MONTSHIRE MUSEUM OF SCIENCE

Montshire at Home: Teacher Guide

WEEKLY THEME: DENSITY – Eureka! Density is a property of all substances. It is a relationship between the mass of a substance and how much space it takes up (volume).

MONTSHIRE AT HOME is a series of learning activities, resources and short videos, developed, hosted and curated by the Montshire's Education team. It's designed to support children, families, and teachers with easily accessible concepts, content, and materials while learning at home.

Teachers can use these materials to support remote science learning opportunities for their students at home. Below is a suggested learning progression using this week's theme, activities, and resources found on the Montshire's Online Resource web page.

SUGGESTED LEARNING PROGRESSION

Day 1: Week-long Density Experiment Set-up

EXPLORE

- What does it mean to dissolve?
- How does dissolved salt change the density of water?

DISCOVER

- Salt crystals are small but still more dense than water, and settle to the bottom of the container.
- A golf ball is also more dense than water. The mass of the volume of water it displaces (pushes out of the way) is less than the mass of the golf ball, so it sinks.
- Over time, the salt begins to dissolve. The solid salt breaks apart into sodium and chlorine ions that are in solution in the water.
- *Making Predictions*: How might the water level, height of the golf ball, and salt level change over the course of one or more weeks?

Day 2: Sink & Float

EXPLORE

- Learn how density is related to whether an object sinks or floats.
- Predict and then test your predictions of whether an item sinks or floats.

DISCOVER

- An object that sinks in water is more dense than water. An object that floats in water may be less dense.
- Some items that are more dense than water can be made to float because of the surface tension of water or because they have air in them. To confirm, push the item under the water and if it comes back up, it is less dense than water.
- Density is a property of the material. If you have a little rock and big rock, they are both going to sink because the rock is more dense than the water. (Pumice, a very cool volcanic rock is the one exception to rocks sinking, and it floats because it is full of air bubbles!)

Day 3: Liquid Rainbows

EXPLORE

- Can one liquid float on top of another liquid?
- Which of the two solutions must be on the bottom so they do not mix?

DISCOVER

- For the solutions to layer, they must have different densities. Adding salt increases the density of the water – more stuff is now in the same volume of water.
- Once the waste cup has enough liquid, use it as a third layer in the density column. Where will it go?
- *Making Predictions*: What will happen to the layers if the test tube is left undisturbed for a couple days?

Day 4: Hot and Cold Layers

EXPLORE

- Have you ever been swimming in a pond and felt a pocket of cold water?
- Why does ice float?

DISCOVER

- Changing the temperature of water, changes its density.
- Heating up water, giving it more energy, causes the molecules to move around more and take up more space. The volume increases slightly, but the mass stays the same – no water is added or taken away – so the density decreases. Take the heat energy away, and the volume of the water decreases, and the density increases. As water approaches its freezing point, it expands, and ice is less dense than liquid water.
- Thermal stratification occurs in bodies of water when the sun warms the top layer of water but the bottom layer stays cold.

Day 5: Kitchen Density Columns

EXPLORE

- What happens when you combine oil and water?
- Predict the relative densities of household materials before layering them.

DISCOVER

- Oil and water are immiscible – no matter how much you mix them together, they always separate out.
- Whether an object sinks or floats depends on its density compared to the density of the liquid you put it in. Some objects may sink in water but float in other liquids. Find objects that float between different layers in the column.

EXTENSIONS

- *Supersaturated Solutions*: More salt will dissolve in warm water than room temperature water. Prepare a supersaturated solution and use it to make 5 or more solutions with different density and then try layering them all.

MONTSHIRE AT HOME: **DENSITY**

MONTSHIRE MUSEUM OF SCIENCE

Activity: Density Column

Create a density column, or a density tower, using common household liquids.

Materials

- Tall clear glass or container
- Salt
- Water
- Markers, 3 colors
- Golf ball (substitutes: small potato, rubber ball)
- Tape (masking or painters tape)

Instructions

1. Attach a strip of tape up the entire side of the glass.
2. Add a layer of salt about 1.5" thick to the bottom of the glass.
3. Slowly pour in water until the glass is full.
4. Allow the salt to settle and the water to clear.
5. Drop the golf ball into the glass.
6. Use the markers to record the water level, the height of the salt, and the top of the golf ball.
7. Place the glass on a window sill or another sunny spot where it can remain undisturbed for the week.
8. Each day, check and record the water, salt, and golf ball heights.
9. Optional: Take pictures of the glass each day.

Questions

- Do you think the height of the water, salt, and/or the golf ball will change over the course of the week?

- What do you think might cause them to change?

MONTSHIRE AT HOME: **DENSITY**

MONTSHIRE MUSEUM OF SCIENCE

Activity: Sink and Float – Exploring Density

One way to explore relative density is by testing whether something sinks or floats in liquid or gas. For this experiment, we're going to see if objects are more dense or less dense than water by observing if they sink or float. Objects that sink are more dense than water. Objects that float are less dense.

Materials

- Small objects around your house that can get wet
- Towel, to help with spills and to place wet items
- A tub of water

Suggestions for Objects to Use

- Lego
- Plastic lid
- Ice cube
- Small balls (golf, wiffle, tennis)
- Crayon
- Rubber band
- Packing peanut
- Coin
- Cork
- Rock
- Grains of sand
- Piece of wood
- Small bottle
- Fruits and vegetables

Instructions

- Once you have collected all your materials, begin sorting them into piles: those that you predict will float and those that you think will sink. If you are doing this experiment with someone else, you may also have a third pile for those items that you don't agree on.
- Once you have all your predictions, you should begin testing your objects one by one. Did it do what you predicted? Often, incorrect predictions are the most interesting ones!
- If an object floats, you should do an additional test of pushing it under the water to see if it floats back up. There are some items that we can make float because of the surface tension of water or air that is in the item. But when those items are pushed under water and do not float back to the surface, they are actually more dense than water.

What's Going On?

- Density can be a confusing concept because we often think of it only in terms of weight – whether something is heavy or light. But density also has to do with volume, or how much space an object takes up.
- Density is the relationship between weight and volume and it's a property of matter. For example, a twig doesn't weigh very much and floats. But the whole tree, which is really heavy, will do the same thing. Because it is made of the same material as the twig, it has the same density and it will also float.
- Try a rock – does it sink or float? What if you try a grain of sand, which is basically a tiny rock that doesn't weigh very much? What do you think it will do? Try it and find out!

Extension

- Find a small bottle with a lid. Test its density when it's filled with air. Then test its density when it's filled with water.
- Air is much less dense than water and is great at helping things float. Think about when you blow bubbles underwater; the bubbles go up!
- Try to find the right combination of water and air in the bottle that just makes it float or sink.

MONTSHIRE AT HOME: **DENSITY**

MONTSHIRE MUSEUM OF SCIENCE

Activity: Liquid Rainbows

Have you ever wondered how liquids can stack on top of each other instead of mixing together? It's because they have different densities and don't mix well together.

See this in action! Create a liquid rainbow. Use density to colorfully layer salt solutions.

Materials

- 2 cups of water
- 1 empty cup (for waste water)
- Test tube (or other clear, skinny container)
- Pipette (substitutes: eye dropper, straw, syringe)
- 1 tablespoon of salt
- Spoon
- Food coloring, 2 colors

Instructions

1. Add salt to one cup of water. Stir and observe. What do you notice happening in the cup?
2. Stir until most of the salt is dissolved. Allow the water to settle until it is almost clear again.
3. Add 2–3 drops of food coloring into the salt water and fresh water cups. How does the food coloring behave in each cup? Why do you think this is happening?

   NOTE: If you and a buddy are each doing your own project, add one color to your cups and a different color to your friend's cups. This will help later on in the experiment.
4. Add a few more drops of food coloring in each cup to darken the color. Stir to mix.
5. If you and a friend made different colored solutions, trade your fresh water with your friend's fresh water. If not, get another cup of water and make it a different color.
6. One at a time, add the 2 colored solutions to the test tube to try and get them to layer (not mix together). Which solution, salty or fresh, do you think should go in first?
7. Use the empty cup as a waste container to dump out your test tube and try again!

What's Going On?

Density is the amount of mass in a given volume. By dissolving salt into one of the water cups, we gave that water a bit more mass and increased its density. If carefully added to the test tube in the correct order, the more dense salt water will layer under the fresh water.

Challenge

After you've tried a few times and have started to fill the waste cup, you now have a third solution. What is the density of this water? Could you use it to make a three-layered rainbow?

MONTSHIRE AT HOME: **DENSITY**

MONTSHIRE MUSEUM OF SCIENCE

Activity: Ice Cubes in Fresh and Salt Water

How quickly will ice melt in fresh and salt water?

Materials

- Two glasses of water (one for fresh water; one for salt water)
- Colored ice cubes

Instructions

1. Make the colored ice cubes ahead of time.

   To make colored ice cubes: Add food coloring to water and pour in an ice cube tray. Freeze the tray to create colored ice cubes.

2. Fill two glasses of water.
3. In one glass, dissolve one spoonful of salt at a time until the salt no longer dissolves.
4. Add one ice cube to each glass and observe. Record your observations below.

Observations

Sketch each glass of water as the ice melts

Fresh Water

Salt Water

MONTSHIRE AT HOME: **DENSITY**

MONTSHIRE MUSEUM OF SCIENCE

Activity: Underwater Fireworks

Set off fireworks underwater! Create cool patterns by making food coloring "erupt" in water.

Materials

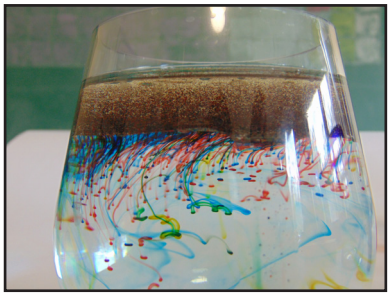
- Clear, tall glass
- Small glass or mug
- Water
- Vegetable oil
- Food coloring
- Fork

Instructions

1. Fill a glass ¾ with water.
2. Add 3–4 tablespoons of oil to the small glass.
3. Add 10–12 drops of food coloring to the oil. Use different colors if you have them.
4. Mix the oil with the fork until the food coloring is broken up into hundreds of small droplets.
5. Pour oil into the water glass and observe








What's Going On?

Food coloring is water-based and the dyes are insoluble in oil. Water is also more dense than oil, so the tiny droplets of food coloring slowly sink through the oil and "pop" into the water releasing the "fireworks."