# Chapter- 11 Force and Pressure

**Force**

**Types of Force**

**Pressure**

# Force

## Force – A Push or a Pull

A push or a pull on an object is called a **force**. An applied force is a force that is applied to an object by a person or another object. If a person is pushing a desk across the room, then there is applied force acting upon the object. The applied force is the force exerted on the desk by the person.

## Forces are due to an Interaction

At least two objects must interact for a force to come into play. Thus, an interaction of one object with another object results in a force between the two objects.
It is clear from the picture that the man is pushing the car with his hands and applying force. There is interaction between the man and the car.

Force acting on the car by the man

## Exploring Forces

When two or more forces are applied in the same direction then the forces add up to give the net force and that's why they are able to push the box easily.

The strength of a force is usually expressed by its magnitude. If the direction or the magnitude of the applied forces changes, its effect also changes. In some cases it adds up where as in other it gets deducted.

## A Force can Change the State of Motion

Force can move a body which was initially at rest; it can bring a moving body to rest; it can change the direction of a moving object and it can change the speed of the moving objects.

### Activity

Take a ball of some soft material and do following tasks: Place the ball on the floor and give it a push. What do you observe? You observe that it starts moving. Now push the ball in the direction opposite to the ball. What will happen? It will stop. Now push the ball again so that it starts moving. Then give it a push at some angle. What happens to the motion of ball? Direction of motion of the ball changes at last take ball between your palms and try to push. What do you observe? You observe that the ball squeezes.

A change in either the speed of an object, or its direction of motion, or both, is described as a change in its state of motion.

Thus, a force may bring a change in the state of motion of an object.

## Force can Change the Shape of an Object

The force can change the size of an object. The shape of a deflated football can be changed by inflating it. When the football is inflated, force is applied on the pump.

# Types of Force

## Contact Forces

Forces acting between two bodies can be classified into two broad categories: Contact force and non-contact force.

Contact forces act between two objects, which are in direct contact with each other. The two common examples of contact forces are muscular and frictional. When the trucks or cars apply brakes it stops. This happens due to the external force acting between the road and tyres of the vehicle. This force is known as the frictional force.

## Frictional force

Frictional force acts between all moving bodies and the surface on which they are moving.

It always acts opposite to the direction of motion and the magnitude of this force depends on the nature of the surface in contact.

## Muscular Force

The force applied by the action of muscles in our body is termed as *muscular force*.

Like humans, animals & birds also use muscular force to run and fly. For example, birds fly in the air by flapping their wings.

Muscular force

## Friction

The frictional force on an object in a fluid depends upon its speed with respect to the fluid. The frictional force also depends on the shape of the object and the nature of the fluid.

The friction between two surfaces depends on two factors:

- The nature of two surfaces (smoothness or roughness of the two surfaces)

More the roughness of a surface, larger is the number of irregularities on its surface & hence greater will be the friction.

- The force with which two surfaces are pressed together

Pressing together two surfaces of objects with a greater force will increase the interlocking in the two surfaces & hence increase the friction.

## Advantages of friction:

- It is the friction between the sole of our shoes & ground that enable us to walk without slipping.
- It is the friction between brake pad & rims that prevents the wheel from moving ahead. Due to this, the running bicycle slows down & finally stops.
- Friction enables us to write on paper.

## Disadvantages of friction:

- Friction wears away the soles of our shoes.
- Due to friction between the surface of tyres & the surface of road, the tyres wear out gradually.
- Friction wears out the brake pads of vehicles gradually. As a result brake pads of cycles have to be replaced quite often.

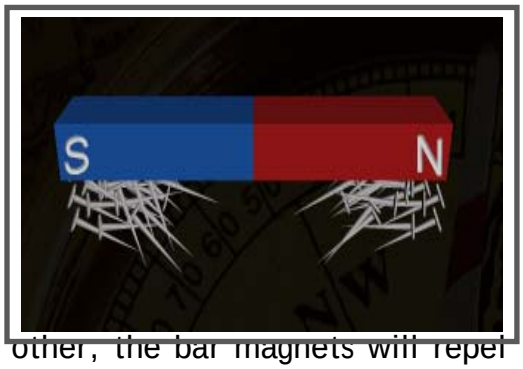
## Non-contact Forces

Non-contact forces are those forces that act between two objects, such that objects are not in direct contact with each another.

Examples of non-contact forces include magnetic force, electrostatic force and gravitational force.

### Magnetic Force

A magnet is a substance which can attract certain objects like iron, cobalt, nickel etc. towards it. It has two poles namely: North Pole & South Pole. If you bring the South Pole of a bar magnet close to the North Pole of another bar magnet, the magnets will attract each other and if you bring the North Pole of both bar magnets close to each other, the bar magnets will repel each other.



Magnetic force

The force with which they attract and repel each other is known as magnetic force.

### Electrostatic Force

The comb acquires a charge and exerts a force called electrostatic force. Electrostatic force can also act from a distance and is therefore a non-contact force. A body with electrostatic charge can either attract or repel another charged body.

Electrostatic force is used to separate solid pollutant particles from smoke given out from factories.

## Gravitational Force

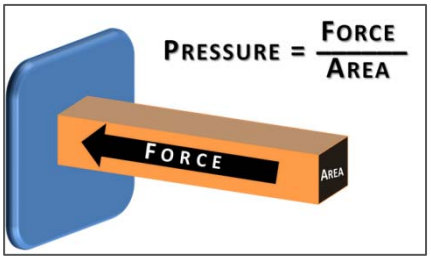
The Earth attracts every object which is near or on its surface; towards its centre by a non-contact force known as gravitational force.

It is this gravitational force which makes an apple fall down from the tree and makes the water from a tap to flow down.

Gravitational force depends on the distance between the object and the Earth.

# Pressure

Pressure is the force that acts perpendicularly on a unit surface area. Thus, the formula for pressure is: F/A




The S.I. unit of pressure is Pascal which is equal to Newton per square meter. The force acting on a smaller area exerts a larger pressure as compared to the pressure it exerts on a larger area. This is the reason why drawing pins have pointed tips.

## Applications

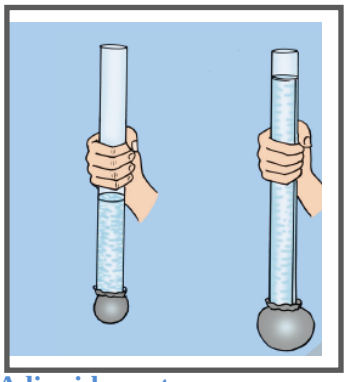
- When you cut an apple with a knife, the shaper the knife, the smaller is the area of contact of the knife with the apple. Thus a sharper knife exerts a greater pressure making it easier to cut the apple.
- It is easier to pierce a piece of cardboard with a pin if the pin has a sharp point, as the area of contact is then smaller.
- School bags and shopping bags have broad belts or straps as handles. Narrow string-like handles cause severe pain in the hand because the weight of the bag acts on a small area and so the pressure is considerably higher.
- Porters wear turbans when they have to carry heavy loads on their heads, to increase the area of contact. This reduces the pressure on the head.

## Pressure exerted by Liquids and Gases

Friction exerted by fluids i.e. gases or liquid is termed as fluid friction or drag.
The magnitude of drag (fluid friction) depends on

- Speed of the object
- Shape of the object
- Size of the object
- Nature of fluid

Liquids exert equal pressure at the same depth



A liquid exerts pressure on the walls of the container

Pressure exerted by water at the bottom of the container depends on the height of its column.

When object moves through the fluids, they have to overcome friction acting on them. In this process they lose energy. Therefore efforts are being made to minimize energy by giving special shape to the objects called 'streamlined shape'. That's why cars, airplanes & rockets streamlined.
Pressure at the bottom of the ocean is very high. Deep sea divers wear steel diving suits to prevent their bodies from begin crushed by the tremendous pressure of water exerted on all sides.
Submarines are built of hard thick sheets of metal to withstand the high pressure under water. For the same reason dams are broader at the base than at the top.

An instrument called a **monometer** is used to measure liquid pressure.

## Atmospheric Pressure

Earth is covered with the envelope of gases known as atmosphere. The atmospheric air exists to height of about 1000 km. But beyond 100 km the air is very thin. The pressure exerted by the air present in the atmosphere is called atmospheric pressure.
The pressure is equal to force divided by area. So if we assume a long cylinder having a base area equal to one and filled with air, then the weight of air inside it is equal to atmospheric pressure.