Review and apply
Investigation 6

Let's review
Pages 376-377

1. **Think back to the movement of the color in hot and cold water. Does adding heat energy make water molecules move faster, slower, or have no effect?**
   Heat energy makes water molecules and molecules of color move faster.

2. **What did you observe in the demonstration with food coloring in hot and cold water that supports your answer?**
   The molecules of color spread throughout the water quicker in the hot water. In the cold water, the molecules of color stayed toward the surface longer, and took longer to spread throughout the cup.

3. **The speed of molecules can help explain why the bubble film grew and shrunk when you heated and cooled the air inside a bottle. Describe the movement of air molecules inside the bottle…**
   When you placed it in warm water.
   The molecules in air speed up when heated. These faster moving molecules push against the bubble film, forming a bubble.
   When you placed the bottle in cold water.
   The molecules in the air slow down when cooled. When the molecules slow down, they don't push as hard on the bubble film so the bubble shrinks.

4. **You did an evaporation experiment with a drop of water on two pieces of paper towel. You heated one paper towel and kept the other at room temperature. Why did you use two paper towels and not just one?**
   The paper towel at room temperature served as the control. The paper towel that was heated served as the variable in the experiment. If you only heated one and saw what happened, you would have nothing to compare it to to see the effect of the heat.

5. **If you breathe on a window when it's cold outside, you will make the window look cloudy. Based on your experiments, explain why this happens.**
   In *Activity 6.3—Condensation*, students noticed that when water vapor cooled, it changed to visible liquid water on the inside surface of a cooler cup. This is what happens when you breathe on a window on a cold day. Your warm breath contains heated invisible water vapor that condenses into visible liquid water on the cooler surface of the glass window.

6. **When you take a container of ice cream out of the freezer, you often see frost form on the outside of the container. What causes this frost to form?**
   Frost forms on the outside of an ice cream container because water vapor in the air condenses into liquid water on the outside of the container. Because the container is so cold, the liquid water freezes on the outside of the container, causing frost.

Science in action!

Page 378

1. **Does the water on the inside surface of the top cup look colorless or does it seem to have any of the color from the colored water?**
   The water might look colored because of reflection from the colored water below but if students check it with a white paper towel or napkin, it is actually colorless.

2. **Imagine that you were stranded on an island surrounded by saltwater. Use your imagination to describe one way that you could distill saltwater to make water that you could drink.**
   Answers will vary. Students might design a distillation system similar to the colored water containers that allows for water to evaporate from the bottom container to the top. The bottom cup will eventually contain salt, and the top cup will contain pure water. Students should then have some container that collects this distilled water before it drops back into the bottom cup and remixes with the salt.

Think about it

Pages 381-382

1. **Water molecules evaporate from a puddle after a rain storm. In this sentence, what does the word *evaporate* mean?**
   a. Water molecules in the puddle are in the liquid state, and the molecules are not moving.
   b. Liquid water molecules move fast enough to turn into a gas called water vapor.
   c. Liquid water molecules slow down and form a solid on the ground called ice.
   d. Liquid water molecules stay the same speed, neither moving to the air nor staying on the ground.

2. **Solid water crystals can form…**
   a. sleet.
   b. hail.
   c. snow.
   d. all of the above.

3. **Condensation happens faster if water vapor is…**
   a. heated.
   b. cooled.
   c. evaporated.
   d. in the solid state.

4. **Clouds are made by the process of…**
   a. condensation of water vapor in the air.
   b. cooling ocean water.
   c. mist evaporating from the ground to form a gas.
   d. fog and dew found on the ground forming a liquid.

5. **The author probably wrote this article in order to…**
   a. tell about the weather patterns over a period of time.
   b. describe how the clouds are made.
   c. persuade people to watch the weather channel.
   d. explain how the water cycle affects weather.

6. **Evaporation happens faster if water is…**
   a. cooled.
   b. vapor.
   c. heated.
   d. condensed.

7. **The water cycle is a very important process for life on Earth. Why is it called a "cycle"?**
   Water evaporates from the ground, condenses in the atmosphere, and falls back to the ground where it evaporates again. This process continues over and over which is why it is called a cycle.

8. **In addition to temperature, what else has an effect on how fast a puddle of water evaporates?**
   In addition to temperature, how much moisture that is already in the air affects how fast a puddle of water will evaporate. If the air is humid, the puddle will not evaporate as quickly as it does when the air is dry.

9. **Your breath contains water vapor. Why can you sometimes see your breath when it's cold outside?**
   Your breath contains water vapor and is exhaled at your warm body temperature. When this water vapor hits the cold air outside, the water molecules slow down and join together. This makes tiny droplets of liquid water or "fog" that you can see.

10. **When some people see dew on the ground, they might think that it rained. But dew and rain are different. How does dew form?**
    Rain, which comes from the clouds, is different from dew. Dew comes from water vapor in the air which cools and condenses to form drops of liquid water on cool surfaces.

What's going on here?

Page 384

1. **If heat energy is added to a solid like ice, it will begin to melt. What happens to the water molecules in an ice cube as it melts to become liquid water?**
   Water molecules in ice, like in all solids, are vibrating in fixed positions. When heat is added, these vibrations increase. This added movement of the water molecules competes with the attractions the molecules feel for each other. When the molecules move fast enough, they overcome the attractions, the molecules begin to slide past one another and the ice melts.

2. **If heat energy is added to a liquid like water, it will begin to evaporate. What happens to the water molecules in a drop of liquid water as it evaporates to become the gas water vapor?**
   In a drop of liquid water, the molecules are vibrating and moving past each other. As heat energy is added, the motion of the water molecules increases. If they move fast enough, their motion will overcome the attractions they have for other water molecules, and they will go into the air as a gas called water vapor.

3. **If a gas like water vapor is cooled enough, it will begin to condense. What happens to the water molecules in water vapor as they condense to become tiny drops of liquid water?**
   When water vapor cools, the molecules in the gas slow down and lose energy. If enough energy is lost, their attraction for each other will overcome their motion. This attraction causes the gas molecules to join together and become liquid water in a process called condensation.

4. **If liquid water is cooled enough, it will begin to freeze. What happens to the water molecules in water as they freeze to become ice?**
   When heat energy is removed from liquid water, the water molecules begin to slow down. The attractions between the water molecules overcome their motion and cause them to arrange themselves in more fixed and orderly patterns into a solid.