

Essential Question: How do particles behave in the four states of matter?

S8P1b. Develop and use models to describe the movement of particles in solids, liquids, gases, and plasma states when thermal energy is added or removed.

Activating Strategy

Watch the first 3 – 3 1/2 minutes of the video below. Ask students how they would answer the commentator's questions.

<http://www.youtube.com/watch?v=KCL8zqjXbME>

Matter-anything that has mass and takes up space

- Atoms and molecules in matter are always in motion and are always bumping into one another.
- The speed and attraction of particles determines the state of matter.

(There are 3 familiar states of matter: solid, liquid, and gas. A fourth state of matter called plasma, only occurs at very high temperatures)

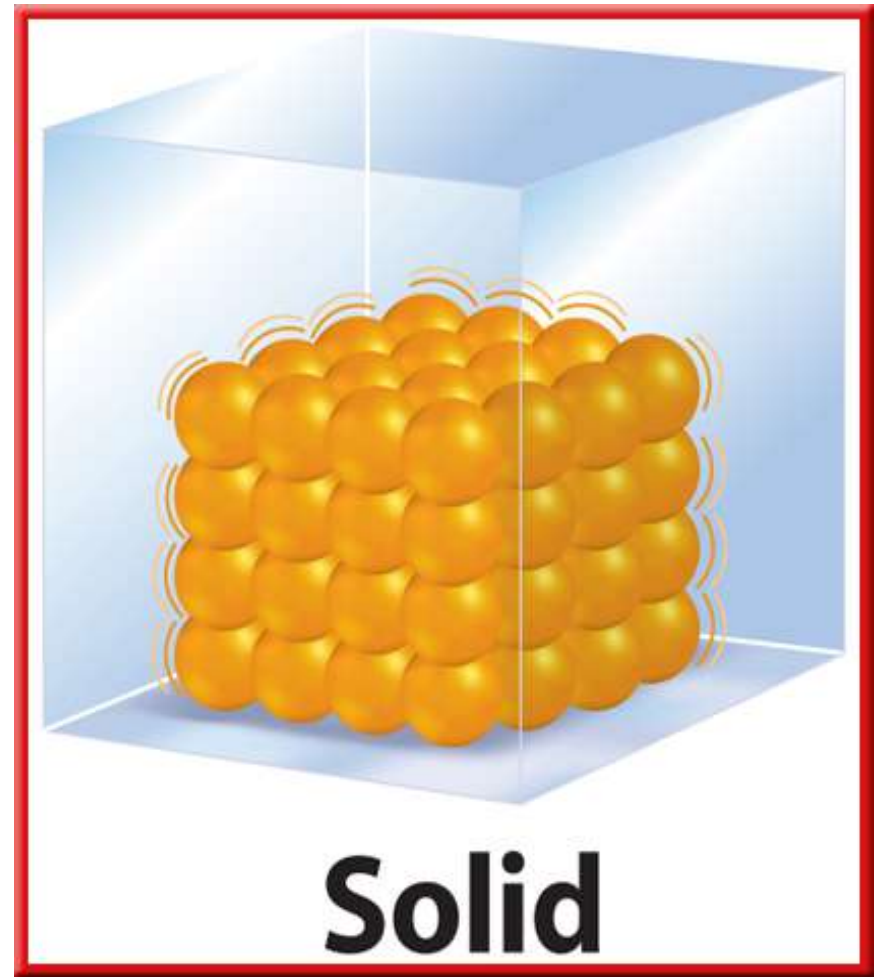
Imagine dropping a marble into a bottle.

Would anything happen to the shape or size of the marble?

Would the shape or size of the marble change if you put it in a larger bottle?

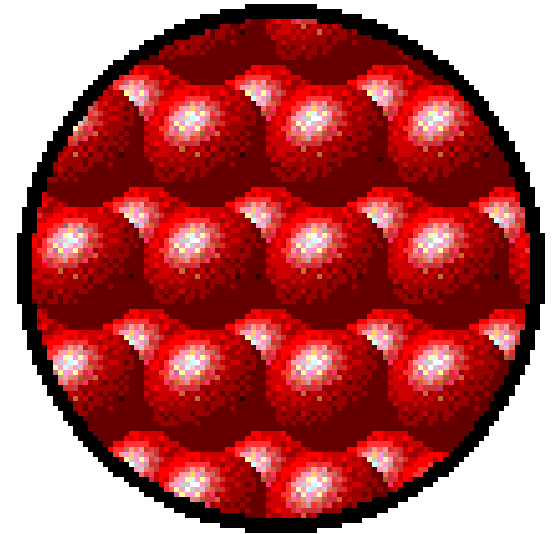
Even in a bottle, a marble keeps its original shape and volume because it is a solid.

- A solid is the state of matter that has a definite shape and definite volume.
- The particles of a substance in a solid state are very close together and there is a strong attraction between them



- The particles in a solid move, but they do not move fast enough to overcome the attraction between them.
- Each particle vibrates in place.
As shown in the diagram to the right
- Particles in a solid have LESS ENERGY than particles in other states
- http://www.middleschoolchemistry.com/multimedia/chapter1/lesson4#particles_of_a_solid

Solid



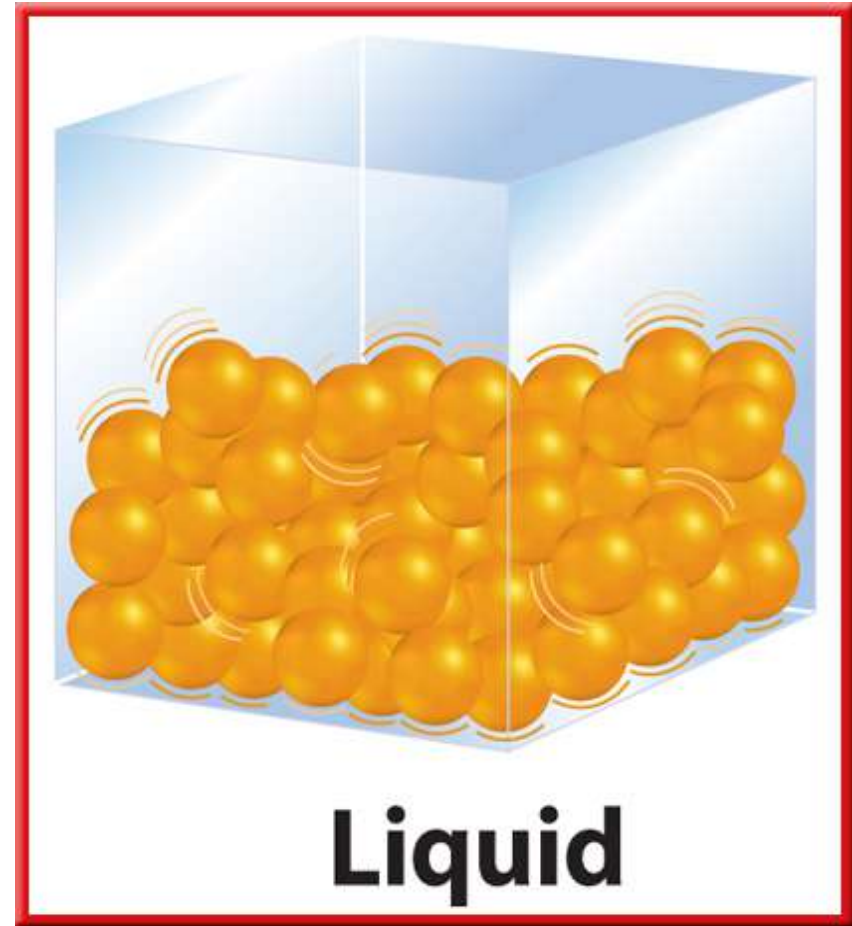
What do you think would change about soda if you poured it from a can into a glass?

Would the volume of the soda be different?

Would the taste of the soda change?



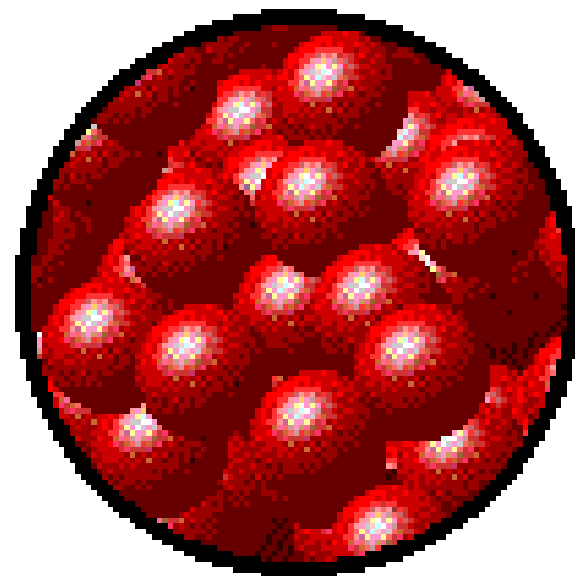
- Liquid is the state of matter that has a definite volume but no definite shape
- A liquid takes the shape of its container
- Although liquids change shape, the volume stays the same



- The particles in liquids move fast enough to overcome some of the attractions between them.
- The particles slide past each other until the liquid takes the shape of its container
- Particles in liquids have more energy than particles in solids
- Comparing solid and liquid movement of particles:

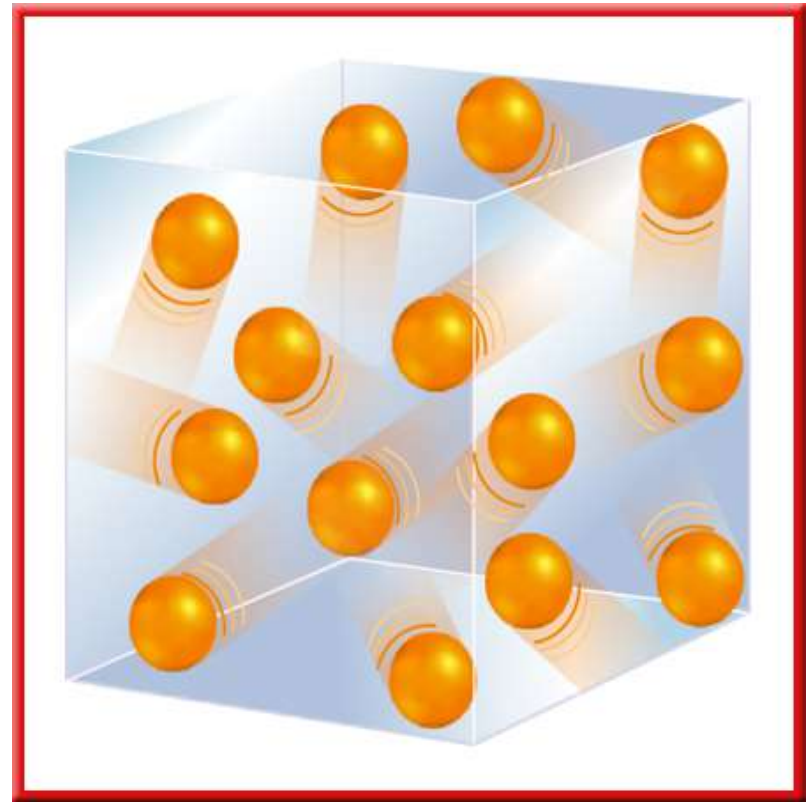
http://www.middleschoolchemistry.com/multimedia/chapter1/lesson4#particles_of_a_solid

Liquid



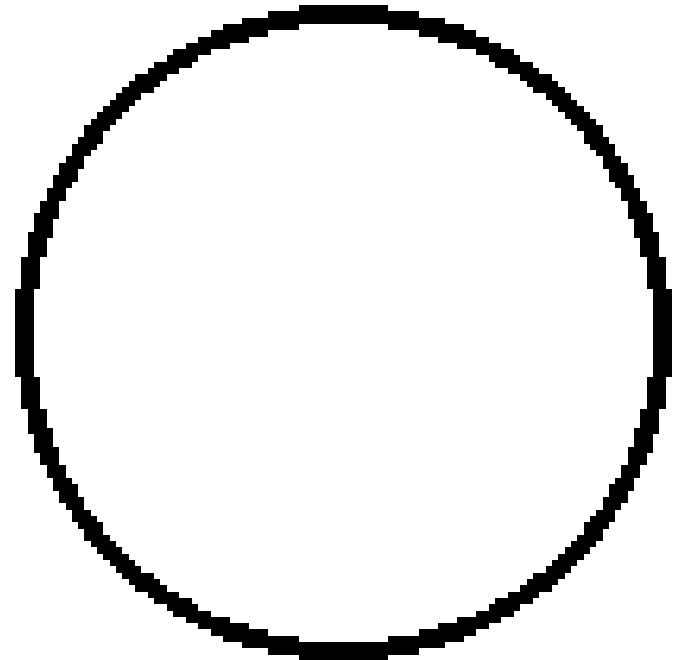
- A gas is the state of matter that has NO definite shape or volume. (lack attractive forces between particles)
- The amount of empty space between gas particles can change
- The particles of a gas move quickly. So, they can break away completely from one another- far apart and move freely

Gas

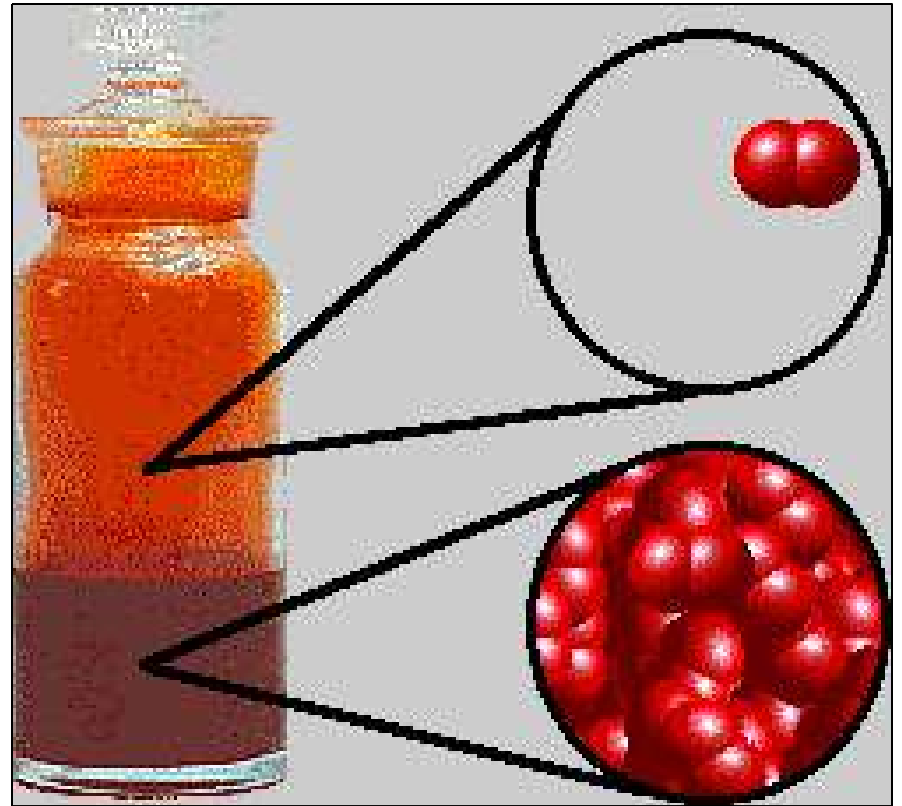


- The particles of a gas have less attraction between them than do particles of the same substance in the solid or liquid state.
- The particles of a Gas have more energy than the particles of a liquid or a solid

Gas



Comparing the Liquid and Gas State of the Element Bromine



**Which is the Liquid State?
Which is the Gaseous State?**

Study Jams Video: Solids, Liquids, Gases

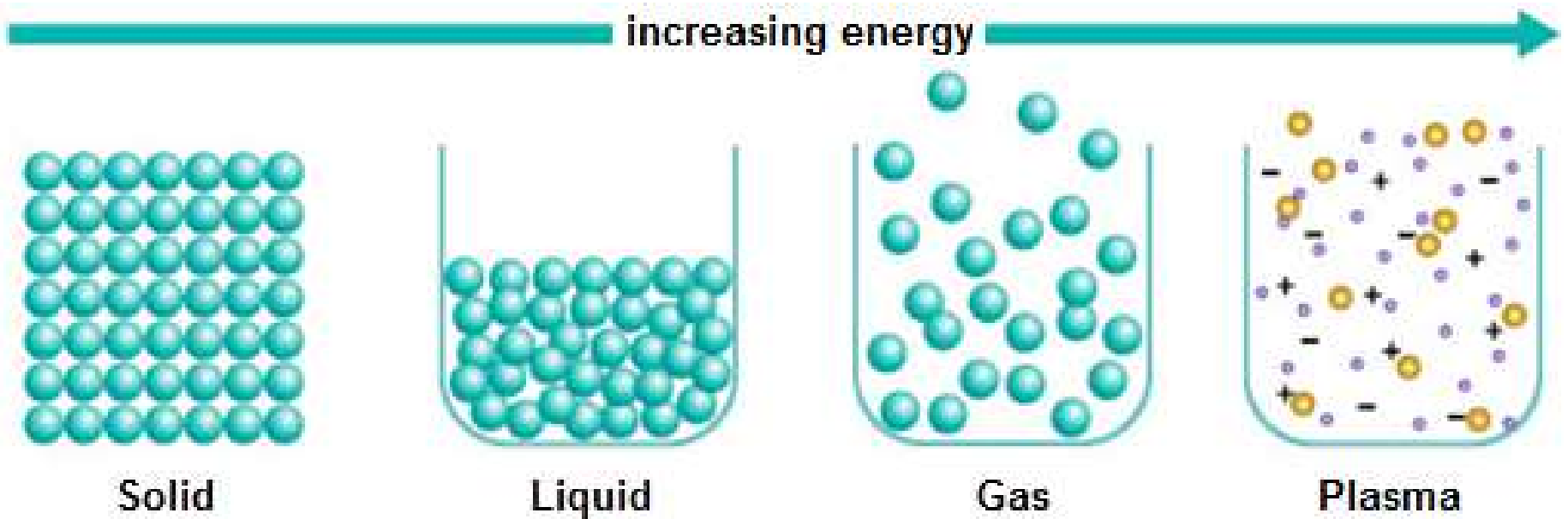
Plasma

(write all below)

- Plasma is high-energy matter consisting of positively and negatively charged particles.
- The most common state of matter in space.
- Examples: Lightning, fire, fluorescent and neon lights, and stars, such as the sun.



(copy diagram below)



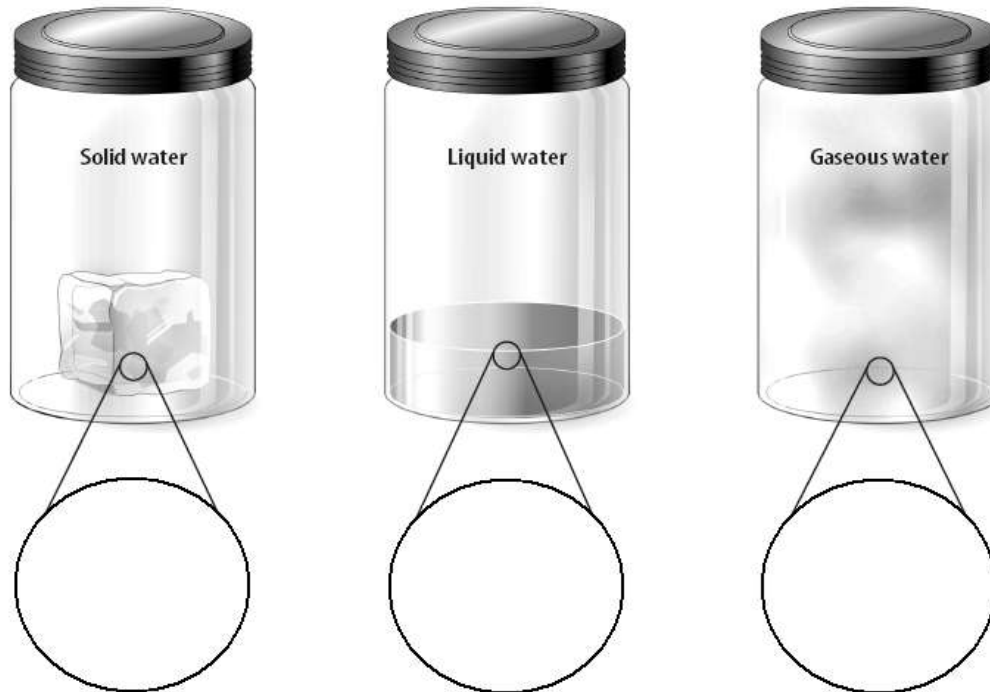
States of Matter Song

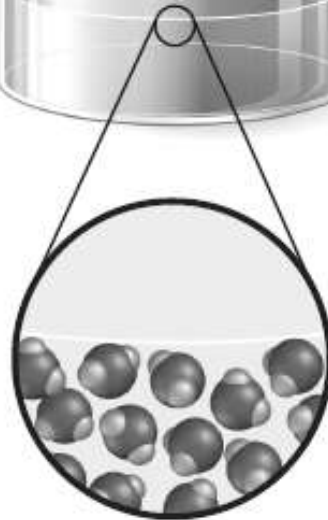
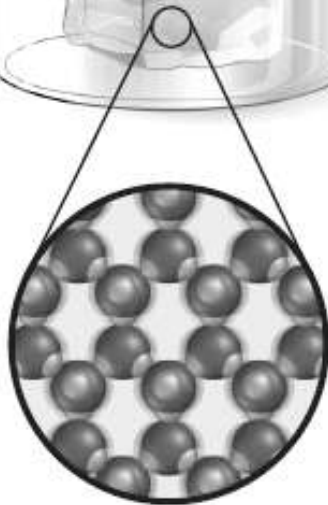
[uses some concepts and vocabulary
beyond our standard]

[http://www.youtube.com/watch?
v=vDZhUkp30tE](http://www.youtube.com/watch?v=vDZhUkp30tE)

Distributed Summarizing

Illustrate the movement of particles in a solid, liquid, and gas in the diagram on your Notes Sheet.





Additional Activities [see resources]:

- States of Matter Game
- Let It Change! Activity
- Scattered Matter Demonstration
- Moving on Up – Modeling Phase Change Task
- Pop Top
- Demonstration of warm air expanding and rising

It can be tricky to eat a frozen juice bar outside on a hot day.

In just minutes, the juice bar will start to melt. Soon the solid juice bar becomes a liquid mess.

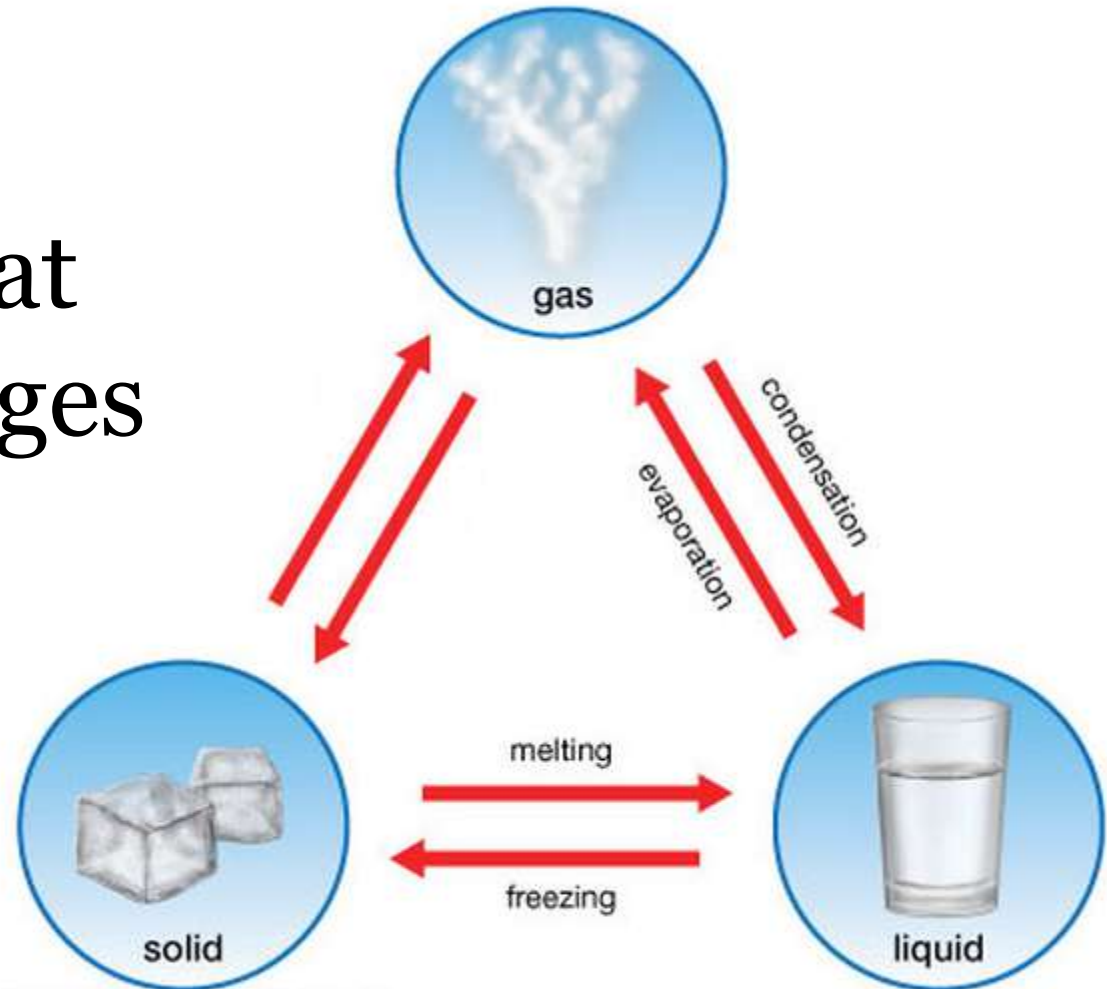
As the juice bar melts, it goes through a change of state.



Changes in State

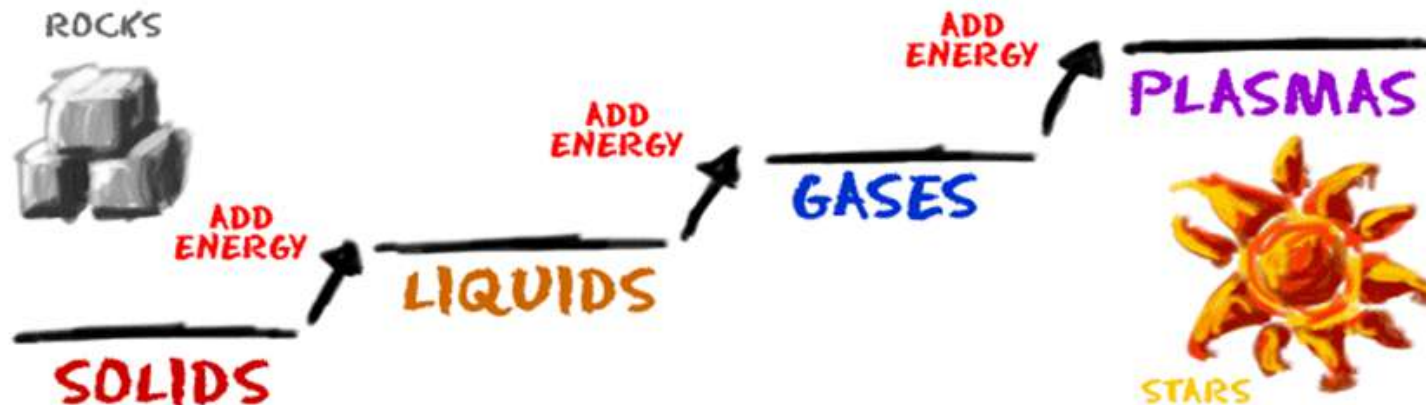
[Phase Change]

We will look at
only four changes
of state

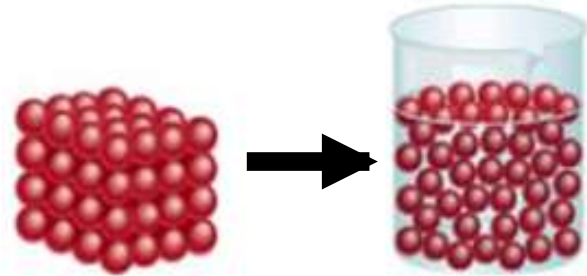


Energy and Changes in State

- As described earlier, particles in liquids have more energy than particles in solids, and particles in gases have more energy than particles in liquids
- Therefore, to change a substance from one state to another, you must add or remove energy

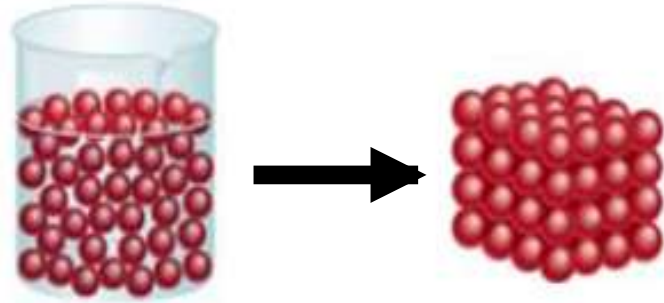


1) Melting: Solid to Liquid



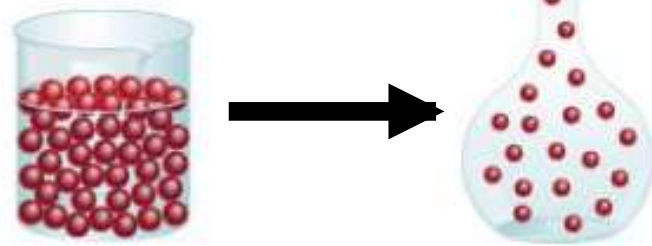
- Adding energy to a solid increases the temperature of the solid. As the temperature increases, the particles of the solid move faster.
- When a certain temperature is reached, the solid will melt.
- The temperature at which a substance changes from a solid to a liquid is the melting point of the substance. (water 0 C or 32 F)

2) Freezing: Liquid to Solid



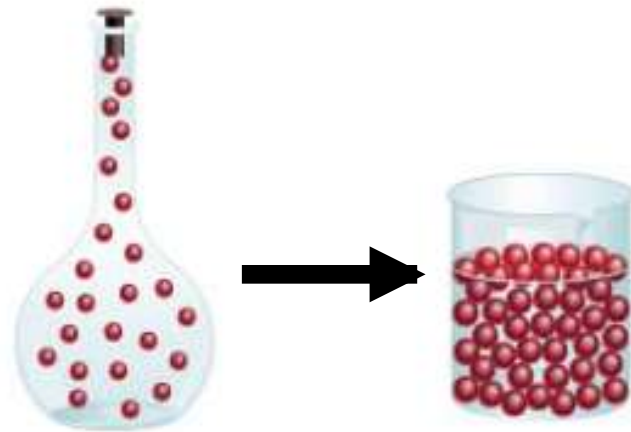
- Removing energy from a liquid (decreasing temperature) will cause the particles to slow down and begin locking into place
- When a certain temperature is reached, the liquid will freeze. Freezing is the reverse of melting; thus, freezing and melting occur at the same temperature (one adds energy and one removes energy)
- The temperature at which matter changes from the liquid state to the solid state is its freezing point. (water 0 C or 32 F)

3) Vaporization: Liquid to Gas



- As energy is added to a liquid (increasing temperature), particles throughout the liquid move faster
- When particles move fast enough to break away from other particles, they evaporate and become a gas
- Vaporization that occurs within a liquid is called boiling. Temp. at which boiling occurs in a liquid is called its boiling point. (water 100 C or 212 F)
- Unlike boiling, evaporation is vaporization that occurs only at the surface of a liquid.

4) Condensation: Gas to Liquid



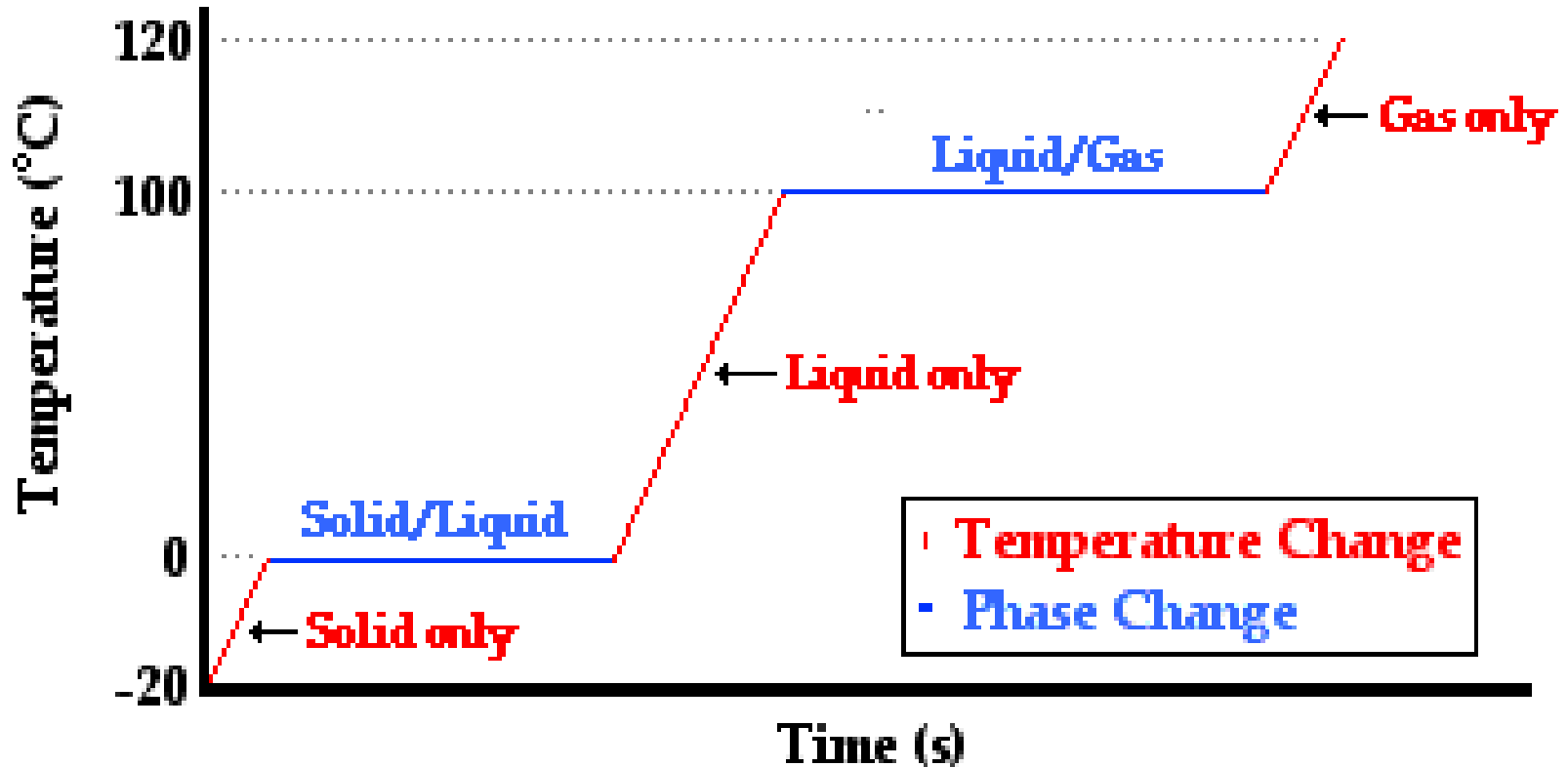
- Removing energy (decreasing temperature) from a gas will cause the particles to slow down
- When the attraction between the particles overcomes their motion, the particles clump together to form condensation (glass of ice tea on summer day)
- Sublimation is changing from a solid to a gas without going through the liquid state (dry ice)
- Deposition is changing from gas to solid without going through the liquid state (frost)

Relationship between Energy, Temperature, and Particle Movement

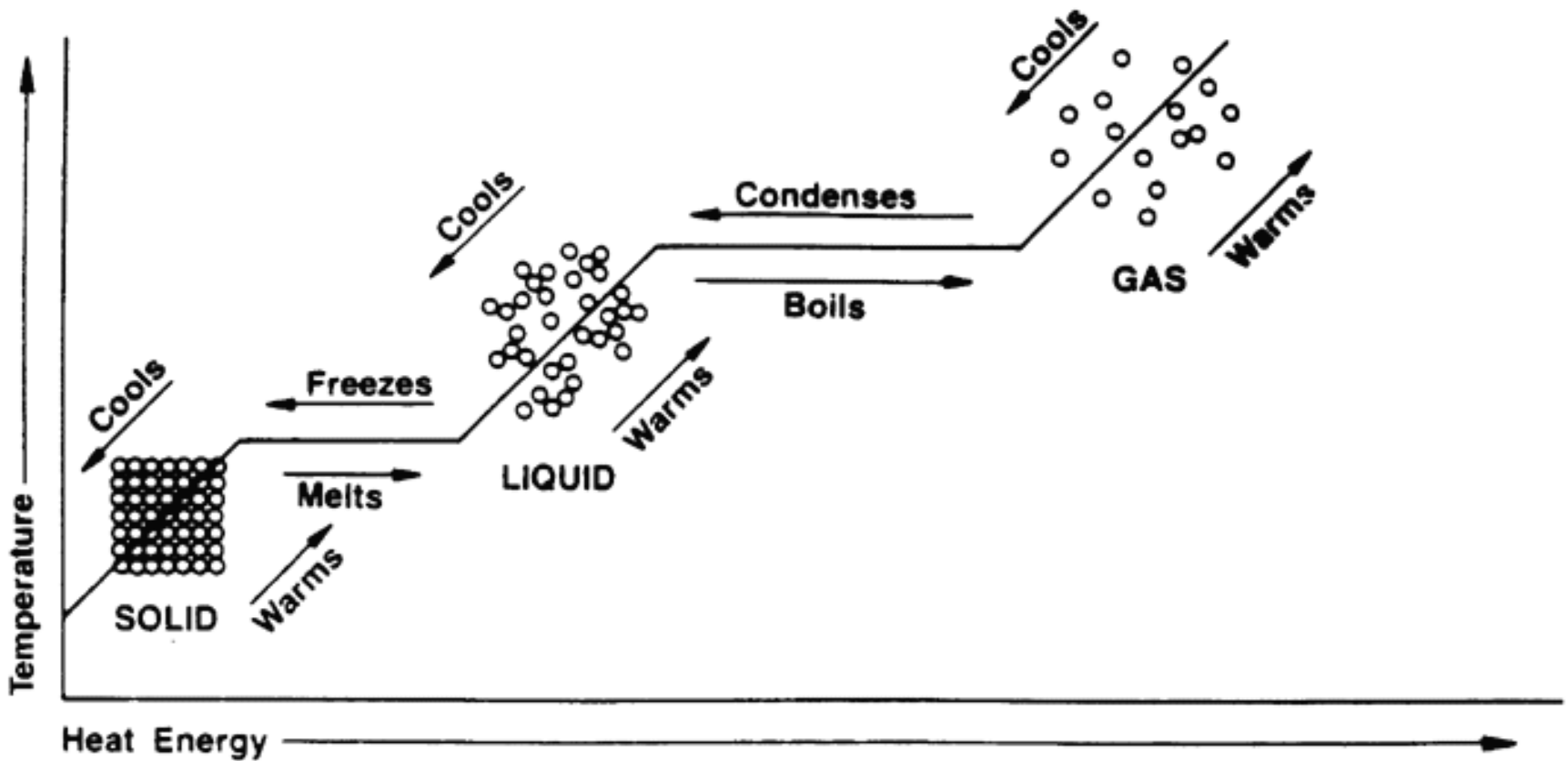
- When most substances lose or gain energy, one of two things happens to the substance: its temperature changes or its state changes.
- The temperature of a substance is related to the speed of the substance's particles.
- So, when the temperature of a substance changes, the speed of the particles also changes.

Relationship between Energy, Temperature, and Particle Movement

Heating Curve for Water



Relationship between Energy, Temperature, and Particle Movement

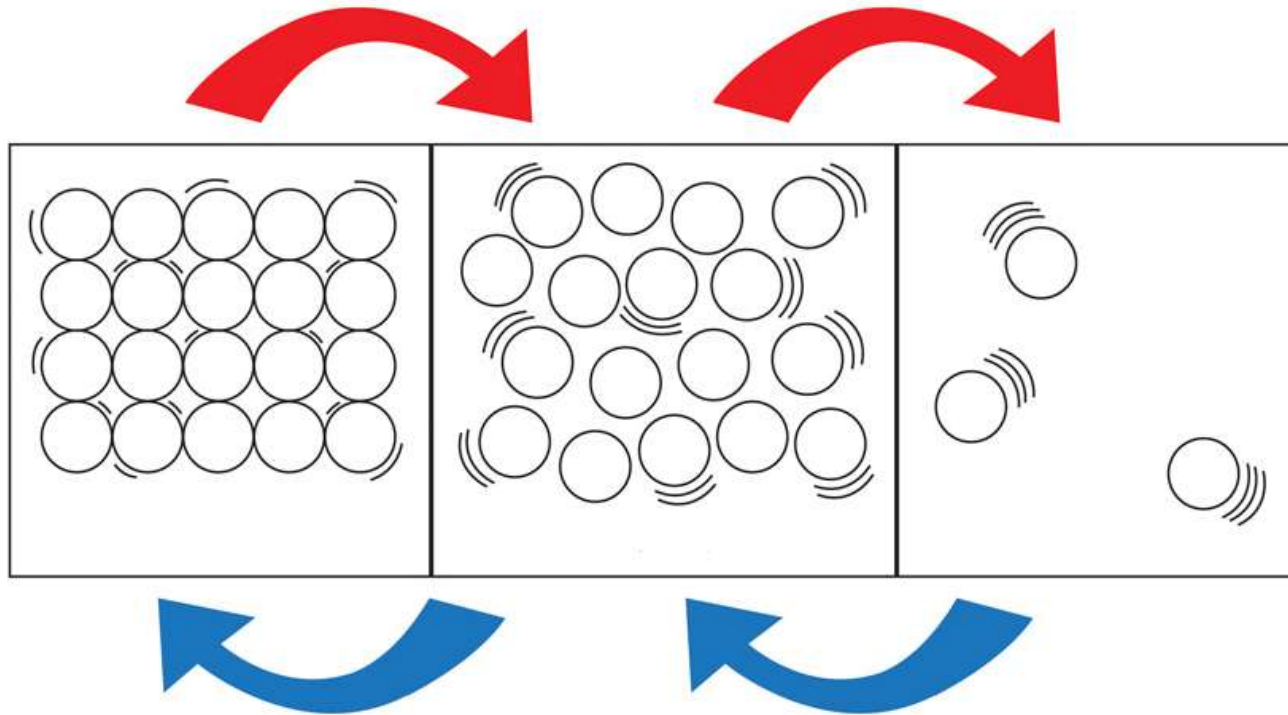


Let's see the Effects of Temperature and Particle Movement

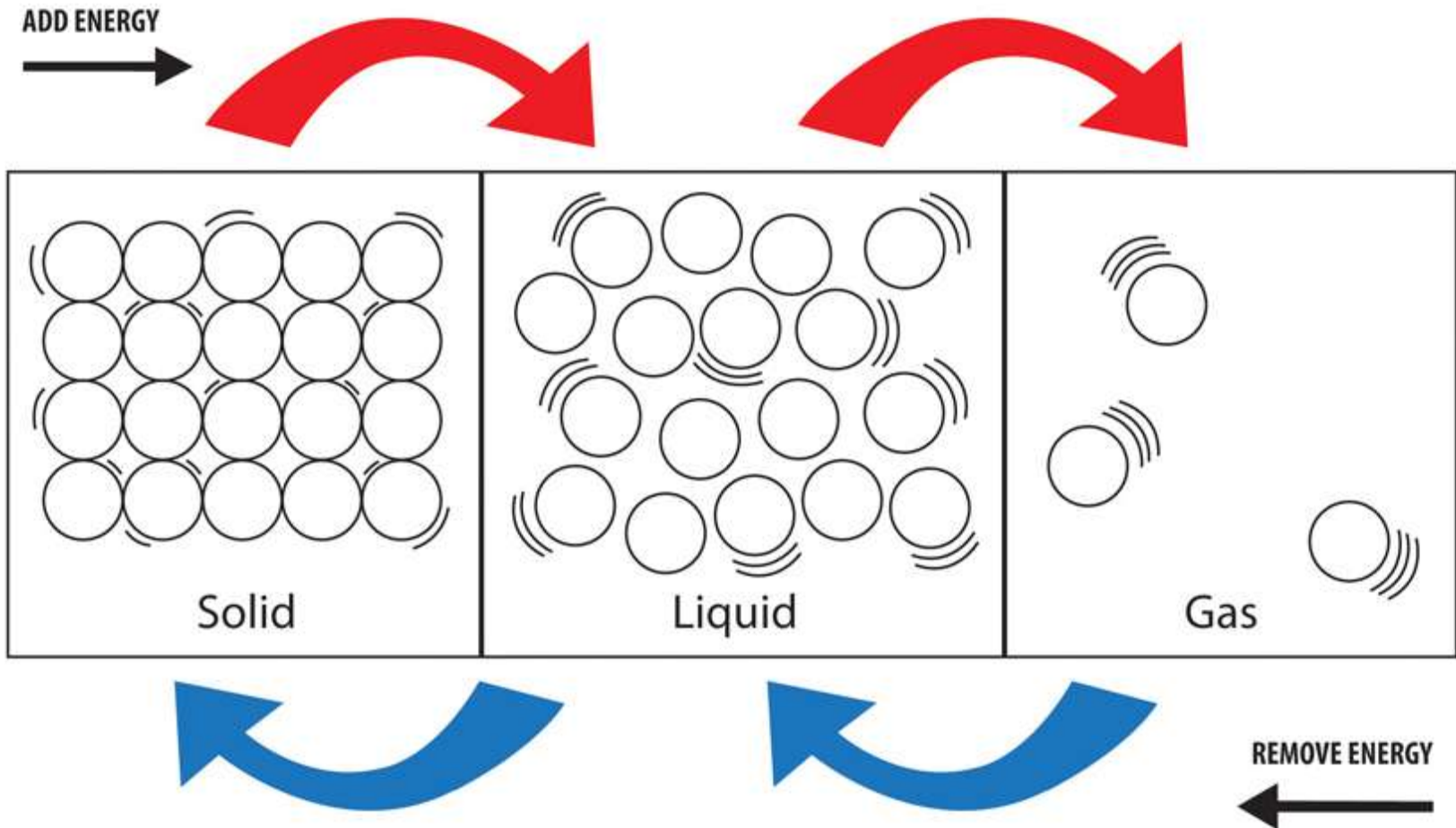
As particles in matter move faster, they push out with greater force and can cause matter to expand

http://www.middleschoolchemistry.com/multimedia/chapter1/lesson4#heating_cooling_metal_ball

Identify which box represents a solid, liquid, and gas. Then, identify what both arrows represent

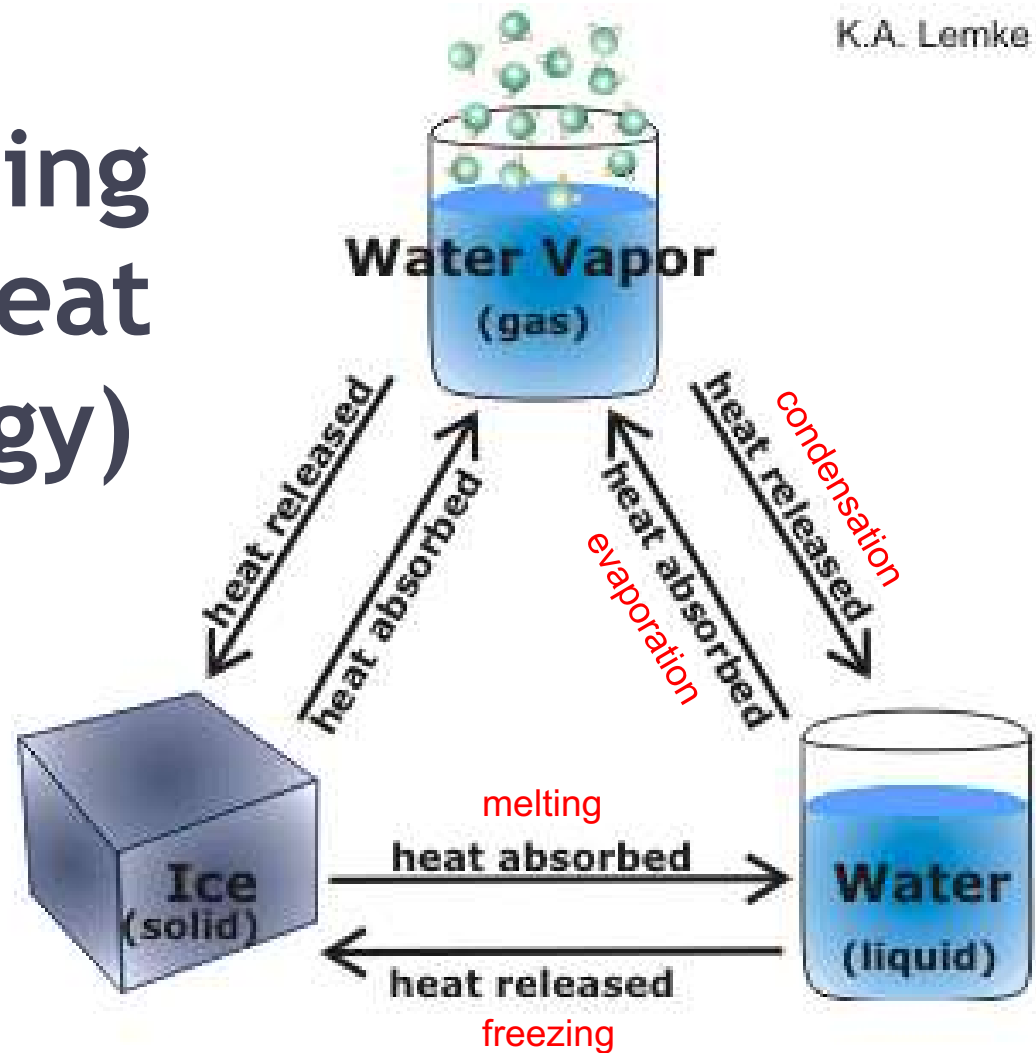


Energy and Changes in State



Adding Energy
can also be
viewed as adding
or removing heat
(form of energy)

K.A. Lemke



Simulation of the movement of particles in solids, liquids, and gases when heat is added:

<http://www.pbs.org/wgbh/nova/physics/states-of-matter.html>

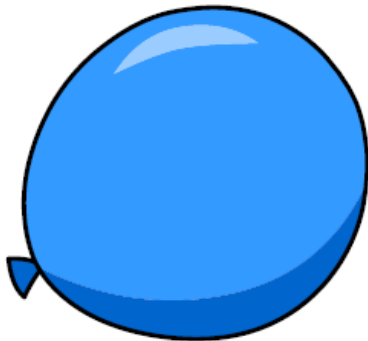
Distributed Summarizing:

**Modeling Particle
Movement in Phase
Change Activity**

Summarizing Strategy: Balloon Flux Constructed Response

Two balloons are filled with an equal volume of air. One is put in the refrigerator for an hour, while the other is heated in a slightly warm oven. Identify which balloon is which, and explain why.

A.



B.

