Help the children relate this activity to their daily experiences.

Special Hint

If children are likely to put their fingers in their mouths, provide reminders and adequate supervision and ask them to wash their hands after the activity.



Activity 1A

Swirling Colors

Science: Behind the Scenes

Do not use this material as a lecture. It is intended to increase your background knowledge and comfort level with the subject. Allow the children to explore.

In this activity, you will see that soaps, detergents, and similar cleaning products cause swirling action in milk, whereas other types of liquids do not. In Activity 1B, you will observe that oil and water do not mix well—if you stop shaking a jar containing these two liquids, they quickly settle into distinct layers. But when you add just a few drops of detergent, the oil and water will stay mixed.

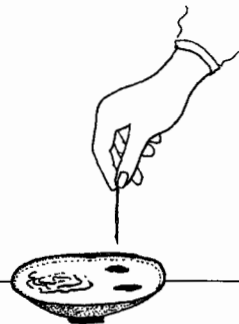
How does detergent make milk swirl or cause layers of oil and water to mix? Soaps and detergents have chemical properties that cause other compounds to disperse, or spread out. When you place a drop of detergent into a spot of color in the milk, it causes the surrounding solution to spread in all directions. When you add a few drops of detergent to the oil and water in a jar, the detergent helps to break the oil into small droplets that spread throughout the water.

These same chemical properties make soaps and detergents very useful for cleaning. These products help to dislodge the oil on your skin or the grease on your dishes or clothing. They cause the oil or grease to break into droplets, which spread out, mix with water, and get washed away.

When cleaning up oil spills in the environment, sometimes we want the oil to remain in one place where it can be collected. Under other circumstances, we want the oil to disperse. These concepts will be explored further in Activity 1B, *Cleaning Up an Oil Spill*.

Activity 1A

Swirling Colors



Supplies and Preparation

Focus Supplies

Focus items can be shared by the group.

- small amount of shortening or cooking oil
- hand soap or a few drops of dish detergent
- bucket of water or wet washcloth

Activity Supplies

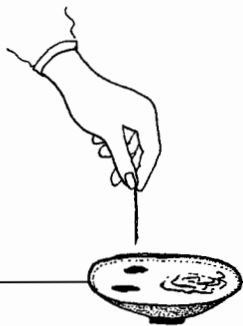
Activity supplies are listed for individuals unless otherwise noted; multiply as needed.

- newspaper
- smocks, old shirts, or aprons
- 2 bowls or pie plates
- 2 cups whole milk¹
- liquid food colorings in 2 or more colors
- several toothpicks
- 1 tablespoon or more of liquid dish detergent, poured into a bowl (for the group to share)
- 1 tablespoon or more of a variety of other household liquids, in bowls (for the group to share)²

¹Try to use whole milk instead of 1% or 2% milk. The lowfat milks will swirl, but not as well.

²Use some liquids that are soaps or detergents and others that are not (e.g., honey, cooking oil, molasses, shampoo, liquid hand soap, vinegar, fruit juice, or liquid cleaning solutions).

Swirling Colors

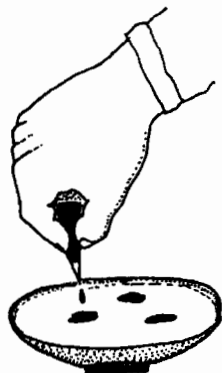


Focus

Rub your hands with cooking oil or shortening and show them to the children. Tell them you would like to remove the oil. Using a bucket of water or a wet washcloth, demonstrate that water alone will not do the job. Ask the children how you could do better. Chances are they will suggest using soap, and you can demonstrate that with soap the oil can be removed much more thoroughly. You could conclude by suggesting that in the following activity we will see this same effect of soap in a different way.

Activity

1. Cover the tables with newspaper and have the children put on their smocks.
2. Pour enough milk into a bowl to make a layer about $\frac{1}{2}$ -inch deep.
3. Once the milk has settled, add a drop of two or three different colors of food coloring at different locations on the surface of the milk. Do this gently, being careful not to stir the mixture.



4. Ask the children to predict what will happen if they gently dip a toothpick into one of the colored dots. Then let them try dipping, being careful not to stir, and watch for any changes in the food coloring and milk as they do so.

I wonder...

Keep track of "I wonder..." statements you and the children express while doing the activity. Children might wonder

why water won't wash the oil off.

what soap does to the oil.

Conversation

Questions You Might Ask

What does dish detergent do to the color spots?

What do you think makes the colors swirl?

What do you think would happen if you used something besides dish detergent on the toothpicks?

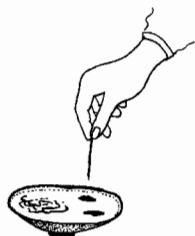
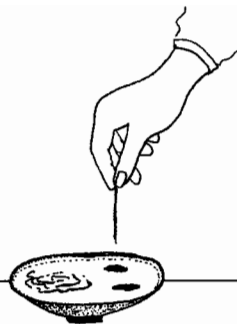
What happens if you put honey on your toothpick? How about a bit of oil?

Can you think of another chemical that might work? How about a different kind of soap or detergent?

Do you think the same kind of swirling would happen if water were used instead of milk?

Activity 1A

Swirling Colors



5. Now pass around the bowl of dish detergent and have the children dip their toothpicks into detergent. Ask what they think will happen when they use these toothpicks to touch the spots of color. Let them try dipping, and give them time to play with their mixtures, watching the colors swirl wherever they dip the coated toothpicks.
6. Starting with a fresh bowl of milk and colored spots, encourage each child to dip toothpicks into substances other than dish detergent, predicting and then testing their effects on the milk spots. You could let them choose from a variety of common substances that will stick to a toothpick, such as honey, cooking oil, shampoo, or liquid hand soap. You could also include liquids that are less sticky but will soak into a toothpick, such as vinegar, fruit juice, or liquid cleaning solutions.
7. Discuss any observations the children have made about what substances caused mixing in the milk.

Transition or Closure

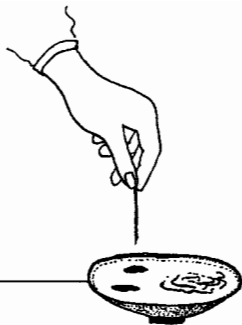
If you are doing only Activity 1A, review the “I wonder...” statements. If you are doing Activities 1A and 1B together, help the children clean up their work areas. Then shift their attention to the oil spill activity.

I wonder...

Keep listening for “I wonder...” statements after the activity. Children might wonder

why soap makes the color spread out.

why honey doesn't do the same thing.



Activity 1A

Swirling Colors

A Step Beyond

I wonder whether this would work in water instead of milk.

Try it! The children might want to try the same activity in a variety of liquids such as water, fruit juice, skim milk, or tea. You are likely to see the same effect in any of these other liquids, but it will be much more dramatic in some than others. In water, most of the food coloring tends to sink, and only the small amount left at the surface will react to the toothpick tests. Liquids that contain tiny suspended particles do a better job of keeping the color in dots at the surface. These include any variety of milk or cream and fruit juices such as orange juice or cider.

Activity 1B

Cleaning Up an Oil Spill



Leader's Guide

What's the point?

Children learn that environmental oil spills are difficult to clean up. For some steps of the cleanup process, it is useful to contain the oil, and for other steps it is desirable to have it spread out or disperse. A detergent is an example of a chemical that helps oil disperse in water, just as it caused the colored spots to spread in milk in Activity 1A.

For additional information, read Science: Behind the Scenes (page 25).

What's the plan?

1. Read the activity (page 27).
2. Gather the supplies (page 26).
3. Try the activity.
4. Note special hint (below).

What's my role?

- Guide the children through the activity by doing the procedures with them.
- Encourage conversation about what they are doing and observing. Use the conversation questions as a guide, not a script to be followed.
- Listen for and summarize "I wonder..." statements the children make during the activity. (See "I wonder..." statements, page 10, Monitoring Success, page 13, and Evaluation Form, page 107.)
- Help the children relate this activity to their daily experiences.

Special Hint

If a child has problems holding a regular spoon handle, make the handle "fatter" by folding a washcloth in quarters lengthwise and wrapping the folded cloth snugly around the handle, fastening it with rubber bands.

A black and white illustration of an oil barrel with a dark spill on the ground next to it. The barrel is cylindrical with horizontal ridges and a top flange. The spill is a dark, irregular shape on the ground to the left and slightly in front of the barrel.

Cleaning Up an Oil Spill

Science: Behind the Scenes

Do not use this material as a lecture. It is intended to increase your background knowledge and comfort level with the subject. Allow the children to explore.

Oil and water do not mix—when you stop shaking them together, they quickly separate into distinct layers. Adding a few drops of dishwashing liquid causes the oil to break up into small drops that tend to remain mixed with the water rather than settling out. This is how dishwashing liquid removes grease from pots and pans, and it can also be useful in cleaning up oil spills in the environment.

When oil is spilled in a lake or ocean, it forms a floating layer called an oil slick that is very difficult to clean up. Exxon spent more than two billion dollars on cleanup operations following the Valdez spill in Alaska! Usually the first strategy in cleanup operations is to try to surround the oil slick so that it will not be able to spread. Then efforts are made to pump or soak it up. In the case of smaller spills, or the residues left after removing as much as possible of larger ones, the next line of attack is to apply dispersants. These are chemicals that act in the same way that dish detergent does in our experiment—they break the oil into small droplets that disperse in the environment.

When an oil tanker crashes, it creates an ecological disaster and big headlines in the news. You may be surprised to learn, though, that much of the oil that ends up in lakes and oceans comes not from these huge accidents but from much smaller leaks and spills. One significant source is used motor oil that people pour into storm drains rather than recycling it or disposing of it safely. Most storm drains lead directly to a river, lake, or ocean. Another significant source is the oil and gas that leaks or gets dumped from motorboats. It's important to remember that it is much easier to keep oil out of water than to try to clean it up once a leak or spill occurs.

Activity 1B

Cleaning Up an Oil Spill



Supplies and Preparation

Focus Supplies

Focus items can be shared by the group.

- 2 jars containing several inches of water, a couple of drops of blue food coloring, and a thin layer of vegetable oil. Make sure that the jars don't leak because the children will be shaking them vigorously.
- a few drops of dish detergent

Activity Supplies

Activity supplies are listed for individuals unless otherwise noted; multiply as needed.

- newspaper
- smocks, old shirts, or aprons
- pie tin or flat bowl
- water
- vegetable oil, several tablespoons
- materials for making small animals or boats¹
- oil cleanup supplies such as cotton balls or paper towels²
- optional: 1 cup of gravel or sand
- liquid dish detergent
- eyedropper
- spoon

¹Pipe cleaners, foam trays, feathers, and fuzzy fabrics

²Sponges, string, pipe cleaners, cotton balls, paper towels, cotton swabs, pieces of hay or straw, a spoon, etc.

Cleaning Up an Oil Spill



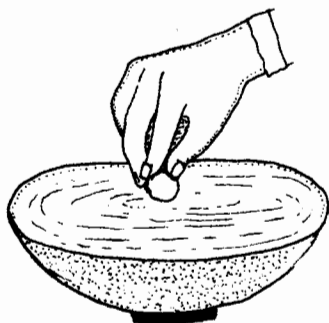
Focus

Ask whether anyone has seen pictures of an oil spill in an ocean or lake. What does it look like? Does the oil float or sink? As you hold this discussion, pass around a bottle containing water and oil. Ask the children to shake it up and observe what happens when they stop shaking it.

Put a few drops of dish detergent into a second jar containing water and oil. Pass this jar around as well, again asking the children to shake it up and observe what happens.

Activity

1. Cover the table with newspaper and have the children put on their smocks unless already in place from the previous activity.
2. Fill a pie tin or flat bowl with one inch of water. Add several tablespoons of vegetable oil to the water surface in each bowl.
3. Using pipe cleaners, bits of fuzzy fabrics, feathers, or other scrap materials, ask the children to design small animals to float on or swim in the water.



4. Optional: Allow the children to add sand or gravel on one side to make a beach or shoreline area.

I wonder...

Keep track of "I wonder..." statements you and the children express while doing the activity. Children might wonder

why water and oil don't stay mixed.

why oil floats on water.

Conversation

Questions You Might Ask

Suppose that an oil tanker crashed, causing a large oil spill in the ocean. How do you think you might clean it up so that it wouldn't kill too many birds, fish, whales, or other living things?

What materials seem to work best for gathering all the oil into one place?

What materials work best for soaking up the oil?

Which materials spread out the oil?

If you mix the oil into the water, can you make the oil slick go away? Does it stay away? If you add a bit of dish detergent, does this help or make it worse?

Is it possible to clean up all the oil?

Activity 1B

Cleaning Up an Oil Spill



5. Provide a variety of supplies such as cotton balls, string, sponges, bits of hay or straw, cotton swabs, and a spoon. Challenge the children to collect as much of the oil as possible and remove it from the water and beach (if they built one in step 4). Encourage them to try various collection techniques.
6. Discuss whether it is possible to remove all the oil and ask whether the children have ideas for additional ways to clean it up. If they don't mention soap, you could remind them to think about when you were trying to get oil off your hands.
7. Now provide dish detergent and eyedroppers and ask the children to figure out whether detergent helps to clean up what's left of their oil spills.
8. Ask what effect the oil has on the toy animals in their bowls and have the children experiment with how this oil might best be removed.

Closure: Connecting Chemistry and Environment

If you are doing only Activity 1B, review the "I wonder..." statements. If you are doing Activities 1A and 1B in one session, talk with the children about how the activities helped them to think about how to disperse an oil spill. Discuss which technique worked better at cleaning up the oil spill. Did adding detergent make the oil easier or more difficult to remove? Did it help when you wanted to mix the oil into the water rather than remove it?

I wonder...

Keep listening for "I wonder..." statements after the activity. Children might wonder

how ducks get the oil off their feathers.

how many cotton balls it would take to clean up an oil spill in the ocean.



Cleaning Up an Oil Spill

A Step Beyond

I wonder how real oil spills get cleaned up—it would take millions of cotton balls to clean up the ocean! I wonder whether people use detergents to clean up real oil spills.

Looking into questions such as these would make a good library project. *Oil Spill!*, by Melvin Berger, is an excellent book on this topic for young children (see References). Children may also be interested in looking in encyclopedias or books about the ocean, then coming back and sharing ideas they have found about environmental cleanup operations.

Although cotton balls certainly would not be practical on an environmental scale, other absorbent materials are used to soak up oil spills, and chemicals similar to detergents are used to disperse what is left. For more information, see *Science: Behind the Scenes*.

