



## 6

## ORDINARY MACHINES

Have you ever tried to open the lid of a soft drink bottle without an opener? If yes, did you succeed? It is difficult to do this with the help of only your fingers. But with the opener we can open the bottle easily. Similarly can you carry heavy weight on a cart or wheelbarrow without wheels? To do this you have to apply a lot of force. But you can easily carry heavy weight on wheels. A bottle opener or both opener and wheel are machines. In fact, they are so simple that we do not know them as machines. Similarly, scissors, tongs, nail catching machine, and plane etc. are all simple machines that we use in our daily life. What would you do if you had to reach the high terrace? For this, either you will reach the terrace by walking on a long steep path or you will climb the stairs to reach the terrace. It is easier to walk on the sloping path than climbing the stairs, so the sloping surface or path is also a simple machine. Even a simple object like a scissors can be a machine and a complicated thing like a computer can also be a machine.

In this lesson, we will study about the types of ordinary machines, the principles of their working and their utility in our daily lives.



Notes



## OBJECTIVES

After reading this lesson you will be able to:

- learn about various types of simple machines; and
- explain the use of these machines in daily life.

### 6.1 DIFFERENT TYPES OF MACHINES

Ordinary machines do not have many components. In fact, machines either make our work easier by changing the direction of force, such as a pulley, or they increase the force we exert, making it easier for us, such as by force or by increasing the speed, such as the wheel of a cycle. We mainly use the following six types of simple machines-

1. lever, 2. pulley, 3. wheel, 4. Sloping floor, 5. screw, 6. quoin



Fig. 6.1 Worker picking stones from a crow bar



## 1. Lever

You must have seen the workers lifting heavy stones with the help of a crow bar. Have you ever wondered how they do this? You can also try to lift heavy stones yourself. Let us do an activity for this.



### ACTIVITY 6.1

**What you need to do:** Lift the heavy book.

**What you need:** a heavy book, foot scale of iron and small wooden blocks

**How you have to do:**

- i. Press one end of the iron scale under the heavy book.
- ii. Place a piece of wood under the iron scale near the book.
- iii. Now apply downward force at the other end of the scale.

**What You Learned:** When we apply a downward force on the scale, the book rises upwards.

**But why so?** This is because the scale acts like a lever and increases the force you exert and you can lift the book with a little pressure. In this way your work becomes easy.

In the above state the book was the load, this piece of wood on which the scale was fixed was the fulcrum and the force applied on the scale was effort. We will use these three words to understand the types of levers.



### Different types of levers

In our daily life, we use many types of levers every day. The spoon acts as a lever in opening the lid of a tin with a spoon. When we work on paper with a pen, the pen is a kind of lever. Similarly, when the frog jumps, its legs act as levers. There are three types of levers according to the comparative position of effort, load and fulcrum.

**(1) First-class lever:** In the first-class lever, fulcrum is situated between the load and effort.

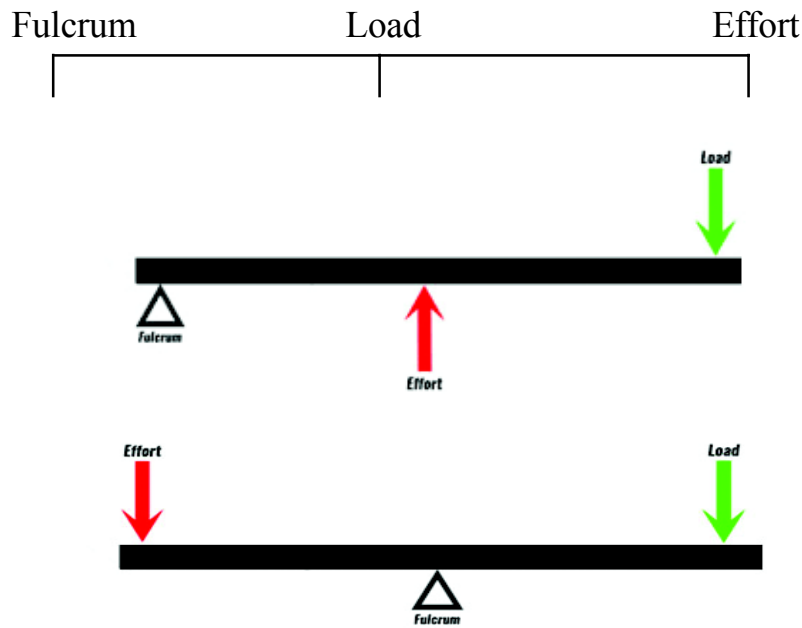


Fig. 6.2 First-class lever

Some levers of this category are shown in Fig. 6.3.

**(2) Second-class lever:** The second-class lever has an umbrella at one end of the rod, the effort is applied at the other end and the load is in the middle.

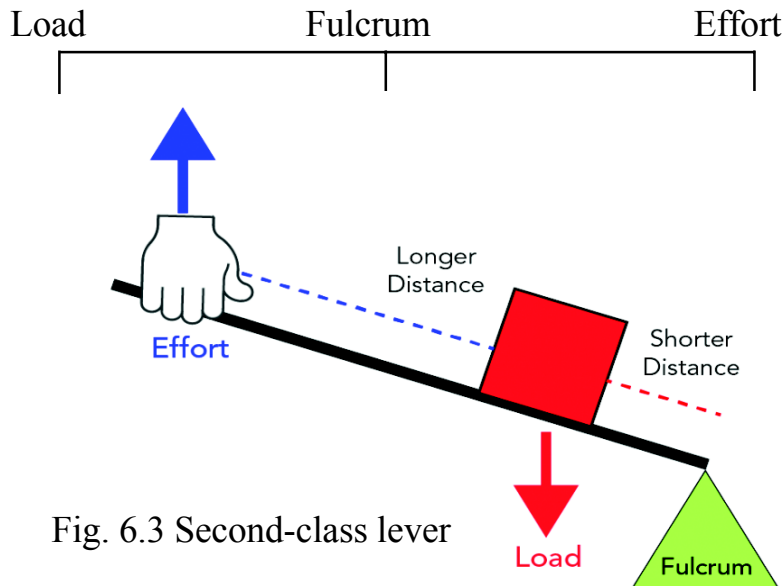


Fig. 6.3 Second-class lever

A few examples of the levers of the second class are shown in Figure 6.3 as well.

Note: The effort in this type of lever is always longer than the arm load and the arm. Therefore, with less effort, more weight can be carried.

**(3) Third-class lever:** In third-class lever, effort is put between the fulcrum and the load.

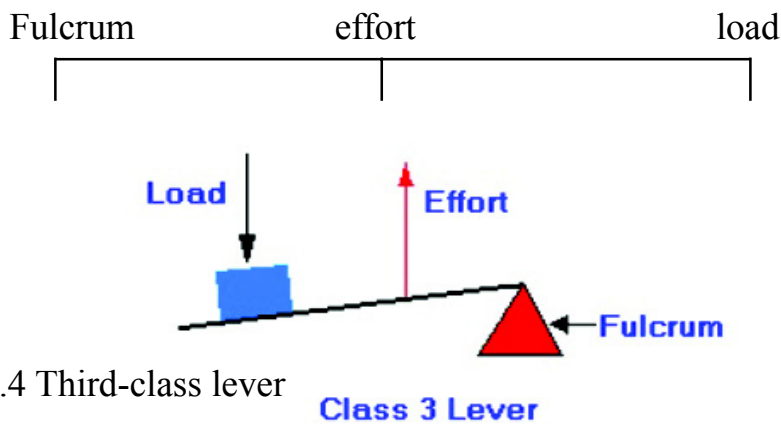


Fig. 6.4 Third-class lever

Some such levers are shown in Figure 6.4.

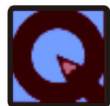


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Note: In this category of lever, the effort arm is always smaller than the load arm, so in this type of lever, less weight can be lifted with more effort. This type of lever is used to change the location of the point where the force is to be applied.



### INTEXT QUESTIONS 6.1

Fill in the blanks:

1. Ordinary machines are ..... attractive or ..... magnifying.
2. Levers are of ..... type.
3. In the first class lever ..... is in the middle.
4. In second class lever ..... is in the middle.
5. In the third class lever ..... is in the middle.
6. In the first class lever used as a force magnifier, the length of effort arm in the lever should be ..... than the length of the load arm.

### 2. Pulley

A woman is pulling water from a well with the help of a pulley. Actually, a pulley is a wheel that has a groove around its circumference. It rotates on the axle of the shell that is in the block. The groove consists of a thread or rope and it prevents the rope from sliding and helps in lifting the weight by changing the direction of the force used.

When we take out a bucket full of water from the well, we work against gravity, so we need more effort. But with a pulley, we



pull the rope in the direction of gravity, which makes the work easier. There are two types of pulley:

(1) static pulley and (2) movable pulley

**(1) Static pulley:** The block to which the pulley is attached is fixed, does not move. The distance traveled by the effort in a static pulley is equal to the distance traveled by the load, so + it does not decrease or increase the force. To remove water from the well or to hoist the flag, a permanent pulley is used.

**(2) Moving pulley:** In this type of pulley, the block moves along with the load and pulley. Two parallel ropes carry the same amount of weight. Many times many pulleys are used together to lift the load. By adding many pulleys, more weight can be carried in the same effort and there is no more stress on the rope.



### ACTIVITY 6.2

**What you need to do:** make a pulley.

**What you need:** bobbin of a cloth sewing machine, an iron rod, thick wire on which the bobbin can rotate, a thread and a stone.

**How to do this:**

1. Put an iron rod in the hole of the bobbin,
2. Put both the ends of the rod on a shell
3. Tie a stone with the thread, and
4. Pass the thread over the bobbin and pull it down the other side, your pulley is ready



### 3. Wheel

We see the wheel being used round us in many ways. Wheel is one of the great inventions of mankind, which has greatly simplified human life. Prior to the invention of the wheel, heavy objects were pulled or carried on the backs of humans or animals. There were no vehicles and people used to come from one place to another with their feet. But the scene changed after the invention of the wheel. Take the example of bicycle, which runs on wheels. You can reach more quickly on the bicycle than on feet. Hence the wheel of the bicycle acts as a moving magnifier. The wheel has made human life faster, easier, less hard-working. Wheels are used in cars, bicycles, carts, trains and buses etc. The wheel is a simple machine that can be used in a vehicle with a knob and used as a force magnifier. The wheel operates on the principle that rolling friction is always less than sliding friction.

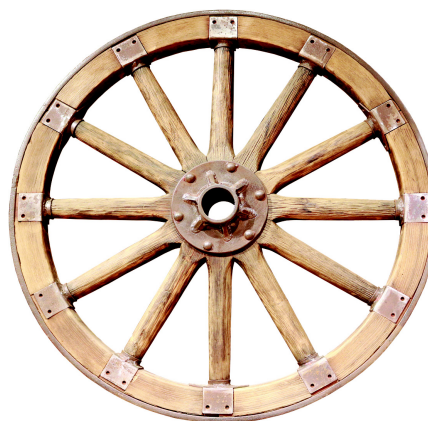
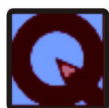


Fig. 6.5 Use of Wheels



### INTEXT QUESTIONS 6.2

Fill in the blanks:

1. By changing the ..... of effort with the help of a pulley we can conveniently lift more load.
2. The pulleys are of ..... types.



3. Rolling friction is always less than ..... friction.
4. A moving pulley with a knob acts as a ..... magnifier and a ..... amplifier.



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## 6.2 OTHER ORDINARY MACHINES

### 1. Inclined Plane

You must have seen from which high place the drum is rolled, because it is easier to roll the drum from such a place than to lift it. This slope is called inclined plane. The inclined plane is such a plane, one end of which is to make the slope raised.

It is used for lifting heavy goods. You may have noticed that a flat board is used to load or unload goods in the truck. The houses have slopes that are built on high altitude. These slopes are used for mounting or descending cars or scooters. You must have seen that sloping places are made in hospitals, so that stretchers and wheel chairs can easily come in and out of them. Similarly, the roads on the hills have a slight slope so that the vehicles can run smoothly. These types of slopes are also magnifying forces, which are very helpful in unloading the goods. If we lift the same weight perpendicularly to the earth, it will seem more difficult.



Fig. 6.6 The example of inclined plane



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## 2. Screw

The screw looks like any nail, but it has curved cuts whose sides are curved. Screw is used to connect objects. The screw uses a hoist to lift the car, which operates on the principle of inclined plane. When you rotate the handle of the car jack, the screw of the jack rotates round and round each time the car lifts up the distance between the two bangles of the screw. The handle on which we apply force covers a greater distance than the car, so with the help of a screw, heavy weight can be lifted using small force.

Screw, if carefully looked at, is a form of sloped area i.e. the inclined plane. To understand this, let us do the following activities:



### ACTIVITY 6.3

**What you have to do:** To see that screw is a form of inclined plane.

**What you need:** a pencil and a square piece of paper.

**How to do you:**

1. Cut the paper in the form of a right angled triangle by folding it in the middle.
2. Color its hypotenuse with ink.
3. Now wrap it on the pencil as shown in Figure 6.11.

**You will see that:** The colored edge of the paper looks like a ring of screw bangles.



**Conclusion:** Therefore, we can say that the screw is also a form of inclined plane.

### 3. Wedge

Wedge is a metal or triangular piece of wood, which is used to lift something or separate logs of wood. Wedge is probably one of the oldest machines used by humans. Stab, knife and chisel etc. are commonly used wedge.

It is difficult to separate the two sections, but with the help of a wedge it can be easily done. The wedge increases the applied force. To separate blocks till 2 cm the wedge is hammered i.e. thumped about 6 cm. In other words, the wedge works because it is longer than the thickness.



#### ACTIVITY 6.4

**What you need to do:** Make a wedge by joining the back of two inclined plane.

**What you need:** Clay, knife.

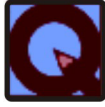
**How you have to do:**

1. Make a clay spoon,
2. Cut it with a sharp-edged knife as per the picture,
3. Now you have two sloping areas.

**Conclusion:** This is how we can say that wedge is made by joining the back of two inclined planes.



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### INTEXT QUESTIONS 6.3

1. What is inclined plane?
2. Give two examples of inclined plane.
3. How do you prove that the screw is an inclined plane, perform an activity.
4. What is a wedge? Give two examples of this.



### WHAT HAVE YOU LEARNT

- Machines make our work easy and fast.
- Simple machines either change the direction of force or increase the force used.
- Simple machines are of various types, such as levers, pulleys, ventilators, screws, and spikes. There are three types of levers, first class, second class, third class.
- The first class lever consists of fulcrum, effort and load.
- The second class lever carries a load between effort and fulcrum.
- The third class lever consists of effort between fulcrum and load.
- A pulley is a wheel around which there are cuts. It lifts the load by changing the direction of the force.



- Invention of the wheel made human life simpler, faster and easier.
- The inclined plane is a flat surface, which is raised at one end to form a slope.
- The screw is an inclined plane.



### TERMINAL QUESTIONS

1. State whether the following statements are true or false:
  - (i) The point at which the lever is supported is called its shell.
  - (ii) Scissors is an example of a first-class lever.
  - (iii) Rolling the drum from the sloping area is more difficult than lifting.
  - (iv) Stairs are an example of an inclined plane.
2. Fill in the blanks:
  - (i) ..... is in the middle of the first type of lever.
  - (ii) Pulley transforms the force of the .....
  - (iii) The point of support in the lever is called .....
3. Match the statement of column 'A' with the statement of column 'B':

**Column 'A'**

**Column 'B'**

- |               |                                |
|---------------|--------------------------------|
| (i) The lever | (a) is a wheel which has cuts. |
|---------------|--------------------------------|



- |                 |   |
|-----------------|---|
| (ii) Slope area | (b) Helps move the object with a little force.            |
| (iii) The wheel | (c) is a hard rod, which revolves around the fulcrum.     |
| (iv) The pulley | (d) is a flat surface, raised at one end to form a slope. |

4. What are simple machines called? Give examples of four simple machines.
5. How are simple machines useful to us? Explain the three uses of simple machines.
6. What is a lever?
7. How many types of levers are there? Give two examples of each type of lever.
8. Divide the following into first, second and third class levers- scissors, pliers, tweezers, bottle-opener, lemon juicer, stick.
9. What is a pulley? Write two examples of pulley. How is pulley useful to us?
10. How the invention of the wheel changed our lives, explain.
11. What is inclined plane? How is it useful for us?
12. Give the definition of (i) load, (ii) fulcrum and (iii) effort.

13. Why is it easier to open a tin lid with a spoon than with fingers?
14. Write the names of three points (load, fulcrum and effort) and the type of lever in each of the following friends.



Notes



## ANSWERS TO INTEXT QUESTIONS

### 6.1

1. Force, Speed
2. Three
3. Fulcrum
4. load
5. Effort
6. longer

### 6.2

1. Direction
2. Two
3. sliding
4. Moving, Force



Notes

**6.3**

1. The plane with a slope is called an inclined plane.
2. (i) slope made in front of door of a house for mounting scooter or car.  
  
(ii) inclined plane or board for loading of goods on the truck
3. See Activity-3
4. A wedge is a triangular piece of metal or wood. Examples are knives, chisel etc.



