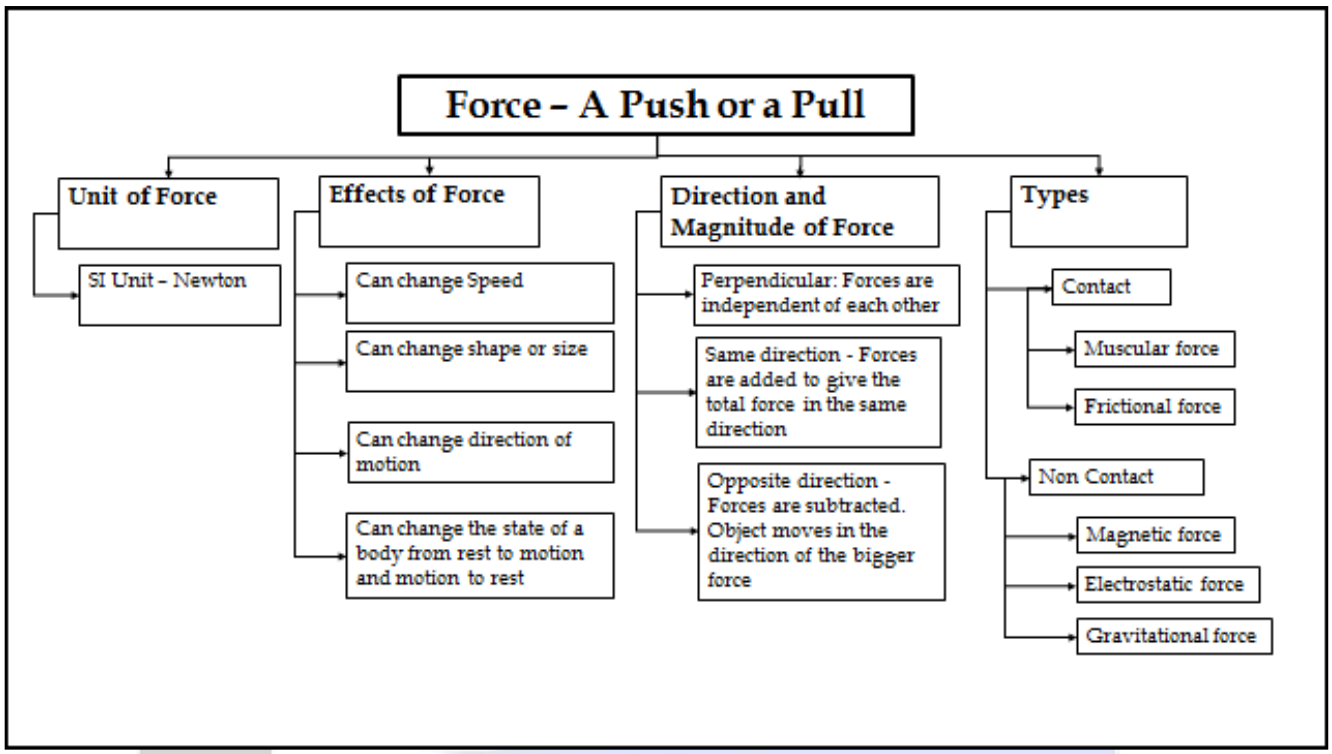
MIND MAP - FORCE



1. FORCE

A force is a push or pull upon an object resulting from the object's interaction with another object. A pull or push over an object is called force. SI unit of force is **Newton**.

Example – To open a drawer, one has to pull it; and to close the drawer one has to push it. Thus, in both the conditions a person applies force by pull or push.

- To kick a ball, one has to push it, i.e. a force is applied.
- To apply a force over an object interaction between the object and source of force is necessary.

1.1 DIRECTION AND MAGNITUDE OF FORCE

- Force is a vector quantity, so it has a magnitude and direction.
- The measure of amount or strength of force is called the magnitude of force. Thus, strength or amount of force is expressed in terms of magnitude.
- Condition when more than two forces are applied over an object:

1.1.1 Forces applied in same direction:

When more than one force is applied in the same direction, the total force is the sum of the magnitudes of both the forces.

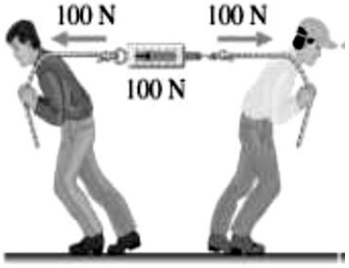
The total amount of force = sum of both forces

1.1.2 Forces applied in opposite direction:

When two forces are applied on an object from opposite directions, the total effective force is the difference of two forces.

Example –

(a) When two persons are applying equal force in opposite directions and the magnitude of both the forces is equal, then the object will not move because the difference of two forces will be equal to zero.



Let a person applying 100 units of force in one direction and other person also applies 100 units of force in the opposite direction, then the resultant force is 0. The magnitude of total force =100 unit – 100 unit = 0

(b) If one person is applying a force of 4 unit in east direction and another person is applying a force of 6 units in the opposite direction,

Then total magnitude of force = 6 unit – 4 unit = 2 unit

Thus, force will act in the direction of larger magnitude of force i.e. in the west direction.

1.2 EFFECTS OF FORCE

1.2.1 A Force can change the state of motion:

State of rest: An object is said to be in the state of rest when it is not moving with time. This means a stationary object is in the state of rest. For example – a building, an electric pole, a ball kept over the ground and not moving, etc.

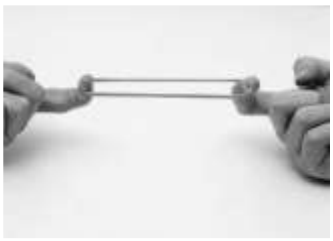
State of motion: A moving object is said to be in the state of motion.

- Force can speed up a moving object.
- Force can decrease the speed of a moving object.
- Force can stop a moving object.
- Force can change the direction of a moving object.
- Force can move a stationary object.

Examples –

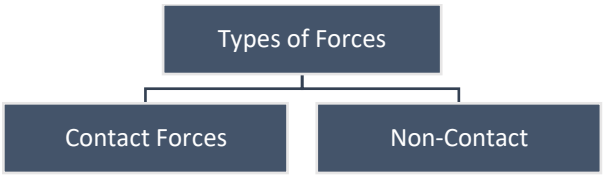
- In the game of cricket, when a batsman pushes a fast moving ball in the same direction of the movement of ball, the speed of the ball is increased.
- When a batsman pushes a fast moving ball in the opposite direction, the speed of ball decreases because of the force being applied from his bat.
- When a player in the game of football kicks the ball to his mate, he changes the direction of the moving football by applying force through his kick.
- A goalkeeper stops the football going towards the goal post by applying a force by his hand.

1.2.2 Force can change the shape of an object:



- When you apply force on an inflated balloon; using your hand from both sides, the force of pressure changes the shape of balloon.
- Your mother changes the shape of the dough into a chapatti by applying force with a rolling pin.
- A blacksmith changes the shape of an iron rod by applying force using a hammer.
- When a rubber band is stretched in opposite directions, its shape is changed.

1.3 TYPES OF FORCES



1.3.1 Contact Force

- Forces that cannot be applied from a distance are called contact forces i.e. there must be a contact between the interacting objects for the application of this type of force. Contact force acts on the point of contact.
- Example: Pushing a car, Opening a drawer, Kicking a ball, etc. In these examples, interaction between objects is necessary.

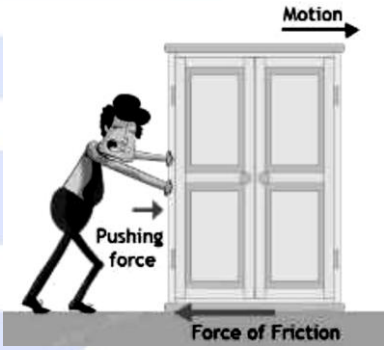
Types of contact force: Muscular force, Frictional force, etc. are types of contact force.

(i) Muscular Force

Force caused by the action of muscles is called muscular force. In other words, force resulting because of action of muscle is called muscular force. Muscular force can be applied only after interaction with the object. Hence, it is a type of contact force.

- While kicking a ball, the player applies force over the ball using his leg muscles.
- While pulling a cart, the horse or the ox applies the force of its muscles.

(ii) Frictional Force

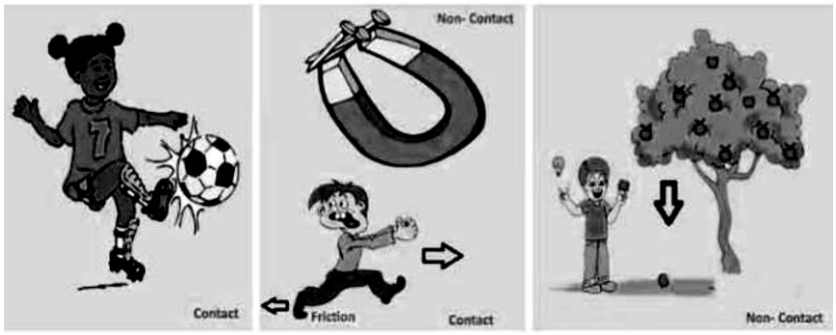


Force acting between the surfaces of two objects is called the force of friction. Force of friction always acts in the opposite direction of the movement of object. Force of friction is acting over all the moving objects.

- A moving football stops after going to a certain distance. This happens because of force of friction between the surface of ground and the surface of football.
- A moving boat stops after some distance because of friction between the surface of water and the surface of boat.

Since force of friction comes into action only after interaction between two objects, thus, it is a type of contact force.

Contact and Non-Contact Forces



1.3.2 Non – contact Force

Force that comes into action without contact or physical interaction between two objects is called non-contact force. For example; a magnet can pull an iron nail from a distance. So, magnetic force can be called a non-contact force**.**

Types of non-contact forces: Magnetic force, Electrostatic force and Gravitational force are types of non-contact force.

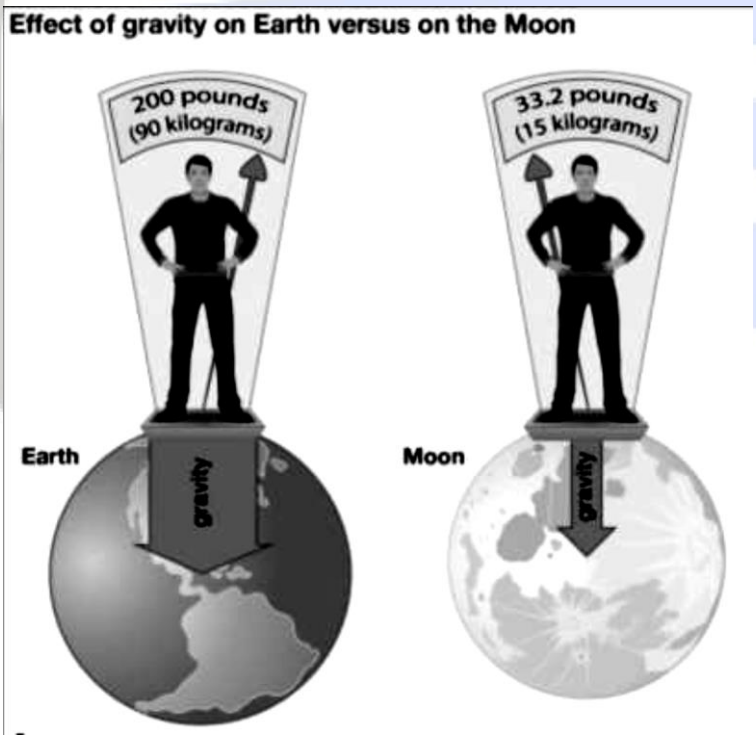
(iii) **Magnetic Force**: Force exerted by a magnet on another magnet or on magnetic substances is called magnetic force. A magnet can exert force even without coming in contact, thus it is a non-contact force.

A magnet attracts the opposite pole of another magnet and repels the similar pole of another magnet.

(iv) **Electrostatic Force**: Force exerted by a charged body is called electrostatic force. A charged body attracts an uncharged body. A positively charged body attracts a negatively charged body and repels a positively charged body without coming in contact, thus it is a non-contact force.

(v) **Gravitational Force:** Force exerted by earth, moon, sun and other planets is called gravitational force. Earth attracts all objects towards it. Similarly, all other planets along with moon attract all objects towards them. Since, earth attracts all objects even without coming in contact, thus gravitational force is a non-contact force.

When anything is released from a height, it falls over the ground because of gravitational pull of earth.



Difference between Contact and Non-contact Forces

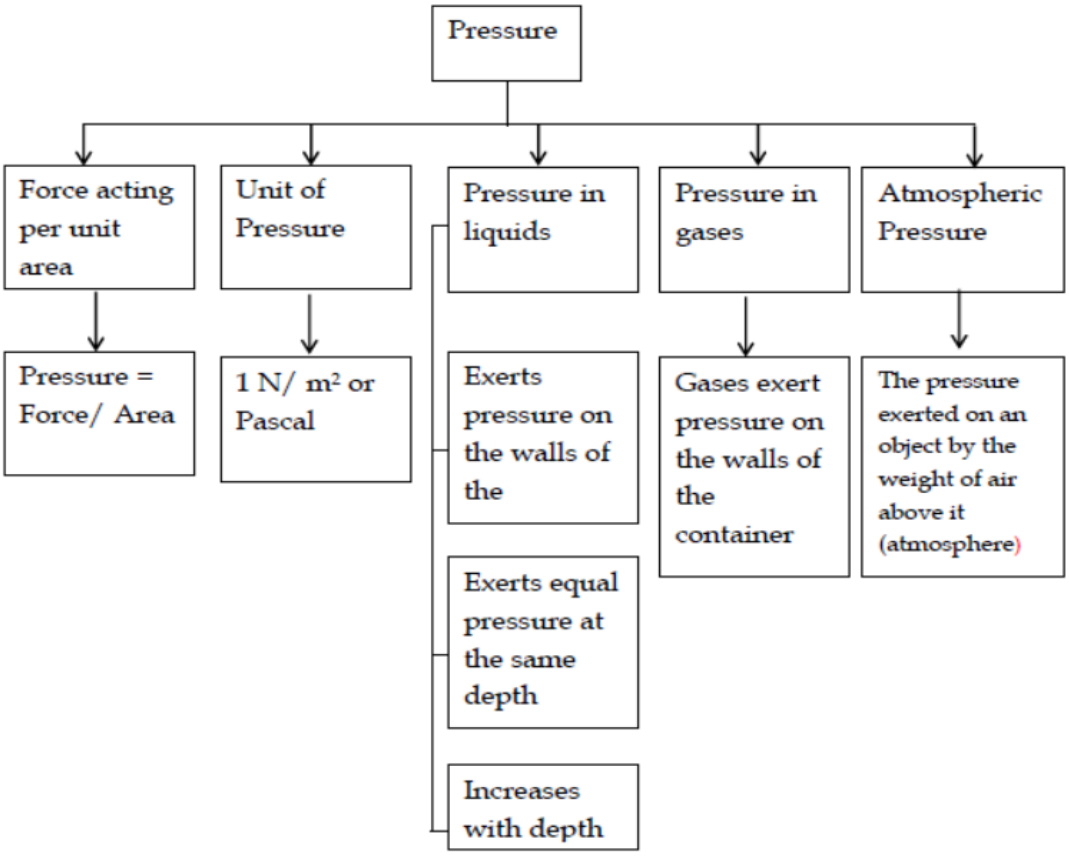
Contact Force	Non-Contact force
For the application of this type of force, a physical contact between the interacting bodies is essential.	For the application of this type of force, no physical contact between the interacting bodies is essential.
Contact forces take effect immediately after application.	There is a time gap between the application and the effect of non-contact forces.
There are no fields associated with a contact force.	There is always a field associated with a non-contact force.

Force can be expressed as the product of mass of the object on which it has been applied and the acceleration produced i.e.

Force= Mass X Acceleration

1 N is the force required to produce an acceleration of 1m/s2 in an object of mass 1kg. It can also be understood as the weight of an object having 100gm mass. Force can be measured by a spring balance.

MIND MAP - PRESSURE



2. PRESSURE

A force applied over the unit area of a surface is called pressure. In other words, force per unit area is called pressure. The SI unit of pressure is **Pascal**, represented by **Pa** (1 Pascal= 1N/m^2).

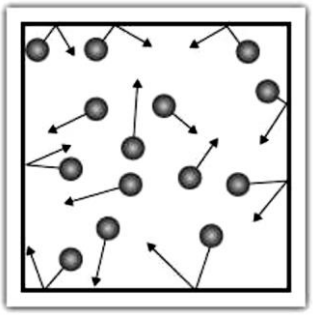
Pressure = Force / Area

Since area is indirectly proportional to the pressure, pressure decreases with increase in area and increases with decrease in area.

Example:

- While cutting an apple, we need to use the sharp edge of the knife. Using the blunt edge of knife shall not serve the purpose. The blunt edge of knife has larger surface area than the sharp edge. Because of smaller surface area; more pressure can be applied through the sharp edge of the knife and something can be easily cut.
- While putting a nail into a wooden board, the pointed end of the nail is kept at the front. The pointed end of the nail has very small surface area and this enables us to apply a greater pressure with the applied force.
- School bags have broad shoulder straps. Because of broad shoulder straps, the pressure decreases as the weight of the school bag is distributed over a larger area and it becomes easier to carry the bag.

Pressure exerted by Liquid and Gas: Similar to solids, liquids and gases also exert pressure. Liquids and gases exert pressure on inner walls of the container in which they are kept.



Example –

- Water starts leaking if there is a pore in the bottle. This happens because water exerts pressure over the walls of the bottle.
- Water flows from higher level to lower level of the ground. This happens because of pressure exerted by water.
- When air is filled, a rubber balloon gets inflated from all sides. This happens because air, which is a gas, exerts pressure over inner walls of the balloon.

The fluid pressure depends upon:

i) The depth of the point at which the pressure is to be measured,

ii) The density of the fluid.

At the same depth, fluid pressure is same in all the directions.

2.1 ATMOSPHERIC PRESSURE

Our atmosphere is made of air. Since air is mixture of gases and gas exerts pressure, thus air exerts pressure. Pressure exerted by air (present in atmosphere) is called atmospheric pressure. We do not feel the atmospheric pressure over us because the pressure inside our body nullifies the atmospheric pressure.

Example–

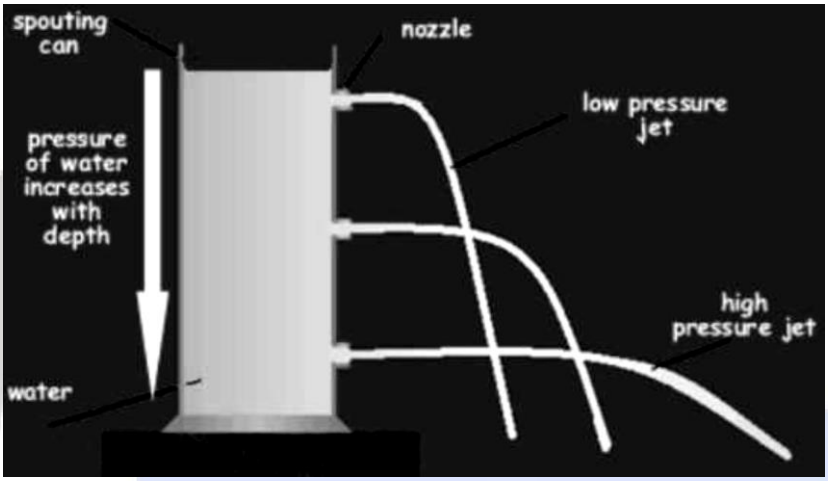
- A pressed rubber sucker on a plane surface does not come off easily because of atmospheric pressure.
- When you go to hills and mountains, it is difficult to breathe. This happens because of low atmospheric pressure.
- The ink of a fountain pen spills out in aeroplane because of low pressure at higher altitude.

- At higher altitude, lentils (pulses) take longer to get cooked. This happens because of low atmospheric pressure at higher altitude. Because of low atmospheric pressure, water boils at a lower temperature and that temperature is not enough for cooking the pulses.

3. ACTIVITY

3.1 EXPERIMENT 1

Aim: To demonstrate that pressure exerted by water at the bottom of the container depends on the height of its column.



Material Required: A plastic bottle, 3 bendable straws tube, a needle, pair of scissors and water.

Theory: Liquid exerts pressure on the walls of the container.

Procedure:

- Cut plastic bendable straws into pieces.
- Make holes at different levels in the plastic bottles and insert the straw pieces in the bottle.
- Pour water in the bottle till the mouth of the bottle and close it tightly with the cap.
- Then open the bottle gradually by gentle unscrewing of the cap.
- Observe the pressure by measuring the jet of water coming out.

Observations: Length of water jet is different at different level, being the longest in the bottom and decreases with height.

Precaution:

- Straw pieces should be heated slightly to fix it in the plastic bottle.
- Leaking should be avoided by sealing the joint.

3.2 EXPERIMENT 2

Aim: To show that liquid exerts pressure on the walls of the container.

Material Required: A plastic bottle, a cylindrical glass tube, a rubber balloon, water.

Theory: Liquid exerts pressure on the walls of the container.


A liquid exerts pressure on the walls of the container

Procedure:

- Insert the cylindrical tube at the bottom of the plastic bottle by slightly heating one end of the tube.
- Seal the joint with molten wax to avoid the leaking.
- Cover the mouth of the glass tube with a thin rubber balloon.
- Fill the bottle up to half with water.
- Observe the balloon.
- Pour some more water and observe how the rubber balloon bulges.

Observations: Rubber balloon bulges as the water column increases.

Precaution:

- Glass tube should be heated slightly to fix it in the plastic bottle.
- Leaking should be avoided by sealing the joint