

# CHAPTER 16

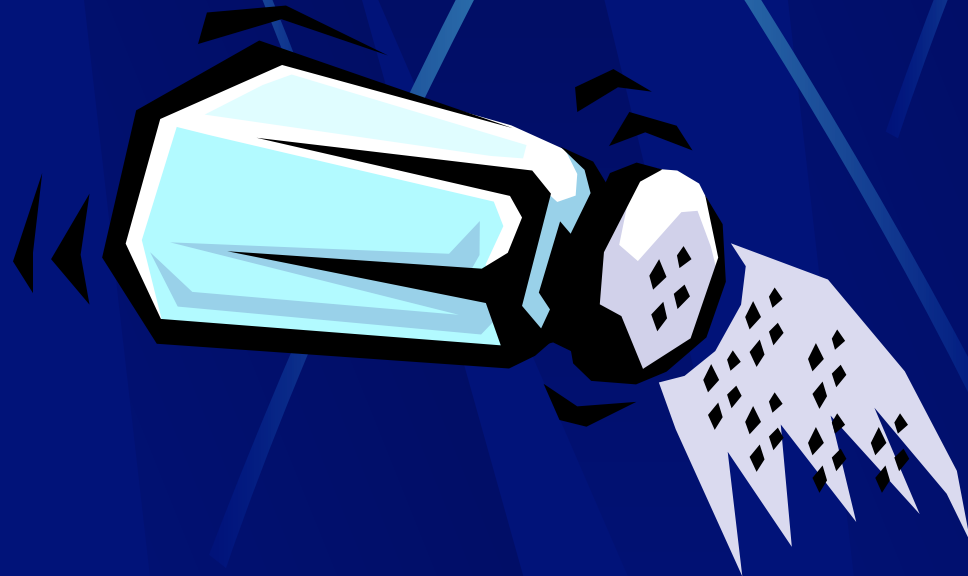
# WHAT IS MATTER?



## Section 16.3

## States of Matter

**How small is the  
smallest grain  
of salt?**



**i.e. How low can you go?**

**Molecule: the  
smallest particle of a  
compound that  
retains all the  
properties of that  
compound.**

**Atom: The  
smallest particle of  
an element.**

**Atoms and  
molecules are  
always in motion.**

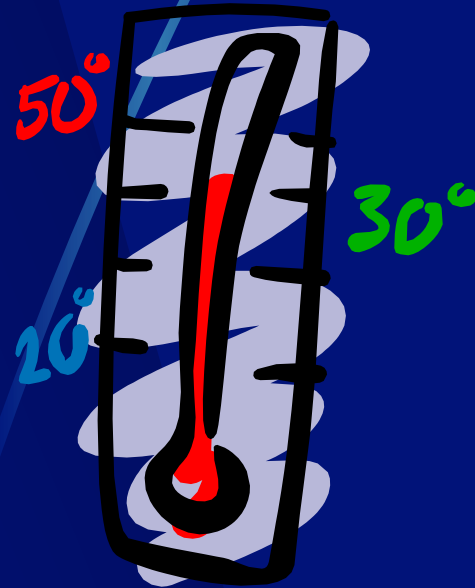


At higher temperatures, atoms/molecules move faster and bump into each other with more force. At lower temperatures, they move with less energy.



# What is temperature, anyway?

Temperature is a measure of the average energy of molecules and is related to their average velocity (speed).



# States of Matter

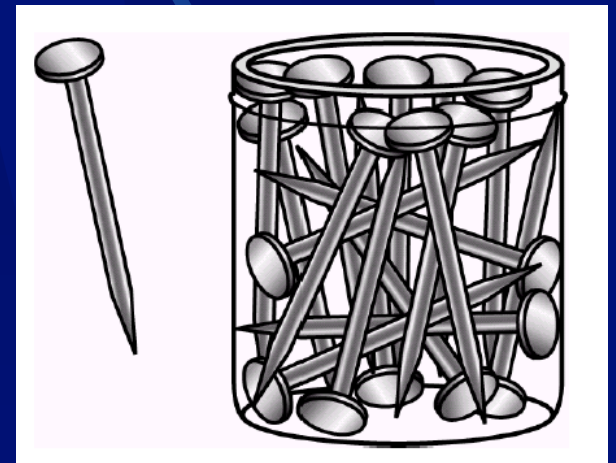
- All substances can exist as a solid, liquid, or gas.
- Plasma is a fourth state of matter.



**Molecules in  
solids, liquids, and  
gases vibrate  
(move) differently  
depending on the  
temperature.**

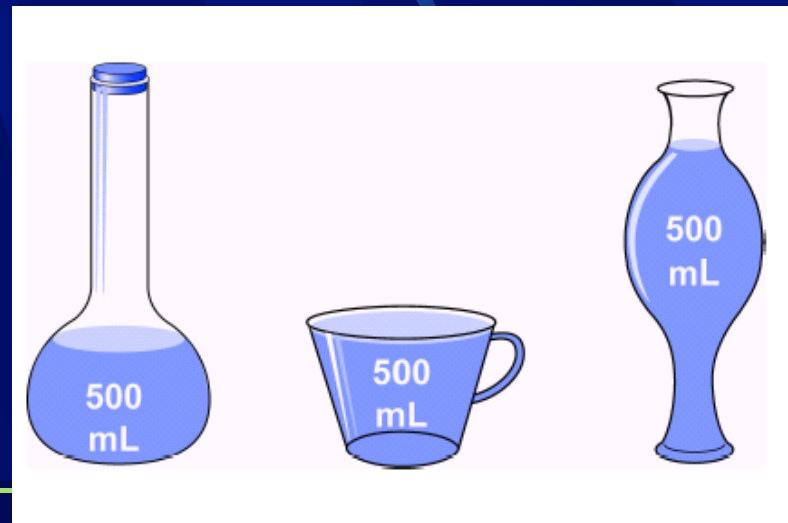
# Solids

- Molecules vibrate, but cannot change position.
- A solid has a definite shape and definite size.



# Liquids

- Molecules move over and around each other.
- Liquids have a definite volume, but no definite shape.



# Gases

- Molecules move around freely and are widely separated from each other.
- A gas has no definite volume or shape. It will spread out to fill its container.



# Plasma

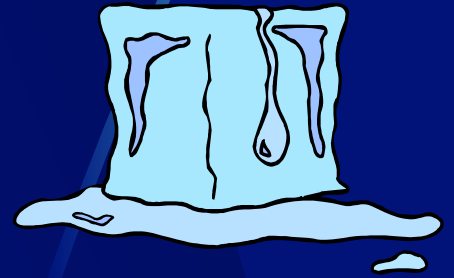
- Molecules are super-heated, begin to break apart, and lose their outer layer of electrons.
- Exists on the sun, in neon lights, and when you see lightning.



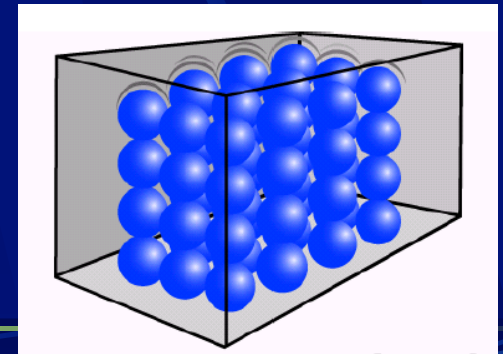
● Each substance has a characteristic temperature and pressure at which it will undergo a change from one state to another.

# A Look at Water (H<sub>2</sub>O)

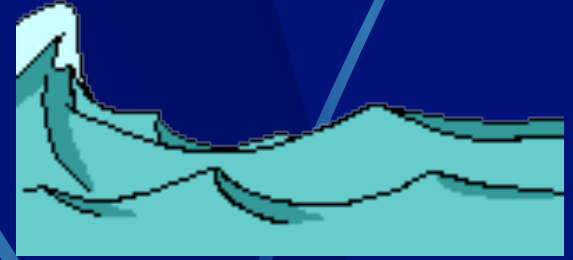
- Below 0°C, water is a solid called ice.



- In a solid, molecules vibrate, but can't move around or change position.



● Between  $0^{\circ}\text{C}$  and  $100^{\circ}\text{C}$ , water is a liquid.



● In a liquid, molecules move faster and slip out of position, so liquids can flow.






● Above  $100^{\circ}\text{C}$ , water becomes a gas.

● Molecules are widely separated in a gas and move extremely fast.



**Temperature  
influences state  
changes.**



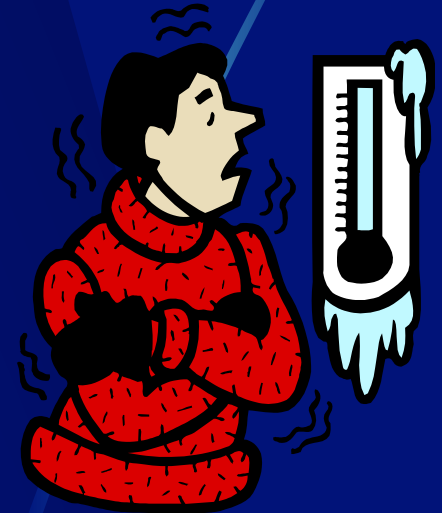
**Coming up next...  
6 state changes.**

● Melting – when a substance changes from a *solid* to a *liquid*.

● Different substances have different melting point temperatures.



● Freezing –  
when a substance  
changes from a  
*liquid* to a *solid*.



● The freezing point of a  
substance is the *same*  
temperature as its  
melting point.

● Boiling –  
when a  
substance  
changes from  
a *liquid* to a *gas*.

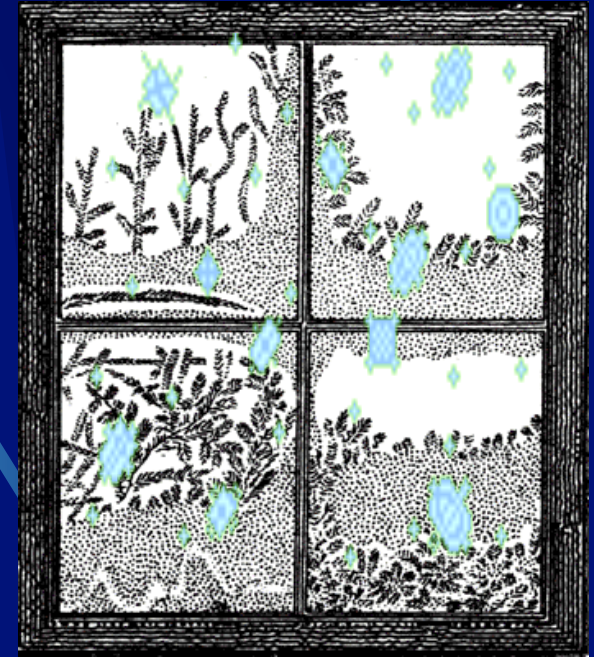
● Different substances  
have different boiling  
point temperatures.



# Evaporation is not the same as boiling.

- Evaporation occurs at room temperature and at the surface of the liquid.
- Boiling occurs at a higher temperature and occurs within the fluid.

● Condensation –  
when a  
substance  
changes from  
a *gas* to a *liquid*.



● The condensation point of  
a substance is the *same*  
temperature as its boiling  
point.

● Sublimation –  
when a substance  
changes directly from a  
*solid* to a *gas*.

● Example:  
Dry ice





● Deposition –  
when a substance  
changes directly  
from a *gas* to a  
*solid*.

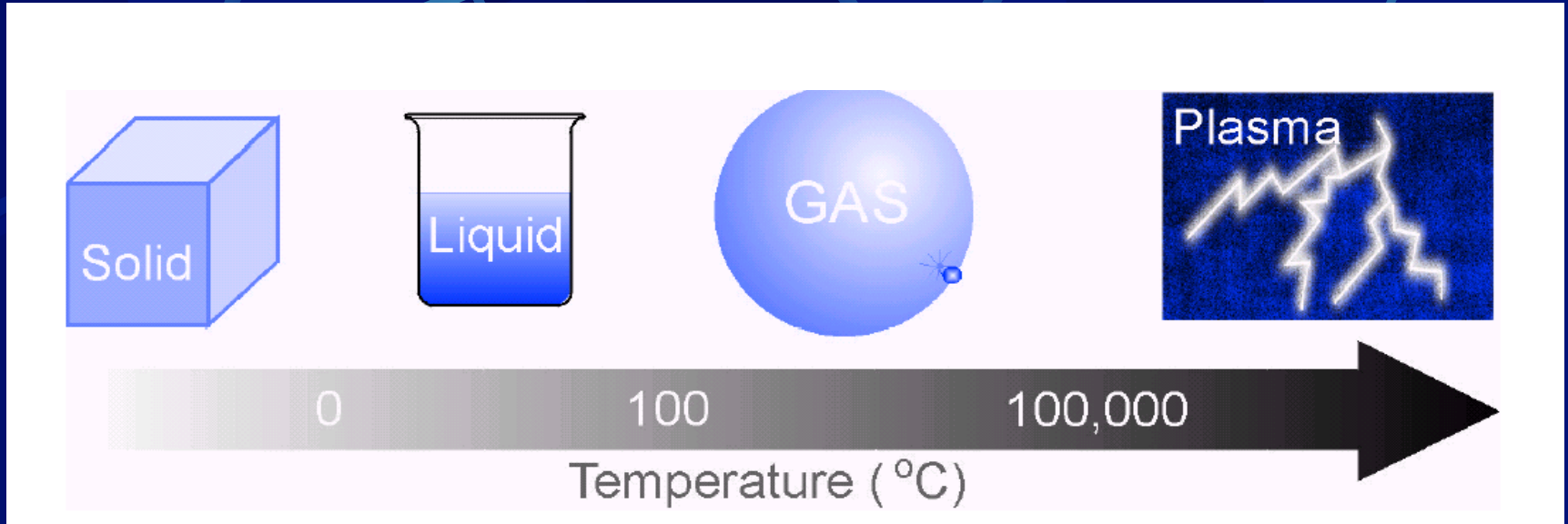


● Example: Water vapor in  
the freezer becomes frost.

# **Pressure also affects state changes.**

- **At lower air pressure (higher altitude), water boils at a lower temperature.**
- **Freezing points are also affected.**

# Summary



**Only the movement of molecules changes during a state change. The mass of the substance remains the same.**