Chapter 12

Force

Points to study

12.1 The Concept of Force
- Effects of Force
- Unit of Force

12.2 Different Types of Force

What do you do to open and close the door? To take a box, cupboard or any other heavy article from one place to another at your home, school or any other place, what do you do? Either you pull them or push them. In our daily life we often bring an object from rest to motion. To bring an object in the state of motion from the state of rest you have to pull it or push it. To take out a bucket full of water from the well you have to tie it to a rope and then pull it out. Also, to lift objects you have to pull them. While playing hockey the player push or pull the ball from his/her stick. A push or a pull is known as force, but this definition of force is incomplete. What is force in the language of science? Let's find out -

12.1 The Concept of Force

We summarize the concept of force on the basis of the effects of force. On the basis of some activities, we will try to understand concept of force.

How many objects must interact for the force to act? Let's find out -

Activity - 1

Complete the table 12.1 by carrying out the activities given in it.

Table 12.1

S.No.	Event	Object through which force is applied	Object on which force is applied
1	Opening a book		
2	Closing the door of the cupboard		
3	Combing your hairs		
4	Opening the drawers of a table		
5	Closing a book		

In Fig. 12.1(a) one girl is pulling the other and in Fig. 12.1(b) the boy is pulling the horse.

Figure 12.1(a) Two girls pulling each other

Figure 12.1(b) A boy pulling a horse

From looking at Table 12.1 and at the above figures find out how many objects must interact for the force to act. You'll reach to this conclusion -

Two objects must interact with each other for the force to act.

Effects of Force

Applying force has different effects on different objects in different ways. Let us find out the changes that take place on applying force.

Activity - 2

Take a ball. Put it on a table and push it slightly. Is there any change in the position of the ball? Put a sheet of paper on the table and blow it. Again, is there any change in its position? In the same way we observe the leaves and the branches of a tree move because of the force applied by the air. A kick brings a football in motion. You can find out from similar examples that -

The applied force may change the state of an object or it may bring an object from rest to motion.

What would happen if the force is applied in the direction of motion of a moving object? Let's find out -

Figure. 12.2 Applying force in the same direction

Activity - 3

(I) Roll a ball on the floor. Apply a little force on the ball with your hand in the direction of its motion. What is the effect on the speed of the ball?

(II) Observe Fig. 12.2.

In Fig.12.2, a person is pulling a cart and another person is pushing it from back. What is the effect on the speed of the cart?

It is clear from the above examples that on applying force in the direction of their motion, the speed of the ball and cart increases. So we can say that -

On applying force in the direction of motion of a moving object, its speed increases.

What will happen if we apply force in the opposite direction of the direction of motion of a moving object?

Let's find out -

Activity - 4

(I) Push a table so that it starts moving. Ask your friend to push it from the opposite side. What is the change in the motion of the table? (Fig.12.3)

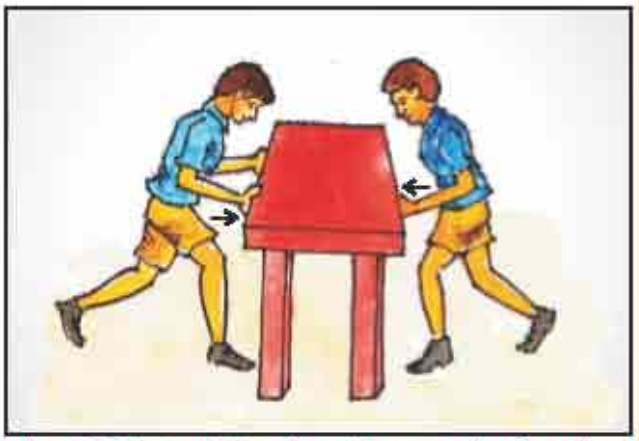

Figure12.3 Applying force in opposite directions

(II) You must have observed that the cart of a street hawker suddenly starts catching speed on a slope.

To slow down the speed of the cart the hawker has to pull the cart from behind.

It is clear from both these situations that on applying force in the opposite direction of motion of an object, its speed decreases.

In which direction an object will move if we apply two forces in the opposite directions simultaneously?

If two forces are simultaneously applied in the opposite directions then the object will move in the direction of greater force.

We can conclude from activity 3 and 4 that the forces can increase the speed of an object as well as decrease it. So we can say that -

On applying force on an object in motion, its speed might be changed.

Do you know what a player do in the game of football, hockey or cricket to change the direction of the ball? Some type of force is applied by the players in these games to change the direction of the ball. From this we can say that -

Force applied on a moving object can change its direction of motion.

Can you give some more examples in which the direction of motion of moving objects gets changed on applying force?

Activity - 5

Take a balloon, a sponge, a spring and a rubber-band.Blow the balloon and press it slightly.In the same way apply force on all these objects by pressing or stretching them.

Write down your observations in Table 12.2

Figure 12.4 Change in shape of objects on applying force

Table 12.2

S. no.	Activity	Change in shape (yes/no)
1	Pressing a balloon filled with air	Yes
2	Pressing a sponge	
3	Stretching a spring	
4	Stretching a rubber-band	

You will observe that -

On applying force, the shape of an object changes.

We can conclude from the above discussions that the force may change the state, speed, direction of motion and shape of an object.

So we can say that -

Force is a factor which -

1. May change the state of an object.
2. May change the speed of an object.
3. May change the direction of motion of an object.
4. May change the shape of an object.

This is the concept of force.

Unit of Force

The S.I. unit of force is 'Newton' (N). The great scientist Sir Isaac Newton studied force. He gave the laws for gravitational force and motion. The unit of force is named after him in his honour. Newton was also a great mathematician. Born in a poor farming family of England, Newton is generally regarded as the most original and influential theorist in the history of science.

Figure 12.5 Sir Isaac Newton

12.2 Different Types of Force

Gravitational Force

Where does fruit falls from a tree ? Where does an object falls after throwing upward ? Why all objects falls on the earth ? The Earth attracts each and every object towards it.

The force by which the Earth attracts all the objects towards it is known as the gravitational force of the Earth.

Muscular Force

Can you tell by your experiences that what you have to do to lift a heavy box? It is clear that you have to apply force. This force is exerted by your muscles; therefore it is called muscular force.

Humans and animals both exert muscular force. Discuss how many activities you can carry out with the help of muscular force.

Electrostatic Force

Activity - 6

Take a plastic scale. Rub it on your dry hairs or on a woollen cloth. Take it near tiny pieces of paper. What do you observe? Repeat this activity by taking a comb in place of the plastic scale. What do you observe now?

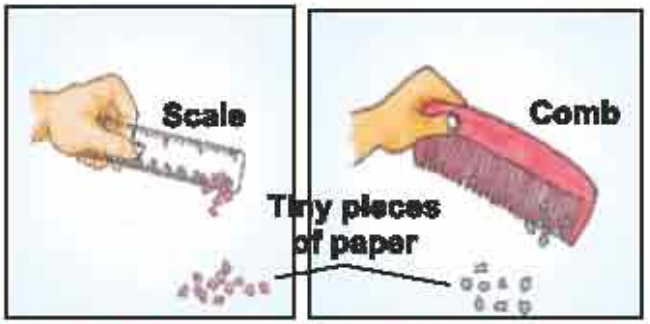

Figure 12.6 Demonstration of electrostatic force

From the above activity you can say that tiny pieces of paper get attracted towards the plastic scale or comb. Why does this happen?

When the plastic scale or comb is rubbed with dry hairs, it accumulates electrostatic charge; this electrostatically charged scale or comb exerts an electrostatic force on the tiny pieces of paper and thus attracts them.

> The force acting between electrostatic charges is known an electrostatic force.

Frictional Force

We know that to stop a moving object, we have to apply force in the opposite direction. But a ball rolling on ground gradually slows down and comes to rest. Why does this happen?

In the same way when you stop paddling your bicycle, it automatically stops after some time. Why does this happen?

> When an object moves on a surface, then a force is applied to it by the surface in the opposite direction of the motion of the object. This force is known as the frictional force or just friction.

Friction opposes the motion. That's why an object moving on the ground gradually slows down and comes to rest. Does friction depends on something? Why do we fall down when we step on a banana peel? Why it is not easy to walk on ice? Why we can walk easily on rough surfaces?

Let's find out -

Activity - 7

Take a glass marble. Create an apparatus as shown in Fig. 12.7.Roll it down the apparatus on a smooth surface. How far does it move before coming to rest? Now roll down the glass marble on the same apparatus but on a rough surface. How far does it move this time before coming to rest? You will find that the glass marble comes to rest earlier on the rough surface.

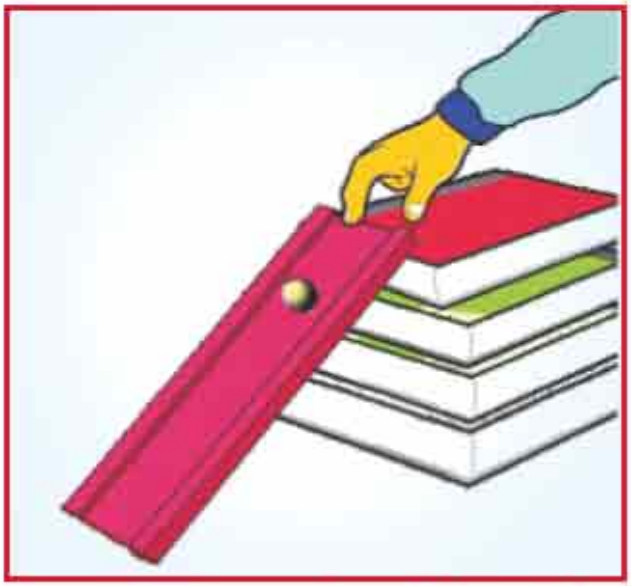

Figure 12.7 Demonstration of frictional force

It is clear that friction depends on the surface in contact. If the surface is smooth, then the force of friction will be less whereas if the surface is rough, then the force of friction will be more.

To walk easily force of friction is important. The surface of banana peel and ice is smooth. That's why we can't walk on it easily and fall down.

Magnetic Force

Activity - 8

Take a bar magnet. Bring it near some iron nails. What do you observe? The iron nails get attracted towards the magnet.

The force applied by a magnet on magnetic materials is called as magnetic force.

Besides gravitational force, friction force, muscular force, electrostatic force and magnetic force; there are other types of forces also. You will study about them in higher classes.

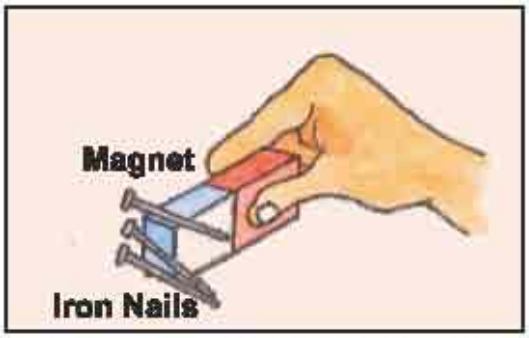

Figure 12.8 Demonstration of magnetic force

What have you learnt

1. Force is a push or a pull. But in the language of science, force is that quantity which can change the state, speed, direction of motion and shape of an object.
2. The S.I. unit of force is Newton (N).
3. The force by which the earth attracts objects towards it is known as the gravitational force of the Earth.
4. The force exerted by muscles is known as muscular force.
5. The force acting between electrostatic charges is known as electrostatic force.
6. The force applied on an object in the opposite direction of its motion by the surface is known as frictional force.
7. The force exerted by a magnet on magnetic materials is known as magnetic force.

Exercises

I. Tick the correct answers from the following -

1) Which force is used by a horse in pulling a chariot?

a) Magnetic force b) Electrostatic force
c) Friction d) Muscular force ( )

2) In winter season, you can hear a crackling sound and see sparks while pulling off woollen clothes because of -

a) Electrostatic force b) Magnetic force
c) Gravitational force d) Muscular force ( )

3) The S.I. unit of force is -

a) Joule b) Kilogram
c) Newton d) Second ( )

4) Which among the following cannot be changed by applying force?

a) Direction of motion b) Speed
c) Shape of an object d) Mass of an object ( )

II. Fill in the blanks -

1) The force acting between electrostatic charges is called .....
2) A push or a pull is known as .....
3) Falling of a fruit from a tree is an example of .....

III. Match the following -

Column 1	Column 2
1. Gravitational force	e) The force exerted in the opposite direction of motion by the surface in contact
2. Muscular force	f) The force exerted by the Earth
3. Friction	g) The force acting between electrostatic charges
4. Electrostatic force	h) The force exerted by muscles

IV. Short answer questions -

1) Why does an object finally fall down when we throw it up?
2) On which thing does friction depend?
3) Differentiate between gravitational force and magnetic force.
4) Write the S.I. unit of force.
5) A 5 Newton and a 3 Newton force is applied on an object in the opposite directions simultaneously. In which direction will the object move?

V. Long answer questions -

1) Explain the effects of force with the help of examples.
2) Friction opposes the motion of an object. Explain this with the help of an activity.
3) Explain through an experiment that the shape of an object can be changed on applying force.

Creative work

I. Prepare a toy car according to the Fig. shown below by using a match box, broomsticks and rubber caps. Now perform the activities given in the table below and conclude that by applying force, the speed of an object can be increased and decreased.

S. no.	Activity	Observation
1	To apply force in forward direction by pulling the string of stationary toy car on a plane surface.	The toy car changes its state from rest to motion.
2	To apply force on the moving toy car in the direction of its motion.	The speed of the toy car increases.
3	To apply force on the moving toy car in the opposite direction of its direction of motion.	The speed of the toy car decreases.