

Phases (or States) of Matter

Developed with Jessica Sullivan at Gouverneur MS through a grant provided by Title II Math/Science Partnership Grant

Focus Questions and Goals

- 1) What is matter?
- 2) Name the three phases (states) of matter?
- 3) Identify and describe the particle in each phase of matter and how they are different in each phase of matter.

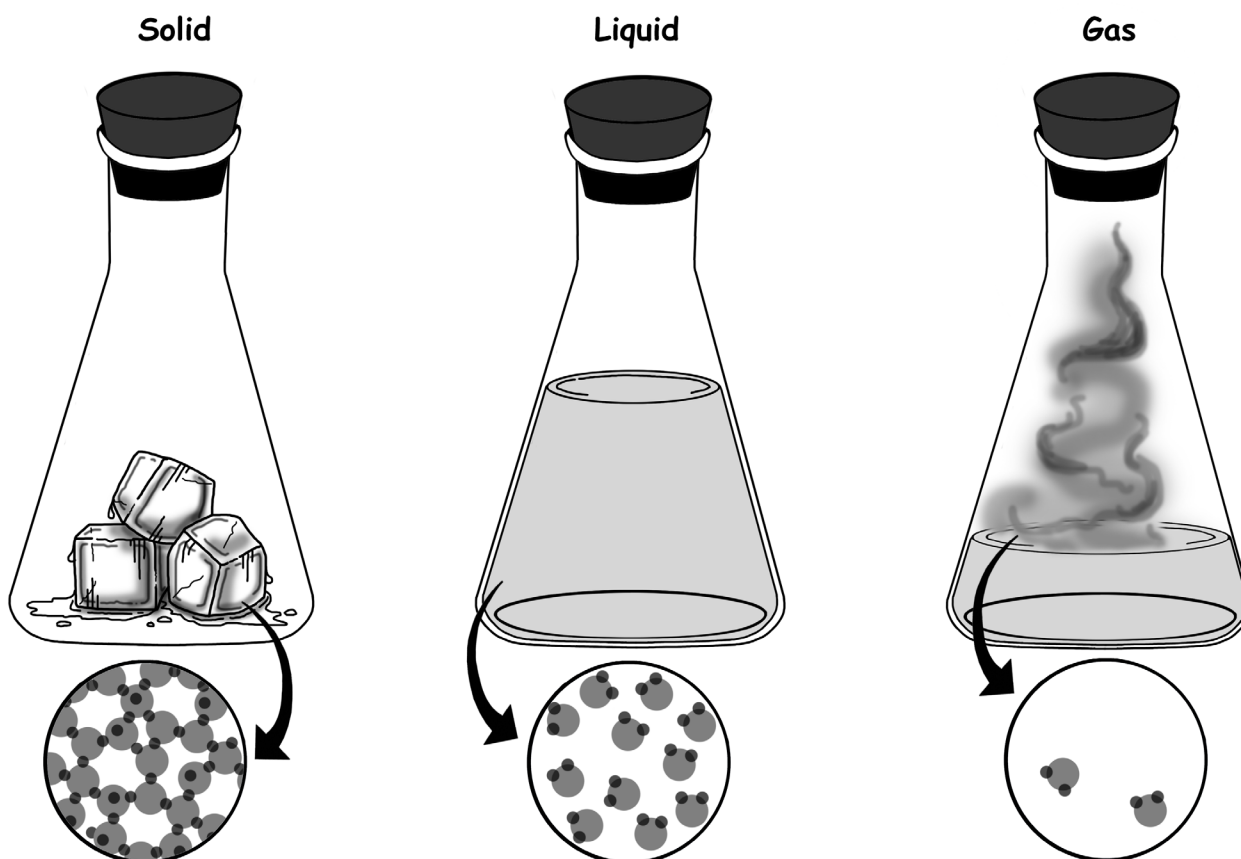
Reading About Matter

Matter is something that has mass and volume (takes up space). Matter can be found in several *phases* or *states*. The three most common phases of matter on Earth are **solids**, **liquids** and **gases**. Less commonly, we can also find matter as a *plasma* or *Bose-Einstein (BE) condensate*.

Solids have a fixed shape and **volume**. A solid's particles are packed closely together. There is not much space between the particles and there is little particle movement. A solid is not easily compressed.

Liquids have a fixed volume, but take the shape of the container in which they sit. There is not much space between the particles, but they can slide past each other and flow easily. A liquid is not easily compressed.

Gas fills the shape and volume of the container in which it sits. There is a lot of free space between its particles and they flow easily past each other. Gas can be compressed.



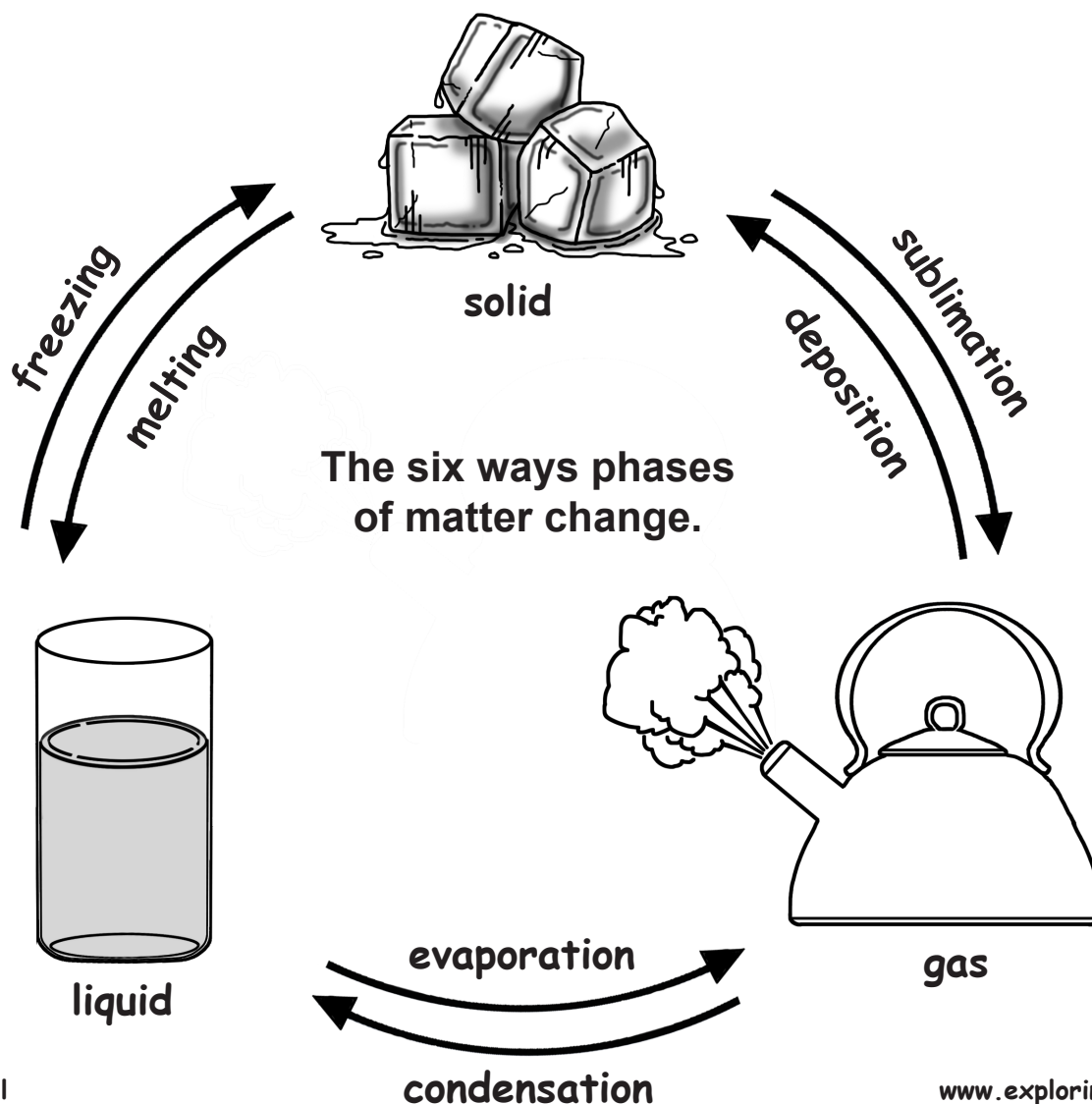
These are **physical states** of the molecules of matter. Molecules can shift from one physical state to another without changing their molecular structure (or chemical state). Water is still H_2O when it is ice, steam or a liquid – even though its physical state has changed.

Physical states can be changed by adding **energy** (i.e. increasing temperature or pressure) or releasing energy (i.e. cooling or lowering pressure). This does not change the matter's molecular structure. It is still the same matter or substance. When you heat a substance, you are adding energy to it. The movement of its molecules will increase until its physical state changes.

The six ways to change the phase (state) of matter:

- 1) **Melting** changes a solid to a liquid. (i.e. dripping icicles)
- 2) **Freezing** changes a liquid to a solid. (i.e. lake freezing over)
- 3) **Evaporation** changes a liquid to a gas. (i.e. clothes drying on a clothesline)
- 4) **Condensation** changes a gas to liquid. (i.e. water forming on the outside of a cold glass)
- 5) **Sublimation** changes a solid to a gas. (i.e. ice cubes shrinking in the freezer)
- 6) **Deposition** changes a gas to a solid. (i.e. frost forming on the windows)

These changes happen at precise temperatures for different substances. Scientists refer to these as **melting point**, **freezing point**, **condensing point** and **boiling point**. Water's melting point is $0^{\circ}C$, while its boiling point is $100^{\circ}C$.

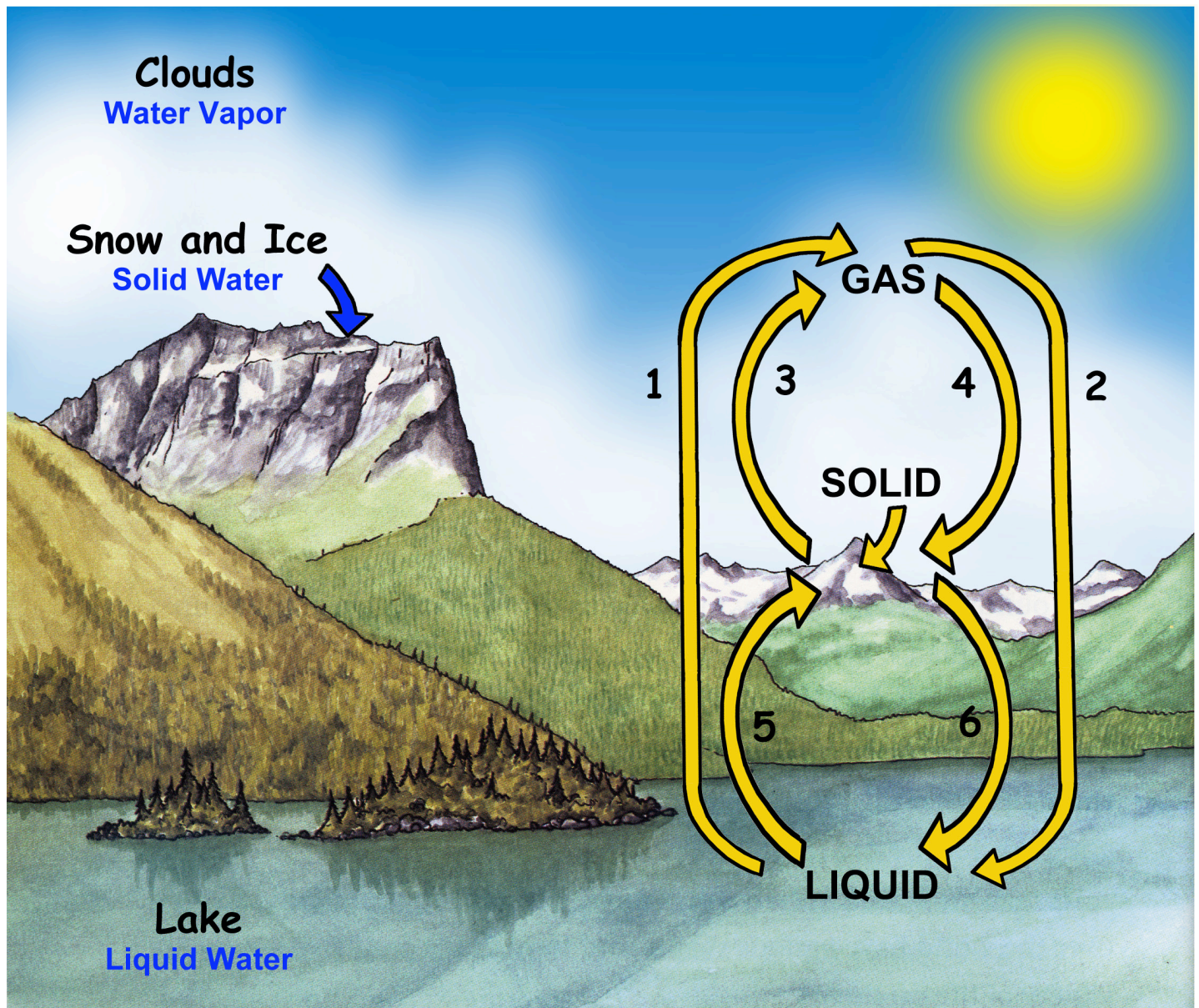


Water's Unique Quality

Usually solids are more dense than liquids because their molecules are closer. Water is an important exception to this rule. When water freezes, it forms a bonded arrangement of molecules that is actually less dense than liquid water, yet takes up more space. This is an important feature of water in that when ice forms on a lake or other waterway, it is less dense than the liquid water – so forms on top of the liquid water. This allows water animals to stay alive all winter under the ice. Without this trait, many of the living things on Earth would not have survived and evolved to what we have today.

It is also important to note (and helpful to us) that other substances have much higher melting temperature than water. Imagine if salt or sugar melted at room temperature the way water does.

Phase Changes of Matter in Nature Water



The six ways the phases (states) of matter change:

1. evaporation 2. condensation 3. sublimation 4. deposition 5. freezing 6. melting