Introduction:

Our teacher requested that we do a unit on the phases of matter focusing on water, because her class had recently studied the water cycle. We began the module by briefly reviewing the water cycle, using a poster that looked a lot like this:

Next, we introduced the concept of solids, liquids, and gases. We made a poster that listed some key properties of each phase of matter, and went over the poster with the kids.

**Solids:**
- Have their own shape
- Have a constant volume

**Liquids:**
- Don’t have their own shape
- Have constant volume

**Gases:**
- Don’t have their own shape
- Don’t have constant volume

First, we explained that all matter (all the stuff in the universe) is made up of really tiny particles called atoms or molecules. Sometimes these molecules are moving really fast, and sometimes they’re moving very slowly. Matter can be in different phases depending on how fast the molecules are moving.

In solids, the molecules are packed really close together, and aren’t moving very fast. We brought in a rock to use as an example of a solid, and talked about how it had its own shape, and pretty much always would take up the same amount of space (it’s hard to compress solids to make them smaller, or stretch them out to
make them bigger). It would probably be a good idea to ask the kids to name other examples of solids, although we didn’t.

In liquids, the molecules are moving a little faster and can slide past each other. We used some water (with blue food coloring in it, to make it easier for the kids to see) as an example of a liquid. We talked about how it doesn’t have its own shape, like the rock—instead, it takes the shape of whatever container you put it in (we tested this out by pouring the water into variously shaped containers). We also measured the volume of the water before and after pouring it into a different container to show that even though the shape a liquid takes can change, it always takes up the same amount of space (has the same volume). It would probably be a good idea to ask the kids to name other examples of liquids.

In gases, the molecules are moving really fast and are really far apart. Gases take the shape of whatever container you put them in, like liquids. But unlike liquids, their volume can change! If you compress them so they fit in smaller containers, and if you put a gas into a really big container it will expand to fill the whole container. We talked about the air in the classroom as an example of a gas. You could ask the students to name other examples of gases as well.

**Molecules Game:**

Next, we played a game to help the kids learn how molecules move in solids, liquids, and gases by having them pretend to be molecules. First we asked them to be molecules in a solid, by clumping together and jiggling a little bit, but not moving their feet at all. Next, they were liquid molecules, and could move around the room a little bit. Lastly, they pretended to be gas molecules by walking really fast around the room.

**Phase Changes Experiment:**

We broke the kids up into four groups of five kids, and each of us supervised one group. We explained that matter can change from one phase to another depending on its temperature, because as matter gets hotter the molecules start moving faster, and as matter cools down the molecules move more slowly.

We then used hot water, ice, and some plastic cups to demonstrate evaporation (hot water turning into steam and evaporating into the air), condensation (either by holding another plastic cup over the one containing hot water and observing the droplets of water that formed on the second cup, or by observing that drops of water had formed on the outside of the cup containing the ice), and melting (the ice heating up as it sat at room temperature during the experiment). We also talked about freezing as the opposite of melting, although we didn’t demonstrate it. I asked my group of kids to imagine what happens when you make ice cubes in your freezer—you put liquid into the freezer and it comes out as a solid.

Before demonstrating each phase change, we asked the kids to form a hypothesis about what they expected to happen. For example, before demonstrating evaporation, we asked the students what phase they thought a liquid would change into when it was heated up. Based on the fact that heating something up makes the
molecules move faster, and that molecules in a gas move faster than those in a liquid, the kids were eventually able to guess correctly.

**Sublimation with Dry Ice:**
We asked the kids if they thought that a solid could ever turn straight into a gas, without passing through the liquid phase. Most of them said no. We explained that although it’s very unusual, some types of matter do just that, and that this phenomenon is called “sublimation.” We brought out some dry ice and poured water on it to demonstrate. The kids were pretty fascinated—it was a fun way to end the module!

We did not end up explaining that deposition is the opposite of sublimation, but if you wanted to, this would be the time to do it!