

# Simple Machines

## BEFORE WE START, LET'S CHECK

### What you already know

Tick (✓) the pictures which show that work is being done.

☐☐☐☐

### What you will know

What are machines?



How are machines useful to us?



What are different kinds of machines?



How do we use simple machines in our daily lives?



## MACHINES

In our daily lives, we have to do many kinds of work. For doing work, we need energy. Some work is simple to do but some tasks are hard. Hard tasks require a lot of energy. Some of them can't be done by muscular force alone. For doing such tasks, we use **machines**.

A machine is a tool or a device that makes work easier.

Machines make our work easier by:

- \* increasing the force applied by us.
- \* changing the direction of the force.
- \* increasing the speed of work.

### Kinds of machines



complex machine

There are two kinds of machines: **complex** and **simple**.

You must have seen many machines in and around your house, for example the refrigerator, washing machine, crane and road roller. All these are **complex machines**.

Do you know that a spoon, scissors and tongs are also machines? So anything simple that makes our work easier is a **simple machine**.

All complex machines are made up of two or more simple machines.

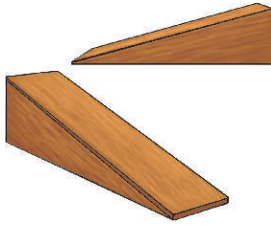


simple machine

## SIMPLE MACHINES

There are six kinds of simple machines. Let us learn about each of them.

### 1. Inclined plane



An inclined plane is a **slope**. One of its ends is higher than the other.

An inclined plane reduces the force you have to use to lift something. This is because it is easier to move an object by pushing or rolling it rather than lifting it straight up.

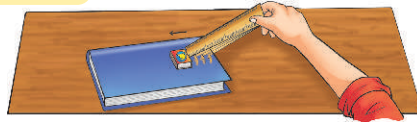
Here, it must be noted that the distance (x) you need to cover along the plane is greater than the distance (y) you would cover to lift the load, i.e.  $(x > y)$ . But even then, it is easier for you as it divides the work into smaller parts and you have to apply less force each time.



#### Fun and Learn



Take a book, a matchbox, a ruler and a duster.



Place the book on a table. Put the match box on it and push it to the other end of the book using a ruler.



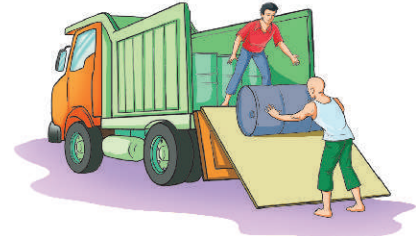
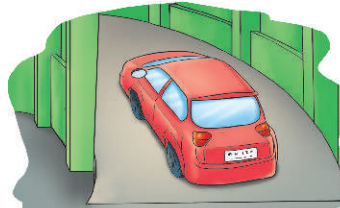
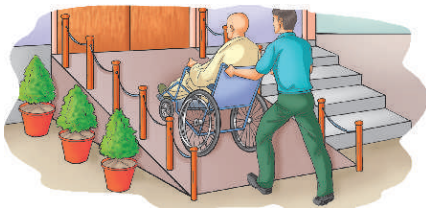
Now place the duster under one end of the book. Then place the match box at the top of the upper end and repeat the activity.

What do you observe? Why does it happen? Tell your teacher.

Inclined planes, called **ramps**, are usually used in hospitals, cinema halls, foot overbridges, etc. They make the movement of stretchers, wheelchairs, etc. easier.

Many shopping malls and other high buildings have parking spaces in their basements. You can see large ramps there. It is convenient to drive vehicles up and down the ramps.

Similarly, inclined wooden planks make the loading and unloading of goods from trucks easier.



### 2. Lever



A **lever** is a straight rigid rod that can turn or move about a fixed point or support. A lever is used to lift or move something. A lever needs three things to work.

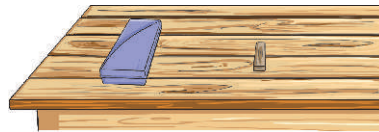
- 1. Fulcrum (F):** It is the fixed point about which the rod moves.
- 2. Load (L):** It is the object that is to be lifted or moved.
- 3. Effort (E):** It is the force applied to the rod.



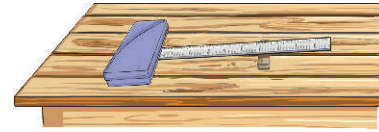
## Fun and Learn



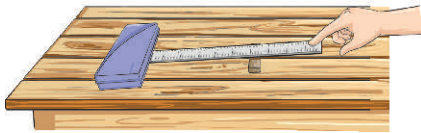
1. Take a wooden ruler, an empty pencil box and a small piece of wood.



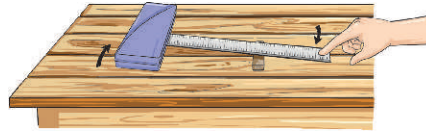
2. Place the pencil box on a table. Fix the wood about 8 inches away from the box.



3. Now, place the ruler on the wood. Then place the box on one end of the ruler.



4. Now, press the other end of the ruler down.



5. You will see that the pencil box is lifted up.

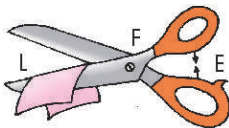
⇒ Here,  
The pencil box is the **load (L)**.  
The force you apply is the **effort (E)**.  
The resting point of the ruler on wood is the **fulcrum (F)**.

**Types of levers:** On the basis of the position of the load (L), the fulcrum (F) and the effort (E), levers are of three types.

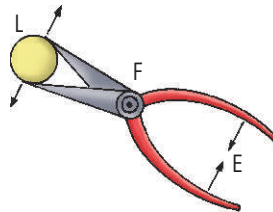
**1. First-class levers:** In a first-class lever, the fulcrum (F) is between the load (L) and the effort (E).

LOAD      FULCRUM      EFFORT      ⇒      LFE

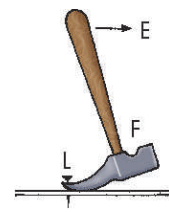
Examples: scissors, pliers, a claw hammer and a hand pump



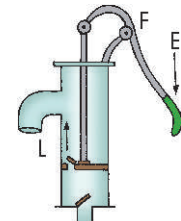
scissors



plier



claw hammer



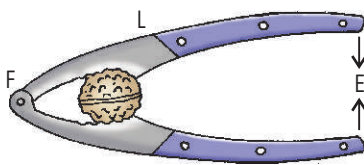
hand pump

*some first-class levers*

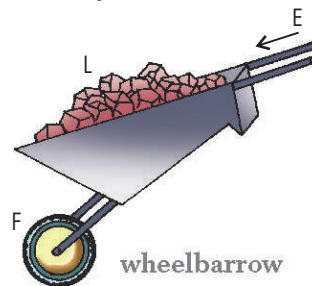
**2. Second-class levers:** In a second-class lever, the load (L) is between the fulcrum (F) and the effort (E).

FULCRUM      LOAD      EFFORT      ⇒      FLE

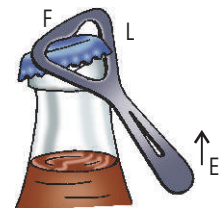
Examples: nutcracker, wheelbarrow and bottle opener



nutcracker

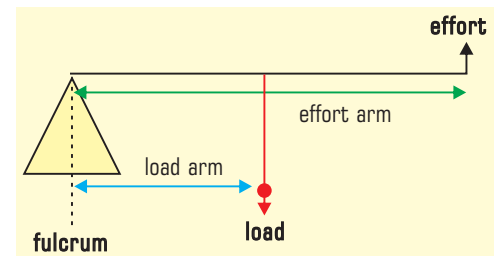
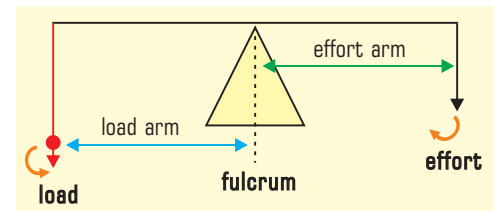


wheelbarrow



bottle opener

*some second-class levers*



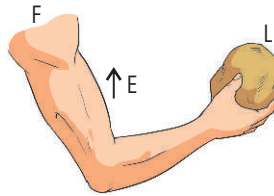
**3. Third-class levers:** In a third-class lever, the effort (E) is between the fulcrum (F) and the load (L).

FULCRUM      EFFORT      LOAD      →      FEL

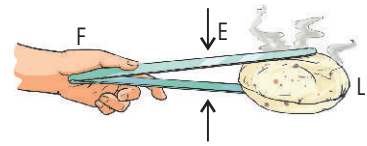
Examples: a fishing rod, tongs, tweezers and a spade



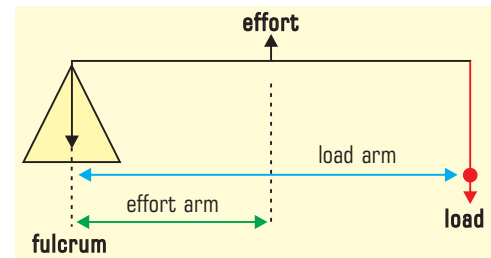
fishing rod



lifting load with a hand



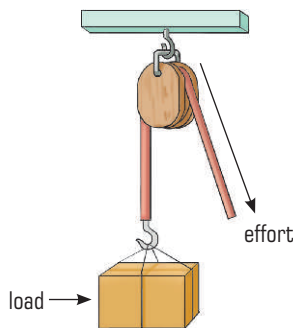
tongs



### 3. Pulley

A **pulley** is a wheel with a groove in its rim. A rope, chain or belt passes through the groove. The pulley changes the direction of the force and thus makes it easier to lift things to some heights.

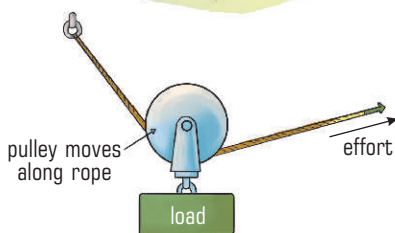
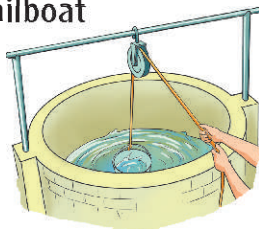
There are two types of pulleys: fixed pulleys and movable pulleys.



**Fixed pulley:** In a fixed pulley, the wheel is attached to a hook or a wall. The wheel cannot move but it spins at one fixed place.

When we lift a load, we have to apply force in an upward direction. If we attach the load to a rope and pass the rope through a pulley, the load can be lifted by pulling the rope down from the other end. Pulling the rope down is easier than lifting it up. Thus, a pulley makes our work easier.

Examples: drawing water from a well, raising a flag on a flagpole, and hoisting sails on the mast of a sailboat



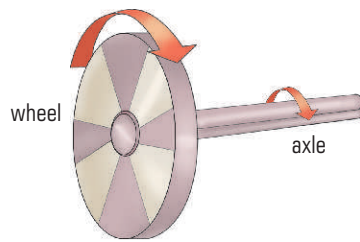
**Movable pulley:** A movable pulley is a pulley that is free to move up and down. It is attached to a ceiling or any other object by two lengths of the same rope.

A movable pulley reduces the effort required almost by half as two parts of the rope support the weight.

Examples: raising or lowering of elevators, and by lifting of wrongly parked vehicles using cranes



## 4. Wheel and axle



A wheel and **axle** is a simple machine. It consists of a wheel and an axle.

The wheel is a circular disk or cylinder. It rotates around the axle. The axle itself is a long cylindrical wheel which is fixed in between the bigger wheel. Thus, the axle moves automatically with the movement of the wheel.



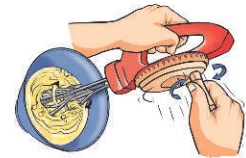
### Fun and Learn



Take an egg, a bowl and an egg beater with wheels.



Break the egg in the bowl.



Beat the egg by rotating the wheel of the egg beater.

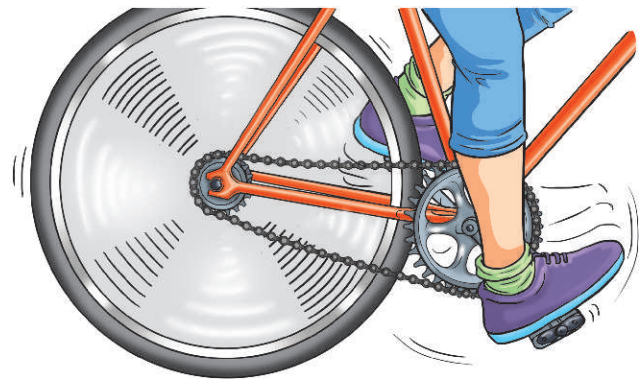
Check the wheel and axle arrangement in it.

A wheel and axle helps us in turning and moving things easily.

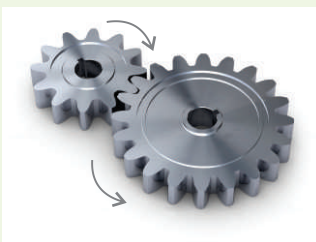
They also help us in changing the amount of movement. Changing the amount of movement is very important because it allows us to travel long distances without making too much effort.

There are three wheel and axle systems in a bicycle— a small system in the pedal wheel and two larger systems in the main wheels. So by turning the small pedal wheels each time, you cover a much longer distance that is equal to the circumference of the bicycle wheel.

Some other examples of a wheel and axle are doorknobs, the steering wheel of a car, a screwdriver and the base of a merry-go-round.



### GEARS



A **gear** is a wheel with teeth. A gear system has two or more gears with their teeth fitting into each other.

Gears perform two main functions:

1. They increase or decrease the speed of work.  
(As a slow big gear will make the little gear move quickly.)
2. They change the direction of movement.  
(As one gear make another one turn in the opposite direction.)

## 5. Screw

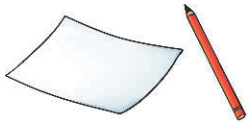


Have you seen a **screw**? It looks like a nail but it is not. It has some grooves cut into it. It is used to hold things together.

A screw is an inclined plane wound across a rod.



### Fun and Learn



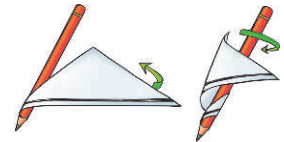
Take a piece of paper and a pencil.



Cut the paper in the shape of a triangle.



Draw a thick line on the longest side of the triangle.

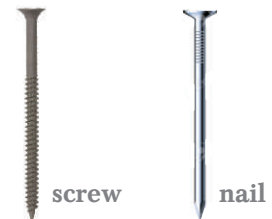


Wrap the paper around the pencil as shown.

Your pencil now looks like a screw. Isn't it!

A screw allows movement from a lower position to a higher position. But at the same time, it moves in a circle that makes it take up less horizontal space.

A screw is also used to hold things together tightly. Can you compare a screw and a nail? Which is better? Why do carpenters prefer screws to nails to join two pieces of wood together? It is because a screw has grooves on it which makes the grip stronger.



Screws are used in jar lids, drills, bolts, light bulbs, taps, bottle caps, screw jacks, etc.



jar lid



drill



bolt



light bulb



screw jack

## 6. Wedge



A **wedge** is made up of two inclined planes. These planes meet and form a sharp edge.

Unlike an inclined plane, which is fixed, a wedge works by moving.

A wedge is used to split an object. It is needed to cut, tear or break something in two.

Examples: a knife, an axe and a chisel



knife



axe



chisel

A wedge can also be used to keep things together or to stop the movement of things.

Examples: a stapler, pushpins, tack, etc.

## Words to Remember

machine	–	a device that makes work easier
slope	–	a surface whose one end is higher than the other
ramp	–	a sloping surface as at the entrance of a building
lever	–	a rigid bar resting on a support used to move a load with one of its ends when pressure is applied to the other
load	–	the object that is to be lifted or moved
effort	–	the force applied to the load
fulcrum	–	the fixed point about which the rod of the lever moves
pulley	–	a wheel with a grooved rim through which a rope, chain or belt passes
axle	–	a rod or spindle (either fixed or rotating) passing through the centre of a wheel or group of wheels
gear	–	a wheel with teeth around its rim that fit into the teeth of another similar wheel
screw	–	a spirally grooved solid cylinder
wedge	–	a piece of material, thick at one edge and tapered to a sharp thin edge at the other

## Points to Recall

- \* We use many machines as they make our work easier and less time consuming.
- \* Complex machines are made up of two or more simple machines.
- \* There are six types of complex machines: inclined plane, lever, pulley, wheel and axle, screw, and wedge.
- \* Inclined planes are used as ramps in hospitals, cinema halls, basement parkings, etc.
- \* Levers are used to move heavy loads easily.
- \* According to the position of the fulcrum, load and effort, the levers are of three types.
- \* Pulleys also help us in lifting heavy loads easily.
- \* Pulleys are used for drawing water from wells, hoisting flags, in elevators, cranes, etc.
- \* A wheel and axle helps us by changing the amount of the movement.
- \* Gears can change the speed of work and the direction of movement.
- \* Screws are mainly used to hold things together tightly.
- \* The wedge is used to separate an object apart.

## Exercises

### A. Tick (✓) the correct option.

- Which of the following is not a simple machine?  
 (a) screwdriver ☐ (b) scissors ☐ (c) fridge ☐ (d) pliers ☐
- Which of the following is not a first-class lever?  
 (a) hand pump ☐ (b) pliers ☐ (c) claw hammer ☐ (d) nutcracker ☐
- Which of the following is in the middle in a second-class lever?  
 (a) fulcrum ☐ (b) load ☐ (c) effort ☐ (d) none of these ☐
- A movable pulley is used in  
 (a) an elevator ☐ (b) a well ☐ (c) a flagpole ☐ (d) a sailboat ☐
- Which of the following is an example of a wheel and axle?  
 (a) tongs ☐ (b) nutcracker ☐ (c) screwdriver ☐ (d) tweezers ☐

**B. Write 'T' for true statements and 'F' for false ones.**

1. A movable pulley reduces the effort required almost by half.
2. In a pulley, the load and the force is at the same end of the rope.
3. Two gears fitted together move in the same direction.
4. A screw holds things together more tightly than a nail.
5. The wedge is used only to split an object.

**C. Answer in one or two words only.**

1. Name a complex machine used in homes.
2. Does a fixed pulley change the direction of force?
3. Which of these has a bigger diameter—the wheel or the axle?
4. How many inclined planes is a wedge made up of?
5. Give an example of a wedge being used to keep things together.

**D. Answer in one sentence only.**

1. How many kinds of simple machines are there? Name them.
2. Why is it easier to roll a load up an inclined plane than to lift it up?
3. How are inclined planes useful in hospitals?
4. What is the fulcrum?
5. What is the difference between the working of a wedge and that of an inclined plane?

**E. Answer in a few sentences.**

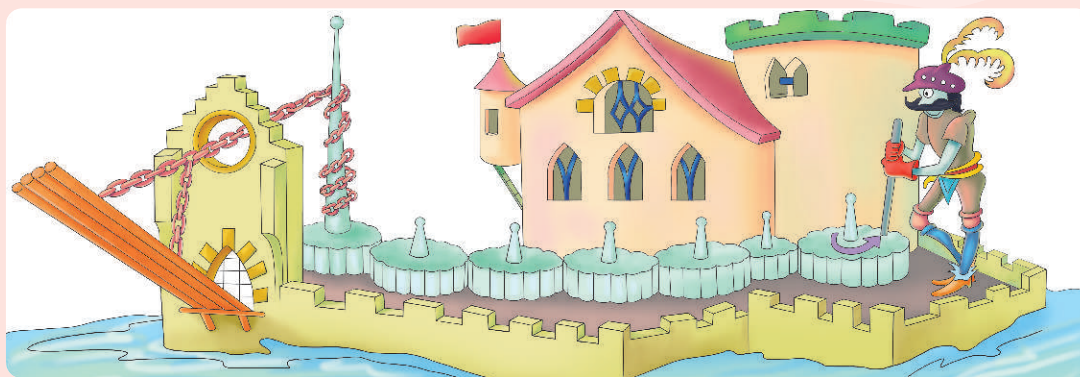
1. How does a machine make our work easier?
2. Describe a lever and its parts.
3. Explain the working of a fixed pulley with the example of a well.
4. A wheel and axle helps us by changing the amount of movement. Explain it with an example.
5. Why is a screw better than a nail to hold things together?

## Creative Skills



### BRAINSTORM

Look at the picture carefully. In which direction will the wooden gate move—upwards or downwards.







## TELL YOUR TEACHER

Read the following and tell your teacher what right or wrong each child did.

- Jatin and Radha were in the park. They were playing on a see-saw. Suddenly, Jatin got up without telling Radha about it.
- Rohit's grandfather had to go abroad. Rohit's mother was at the market to buy a suitcase for him. Rohit was also with her. Rohit requested his mother to buy a travel bag with wheels instead of suitcase.
- Shalu and her friends were playing hopscotch in her courtyard. They had a flat stone as the marker. After a few shots, they felt that the stone was a little too big. Shalu at once went inside the house and brought a knife. She started trying to cut the stone with the knife.

## FIND OUT

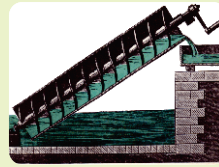


What do we call this? What is the advantage of it?

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What is an Archimedes's screw? What is it used for?

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## Project

Take a pencil and a notebook. Move around your house. Make a list of 5 simple machines that are used in each of the following rooms:

- kitchen
- living room
- bathroom

Write their names and explain how each of them makes our work easier. Submit it to your teacher.



## Activity Time

### Making a well

#### Steps

#### What you need

a corrugated sheet

two plastic rulers of 6 inches

a plastic cord



a toy bucket

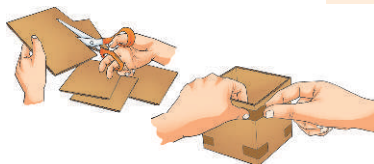
a 6-inch long iron wire



a used wooden reel



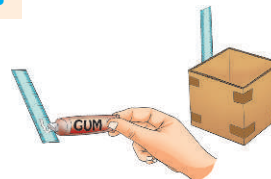
Fevicol



1. Cut four rectangular pieces of 4" × 4" off the corrugated sheet and paste them as shown.



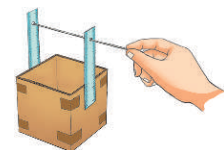
4. Take the wooden reel and hang it on the wire as shown.



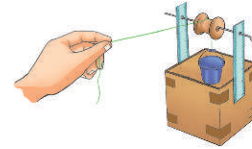
2. Paste the rulers on both sides of the walls as shown.



5. Now take the cord and tie one of its ends to the toy bucket.



3. Make two holes on the rulers at one inch from the top and insert the wire through them.



6. Pass the cord through the reel as shown.

Your well with pulley is ready. The bucket will go up or down as you pull or release the rope.

# Revision Exercise 1

(Based on chapters 1 to 7)

## A. Tick (✓) the correct option.

- Which vitamin deficiency causes night blindness?  
(a) vitamin A ☐ (b) vitamin B ☐ (c) vitamin C ☐ (d) vitamin D ☐
- The muscles are attached to the bones by  
(a) tendons ☐ (b) ligaments ☐ (c) cartilage ☐ (d) none of these ☐
- Which of the following is in the middle in a second-class lever?  
(a) fulcrum ☐ (b) load ☐ (c) effort ☐ (d) none of these ☐
- A strawberry plant reproduces from  
(a) bulbs ☐ (b) runners ☐ (c) leaves ☐ (d) none of these ☐
- Which part of your brain is involved when you are walking?  
(a) cerebrum ☐ (b) cerebellum ☐ (c) medulla ☐ (d) brainstem ☐
- How many bones are there in the skull?  
(a) 206 ☐ (b) 600 ☐ (c) 14 ☐ (d) 22 ☐
- Which of the following animals plays dead if it sees no escape?  
(a) Arctic fox ☐ (b) hognose snake ☐ (c) armadillo ☐ (d) mountain goat ☐
- Which of the following is not a communicable disease?  
(a) typhoid ☐ (b) measles ☐ (c) diarrhoea ☐ (d) osteoporosis ☐

## B. Write 'T' for true statements and 'F' for false ones.

- A screw holds things together more tightly than a nail.
- As compared to other nutrients, we need to take a great quantity of vitamins.
- In India, the Wildlife Protection Act was introduced in 1992.
- An old lady needs more protein than a young sportsperson.
- A newborn baby has more bones than an adult.

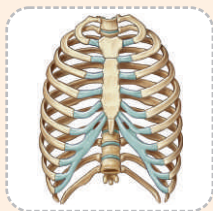
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## C. Fill in each blank choosing the correct word.

- Two gears fitted together move in \_\_\_\_\_ direction/directions. (*the same / opposite*)
- Nerve fibres, called \_\_\_\_\_, carry information towards the cell body. (*dendrites / axons*)
- The \_\_\_\_\_ is the longest bone in the human body. (*backbone / femur*)
- Fertilisation takes place when pollen enters the \_\_\_\_\_. (*stigma / stem*)
- Shahtoosh is obtained from the Tibetan \_\_\_\_\_. (*sheep / antelope*)

**D. Identify the following and write their names.**

1.

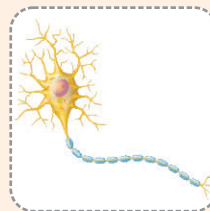
2.

3.

4.

5.

**E. Answer in one or two words.**

1. How many floating ribs are there in the ribcage?
2. Name the mineral needed to maintain water balance in the body.
3. Name a fruit whose seed is dispersed by water.
4. What are the tiny bumps on top of the tongue called?
5. Name the animal which makes the longest migration.

**F. Answer in one sentence.**

1. Why is it easier to roll a load along an inclined plane than to lift it up?
2. Why do some animals hibernate?
3. What should we do while sneezing or coughing?
4. What do you understand by vegetative propagation?
5. How does the pivot joint work?

**G. Answer in a few sentences.**

1. What are viruses? Name a few diseases caused by viruses.
2. Using a diagram, explain the structure of a neuron.
3. Write a short note on roughage.

**H. Think and answer.**

1. Why are lizards usually not seen in winter?

*or*

Why do our eyes close if we come out in the bright light from a dark room?

2. Why can't we bend our elbows backward?

*or*

Why does a doctor advise a patient of rickets to sit in the sun regularly?