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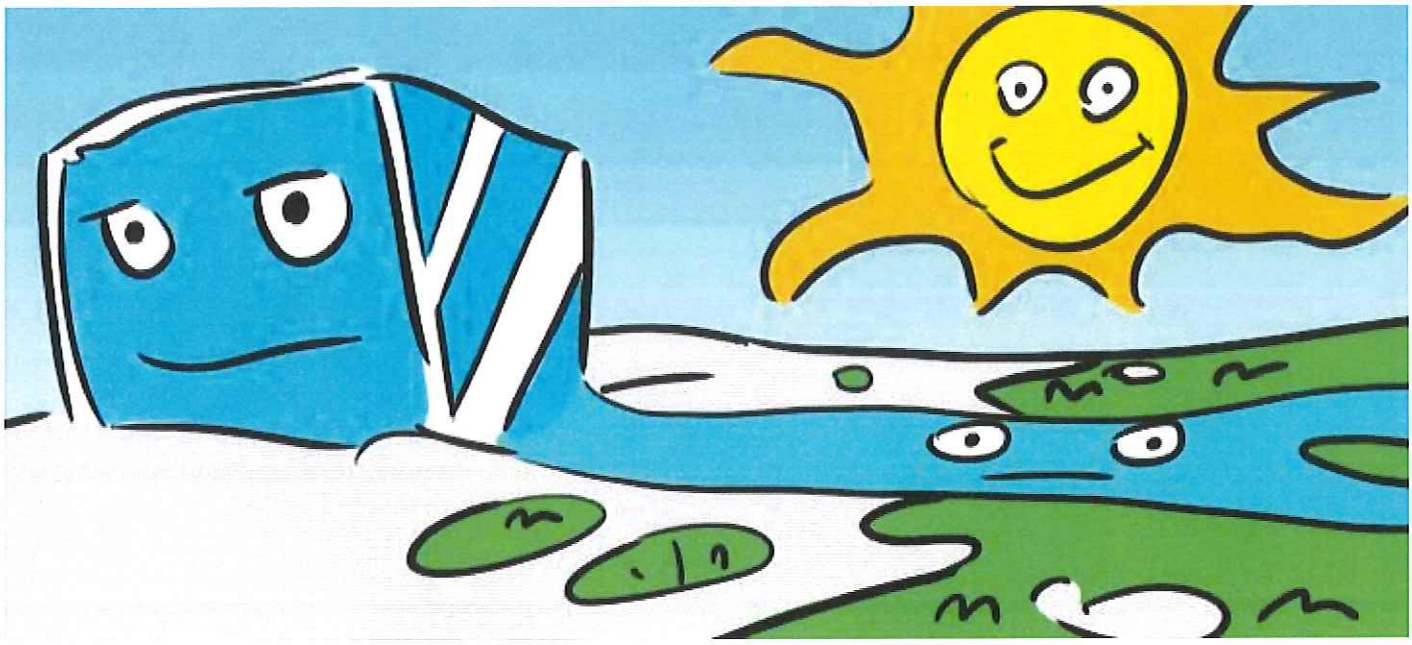

Matter Changes

During a soccer game on a sweltering hot day, you reach for a cup of water with ice cubes in it. If you leave your cup out in the sunlight during the game, the heat will melt the ice and transform it into water. When you get home from your game, you discover a pot on the stove with curls of steam drifting up from it. Water, ice, steam. These are all water, but why do they appear so different?

Water freezes when it's cold outside. With less heat, the water molecules don't have as much energy and don't bounce around as much. They stop moving around each other and lock together to create ice. They remain packed together tightly, like a group of penguins bunched up together to keep warm in Antarctica. They hardly move. Once the water is frozen, it maintains the same shape and occupies the same amount of space -- until it melts, of course. Ice is a **solid**, meaning it always maintains the same shape and occupies the same amount of space.

When sunlight beats down on your water bottle, it adds energy in the form of light. This light heats the water and causes the water molecules to move faster and eventually to move away from each other. Think of it this way: have you ever tried running while clutching your friends' hands? Once you get moving quickly, it's hard to hang on to each other. That's what occurs with the water. The molecules can't stick together once things heat up. They move over, under and all around each other. Over time, the ice begins to lose its shape and turns into water. Water is a **liquid**, which means it always occupies the same amount of space but doesn't keep a fixed shape. Liquids can squish around and take up the shape of whatever is holding them – like your water bottle.

If you left your water bottle outside with the cap off and returned a few days later, some or most of your water would have disappeared. What happened? As time passes, the sun adds a lot of heat and energy to the water. The water molecules pick up speed, moving faster and faster, spreading out even more than they did when they transformed into water. Some of the water moves so much that it escapes the water bottle completely and moves around in the open air. This is how water turns into a **gas**, meaning it

doesn't have a set shape and doesn't take up a fixed amount of space. A group of molecules in a gas will take up as much room as you allow them, whether it's a water bottle or the entire sky.

Have you ever seen a white mist rising up from the ground on Halloween? Or maybe you have noticed something like that in a play or in a movie. It is carbon dioxide gas, which is often called "dry ice." Dry ice is different than regular ice. It changes directly from a solid to a gas at -109.3 degrees Fahrenheit. It does not become water-like in between.

Dry ice isn't just for making special effects. Dry ice often is used to keep things cold. It is used in medicine to keep things cool and keep germs away. People also use it to keep food fresh. You might even see dry ice on Mars. Some people think the worm-like grooves seen there were caused by dry ice pieces slipping down sand dunes.

What if you kept adding heat to water after it was already a gas? The heat energy would cause the molecules move around so much they would finally separate into tiny pieces. Imagine shaking a toy until its pieces started flying off. Maybe the wheel of a toy car came off and kept on moving. That would require immense amounts of energy. **Plasma** is formed when a gas has so much energy that the molecules separate into smaller pieces and keep on moving. Sometimes things in this state go so crazy that they even let off light, like the fluorescent lights in your classroom.

Things can come in different forms, depending on how hot it is. When you add heat to something, you add energy. Then things move more, and move apart. Even though ice appears strong and hard, the molecules vibrate just a little bit. Over time, the sun's heat changes the ice to water and even gas. And when things are super hot, stuff can turn into plasma, which is what our sun is made of in the first place.

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