**Matter**

**Lesson #8:** **Water – Changing States (Part 2)**

**Time Frame:** 45-60 minutes

**Learning Standards:**

*Science*

Physical Science: States of Matter

1. Compare and contrast solids, liquids, and gases based on the basic properties of each of these states of matter.
2. Describe how water can be changed from one state to another by adding or taking away heat.

Skills of Inquiry

1. Ask questions and make predictions that can be tested.
2. Keep accurate records while conducting simple investigations or experiments.
3. Recognize simple patterns in data and use data to create a reasonable explanation for the results of an investigation or experiment.
4. Record data and communicate findings to others using graphs, charts, maps, models, and oral and written reports.

**Student will be able to:**

1. Observe and explain how adding or taking away heat makes water change between the solid, liquid, and gas state.

**Resources and Materials:**

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| **Item** | **Amount** |
| Science notebooks  |  |
| “Water Changing States” overhead | 1 (in binder) |
| “Water Changing States” student handouts | 30 (in bin) |
| Large glass bottle with lid | 1 (in bin) |
| Plastic bowls | 2 (in bin) |
| Balloons | 1 bag (in bin) |
| Food coloring | 5 boxes (in bin) |
| Beakers | 30 (in bin) |
| Baby food jars | 2 (in bin) |
| 5 x 8 index cards | 2 (in bin) |

**Focus Activity:** Ask the students to answer the following question in their science notebooks.  How is temperature related to water changing states? Discuss the student ideas as a class.  Tell students that higher temperatures mean faster moving molecules.  What does that say about the speed of water molecules in its different states?

**Introduction:** Tell students that gases have the most energy (gas molecules move the fastest and take up the most volume) and solids have the least energy (solid molecules move the slowest and usually take up the least volume) and that liquids are in between.  Tell students that when changing between states of matter, energy is released into the environment if the molecules in the second state of matter move less than the molecules in the first state of matter.  If the molecules move more in the second state, then energy is absorbed from the environment.  Make a drawing of an ice cube and a water droplet on the board and draw an arrow from the ice cube to water droplet.  Ask students what this process is called (melting) and if this process absorbs or releases energy.  Do the same with freezing (liquid water to ice), evaporating (liquid water to gas), and condensing (gas to liquid water). Discuss the idea of energy each time.

**Activity:**

1. Pass out the “Water Changing States” handout and show the colored overhead to the class.  Review the way that water changes and how heat is involved.  Discuss the arrows in the diagram and what they represent.  Discuss the boiling of water and how this represents a large amount of heat from the environment being absorbed to make water evaporate more quickly than it would at room temperature.
2. Investigate the water experiments from the last week of class and discuss and review the results as necessary.  What happens to water when it freezes?  Do most liquids expand when they freeze (become solid)?  Review the idea that water molecules form special bonds when they get cold that hold them together but also hold them slightly apart.  This is why water has more volume as a solid than as a liquid.  Why is there less water in the straw left in the room?  Where did the water molecules go?  Relate these questions to evaporation.
3. Tell the students that they will investigate how heat energy affects molecules.  What happens to molecules when they are heated or cooled?
	1. Start with a demonstration with a large glass bottle and a balloon. Fill one plastic bowl with water and ice cubes.  Fill the other plastic bowl with very hot water.  Attach the balloon over the mouth of the glass bottle.  Ask students for predictions about what will happen to the balloon when the bottle is placed in the hot and cold water. Place the bottle in the hot water and observe and discuss the results.  Place the bottle in the cold water and observe and discuss the results.  (Students may make drawings of the results in their science notebooks.)  Discuss this experiment as it relates to gas molecules and heat energy.  Ask the students questions about their observations.
	2. Break the students up into small groups.  Give each group a beaker with ice water, a beaker with room temperature water, and a beaker with hot water (labeled).  Tell them that they will add a drop of food coloring to each beaker and ask them to make predictions about what will happen.  Students may make drawings of their predictions in their science notebooks.  Let students conduct the experiment and record their results through drawings and descriptions in their science notebooks.  What happened to the food coloring in the cold water?  In the room temperature water?  In the hot water?  What does this tell you about the movement of water molecules at different temperatures?  Which beaker had the most evaporation occurring?  Why?   Relate this experiment to water changing states and ask students to write their final conclusions in their science notebooks.
	3. Conduct a final demonstration in front of the class.  Get out two baby food jars.  Fill one of the jars completely with hot water and add a drop of food coloring.  Fill the other jar completely with cold water and add a drop of different colored food coloring.  Place a piece of an index card (cut to slightly larger than the opening of the jar) on top of the jar with the hot water and tap it into place.  (It should stay in place when you invert the jar, if not, use your hand to hold it in place.)  Quickly, invert the jar and set it on top of the jar with the cold water.  Line up the lips of both jars and gently slide out the piece of index card.  (Note: The hot water will stay on top and the cold water will stay on bottom, they will not mix.)  Discuss the results of this experiment with the class.  If time permits, conduct the experiment again with the hot water on the bottom and the cold water on the top and discuss the results.
4. Relate the ideas of heat and water changing state to real-world examples. Put the “Water Changing States” overhead back on the board.  Discuss sweating with the class.  How does sweat help humans cool off? (Evaporating water absorbs heat from our bodies).  What happens to a drink with ice in it?  Why does the drink get warmer as the ice melts? (Water as a solid (ice) releases heat as it turns into a liquid).  If your coat (or scarf) is covering your mouth, why does it get wet?  (Water vapor (gas) in your breath condenses to liquid water because body temperature is warmer than air temperature and water vapor loses heat energy.) Move on to the closure questions relating water and weather.

**Closure:** Discuss the following questions with the class:  What makes water change from one state to another?  How is water the same and how is water different when it is in the three states?

**Assessment:** Science notebook responses, predictions, results and conclusions from the experiments in class, participation in class discussions

