11

Force and Pressure

FORCE

How many times do you push or pull something every day? When you open a drawer you are pulling. When you close a drawer you are pushing. Lifting your school-bag is pulling.

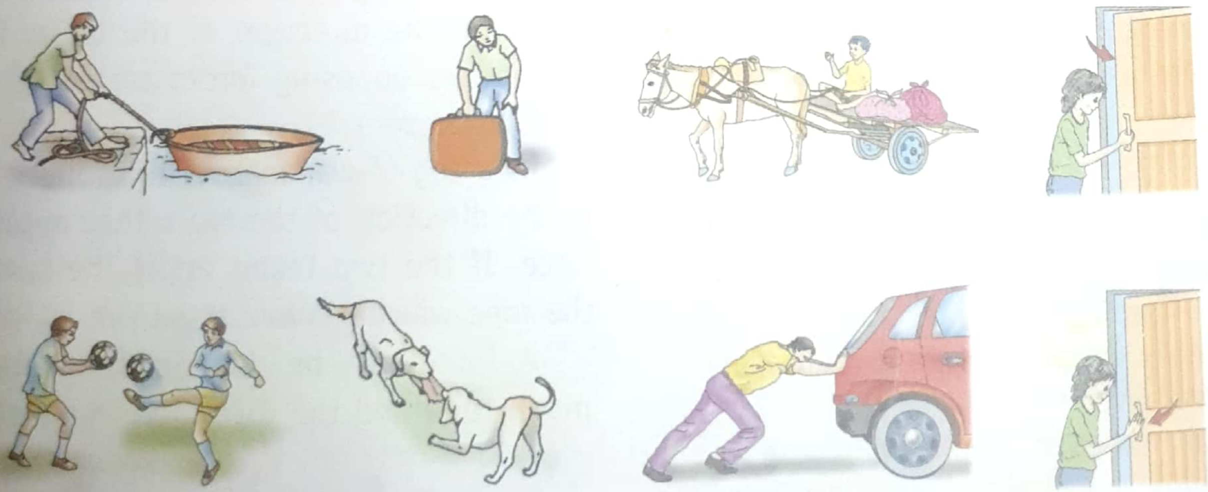

FIG. 11.1 Can these be grouped as pushes or pulls?

IN THIS CHAPTER

TYPES OF FORCE AND ITS EFFECTS ◆ PRESSURE AND ITS APPLICATIONS IN DAILY LIFE ◆ PRESSURE EXERTED BY LIQUIDS ◆ ATMOSPHERIC PRESSURE

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Activity 1 (Critical thinking):
To identify any action as push or pull

Look at the pictures in Figure 11.1. Identify the action in each picture as pushing, pulling, lifting, kicking, stopping, throwing, etc. Then try to see if the action can be grouped as a push or a pull.

You will notice that each of these actions is either a push or a pull.

Pushes and pulls are **forces**. The direction in which an object is pushed or pulled is called the **direction of the force**. We apply force to perform various activities—to lift a glass of water, to ride a bicycle, to push the switch of a TV set to put it on, or to open a car door to get in.

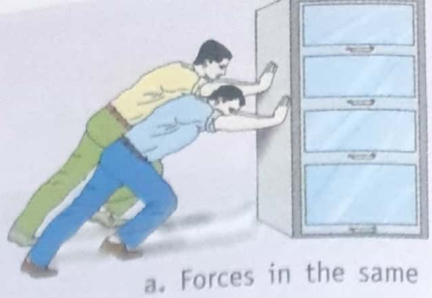
If you stand in front of a door, it will not open by itself. You have to interact with the door by pushing or pulling it, i.e. by applying force on it, to make it open. The two dogs in Figure 11.1 are pulling at each other to apply force. They are also applying force by interacting with each other. What about the other situations in Figure 11.1? Can you say which objects are interacting to apply force?

We therefore conclude that objects must interact with each other for a force to come into play.

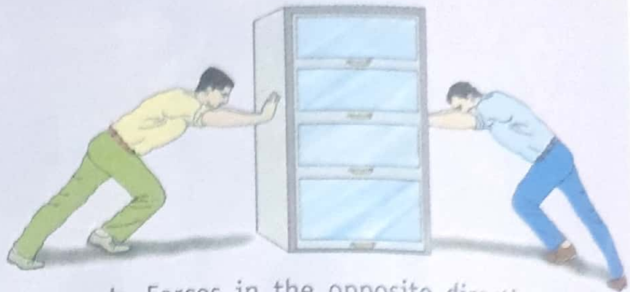
Activity 2 (Experimental investigation):
Net effect of two forces acting on a body

Push a heavy object to move it. You might be able to move it with some difficulty. Now ask one of your friends to help by pushing with you in the same direction. Can you together push it more easily? Why?

Now push the object again, but ask your friend to push it from the opposite direction. Does the object move now? Why?



a. Forces in the same direction



b. Forces in the opposite directions

FIG. 11.2

These activities suggest that:

- When forces are applied on an object in the same direction, they add up. The net force on the object is a single force whose magnitude is the **sum of the two forces**. The net force acts in the same direction as the two forces.
- When forces are applied on an object in opposite directions, they oppose each other. The net force on the object is the **difference between the two forces.** This net force will act in the direction of the larger force. If the two opposing forces are equal, the net force is zero.

In a tug-of-war match, the rope will move in the direction of the team that applies more force. If the two teams apply the same force, the rope will not move at all.

A force can be described by stating its **magnitude** and the **direction** in which it acts.

FIG. 11.3 A game of tug-of-war

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When two forces act on an object in the same or opposite directions, the effect on the object is due to the net force acting on it. In this case it is the sum or difference of the two forces.

What about a situation where two or more forces act on a body in different directions?

ACTIVITY 3 (Observation and deduction): Two or more forces acting on a body

Observe a group of ants trying to pull a dead insect to their anthill. If all ants were to pull in the same direction, the forces would add up and their job would be easy. However, the ants do not know this! Notice that the ants do not pull in one direction—each ant pulls in a different direction. The insect moves in the direction of the net effect of all these forces. If the insect moves in the desired direction, the ants keep on pulling. But if it moves in a different direction, they change their positions and pull again. They keep adjusting their positions until the net force acts in the desired direction and the insect moves towards their anthill!

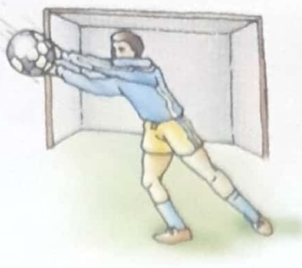
We conclude that when two or more forces act on an object in different directions, the effect on the object is due to the magnitude and direction of the net force acting on it.

EFFECTS OF FORCE

What can force do?

1. **Force can make a stationary object move, or can change its position of rest:** When you kick a stationary football, you make it move. When you pick up a glass of water, you change its position of rest.

2. **Force can change the speed of a moving object:** A goalkeeper applies force to stop a football and reduce its speed to zero (Fig. 11.4a). If he is not able to stop the ball properly, it may only slow down and not come to a position of rest. When a player kicks a moving football, it starts moving faster (Fig. 11.4b).



a. To slow down or stop a moving object

b. To make a moving object move faster

FIG. 11.4 Some effects of force

A goalkeeper slows down or stops a football by applying force in the opposite direction to which the football is moving. On the other hand, to make the ball move faster, the player applies a force in the same direction in which the ball is moving.

3. **Force can change the direction of motion of a moving object:** When a batsman hits a ball with his bat, he applies force to change the direction of the motion of the ball. If you allow a moving ball to hit the palm of your hand, a force is exerted on the ball which changes its direction of motion.

The state of motion of a body is described by its speed and direction of motion. The state of motion of an object at rest is the state of zero speed. A change in the speed of an object, or its direction of motion or both is referred to as change in the state of motion of the object.

Thus, the above three effects of force can be stated as: force brings about a change in the state of motion of a body. However, a force may not always bring about a change in the state of motion of an object. For example, if you push a wall, there is no change in the state of motion of the wall.

4. **Force can change the shape or size of an object:** If you squeeze a sponge, its shape

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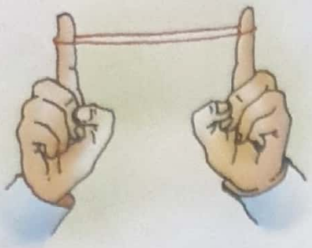

FIG. 11.5 A rubber band on pulling becomes longer.

changes. If you pull a rubber band, it becomes longer (Fig. 11.5). You can use the force of your hand to change the shape of plasticine or an inflated balloon. In the kitchen, force is applied to change the shape of dough to make thin, circular *chapattis*. You can pull a spring to increase its length, and push it to reduce its length.

However, a force acting on an object does not always bring about a change in its shape or size. For example, if you squeeze an iron ball, its shape or size does not change.

TYPES OF FORCES

Some forces act on bodies only when they are in contact with the body. Examples are muscular force and frictional force. These are known as **contact forces.** Some other forces can also act on bodies which are not in contact. Examples are gravitational force, magnetic force and electrostatic force. These are **non-contact forces.**

Contact Forces

Muscular force: When you lift your school bag, or kick a football, you apply force. This force is exerted by the muscles of your body, and is called **muscular force**. A horse uses muscular force to pull a cart. Your blood gets pushed into your arteries by the muscular force exerted by your heart.

Frictional force: What happens when you stop pedalling a bicycle? It slows down and stops after some time. If you kick a small block of wood, it slides for some time and then comes to rest. Why? This happens because of a force called **friction.** Friction is a force that slows things down or prevents things from moving.

Whenever one surface moves or tries to move over another surface, the force of friction starts acting on the surfaces. It always opposes the motion. There is friction between the tyres of a bicycle and the road, and between the block of wood and the floor.

Since the force of friction arises due to contact between surfaces, it is a contact force.

Non-contact Forces

Gravitational force: A force that acts on you and on all objects around you all the time is the force of **gravity.** Gravity is the force with which the earth pulls everything towards itself. It is due to gravity that things on earth fall downwards and not upwards. A ball thrown up slows down and then falls down towards the earth because of the force of gravity.

Gravitational force is the force of attraction between particles of matter. Every object exerts this force on every other object. The magnitude of this force depends on the masses of the two objects and the distance between them. Two cars pull each other with a gravitational force even though it is very small. Because the earth has such a large mass, objects on the earth are pulled towards the earth (due to the force of gravity of the earth) more than they are pulled towards each other. The earth pulls a car towards itself with a force which is about 30,00,00,00,000 times more than the force with which two cars pull each other!

ACTIVITY 4 (Experimental investigation): Gravitational pull
Tie a small stone to a rubber band and let it hang. The rubber band gets stretched slightly as the earth pulls the stone

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towards it. Now tie a bigger stone to it. What do you notice? The rubber band is stretched more. Why?

This is because the earth pulls the bigger stone with greater force. We say that the big stone has more **weight** than the small stone. Thus, **weight** is a measure of the earth's gravitational pull on an object.

When you weigh an object using a spring balance, you measure the earth's gravitational force on the object (Fig. 11.6). You would weigh less on the moon than on the earth because the moon has less mass than the earth, and hence smaller force of gravity. It, therefore, pulls objects towards itself with lesser force. On the other hand, you would weigh three times more on Jupiter which has greater mass than the earth, and hence greater force of gravity.

FIG. 11.6 A spring balance

Magnetic force: Look at Figure 11.7. A large magnet is being used to pick out scraps of iron from the garbage. It is using force to lift the iron pieces. This force is called **magnetic force** or **magnetism.** Magnetic force is exerted by a magnet on certain metals such as iron.

FIG. 11.7 A magnet being used to pick scraps of iron.

ACTIVITY 5 (Experimental investigation): Magnetic force I

Put some iron nails on a sheet of paper. Bring a small magnet near these iron nails. You will see that the iron nails are pulled towards the magnet even when they are a little distance away from it (Fig. 11.8). This shows that magnetic force can act from a distance.

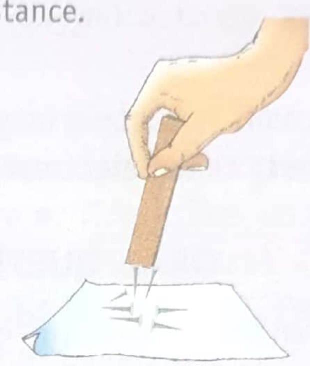

FIG. 11.8 Magnetic force acting from a distance

A magnet can act from a distance because it is surrounded by an invisible field of magnetic force. When large scraps of iron from garbage, or small iron pieces get close to that field of force, they are pulled towards the magnet. Thus magnetic force is a non-contact force.

However, what happens when two magnets are brought close together?

ACTIVITY 6 (Experimental investigation): Magnetic force II

Take two bar magnets. Bring them close together end to end, so that their north poles face each other. What happens? Do they attract or repel each other? Now bring the south pole of one of the magnets near the north pole of the second magnet and try again. What happens now? You will find that their behaviour is opposite to what you observed earlier.

Thus, two magnets attract or repel each other depending on which ends are facing each other. Like poles repel each other, whereas unlike poles attract each other.

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Electrostatic force: There is another kind of non-contact force, which is observed in the following activity.

ACTIVITY 7 (Experimental investigation): Electrostatic force

Rub a comb through your dry hair for some time. Then bring the comb near bits of paper. Are they attracted towards the comb?

When the comb is rubbed in your hair, it acquires a property called **electrostatic charge.** Electrostatic charge can exert a force called electrostatic force. It is because of this force that the bits of paper move towards the comb. Electrostatic force, like magnetic force, also acts from a distance, and is a non-contact force.

FIG. 11.9 Electrostatic force acting from a distance

Electrostatic force is used to control pollution by separating solid pollutant particles from smoke given out from factories.

ORAL QUESTIONS FOR FORMATIVE ASSESSMENT

1. A force can move a stationary object. If force is applied to a stationary object, does it always move?
2. Two equal forces act on an object. Is this information enough to say which way the object will move? Give reasons.
3. Name the force that acts on all bodies on the earth at all times.
4. Name a force that always opposes motion.
5. Can a force act on an object even when it is not in contact with the object? Give examples.

PRESSURE

Consider a force applied on an object. You have already seen the effects that a force can produce on the object. But how do we find out how much effect the force will produce on the object?

The effect that a force produces on an object depends on two factors.

- The magnitude of force applied—the greater the force, the greater is its effect.
- The area over which the force is applied, i.e. the area of contact between the two objects. When you cut an apple with a knife, the area of contact is the area of the cutting edge of the knife. If the knife has a sharp edge, the area of contact is small. But if the knife has a blunt edge, the area of contact becomes larger. In which case is it easier to cut the apple—when the knife is sharp or when it is blunt? What does this show? This shows that the smaller the area of contact, i.e. the smaller the area over which the force acts, the greater is the effect of the force.

ACTIVITY 8 (Experimental investigation): Force and area of contact I

Sharpen a pencil at one end. Hold it between the index fingers of both your hands and press it from both sides (Fig. 11.10). On which finger do you feel pain? On which finger does the pencil leave a deeper mark? Why?

FIG. 11.10 Effect of a force is greater when area of contact is smaller.

You will see that the pencil leaves a deeper mark on the finger pressing the pointed end. This shows that the effect of the force is felt

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more on the finger pressing the pointed end of the pencil. This is because the area of the pointed end of the pencil is smaller than the area of the head of the pencil.

Another interesting activity to prove this is given below.

ACTIVITY 9 (Experimental investigation): Force and area of contact II

Perform this activity in a freshly watered flower bed, where the soil is still soft. First, place one brick upright in the soil (Fig. 11.11a). Remove it to see how deep an impression it has made in the soil. Next, keep two bricks, one on top of the other as shown (Fig. 11.11b). This increases the force exerted on the soil, with the area of contact remaining the same. Is the impression in this case deeper? Why?

Now lay the first brick on the soil on its widest base and note the impression it makes (Fig. 11.11c). Is the impression in this case the shallowest? Why?

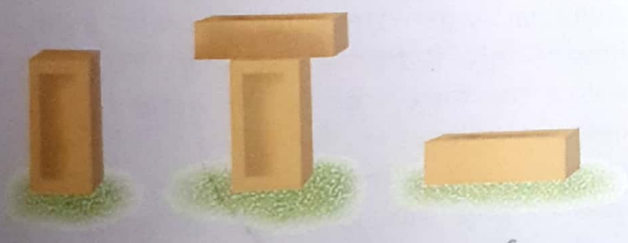

FIG. 11.11 To show that the effect of force depends on the area of contact

Unit of force

In the SI system, the standard units of length, mass and time are metre, kilogram and second, respectively. In this system, the standard unit of force is **newton (N)**. In the CGS system, the unit of force is **dyne** (1 N = 10^5 dynes).

To measure and describe the effect of the force acting on a surface, we need a quantity that takes into account the force applied as well as the area over which it is applied. Such a quantity is **pressure**. Pressure is defined as the force exerted per unit area.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area over which the force acts}}$$

It is clear from this that smaller the area over which a force acts, the greater is the pressure, and, therefore, the greater is the effect of the force.

(**NOTE:** The 'force' used in defining pressure is the force acting perpendicular to the area on which it acts.)

Unit of pressure

In the SI system, the unit of pressure is **newton per sq metre or N/m²**. This unit of pressure is commonly known as **pascal (Pa)** after the French scientist Blaise Pascal. Pressure can also be measured in **kg-wt/m²**.

$$\text{Pressure (in Pa)} = \frac{\text{Force (in newton)}}{\text{Area (in m}^2\text{)}}$$

In the CGS system, the unit of pressure is dyne per square centimetre or **dyne/cm²**.

EXAMPLE: Calculate the pressure exerted by a brick, which applies a force of 2.5 N, when (a) it is placed upright on the soil, (b) when it is placed on its widest base. The dimensions of the brick are 25 cm × 10 cm × 5 cm.

SOLUTION: (a) When the brick is placed upright: Area in contact with soil

$$= 10 \text{ cm} \times 5 \text{ cm} = \frac{10}{100} \text{ m} \times \frac{5}{100} \text{ m}$$

$$= 0.005 \text{ m}^2$$

$$\therefore \text{ Pressure exerted} = \frac{F}{A} = \frac{2.5 \text{ N}}{0.005 \text{ m}^2}$$

$$= 500 \text{ Pa}$$

(b) When the brick is placed on its widest base: Area in contact with soil

$$= 25 \text{ cm} \times 10 \text{ cm} = \frac{25}{100} \text{ m} \times \frac{10}{100} \text{ m}$$

$$= 0.025 \text{ m}^2$$

$$\therefore \text{ Pressure exerted} = \frac{F}{A} = \frac{2.5 \text{ N}}{0.025 \text{ m}^2}$$

$$= 100 \text{ Pa}$$

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Application of force and pressure in daily life

Have you ever tried to run on sand? It is difficult because your feet sink into the sand. A camel is able to move fast on sand because it has flat broad feet. This increases the area of contact with the sand. Hence, the pressure exerted by the camel on the sand is reduced and the camel's feet sink very little in the sand.

Trucks meant to carry heavy loads have eight rather than four tyres to increase the area of contact with the road. Heavy tanks have broad chains called caterpillar tracks which considerably increase the area of contact. The tracks help the tank to distribute its weight more evenly over a larger surface area than wheels can. This prevents it from sinking in areas where wheeled vehicles of the same weight would sink.

Cutting and piercing tools, such as knives, needles and saws, have sharp blades or points to reduce the area of contact so that they exert greater pressure with a comparatively small force. It is easier to hammer a sharp nail into wood than a blunt one. Can you say why?

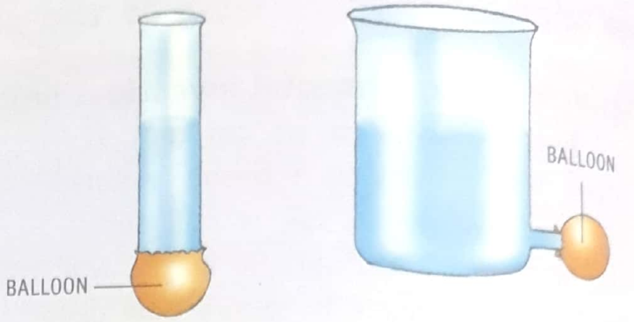
Pressure exerted by liquids

Liquids also exert pressure, as we will learn from the activity given below.

ACTIVITY 10 (Experimental investigation): Liquid pressure

Take a wide glass tube open at both ends. Tie a rubber balloon to its lower end. Pour water into the tube (Fig. 11.12a). You will notice that the balloon bulges downwards. This shows that liquids exert pressure on the base of the container in which they are kept.

Now take a vessel with a tap-like opening at its side. Tie a balloon to the opening and fill the vessel with water (Fig. 11.12b). You will notice that the balloon bulges outwards. This shows that liquids exert pressure not only on the base of the container but also sideways on the walls of the container. This sideways pressure is exerted by liquids but not by solids.



a. Liquids exert pressure downwards.

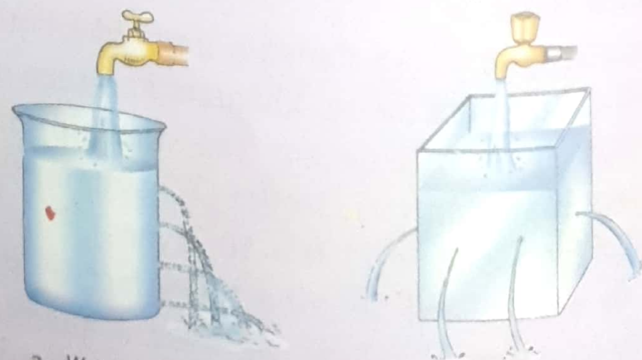
b. Liquids exert pressure sideways.

FIG. 11.12 Liquids exert pressure.

ACTIVITY 11 (Experimental investigation): Variation of liquid pressure with depth

Take a plastic container and make four holes in it at different heights. Fill the container with water, and let water keep flowing into it from a tap (Fig. 11.13a). Notice the force with which water comes out of the holes.

You will find that water comes out with greater force from the holes at greater depth. Water from the bottom-most hole will be spurted out the farthest from the container. This shows that the pressure in a liquid increases with increasing depth.



a. Water pressure increases with depth.

b. Pressure at the same depth is the same in all directions.

FIG. 11.13

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Now take another plastic container and make holes all around it at the same depth, by measuring from the top of the container (Fig. 11.13b).

You will notice that water comes out from all the holes with the same force. This shows that at the same depth, the pressure is the same in all directions.

The pressure at the bottom of the sea is much greater than near the surface. This is the reason why deep-sea divers have to wear special suits to prevent their bodies from being crushed.

Measuring liquid pressure

An instrument used to measure liquid pressure is called **pressure gauge.** The simplest form of pressure gauge is a **manometer**, which measures pressure difference. You can easily make your own manometer.

Activity 12 (Making a model): Improvised manometer

Take a U-tube made of glass or transparent polythene. Fix it vertically on a stand. Pour coloured water into it so that it is half-full of water. The level in both arms of the U-tube will be the same.

Attach a polythene tube to one end of the U-tube. At the other end of the

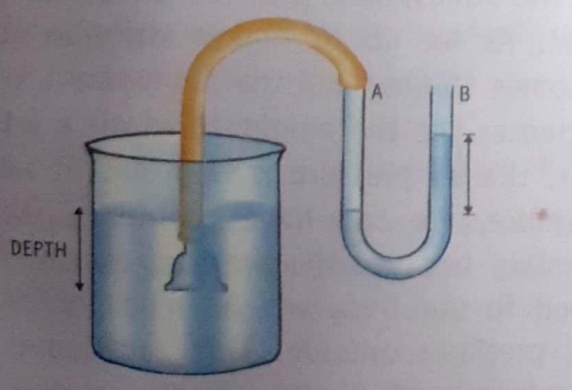

Fig. 11.14 Measuring pressure at different depths

polythene tube, attach a thistle funnel. Stretch and tie a thin rubber balloon over the mouth of the funnel so that the rubber remains taut. Your manometer is ready to measure pressure.

Take a large glass jar full of water. Slowly lower the funnel into the water. As the funnel goes deeper and deeper into the water, the difference in the liquid level in the U-tube goes on increasing. If you double the depth from 10 cm to 20 cm, does the difference in liquid level also double?

The difference in liquid levels in the U-tube is a measure of the pressure applied by the water.

Atmospheric pressure

The earth is surrounded by a layer of air called the atmosphere. We live at the bottom of this layer. The air above presses down on us with a force equal to that exerted by a mass of 1 kilogram, on every square centimetre. This is called the **atmospheric pressure**. The reason we are not crushed under this weight is that the pressure exerted by our body is equal (and opposite) to the atmospheric pressure acting on our body, and so cancels the effect of the atmospheric pressure.

Let us understand this phenomenon with a simple example. The area of the palm of your hand is about 100 square centimetres. Thus, a force equal to that exerted by a mass of about 100 kg acts on your palm due to the atmospheric pressure. You cannot feel it because an equal force is acting from within your hand, which balances the force due to the atmospheric pressure, and cancels its effect.

To demonstrate the effect of atmospheric pressure that can act on a surface, we need to remove the air from one side of that surface. This can easily be done, as shown in the activity given below.

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ACTIVITY 13 (Experimental investigation): Air pressure

Take a rubber sucker. Press it hard against a smooth surface such as a window pane. This expels the air between the sucker and the surface. Now try to pull it away (Fig. 11.15).

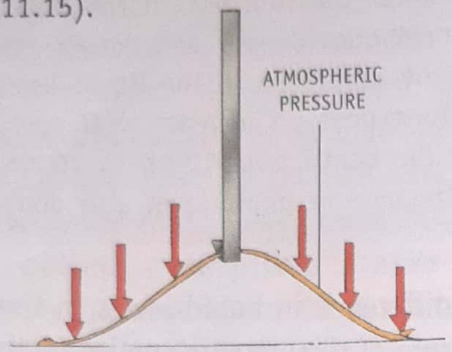

FIG. 11.15 A rubber sucker pressed on a smooth surface

You will have great difficulty in doing so. This can easily be explained. There is very little air between the sucker and the smooth surface of the window pane to push from inside. Therefore, the greater atmospheric pressure from outside pushes the sucker firmly to the window pane.

IT'S A FACT!

We cannot dive more than about 120 m in water. The water pressure below this is enough to crush the human body.

The following activity also demonstrates how strong atmospheric pressure can be.

ACTIVITY 14 (Experimental investigation): Atmospheric pressure

Take a plastic bottle. Put some boiling water in it. The steam coming out of the water will expel most of the air from inside the bottle. After about two minutes, screw the cap tightly on the bottle. Put the bottle in a trough and pour some cold water mixed with ice on it (Fig. 11.16). As the bottle cools down and the steam condenses, what do you observe? Why does the bottle get crushed?

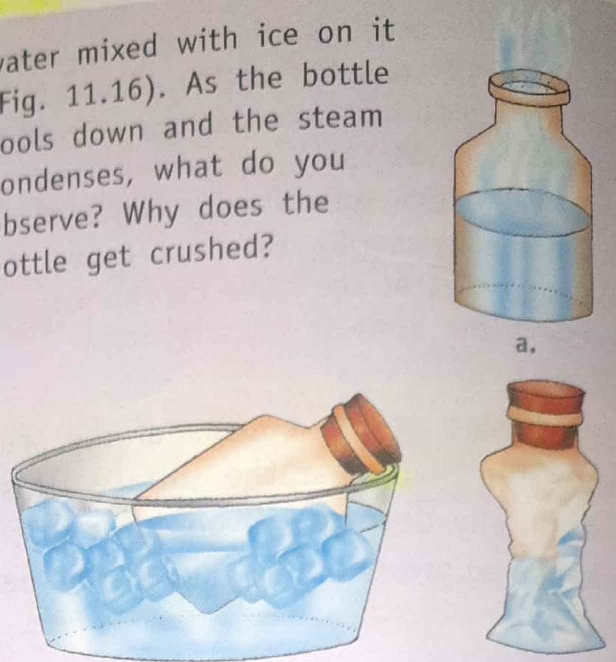

FIG. 11.16 Air exerts pressure in all directions.

Since the steam had expelled most of the air from inside the bottle, and since the steam inside the bottle has also been condensed, the bottle now has very little air inside it. The atmospheric pressure acting on the bottle from outside is, therefore, much larger than the pressure exerted by the air inside it. This causes the bottle to get crushed.

You will see that the bottle gets crushed from all sides. The activity also shows that atmospheric pressure, like the pressure exerted by liquids, acts equally in all directions.

The atmospheric pressure is maximum at sea level. As we go to higher altitudes, the air becomes thinner and the atmospheric pressure decreases. At the height at which a jet plane flies, the air pressure is very low. At such low pressure, we can have problems like nose bleeding because the pressure exerted by the blood in our body will be much higher than the pressure outside. This can cause blood vessels to burst. That is why the pressure inside an aeroplane is maintained at the normal ground level atmospheric pressure.

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ORAL QUESTIONS FOR FORMATIVE ASSESSMENT

1. A force acts perpendicular to a given surface. What is the quantity 'force per unit area' known as?
2. How is pressure related to the area over which a force acts?
3. What is the force of 1 N acting over an area of 1 m^2 called?
4. How does the pressure exerted by a liquid vary with **a.** direction? **b.** depth?
5. You are put into a room where the air pressure is very low. What effect will this have on your body?

NOW YOU KNOW

- Pushes and pulls are forces.
- For a force to come into play, objects must interact with each other.
- A force can be described by stating its magnitude and the direction in which it acts.
- When two or more forces act on an object in different directions, the effect on the object is due to the magnitude and direction of the net force acting on it.
- Force can: make a stationary object move or change its position of rest, change the speed of a moving object, change the direction of motion of a moving object, and change the shape or size of an object.
- Muscular force and frictional force are contact forces.
- Friction is the force that slows things down or prevents them from moving.
- Gravitational force, magnetic force and electrostatic force are non-contact forces.
- Gravity is the force with which the earth pulls eyerything towards itself.
- Weight is a measure of the earth's gravitational pull on an object.
- The effect that a contact force has depends on the magnitude of the force and the area over which it acts. The smaller the area of contact, the greater is the effect of the force.
- Pressure is the force exerted per unit area.
- Pressure in a liquid increases with depth, but at the same depth, the pressure exerted is equal in all directions.
- The pressure exerted by air is called atmospheric pressure. It is exerted equally in all directions. It reduces with height above sea level.

NEW WORDS

CONTACT FORCE—a force that acts only when it is in contact with an object
NON-CONTACT FORCE—a force that acts on an object without being in contact with it
MAGNETIC FORCE—force with which a magnet pulls objects made of certain metals, for example, iron, towards itself
ELECTROSTATIC FORCE—force exerted by an object with static electric charge on it
PRESSURE—force exerted per unit area
ATMOSPHERIC PRESSURE—pressure exerted by the atmosphere on all objects

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FOR FORMATIVE AND SUMMATIVE ASSESSMENT

A. MULTIPLE-CHOICE QUESTIONS: Choose the most appropriate answer.

1. There is one force which is exerted by all matter on all other matter. Which force is this?
   a. gravitational force
   b. magnetic force
   c. electrostatic force
   d. frictional force
2. Which of these is a contact force?
   a. friction
   b. magnetic force
   c. gravitational force
   d. electrostatic force
3. Which of the following is true for the pressure exerted by a liquid?
   a. Pressure does not depend on depth.
   b. Pressure is only exerted in the downward direction.
   c. Pressure is exerted both downwards and sideways but downwards pressure is greater than sideways pressure.
   d. At the same depth, pressure is same in all directions.
4. The SI unit of pressure is
   a. kg/m^3.
   b. kg/m^2.
   c. pascal.
   d. newton.
5. Two forces A and B act on an object in opposite directions. A is bigger than B. The net force on the object is
   a. A + B acting in the direction of A.
   b. A – B acting in the direction of A.
   c. A + B acting in the direction of B.
   d. A – B acting in the direction of B.
6. Which of these can a force acting on an object not change?
   a. direction of motion
   b. state of rest
   c. shape
   d. mass
7. The weight of an object is due to
   a. gravitational force.
   b. frictional force.
   c. both gravitational and frictional force.
   d. neither gravitational nor frictional force.
8. A force of 10 N acts on an area of 0.1 m^2. The force is kept the same but the area is reduced to half. Which of the following is true?
   a. The pressure does not change.
   b. The pressure reduces to half.
   c. The pressure increases by 1.5 times.
   d. The pressure doubles.

B. VERY SHORT-ANSWER QUESTIONS: Give one-word answers.

1. All pushes and pulls are forces. True or false?
2. If a force acts on a body it will move in the direction in which the force acts. True or false?
3. A force with magnitude A and another with magnitude B act on an object in the same direction. What is the net force acting on the object?
4. A force with magnitude A and another smaller force with magnitude B act on an object in the opposite directions. What is the net force acting on the object?
5. Does a force acting on a body always cause a change in its state of motion?

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6. Only the earth exerts gravitational force on all objects. True or false?

7. What measures the earth's gravitational pull on an object—its weight or mass?

8. This force acts from a distance and affects only objects made of certain metals such as iron. Name the force.

9. Which type of force is exerted by an electrostatic charge?

10. Which force tends to slow down objects or prevent them from moving?

11. The larger the area over which a force acts, the __________ is the pressure.

12. Does pressure exerted by a liquid increase or decrease with depth?

13. Every square centimetre of your body experiences a force equal to the weight of 1 kg due to the atmospheric pressure. True or false?

14. Atmospheric pressure increases with height. True or false?

C. SHORT-ANSWER QUESTIONS (TYPE I): Answer in a sentence or two.

1. What two things fully describe a force?
2. If several forces act in different directions on a body, in which direction will the body move?
3. If an object is thrown up, it finally comes down. Why?
4. What is the difference between mass and weight?
5. Why can a magnet act from a distance?
6. What is pressure? What does pressure depend on?
7. What is atmospheric pressure? What is it caused by?
8. Why is it difficult to cut vegetables with a blunt knife?

D. SHORT-ANSWER QUESTIONS (TYPE II): Answer in about 30 words.

1. What is force? What are the four main effects of force?
2. What is the difference between contact and non-contact forces? Explain with the help of one example of each.
3. What is friction? Explain with an example.
4. Why are caterpillar tracks used in battle tanks instead of tyres?
5. How does the pressure exerted by a liquid change with depth? Explain with a diagram.
6. When you press a rubber sucker on a smooth surface, it sticks to the surface. Explain why this happens?

E. LONG-ANSWER QUESTIONS: Answer in about 60 words.

1. Two forces act on an object. Explain what the net force acting on the object will be in different situations.
2. Explain the effects that a force acting on an object can have on the object.
3. Describe an experiment to show that air exerts pressure in all directions.

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HOTS QUESTIONS: Think and answer.

1. If a body is moving with uniform speed in a particular direction on a perfectly smooth surface, then no force is acting on it. True or false? Explain.
2. If you use a stick to push an object, the muscular force acting on the object is a non-contact force since your body is not in contact with the object. True or false? Explain.
3. Gravitational force exists between you and a building. Why are you not pulled towards the building?
4. Why do you think it is necessary to define a separate quantity called pressure? Why is defining only force not enough?
5. Suppose you are going in a jet plane, and one of the windows breaks due to an accident. What problems do you think you will face?
6. If you press a rubber sucker on a rough surface, it does not stick to the surface. Why?

FOR FORMATIVE ASSESSMENT*

In the Library—Research Project

A beam of light is also affected by gravity. But the effect is so small that it cannot normally be observed. However, there are certain bodies in outer space which are very dense. Gravity on these bodies is so high that no object, not even light, is able to escape from their surfaces. So these bodies cannot be seen or detected by any scientific instrument since they cannot reflect light. The presence of these bodies can only be detected by the effect of their gravity on nearby stars. For example, if a massive star is seen revolving around with no visible star at the centre of its orbit, then we can assume the presence of this body at the centre of the orbit. Find out the names of these bodies. The presence of these bodies was predicted by an Indian-born scientist. Find out his name.

To find out more about these objects refer to the NASA site:
http://imagine.gsfc.nasa.gov/docs/science/know_l2/black_holes.html

My Virtual Library—Research/Activities on the Internet

- Go to http://www.bbc.co.uk/schools/ks3bitesize/science/energy_electricity_forces/forces/revise1.shtml to get tutorial on force and pressure.
- Go to http://www.exploratorium.edu/ronh/weight/ to investigate the difference between weight and mass—find your weight on different planets and stars.
- Go to http://www.learner.org/interactives/parkphysics/coaster/ to design your own roller coaster using principles used to design actual roller coasters.

To Meet—Research on Scientist

Sir Isaac Newton (1642–1727) was one of the greatest scientists who ever lived. He was a mathematician and physicist. Many theories of modern science are based on the laws that he discovered.

Newton was born in Woolsthorpe in England. In 1669, at the age of 27, he became Professor of Mathematics. In 1686, he published his famous book *The Mathematical Principles of Natural Philosophy* in which he presented his theory of gravitation and the laws of motion. His **theory of gravitation** says that all matter pulls all other matter towards itself. Newton studied moving objects and gave the famous **laws of motion**.

*For more tasks see Page 200

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Newton invented the **mirror telescope**, which overcame some defects of telescopes in use at that time. Many of our present-day telescopes are based on his design.

Newton, along with another mathematician Leibniz, is considered to be the father of a very important branch of mathematics called **calculus**.

Find out more about the life and work of Newton.

Talk to the Class—Presentation

Make a presentation on the life of Sir Isaac Newton and his numerous contributions to the progress of science.

LIFE SKILL

Lifting a heavy weight

A number of back injuries happen when trying to lift heavy loads. Lifting a load causes considerable stress on the muscles and ligaments that support the spine, and exert pressure on the discs. To reduce the danger of injuries to your back, follow these precautions.

- Stand close to the load. Centre yourself and put your feet apart to the same length as your shoulders. Tighten your abdominal muscles. Carefully lift up on one edge of the object to get an idea of how heavy it is. If the object seems too heavy, it is not advisable to lift it yourself.
- Bend your knees and squat down to reach for the load **while keeping your back as straight as possible**. The most common mistake people make is to bend their back while getting hold of the load.
- While lifting the load, maintain a straight back and keep the load close to your body. Begin applying force with your legs and arms. Do this slowly. If you give a sudden hard pull or jerk, you could injure your back.
- While placing the load down, bend through your knees and keep a straight back.

bend your knees, not your back while lifting a heavy object

SKILLS INVOLVED: Thinking skill, Self-preservation

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