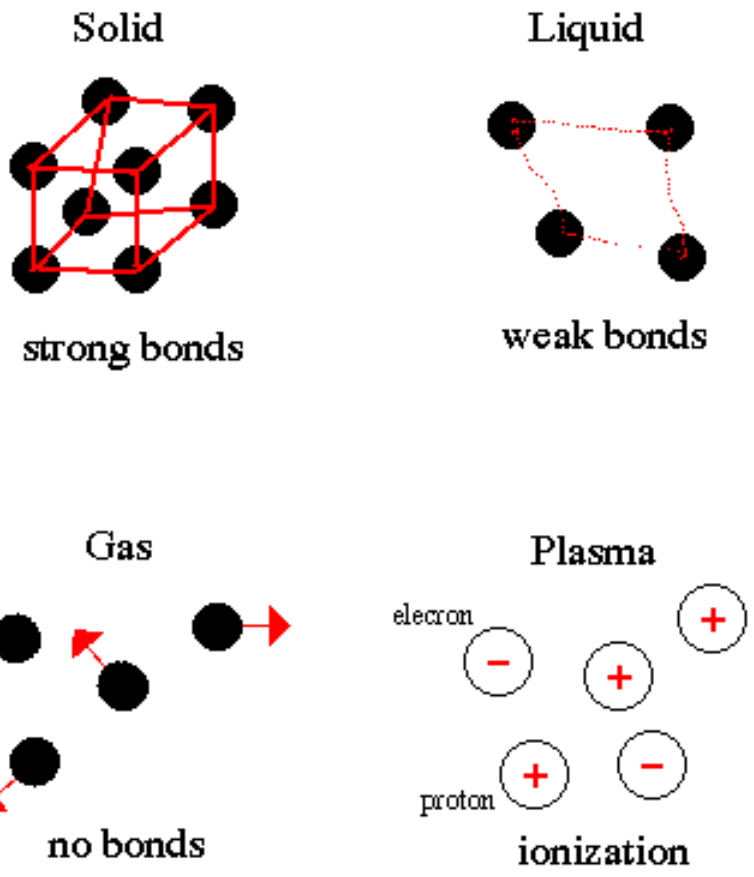
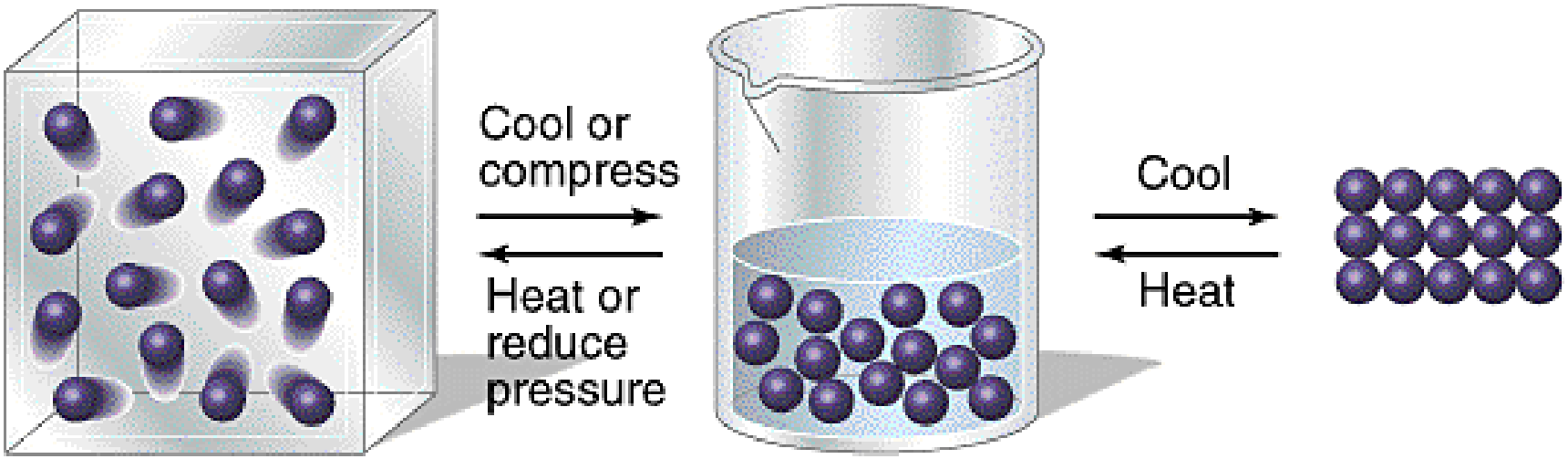
Solids, Liquids & Gases

Matter and Temperature

- **There are four states of matter**





Gas

Total disorder; much empty space; particles have complete freedom of motion; particles far apart.

Liquid

Disorder; particles or clusters of particles are free to move relative to each other; particles close together.

Crystalline solid

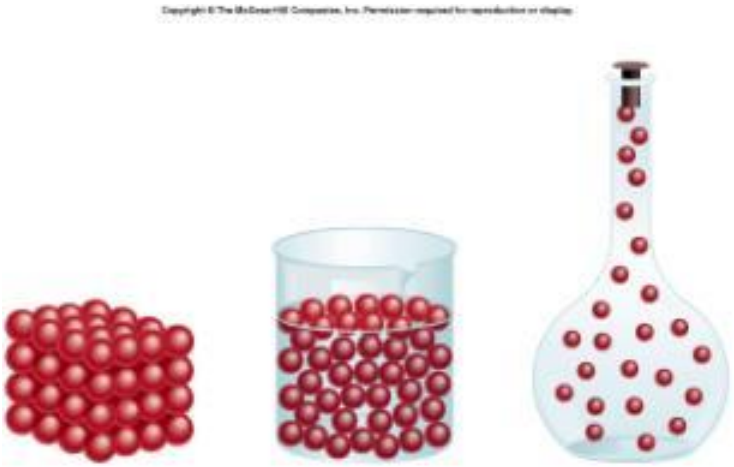
Ordered arrangement; particles are essentially in fixed positions; particles close together.

Solids

- **definite shape and volume**
  As with all materials solids are made up of particles in constant motion

Kinetic Theory of Matter

- All matter is made of tiny particles and those particles are in constant motion

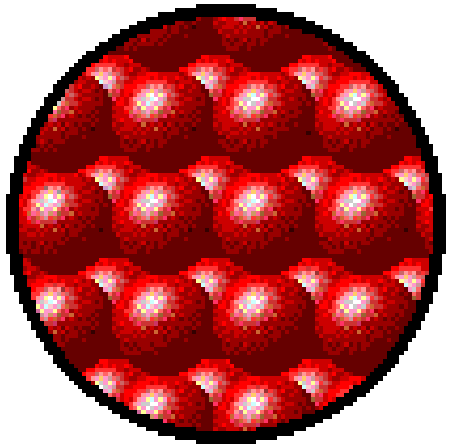


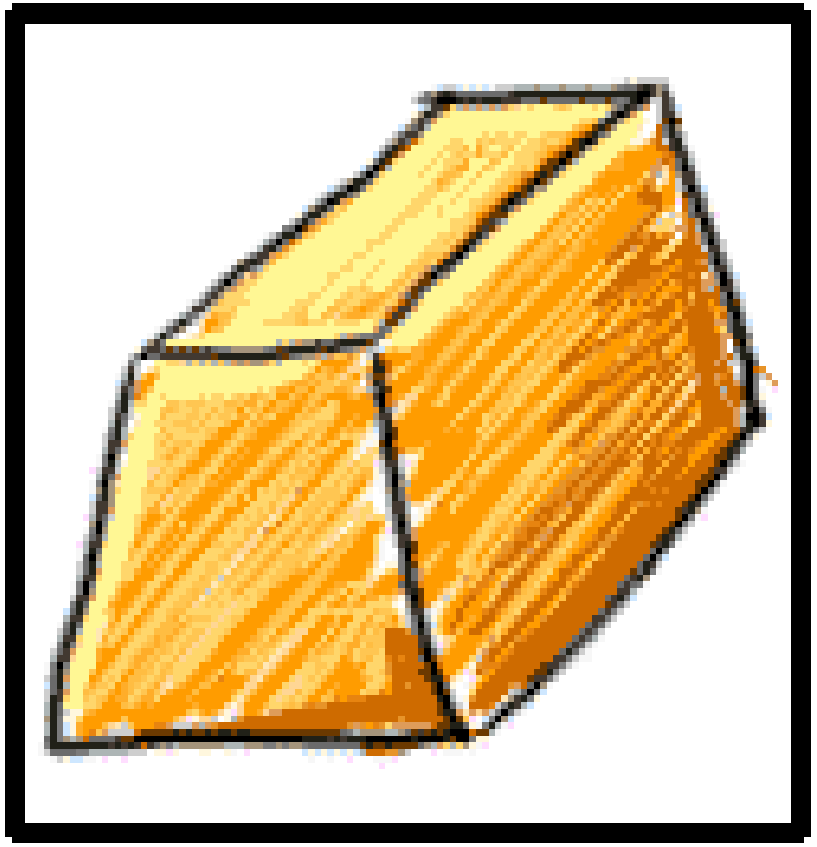
Solids

- **Crystalline solids – definite repeating geometric pattern**
- **Non crystalline Solids – no definite repeating geometric pattern**
  - **Amorphous – has no form**
    Some classify as a thick liquid
    Plastic and glass

Particles in Solids:

- Are packed tightly together
- Have very little energy



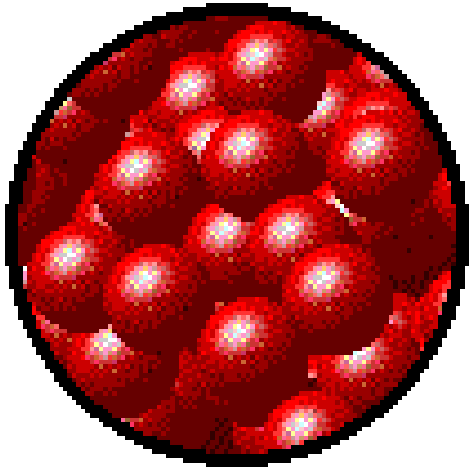


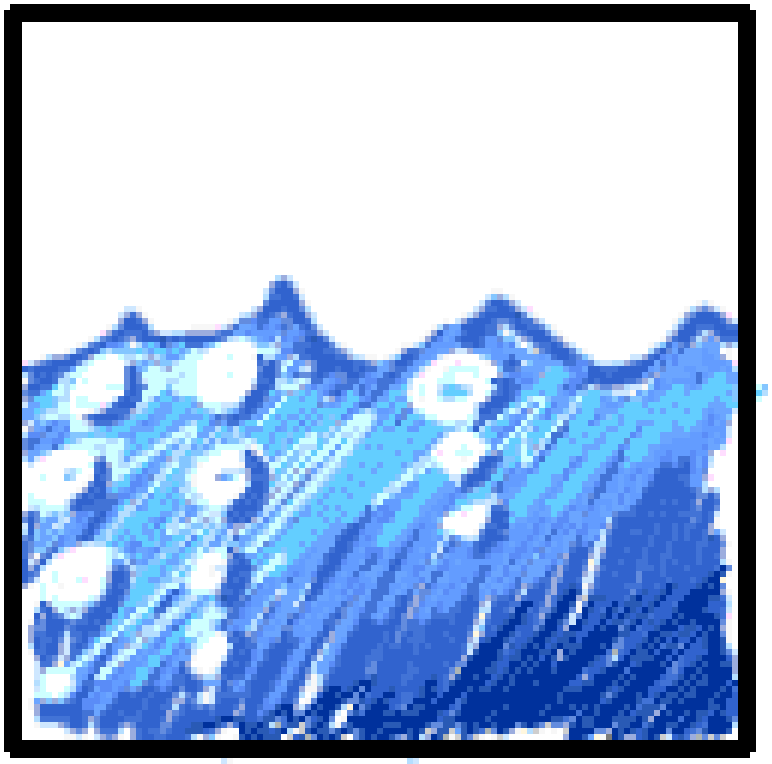
Liquids

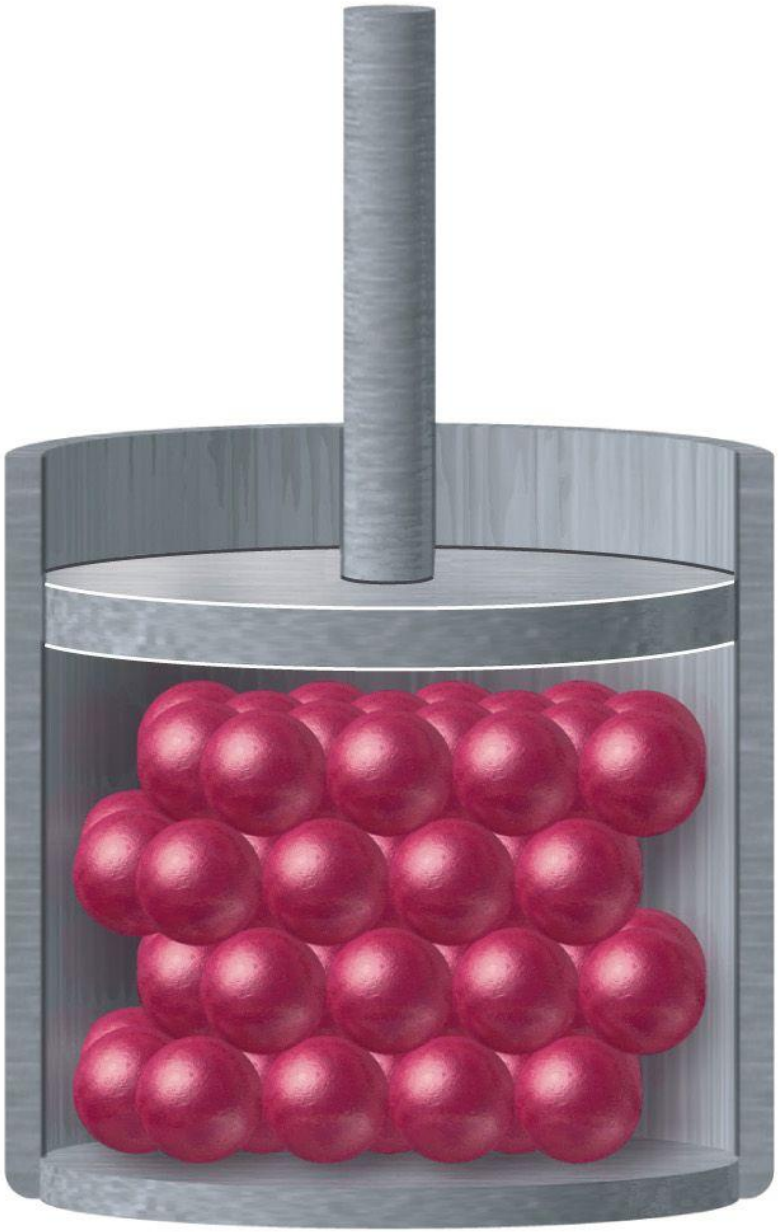
- **definite volume and no definite shape (cannot be compressed)**
- **Have more kinetic energy than a solid**
- **Particles can move over each other**

Particles in Liquids:

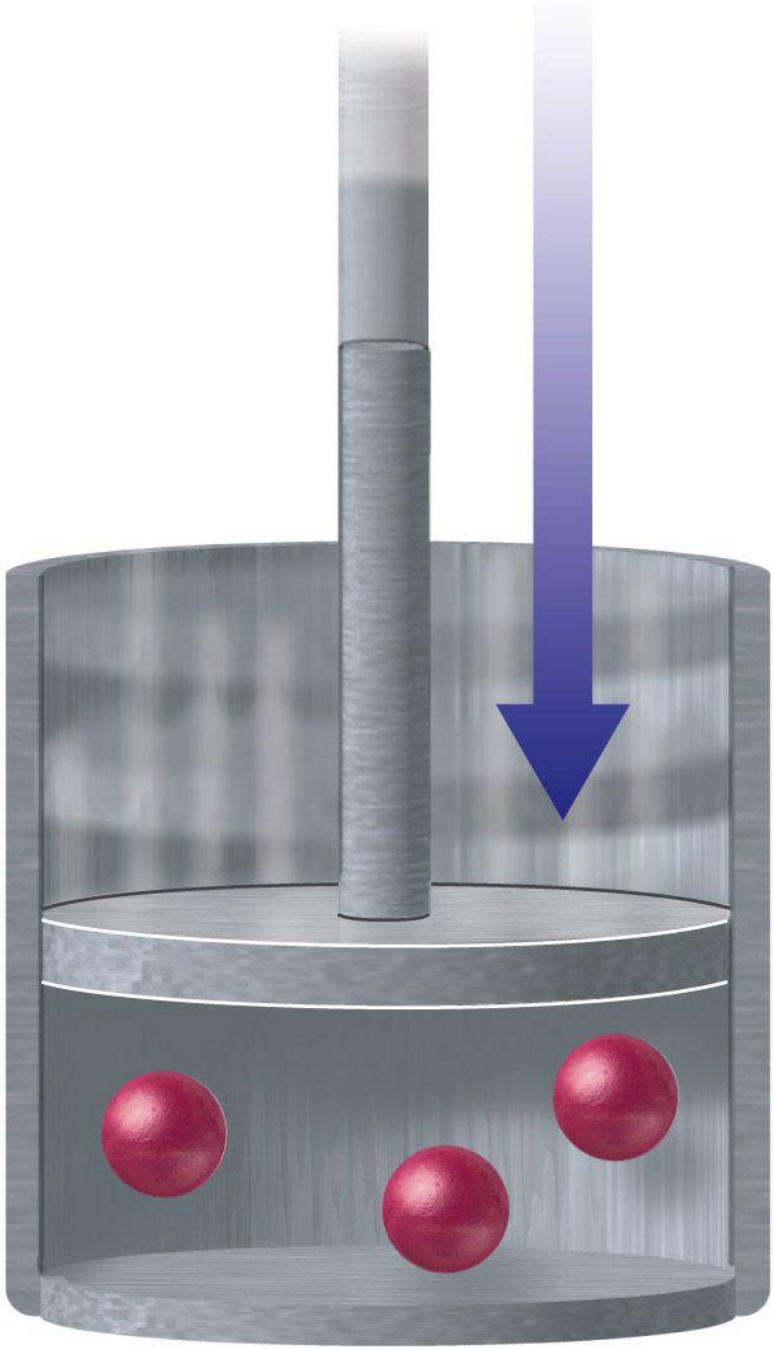
- Are loosely packed
- Have medium energy levels







Solid–not compressible



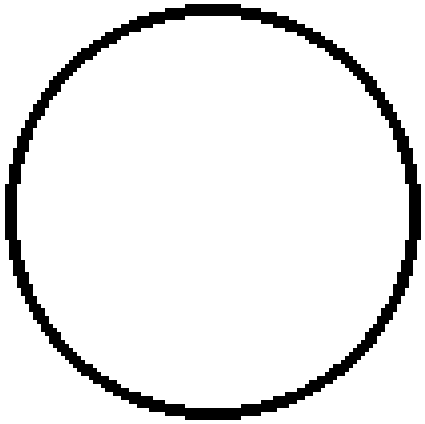
Gas–compressible

Gases

- **neither definite volume or shape**
- **Have enough kinetic energy to separate completely from each other**
- **Can be compressed**

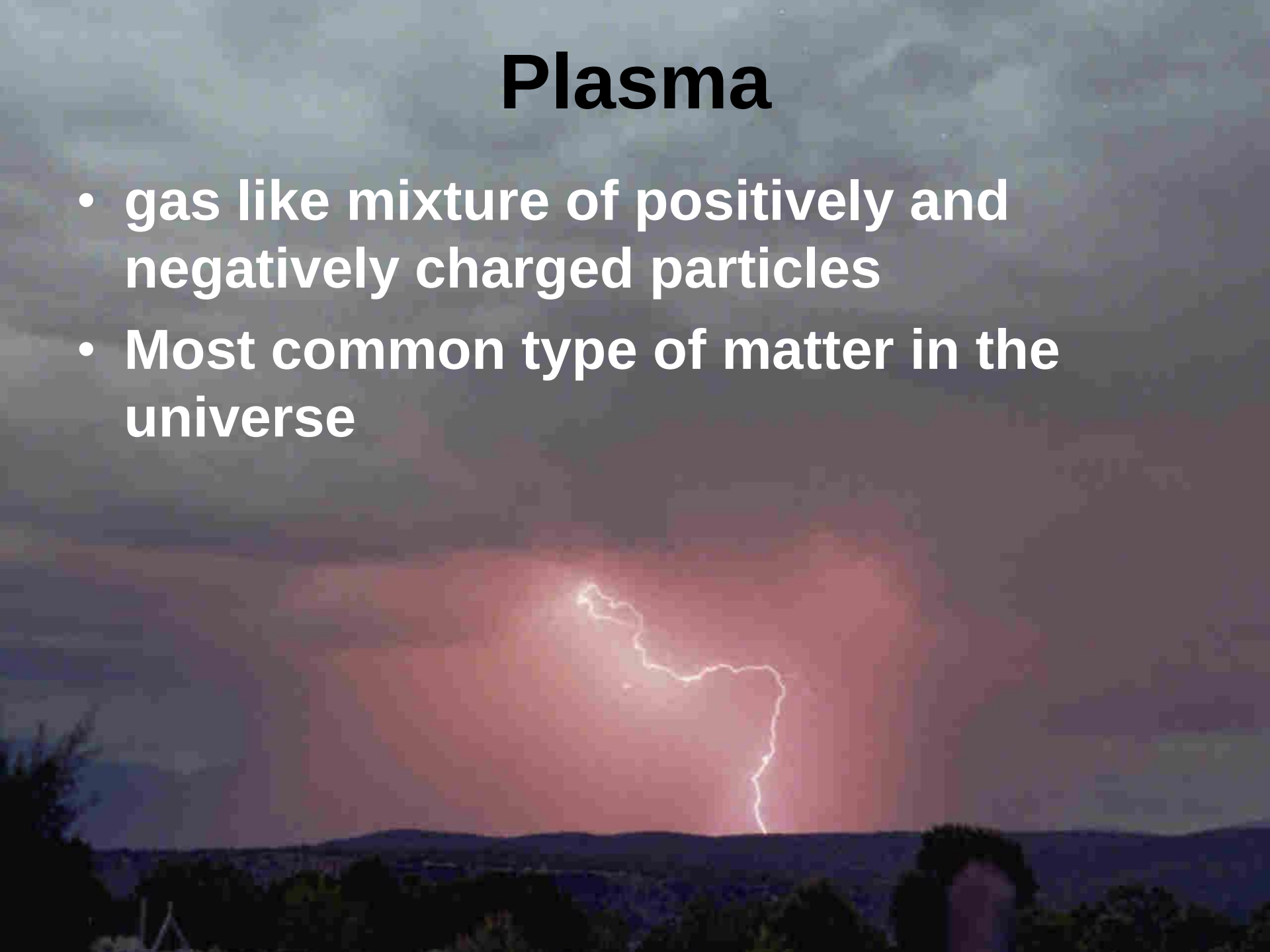
Particles in Gasses:

- Move freely
- Have LOTS of energy



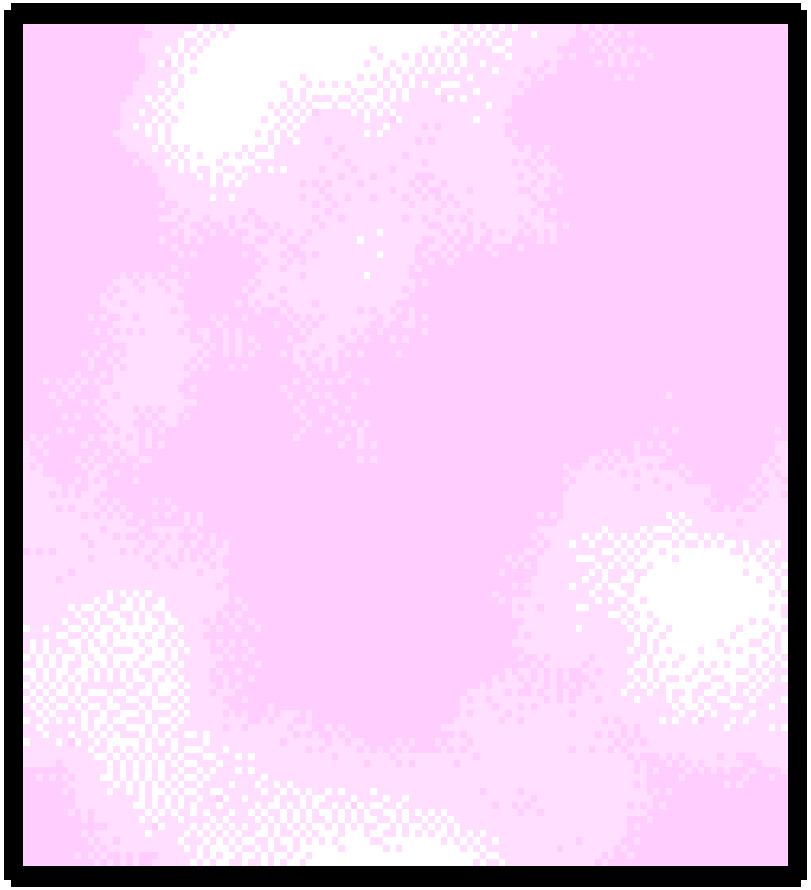
Plasma

- gas like mixture of positively and negatively charged particles
- Most common type of matter in the universe



Particles in Plasma:

- Are electrically charged
- Have EXTREMELY high energy levels



Some places where plasmas are found...

1. Flames


2. Lightning

3. Aurora (Northern Lights)

The Sun is an example of a star in its plasma state

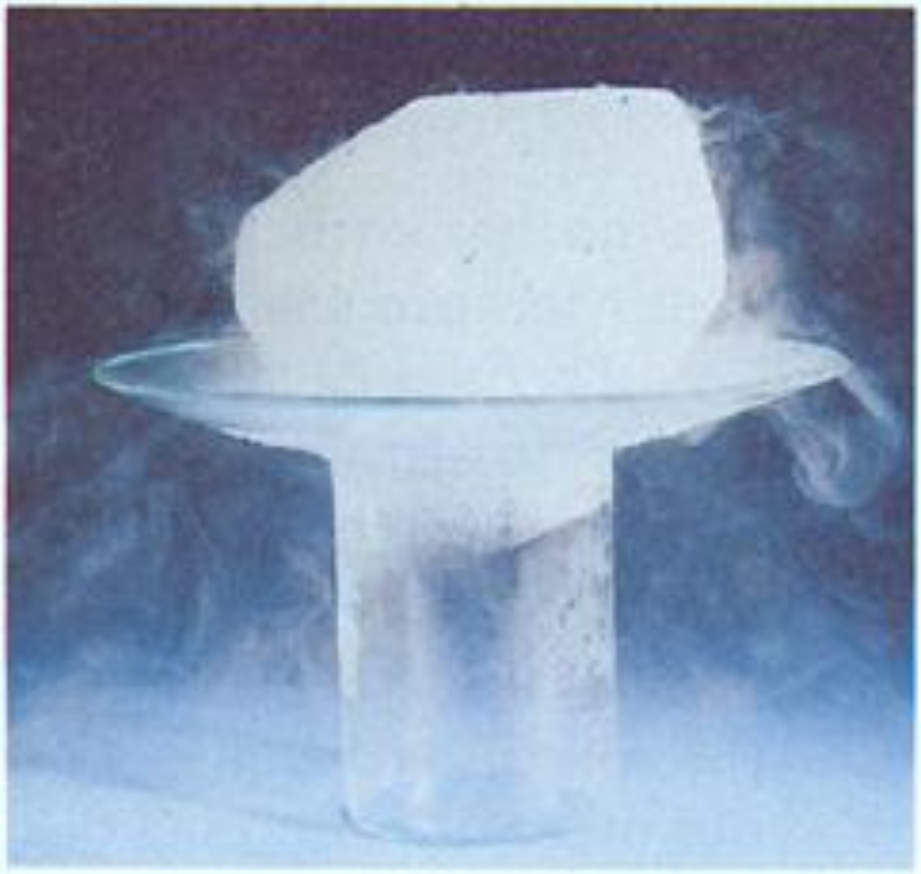
Thermal expansion

- **expansion of matter caused by heat Illustration of people in a tight place**
- **How does a thermometer work ?**
- **Thermal Pollution read page 222–223**

Changes in states in matter

- **Evaporation – liquid changes to a gas**
- **Boiling point – temperature at which bubbles of gas (liquid to gas develop below the surface of the liquid**
  - **Liquids or even solids do not have to be at boiling point to evaporate**
  - **The molecules just have to gain enough energy to change to the gas state**
- **Condensation – change from a gas to a Liquid is do to a loss of energy**
- **Sublimation**

Sublimation of Dry Ice and Iodine



Heat and state changes

- **Heat of fusion – the amount of energy needed to change a material from a solid to a liquid**
- **Heat of vaporization -is the amount of energy needed to change a material from a liquid to a gas**

Energy & Change in State

- **It takes extra energy to break the attraction of particles so that they can change states**
  It takes 334 j/g for solid water to change to a liquid
  It takes 2260 j/g for water to change from it liquid state to the gas state

Behavior of gases

- **Pressure – the force per unit area exerted by fluid particles**
  P = F/A
- **Measuring pressure**
  - **The unit of force is the Newton**
  - **The unit of area is the square meter Newton/meter2 = Pascal**
  - **A Pascal is a very small unit of pressure and so we use the kilo Pascal or kPa**

Pressure of air at sea level

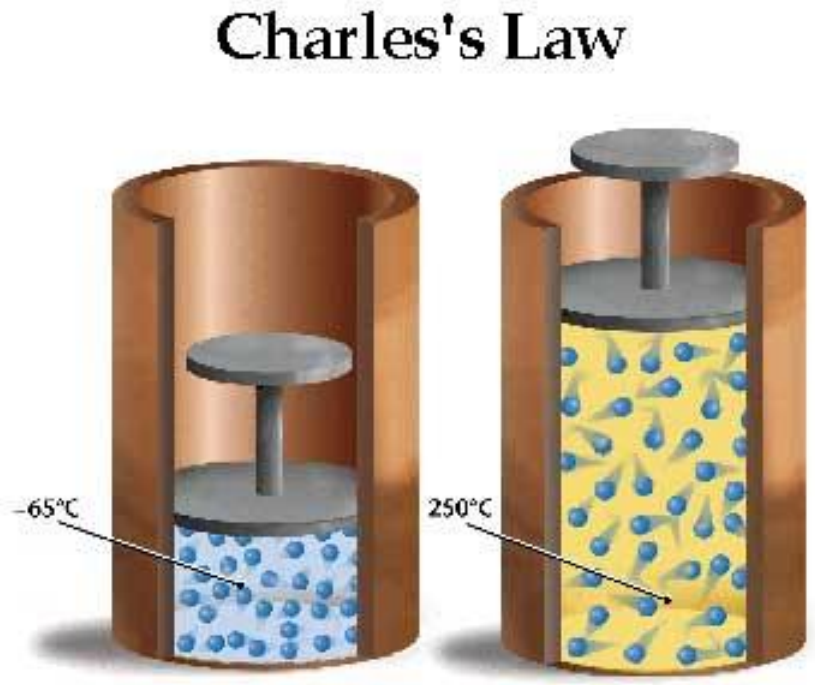
- **101.3 kPa**
- **This is 101,300 N/m^2**
- **Air particles at the surface of the earth are moving close to 1610 km/hr**
- **Particles collide with you on billion times per second**
- **As you go up in the atmosphere the pressure decreases**

Boyle's Law

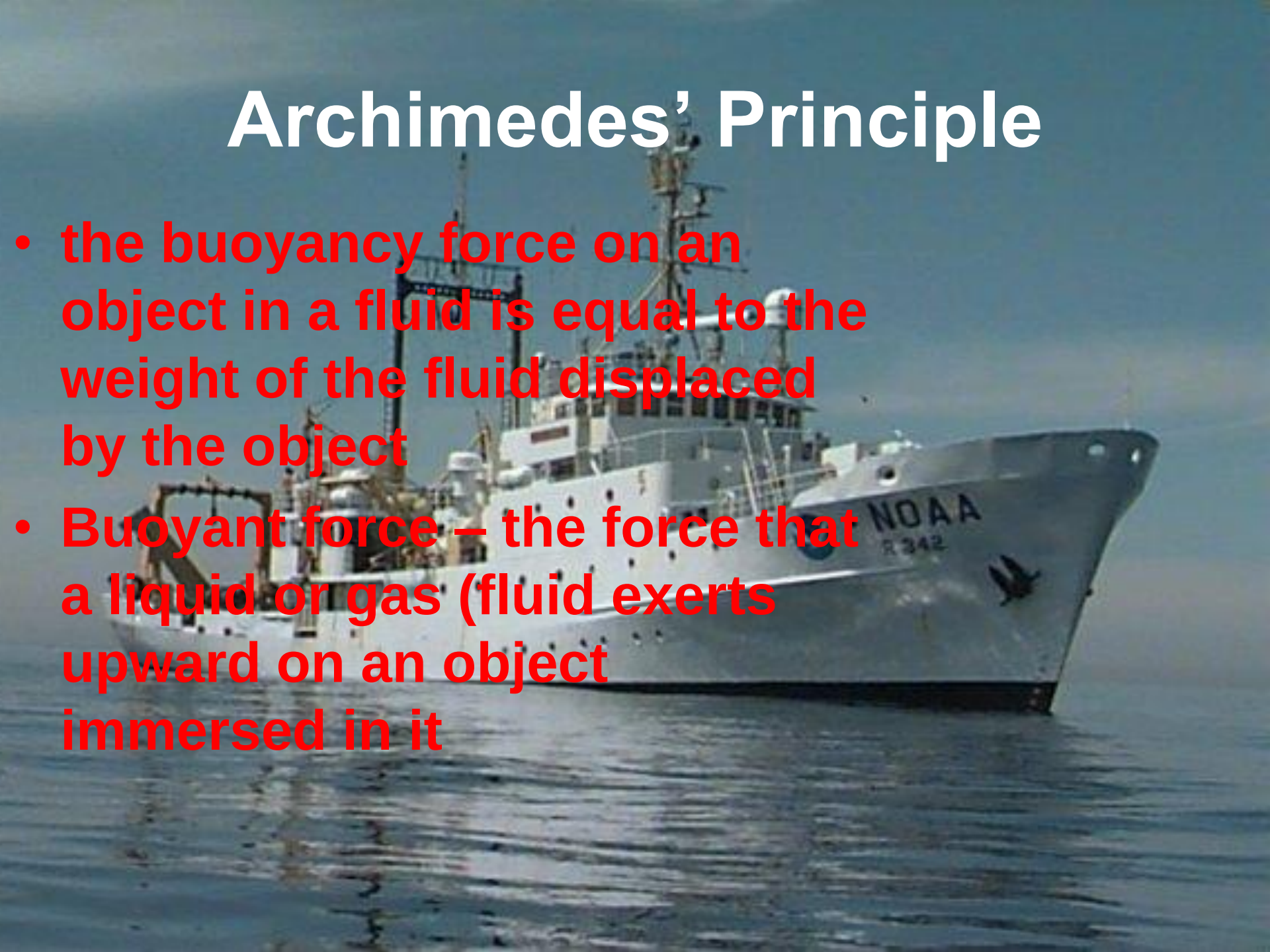
- **decrease volume you increase pressure if temperature is constant Inverse relationship pv=constant**

Charle's Law

- **If you increase temperature you increase volume if pressure is constant**
- **Direct relationship T/V=constant**

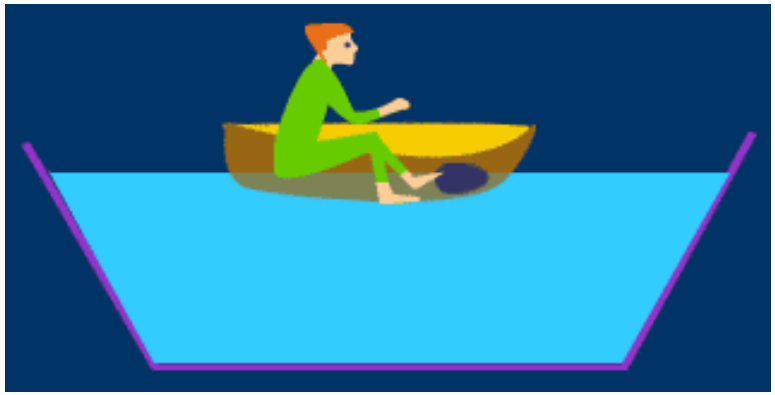


Archimedes' Principle



- the buoyancy force on an object in a fluid is equal to the weight of the fluid displaced by the object
- Buoyant force – the force that a liquid or gas (fluid exerts upward on an object immersed in it

Boat-in-Pool Puzzler



Here we have a boat in a swimming pool. In the boat is an inquisitive experimenter. Also in the boat is a rock.

Our experimenter picks up the rock and tosses it into the pool. The rock sinks to the bottom. No water leaves the pool from the splash made by the rock.

Now for the question: Does the pool's water level rise, lower, or stay the same?

- The water level rises.
- The water level lowers.
- The water level stays the same.

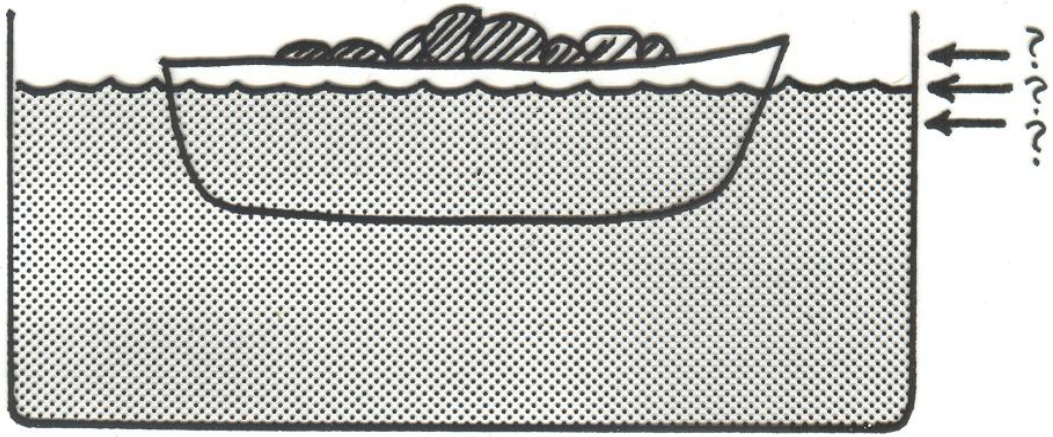
Balloon-in-Car Puzzler

You're sitting in a car that's not moving. Also in the car is a helium-filled balloon, which is resting up against the car's ceiling somewhere near its middle. The driver hits the gas and the car accelerates forward. You're thrown back into your seat.

What happens to the balloon? (Before you answer, think about what will make the balloon act the way you think it will.)

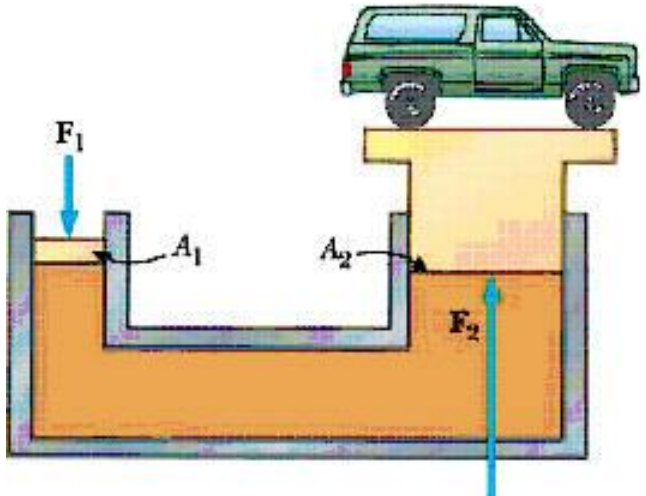
- It floats toward the back of the car.
- It floats toward the front of the car.
- It stays put.

CONSIDER A BOAT LOADED WITH SCRAP IRON IN A SWIMMING POOL. IF THE IRON IS THROWN OVERBOARD INTO THE POOL, WILL THE WATER LEVEL AT THE EDGE OF THE POOL RISE, FALL, OR REMAIN UNCHANGED?



Pascal's Principle

- – Pressure applied to a fluid is transmitted unchanged through out the fluid
- Hydraulics work on Pascal's Principle

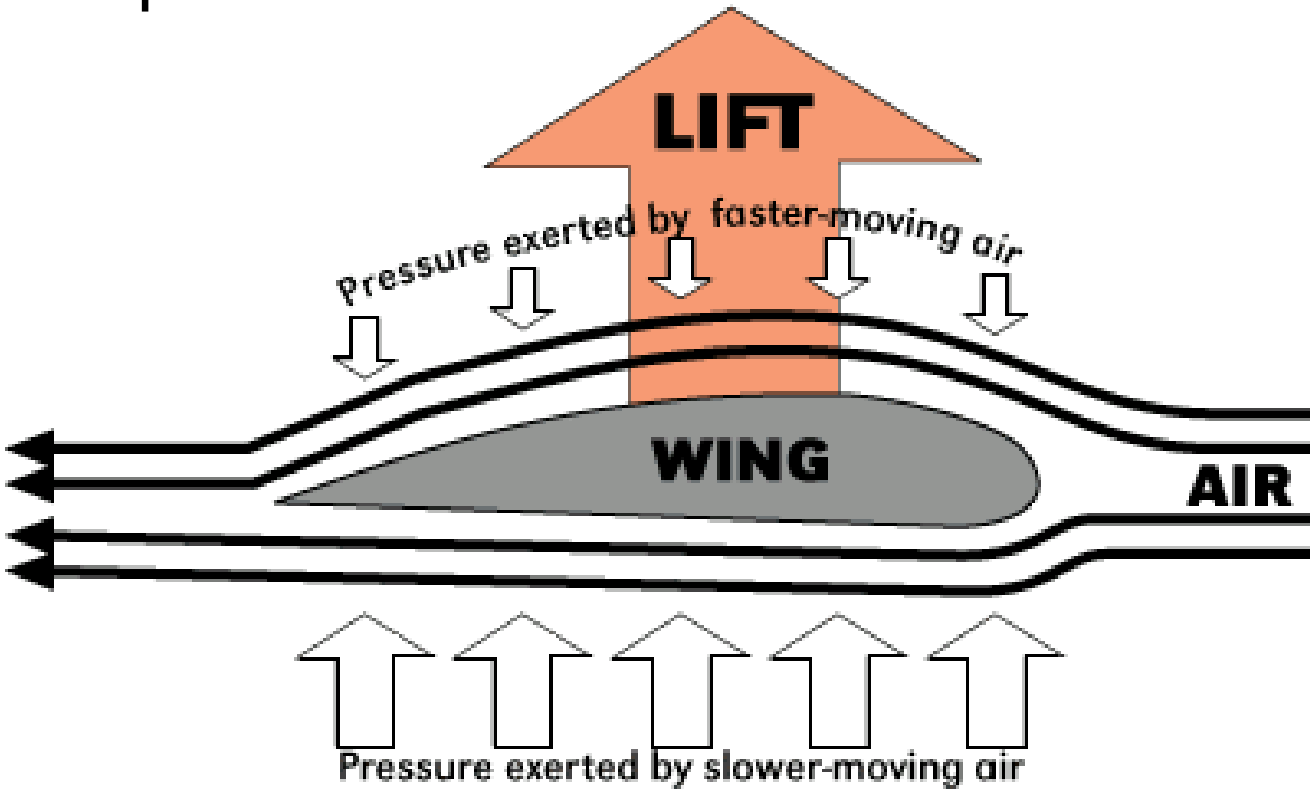


Pascals Principle

- **If you apply a force of 1 Newton to 1 cm^2 area there will be one Newton of force on every cm2 IN THE CONTAINER**
- **If you apply 500 N to a 5 cm^2 hydraulic piston and it is connected to a 50 cm^2 piston how much force does the second piston push up with ? (Shows a direct relationship)**

Bernoulli's Principle

- As the velocity of a fluid increases the pressure exerted by the fluid decreases
  - Why an airplane flies



Quiz

1. Give the following laws and principles:
    1. Charles' Law
    2. Boyles' Law
    3. Archimedes' Principle
    4. Bernoulli's Principle
    5. Pascal's Principle