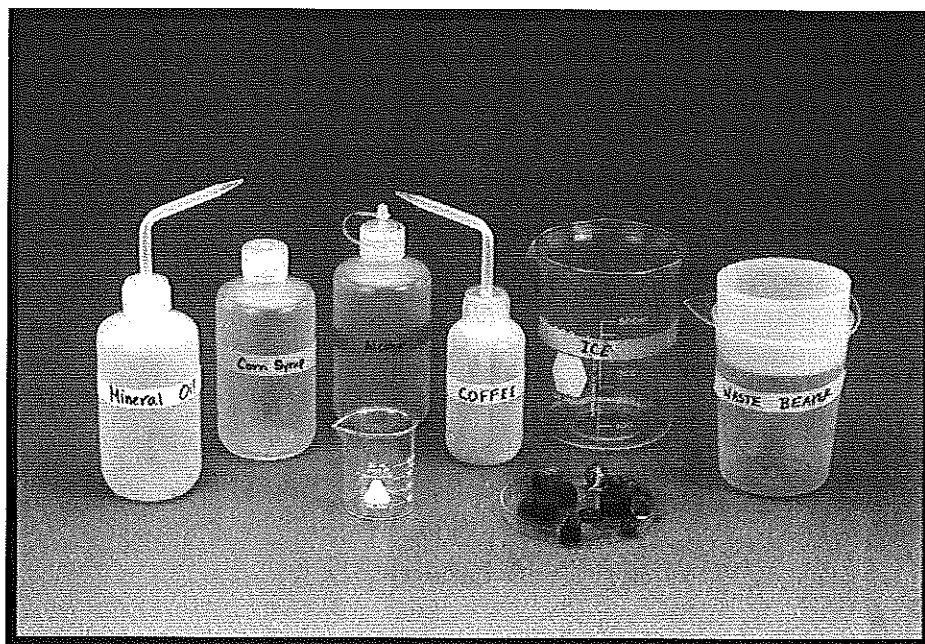


EXPERIMENT

# Layers of Liquids

Visitors pour equal amounts of coffee, mineral oil, corn syrup, and alcohol into a beaker. They observe the layering of the liquids and infer which liquids are the most and least dense. Visitors then place small objects into the beaker and predict where the objects will float.



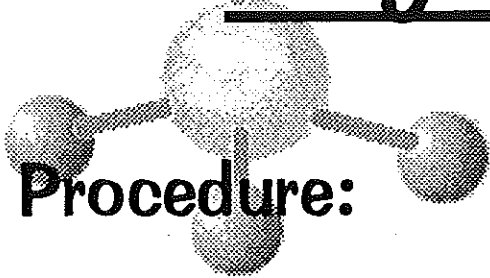
## OBJECTIVES:

Visitors learn that different liquids have different densities and that not all liquids are miscible. They learn that the ability of an object to float depends on the density of the object and the density of the liquid.

SCIENCE TOPICS	PROCESS SKILLS	VOCABULARY
Miscibility	Observing	Chemical
Density	Measuring	Density
Properties of Liquids	Comparing/Contrasting	Mass
	Inferring	Miscibility
	Investigating	Volume
	Predicting	

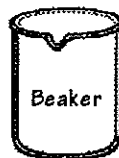


# Layers of Liquids



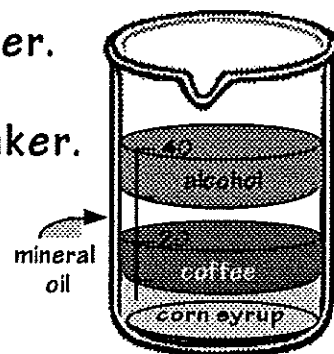
## Procedure:

1. Always wear safety goggles.
2. Rinse the small beaker at the sink.
3. Pour 10 ml of coffee into the beaker.

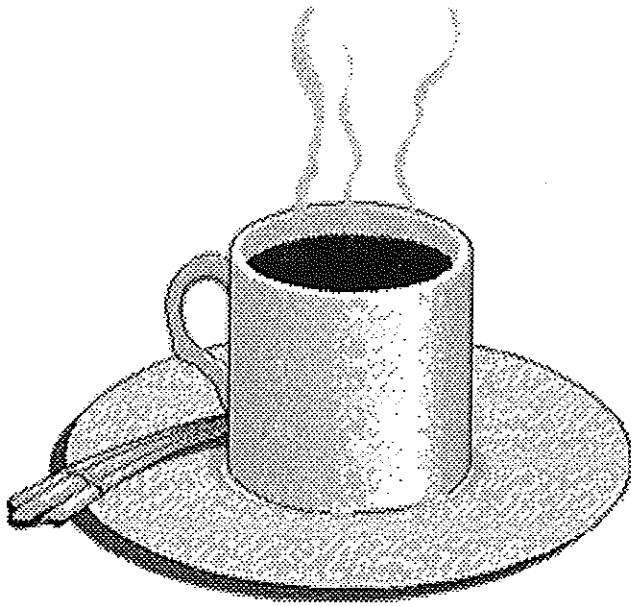


4. Watch as you add 10 ml of mineral oil to the beaker.
5. Watch as you add 10 ml. of corn syrup to the beaker.

Which liquid is heaviest?



6. Add 10 ml of alcohol to the beaker.
7. Choose a small object from the plastic dish—what is it made from?
  - Try to predict in which layer it will float.
  - Test your prediction by dropping it into the beaker.  
Were you correct?
  - Try again with a different object.
8. Pour the contents of the beaker into the waste container with the built-in strainer. Put the small objects back into the plastic dish.
9. Rinse the beaker in the sink.



## Why do things float?

### A Closer Look:

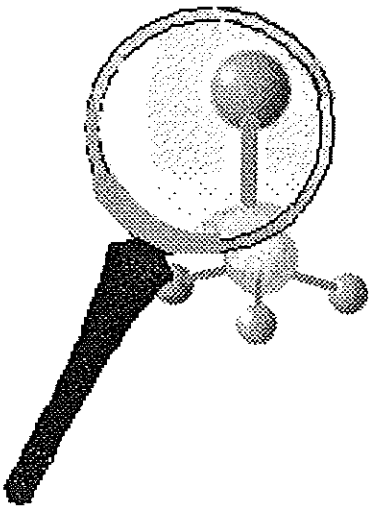
Mass is the amount of material in an object.

Volume is the amount of space an object occupies.

Density is the mass of an object divided by its volume. If two objects are the same size, the heavier one, with greater mass, is more dense.

Less-dense objects and liquids float, while more-dense objects and liquids sink. For example, less-dense alcohol floats on more-dense oil.

Metal objects usually are dense and will sink in most liquids. Wood is usually less dense than, and floats on, the oil. The density of a plastic object depends on many factors, including its chemical composition and whether the object is hollow.



**MATERIALS**

(with amounts to have on hand)

- One 50-ml glass beaker
- One 500-ml plastic beaker (for waste)
- One 3-in.-diameter strainer to fit in the waste beaker
- One 600-ml beaker
- One petri dish lid (or other small plastic container)
- Ice
- About one dozen assorted small objects made variously of wood, glass, plastic, and metal (plastic game pieces, etc.) (avoid using sharp objects or very small parts)
- Corn syrup (1 gal)
- Cold coffee (1 L per day)
- Mineral oil (1 gal)
- C<sub>2</sub>H<sub>5</sub>OH (ethyl alcohol or ethanol) (1 gal)
- Green food coloring
- Two 125-ml plastic squeeze bottles
- One 125-ml dropper bottle
- One 125-ml plastic bottle
- Two 1000-ml plastic bottles

**Setup/Takedown Procedures****ORIGINAL SETUP**

- Label the 500-ml plastic beaker "Waste."
- Label the 125-ml plastic squeeze bottles "Mineral Oil" and "Coffee."
- Label the 125-ml dropper bottle "Alcohol."
- Label the 125-ml plastic bottle "Corn Syrup."
- Label the 1000-ml plastic bottles "Stock Colored Ethyl Alcohol" and "Stock Coffee."
- Label the 600-ml beaker "Ice Water for Coffee."

**WEEKLY SETUP**

- Fill the labeled 1000-ml bottle with coffee and **STORE IT IN THE REFRIGERATOR.**
- Place the corn syrup bottle under the counter.

- Get the large mineral oil and  $C_2H_5OH$  (ethyl alcohol or ethanol) containers from the flammables cabinet. Store the mineral oil under the counter.
- Get the large corn syrup container from the household supplies cabinet. Store these under the counter.
- Fill the 1000-ml labeled bottle with  $C_2H_5OH$ . Add 2-3 drops of green food coloring. Store this in the tub.
- Return the  $C_2H_5OH$  container to the flammables cabinet.

**DAILY SETUP**

- Set out the visitors' instructions in a Plexiglas holder.
- On a tray lined with a white mat, set out the following:
  - One 50-ml glass beaker
  - A labeled squeeze bottle with coffee FROM THE REFRIGERATOR
  - The labeled waste beaker with the strainer in it
  - The labeled squeeze bottle with mineral oil
  - The labeled ice-water beaker  $\frac{1}{2}$  full of ice water
  - The labeled dropper bottle with colored ethyl alcohol
  - The labeled bottle of corn syrup
  - The petri dish lid with the small objects
- Put the coffee in the ice bath to cool.
- Refill all bottles on the tray.
- If the stock colored ethyl alcohol is low, prepare more by adding 2-3 drops of green food coloring to 100 ml  $C_2H_5OH$  (ethyl alcohol or ethanol).

**DAILY TAKEDOWN**

- Wash all sticky material and containers.
- Return the coffee to the REFRIGERATOR.
- When necessary, refill the coffee supply from the cafe.
- Tightly cap all bottles.
- Return all equipment to the tub.
- Store all bottles in an upright position.

**WEEKLY TAKEDOWN**

- Return all large corn syrup container to household supplies.
- Return the large mineral oil container the to flammables cabinet.

- Pour out any leftover coffee, including coffee in the REFRIGERATOR.
- Wash all empty bottles.
- Wash the tray, tub, glassware, dishes, strainer, and outsides of all bottles.
- Clean the tray and leave it at the station.
- Return the mat to general lab storage.



### RUNNING SUGGESTIONS

- ◇ Suggest that visitors try adding liquids in a different order. "What do you think would happen?"
- ◇ Keep the area and materials clean, but **do not use soap until cleaning time at the end of the day.**
- ◇ To keep coffee cold, occasionally add a few pieces of ice inside the squeeze bottle.



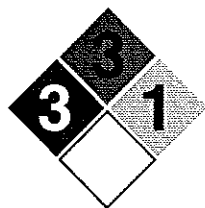
### EXTENSIONS

Set up a bigger version to demonstrate the density of other objects. Think of other objects that may float/sink, that are miscible/immiscible.

**Some examples:**

- Object floating on fresh water vs. saltwater (mountain lakes like Crater Lake vs. the Pacific/Atlantic Oceans)
- Salad dressing: oil and vinegar are immiscible; herbs and seasonings float in strata
- Environmental cleanup of oil spills in water
- Unit 1 Side Display: Sink or Swim?
- Density Take-Home Activity

### SAFETY & DISPOSAL



$C_2H_5OH$  (ethyl alcohol or ethanol) and mineral oil are flammable substances; follow the handling and disposal instructions.

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