



# May Dose of Discovery: Week 1

## Kitchen Science: States of Matter



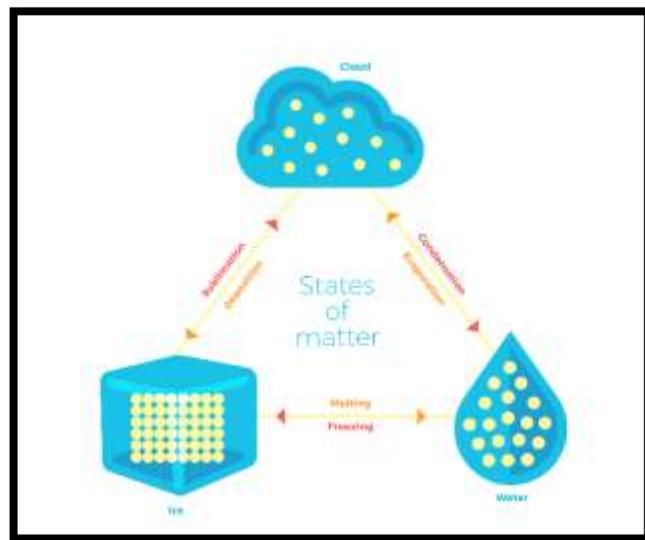
### Learning Points:

- Children will be able to have fun and experiment with different states of matter.
- Children will be able to experience the differences between solids, liquids, and gases and observe the changes that happen when matter changes states.
- Children will be able to change the states of matter using two different factors: Temperature and Pressure.
- These activities can be done all in one afternoon or broken up in the week or weekend, as desired.

### Background Information:

“Atoms and molecules are the particles that make up matter. A substance’s state of matter — solid, liquid, gas, or plasma — depends on how its molecules move and maintain their volume and shape. Particles are in constant motion, but they interact differently depending on the state of matter.

- Solid – particles stay in contact with each other, vibrating in place but not moving relative to each other, maintaining the solid’s shape and volume.
- Liquid – particles stay in contact, but they are able to move relative to each other. Liquids change shape based on their container, but maintain their volume.
- Gas – particles do not stay in contact, although they can collide. They move quickly relative to each other. Gases expand or contract to fill the available space, meaning they don’t maintain their shape or volume.



A substance’s state of matter is an extrinsic property, meaning it can be changed by its environment. Physical conditions like temperature and pressure affect state of matter. Both temperature and pressure can be measured, and state changes can be observed. When thermal energy is added to a substance, its temperature increases, which can change its state from solid to liquid (melting), liquid to gas (vaporization), or solid to gas (sublimation). When energy is removed, the opposite happens, decreasing the substance’s temperature and turning it from liquid to solid (freezing), gas to solid (deposition), or from gas to liquid (condensation). When the pressure exerted on a substance increases, it can cause the substance to condense. Decreasing pressure can cause it to vaporize.”

-Legends of Learning

## Materials:

- Solid to a Liquid
  - 3 ice cubes; 1 plate; pinch of sugar, salt, and pepper; 1 plastic container; 1 big tray; water; salt; 3 different colors of food coloring or ink
  - 1 large ice cube; about 8 inches of strong nylon thread; 2 pencils; 1 large plastic box
- Liquid to a Gas
  - 2-liter clear, plastic soda bottle; 1 balloon; 1 watch
- Gas to a Liquid
  - 2-liter clear, plastic pop bottle from last experiment (washed); several matches; warm water
- Liquid to a Solid
  - ½ cup whipped cream; ½ lb cut up strawberries (or any ice cream ingredient); 2 drops vanilla extract; ½ tablespoon lemon juice; 2 tablespoons powdered sugar; 1 bowl; 4 smaller bowls
  - 1 jar with lid; small carton of whipping cream; 1 spoon or butter knife; 1 cup milk; 1 small saucepan; 2 tablespoons vinegar; large spoon; fine sieve; parchment paper; cookie cutters (optional)

## Activities:

### *Changing Water from a Solid to a Liquid with Temperature: Melting Race!*

**Step 1:** Fill a plastic container with water and leave it in the freezer overnight.

**Step 2:** Place three ice cubes on a plate. Sprinkle one with sugar; one with salt; and one with pepper.

*Which melts the fastest?*

*The temperature at which ice changes to water is called its melting point. Adding things to ice can lower the melting point. Salt lowers it the most, so the salty ice cube should melt the fastest. Pepper lowers it the least, so the peppery cube should melt the slowest.*

*Salt lowers the melting point. The ice that the salt touches melts faster than the rest of the ice creating cracks and rivulets. The ink flows into the gaps and helps you see what's happening!*



**Step 3:** Take out the plastic container that is in the freezer and tip it out on to the big tray and sprinkle a thin layer of salt over the top.

*Hint: You may have to wait for the ice to melt a little to get it out of the box.*

Add some drops of the different food coloring or ink on the top.

*What happens to the food coloring/ink?*

## Changing Water from a Solid to a Liquid with Pressure: Cutting Ice!

**Step 1:** Take the piece of strong nylon thread and tie it around the middle of two pencils, like this.....

Put an ice cube on the large plastic box and place the middle of the thread on top. Push down on the pencils, so the thread presses firmly on the ice.



*The pressure of the thread lowers the melting point. This helps the ice melt, allowing the thread to slip down into the ice. The water above the thread is still cold enough to refreeze, so the ice cube remains in one piece.*

**Step 2:** Watch the thread as you press down. It should move gradually down through the ice.

*See if you can cut the ice cube in two!*

## Changing from a Liquid to a Gas with Pressure: Soda in a Balloon!

**Step 1:** Open a bottle of soda and set it on a table. Immediately slip the end of a balloon over the neck of the bottle. Pull the balloon's end well down over the bottle so that it fits tightly.

**Step 2:** Check on the balloon about every 10 minutes for any changes.

*Soda is carbonated, which means that carbon dioxide gas has been dissolved in the liquid under high pressure. Opening the bottle releases that pressure and the carbon dioxide gas begins to escape from the liquid. The balloon traps the gas as it left the bottle and inflates the balloon.*

## Changing Water from a Gas to a Liquid with Pressure: Cloud in a Bottle!

**Step 1:** Dump out, clean, and fill the plastic 2-liter bottle from the last experiment 1/3 full of warm water and place the cap on. As warm water evaporates, it adds water vapor to the air inside the bottle. This is the first ingredient to make a cloud.

**Step 2:** Squeeze and release the bottle and observe what happens. You'll notice that nothing happens. *Why?* The squeeze and release is like the warming and cooling that occurs in the atmosphere. *Hint: If the bottle becomes covered with water droplets, just shake the bottle to get rid of them.*

**Step 3:** Take the cap off the bottle. Carefully light a match (with adult supervision) and hold the match near the opening. Then drop the match in the bottle and quickly put on the cap, trapping the smoke inside. Dust, smoke or other particles in the air is the second ingredient to make a cloud.

*Water vapor, water in its invisible gaseous state, can be made to condense into the form of small cloud droplets. By adding particles such as the smoke enhances the process of water condensation and by squeezing the bottle causes the air pressure to drop. This creates a cloud!*

**Step 4:** Once again, slowly squeeze the bottle hard and release. What happens? A cloud appears when you release and disappears when you squeeze. The third ingredient in clouds is a drop in air pressure.

1<sup>st</sup> Activity adapted from *How Stuff Works*:  
<https://lifestyle.howstuffworks.com/crafts/science-projects/science-projects-for-kids-states-of-matter4.htm>

And 2<sup>nd</sup> Activity adapted from *Weather Wiz Kids*: <https://www.weatherwizkids.com/experiments-cloud.htm>



## ***Changing from a Liquid to a Solid with Temperature: Frozen Strawberry Cream!***

**Step 1:** Mix all the ingredients from the materials list in a large bowl and then pour the mixture into 4 smaller bowls that can go into the freezer

**Step 2:** Place the bowls in the freezer. Stir the mixture after two hours, then leave it in the freezer until it is frozen.

*You can eat the results!*

*Freezing the cream mixture makes it solid. Stirring it while it freezes breaks it up and make it less hard, so you end up with ice cream!*

## ***Changing from a Liquid to a Solid with Pressure: Making Butter and Plastic from Milk!***

**Step 1:** Fill a jar half way full with whipping cream and put the lid on tight. Shake the jar vigorously for about 10-15 minutes until you see a yellow blob of butter floating in some liquid.

*Hint: Share the labor amongst siblings and do this as a family so that no one tires out too much!*

**Step 2:** Remove the butter from the jar. You can spread it on some bread and eat it if you want to!

**Step 3:** Pour the cup of milk into the small saucepan. Gently warm the milk until it's hot but don't let it boil! Turn off the heat and add the 2 tablespoons of vinegar and stir the milk until lumps form.

*Cream contains a lot of fat. When you shake cream (apply some pressure), the fat starts to clump together to form butter; which is solid. The liquid left behind – called buttermilk – has very little fat in it. See if you can find a recipe that you can make with the buttermilk!*

*Milk contains a kind of protein called casein. When you add vinegar to hot milk, the casein clumps together into rubbery lumps that harden as they dry (evaporation). Casein can also be turned into hard plastic to make buttons!*

**Step 4:** Pour the milk into a fine sieve over the sink. Collect the lumps and press them into different shapes. Leave them to dry on some newspaper for two days.

*Hint: You can press the lumps into cookie cutters to make different shapes!*

**Do not eat this result!**

# MUSEUM *of* IDAHO