Properties of Solids, Liquids & Gases Investigation

Introduction
You will investigate 5 properties of liquids, gases and solids. This is a qualitative lab (non-numerical observations) in which you will determine if a state of matter (aka phase) has a particular property. If more than one phase has a particular property you will rank the phases from highest to lowest for that property. Here are the 5 properties and a brief description of each.

- **Expansion** – The ability of particles to fill any size or shape container. Particles that have this property are said to have no definite shape or volume.
- **Fluidity** – The ability of particles to slide past each other. Particles that have this property are said to have no definite shape.
- **Diffusion** – The spontaneous mixing of two or more substances cause by the random motion of the particles (in other words there is no outside force mixing them together).
- **Effusion** – The ability of a substance’s particles to pass through a tiny opening and escape a container.
- **Compressibility** – The ability of a substance’s particles to be pushed together so they occupy less volume than before.

Compressibility Station
Procedure - You will test the compressibility of gas (air), liquid (water), and solid (steel bolt) using a plastic syringe.

1. With the cap off, pull back the plunger to fill the syringe with air.
2. Keeping your finger on the cap, push the plunger in as far as possible.
3. Observe how much the volume of the air decreases.
4. Repeat steps 1 through 3 using water. Be sure you do not have any air in the syringe.
5. Repeat steps 1 through 3 using the steel bolt. Be sure to observe how much the metal bolt compresses and not how much the rubber tip of the plunger compresses.

Data - Record your observations for each of the 3 phases.

Conclusions – Use your observations to explain your answers to the following questions:

1. Which phase(s) have the property of compressibility?

2. If more than one phase has the property rank the phases from most compressible to least compressible.
Fluidity Station

Procedure – You will test the fluidity of liquid (water) and solid (steel washer)

1. Fill a small beaker about half full of water.
2. Pour the water from the beaker into the small flask.
3. Observe if the water changed to the shape of the flask or if it retained its original “beaker” shape.
4. Repeat steps 1 through 3 for the steel washer.

Data – Record your observations for each of the two phases.

Conclusions – Use your observations to explain your answers to the following questions:

1. Which phase(s) have the property of fluidity?

2. We didn’t test the gas phase, but it does have the property of fluidity. If more than one phase has the property of fluidity, rank the phases from most fluid to least fluid.

Expansion, Diffusion & Effusion Station

Gas Phase Procedure – You will use two gases, hydrogen chloride and ammonia, to observe the property of diffusion. When the gas particles of these two substances collide with each other they undergo a chemical reaction to produce a white precipitate, ammonium chloride. While this new chemical is a solid, it is light enough to travel with the gas. We can use its white color to track the movement of the gas particles.

1. Thoroughly rinse and dry a plastic cylinder and lid. Place the open cylinder on its side.
2. Using a forceps, place a hydrogen chloride cotton ball at the far end of the cylinder.
3. Using a different forceps, place an ammonia cotton ball at the mouth of the cylinder. Put the lid on tight.
4. Observe for a couple minutes to determine if a white, ammonium chloride cloud forms. Record your observations.
5. If a white cloud forms, set the closed cylinder upright. Observe for a couple minutes to see if the gas reaches all areas of the cylinder. Record your observations.
6. Unscrew the lid and observe if all the gas particles remain in the cylinder or if some of them escape the container.

Data – Record your observations from steps #4, #5 and #6.
Conclusions – Use your observations to explain your answers to the following questions about the gas particles.

1. Do they have the property of diffusion?

2. Do they have the property of expansion?

3. Do they have the property of effusion?

Liquid Phase Procedure – You will test two liquids, water and food coloring, for the property of diffusion.

1. Fill a large beaker about two-thirds full of hot water.
2. Place one drop of food coloring in the water.
3. Observe the motion of the food coloring for several minutes to determine if 1) the clear liquid particles and the food coloring particles mix on their own without any external stirring, 2) the liquid particles reach all areas of the beaker and 3) all the liquid particles remain in the beaker or if some of them escape the container.

Data – Record your observations from step #3.

Conclusions – Use your observations to explain your answers to the following questions about the liquid particles.

1. Do they have the property of diffusion?

2. Do they have the property of expansion?

3. Do they have the property of effusion?
Solid Procedure – You will test two solids, brass and steel, for the property of diffusion.

1. Place the steel and lead in a beaker.
2. Observe the motion of the two metals for a few minutes to determine if 1) the steel and brass particles mix on their own without any external stirring, 2) the solid particles reach all areas of the beaker and 3) all the solid particles remain in the beaker or if some of them escape the container.

Data – Record your observations from step #3.

Conclusions – Use your observations to explain your answers to the following questions about the solid particles.

1. Do they have the property of diffusion?

2. Do they have the property of expansion?

3. Do they have the property of effusion?

Summarizing the Properties – Rank the phases in order from highest to lowest.

1. Ability to diffuse.

2. Ability to Expand.

3. Ability to effuse.