



## States of Matter – Grades K-2

*Nebraska Science Standards*

*2.2.1 Students will observe and describe properties of objects and their behavior.*

*2.2.1.a Observe physical properties of objects (freezing and melting, sinking and floating, color, size, texture, shape, weight)*

*2.2.1.d Identify solids and liquids and recognize that liquids take the shape of their container*

**Objective: The objective of this lesson is for students to explore and describe the physical properties of matter. Emphasis will be placed on the unique properties of liquid/water. Students will identify the differences between mixtures and pure substances, physical properties of matter, and will demonstrate the concept of density.**

### **Materials (provided by CSM):**

- Activity worksheet

#### Capillary Action Activity

- Three clear cups
- Paper towels
- Food coloring

#### Penny Experiment Activity

- Pennies
- Paper cups
- Disposable pipettes
- Paper towels

#### Density Activity: Lava Lamp

- Paper towels
- Clear bottle with caps
- Funnel (2-3)
- Oil
- Food coloring
- Glitter and weigh boats for glitter
- Alka-Seltzer tablet broken into pieces

### **Materials (provided by the classroom):**

- Water

### **Setup:**

- Setup stations at the start of the lesson so that the group can go straight into the activities after the discussions.
- Work on the worksheet and perform the molecule demonstration as a class (not in individual groups).
- When ready to begin the density lava lamp activity, break into two groups. Send half of the class to perform the density activity and the other half to start the liquid activities.

### **Discussion: (Questions to ask the students)**

- What is Matter?
  - A physical substance that occupies space and has a definite mass.
  - All matter is made up of molecules; molecules are very small and can be really close together or far apart
  - Mass is kind of like weight (difficult concept to explain to young children so this is fine to say)
- What are the three basic states of matter? Ask the students for some examples of each
  - Solid: definite shape, volume, and mass
  - Liquid: not a definite shape, definite volume, and mass
  - Gas: not a definite shape, volume, or mass
- What are the transitions between each state? Ask the students for examples.
  - Solid to a liquid: melting, ice cream melting
  - Liquid to a gas: evaporation, ocean water evaporating into the sky
  - Gas to a liquid: condensation, fogging mirrors or dew on the grass

### **States of Matter Worksheet**

#### **Procedure:**

1. Handout the worksheet.
2. Explain to the students that the middle images are one of the three states of matter.
3. Ask them what state of matter an ice cube is? (solid) Ask them what state of matter a cup of juice is? (liquid) Ask them what state of matter smoke is? (gas)
4. Now have the students complete the worksheet by matching each of the items on the left and right to one of the states of matter found in the middle.
5. Let the students have time to finish these and then go over the answers together.

#### **Continue Discussion: (Questions to ask the students)**

- What is density?
  - Basically, density is how compact something is with molecules. Every object is made up of small pieces. Many times, those pieces are so small we can not see them with our eyes. The “pieces” are molecules.

- Ask the students what their body is made of.
  - Most will say blood, organs, air, water
  - Explain that they are all correct. Tell them our bodies are made up of lots and lots of tiny cells that make up our different organs (skin, heart, muscles). Tell them each of those cells are made up of molecules. These cells and molecules are too small for us to see but they do exist.
- Density helps to determine the type of matter an object is by their molecules.
- An object with molecules packed together and very close together are denser. Molecules less packed together and far apart, are less dense.
- Molecules also move, so if they are dense, they have very little space to move so the molecules are very slow. If they have more space and are less dense, the molecules are really active.
- When something is dense, we might think it is heavy, but density is actually what helps to explain why a rock will sink to the bottom of the water and a feather will float.
- Are solids, liquids, or gases denser? Which one is less dense?
  - A solid is going to be the densest and therefore will have molecules cramped and unable to move fast. A solid's molecules are slow.
  - A liquid has molecules lightly farther apart than a solid. They are less dense than a solid. Will their molecules be faster or slower than a solid? (faster)
  - Finally, gases are less dense and have molecules far apart. Their molecules are going to be very fast and active.
- Does anyone know what we put into a balloon that makes it float in the air?
  - Helium, a gas, allows balloons to float into the air because helium has less density than air.

### **Density Demonstration:**

- Ask for three volunteers, they will be the molecules.
- Have them stand with their hands down super tight to their sides and ask them to stand very close to each other. Explain that they are very dense and this is what the molecules of a solid are like.
- Now, have them take one step apart from each other in different directions. Now that they have more room, they can move their arms a bit more. They might notice their arms can still touch which is like a liquid, there is a little more room to move around in. They are dense but not as dense as a solid.
- Finally, have them take two more steps away from each other in different directions. They shouldn't be able to touch each other, which should explain that this is a gas. Now, have them wiggle around or move their arms. Remember how gas molecules are really active, these molecules might bump into each other, but like gases, they have more room, are more active, and faster.
- Thank the students and have them sit back down.

### **Density Activity Description:**

For this activity, the students will observe density from the physical properties of oil and water. Students will also create a gas from the mixture.

You will need:

- Paper towels
- Clear bottles with lids
- Funnel (2-3)
- Oil
- Food coloring
- Glitter and weigh boats for glitter
- Alka-Seltzer tablet broken into pieces
- Water

**Setup:**

- Help the students pour the oil and water into their bottles using a funnel. Do not fill it to the very top.
- Give each student a weigh boat with glitter.
- Allow the students to add the drops of food coloring

**Procedure:**

1. Add vegetable oil to the bottle until it is almost  $\frac{2}{3}$  full. Explain to the students that the liquid is now taking the shape of the new container.
2. Add water until the bottle is nearly full. Do not put a cap on the bottle.
3. Ask which is denser, the water or the oil? How do they know or why do they say this?
4. Add 2-3 drops of food coloring and the glitter.
5. Add an Alka-Seltzer tab to the bottle, make sure the tab is broken into a couple of pieces and only give small pieces. One should be good but add another if needed. What happens?
  - A chemical reaction is taking place. The Alka-Seltzer forms gas which is less dense than both the water and oil.
  - Once the fizzing stops, the layers should separate again
6. Let the students place the lid onto the bottle and allow them to take their Lava lamp home with them. Help younger students tighten the lids so there isn't any leakage.

**Liquid Discussion: Unique properties of liquids**

- Liquids have some unique properties
- Adhesion: Liquid molecules can “stick” to other non-liquid molecules or surfaces.
  - Solids can't do this. If you try to stick a pencil to the wall, it won't stick. However, if you spray Windex on the window, the liquids will stick (adhere) to the glass.
- Cohesion: Water molecules come together and “stick” to other water molecules.
  - We will explore this property in one of our activities.

- **Capillary Action or Diffusion:** This is the movement of water within the spaces of a porous material. Porous materials are any sort of material that has spaces between the molecules. Some solids are made of materials that have more spaces between molecules than others.
  - For example, if you spill your milk on the counter and use a paper towel, where does the milk go? The milk is absorbed into the paper towel. The liquid fills the spaces between the paper towel molecules. Now, if you spill your milk on the counter and try to use a rock to clean it up. Does the rock absorb the milk? No, the molecules are too tight in a rock.
  - Capillary action or diffusion Capillary action or diffusion explains how water moves to achieve equilibrium, or a balance.

### **Liquid Cohesion and Adhesion Activity:**

Students will observe the properties of cohesion and adhesion. Cohesion is when the water molecules stick together. Adhesion is when water molecules stick to other surfaces.

You will need:

- Cups with water and disposable pipettes
- Paper towels
- Pennies

### **Setup:**

- Give students a paper towel and a cup of water per pair/group with disposable pipettes (pairs or groups are dependent on the setup of the classroom).
- Give each student one penny, which they will return at the end of class.

### **Procedure:**

1. Have the students place their penny on a paper towel.
2. Carefully drop three drops of water onto the penny. Ask the students what they observe. They should notice that the water makes a dome; it does not spill over the surface of the penny. Explain that the cohesion properties allow each drop of water to bind to each other. Adhesion is allowing the group of water molecules to stay on the surface of the penny.
3. Let the students experiment with how many drops they can fit onto the penny without it spilling over. Do this for about 5 minutes. They may need more paper towels!

### **Liquid Capillary Action Activity:**

Students will observe a demonstration that will show capillary action of water.

You will need:

- Three clear cups
- Paper towels
- Food coloring

- Water

**Setup:**

- A volunteer should help with this, it should be a demonstration.

**Procedure:**

1. Setup three cups in a line and fill  $\frac{1}{2}$  of each end cup with water.
2. Add food coloring to each end cup, each one should have a different color.
3. Fold two paper towels so they are about 1 inch wide and 12 inches long (hotdog style).
4. Place one end of the first paper towel in the cup on one end, place the other end into the empty middle cup, there should only be about 2 inches of paper towel above the cups creating a bridge.
5. Place the second folded paper towel in the middle cup and its other end in the remaining cup.



6. Have the students observe the capillary action of the colored water moving from one jar to the middle jar through the paper towel.