Borax Snowflake Lab
Part 1

When liquid water crystallizes it has six sides. Create a snowflake with six sides.

Borax Snowflake Lab
Part 2

Purpose: To create a supersaturated solution and observe the crystal lattice of borax snowflakes.

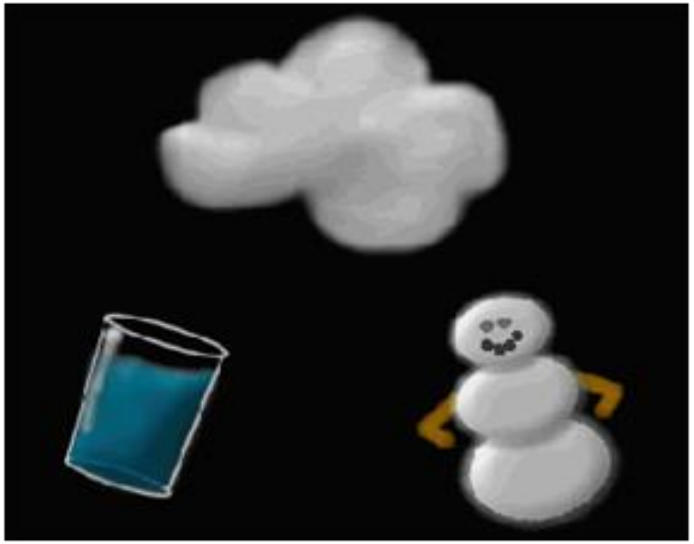
Solid

The state of matter that has a definite shape & volume.

Amorphous Solid

A solid that has a non-crystalline structure and their atoms/molecules are found in a random arrangement.

Other Amorphous Solids….



Cotton

Glass

Marshmallows

Silly Putty

Chewing Gum

Crystalline Solid

A solid that has a regular repeating pattern of atoms/molecules.

Super Saturated Solution

A solution that contains more solute than the solvent can normally hold at a give temperature.

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STATES OF MATTER

WHAT DO YOU KNOW ABOUT STATES OF MATTER?

- What are the three commonly known states of matter?
- What is the **gas, liquid** and **solid** form of water?
- How does matter change state?

Watch this animation on states of matter (click "Play Video"):
Animation: States of Matter
http://teacher.scholastic.com/activities/studyjams/matter_states/
Scholastic

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WHAT ARE STATES OF MATTER?

States of matter are the **physical forms** a substance can take.

There are three common states of matter: **solid**, **liquid**, and **gas**.

Each of these states is also called a **phase**.

THE THREE COMMON STATES OF MATTER

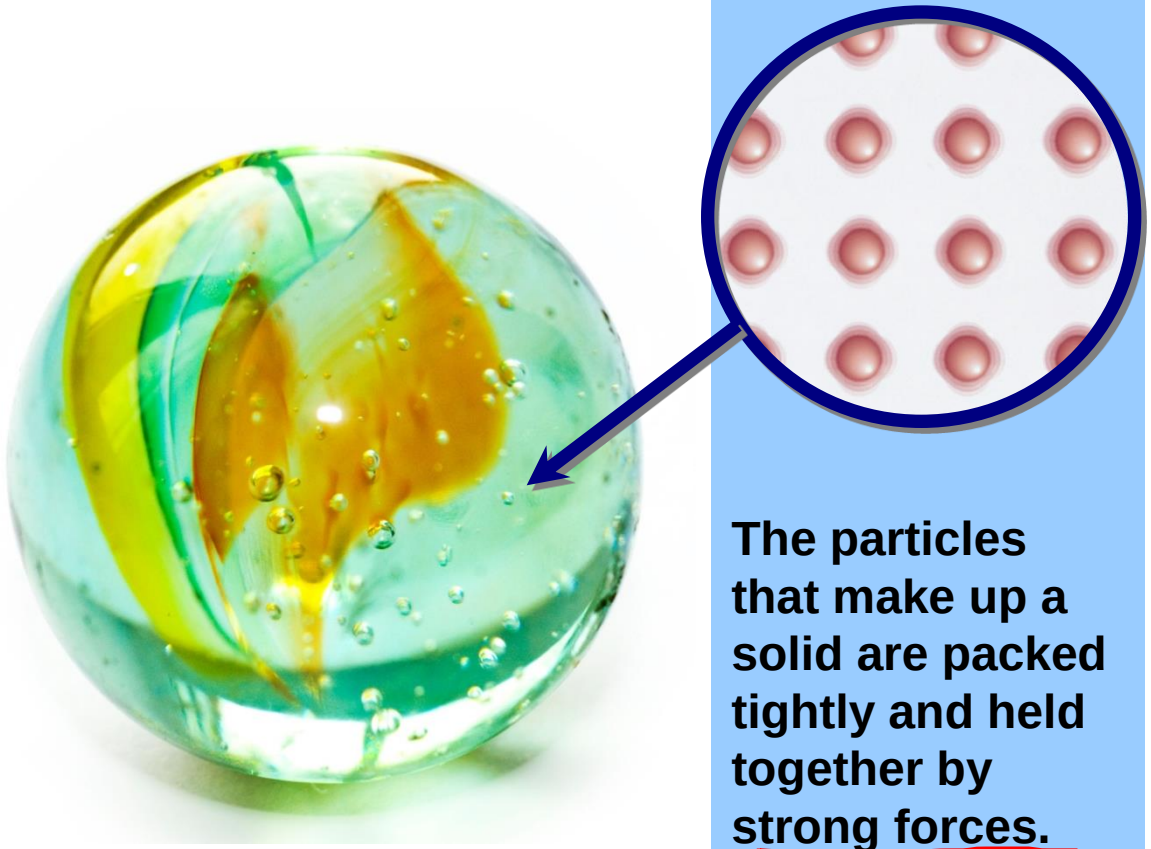
Most substances, like water, can exist in all three states.

An iceberg is made of water in **solid** form.

This glass contains **liquid** water.

A cloud is made of water vapor, a type of **gas**.

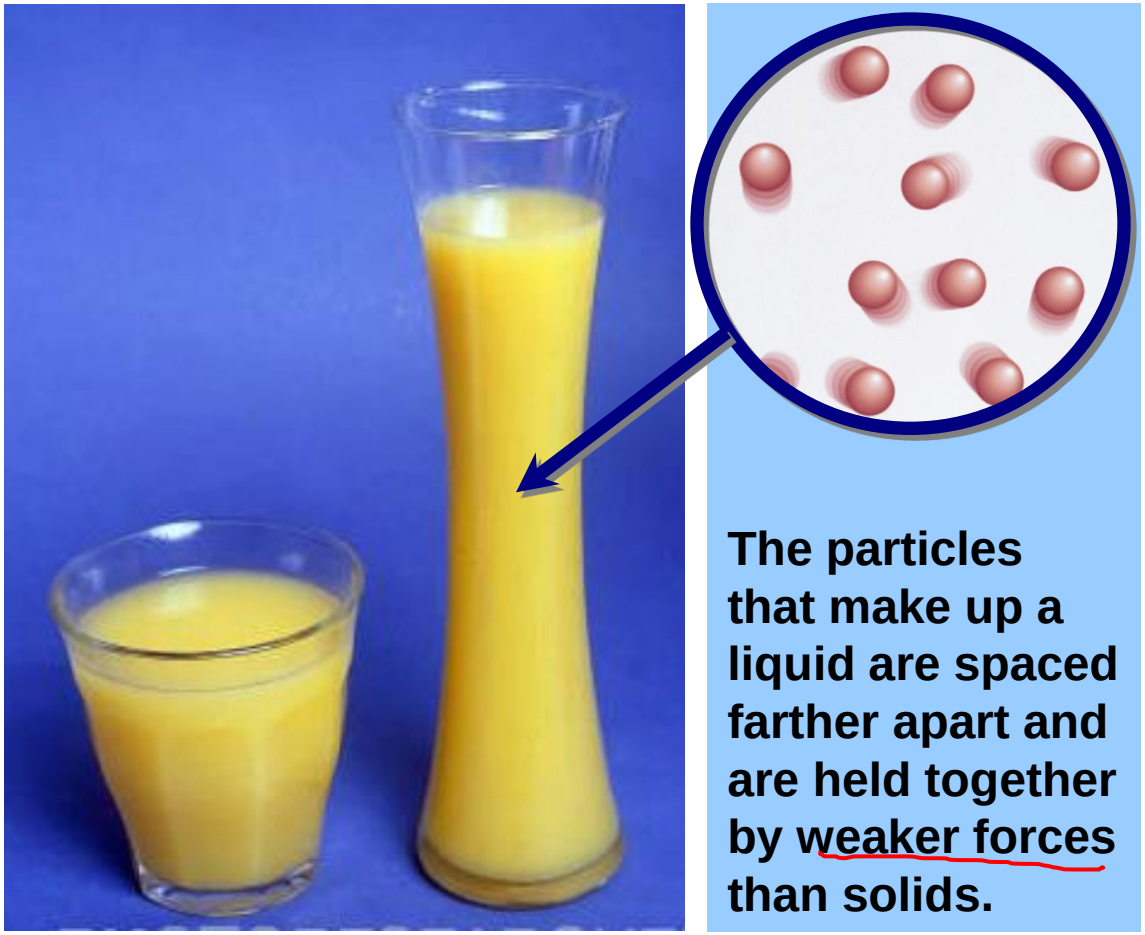
SOLIDS



The particles that make up a solid are packed tightly and held together by strong forces.

- **Solids** have a definite shape and **volume**, or amount of space an object takes up.
- **Solid particles** vibrate in place but cannot move from their position, which is why solids maintain their rigid shape.

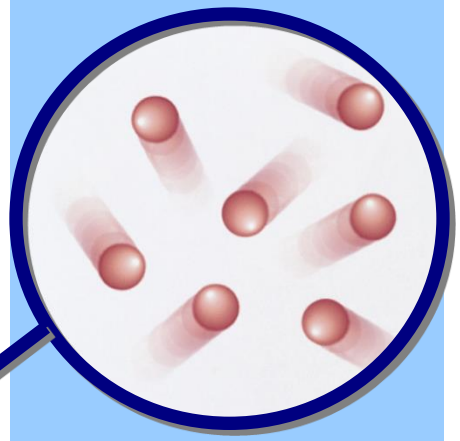
LIQUIDS



The particles that make up a liquid are spaced farther apart and are held together by weaker forces than solids.

- **Liquids** have a definite volume but not a definite shape.
- **Liquid particles** move slightly, which allows liquids to flow and take the shape of the container they are in.

GASES



The particles that make up a gas are fast-moving and are held together by extremely weak forces.

- **Gases** do not have a definite volume or shape.
- **Gas particles** move freely and will expand to fill a container of any size or shape.

PLASMA

- A plasma is an ionized gas.
- A plasma is a very good conductor of electricity and is affected by magnetic fields.
- Plasmas, like gases have an indefinite shape and an indefinite volume.
- Almost 99% of the universe is made of plasma. All of the sun's matter is in the plasma state.

Examples of Plasma

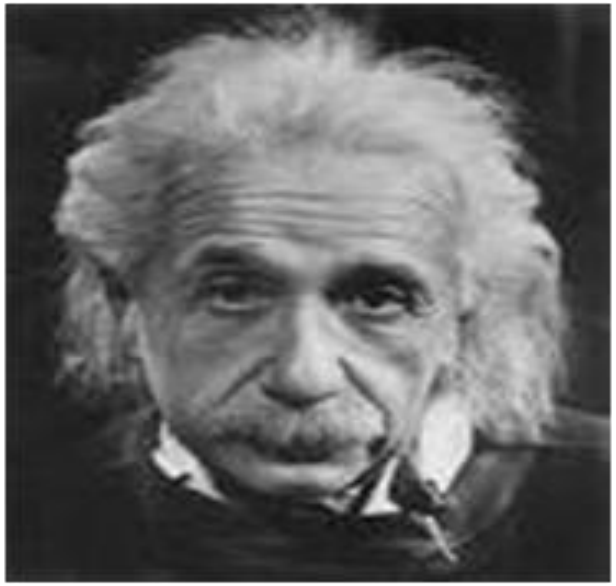
- Lightning
- Aurora
- The Sun
- Stars
- Plasma Ball
- Welding Arcs
- Neon Lights

Bose-Einstein Condensate (BEC)…..

In the 1920s, a young Indian Physicist,
Satyendranath Bose,
conducted experiments with the behavior of photons of light.

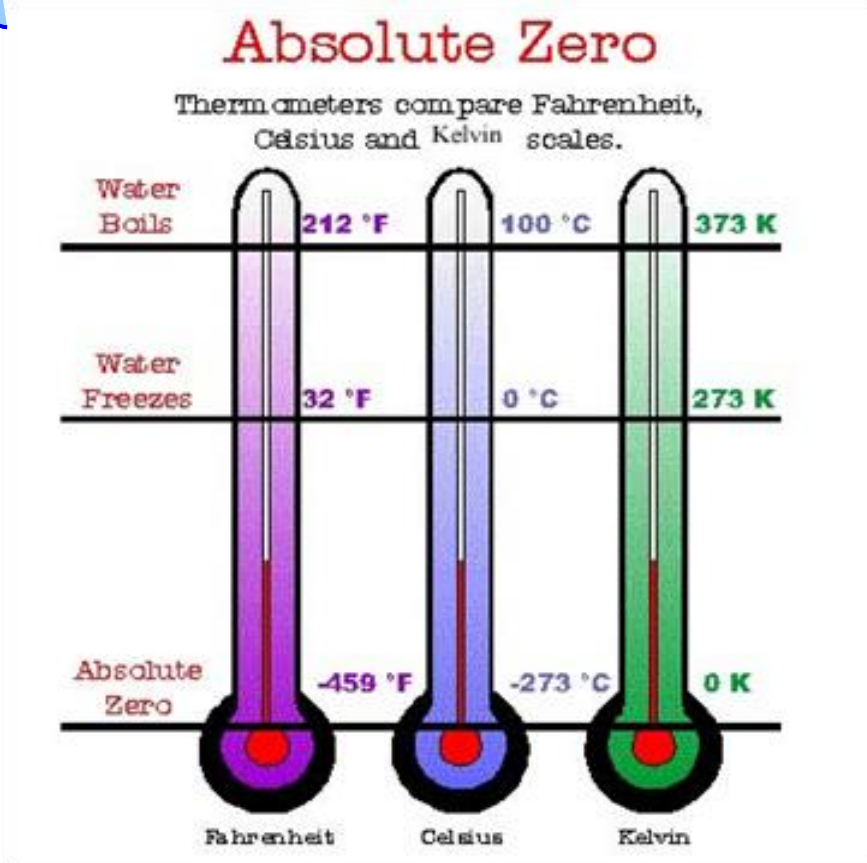
http://www.pronouncenames.com/

Bose shared his works with Albert Einstein who believed that all matter would behave the same way under extremely cold conditions.



At temperatures near Absolute Zero particles would slow down and act as one.

BEC



This is known as
a

CONDENSATE

BOSE EINSTEIN CONDENSATE

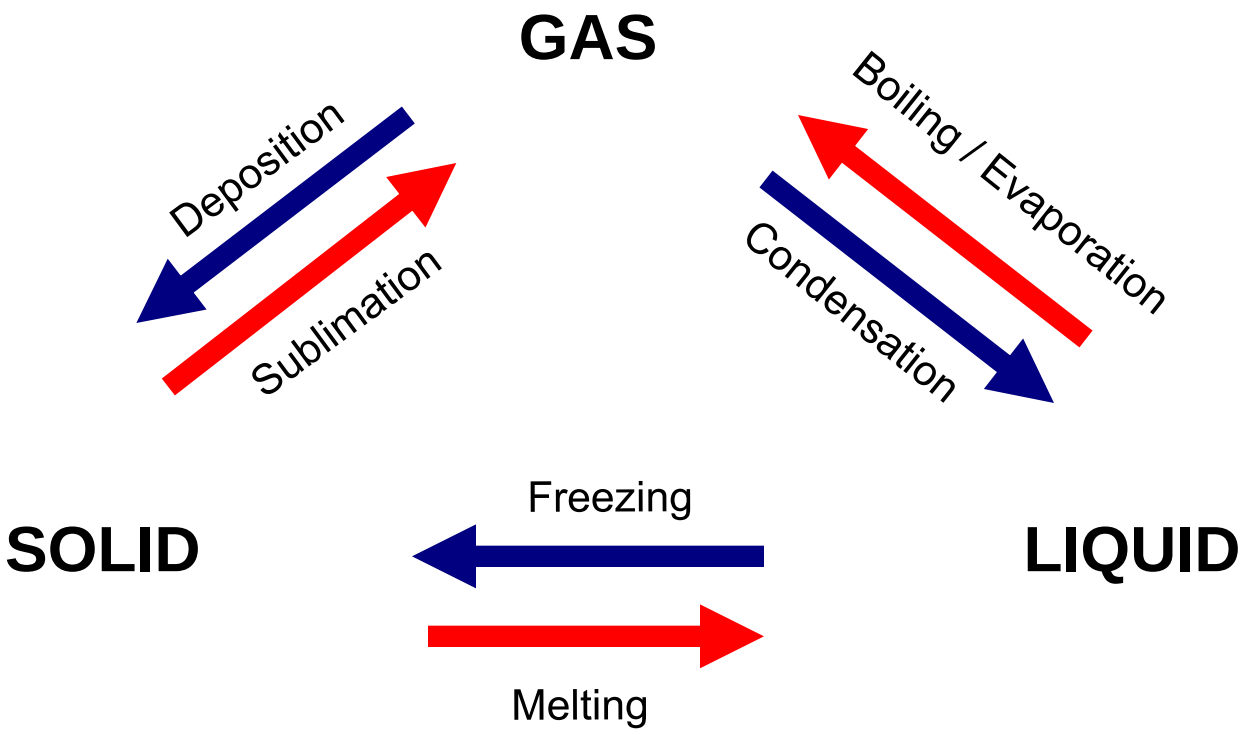
In 1959, scientists were finally able to achieve temperatures near absolute zero and created the new material….known as

‘BEC’

CHANGES OF STATE

- Matter can change from one state to another.
- Even though the physical form of the matter changes, it remains the same substance.
- Changes of state occur when **thermal energy** (*heat energy*) is absorbed or released by a substance.

WHAT ARE THE CHANGES OF STATE?



Adding energy, a solid changes to a liquid.

The process of changing a solid to a liquid is called:

MELTING

When energy is removed from a liquid, it changes to a solid.

The process of changing from a liquid to a solid is called….

<u>FREEZING</u>

Freezing can occur at any temperature… high or low!

Adding energy changes a liquid to a gas

If this phase change occurs below the boiling point, it is called….

<u>EVAPORATION</u>

"I blame global warming!"

Sweat is your body's natural air conditioner!

In order for sweat to evaporate, it needs to absorb heat from your body. This cools your skin!

If boiling occurs to change the liquid to a gas…

This is known as

<u>VAPORIZING</u>

Changing from a gas to a liquid…

CONDENSATION

Sometimes a solid will change directly to a gas.

Cobden Unit School District #17, Illinois

Solid to Gas ….

SUBLIMATION

Dry Ice can be Dangerous!!

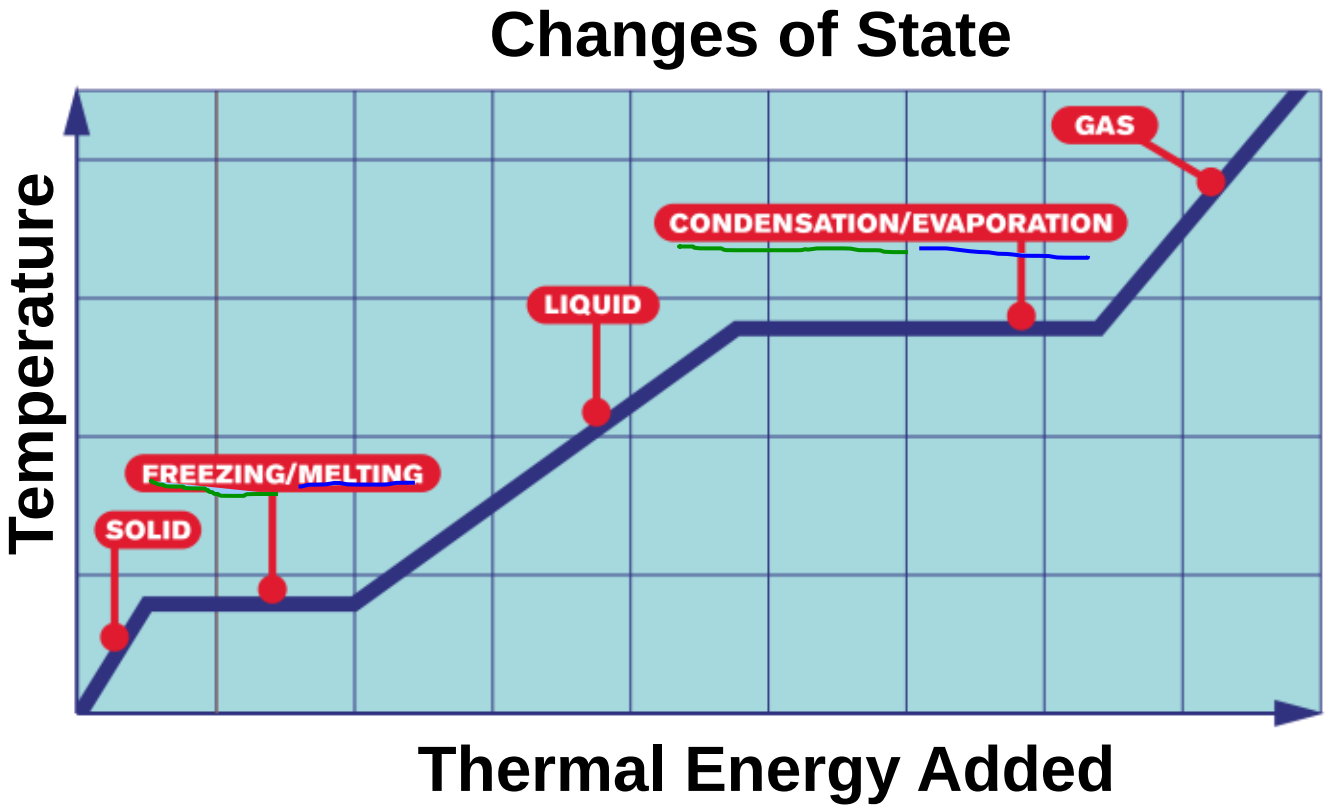
- This injury was caused by a dry ice bomb!

A gas can change directly to a solid….

Frost is an example of this process, called…

<u>DEPOSITION</u>

HOW DOES MATTER CHANGE STATE?



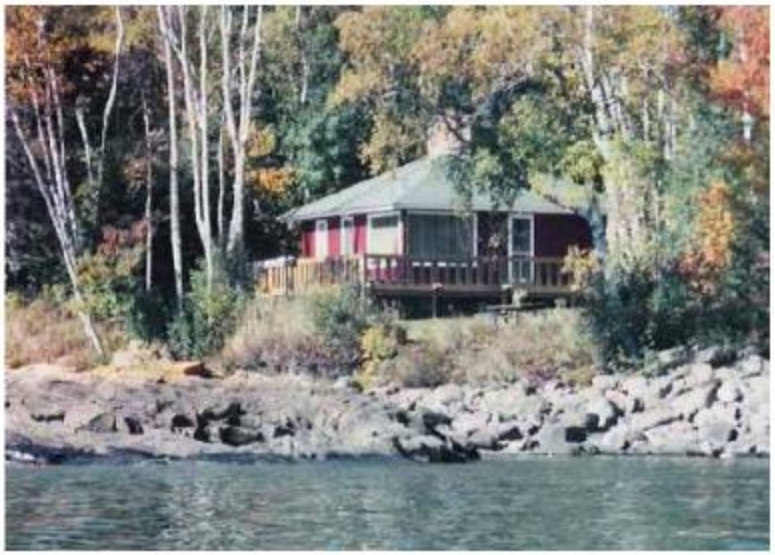
- **As heat increases,** a substance changes from a solid to a liquid, and finally to a gas.
- **As heat decreases,** a substance changes from a gas to a liquid, and finally to a solid.

- **When energy is released , the phase change is <u>EXOTHERMIC</u>**

<u>For example, when liquid water changes to solid ice, energy is</u>
<u>released and warms the surroundings.</u>

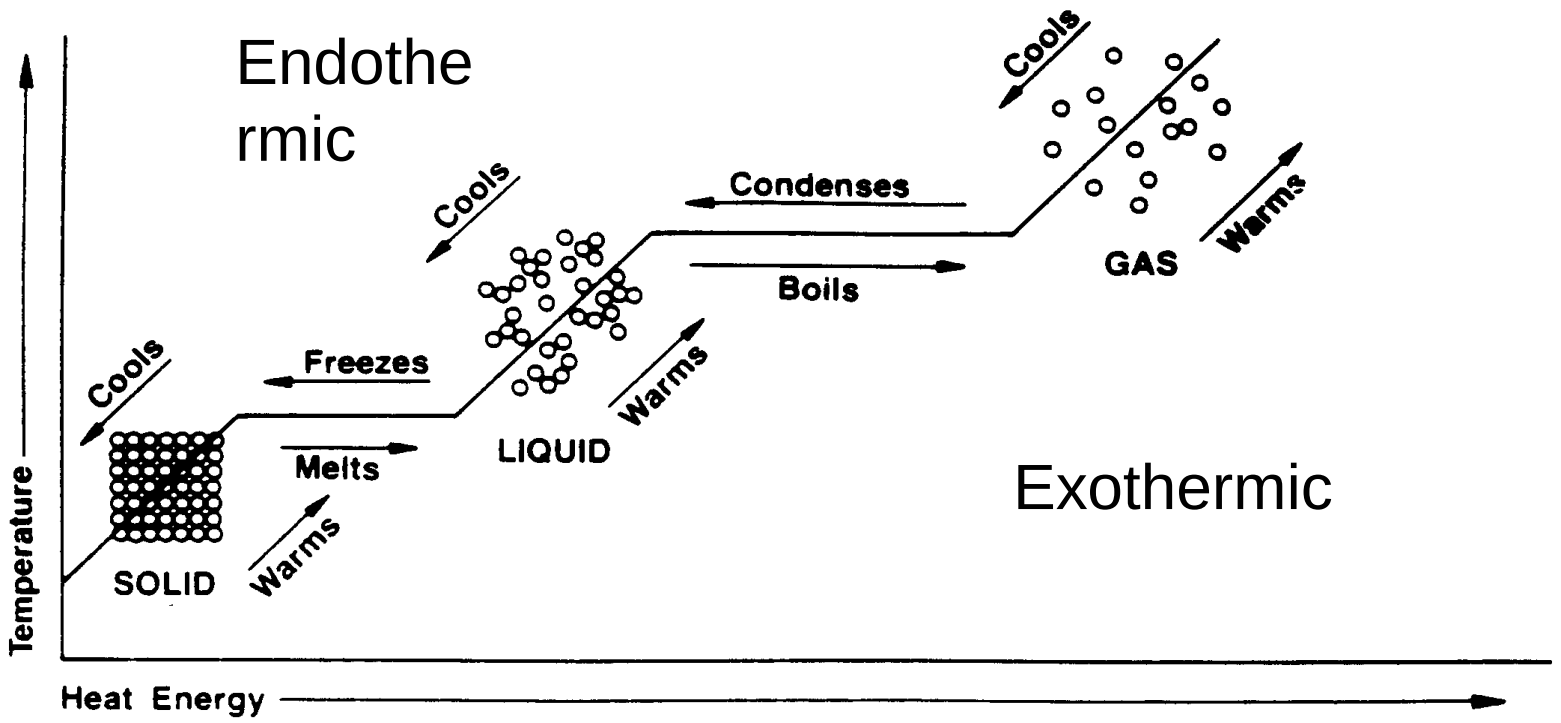
When energy is absorbed , the phase change is <u>ENDOTHERMIC</u>

<u>For example, when liquid water evaporates to a gas, energy is</u>
<u>absorbed and cools the surroundings.</u>



Phase Changes

Endothermic and Exothermic



The temperature at which a substance changes phase is unique for that substance and is used to help identify it.

For example: The Boiling Points (at sea level)…

Oxygen: -182.95^{o} C (-297.31^{o} F)
Bromine: 58.8^{o} C (137.8^{o} F)
Gold: 2856^{o} C (5173^{o} F)

“Freezing Point” = “Melting Point”

(What you call it depends on what you start with.)

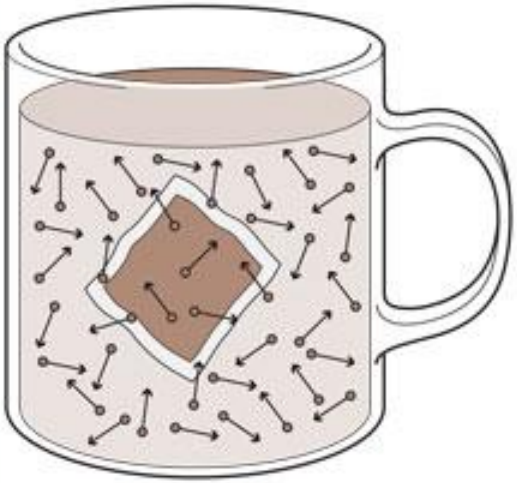
- Liquid water’s “**Freezing Point**” is 0° C.
- Solid water’s “***Melting Point***” is 0° C.

Boiling Points CAN change

- The normal boiling point of water is 100^{o}C. But if you try to cook an egg in boiling water while camping in the Rocky Mountains at an elevation of 10,000 feet, you will find that it takes longer for the egg to cook because water boils at only 90^{o}C at this elevation.

Making a cup of tea in your kitchen

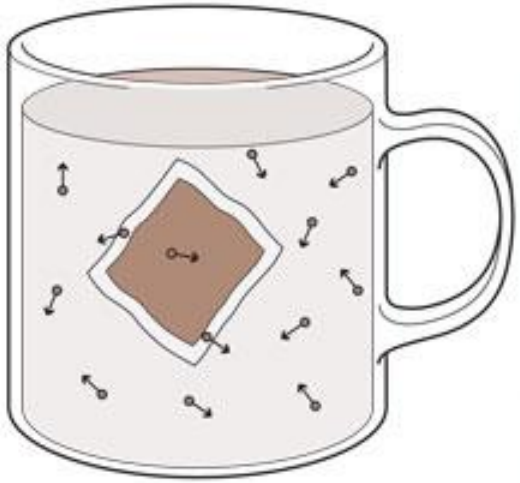
Sea level (Altitude = 0 m)
Atmospheric pressure = 101 kPa
Boiling point of water = 100°c



The chemicals which give tea its flavour diffuse out of the tea bag. Individual particles gain lots of energy from the hot water and move quickly, spreading the great taste of the tea through the cup of water.

Making a cup of tea on Everest

Altitude = 8,850 metres
Atmospheric pressure = 33 kPa
Boiling point of water = 70°c



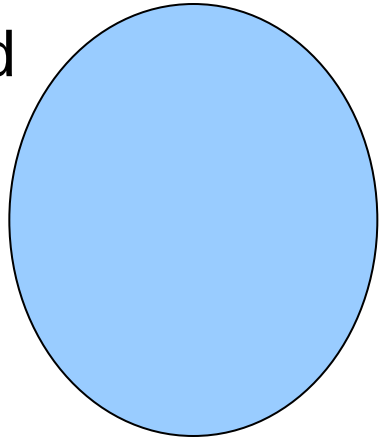
At the summit of Everest water boils at just 70°c. This means that particles diffusing out of the tea bag do not gain as much energy and do not diffuse as quickly through the cup of water.

Extra stuff next!

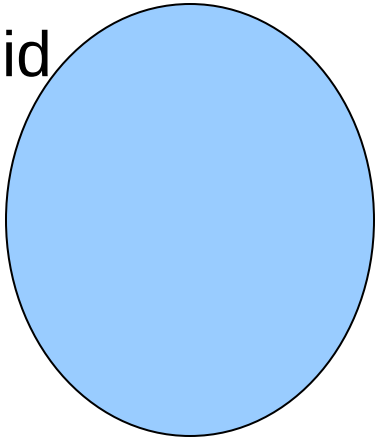
Kinetic Theory

- All matter is in constant motion.
- Kinetic Energy: Energy an object has due to its motion
- The particles that make up matter are in constant motion and have a force of attraction for each other.

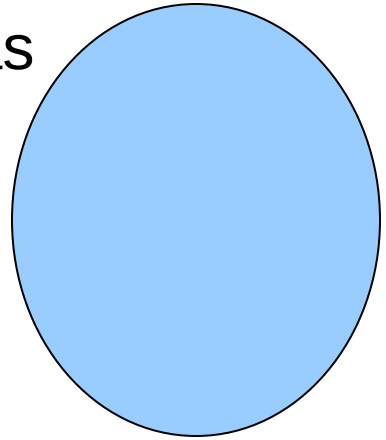
Solid



Liquid



Gas



DISCUSSION QUESTIONS

- **How does pressure and temperature affect the state of water, carbon dioxide, and hydrogen?**

Use this interactive PBS Web site to find out:
www.pbs.org/wgbh/nova/zero/matt-flash.html.

- **On Earth, we typically see gases, liquids, and solids. But is there a fourth state of matter?**

Learn about a fourth state of matter at this Web site:
http://www.spaceweathercenter.org/amazing_plasmas/02/02.html

HANDS-ON SCIENCE (No Lab Required)

This demo explores melting points.

Materials

chocolate chips, candy-coated chocolates, baggies, two mugs, water, thermometer

Directions

1. Place chocolate chips and candy-coated chocolate in separate bags.
2. Place each bag of chocolate in a half-filled mug of room-temperature water.
3. Your teacher will continue to increase the temperature in each mug by adding boiling water a little at a time.
4. As a class, monitor the temperature with a thermometer until the chocolate starts to melt in the bag.

Conclusion

At what temperature does each type of chocolate start to melt?
Why do you think this is?