

07

FORCE AND MACHINES

In this chapter, we will learn about:

- Force
- Effects of force
- Speed
- Simple machines

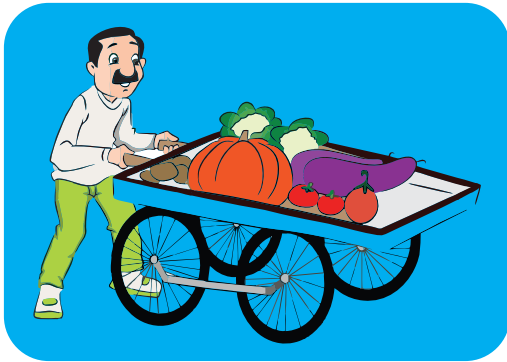


Figure 7.1 Hawker pushing a cart

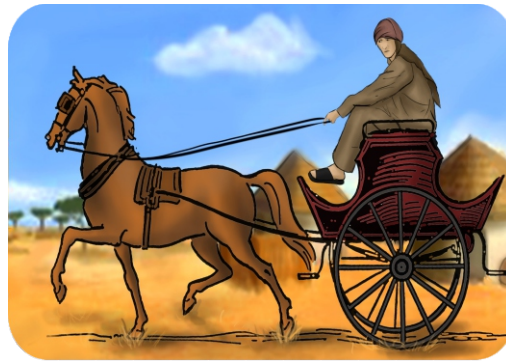


Figure 7.2 Horse pulling a tonga

WHAT IS FORCE?

Pushing and pulling is a part of our daily life. A hawker pushes his cart to move it from place to place (Figure 7.1). A horse pulls a tonga to move the people (Figure 7.2). Similarly, a bicycle moves when you push its pedals. Sometimes a push or a pull is also applied to stop the moving objects. A wicket keeper when catches the ball, he stops it with his hands (Figure 7.3).



Figure 7.3 Wicket keeper catching the ball

There are many other tasks which you do by applying push or pull or both in your daily life. In science, both push and pull are the same things and have one meaning that is force.



Activity 7.1

The objects shown on the right side move either by push or pull. Separate these objects.



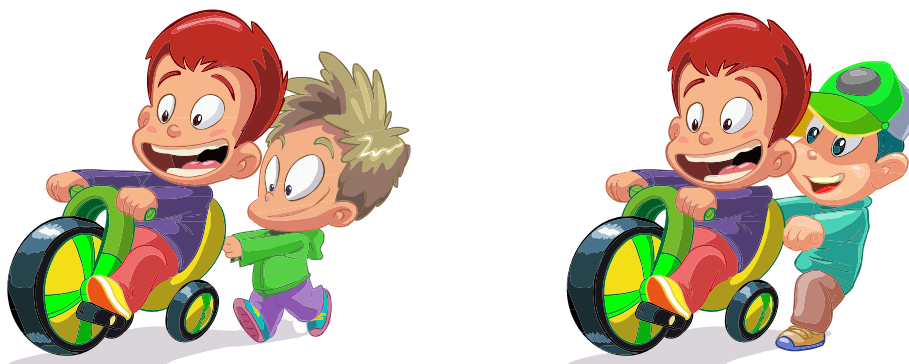
EFFECTS OF FORCE

1- Force and Change in Motion

Motion is important to our lives and it affects so many things that we do. Motion is the change in position of an object. We have already seen that the force can produce motion in a body. Force can also stop a moving body. Another effect of force is that it can change the motion of a body by moving it faster or slower. Let us demonstrate it by an example.

Suppose your friend is riding his bicycle. If you gently pull the moving bicycle from behind, it slows down (Figure 7.4a). Again, if you give it a push, it moves faster (Figure 7.4b).

This means that if a force is applied in an opposite direction of motion of a body, the body will slow down or stop. But if force is applied in the direction of motion, the body will move faster.



(a) A boy by pulling the bicycle slows it down (b) A boy by pushing the bicycle moves it faster

Figure 7.4

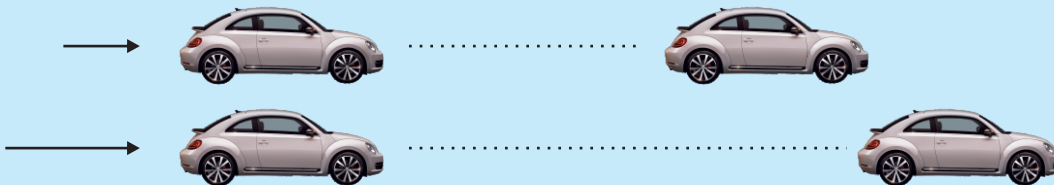


Activity 7.2

Take two identical toy cars. Push both the cars gently with some force. The cars will start to move. How long both of them move, depends upon the amount of pushing force. If the cars are given an equal push they will cover nearly equal distances. Now push one of the cars slightly harder than the other and observe the cars. Which car will cover more distance at this time?



When both the cars are pushed gently with the same force they cover the same distance.



When one car is pushed slightly harder than the other then they cover the different distance.

Greater the force, greater will be distance covered by the object.

2- FORCE AND CHANGE IN DIRECTION OF MOVING OBJECT



Figure 7.5

Force not only makes the objects move slow or fast but it can also change the direction of the moving objects. For Example, when a batsman hits the ball with bat, his force not only moves the ball faster but changes its direction as well (Figure 7.5).



Figure 7.6

Similarly, a football player changes the direction of motion of the ball by kicking it with his foot (Figure 7.6).

3- FORCE AND CHANGE IN SHAPE OF THE OBJECTS

What happens when we apply force to a rubber band? It stretches out. But when we remove the force, the rubber band shrinks back to its original shape. A force can stretch, compress, squeeze and cause change in the shape of the objects. The change in the shape of the objects, when a force is applied may be temporary or permanent. Let us understand how force changes the shape of objects temporarily.

Be Careful

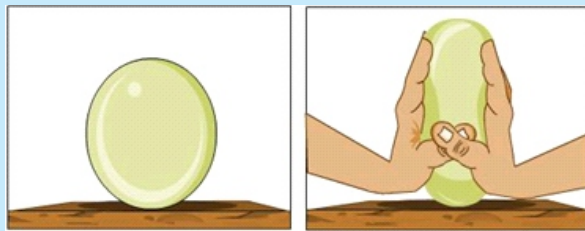


When stretching rubber bands, they can snap if you stretch them too far and can flick against your skin.



Activity 7.3

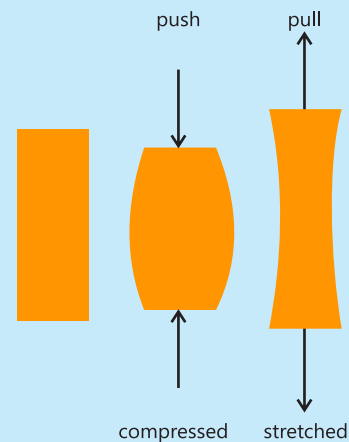
- Take an inflated balloon. Press this balloon between the palms of your hands.
- What happens to the shape of balloon?
- What happens when you remove the hands?
- What do you conclude from this activity?



Activity 7.4

Take a rectangular sponge and compress it from both ends. The sponge changes its shape.

- What happens when you remove the force?
Now pull the both ends of the sponge. It again changes its shape.
- What happens when you remove the force of your hands?



From the above activities we can observe:

some objects return to their original shape after the removal of force. These objects are called Elastic objects.

Shape of some objects is changed permanently when force is applied on them. For example, the molding of clay is a permanent change in shape by the force (Figure 7.7).



Figure 7.7 Moldings of clay



Activity 7.5

Take a ball of dough, press it with the help of a roller to make a round flat bread.

- Does the flat round bread become a ball again when you remove the roller?



From this activity we can observe:

Some objects do not return to their original shape after the removal of force. These objects are called inelastic objects.



Activity 7.6

Force is applied on the things shown below, so that their shapes may or may not change. Identify the temporary or permanent changes in the given objects when the force is removed from them.



DISTANCE AND SPEED

Mr. Saleem and Mr. Kareem started their journey from Lahore to Islamabad (400 km).

Mr. Saleem boards a train from Lahore. He travels for 4 hours and reaches Islamabad.


On the other hand, Mr. Kareem boards a bus. But the bus reaches only Jhelum in 4 hours.

- Who covers more distance in the same time, the train or the bus?
- Which is moving faster?

From the above example we can know more about motion by relating the distance covered by the object with the time taken to cover this distance.

- Can you define a new term that is called **speed** of the moving object?
- Can you find the speed of train in the above example?

i *For Your Information*



The speed of an object can be measured at any time during its motion by using this relation:

$$\text{Speed} = \frac{\text{Distance covered by the object}}{\text{Time taken to cover this distance}}$$

SIMPLE MACHINES

A thing that helps us to do something faster or easier is called simple machine. Simple machines are the lever, the pulley, the inclined plane and the wheel and axle. We shall learn about them one by one

Lever

Lever is a simple machine which is usually a long rod. Lever is mostly used for lifting heavy loads by applying a smaller force (Figure 7.8). The rod is pivoted at a point that is called fulcrum. One end of rod is placed under the load to be lifted, while a downward force is applied on the other end to lift the load.

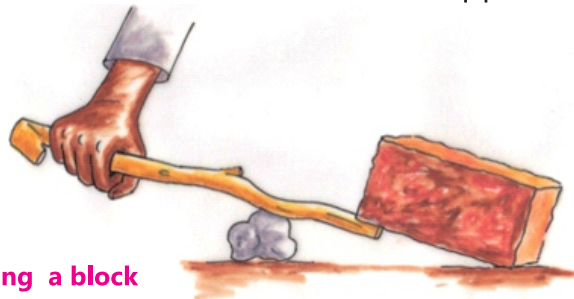


Figure 7.8 Lever lifting a block

Levers are all around us. Some examples of lever are scissors, nut cracker, wheel barrow and human arm (Figure 7.9).



7.9 Examples of lever

Pulley

Pulley is another simple machine which is used for changing the direction of force and moving the things up or down. A pulley is used for drawing water out of a well. It is also used in cranes for lifting heavy loads (Figure 7.10).

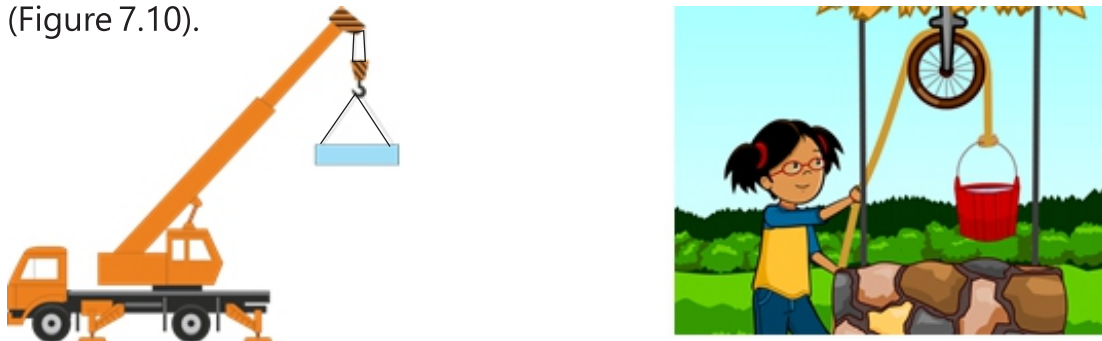


Figure 7.10 Examples of Pulley

Inclined plane

It is also a simple machine. The inclined plane is simply a ramp, with the help of which we can move things from lower to higher places or higher to lower places easily.

Usually, ramps are used to load the heavy objects on the trucks (Figure 7.11). They are also used in hospitals to carry patients to upper storeys conveniently and comfortably without using stairs.



Figure 7.11 Use of inclined planes

WHEEL AND AXLE

Wheel is the major invention in the history of mankind. Wheel does not work without axle. Axle is a rod passing through the centre of the wheel. It allows the wheel to turn around it. Wheel combined with the axle forms a simple machine 'wheel and axle' which changes sliding motion into rolling motion (Figure 7.12). Wheel and axle have many uses in our daily life. A few are shown in the Figure 7.13.



Figure 7.12 Merry-go-round is an example of wheel and axle

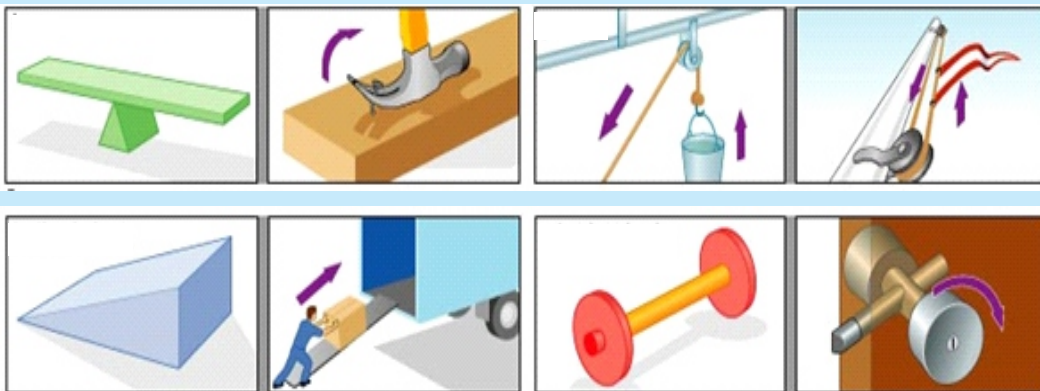


Figure 7.13 Use of wheel and axle



Activity 7.7

Identify the simple machines given below.



KEY POINTS

- The effort made to push and pull an object is the force.
- Position of an object can be changed by applying force on it.
- Greater the force greater will be the distance covered by an object.
- Force can change the shape of an object permanently or temporarily.
- Speed of an object is determined by dividing the distance covered with the time taken.
- A thing that helps us to do something faster or easier is called simple machine.
- A pair of scissors is a simple machine, used to cut cloth, paper and other things.
- A hammer is an example of lever, used to press something hard or to break it.
- A pulley is a simple machine used to lift or lower heavy objects.
- A wheel barrow is a type of trolley used to transport material from one place to another.

GLOSSARY

Force: Effort made to push and pull an object.

Speed: Distance travelled in unit time.

Simple Machine: Device that makes work easier.

EXERCISE

7.1 Encircle the correct option.

(i) Which is not a force?

- a. speed b. friction c. pull d. push

(ii) Anything that causes change in position or speed is called:

- a. distance b. mass c. force d. moment

(iii) What must be applied to push or pull an object?

- a. force b. gravity c. speed d. distance

- (iv) People use simple machines because:
- a. they make things smaller.
 - b. they do the work for us.
 - c. they make work easier.
 - d. they are found everywhere.
- (v) Which will be the better change in baseball by a force?
- a. change in its direction.
 - b. change in its weight.
 - c. change in its shape.
 - d. change in its colour.
- (vi) If you wish to kick a soccer ball to go as far as possible, what should you do?
- a. kick it from the side.
 - b. kick it very hard.
 - c. kick it without shoes on.
 - d. kick it to a team-mate.
- (vii) Which of the following simple machines makes up the base of light bulb?
- a. wheel and axle
 - b. lever
 - c. screw
 - d. pulley
- (viii) Which simple machine is used in bicycle to travel?
- a. Screw
 - b. Inclined plane
 - c. A pulley
 - d. A wheel and axle
- (ix) Which moves with greater speed?



(a)



(b)



(c)



(d)

7.2 Fill in the blanks.

- (i) A push or pull is _____.
- (ii) You _____ the oven door to open it.
- (iii) The swing moves faster when you _____ it.
- (iv) A swing machine is made up of many _____.
- (v) A flag is raised or lowered with the help of _____.

7.3 Short Answer Questions.

- (i) Give three examples of each of "Push" or "Pull" force.
- (ii) What is pulley?
- (iii) Define speed.
- (iv) Where are pulleys used?
- (v) What is lever? Give examples of lever used at your home.

7.4. Draw a labeled diagram of pulley used to lift a pail.

7.5. What is an inclined plane? Give three examples where inclined plane is used in our daily life.

7.6. What is wheel and axle? Give two examples where it is used in our daily life.