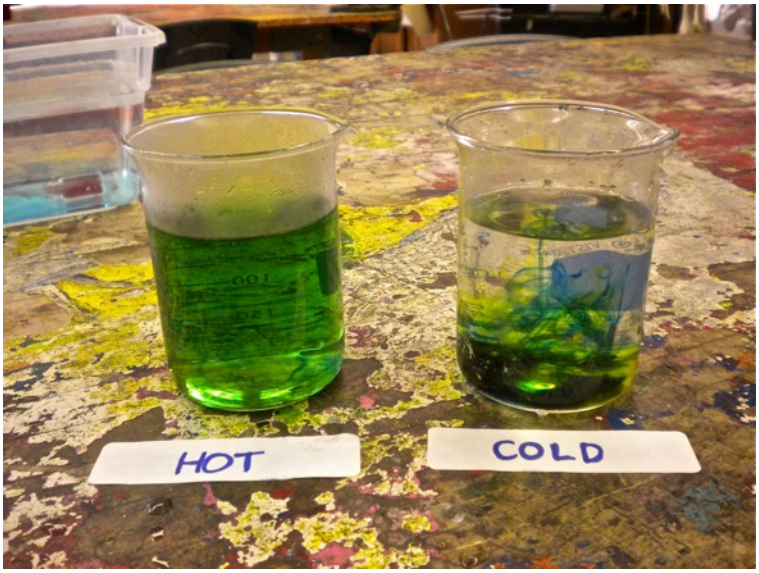
Energetic Water

Category: Physics

Type: Class Experiment (60 min class)



Materials:

1	Bottle of red food dye
1	Bottle of blue food dye
1	Bottle of yellow food dye
	Room temperature water
	Cold water
	Hot water
1	Hot plate
1	Saucepan
1	Large plastic container per group of students
2	Glass beakers per group
1	Small glass bottle per group
1	Ice cube tray with enough cubes for one per group

Video: http://www.youtube.com/watch?v=duYKi279Plk

How To:

Experiment 1: Make blue ice ahead of time: add one drop of blue food dye to each section of the tray and fill with water. Place in the freezer until frozen.

Before starting the experiments, begin boiling water. Place one drop of red food dye in the bottom of a small glass vial. Fill a syringe with hot water and fill the vial.

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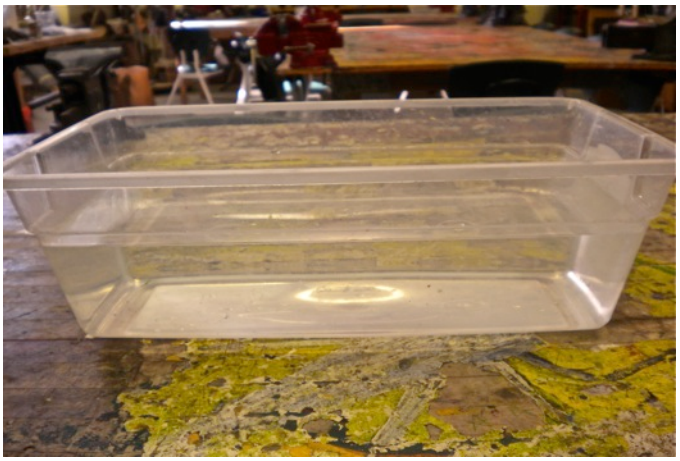
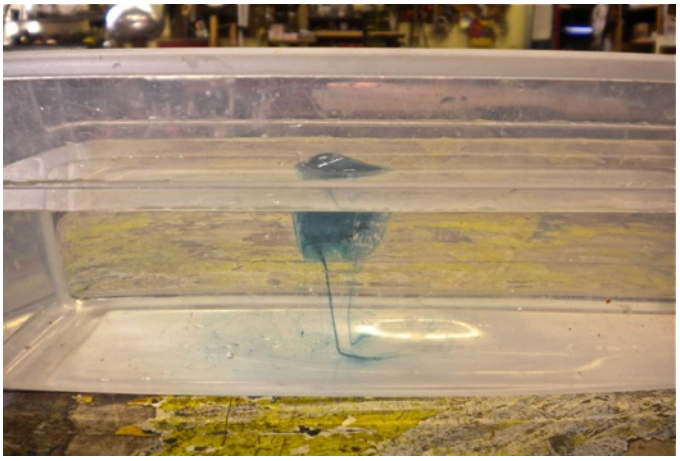
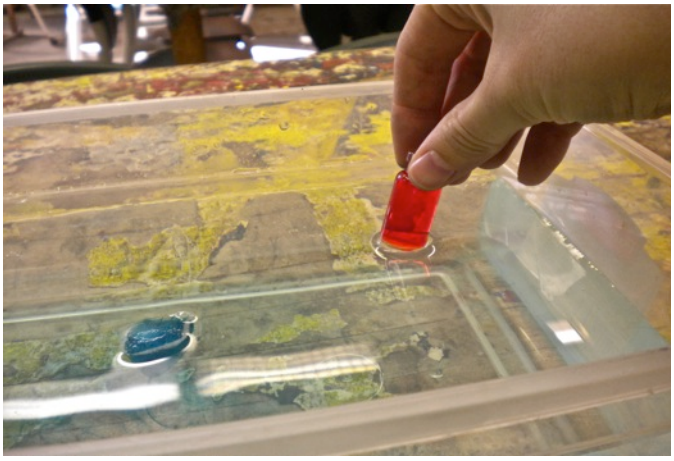


Fill a plastic container with cold tap water approximately ¾ full.

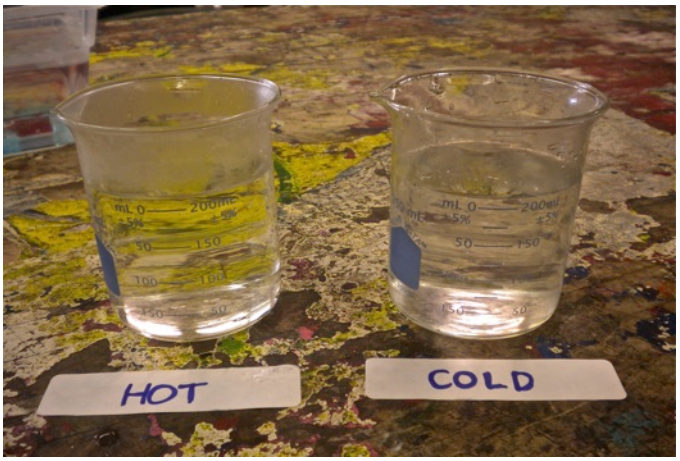
Give a container to each group. Remove an ice cube from the tray and discuss what may happen when it is placed in the water.



Place a blue ice cube into the container of water. Observe what happens.



Predict what will happen to the hot water when the vial is placed in cold water. Place the vial in the water and watch.



Experiment 2: Fill one beaker with hot water and fill the second with cold water (fridge temperature).

Discuss what may happen when you put the dye in the beakers. In which beaker will the dye spread faster?

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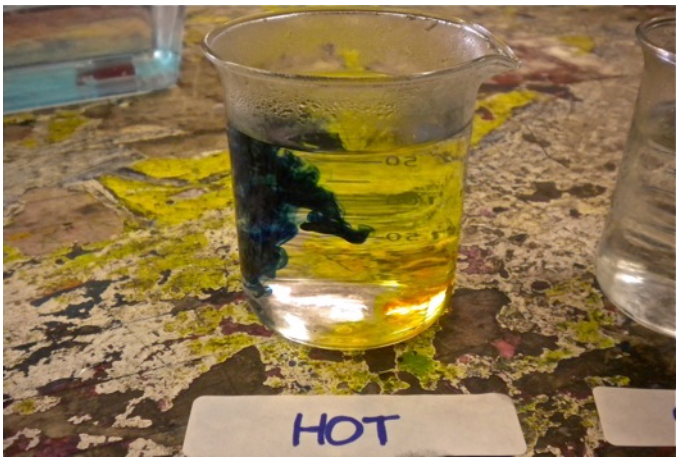

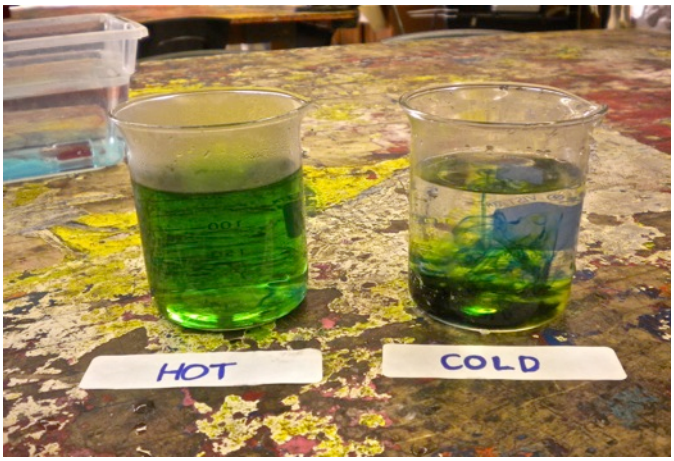

Carefully place a couple of drops of food dye into each beaker and observe what happens.

Discuss what you see and why you think it occurs.

Fine Points:

→ These experiments involve hot water. It is important to warn the class and tell them not to touch the beakers.

→ If you don't have lab beakers you can use normal glasses or even plastic cups if they are made for hot liquids. The water does not have to be boiling, just pretty hot.

→ During the second experiment the beakers should not be touched or moved; it is an exercise in observation.

Objectives:

During this experiment, students will:

1. Observe that temperature affects liquids rising and falling.
2. Learn that this is related to their density.
3. Observe molecular motion within liquids and the effect of temperature change on that motion.

Concepts Involved:

- Hot water is less dense and will float to the top of room-temperature water.
- Cold water is denser and will sink to the bottom of room-temperature water.
- Heating water increases the speed of the molecules.
- Cooling water decreases the speed of the molecules.

Focus Questions:

1. How do you think colored water will move when you put it in clear water?
2. Do you think the temperature of the colored water or the clear water will have an impact on how the color moves?
3. What do you think happens to the molecules (tiny pieces) of water when you heat them?

Elaboration:

Density is a quantity that describes how much mass is in a certain volume of a material. If you have two materials that are exactly the same size, the heavier one has a greater density. If you have two materials that are the same mass, the smaller one has the greater density. It works the same way with liquids and gases.

Experiment 1: Temperature affects density. When water is heated it expands and becomes less dense. Any object or substance that is less dense than a fluid will float in that fluid, so hot water rises in room-

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temperature water. When water is cooled, it contracts and becomes denser. Any object or substance that is more dense than a fluid will sink in that fluid, so cold water sinks in the water.

Experiment 2: A molecule is a tiny piece of anything, or the smallest possible amount of a substance that can still be identified as that substance. We can't see these molecules unless we use microscopes but in our simple experiments we can show that molecules move at different speeds depending on temperature. Even though we may think they are standing still, molecules are always moving. The moving water molecules in the cup push the drops of food coloring around. The molecules in hot water move faster so the food coloring spreads through the water more quickly than it does through the slower-moving molecules of the cold water. This mixing of liquids or gases in the absence of any external forces is called *diffusion*.

Links to k-12 CA Content Standards:

Grades k-8 Standard Set Investigation and Experimentation:
Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

Grades k-12 Mathematical Reasoning:
1.0 Students make decisions about how to approach problems:
1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.
1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:
1.1 Use estimation to verify the reasonableness of calculated results.
1.2 Apply strategies and results from simpler problems to more complex problems.
1.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.
2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:
3.1 Evaluate the reasonableness of the solution in the context of the original situation.
3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
3.3 Develop generalizations of the results obtained and apply them in other circumstances.

Kindergarten Standard Set 1. Physical Sciences
Properties of materials can be observed, measured, and predicted. As a basis for understanding this concept:
1.b. Students know water can be a liquid or a solid and can be made to change back and forth from one \ form to the other.

Grade 1 Standard Set 1. Physical Sciences
Materials come in different forms (states), including solids, liquids, and gases. As a basis for understanding this concept:
1.a. Students know solids, liquids, and gases have different properties.
1.b. Students know the properties of substances can change when the substances are mixed, cooled, or

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heated.

Grade 3 Standard Set 1. Physical Sciences

Energy and matter have multiple forms and can be changed from one form to another. As a basis for understanding this concept:

1.b. Students know sources of stored energy take many forms, such as food, fuel, and batteries.

1.c. Students know machines and living things convert stored energy to motion and heat.

1.d. Students know energy can be carried from one place to another by waves, such as water waves and sound waves, by electric current, and by moving objects.

1.e. Students know matter has three forms: solid, liquid, and gas.

1.f. Students know evaporation and melting are changes that occur when the objects are heated.

1.h. Students know all matter is made of small particles called atoms, too small to see with the naked eye.

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