

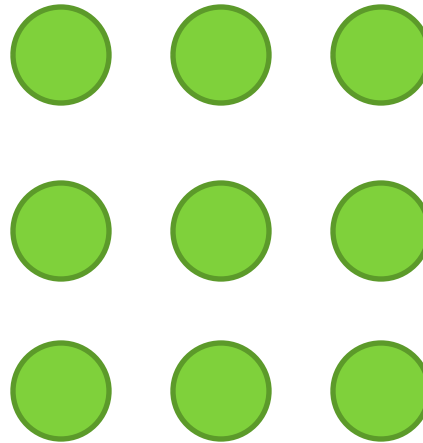




Phases of Matter

{ Phases of Matter }

- **Solids**: Particles are tightly packed together and DO NOT move past each other. They vibrate in place.



{ Phases of Matter }

- Examples of Solids:



{ Phases of Matter }

- Solids have a definite **SHAPE**
- Solids have a definite **VOLUME**



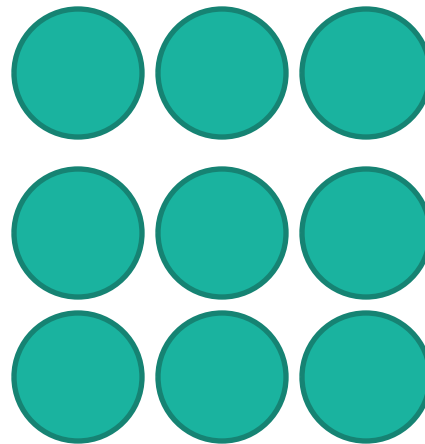
Example—Marble

Shape = Sphere

Volume = can be found
using water displacement

{ Phases of Matter }

- **Liquids**: Particles are still tightly packed together and they SLIDE move past each other.



{ Phases of Matter }



- Examples of Liquids:



{ Phases of Matter }

- Liquids **DO NOT** have a definite **SHAPE**, they take the shape of their container.
- Liquids have a definite **VOLUME**



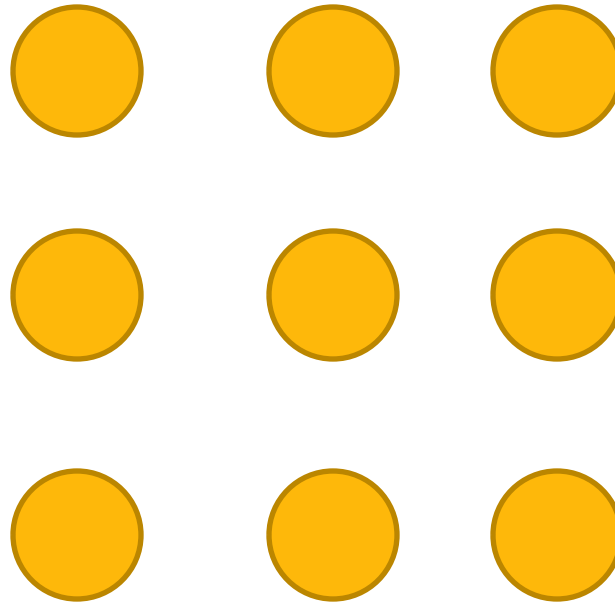
Example—Orange Juice

Shape = None, it takes the shape of the glass.

Volume = can be found using a beaker or graduated cylinder.

{ Phases of Matter }

- **Gases**: Particles are not tightly packed together, and have so much energy they slip past each other quickly.



{ Phases of Matter }

- Examples of Gases:



{ Phases of Matter }

- Gases **DO NOT** have a definite **SHAPE**
- Gases **DO NOT** have a definite **VOLUME**



Example—Smoke

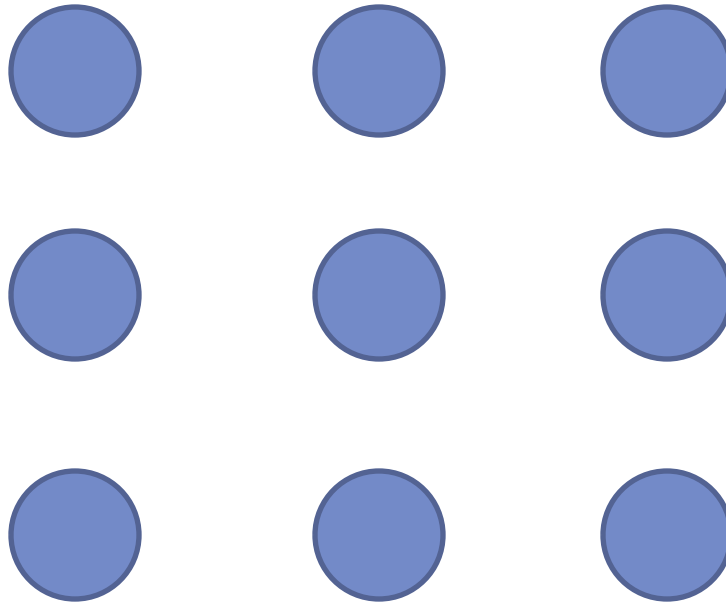
Shape = Not definite.

Volume = Not definite.

Gases are usually always expanding.

{ Phases of Matter }

- **Plasma**: Particles are moving so quickly it is hard to see what they are actually doing.



{ Phases of Matter }

- Examples of Plasma on Earth:



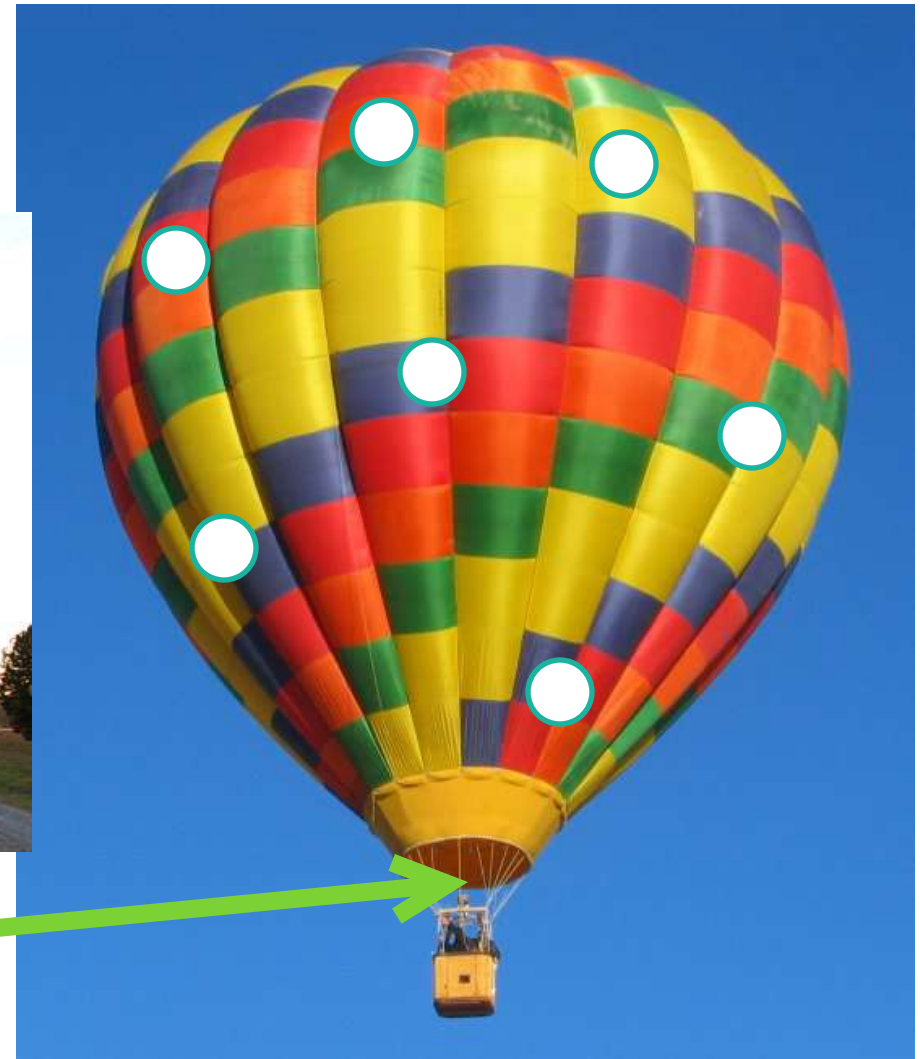
{ Phases of Matter }

- Two “laws” about gases...


$$\uparrow T = \uparrow V$$

1. Charles' Law

- Volume (of gas) and Temperature
- When temperature goes **up**, volume goes up
- When temperature goes **down**, volume goes down



Gas + Heat
= Expansion!

{ Phases of Matter }

- Two “laws” about gases...


$$\uparrow V = \downarrow P$$

2. Boyle's Law

- Volume (of gas) and Pressure
- When pressure goes **up**, volume goes down
- When pressure goes **down**, volume goes up



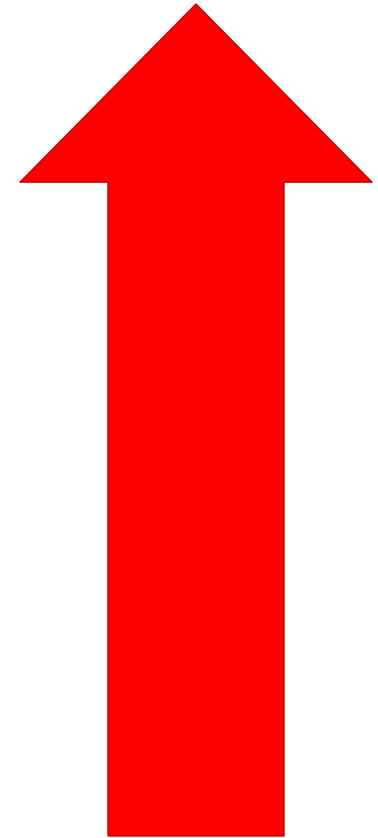
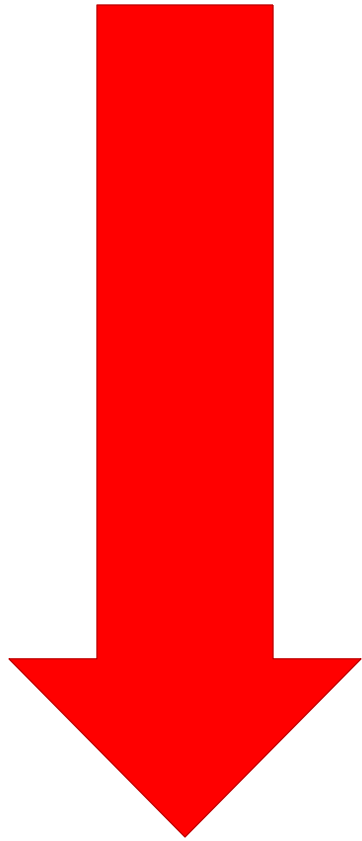
The amount of
water pressure
determines the size
of bubbles in the
water.



Bubbles

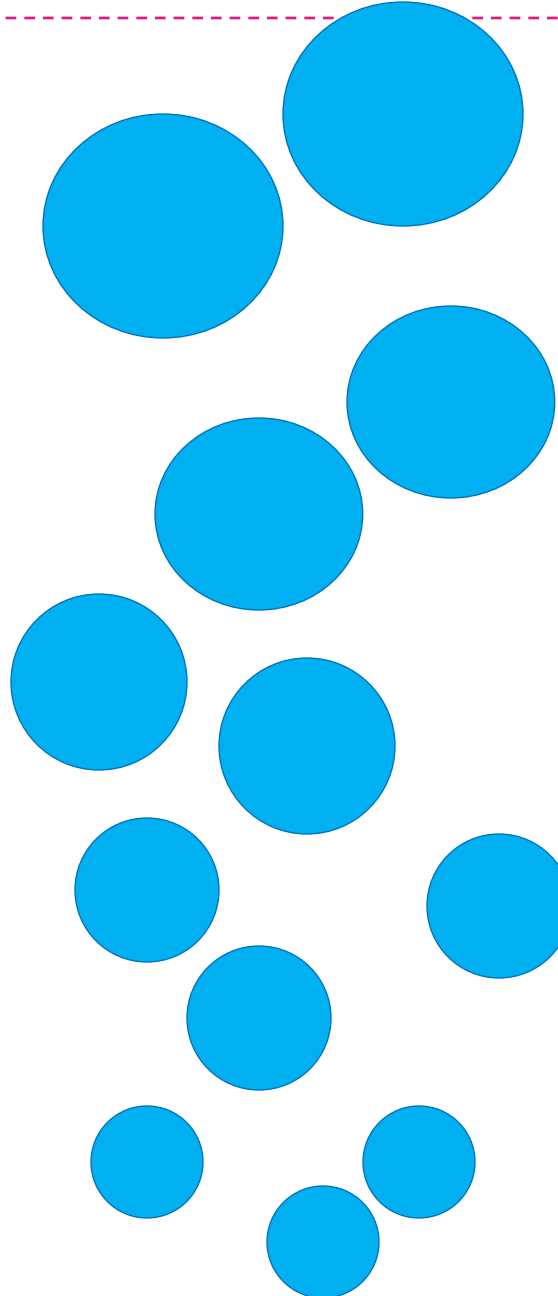
Low pressure

Large Volume



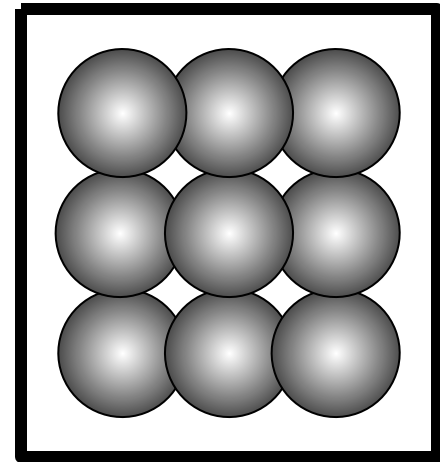
High pressure

Small Volume



{ Bose-Einstein Condensate }

- Exist at extremely cold temperatures (around absolute zero or -460°F)
- Particles are super unexcited
- Particles lock or "clump" together so firmly that they move as a single unit
- Definite shape and volume (?)

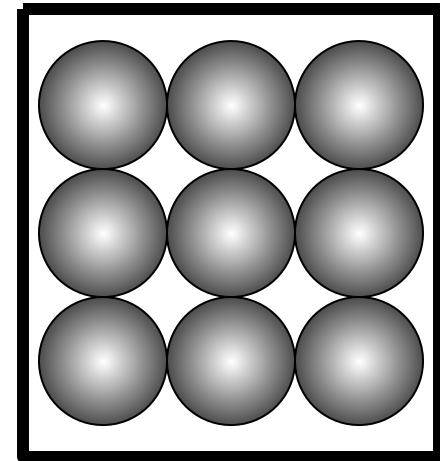




Solid



- Particles are tightly compact
- Very Dense (thick)
- Particles **vibrate** without the ability to move freely
- Definite (exact) shape and volume
- Solid Animation



{ Phases of Matter }

- **ADDED**

The added energy has caused the chocolate particles to speed up. Before they were vibrating in place, now they are moving fast enough to slip past one another.



Solid

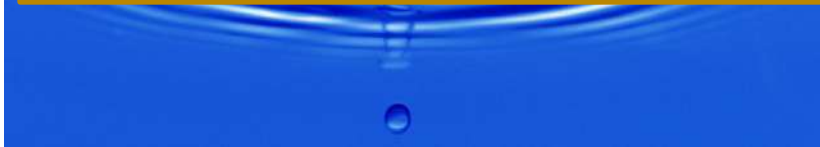


Liquid

{ Phases of Matter }

- **ADDED**

The added energy has caused the water particles to speed up. Before they were moving fast enough to slip past one another, now they have enough energy to break away from one another and expand.



Liquid



Gas

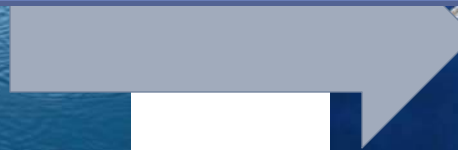
{ Phases of Matter }

Taken Away

Taking away energy from a rain drop slows the water molecules down so that they no longer slide past one another.



Liquid



Solid

Matter

- Anything that has mass and takes up space (volume)
 - Examples:
 - A brick(a solid) has mass and takes up space
 - A desk has mass and takes up space
 - A pencil has mass and takes up space
 - Air (a gas) has mass and takes up space
 - Gasoline (a liquid) has mass and takes up space

All of the above examples are considered matter because they have mass and take up space. Can you think of anything that would not be considered matter?

Matter

- Yes! Fire is NOT an example of matter

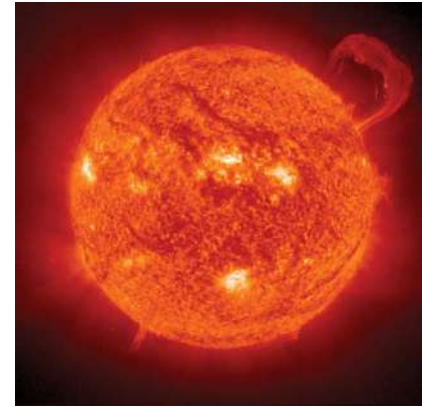


WHY

Fire is NOT an example
of matter



When a gas is heated by many thousands of degrees, the individual atoms collide with enough violence to knock electrons free, resulting in a collection of positively charged ions and free, negatively charged electrons. The gas is said to be ionized, and when a sizable number of the atoms become ionized, the gas is called a plasma.

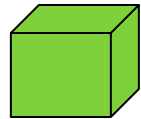


Photograph: The interaction of the Sun's magnetic field with the motions of the plasma in and around the Sun ... The interaction of the Sun's magnetic field with the motions of the plasma in and around the Sun ... NASA

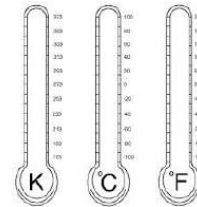
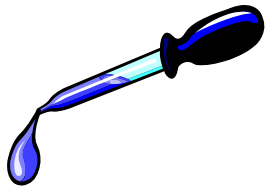
Fire while hot does not ionize with enough particles under pressure to be considered a traditional plasma or for that matter... MATTER; it is considered by most scientists to be a chemical reaction.

Physical Properties of Matter

- Any property of matter that can be observed or measured without changing the identity of the matter
- Examples



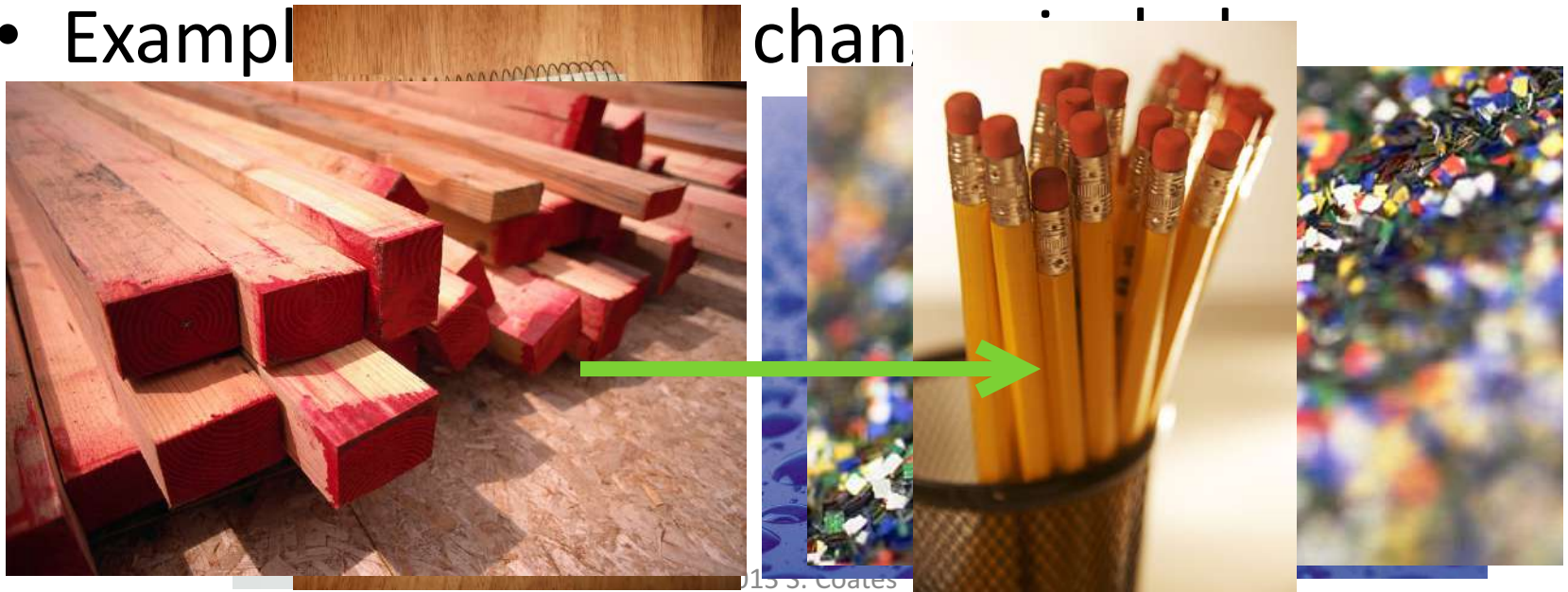
temperature
color
shape
taste
state/phase
density



$$D = \frac{m}{V}$$

{ Phases of Matter }

- Physical Changes: only the phase changes, the substance does not.
- Physical changes usually change the size or shape of the substance.
- Example



Chemical Properties of Matter

- any property of matter that describes a substance based on its ability to change into a new substance
- Examples



flammability

reactivity with vinegar

reactivity with oxygen



Iron + Oxygen \rightarrow Iron oxide (rust)



{ Phases of Matter }

- Chemical Changes: changes that create NEW materials.
- The original materials are changed into something different.
- Examples of chemical changes include:



Chemical or Physical Property?

1. Paper is white

_____ Property

2. Boiling point of H_2O is 100°C

_____ Property

3. Zinc reacts with hydrochloric acid and creates hydrogen gas

_____ Property

4. Nitrogen does not burn

_____ Property

5. Sulfur smells like rotten eggs

_____ Property

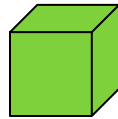
Comparing Physical and Chemical Properties

<u>Substance/Matter</u>	<u>Physical Property</u>	<u>Chemical Property</u>
Helium	Less dense than air	Nonflammable
Wood	Grainy texture	Flammable
Baking soda	White powder	Reacts with vinegar to produce bubbles
Powdered sugar	White powder	Does not react with vinegar
Rubbing alcohol	Clear liquid	Flammable
Red food coloring	Red color	Reacts with bleach and loses color
Iron	Malleable	Reacts with oxygen

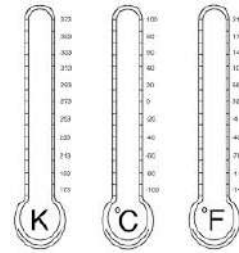
Physical Properties of Matter

- Any property of matter that can be observed or measured without changing the identity of the matter

- Examples



temperature

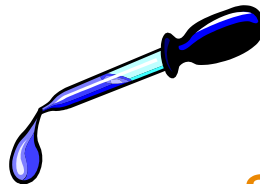


color



shape

taste



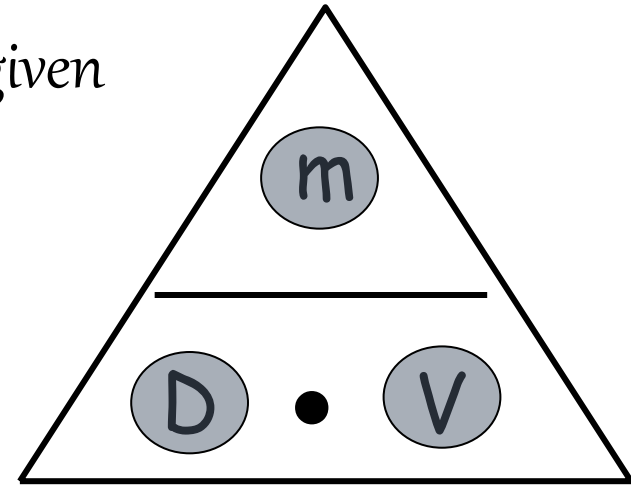
state/phase

density

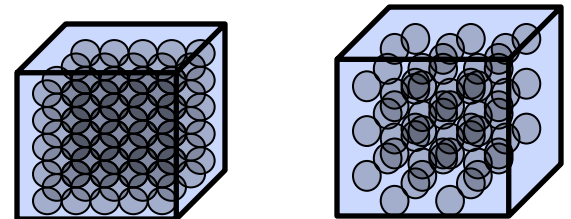
$$D = \frac{m}{V}$$

Density

- a measure of the amount of matter present in a given volume of a substance
- typically expressed in the following units:
 - grams per cubic centimeter (g/cm^3) for solids
 - grams per milliliter (g/ml) for liquids
- can change as temperature and pressure change
- does not depend on how much of a substance you have (intrinsic property) – in other words, the density of a gold bar would be the same as the density of a gold flake

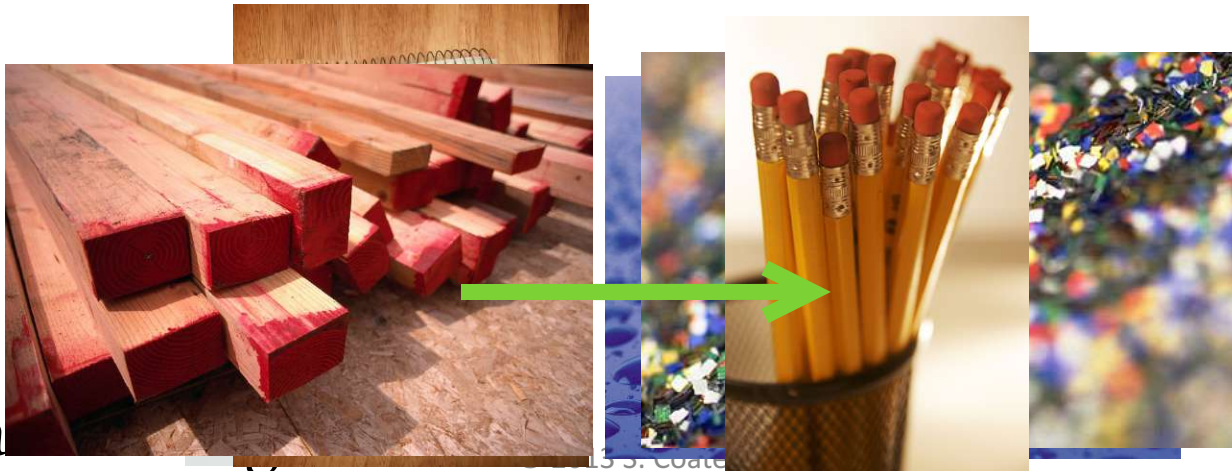


Which do you think is more dense? Why?



Phases of Matter

- Physical Changes: only the phase changes, the substance does not.
- Physical changes usually change the size or shape of the substance.
- Examples of physical changes include:

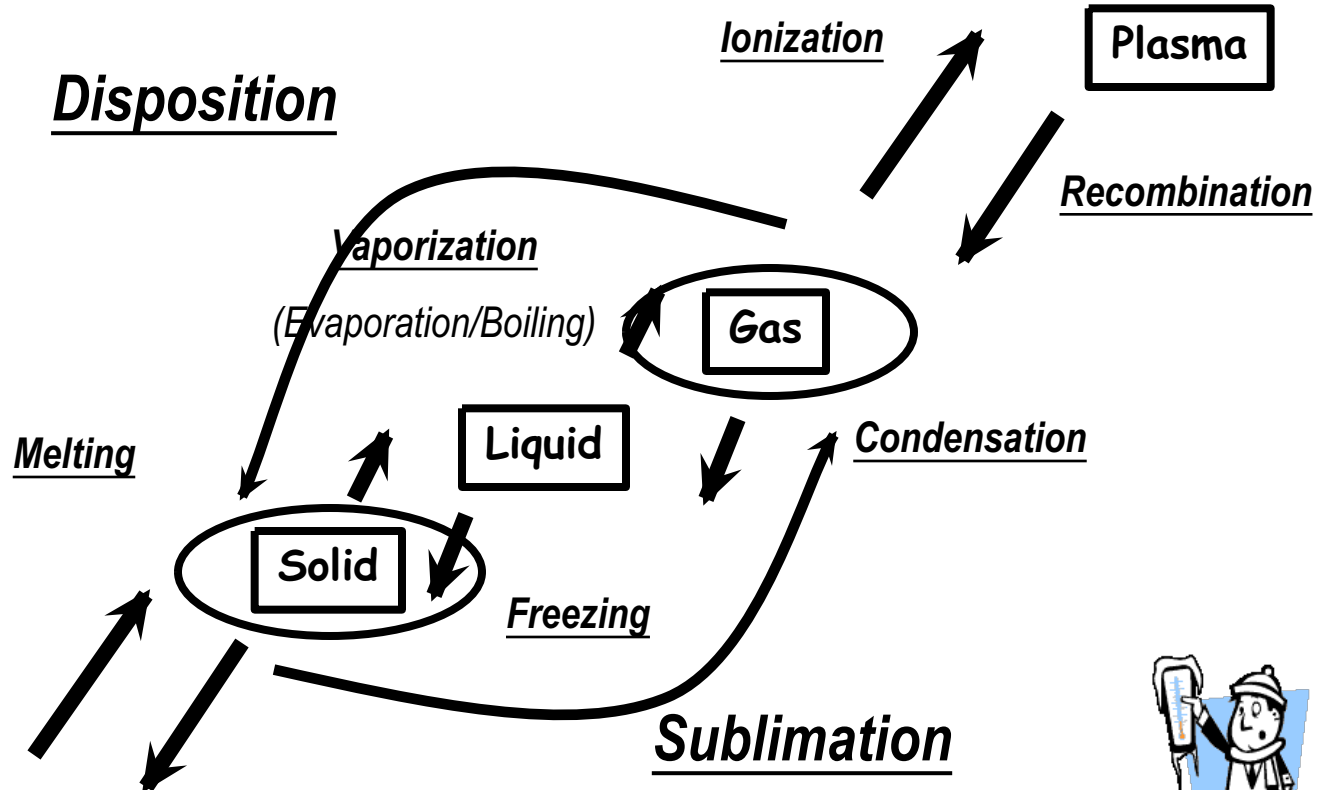


- And Ph

Why do you think Bose-Einstein and plasma are not equally distanced from the other three states of matter?



Disposition

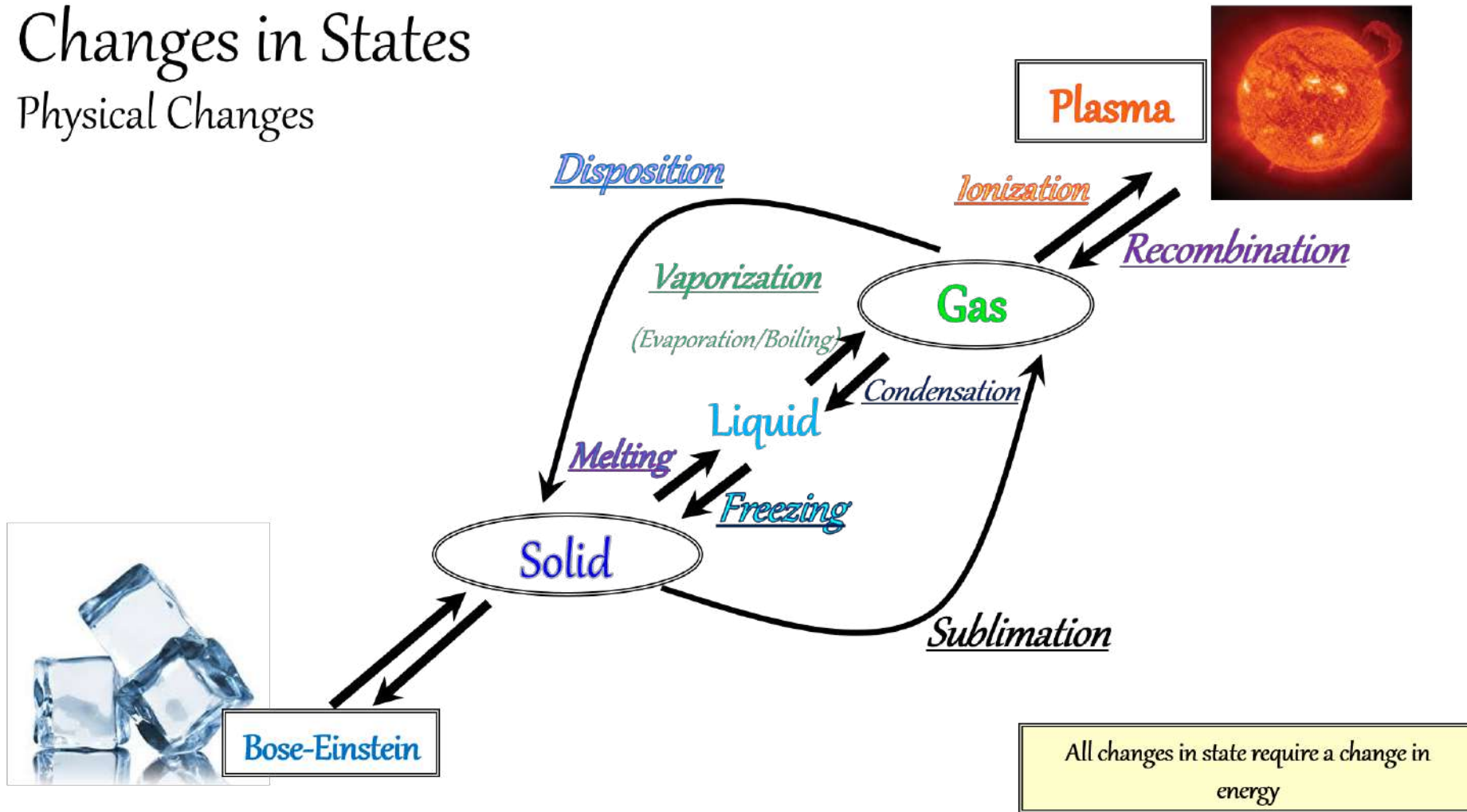


Bose-Einstein

All changes in state require a change in energy

Changes in States

Physical Changes



Chemical Properties of Matter

- any property of matter that describes a substance based on its ability to change into a new substance
- Examples



flammability

reactivity with vinegar

reactivity with oxygen



Iron + Oxygen → Iron oxide (rust)



Chemical or Physical Change?

1. Bending a Paper Clip

Physical Change

2. Baking a cake

Chemical Change

3. The sublimation of carbon dioxide

Physical Change

4. Crushing an aluminum can

Physical Change

5. Vinegar and baking soda combining to create salt and water

Chemical Change

EXOTHERMIC

Exothermic- the word describes a process that releases energy in the form of heat.

Forming a chemical bond releases energy and therefore is an exothermic process.

Exothermic reactions usually feel hot because it is giving heat to you.

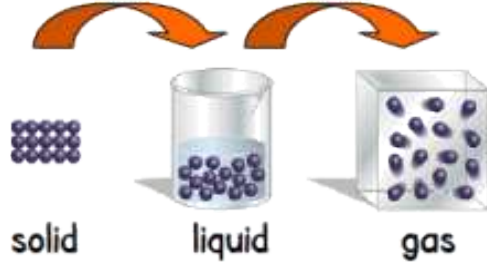
ENDOTHERMIC

Endothermic - a process or reaction that absorbs energy in the form of heat.

Breaking a chemical bond requires energy and therefore is Endothermic.

Endothermic reactions usually feel cold because it is taking heat away from you.

PHYSICAL CHANGES



Changing state from solid to liquid to gas and back again is a **reversible change**.

Heating is the process of increasing the temperature. Cooling is the opposite process where temperature is decreased. We use a **thermometer** to measure temperature.



A wind turbine helps to generate electricity from **renewable** sources.



When chocolate is **melted** it can **solidify** again. The change is **reversible**.

Cooking eggs, by frying, boiling, scrambling, poaching etc., is always an **irreversible change**.



When oil, vinegar and egg yolks are mixed together they make a **precipitate** called mayonnaise. This change is **irreversible**.

Dissolving sugar in water is a reversible change. When the water is **evaporated** it leaves the sugar behind.



When vitamin tablets **effervesce** (fizz) a gas is produced. This is an **irreversible change**.

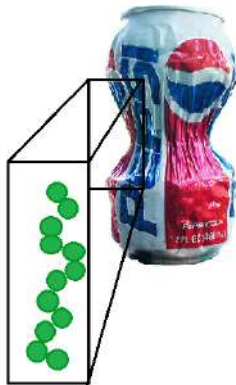
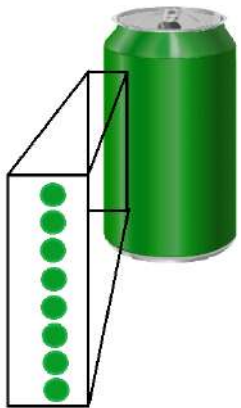
Any **reaction**, such as burning, that causes new **substances** to be formed is called a **CHEMICAL CHANGE**. These changes are **irreversible**.



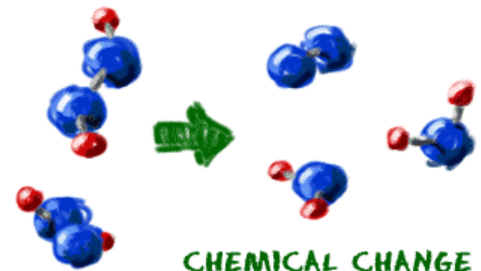
Coal, gas and oil are all **fossil fuels**. They **non-renewable** energy sources.

Law of Conservation of Matter

- Matter cannot be created or destroyed. Either it is changed physically or chemical changes allow for atoms to break and establish new bonds creating different substances with the same molecules.



PHYSICAL CHANGE
OF WATER INTO ICE



CHEMICAL CHANGE
OF HYDROGEN PEROXIDE
INTO WATER

Mass vs. Weight

Mass

- a measure of how much matter an object is made of
- does not change, regardless of where something or someone is



Mass = 59 kg

Weight = 579 N

Why do you think
the person's weight
is less on the
moon?

Weight

- the force of gravity on an object
- equal to the mass of the body times the local acceleration of gravity



Mass = 59 kg

Weight = 96 N

<http://www.exploratorium.edu/ronh/weight/index.html>



5 Physical States of Matter

- Bose-Einstein
- Solid
- Liquid
- Gas
- Plasma



Phases of Matter

- Matter can change phases permanently or temporarily.
- Temporary changes are called **PHYSICAL** changes.
- Permanent changes are called **CHEMICAL** changes.

{ Phases of Matter }

- ## Chemical

The bottle rocket is being turned into a new substance.



{ Phases of Matter }

- ## Physical

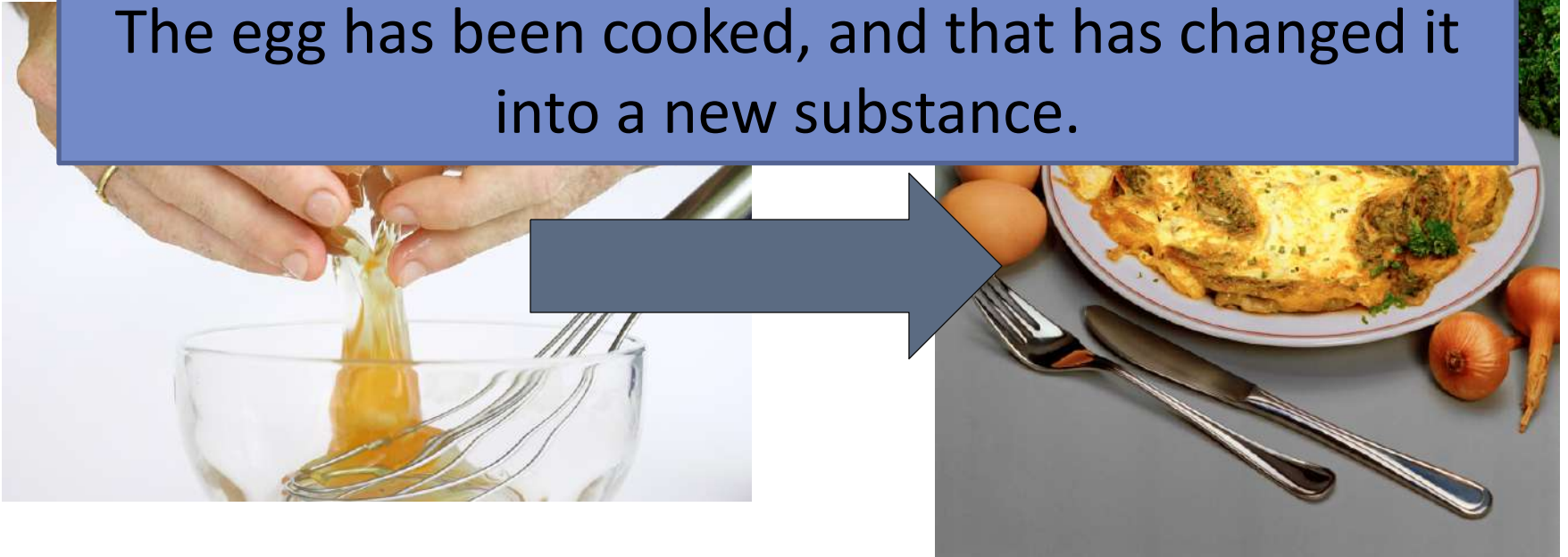
The ingredients for ice cream are mixed and cooled in a machine. The ice cream has the same chemical structure when it was a liquid as it does when it is a solid.



{ Phases of Matter }

- ## Chemical

The egg has been cooked, and that has changed it into a new substance.



{ Phases of Matter }

- Let's summarize:

Phase	Motion of Particles	Speed of Particles
Solid	Particles vibrate in place	Slow
Liquid	Particles are close, but can slide past one another	Medium
Gas	Particles are constantly expanding	Fast
Plasma	Unknown	Faster than we can see

{ Phases of Matter }

- Let's summarize:

Phase	Definite Shape?	Definite Volume?
Solid	YES	YES
Liquid	NO	YES
Gas	NO	NO
Plasma		

Self-Check

1. I can **describe** how atoms move in a solid, liquid, and gas
2. I can **describe** the speed/energy of the atoms in a solid, liquid, and gas.
3. I can **explain** how the distance between atoms is related to the states of matter.
4. I can **indicate** whether or not each state of matter has a definite shape and volume
5. I can **explain** how the volume of a gas is changed by a change in pressure.
6. I can **explain** how the volume of a gas is changed by a change in temperature.

YES	NO