# Particle Model

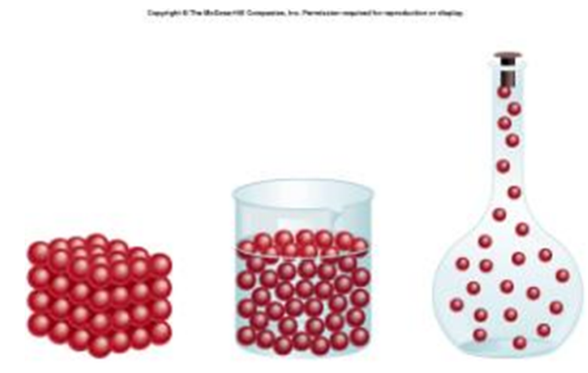
Models are visual representations of abstract things. They:

- Are simple to understand
- Explain several observations
- Help us predict future phenomena
- Can be modified

Particle Model is a scientific model based on the idea that matter is made up of tiny particles (ATOMS!!)

Can help explain how particles behave and are organized in the three phases of matter.

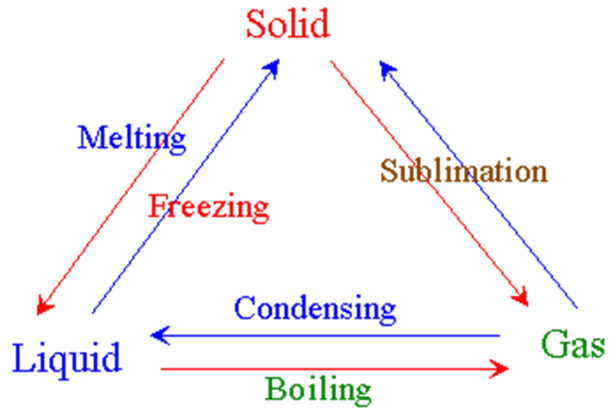
- Matter is not continuous but is made up of specific kinds of particles (extremely small)
- Forces of attraction hold particles together (they attract to each other)
- Particles are always moving
- At high temperatures, particles move faster (at low temperatures particles move slower)



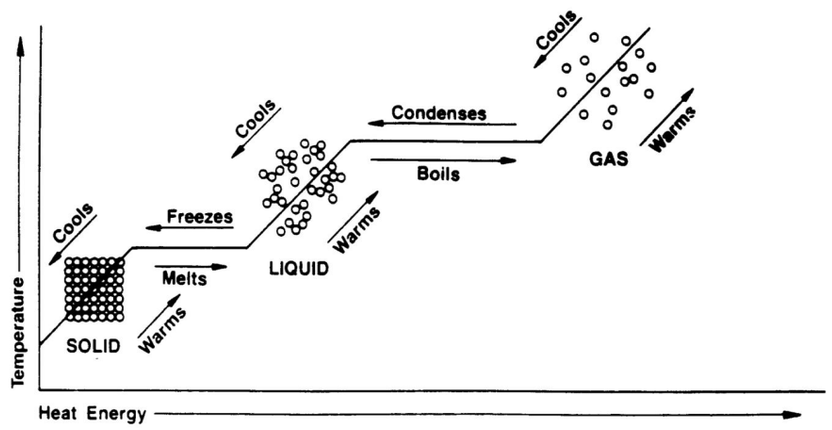
| | Solid | Liquid | Gas |
|---|---|---|---|
| Description | Have definite structure and shape | Have definite mass and volume, not shape | Have definite mass, not volume or shape |
| Space between particles | Particles are very close together | Particles are close together | Particles are far apart |
| Force of attraction | Very Strong | Weaker than solids | Not bound by force of attraction |
| Movement of Particles | Very little freedom of movement. Vibrate in place | More freedom of movement | Complete freedom of movement |
| Energy | Lowest | Medium | Highest |

# Phase Changes

| Chemical changes signs | Physical changes signs |
|---|---|
| · colour change<br>· heat or light given off<br>· precipitate formed<br>· bubbling<br>· mass change | · condensation<br>· fusion<br>· sublimation<br>· evaporation<br>· solidification<br>· deposition |




| | |
|---|---|
| Boiling Point | The temperature at which a substance turns from liquid to gas. |
| Melting Point | The temperature at which a substance goes from solid to liquid. |



# Fluids

Def: A substance that has no definite form and is able to flow all directions.

All Liquids and Gases are Fluids

**Examples in the body**:

- Blood = Liquid  Air = Gas

**Exception:** Powders such as flour or sand are not considered fluids even though they have no form and flow. They are composed of small particles with a definite form.

## Properties of Fluids

| | |
|---|---|
| Viscosity | The ability of a liquid to flow<br>> Honey: High Viscosity<br>> Water: Low Viscosity |
| Density | The relationship between a fluids mass and volume (mass/volume) |

These properties vary between fluids

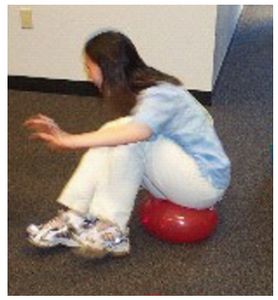
| | Compressible Fluids | Incompressible Fluids |
|---|---|---|
| Definition | Its volume can be reduced by exerting a force on the fluid | Impossible to decrease the volume by exerting a force |
| State | Gas | Liquid |
| Example | Air, Propane Tanks. | Blood, Hydraulic Brakes |
| Why? | Particles are far apart. | Particles are close together |
| Pressure vs. Volume | Increased Pressure = Decreased Volume<br>Decrease pressure = increase volume | Constant Volume |

# Pressure

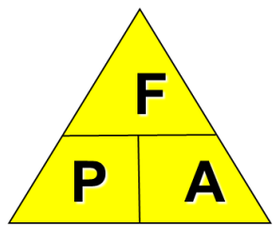
Def: The measure of the amount of force exerted on a certain area

- When we push something we are applying a force to it.
- If that force is large enough it will move or deform the object.
- **When a force is applied to a fluid, the fluid exerts a force on the container holding it.**

- Force: action that modifies than change the movement of an object or causes the shape of the object to change



$$\text{Pressure (newtons/meter}^2\text{)} = \frac{\text{Force (newtons)}}{\text{Area (meter}^2\text{)}}$$




| Units | Description |
|---|---|
| Pascal (Pa) | The international unit for pressure.<br>$1Pa = 1N/m^2$ (Very Small)<br>kPa (1000Pa) is used to measure atmospheric pressure |
| Atmosphere (atm) | Normal atmospheric pressure at sea level. (1 atm = 101.3 kPa) |
| Millimeters of Mercury (mmHg) | 101.3 kPa = 760 mmHg = 1 atm |

## Relationship between Pressure and Area

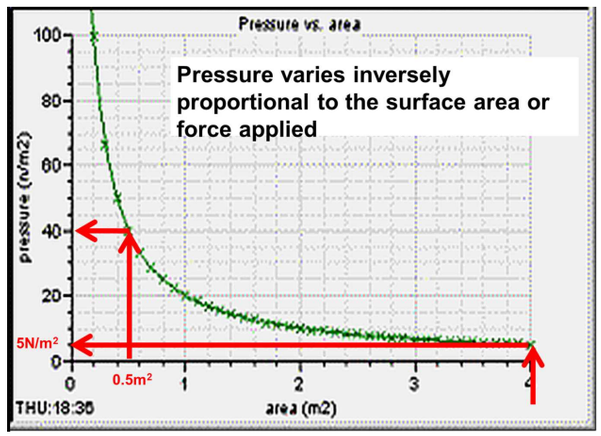
- The force an object exerts on the floor consists of the person's mass and the gravitational pull
- This is what we call an objects:
  **weight = (mass x gravity)**

How can we explain this?

By changing the area the force is acting on you notice a change in pressure:

Increased area = Decreased Pressure

Decreased area = Increased Pressure




- If 1,000N were applied to an area of $100m^2$ what would the exerted pressure be?

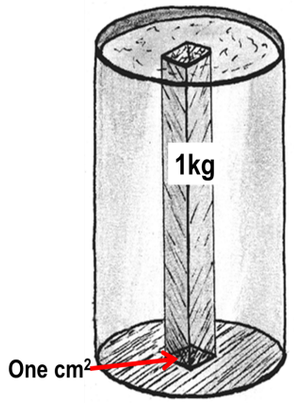
- If the same force (1000N) were applied to ½ the previous area( $50m^2$) what would the pressure be?

# Did You Know?

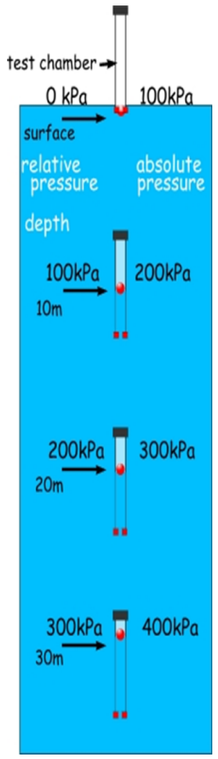
- There is more pressure exerted under the heel of a stiletto shoe than under the Empire State Building?

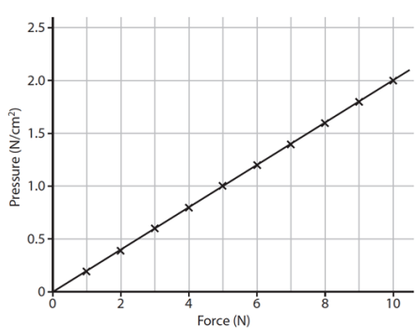
# Relationship Between Pressure and Force

- The weight of water exerts a force upon anything submersed in it
- The pressure at the bottom of the barrel = the weight of the column of water directly above an area of $1cm^2$
- If the barrel were 1m high there would be $1000cm^3$ of water ($1cm^3$ =1g) pushing down (1kg)




- When a person dives underwater the water column above the person pushes down on them
- The deeper you dive the more pressure is exerted on your tissues
- You can feel the pressure on the ear drums ( painful) - more depth and you can rupture them




Pressure and Force are Directly Proportional

## Particle Theory to Explain Pressure

- A tire pumped up with air has a force exerted upon it by the air inside.
- If the pressure is high enough the tire will remain firm even if pressure is applied to it
- This is explained by the air molecules inside the tire having lots of energy hitting the walls
- Adding more “air “ increases the number of molecules pushing outward = harder tire

### Compressible fluid Pressure

- Particles of compressible fluid (gas) move randomly in all directions, if meet an obstacle they change direction
- With each collision the fluid particles exert a force on the obstacle
- The sum of these forces that create the pressure from a compressible fluid
- Depends on: # of collisions (the more collisions = more pressure)
  - Factors that increase collision:
    - « # of particles (the more particles = the more collisions)
    - « Temperature (speed of particles increase when temp. increase) (Higher temperature= more pressure. Lower temperature=less pressure)
    - « Volume of Fluid (available space)

## In the Body

- In the body, fluids exert pressure on blood vessels (arterial pressure)
- The pressure difference causes fluids to move (from high pressure to low pressure)
  - > Lungs – air moves into lung

## Atmospheric Pressure

- When you suck on the straw, you're drawing all the air from the inside of the box; this air was exerting a force on the walls of the box that was equal to the pressure from the atmosphere outside the box. When you remove the air inside, you remove that force pushing out, there are no more particles pushing against the walls, so the force of the atmosphere is able to crumple to juice box.
- When you suck on the straw, the air pressure in the box is reduced.
- The pressure of air outside the box collapses it.