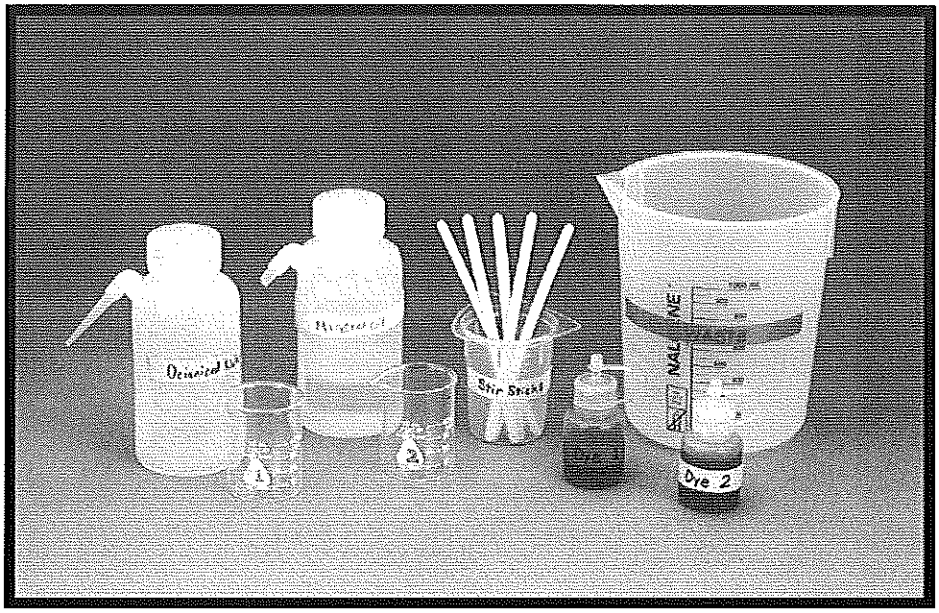
EXPERIMENT

To Dye For

Visitors compare the miscibility of two dyes in mineral oil and water.



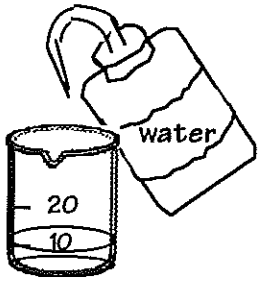
OBJECTIVES:

Visitors learn that the molecular structure of a dye determines whether it will mix well with oil-like substances or with water-like substances.

SCIENCE TOPICS	PROCESS SKILLS	VOCABULARY
Miscibility	Observing	Molecule
Properties of Molecules	Investigating	
	Comparing	
	Inferring	

To Dye For

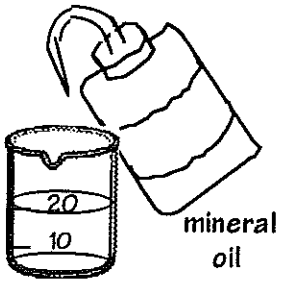
Procedure:



1. Always wear safety goggles.

2. Rinse the two small beakers in the sink.

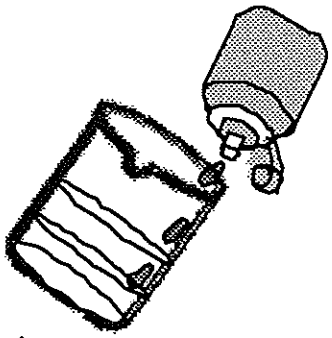
3. Fill Beaker 1 and Beaker 2 to the 10-ml line with water (H_2O).



4. Add mineral oil to both beakers until the liquid in each is at the 20-ml line.

   What do you notice about the two liquids?

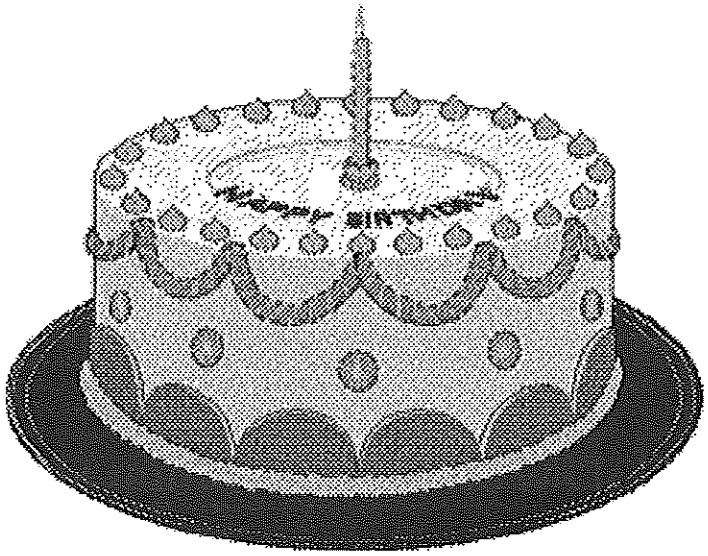
5. • Add 5 drops of red Dye 1 to Beaker 1.
   • Stir the contents gently with a wooden stick.
   • Observe the beaker from the side. What do you see?



6. • Add 5 drops of blue Dye 2 down the inside of Beaker 2. Tilt the beaker slightly as you put in the drops.
   • Wait about 30 seconds, then stir the liquids gently with a wooden stick.
   • Observe the beaker from the side. What do you see?

   What do you think would happen if you added red Dye 1 to Beaker 2? Try it!

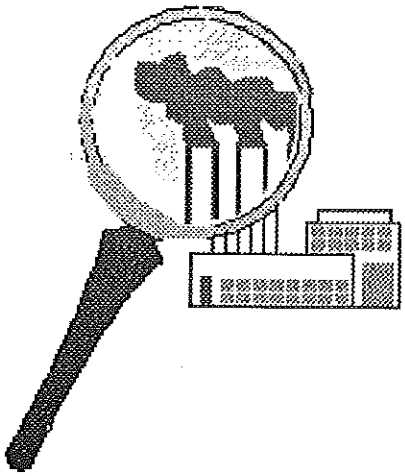
7. Pour the contents of both beakers into the large waste beaker. Rinse both beakers in the sink.



Which dye do you think is used to color food?

A Closer Look:

Mineral oil and water are two liquids that do not mix with each other. The molecules of mineral oil (made mostly of carbon and hydrogen) are large and balanced in shape and electric charge. In contrast, the water molecules (H_2O) are small and unbalanced. Structurally similar molecules generally mix well.



The red dye in the experiment is an industrial dye used to color wax ceramic molds. Because mineral oil has a very similar molecular structure to wax, the red dye mixes well with mineral oil. The blue dye is an industrial food coloring that mixes well with water. Most food contains water, so the blue dye works well for food coloring.

MATERIALS

See Materials Prep for more details

(with amounts to have on hand)

- Two 50-ml beakers with graduations
- Two 30-ml dropper bottles
- Two 250-ml squeeze bottles
- Wooden stirring sticks (keep four on hand)
- One 1000-ml plastic beaker
- Two 500-ml plastic bottles
- Mineral oil (keep 500 ml on hand)
- Blue food coloring (keep 25 ml on hand)
- Sudan IV indicator (keep 50 g on hand)
- One 1-gal plastic container (an empty mineral-oil container works well)
- One 100-ml plastic beaker
- One separatory funnel and stand (you can use the setup from "Making Waves," Unit 6)

Setup/Takedown Procedures

ORIGINAL SETUP

- ❑ Label the two 50-ml beakers "Beaker 1" and "Beaker 2."
- ❑ Label the two 30-ml dropper bottles "Dye 1" and "Dye 2."
- ❑ Label the two 250-ml squeeze bottles "Water (H_2O)" and "Mineral Oil."
- ❑ Label the 1000-ml plastic beaker "Waste Beaker."
- ❑ Label one 500-ml plastic bottle "Oil-Soluble Dye Solution: 2.5 g Sudan IV/500 ml Mineral Oil."
- ❑ Label the other 500-ml plastic bottle "Blue Food-Coloring Solution: 10 ml/500 ml Water."
- ❑ Label the 1-gal plastic container "Used Mineral Oil and Dye."
- ❑ Label the 100-ml plastic beaker "Stirring Sticks."

WEEKLY SETUP

- ❑ Get the "Oil-Soluble Dye" and the mineral oil from the flammables cabinet. Store them in the cabinet under the counter with the experiment supplies.
- ❑ If there is less than 100 ml of oil-soluble dye solution, prepare more stock. (See Materials Prep.)

- ❑ If there is less than 100 ml of blue food-coloring solution, prepare more stock. (See Materials Prep.)

DAILY SETUP

- ❑ On a tray lined with a white mat, set out the following:
  - Two labeled 30-ml dropper bottles
  - Two labeled 250-ml squeeze bottles
  - One large, labeled, plastic waste beaker
  - Two labeled glass beakers
  - One small labeled beaker with two stirring sticks inside
- ❑ Refill the labeled dropper bottles with oil-soluble dye solution and food-coloring solution. (Keep 100 ml of each solution on hand.)
- ❑ Refill the labeled squeeze bottles with dH_2O (deionized water) and mineral oil.

DAILY TAKEDOWN

- ❑ Remove the used mineral oil from the "Waste Beaker" by using a separatory funnel. Pour the red oil into the 1-gal plastic container labeled "Used Mineral Oil and Dye" (from flammables cabinet). Return the "Used Mineral Oil and Dye" to the flammables cabinet. This oil can be reused in "Making Waves," Unit 6, and in "Cleaning Up," Unit 7. Discard the waste blue water solution down the sink.
- ❑ Wash the beakers, outsides of bottles, stirring sticks, mat, and counter with soap and water.
- ❑ Store the beakers and stirring sticks in the tub.
- ❑ Tightly cap all dropper and squeeze bottles and store them in an upright position in the tub. **Note:** The mineral-oil squeeze bottle can be stored upright in the waste beaker to avoid spillage.

WEEKLY TAKEDOWN

- ❑ Wash the tub with soap and water.
- ❑ Clean the outsides of all bottles with soapy water.
- ❑ Empty the squeeze bottles and wash them.
- ❑ Store the empty bottles in the tub.
- ❑ Return all dropper bottles to the tub. Store them tightly capped and upright.
- ❑ Return oil soluble dye solution and mineral oil to flammables cabinet.
- ❑ Tightly cap the 500-ml bottle of blue food-coloring solution. Store it in the tub.

- ❑ Clean the tray and leave it at the station.
- ❑ Clean the mat and return it to general lab storage.

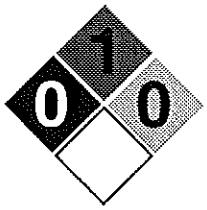
RUNNING SUGGESTIONS

- ◊ Empty the beakers if visitors neglect to do so after finishing the experiment so that the next visitor does not see the finished product.
- ◊ Visitors may have some trouble mixing the food coloring with the water, since bubbles get caught in the mineral oil. Poking at individual bubbles with the stirring stick seems to help. If a few bubbles remain, it won't really matter; you can use the bubbles as further proof that oil and water don't mix.
- ◊ If the visitors do not see the layers, make sure they look at the beaker from the side, not from the top. (If visitors observe the beaker from above after both dyes have been added to the same beaker, the liquid may appear purple, whereas from the side they will see the distinct layers of red and blue.)

EXTENSIONS

Ask the visitors to come up with situations in which they would want to use one dye or the other. For example, you would want the oil-soluble dye to make candles, but you would want the water-soluble dye to color Jell-O®.

SAFETY & DISPOSAL



The oil-soluble dye and mineral oil are flammable substances; follow the handling, storage, and safety instructions.

Consult the Material Data Safety Sheets (MSDS) for additional information.

MATERIALS PREP

To prepare oil-soluble red dye solution:

- ❑ Weigh 2.5 g Sudan IV.
- ❑ Measure 500 ml mineral oil.
- ❑ Add the 2.5 g Sudan IV to the 500 ml mineral oil.
- ❑ Mix the ingredients well.
- ❑ Store the solution in a labeled/dated 500-ml plastic bottle in the flammables cabinet.

To prepare water-soluble dye solution:

- ❑ Measure 10 ml blue food coloring.
- ❑ Add 500 ml water.
- ❑ Store the solution in a labeled/dated 500-ml plastic bottle.