Activity Title: The Hot And Cold Of It: Thermal Energy Experiments

Recommended Grades

Grade 1, Grade 2, Grade 3, Grade 4, Grade 5

Curriculum Connections:

Matter
- 3 – matter can change state, temperature and liquid
- 5 – movement of particles in liquid, density of liquid

Energy
- K – how can objects move (link to why the water moves)
- 1 – how objects move (link to why the water moves), how movement can be influenced
- 5 – geothermal energy

Earth Systems
- K – changes in environment related to temperature

Scientific Methods
- 1 – carry out an investigation, data recorded
- 2 – methods and processes used in investigation, data collection
- 3 – data can be used to analyze
- 4 – how can evidence advance knowledge in science, data types
- 5 – observe phenomenon, variables

Time

10-20 minutes

Skills Focused On

• Critical Thinking	• Teamwork	• Observation

Materials Needed

Experiment 1: Water and Density	Experiment 2: Water Tower
• Clear large container • Ice cubes (dyed blue) – you will need to do this the night before • Food colouring (a different colour than blue) • Hot water • Little container • Room temperature water	• Two of the same glass jars • Plastic sheet • Tray • Stir sticks • Two colours of food colouring

Background Information

Everything around us has energy and it comes in many forms. Thermal energy is the energy associated with an object that we measure by taking its temperature. An object's thermal energy can change its properties, like phase and density. For example, water - when it is hot, has higher thermal energy, it is a gas; when it is cold, has lower thermal energy, it is a solid - the phase has changed.

Density refers to the number of molecules in a given amount of space. When water is hot, there are fewer molecules in a given area, there is more space between them; when water is cold, the molecules are closer together. You might think weight and density are the same thing. However weight is the measure of how heavy something is in total. Density is the mass in relation to its size.

Explore thermal energy with these colourful water experiments.

Experimental Steps

Experiment 1: Water and Density

1. Make blue ice cubes
2. Fill the large container with room temperature water
3. Fill the small container with food colouring and hot water
4. Gently lay a few ice cubes to one side of the container
5. Gently pour the hot water to the other side of the container
6. Give it a few moments and observe what happens

Experiment 2: Water Tower

1. Fill one jar with cold water and one jar with hot water to the brim
2. Put different colours of food dye in each jar and mix carefully
3. Place the jars in the tray
4. Place the plastic sheet on top of the cold jar of water so it forms a vacuum
5. Flip the cold jar on top of the hot jar and line up the edges
6. Carefully remove the plastic sheet and observe
7. Repeat, but place the hot jar on top of the cold jar

Discussion/Experimental Extensions

Why did you observe what you did?

Experiment 1: Water and Density

The hot water is less dense and floats to the top, whereas the cold water sinks to the bottom. You may have experienced this in real life in a lake.

Experiment 2: Water Tower

Since it is denser, when the cold water is on top, it sinks right through the molecules of the hot water beneath it, causing them to mix. The denser material weighs more so it sinks to the

bottom. This movement of heat energy is called convection which is the transfer of heat energy by the movement of a fluid between areas of different temperatures. For example, when we boil water, the heat moves from the burner up into the water. The heat is always transferred from the hotter material to the colder. On the other hand, when the hot water is on top, there is no mixing or movement because the denser, cold water is already on the bottom.

Additional Resources

The Hot And Cold Of It experimental video produced by Future Energy Systems - provides background information and instructions for experiment: https://youtu.be/9YhR1kAzWVE. To relate thermal energy to renewable energy (specifically geothermal energy), Michael Nicol-Seto, Masters student in the Department of Mechanical Engineering, shares his research on Stirling Engines in the above video.

Learn more about Future Energy Systems (https://www.futureenergysystems.ca/) and access more learning content, including storytimes, lab tours, ask an experts and more (https://www.futureenergysystems.ca/engage/learning https://www.youtube.com/channel/UCJr8N9KyFJ6d-t36TPtUlwg).