

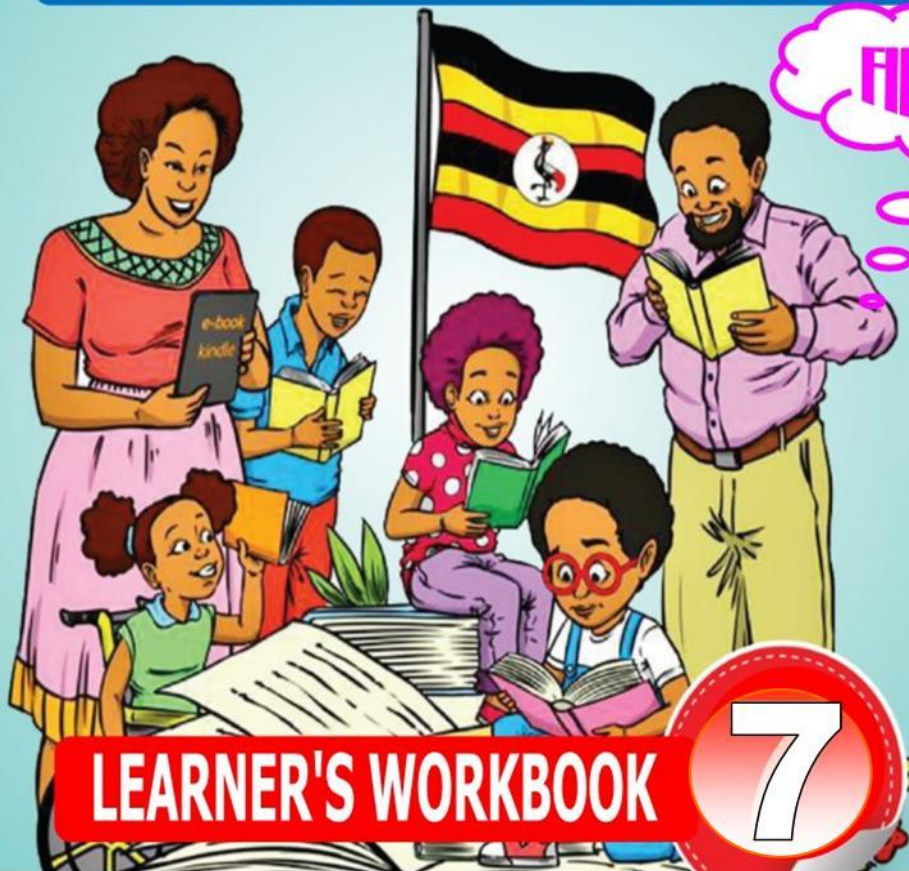
# KIMANJE PARENTS' NURSERY AND PRIMARY SCHOOL



A SIMPLIFIED APPROACH TO LEARNING

## INTEGRATED SCIENCE

FIRST TERM



LEARNER'S WORKBOOK

7

NAME: .....

SCHOOL: .....

CLASS: .....

YEAR: .....

This book is designed for both the learners and the teachers in accordance to the standard curriculum. Each particular child in a class at a specific school deserves a copy of this book.  
**A SCHOOL THAT ASSURES YOUR CHILD A REAL FIRST GRADE. "WORK HARD FOR PROGRESS"**

**THEME: MATTER AND ENERGY**  
**TOPIC: SIMPLE MACHINES AND FRICTION**

**What is a machine?**

- ✍ A machine is a tool used to simplify man's work.
- ✍ A machine is a device which simplifies man's work.

**Ways how machines simplify man's work**

- ✍ Machines reduce the forces used to do a piece of work.
- ✍ Machines change the direction of forces.
- ✍ Machines increase the speed of doing work.
- ✍ Machines convert energy from one form to another
- ✍ Machines change the position of different objects
- ✍ Less energy is needed by a machine to do work

**Quantities used in simple frictions**

**Load (L)** – the force/ weight that is to be overcome.

**Effort (E)** – the force applied at one point of a machine to overcome the load.

Mechanical advantage (MA) is the ratio of the load to the effort applied

MA = ratio of load to effort

$$MA = \frac{\text{Load}}{\text{Effort}}$$

*Mechanical advantage has no unit because it is the ratio of two forces.*

**Examples**

Find the Mechanical Advantage of a machine which carries a load of 120kg and has an effort of 30kg

$$MA = \frac{\text{Load}}{\text{Effort}}$$

$$MA = \frac{120\text{kg}}{40\text{kg}}$$

$$MA = 3$$

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**Activity**

1. What is a machine?

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2. State three ways in which machines simplify man's work.

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3. What do you understand by:

a) Load

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b) Effort

\_\_\_\_\_

c) State the main reason why mechanical Advantage has no specific unit of measurement.

\_\_\_\_\_

4.	Calculate the mechanical advantages of these machines with:		
a)	Load of 30kg and effort of 6kg	b)	Load of 15kg and effort of 3kg
c)	Load of 750kg and effort of 50kg	d)	Load of 100kg and effort of 25kg
e)	Load of 40kg and effort of 20kg	f)	Load of 450kg and effort of 100kg

### Types of machines

The two types of machines are

#### **Complex machines**

Complex machines are these made of many component parts and need training to use them. E.g. tractor, sewing machine

#### **Simple machines**

These with few parts and do not need special training to use them. e.g. knife , panga , hoe

### Common terms used in machines.

(i) Work:- is a product of force and distance moved by the load.

Work can also be defined as the result of any action requiring energy.

Work done = force  $\times$  distance.

Work is measured in units called joules

- (ii) Force: is a push or pull exerted on an object. Force measured in Newtons (N).

**NB:**  $1\text{kg} = 10\text{N}$ .

- (iii) Power: Is the rate at which energy is changed from one form to another i.e. rate of doing work. Power is measured in units called watts (W) or Kilowatts (KW).

**NB:**  $1\text{KW} = 1000\text{w}$ .

- (iv) Mass: is the quantity of matter contained in a body. Mass is measured in grams.

## TYPES OF SIMPLE MACHINES

What are the main groups of simple machines?

**The six main groups of simple machines are;**

- (i) Levers
- (ii) Inclined plane (The slope)
- (iii) Wedges
- (iv) Screws
- (v) Pulleys
- (vi) Wheels and axle

### Activity

1. State any **two** types of machines

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2. Define complex machines

---

3. Why is a tractor not considered as a simple machine?

---

4. Define the term simple machines

---

5. What is work?

---

6. Define the word force in relation to the machine.

7. What term is used to mean the quantity of matter contained in a body?

8. Mention any **two** of the six main groups of simple machines

## LESSON LEVERS

A lever is a simple machine made up of rigid bar (rod) that rests or turns freely at a fixed point called pivot (fulcrum).

### The main parts of a lever

1. **Load (L)** – the force (weight) that is to be overcome.  
- Sometimes load is called **resistance**.
2. **Effort (E)** is the force we exert (apply) when using a lever.
3. **Fulcrum (F)** is a fixed turning point.
4. **Effort arm** is the distance moved from the effort to the fulcrum.
5. **Load arm** is the distance moved from the load to the fulcrum.

### CLASSIFICATION OF LEVERS

- Levers are grouped according to position and arrangement of load, fulcrum and effort.
- They are classified into three groups, namely;
  1. First class lever.
  2. Second class lever.
  3. Third class lever
- The classes are determined basing on the force that lies between the load and the effort.

### FIRST CLASS LEVERS (EFL / LFE)

This is where the fulcrum lies between the load and effort.

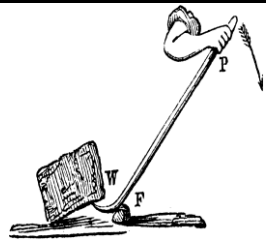
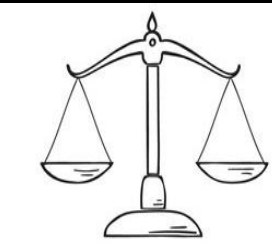
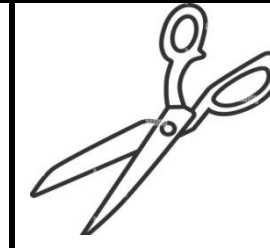
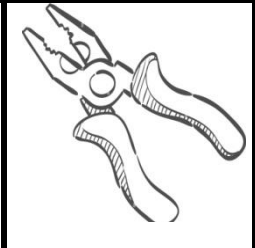

The longer the effort arm, the less the effort used to lift the load.

The advantage of using the first class lever is that less effort is needed to do the work.

### Examples of first class levers

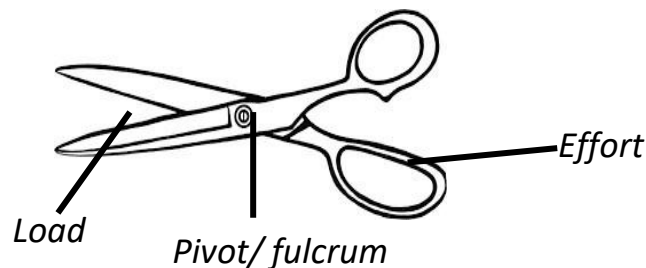
Crow bars, a pair of scissors, a water pump, pliers, a screw driver, a scale balance, see-saw, lid opener, beam balance

## Illustration of some of the first class lever

				
Crow bar	scale balance	Pair of scissor	pliers	Screw driver

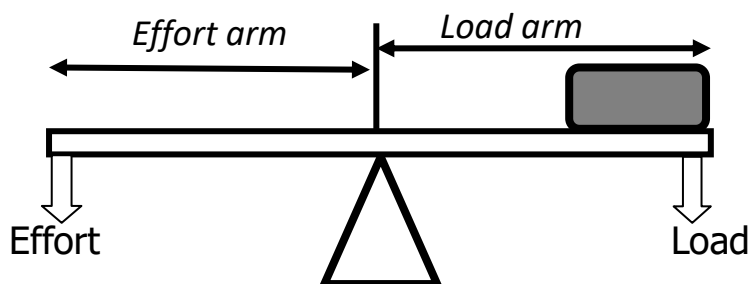
### How do first class levers simplify work?

By reducing the load arm and increasing effort arm so that less force is used.  
Load and effort move in different directions.



NB: A pair of scissors and pliers are called **double lever** because they have two stiff rods with one turning point

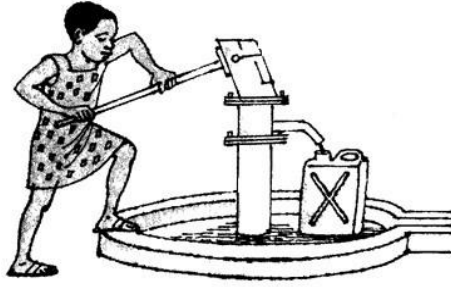
### Arrangement of the parts of the First class lever machine



### Activity

- How do first class levers simplify work?  
\_\_\_\_\_
- Give **one** reason why less effort is applied to move a load using first class levers.  
\_\_\_\_\_
- Which class of lever is the fulcrum between the effort and the load?  
\_\_\_\_\_

**The diagram below shows a simple machine. Use it to answer questions 4.**



a) To which class of levers does the machine above belong?

\_\_\_\_\_

b) Use an arrow with letter P to show the fulcrum on the diagram.

c) Name the type of machine above.

\_\_\_\_\_

d) To which class of levers does a pair of pliers belong?

\_\_\_\_\_

4. what do you understand by the word:

a) Fulcrum

\_\_\_\_\_

b) Lever

\_\_\_\_\_

5. What is the main use of these machines in the first class lever:

a) Beam balance: \_\_\_\_\_

b) A pair of scissors: \_\_\_\_\_

6. Mention any **two** examples of first class levers.

\_\_\_\_\_

7. Why is a pair of scissors called a double lever?

\_\_\_\_\_

8. Apart from a pair of scissors, draw and name any other **two** double levers in the space provided below.

\_\_\_\_\_

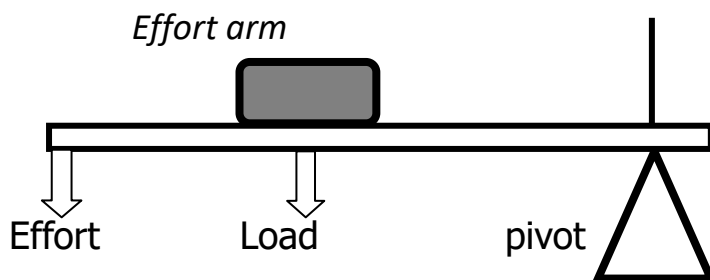
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## LESSON

### SECOND CLASS LEVERS (PLE/ ELP)

- This is where the load is placed between the pivot (fulcrum) and effort.
- In second class lever, both the load and the effort move in the same direction
- The most important use of second class lever is for lifting heavy loads using less force. The second class lever is regarded as the **force multiplier**

## Illustration of the parts of second class lever



### Examples of second class levers

Wheelbarrow, Human foot, Bottle opener, Oar of a boat, Nut cracker, Paper cutter and crow bars

### How does a second-class lever simplify work?

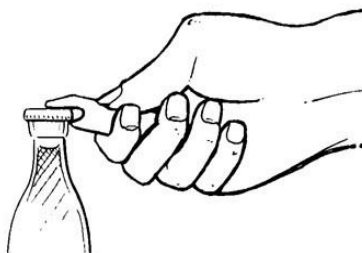
- Makes load and effort moves in the same direction.
- Reduces the load arm and increases effort arm so that less effort is used.

### Activity

1. In which class of lever does the load lie between effort and the pivot?

\_\_\_\_\_

2. The diagram below is of a machine used for opening bottle top. Indicate on it, with letter F, the position of a fulcrum.



(a) To which type of simple machines does the machine above belong?

\_\_\_\_\_

(b) State any **one** use of the simple machine above.

\_\_\_\_\_

(c) Give **two** other examples of a machine that belongs to the above type of simple machine.

\_\_\_\_\_

3. Name the class of lever where the load is placed between the fulcrum and effort.

\_\_\_\_\_

4. Give another name for fulcrum.

\_\_\_\_\_



5. Mention any **two** examples of second class levers

\_\_\_\_\_

6. How does a second-class lever simplify work?

\_\_\_\_\_

7. In which way is the load different from the effort?

\_\_\_\_\_

### THIRD CLASS LEVER

This is the lever where the effort lies between the load and fulcrum.

The third class lever does not change the direction of force

#### Characteristics of machines under third class lever

- ✍ The effort used is greater than the load to be lifted.
- ✍ The load arm is longer than the effort arms.
- ✍ The load is mover through a long distance.
- ✍ Third class levers are **distance multipliers**.

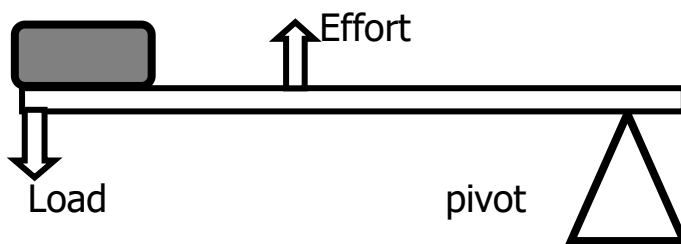
#### Examples of third-class levers

Pair of tongs, pair of tweezers, human arm, a spade in use, fishing rod, a hoe in use

#### What is the advantage of using a third-class lever?

- The effort moves through a shorter distance.

#### Illustration of the parts of third class lever



#### Activity

1. What is the difference between effort arm and the load arm?

\_\_\_\_\_

2. Mention **two** characteristics of machines grouped under third-class levers.

\_\_\_\_\_

3. What is the advantage of using a third-class lever?

\_\_\_\_\_

4. Why is a fishing rod grouped under third class lever?

\_\_\_\_\_

5. What determines the classes of levers in a machine?

\_\_\_\_\_

6. Mention any **two** examples of third-class levers

\_\_\_\_\_

## PRINCIPLE OF MOMENTS

### What is a moment?

- This is the turning effect of a force about a point.
- Moment of a force is the product of force and the perpendicular distance from pivot.
- Force acting on a point left of the pivot tends to turn it anti clockwise while force acting on the right tends to turn the lever clockwise.
- For the lever to balance or be in equilibrium, the left side moments must be equal to the right-side moments.

### The Law of levers

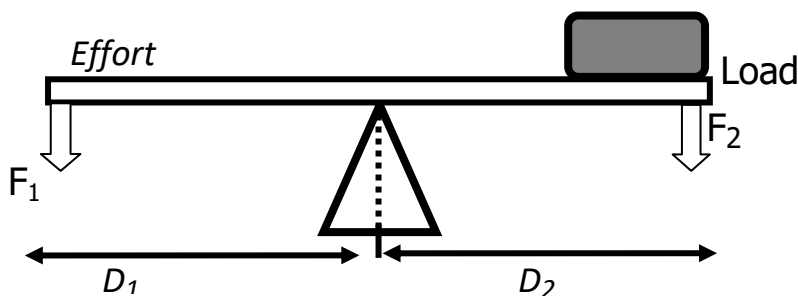
- ✍ The sum of clockwise moments equals the sum of anticlockwise moments.  
OR the product of clockwise moments is equal to the products of anti clockwise moments i.e.

Load X Load arm = Effort x Effort arm.

*In summary, the load force multiply by load arm is equal to the force multiplied by the effort arm.*

- ✍ The sum of forces in one direction is equal to the sum of forces in the opposite direction.

### Illustration of the principles of moment



### Activity

1. What is a moment of a force?

\_\_\_\_\_

2. State the condition necessary for the lever to be in equilibrium

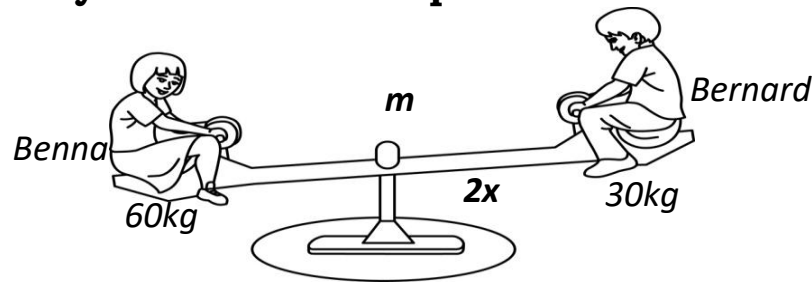
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3. State the law of the lever.

\_\_\_\_\_

\_\_\_\_\_

4. The diagram below shows two children playing on a see-saw. Study it carefully and answer the questions that follow.



- (a) In which class of levers is the machine above classified?

\_\_\_\_\_

- (b) Name point marked M.

\_\_\_\_\_

- (c) How far is Oscar from Joan?

\_\_\_\_\_

### Worked examples on levers

5. A man weighs 90kg and sits 4m away from the pivot of a sea saw. Where will his wife who weighs 60Kgs sit in order for them to balance?

*Solution:*

Load = 90Kg

Load arm = 8m

Effort = 60Kg

Effort arm = **X**m

Load x Load arm = Effort x Effort arm

$$90 \times 4\text{m} = 60 \times X$$

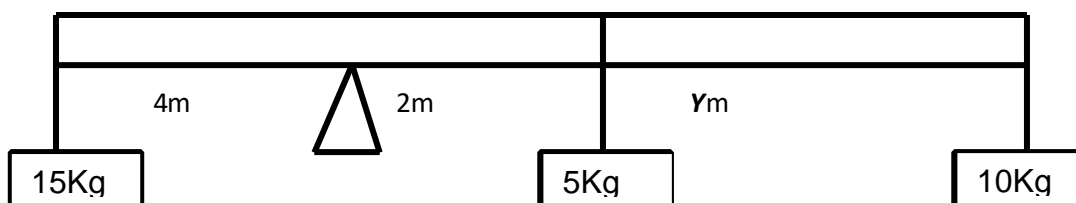
$$360 = 60x$$

$$\frac{360}{60} = \frac{60x}{60}$$

$$6 = x$$

The wife should be 6m away from the fulcrum.

6. Calculate the value of Y needed to balance the scale below.



$$\begin{aligned} (L \times LA) &= (E \times EA) + (E \times EA) \\ (15 \times 4) &= (5 \times 2) + (10 \times (2 + y)) \\ 60 &= 10 + 20 + 10y \end{aligned}$$

$$60 = 30 + 10y$$

$$60 = 30 + 10y$$

$$60 - 30 = 30 - 30 + 10y$$

$$30 = 10y$$

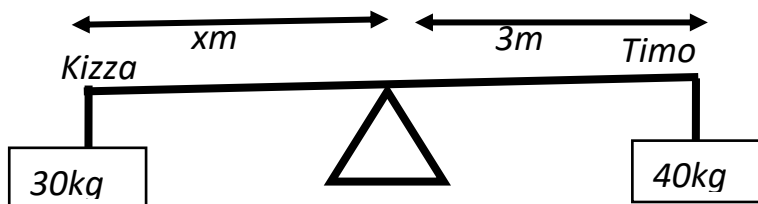
$$\frac{30}{10} = \frac{10y}{10}$$

$$3 = y$$

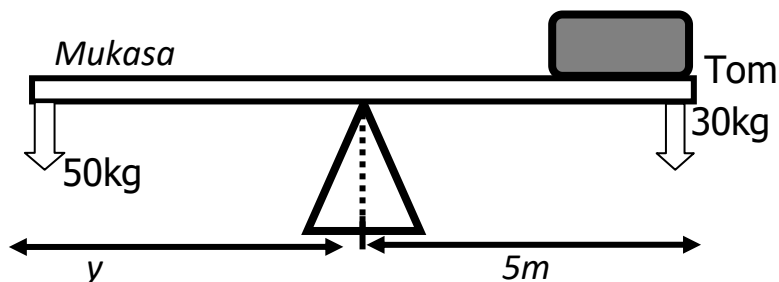
$$y = 3m$$

### Activity

1. Maria is heavier than Raila. They want to play on the see saw. Of the two children. Who will sit closer to the fulcrum to balance the see saw?
2. Tendo who weighs 50kg sits 4m away from the pivot of a sea saw. How far will Magumba who weighs 100kg, sit in order to balance the sea saw?
3. Find the value of  $x$  in order for the two boys to balance on the sea saw below

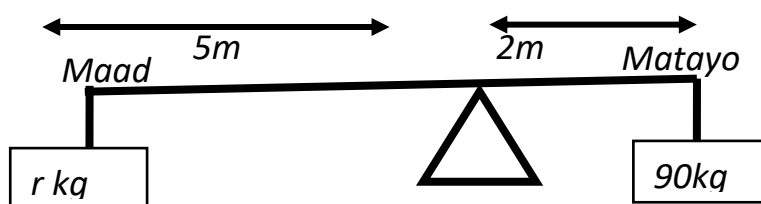


4. Use the diagram below to answer the questions that follow



- A) find the value of  $y$  needed to balance the see saw
- B) Of the two boys, who is heavier?

5. Find the weight of Maad needed to balance Mataayo on the sea saw below



## Terms used with machines

### Mechanical advantage (MA)

- This is the number of times a machine simplifies a given work.
- MA is the ratio of load to effort i.e.

$$\text{MA} = \frac{\text{Load}}{\text{Effort.}}$$

**NB:** If the MA of machine is greater than 1 less effort is used. Whereas when the MA is less than one a lot of effort is needed.

### 2. VELOCITY RATIO: (VR)

- This is the ratio of the distance effort moves to distance moved by the load.

$$\text{VR} = \frac{\text{DME (Distance Effort moves)}}{\text{DML (Distance Load moves)}}$$

The velocity ratio of a lever is the ratio of length of effort arm to the length of Load arm

### 3. EFFICIENCY OF A MACHINE

The efficiency of a machine is the ratio of the work output to work input of a machine.

- The output is the work done on the load by the machine.
- The input is the work done by the effort on the machine.

Efficiency of a machine is always expressed in % and is normally less than 100. This is because some forces are used in overcoming friction.

### How can the efficiency of a machine be improved?

- Replacing and repairing worn out parts.
- Regular oiling (lubrication) to minimize friction.

$$\text{Efficiency} = \frac{\text{output}}{\text{Input}} \times 100.$$

Example:

By using a machine, an effort of 30N was moved through a distance of 15m to raise a load of 120N to a height of 3m. Calculate the efficiency of the machine.

$$\begin{aligned}\text{Efficiency} &= \frac{\text{Load} \times \text{Load distance}}{\text{Effort} \times \text{Effort distance}} \times 100. \\ &= \frac{120\text{N} \times 3\text{m}}{30\text{N} \times 15\text{m}} \times 100 \\ &= \frac{360}{450} \times 100. \\ &= 80\%\end{aligned}$$

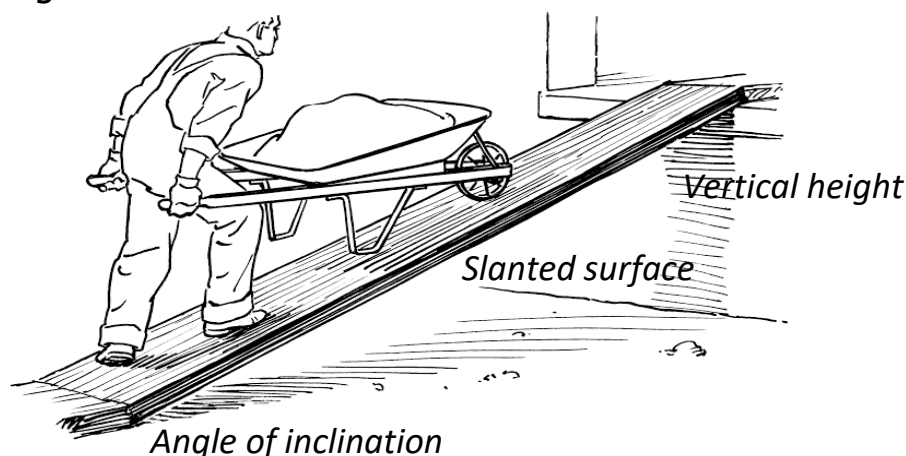
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## Activity

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### INCLINED PLANES /SLOPES

- An inclined plane is a sloping (slanting) surface connecting a lower level to a higher level.



- The vertical height of the inclined plane is the distance moved by load while the slanting surface is the distance moved by the effort.

### How do inclined planes simplify work?

By increasing the length of the plane and reducing the angle of inclination.

### Examples of inclined planes

Stair case (steps) / stairways, slopping floor, road going uphill/ winding roads, ladders, screw nails, ramps,

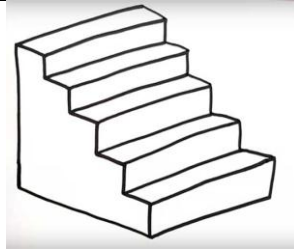
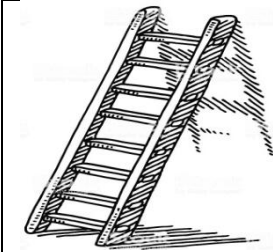
### Uses of inclined plane

- ✍ Loading heavy goods onto Lorries.
- ✍ Climbing tall buildings.
- ✍ Helps vehicles ascend (climb) steep hills and mountains
- ✍ For builders to carry materials to higher levels.

## Activity

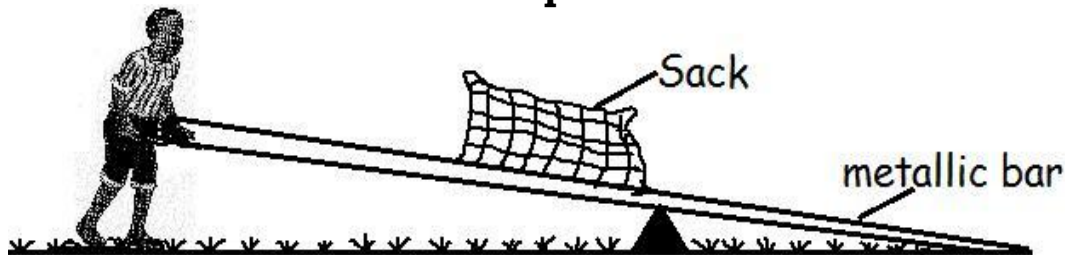
1. Define the word efficiency of a machine.  
\_\_\_\_\_  
\_\_\_\_\_
2. State the reason why the efficiency of a machine is always less than 100%.  
\_\_\_\_\_  
\_\_\_\_\_

3. Name the inclined planes shown below.



4. How can the efficiency of a machine be improved?  
\_\_\_\_\_  
\_\_\_\_\_
5. What term is used to mean a slanting surface connecting a lower level to a higher level?  
\_\_\_\_\_  
\_\_\_\_\_
6. How do inclined planes simplify work?  
\_\_\_\_\_  
\_\_\_\_\_
7. Mention any **two** examples of inclined planes  
\_\_\_\_\_  
\_\_\_\_\_
8. Suggest any **two** uses of inclined planes.  
\_\_\_\_\_  
\_\_\_\_\_
9. In which way is the inclined plane important to the builders?  
\_\_\_\_\_  
\_\_\_\_\_

10. **The diagram shows a boy using a metallic bar to raise a bag of coffee. Use it to answer the questions.**



- (a) Which type of machine is he using?  
\_\_\_\_\_

(b) What can he do to lift the sack more easily?

\_\_\_\_\_

(c) Name the force that slows movement in moving parts of a machine.

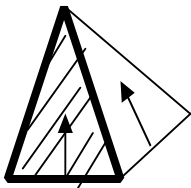
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(d) How is the force in (c) useful in our daily life?

\_\_\_\_\_

## WEDGES AND SCREWS

A wedge is an inclined plane with two sloping surfaces i.e. double inclined plane.



### Examples of wedges

1. Spears and swords, razorblade, plough, nails and chisel

<i>An axe</i>	<i>A panga</i>	<i>knife</i>	<i>scissors</i>	<i>bullets</i>

### Uses of wedges:

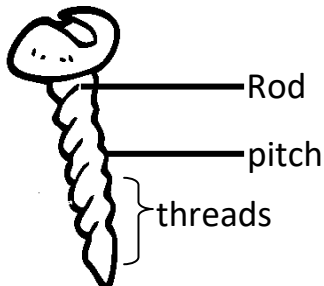
1. For splitting logs of wood
2. For cutting objects like panga, axes, razor blades
3. For sewing
4. For digging
5. Wedges are used for widening different openings

## SCREWS

A screw is an inclined plane that winds around the rod.

The three parts of a screw are: the rod, the pitch and the threads

### Illustration of a screw



A pitch of a screw is the distance between two successive threads

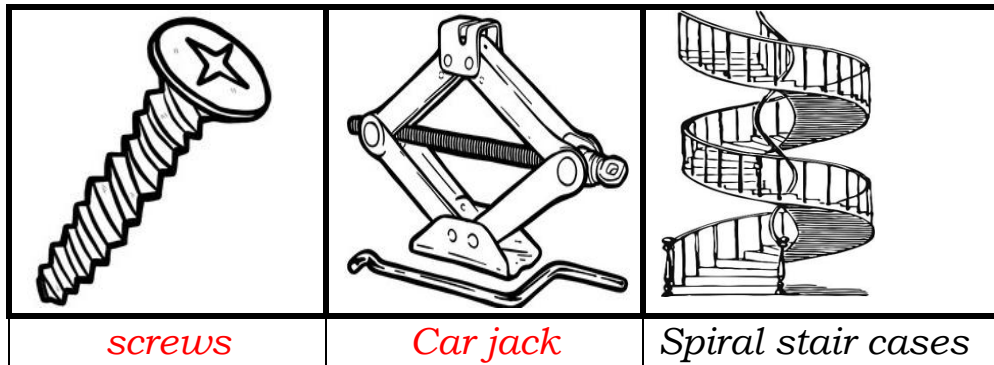


A screw with few threads moves a shorter distance so, more effort is required to overcome the load.

A screw with many threads moves a longer distance so little effort is used to overcome the load

### Examples of machines that use screws

1. Bolts and nuts
2. Bottles lids
3. Motorcar jack
4. Spiral stair cases.



### Uses of screws

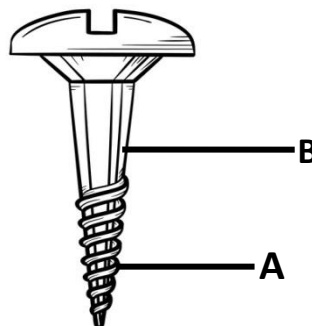
1. Car screw jack is used to lift vehicles.
2. To hold two or more parts of electrical appliances together.
3. To drill holes in wood or metal.
4. To tighten bottle tops.
5. For covering bottles and jar lids

### Activity

1. What is a screw?

\_\_\_\_\_

2. Below is a diagram of a screw. Use it to answer the questions that follow.



- (a) Name the part of the screw marked with letter A and B.

A: \_\_\_\_\_ B: \_\_\_\_\_

- (b) How are threads important to the screws?

\_\_\_\_\_

(c) Mention any **two** examples of machines that use screws at home.

\_\_\_\_\_

3. What name is given to the inclined plane with two sloping surfaces?

\_\_\_\_\_

4. Mention any **two** examples of wedges.

\_\_\_\_\_

5. State any **two** applications of wedges in our homes.

\_\_\_\_\_

6. State the reason why a nail is considered as a wedge.

\_\_\_\_\_

7. Mention any two uses of screws in our daily life.

\_\_\_\_\_

8. Why are bottle tops made of screws?

\_\_\_\_\_

## WHEELS AND AXLE

These are machines composed of two rotating wheels fixed together.

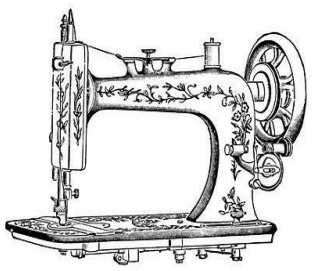

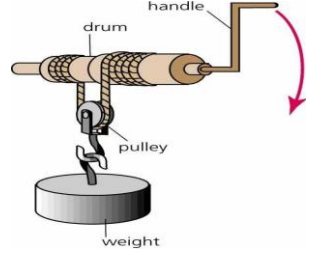
A wheel is a circular rim turning on an axle.

The wheel is fixed on a small wheel called axle or shaft onto which it rotates.

The axle is a rod which passes through a wheel to make it rotate easily.

### Examples of wheel and axle machines

1. Car steering wheel.
2. Wheels of bicycles.
3. Pedal and chains of bicycles
4. Door knobs, egg beater, screw driver,
5. Windlass.
6. Sewing machine

			
<b>Sewing machine</b>		<b>Windlass</b>	<b>Windmill</b>

## Application of wheels and axle in daily life

- ✍ Used in windlasses to draw water.
- ✍ Sprocket wheels and chains used driving bicycles.
- ✍ Car steering wheels.
- ✍ Door knobs used to open doors.

## GEARS AND BELT DRIVES

Gears are special forms of wheels with teeth around their edges.

They are sometimes called **cog-wheels or toothed wheels**.

If toothed-wheels are connected with chains / belts they move in the same direction.

When cog-wheels are joined together, the teeth interlock.

As one wheel rotates, it turns the other but they move in opposite directions.

### Examples of machines that use gear wheels

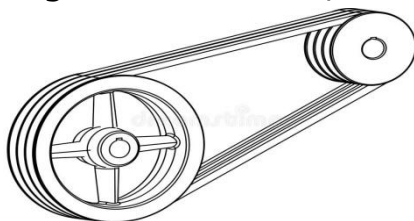
1. Watches
2. Gear boxes
3. Motor cycles
4. Bicycles
5. Electric toys
6. Bulldozers

### Advantages of using gear wheels

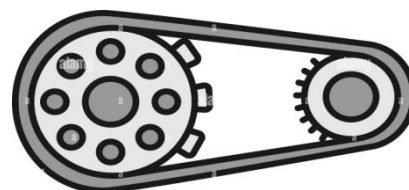
1. They help to multiply force.
2. They change the direction of movement (rotation)
3. They multiply the speed of rotation
4. They can slow the speed of rotation.

### Drive belts:

- Drive belts transmit motion from one wheel to another.
- Both wheels move in the same direction.
- If a driven wheel has 48 teeth and the driving wheel has 12 teeth, the driving wheel will make 4 revolutions in each single revolution of the driven wheel.
- Conveyor belts – that move things from one place to another as in escalators, bottling line in factories, moving luggage in air ports etc.



*A drive belt*



*A bicycle chain*

### Activity

1. What name is given to a machines composing of two rotating wheels fixed together?  
\_\_\_\_\_  
\_\_\_\_\_
2. Mention any **two** examples of wheel and axle machines  
\_\_\_\_\_  
\_\_\_\_\_
3. State at least **two** application of wheels and axle in daily life  
\_\_\_\_\_  
\_\_\_\_\_
4. Name the special forms of wheels with teeth around their edges.  
\_\_\_\_\_  
\_\_\_\_\_
5. State the reason why the special forms of wheels name above is also called toothed wheels.  
\_\_\_\_\_  
\_\_\_\_\_
6. State what will happen when the toothed-wheels are connected with chains.  
\_\_\_\_\_  
\_\_\_\_\_
7. State any **two** examples of machines that use gear wheels  
\_\_\_\_\_  
\_\_\_\_\_
8. Mention any **two** application of using gear wheels  
\_\_\_\_\_  
\_\_\_\_\_
9. If a driven wheel has 36 teeth and the driving wheel has 12 teeth, how many revolutions will the driving wheel make in each single revolution of the driven wheel?  
\_\_\_\_\_  
\_\_\_\_\_
10. Suggest **two** application of conveyor belts in our daily life  
\_\_\_\_\_  
\_\_\_\_\_

### PULLEYS:

- Pulley is a freely rotating wheel with a grooved rim.
  - A rope /chain pass over the grooved rim.
  - The groove prevents the rope from sliding.
- The frame to which the pulley is fixed in called a **block**.

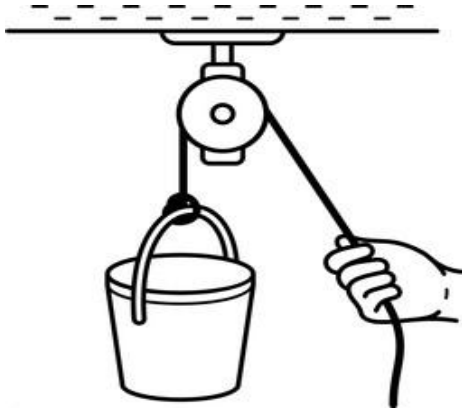
### Three types of pulleys are:

1. Single fixed pulley
2. Single movable pulley.
3. Block and tackle / multiple/ fixed movable pulleys

### a) SINGLE FIXED PULLEY.

In a single fixed pulley, the block is attached to a frame and only the wheel moves.

A single fixed pulley acts as a first-class lever, with the axle at the centre as a fulcrum.



#### Illustration of single fixed pulley

- ✍ A single fixed pulley changes the direction of force.
- ✍ By pulling down wards it is easier to raise an object.
- ✍ It has a mechanical advantage of one.

#### Question

Find the effort applied to pull a load of 50kgf using a single fixed pulley.

$$MA = 1$$

$$L = 50\text{kg}$$

$$E = ?$$

$$MA = \frac{L}{E}$$

$$1 = \frac{50\text{kgf}}{E}$$

$$E \times 1 = \frac{50 \times E}{E}$$

$$E = 50\text{Kgf}$$

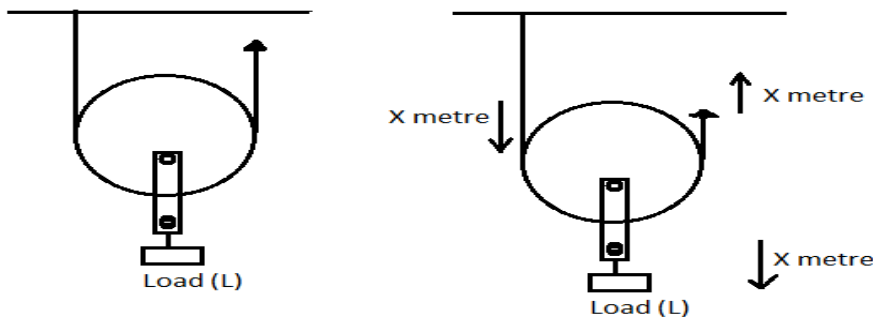
The force needed to lift the load is the same as the load.

### b) SINGLE MOVABLE PULLEY.

*Single movable pulley is a pulley made of a wheel moving from one position to another while rotating.*

- It acts as the second class lever where the load is between the pivot and the effort.
- Single fixed pulley has a mechanical Advantage of two. This is because the effort is always half the load.
- In a movable pulley, the whole pulley block moves along the rope.

- It does not change the direction of force, both load and effort move in the same direction.
- It has a mechanical advantage of 2.
- The effort needed is half the load.



- Single movable pulley acts as a second-class lever with the fulcrum and effort at either side of the wheel.

### Activity

1. Name the simple machine which has freely rotating wheel with a grooved rim.

\_\_\_\_\_

2. Name the part of a pulley system which prevents its rope from sliding.

\_\_\_\_\_

3. The diagram below is of a pulley. Study it and answer questions.



- (i) What type of pulley is shown in the diagram above?

\_\_\_\_\_

- (ii) Use arrow to show the direction of force in the pulley shown above.

- (iii) State any **two** applications of the type of pulleys shown above.

\_\_\_\_\_

- (iv) Calculate the effort needed to raise the load shown in the diagram above.

\_\_\_\_\_

4. (a) State any **two** types of pulleys.

\_\_\_\_\_

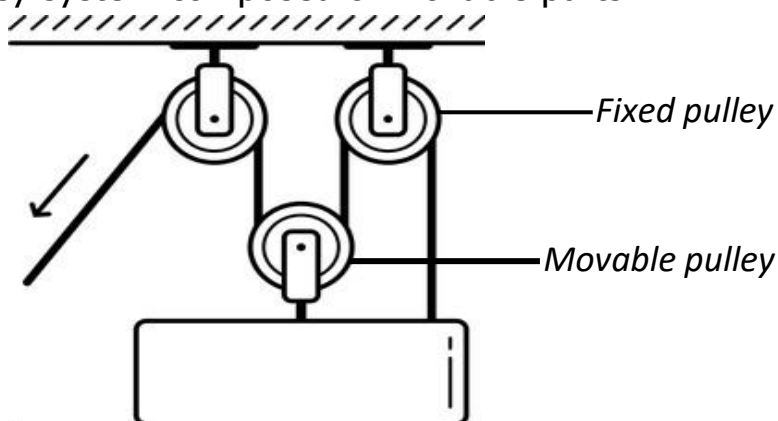
(b) Name the type of pulley where the block is attached to a frame and only the wheel moves.

(c) How does a single fixed pulley change the direction of force?

5. Find the effort applied to pull a load of 75kgf using a single fixed pulley

### Double pulley system (combined fixed and movable pulley)

This is the type of pulley system composed of movable parts

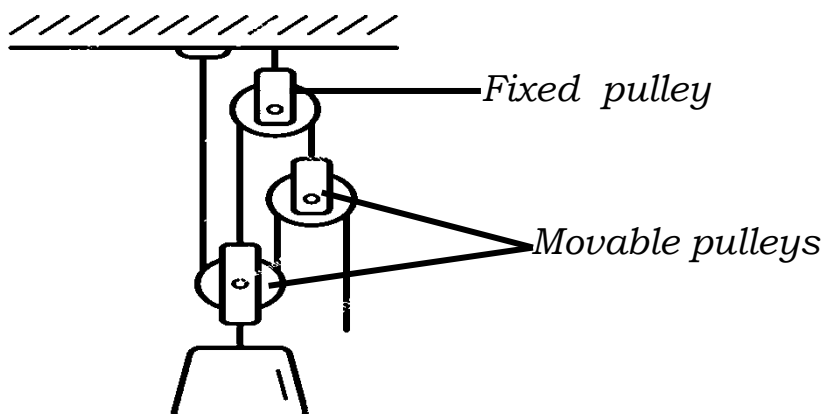


### Comparison of fixed and movable pulleys

Fixed pulley	Movable pulley
Work is done faster	Work is done slowly
There is change in the direction of force	No change in the direction of force
The effort applied is equal to the load	The effort applied is half the load

### Block and tackle pulley

This is the type of pulley system which consists of several movable pulleys and several fixed pulleys



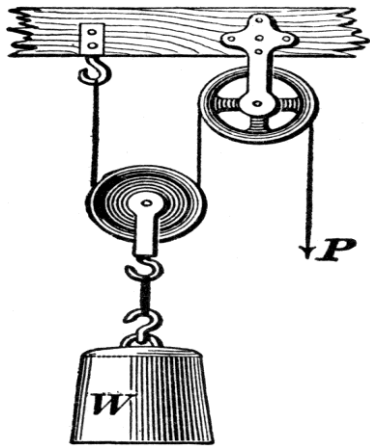
The mechanical advantage of a block and tackle is determined by the number of wheels in the block.

## Uses of pulleys in daily life

1. They are used by break down vehicles to pull stranded vehicles.
2. They are used in lifts / elevators.
3. They are used on cranes to lift and load heavy loads.
4. They are used in scaffolds by painters to paint tall buildings.
5. They are use on flag poles to raise flags at school.
6. They are used in curtain boxes to draw curtains. Pulleys are used in fetching water in deep wells.
7. Pulley is used in hoisting flags on flag poles

### Activity

1. The diagram below is of a pulley system. Use it use to answer questions that follow.



- (a) Name the types of pulley system shown above

\_\_\_\_\_

- (b) Name the part of the pulley marked with letters **W** and **P**

(i) W: \_\_\_\_\_

(ii) P: \_\_\_\_\_

- (c) Use an arrow to show the direction of effort.

\_\_\_\_\_

- (d) If the mechanical advantage of the machine is 2 and the load being carried by the machine is 50kg. Find the effort needed to raise that load.

\_\_\_\_\_

2. The diagram below is a hoisting flag. Use it to answer the questions that follow.





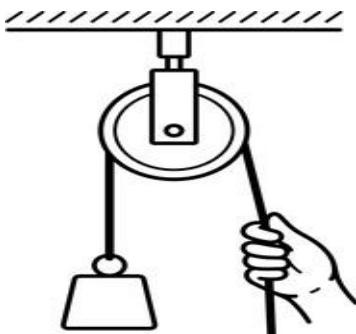
- (a) Name the force that helps to raise up and lower down the flag.  
\_\_\_\_\_
- (b) How is the pulley important to the in raising and lowering of the flag?  
\_\_\_\_\_
- (c) Apart from schools, mention **two** other places where flag poles are used.  
\_\_\_\_\_

3. Which type of pulley acts as a second-class lever with the fulcrum and effort at either side of the wheel?  
\_\_\_\_\_

4. Identify **one** way pulleys are useful on a construction site.  
\_\_\_\_\_

5. Suggest any **two** applications of pulleys in our daily life  
\_\_\_\_\_

**6. The diagram bellow show two types of simple machines labelled A and B. Use it to answer the questions that follow.**



- (a) Name each of the machines shown in the diagram
  - (i) **A:** \_\_\_\_\_
  - (ii) **B:** \_\_\_\_\_
- (b) Which of the two machines would you choose to use to lift the load **X** to a height of two metres?

(e) Give a reason for your choice of machine in (b) above.

## LESSON

### FRICTION

- ✍ Friction is the force that tends to oppose motion between objects or surfaces which are in contact with one another.
- ✍ Friction is the force which acts to oppose the motion between two surfaces as they move over each other.

Heat is produced when the friction is acting between two surfaces.

#### Types of friction:

- ✓ **Static friction** is the friction between two surfaces which are trying to move but have not yet started moving.
- ✓ **Dynamic friction** is the friction between two surfaces when one is moving over the other.
- ✓ **Viscosity friction** is the friction which exists in liquids and gases.

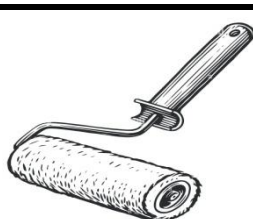
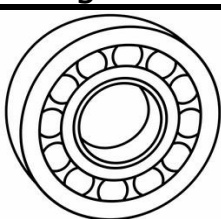
#### Advantages of friction as a useful force

Friction helps us in:-

1. Walking without sliding.
2. Movement of vehicles.
3. Lighting a match stick.
4. Braking of moving vehicles.
5. Climbing trees.
6. Writing using a pen.
7. Grinding corn, grain, flour
8. Washing clothes.

#### Ways of increasing friction.

1. By putting treads on tyres or shoes.
2. Increasing the weight on a surface
3. Putting treads on car and bicycle tyres
4. Putting grips on handles of objects.
5. Putting spikes or studs on playing or sports shoes.
6. Making surfaces of objects rough.
7. Putting tarmac on road surfaces.



## Activity

1. What name is given to the force that tends to oppose motion between objects?

\_\_\_\_\_

2. Below is a diagram of a simple machine. Use it to answer the questions that follow.



- (a) Name the simple machine shown above.

\_\_\_\_\_

- (b) Mention the type of friction which acts in the point marked with letter B

\_\_\_\_\_

- (c) State any **one** effect of friction in the pulley system above.

\_\_\_\_\_

- (d) Give any **one** way of reducing friction in moving machines.

\_\_\_\_\_

3. Which type of friction exists in liquids and gases?

\_\_\_\_\_

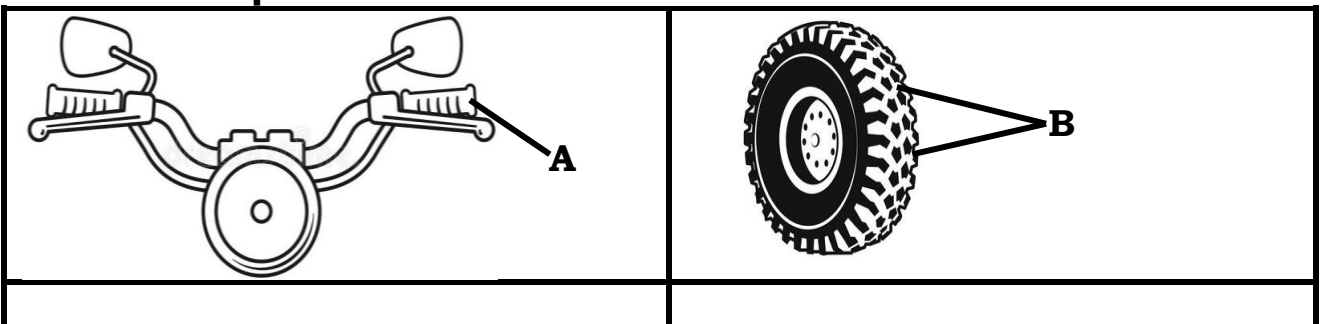
4. Mention any **two** application of friction as a useful force.

\_\_\_\_\_

5. Which type of force enables a match-stick to light when it is struck at the side of its box?

\_\_\_\_\_

**Below are diagrams showing the parts of machines. Use them to answer the questions that follow.**



6. Why are parts marked with letter **A** made with grips?

---

7. Of what importance are treads on the part of machine marked with letter **B**?

---

8. Why do tyres of cars wear out more quickly on tarmac roads than marram roads?

---

9. How do road builders increase friction on the surface of the road?

---

10. Give **one** way in which friction is useful to a person riding a bicycle.

---

11. State **two** ways of increasing friction.

---

### **Friction as a nuisance force**

*The word nuisance means a problem, burden, harm*

### **The disadvantages of friction as a nuisance force**

1. Friction reduced the speed of movement.
2. Friction reduces the efficiency of machines.
3. Friction causes unnecessary heat in machines.
4. Friction causes wear and tear of things.
5. Friction delays work.
6. Friction makes one use a lot of effort.

### **Ways of reducing friction.**

*We can reduce friction so that less effort is used to do work.*

### **Frictions can be reduced by:**

1. Making rough surfaces smooth.
2. Oiling or greasing (lubrication) of moving parts to make them smooth
3. Using ball bearing.
4. Using rollers.
5. By polishing some surfaces to reduce friction
6. Streamlining the bodies of moving vessels.

---

### **Activity**

1. Apart from using more energy, name **one** other disadvantage of friction as a nuisance force.

- 
- 
2. What force makes a pencil to reduce in length as one writes?  

---

---
  3. Name **one** form of energy produced by the force in (a) above as one writes.  

---

---
  4. Whenever John opens or closes his door, the hinges makes noise. What can he do to stop the noise when he is opening the door?  

---

---
  5. Why do flying birds have streamlined bodies?  

---

---
  6. State any **two** examples of streamlined objects  

---

---
  7. Apart from the method state above, mention any **two** other ways of reducing friction.  

---

---

**THEME: HUMAN BODY**  
**TOPIC 6: EXCRETORY SYSTEM**

**LESSON**

**Excretory system** is a body system that deals with the removal of waste products from the body.

**Excretion** is the removal of waste products from the body.

Excretory organs are organs involved in the removal of waste products in the body.

**Organs of excretory system**

The body organs which carry out excretion are;

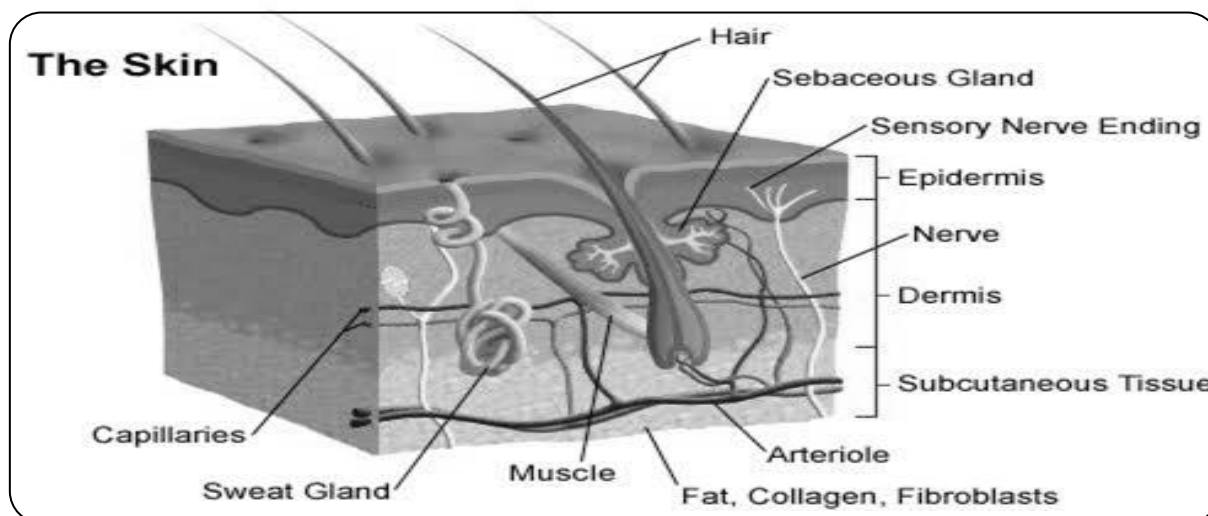
1. The skin.
2. The kidney.
3. The lungs.
4. Liver

**The human skin**

Skin is the sense organ for feeling.

Skin is the organ that covers the human body. It protects the body from the entry of germs, water and other external damages. Skin is the largest organ in the body.

### Illustration of the structure of the skin



**The skin is made of two main layers.**

- ✓ Epidermis.
- ✓ Dermis.

### The Epidermis:

This is the outer most protective layer / region of the skin.

**The epidermis is made up of these layers.**

- a) Cornified layer.
- b) The granular layer.
- c) The Malpighian layer.

### Functions of epidermis

- ✍ It protects inner parts from germs
- ✍ It has opening for the sweat glands

### The dermis

This region is the inner most layer of the skin and it stores fats under it.

*This layer contains sweat glands, which secrete sweat, hair follicles, blood vessels, which carry blood to and from the skin, oil glands which produce oil called sebum to keep the skin soft and moist and sensory nerve endings which make us feel pain, cold, heat, touch.*

**This region contains the following parts.**

1. **Capillaries:** Supply food and oxygen to the skin and removes excretory products. Capillaries help in temperature control.
2. **Sweat glands:** produces and secretes sweat, sweat contains excess salts, urea and water. Sweats cool the body and regulate body temperature.

3. **Sweat duct:** Is an opening / pore that lead sweat to the surface of the skin.
4. **Hair follicle:** Is a deep pit of granular and Malpighian layer cells that multiply to build hair.
5. **Sebaceous glands;** produce oily substances called sebum that keeps the skin water proof.
6. **Subcutaneous fat;** The fat layer beneath the skin act as a heat insulator that helps to control heat loss.
7. **Nerve endings** – Transmit impulses for heat, touch etc.

### **Cornified layer:**

- ❖ It is found on the top surface of the skin.
- ❖ It consists of dead cells that resist damage, fungal, viral and bacterial invasion.

### **Malpighian**

Malpighian is a layer of cells which divide actively to produce the epidermis.

- ❖ In this layer, there are pigments granules and melanin that determine the skin colour
- ❖ The Malpighian layer also acts as a screen against ultra violet rays of the sun.

### **Granular layer**

- ❖ Contains living cells that gradually give way to form the cornified layer.
- ❖ Increases resistance to damage and bacterial invasion.
- ❖ It reduces the loss of water by evaporation.

### **Functions of the skin**

1. Skin excretes salts, water and some urea.
2. Skin regulates body temperature.
3. Skin stores fats.
4. Skin makes vitamin D by the help of sun ultra violet rays.
5. Skin protects the body against germ infections.
6. Skin protects the inner parts of the body from external injury, bacterial infection, strong sunlight, prevent entry of water and dirt.
7. Skin is the sense organ for feeling/ touch

### **Activity**

1. **Table below shows human body organs, the system to which they belong and the organ functions. Study and complete it correctly.**

Organ	System	Organ function
Heart	Circulatory	

	Excretory	Formation of urine
Pancreas		Produces pancreatic juice
Epididymis	Reproductive	

2. Name the human body system to which lungs, kidneys and the skin belong.

\_\_\_\_\_

3. Apart From the skin, give any one example of an excretory organ.

\_\_\_\_\_

4. Name the largest organ of the body.

\_\_\_\_\_

5. Name the outermost layer of the human skin.

\_\_\_\_\_

6. State any **one** waste product removed by the skin.

\_\_\_\_\_

7. Apart from removing wastes, mention **two** other functions of the human skin.

\_\_\_\_\_

8. Why is it a bad practice to apply soil or cow dung on any burnt area of our skin?

\_\_\_\_\_

9. In which **one** way is the function of the skin similar to that of lungs?

\_\_\_\_\_

## LESSON

### BODY TEMPERATURE REGULATION

#### Body temperature regulation

- ✓ Blood vessel vasodilate / widens allowing more blood to flow near the surface and more heat is lost by radiation.
- ✓ Sweat glands produce more sweat through which heat is lost by evaporation.
- ✓ Erector muscles relax causing hair to lie flat on the body to allow wind to easily sweep off heat.

#### On cold days

1. Blood vessel narrows (vasoconstriction) and so blood is withdrawn from the surface limiting heat loss by radiation.
2. Decrease in sweat produce thus reducing heat lost by evaporation.
3. Through shivering, heat is produced by the contracting muscles.



4. Fats under the skin act as heat insulators.
5. Erector muscles contract causing hair to erect and trap air around the skin which acts as an insulator to heat loss.
6. When hair erect, goose pimples appear on the skin.

### **Diseases of the skin**

The skin is commonly affected by diseases like;

1. Ring worm.
2. Scabies.
3. Athlete's foot
4. Leprosy.

#### **Ring worm.**

It is caused by a fungus and spread through direct contact with infected person and clothing.

#### **Signs of ring worms**

- ✍ Red round patches with raised edges on the skin
- ✍ Much itching of the skins
- ✍ Hair falls off leaving the patches of bare skins

#### **Prevention and treatment of scabies**

- ✍ Keep beddings and clothes clean
- ✍ Do not share clothing
- ✍ Treat with drugs

#### **Scabies:**

- ✍ It is caused by itch mites called *sarcoptes scabiei* which is a worm.
- ✍ It is spread through direct contact of the skin with an infected person.

#### **Signs of scabies**

- ✍ Irritation and watery swelling on the skin .
- ✍ Severe itching at night.

#### **Prevention and treatment of scabies**

- ✍ Bathe daily with soap
- ✍ Avoid mites from settling on the skins
- ✍ Maintain personal hygiene
- ✍ Seek medical attention from the hospital

#### **Athlete's foot:**

It is caused by fungus and spread through infested stockings and shoes.

#### **Signs:**

Skin between toes become white, cracks and peels off

**Prevention:**

- ✓ Change socks and shoes
- ✓ Avoid tight shoes
- ✓ Disinfect towels and socks

**Leprosy:**

It is caused by bacillus bacteria and spreads through casual skin contact with an infected person.

**Signs:**

- ✓ Limbs and parts of the body becomes numb
- ✓ Large sores destroy limbs, nose and eyes.

**Prevention:**

- ✓ Avoid contact with infected persons
- ✓ Observe perfect cleanliness

**Other diseases of the skins include:**

- ✍ Chicken pox
- ✍ Herpes Zoster
- ✍ Impetigo
- ✍ Warts

**Disorders of the skin**

1. Dandruff
2. Pimples
3. Skin allergy
4. Wounds and Bruises
5. Sun burn
6. Skin rash
7. Cuts
8. Corns
9. Herpes zoster

**Care of the skin:**

1. Wash your body daily with warm clean water and soap and keep it clean
2. Rub your body with a towel after bathing.
3. Wash your face whenever it is dirty or you sweat
4. Wounds and cuts should be well covered with sterilized bandages.
5. Take exercises daily to keep it working in proper order.
6. Eat a balanced diet.
7. Change stocking and underwear regularly and maintain their cleanliness
8. Keep the finger nails short and clean
9. Protect the skin from too much sunshine

10. If the skins get infection, seek medical attention immediately

### Activity

The diagram below is of a human skin. Use it to answer questions that follow.



1. Name the layers of the skin marked with letter A and B

A \_\_\_\_\_

B \_\_\_\_\_

2. Give the function of the part labelled Y and Z

\_\_\_\_\_

3. State the reason why the rate of sweating is lower in cold days than in hot days.

\_\_\_\_\_

4. Name the process through which heat is lost from the skin.

\_\_\_\_\_

5. State any **two** diseases of the skin.

\_\_\_\_\_

6. Suggest **two** common disorders of the skin

\_\_\_\_\_

7. Mention **two** ways in which we can care of the skin.

\_\_\_\_\_

8. Why should wounds and cuts on the skin be well covered with sterilized bandages?

\_\_\_\_\_

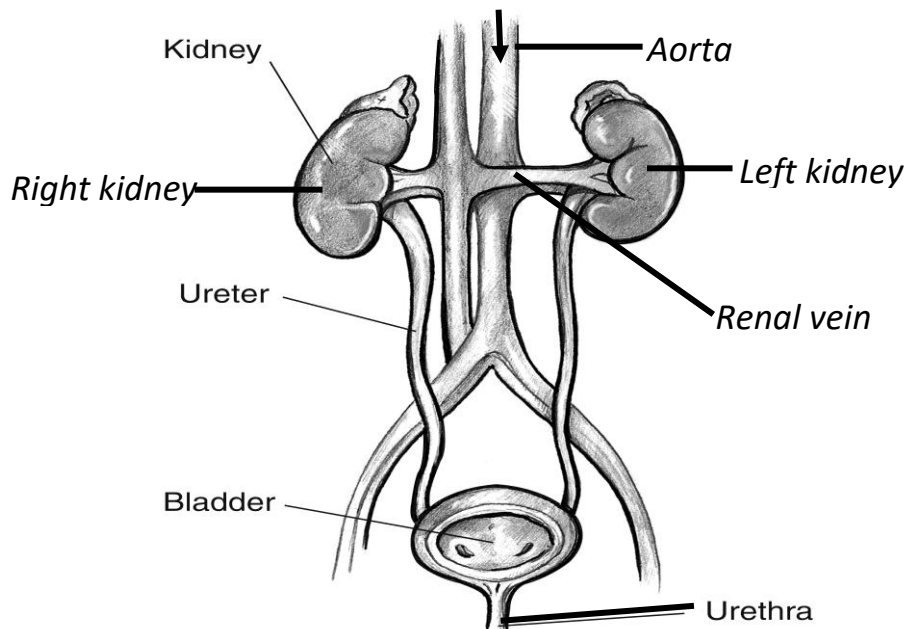
9. Name any **two** plant materials that we can use to clean our bodies.

\_\_\_\_\_

### LESSON

#### Urinary system

Urinary system is made up of organs that eliminate wastes from the body in form of urine.



### Other organs of urinary system

1. Kidney
2. Ureter
3. Urinary bladder
4. Urethra

### Activity

1. What is urinary system?

\_\_\_\_\_

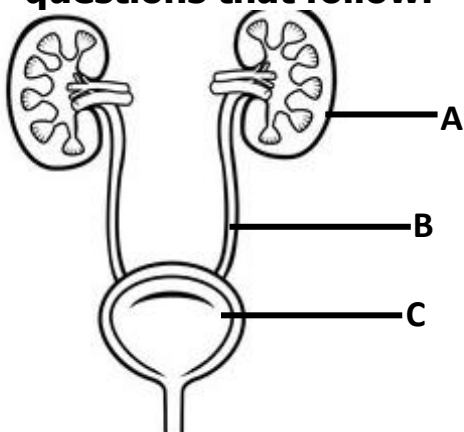
\_\_\_\_\_

2. State any **two** organs of the urinary system

\_\_\_\_\_

\_\_\_\_\_

3. Below is a diagram of a human body system. Use it to answer the questions that follow.



- a) State any **one** use of the part marked with letter **A** to the urinary system.

\_\_\_\_\_

\_\_\_\_\_

- b) Name the waste product excreted by urinary system

\_\_\_\_\_

\_\_\_\_\_

c) How is the work of the part marked with letter **B** different from that of part **C**?

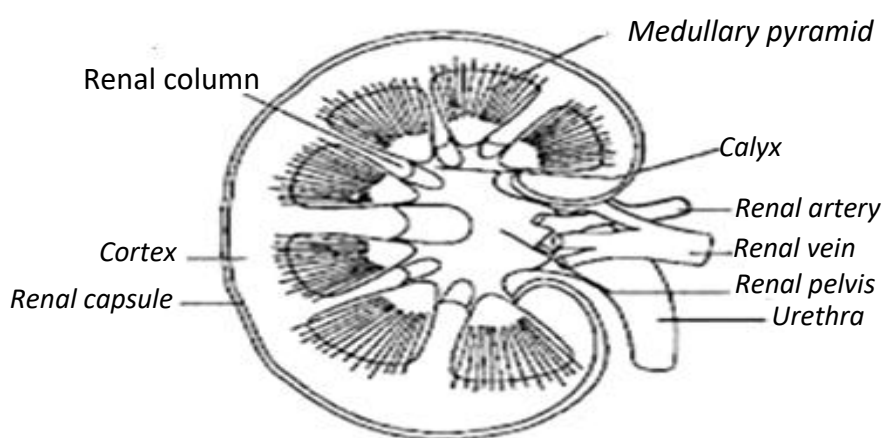
d) Use letter **D** to show the position of urethra and **G** to show ureter.

## THE KIDNEYS

Kidneys are two reddish brown bean shaped organs at the back of the abdominal cavity.

Kidneys are the major organs of excretion in vertebrates.

### Illustration of the internal structure of the kidney



### Parts of the kidney and their functions

#### 1. Renal artery

Renal artery is a branch of aorta that supply oxygenated blood to the kidney.

#### 2. Renal vein:

A renal vein takes deoxygenated blood from the kidney to the vena cava.

#### 3. Medulla

Medulla is a region where selective re-absorption takes place by the nephrons.

#### 4. Pelvis( Renal pelvis)

Urine is collected here temporarily from the numerous nephrons.

#### 5. Urethra

Urethra is a passage of urine to the urinary bladder.

#### 6. Cortex:

Cortex is the outer part of the kidney tissues where filtration of blood takes place.

Blood is filtered to remove Urea, Uric acid, excess salts and water.

NB: Urine is formed through ultra-filtration and selective re-absorption in the kidney

## **7. The Urinary bladder:**

The urinary bladder is an elastic and muscular sack that stores urine briefly.

### **Functions of the kidneys**

- ✍ Kidneys filter the blood
- ✍ It regulates amount of water in the blood
- ✍ It controls the level of salt in the blood
- ✍ Kidney removes nitrogenous wastes in the body
- ✍ Kidney helps in the production of red blood cells

### **Diseases of the kidney**

#### **1. Cancer of the kidney.**

It occurs between the ages of 45 and 60 years. It starts with the appearance of blood in the urine. Treatment is by surgical removal of the affected kidney.

#### **2. Kidney failure,**

This occurs when the kidney is damaged and can no longer perform its roles. When the kidney fails to work, urine formation becomes difficult leading to the accumulation of waste products in the blood streams and this causes death.

#### **3. Kidney stones**

Kidney stones are caused by the obstruction of the bladder and salts which solidify within it.

#### **4. Bilharzias**

### **Waste products excreted by the kidney.**

- ✍ Uric acids
- ✍ Urea
- ✍ Excess salts
- ✍ Excess water

### **Ways of maintaining proper working of the kidney**

- ✍ Eat food containing a balanced diet
- ✍ Drink plenty of boiled water and juices regularly
- ✍ Taking regular exercises
- ✍ Avoid stress
- ✍ Go for regular kidney and body check up
- ✍ Keep the body weight in check
- ✍ Eat food containing less salt
- ✍ Do not eat raw uncooked salt
- ✍ Avoid drug abuse and misuse
- ✍ Do not hold on urine for a long time

### **Activity**

1. What is the main function of the kidney in the body?

\_\_\_\_\_

2. Mention **two** waste products excreted by the kidney.

---

3. Which part of the urinary system act as the passage of urine to the urinary bladder?

---

4. Apart from the kidney, mention other **two** organs of urinary system.

---

5. Name the process by which urine is formed in the kidney.

---

6. Name the artery that supply oxygenated blood to the kidney.

---

7. Suggest **two** diseases of the kidney.

---

## LESSON

### THE LIVER

1. The liver is said to be the most important organ in the body because it performs many functions compared to other body organs.

2. The liver is a large reddish-brown organ below the diaphragm.

3. It is supplied with oxygenated blood by the hepatic artery.

4. The liver receives blood rich in digested food from the alimentary canal by the help of the hepatic portal vein.

#### Functions of the liver

1. The liver regulates blood sugar.

✓ Too much sugars and lack of enough sugar in blood causes **diabetes**.

✓ The liver control sugar levels by the help of insulin.

✓ Insulin is produced by the pancreases and help to stimulate the liver to remove glucose from blood by converting it into glycogen for storage.

✓ The liver deaminates amino acids and converts them into carbohydrates.

✓ Alcohol, poisonous substances and poisonous drugs produced during metabolism are made harmless by the liver through the process of detoxication.

2. It helps in the process of excretion.

3. Stores vitamins and mineral salts.

4. It helps in detoxication process.

5. It produces heat energy.

6. The liver helps in the use of fats

### Diseases of the liver

#### Cirrhosis of the liver

This is hardening of the liver caused by malnutrition

1. Hepatitis.

It is water borne disease caused by virus.

2. Liver abscess. These are boils which form pus in the liver.

### Care of the liver

✍ Avoid taking too much alcohol.

✍ Have a balanced diet.

✍ Always have exercises to keep it in a good working condition.

### Activity

1. Why is liver said to be the most important organ found in the body?

\_\_\_\_\_

2. Which immunisable disease affects the liver?

\_\_\_\_\_

3. Apart from the above disease, state **two** other diseases of the liver.

\_\_\_\_\_

4. Name the artery that supplies blood to the liver.

\_\_\_\_\_

5. Which body organ regulates blood sugar?

\_\_\_\_\_

6. Apart from regulating blood sugar, mention other **two** functions of liver.

\_\_\_\_\_

7. Name the waste product excreted by liver.

\_\_\_\_\_

8. Name the liver disease which forms pus in the liver.

\_\_\_\_\_

9. Give any **two** ways in which the human liver can be kept in proper working condition.

\_\_\_\_\_

10. What causes diabetes?

\_\_\_\_\_



## The lungs as an excretory organ

Lungs as organs of excretion eliminate carbon dioxide.

Carbon dioxide is a by-product of respiration.

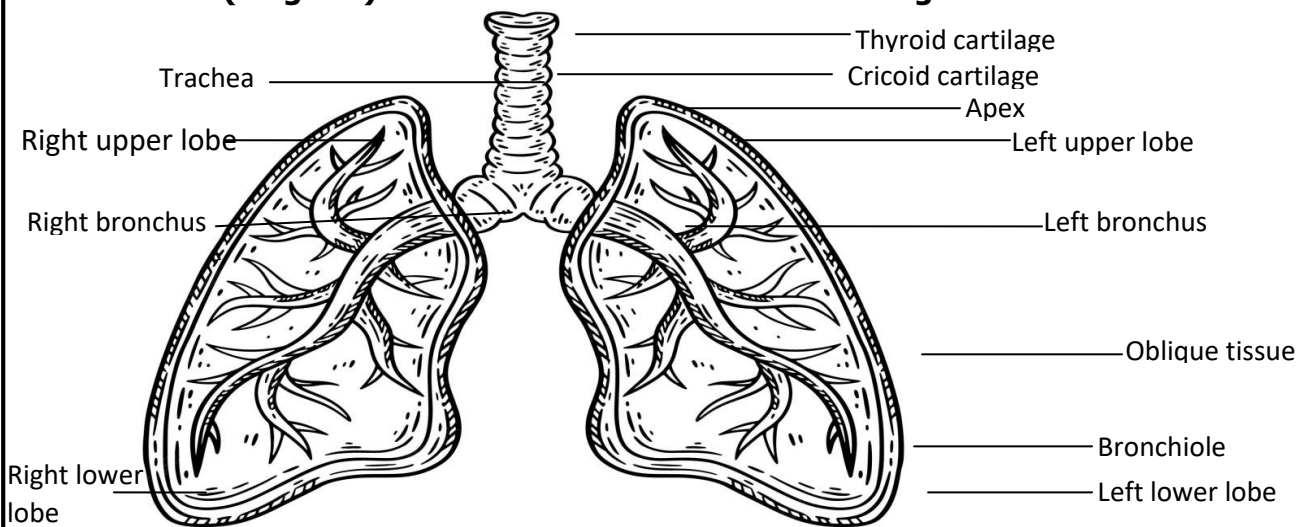
- ✍ In the lungs, the organ for gaseous exchange is the alveoli (Air sacs) carbon dioxide is eliminated from the body through exhalation (breathing out) via a nose.
- ✍ The lungs are both excretory and respiratory organs.
- ✍ This is because they are used in respiration and also putting out waste products.
- ✍ The lungs excrete carbon dioxide from the body which is a waste product of respiration.
- ✍ It is in the lungs where gaseous exchange takes place in the body. However, in the lungs, gases exchange takes place in the air sacs or alveoli.

### Adaptations of air sacs / Alveoli to their function

- ✍ They are thin walled to allow gases diffuse through easily.
- ✍ They are surrounded by a net work of blood capillaries which supply them with blood.

Energy is the main product required by the body.

### Illustration (diagram) of the internal structure of the lungs



- ✍ **Epiglottis** – Is a flap which protects the opening of the trachea during swallowing of food.
  - ✍ **Nose**- The air passage into the trachea.
  - ✍ It contains cilia and mucus which help to trap germs and dirt which enter the nose.
  - ✍ In the nose, air is cleaned, warmed and moistened.
- **It is not advisable to breathe through the mouth because;**
    1. The air will not be warmed so it can chill or make the lungs very cold.
    2. The mouth has no cilia to trap dust and germs.

### Activity

1. Name the main organ for breathing

2. Where exactly in human being does gaseous exchange take place?

3. Give any **two** adaptations of alveoli to its functions.

(i)

(ii)

4. State any **two** waste products excreted by the lungs

(i)

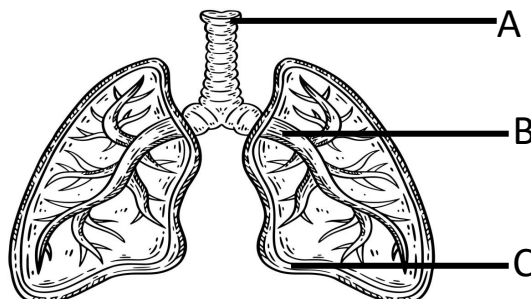
(ii)

5. State any one reason why lungs are regarded as:

(a) Excretory organ:

(b) Respiratory organ:

6. **Below is a diagram of an excretory organ. Use it to answer the questions that follow.**



(a) Name the excretory organ shown above.

(b) Name the part of marked with letter A and C

(c) Why are part marked with letter A made out of cartilage rings?

7. Why are cilia and mucus found in the nose important?

8. State any **one** reason why we should not breathe through mouth.

## THE TRACHEA

✍ It is also called the wind pipe.

✍ It is a passage of air down the lungs.

✍ The trachea contains tiny cilia for trapping dirt and germs.

✍ The trachea is made up of cartilage rings to keep it open all the time.

✍ This help to provide a clear open passage for the air all the time and prevent suffocation

✍ It divides into the bronchi which continue to divide into bronchioles and end up into the air sacs / alveoli.

## Functions of the lungs

- ✍ Lung is the major organ for breathing. It is the central organ for gaseous exchange
- ✍ They are the organs for respiration
- ✍ Oxygen taken in the lungs is carried by the body tissue and used to burn food to release energy
- ✍ Lungs act as excretory organs by eliminating carbon dioxide and water vapour

## Diseases and disorders of the lungs

### Lung cancer

Lung cancer is a non infectious disease that results from the abnormal growth of cells in the lungs. It is caused by tobacco smoking.

### Emphysema

It is the first stage of lung cancer. It is when the cells of the lungs are being destroyed usually caused by smoking.

### Tuberculosis

It is an infectious airborne disease caused by bacteria

### Symptoms of tuberculosis

- ✍ Prolonged cough which causes spitting of thick sputum
- ✍ Prolonged fever
- ✍ Loss of weight

### Non infectious disease of the lungs

Asthma, pleurisy, pneumonia, whooping cough and diphtheria

## Ways of caring for the lungs.

- ✍ Eat a balanced diet.
- ✍ Perform regular exercise.
- ✍ Eat meals containing low animals' fats.
- ✍ Avoid smoking and dusts
- ✍ Early treatment of diseases like tuberculosis and pneumonia
- ✍ Through immunization using BCG Vaccine)

### Good health habits that help to keep the lungs in a good working condition

- ✍ Avoid smoking
- ✍ By having regular physical exercises.
- ✍ Feeding on a balanced diet meal.
- ✍ Keep away from dusty places etc.
- ✍ Practice good personal hygiene
- ✍ Avoid sharing clothes and bedding with people having skin infections
- ✍ Treat diseases associated with excretory diseases earlier
- ✍ Stay in well ventilated houses/places

## Activity

1. Name the passage of air down the lungs

2. Why are trachea made up of cartilage rings

3. State any **two** functions of the lungs in the body

(i)

(ii)

4. Name the non infectious disease that results from the abnormal growth of cells in the lungs.

5. State the first stage of lung cancer

6. Name the infectious airborne disease of the lungs caused by bacteria

7. State any **two** symptoms of tuberculosis

(i)

(ii)

8. Name the organ of the human body affected by emphysema.

9. Write down any **two** non infectious diseases of the lungs

(i)

(ii)

10. State any **two** ways of caring for the lungs.

(i)

(ii)

11. State any **two** good health habits that help to keep the lungs in a good working condition

(i)

(ii)

## THEME: MATTER AND ENERGY

### TOPIC 8: LIGHT ENERGY

#### Energy

Energy is anything that enables man to do work.

Law of energy

Energy can neither be created nor destroyed but it can be changed from one form to another.

## Different forms of energy

- ✍ Heat energy
- ✍ Sound energy
- ✍ Nuclear energy
- ✍ Chemical energy
- ✍ Mechanical energy
- ✍ Light energy
- ✍ Electric energy
- ✍ Magnetic energy

## LIGHT ENERGY

Light is a form of energy which enables our eyes to see objects.

Light is a form of energy which stimulates sense of seeing.

### How we see objects.

- We see objects when they reflect light in our eye.
- Light travels from the objects to our eyes.
- A light consists of waves of electromagnetic radiations and travels in straight lines and in all directions.
- Some objects give out their own light while others reflect light falling on them from other sources.
- A narrow path of followed by the light is called a **light ray**.  
A ray is represented in diagram by a straight line with an arrow to show the direction of its movement.



### Sources of light

- A source of light is an object/ a body which gives out light.

#### There are two types of sources of light.

- (i) Natural sources of light.
- (ii) Artificial sources of light.

#### Examples of natural sources of light

Natural sources of light are sources of light which exist naturally.

They include:

1. The sun (Main natural source of light)
2. The stars
3. Erupting volcanoes
4. Glow worms
5. Lightning
6. Fire flies

*Moon is not a source of light because it emits/ reflects light rays from the sun in to our eyes.*

#### Artificial sources of light

These are man-made sources of light.

They can be extinguished by physical means.

These sources of light can either be luminous or non-luminous sources of light.

### **Examples of artificial sources of light**

Tilley lamps, wick lamps, lanterns, candles, torches, electric bulbs, fluorescent tubes, stove

Electric bulbs	Torches	Lamps	Candles	Fires

### **Activity**

1. What is energy?

\_\_\_\_\_

2. Name the form of energy which enables us to see objects.

\_\_\_\_\_

3. How do we see objects?

\_\_\_\_\_

4. State **two** examples of natural sources of light.

\_\_\_\_\_

5. In the spaces given below, draw any **three** sources of artificial light.



6. Name the main natural source of light in the environment.

\_\_\_\_\_

7. Why is moon not considered as the natural source of light?

\_\_\_\_\_

### **Luminous sources of light**

These are sources of light which emit (send) or produce their own light.

They are also called direct sources of light.

### **Examples of luminous objects**

1. The sun

2. The stars
3. Red hot charcoal
4. Hands and figures of some clocks and watches
5. Some kinds of rocks
6. Working filament of the bulb
7. Bulbs
8. Burning charcoal
9. Erupting volcanoes

### **Examples of insects which produce light at night**

1. Fire flies
2. Glow worms

### **NB:**

Among luminous sources of light, some emit light when they are red hot. These sources are called *incandescent sources of light*.

### **Examples of incandescent sources of light**

1. The sun.
2. The stars.
3. Hot filament of bulbs.
4. Hot charcoal.

### **Non-luminous objects**

These are sources of light which do not emit their own light but just reflect light from another source.

They are also referred to as indirect sources of light or reflectors.

### **Examples of non-luminous objects**

1. The moon
2. The planets
3. Plane mirrors

### **Importance of light**

1. Light enables us to see objects using our eyes.
2. Green plants use sunlight to carry out photosynthesis.
3. Heat and light from the sun help the eggs of reptiles, amphibians and fish to hatch.
4. Light from candles, lanterns, lamps and torch helps us to see in darkness
5. Some part of light e.g Ultra Violet light, is used to treat water to kill germs
6. Light energy from sun is transformed into electric energy
7. Our bodies use sunlight to make vitamin D.

### **Activity**

1. Define luminous sources of light.

\_\_\_\_\_

\_\_\_\_\_

2. Give any **two** examples of luminous objects.

\_\_\_\_\_

\_\_\_\_\_

3. What are incandescent sources of light?

\_\_\_\_\_

4. State any **two** examples of incandescent sources of light.

\_\_\_\_\_

5. What are non-luminous objects?

\_\_\_\_\_

6. Why is moon called **indirect** source of light?

\_\_\_\_\_

7. Mention **two** examples of insects which produce light at night

\_\_\_\_\_

8. Mention any **two** examples of non-luminous objects.

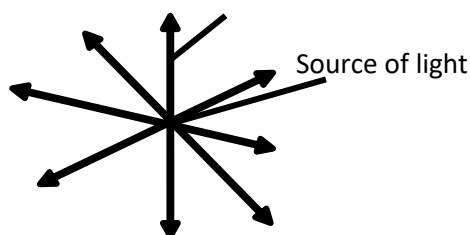
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9. State any **two** importance of light in human life.

\_\_\_\_\_

### Transmission of light (how light travel)

- Light travels in straight lines to all directions from the source.



*Light travels in a straight line in any transparent media e.g. glass, air, water and vacuum. We cannot see around corners, behind corners because light travels in straight lines.*

### Experiments to show that light travels in straight lines.

#### Requirements

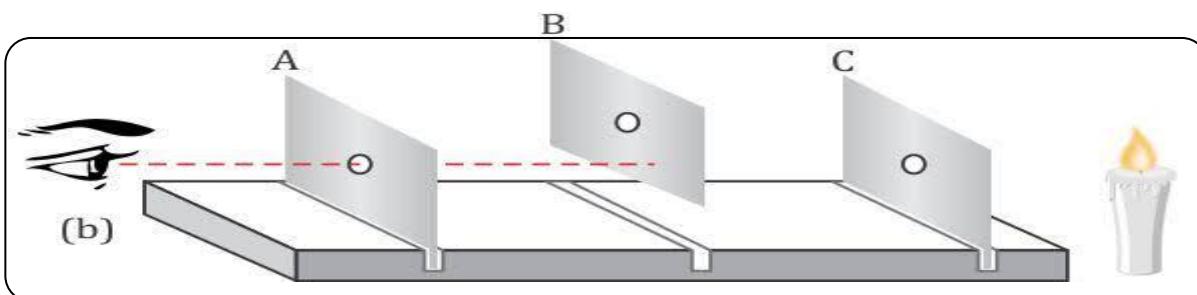
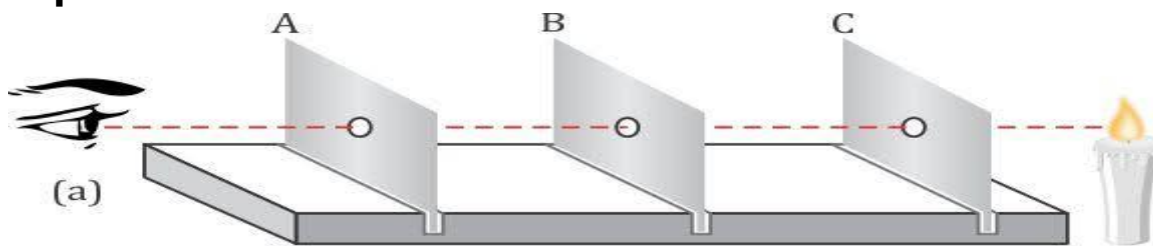
- Card boards
- Candles
- Pieces of wood

#### The experiment below will prove that light travels in straight lines.

- ✂ Cut three card boxes of 15cm by 15cm.
- ✂ Make holes in all the three cards in their centre at exactly the same position.
- ✂ Stick pieces of papers on the pieces of wood using glue or pins.
- ✂ Put a lit candle in front of the first card.
- ✂ If arranged in a straight line, light travels through the holes from the candle to eye.
- ✂ When you shift one of the candles slightly, you will not see the light.



## Experiment two.



a) In (i) when the cards are in straight line, light can be seen.

b) In (ii) when a card is raised a little light can't be seen.

This is why we can't see around corners.

### NB:

We hear sound around corners because sound travels in waves but we can't see around corners because light travels in straight lines.

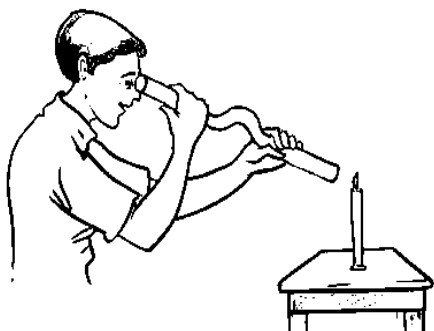
### Activity

1. Define the term rectilinear propagation of light.

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2. Use the diagram below to answer questions that follow.



a) What was the experiment about?

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b) Why was the boy unable to see the light from the candle using the pipe?

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c) What should the boy do in order to see the light from the candle?

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d) Why does light travel in straight line?

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3. Name the medium in which light travels:

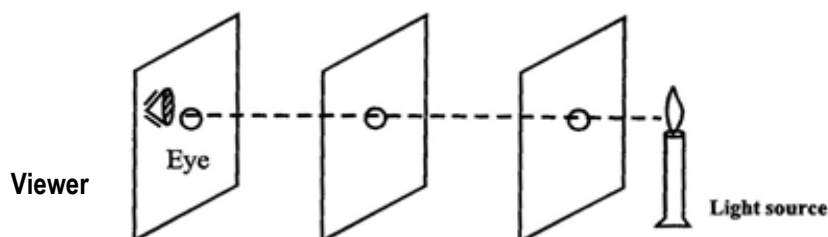
Slower \_\_\_\_\_

Faster \_\_\_\_\_

4. Why does light travel faster than sound?

\_\_\_\_\_

**5. The experiment below was done by the P7 candidates. Use it to answer questions that follow.**



a) What was the experiment about?

\_\_\_\_\_

b) What do you think will happen to the viewer when card B is slightly raised up?

\_\_\_\_\_

c) Name the artificial source of light used during the experiment.

\_\_\_\_\_

### **Rays and beams of light**

A ray of light is a straight path along which light travels in a given direction.

A ray of light is represented by an arrow.



*A ray of light*

### **A beam of light**

A beam is a group of light rays.

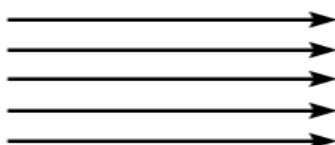
There are three types of beams of light.

- (i) Parallel beams.
- (ii) Diverging beams.
- (iii) Converging beams.

#### **(a) A parallel beam of light**

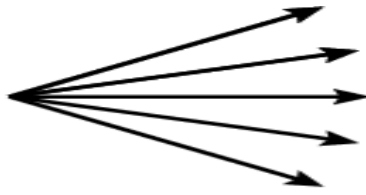
This is a type of beam where the light rays travelling from the source cannot meet.

It has parallel rays of light.



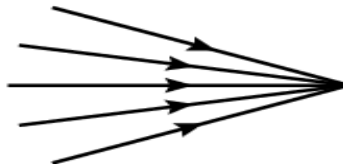
(b) **A diverging beam of light**

This is a beam of light where the light rays from the common source spread out (diverge) away from each other. e.g. car head lamp, bicycle head lamp and torches.



(c) **Converging beam.**

- ✍ This is a beam of light where the light rays from the source come towards a common point (converge).
- ✍ The rays come from different source but later in their path, they do meet at a common point



**Speed of light**

The speed of light is about 300,000Km/s in air and vacuum.

Light travels faster than sound in air.

**Examples to prove that light travels faster than sound.**

- ✍ We hear thunder after we have seen lightning.
- ✍ At a race track, we see the flash of starter's gun before we hear the bang.
- ✍ The sound of an axe is heard after we have seen the axe strike when cutting.

**Activity**

1. Define the word ray of light.

\_\_\_\_\_

2. What name is given to a group of light rays?

\_\_\_\_\_

3. Name the type of beam of light where the light rays from the source spread out.

\_\_\_\_\_

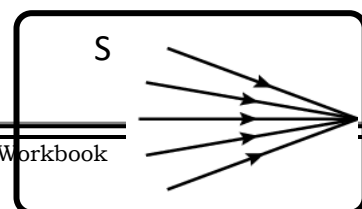
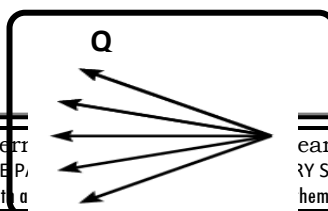
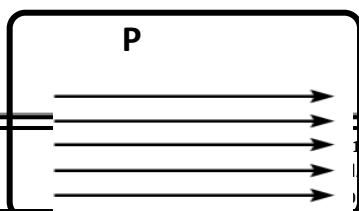
4. Mention **two** examples of objects which use the type of beam of light above.

\_\_\_\_\_

5. In which medium does light travel faster than sound?

\_\_\_\_\_

6. **The illustrations below show different types of light rays. Use them to answer questions that follow:**



(a) Name the following rays of light.

(i) Q \_\_\_\_\_

(ii) S \_\_\_\_\_

(b) Suggest the type of lens that can be used to make light rays move as shown in **S** above.

\_\_\_\_\_

### Effects of light on different materials

*When light meets an object, one of the following will happen.*

- ✍ Light can be absorbed, diffused or scattered.
- ✍ Light may be allowed through transmission.

### Materials which affect light are grouped into:

- (i) Transparent materials
- (ii) Translucent materials
- (iii) Opaque materials

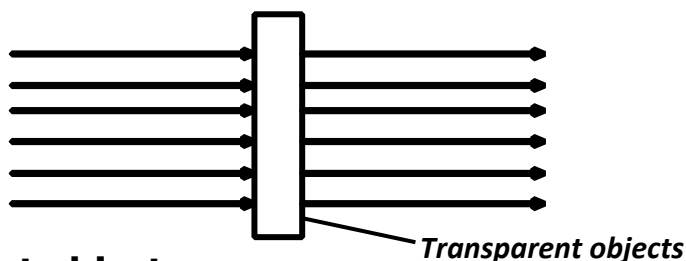
### Transparent materials

These are materials which allow most of the light to pass through and we can see through them.

These are materials through which light can easily pass.

### Examples of transparent objects

1. Clear glass, clean water, air

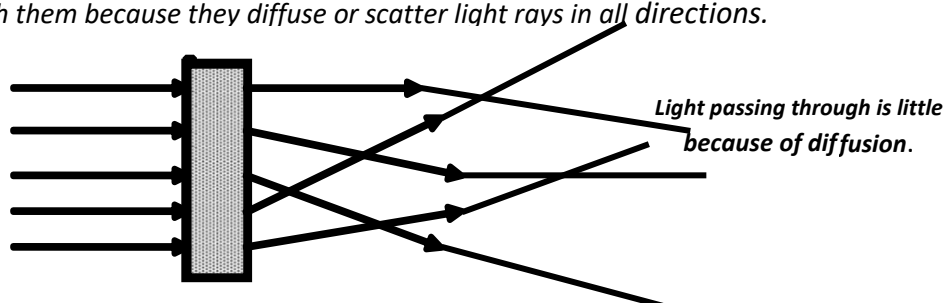


### Translucent objects

These are objects which allow some light to pass through but we cannot see through clearly.

*We cannot see through translucent materials because light directed to translucent material is partially absorbed and part of it is scattered*

*We cannot see through them because they diffuse or scatter light rays in all directions.*



### Examples of translucent objects:

frosted glass, waxed paper, pieces of cloth, polythene papers, tissue paper, light bulbs

### Opaque objects

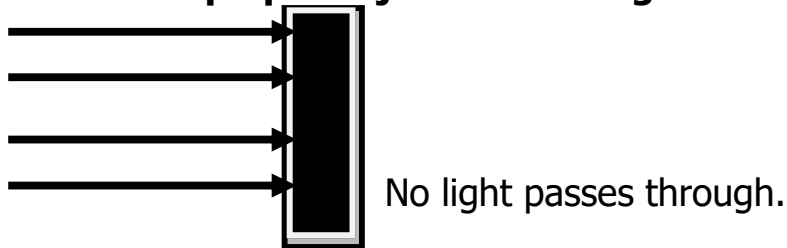
These are objects which don't allow any light to pass through them.

- We cannot see through them because light travels in straight lines.
- Opaque objects instead form shadows.

### Examples of opaque objects

1. Wood, human body, blackboard,
2. Stones
3. Metals.
4. Walls.
5. Bricks.

### Illustration of how opaque objects blocks light and from shadow.



### Activity

1. Mention **two** groups of materials which affect light.

\_\_\_\_\_

2. What are transparent objects?

\_\_\_\_\_

3. State any **two** examples of transparent objects.

\_\_\_\_\_

4. How are transparent objects different from opaque objects?

\_\_\_\_\_

5. Give any **two** examples of :

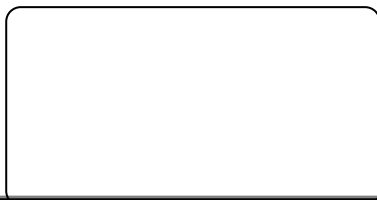
(a) translucent objects

\_\_\_\_\_

(b) opaque objects

\_\_\_\_\_

6. In the box below, draw any **one** opaque object.

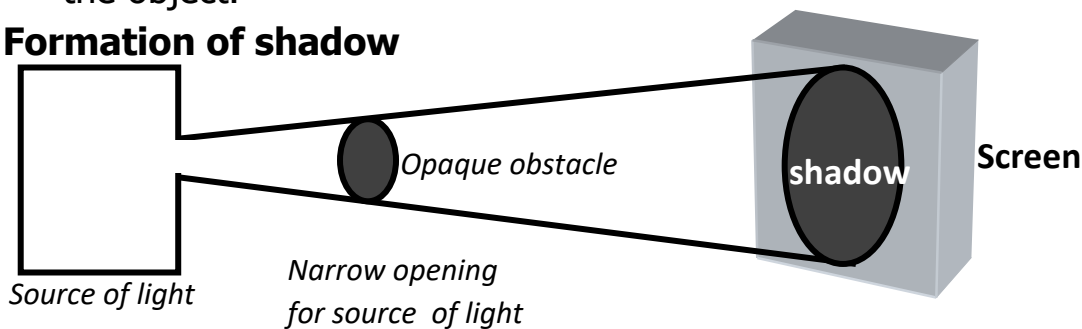


## Shadows

A shadow is a region of darkness caused by obstruction of light rays by an opaque object.

- ✓ When the source of light is a small point, a sharp complete shadow is formed called a total shadow or **umbra**.
- ✓ When the source of light is big, a total shadow called umbra is surrounded by half or partial shadow called penumbra.
- ✓ If the source of light is put further away from the opaque object, the shadow will be smaller.
- ✓ If the source of light is nearer the opaque object the shadow is bigger than the object.

### Formation of shadow

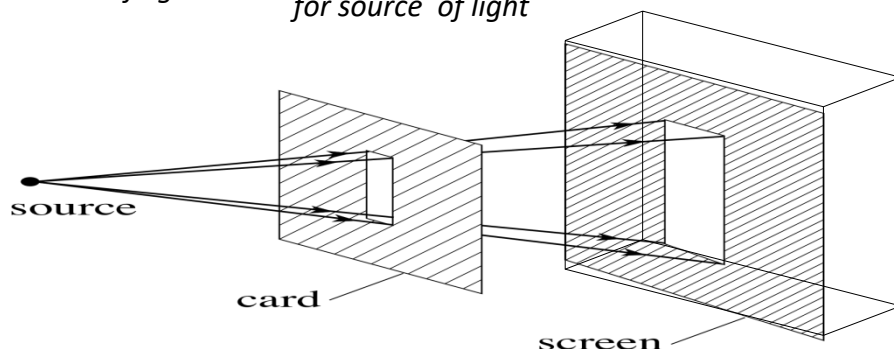
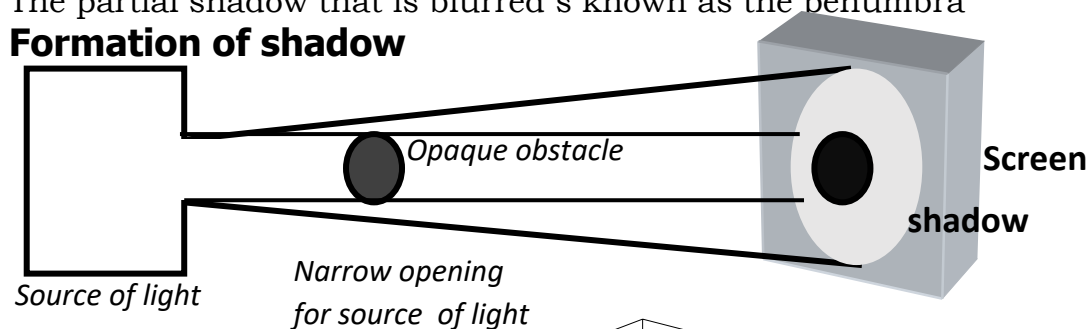


### The edges of the shadows are sharp and clear.

The dark complete part of the shadow is the umbra

The partial shadow that is blurred is known as the penumbra

### Formation of shadow



## Eclipse

An eclipse is a shadow formed by the obstruction of light by either the moon or earth. The word eclipse means 'cut off'

### Note:

- The sun is stationary (in one place)
- The earth revolves round the sun on its fixed path called orbit.
- The moon revolves round the earth but its orbit is not fixed.

### **Eclipse of the sun (solar Eclipse)**

Solar means energy from the sun.

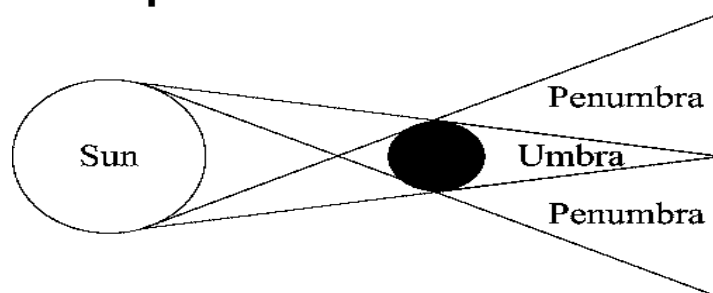
Solar eclipse is known as the eclipse of the sun

- It occurs when the moon comes in between the sun and the earth.
- When this happens the sun casts the shadow of the moon onto the earth.

#### **• Two regions of shadow formed during solar eclipse are:**

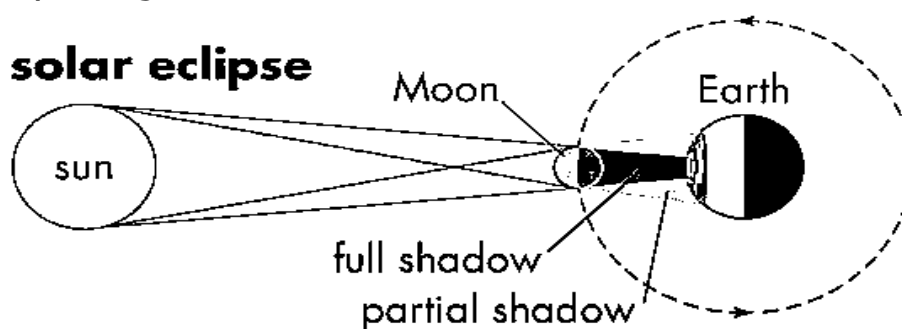
- Umbra (the real/ total eclipse)
- Penumbra ( Partial or lighter eclipse)

### **Illustration of solar eclipse**



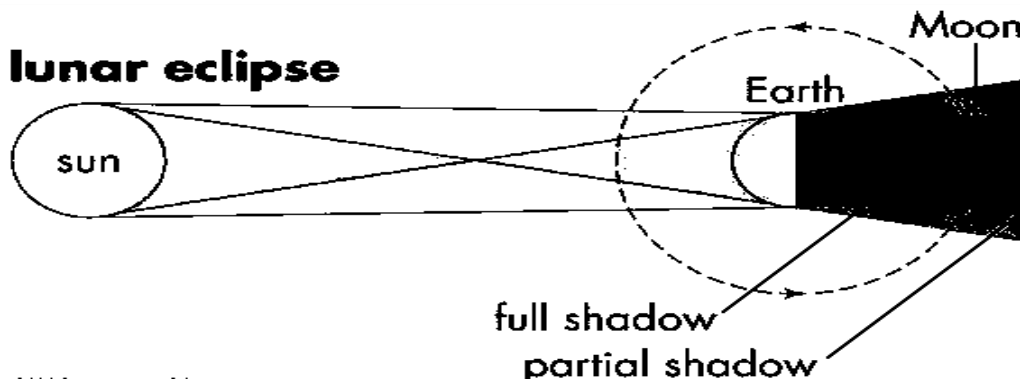
### **Annular eclipse of the sun**

- It occurs in the same way as the solar eclipse. But when the moon is far away from the earth and the umbra fails to reach the earth.
- When this happens the earth only receives the penumbra and the sun will be encircled by a ring.



### **Lunar eclipse (eclipse of the moon)**

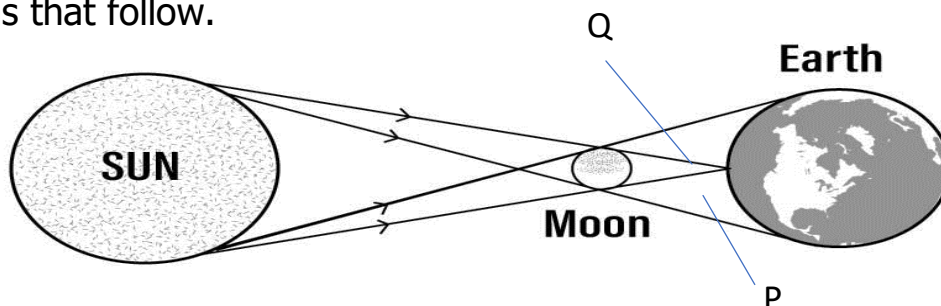
The eclipse of the moon occurs when the earth comes in between the sun and the moon. This happens only when there is a full moon. It usually happens when the earth, the moon and the sun are all in straight line.



The moon is in total eclipse so it doesn't reflect any light.

### Activity

1. The diagram below shows a type of eclipse. Study and use it to answer the questions that follow.



- (a) Name the type of eclipse shown in the diagram above.

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- (b) Name the shadows marked P and Q

P 

---

Q 

---

- (c) What happens to a person who would be in part X during the eclipse?

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2. What type of objects does not form shadows?

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3. At what time of the day is shadows shortest?

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2. State the reason why the shadows of objects are very short at midday.

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3. Draw a diagram showing how a shadow is formed. label your diagram correctly



## LESSON

### REFLECTION OF LIGHT

#### Reflection of light

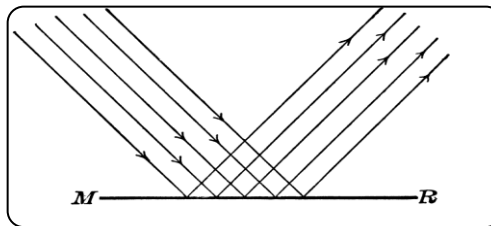
Reflection is the bouncing back of light rays when they strike a shining opaque object.

#### Types of reflection

There are two types of reflection.

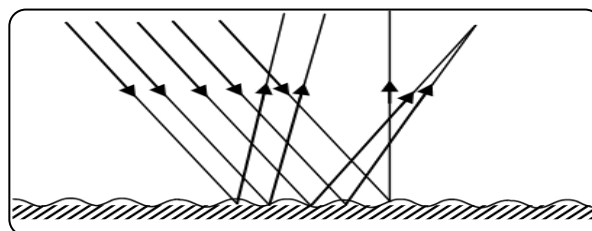
##### Regular reflection

- Is the type of reflection where the beam of light is sent back in a definite direction
- It is produced when light falls on a smooth shiny surface e.g. mirrors.
- We are able to view ourselves in plane mirrors because they are highly polished and give a regular reflection.



##### Irregular reflection

- Is a type of reflection where the beam is scattered and thrown back in all directions.
- Rough unpolished surfaces give irregular reflection (diffuse reflection)
- We are unable to see clear images on walls because they give irregular reflection.



#### Reflection principles and its laws

##### Laws of reflection:

- The incident ray, the reflected ray the normal at the point of incidence all lie in the same plane.
- The angle of incidence is equal to the angle of reflection.

**NB:** when the incident ray strikes the mirror at an angle of  $90^\circ$  the reflected ray takes the same route and this is called total internal reflection.

**Qn:**

The incident ray makes an angle of  $60^\circ$  to the mirror. What is the angle of reflection?

The normal makes  $90^\circ$  to the mirror

$$60^\circ + i = 90^\circ$$

$$60 - 60 + i = 90^\circ - 60^\circ$$

$$i = 30^\circ$$

<of incidence = < of reflection.

<of reflection =  $30^\circ$ .

### Reflection of light by different materials

- Dark dull materials are good absorbers of light which is converted to heat.
- In hot weather people prefer white clothes and in cold weather they prefer dark clothes.
- A black dress appears black because it absorbs all colours and reflects none.
- White objects appear white because they reflect all colours and absorb none.
- Green objects appear green because they absorb all the other colours and reflect only green into our eyes.

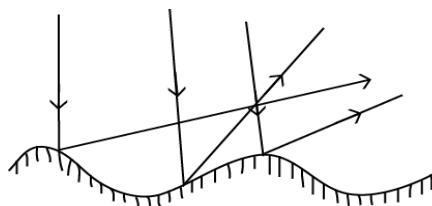
### Activity

1. What is reflection of light?

---

---

**The diagram below shows reflection of light. Study and use it to answer questions 2 and 3.**



2. What type of reflection is shown above?

---

3. Why are the rays reflected as shown in the diagram?

---

4. Why do plane mirrors produce regular reflection of light?

---

5. Give **two** ways in which reflection of light is important to man

6. Mary washes a black and white cloth and hangs them on the sun to dry.

a) Which cloth will dry first?

b) State the reason to support your answer.

c) Why do you think the white cloth will dry last?

### Images and Objects:

An image is a light picture.

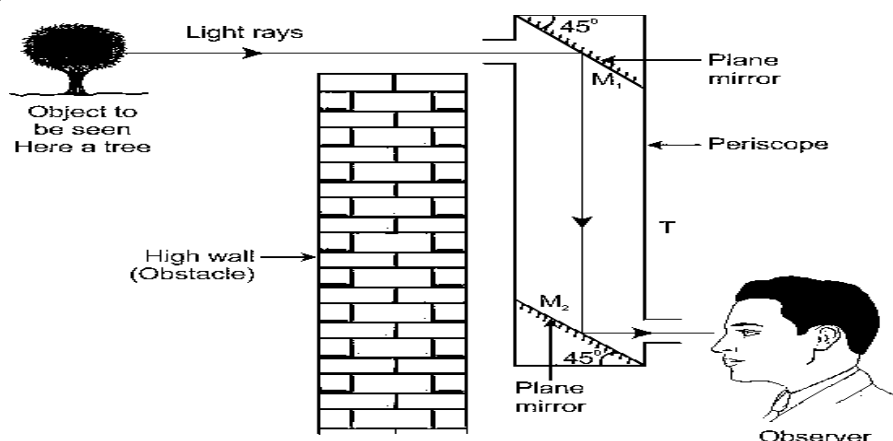
### Characteristics of images formed by plane mirrors

- The distance of the object from the mirror is the same as the distance of the image behind the mirror.
- The images are laterally inverted.
- The image is the same size as the object.
- The image is always upright / erect.
- The image is virtual i.e. cannot be cast on the screen.

### Use of plane mirrors

- a) They are used to see certain parts of the body that we cannot see directly.  
E.g. behind the head.
- b) They are used in periscopes.
- c) A periscope is an instrument which consists of a tube with two mirrors fixed inside facing each other and inclined at  $45^\circ$ .
- d) The mirrors are parallel to each other.
- e) A periscope is used to see around corners by soldiers in trenches and in submarines.

### Illustration



## Curved mirrors

- These are mirrors which are sphere like in shape.
- They obey the laws of reflection.
- The different types of curved mirrors are made by silvering on one side.

### Types of curved mirrors

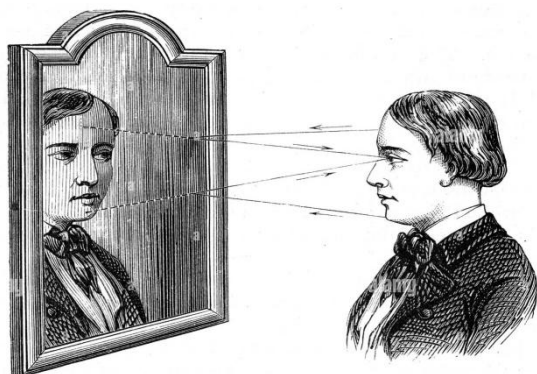
- There are two types of curved mirrors.

(i) Concave mirrors

(ii) Convex mirrors

#### (a) Concave mirrors (converging mirrors)

- It is made by silvering the outside of the sphere.



#### Characteristics of images formed by concave mirrors

1. The image is larger than the object (magnified).
2. They are erect (upright)
3. They are laterally inverted.
4. They are virtual (i.e. Formed behind the mirror so they cannot be cast on the screen)

#### Uses of concave mirrors

1. They are used by barbers as shaving mirrors.
2. They are used by dentists.
3. They are used in search lights, electric torches, head lamps as polished and silvered concave metals
4. They are also used in telescopes.

Telescopes have large concave mirrors, which assist in focusing beams of light from heavenly bodies. Telescopes help in studying about the stars and planets.

#### Convex mirrors (Diverging mirrors)

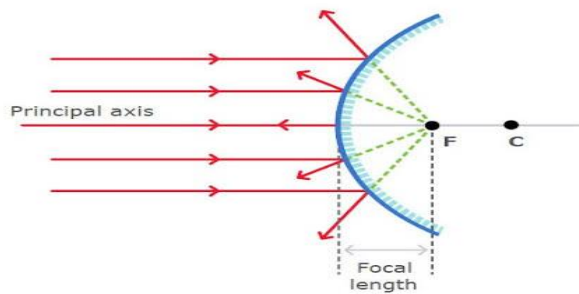
They are made by silvering the inside of the sphere.

#### Characteristic of images formed by convex mirrors

1. The image is smaller than the object – diminished.
2. The image is upright – erect.
3. The image is laterally inverted.
4. The image is virtual – behind the mirror.

## A beam of light on a convex mirror

Reflection of light on convex mirror



### Use of convex mirrors

- 1 They are used as a driving mirror on vehicles.
- 2 They form upright images.
- 3 They give a wide view of the distant object.
- 4 They are used in super markets to see what customer do.
- 5 Security mirrors in bus and cars.

### Activity

1. What is an image?  
\_\_\_\_\_  
\_\_\_\_\_
2. State **two** characteristics of images formed by plane mirrors.  
\_\_\_\_\_  
\_\_\_\_\_
3. Mention any **two** uses of plane mirrors.  
\_\_\_\_\_  
\_\_\_\_\_
4. State the difference between plane and curved mirrors.  
\_\_\_\_\_  
\_\_\_\_\_
5. Write down **two** types of curved mirrors.  
\_\_\_\_\_  
\_\_\_\_\_
6. Suggest **two** characteristics of images formed by concave mirrors.  
\_\_\_\_\_  
\_\_\_\_\_
7. Mention **two** importance of concave mirrors.  
\_\_\_\_\_  
\_\_\_\_\_
8. Write another name for convex mirrors.  
\_\_\_\_\_  
\_\_\_\_\_
9. Mention **two** characteristics of images formed by convex mirrors.  
\_\_\_\_\_  
\_\_\_\_\_
10. Outline any **two** uses of convex mirrors.  
\_\_\_\_\_  
\_\_\_\_\_

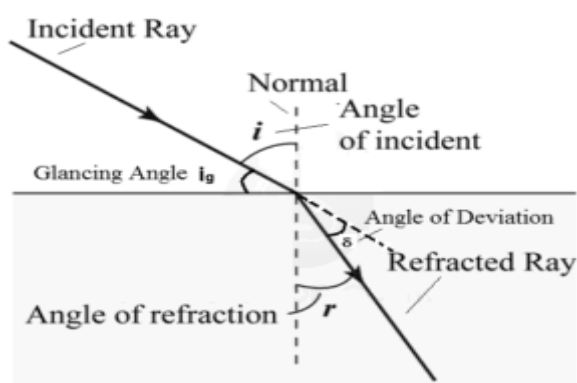
## Refraction of light

Refraction is the bending of light as it passes from one transparent medium to another.

### Examples of refraction of light

- ✓ From air to glass
- ✓ From air to water.
- ✓ From glass to water.

Refraction is caused by change in speed of light as it passes from one transparent medium into another which has different densities.



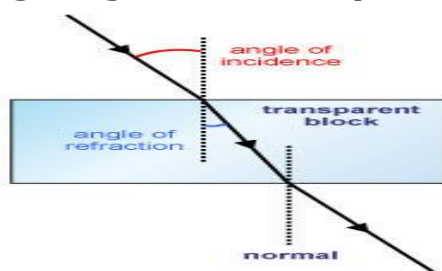
### Note

When a ray of light passes from one medium to a more optically dense medium, the ray bends towards the normal and vice versa is true.

### The laws of refraction

- ✓ The incident ray and the refracted ray are on opposite side of the normal.
- ✓ The incident ray, the refracted ray and the normal all live in the same plane.

### Refraction of light through a glass block / prism



### Effects of refraction

- ✓ A swimming pool appears shallower than its real depth because of refraction. This is seen by placing a stone in a glass, and then views it from the top.
- ✓ A ruler or stick partly dipped at an angle into some water in a glass appears bent or broken due to refraction.
- ✓ Refracted stick fixed vertically and partly dipped in water appears to be shorter than its real length.



- (i) A mirage is an optical illusion caused by the bending of light rays due to layers of air having different densities and temperature e.g. sheet of water seen on a high way during a hot day. It appears like a pool of water seen ahead on the road on a hot day.

### Effects of mirages

- Mirages may lead to accidents on high ways.
- Mirages cause false images along high ways in deserts.

- (ii) Words under a glass block appear to be raised on a different line from those away from the glass because of refraction.

### Activity

1. What is refraction of light?

---

---

2. Give **one** example of where refraction of light can be a disadvantage.

---

---

3. State any **two** examples of refraction of light

---

---

4. State the reason why ruler put in a cup full of water will appear bent.

---

---

5. What causes refraction?

---

---

6. State any **two** laws of refraction.

---

---

7. Mention any **two** effects of refraction.

---

---

8. State any **two** effects of mirages

---

---

## LENSES

A lens is a transparent material with curved side capable of refracting light. The curved surfaces of a lens help to bend or refract light passing through the lens.

### Types of lenses

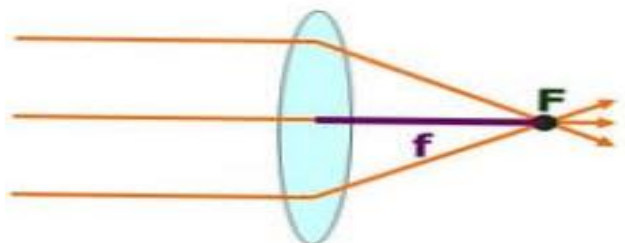
There are two types of lenses.

- (i) Convex lens.
- (ii) Concave lens.

Convex lens (converging lens)

Is a lens which is thicker in the middle and thinner at the edges.

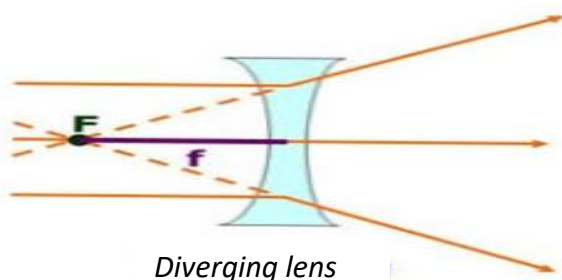
### Illustration



- When a parallel beam strikes a convex lens comes together at a point in front of the lens.

### Concave lens (diverging lens)

- This is a lens which is thinner in the middle and thicker at the edges.



**NB:** The converging meniscus and diverging meniscus are used in spectacles. When a parallel beam of light reaches the concave lens it spreads outwards after passing through the lens.

### Uses of lenses

1. Lenses are used in photographic cameras.
2. Lenses are used in microscopes used by doctors to see germs.
3. Lenses are used in spectacles worn by people with eye defects.
4. Lenses are used as magnifying glasses.



5. Lenses are used in projectors which focus information on film slides into big pictures on the screen.
6. Lenses are used in binoculars to see distant things in magnification. In general lenses are used in optical instrument.

### Optical instruments

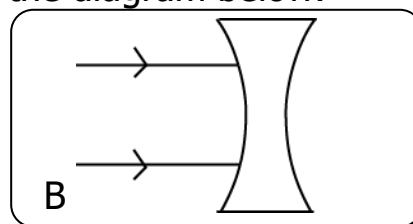
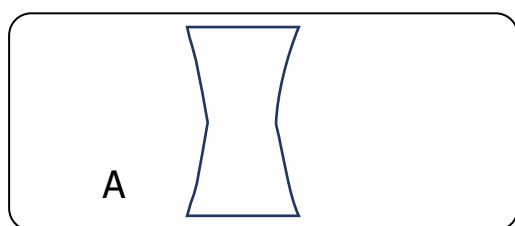
Optical instruments are instruments which use either lenses, prisms, plane mirrors or curved mirrors.

### Examples of optical instruments

1. Cameras
2. Microscopes
3. Spectacles
4. Magnifying glasses
5. Telescopes
6. Binoculars
7. Projectors

### Activity

1. Complete the rays through the lens in the diagram below.



2. Name **the** types of lenses marked A and B.

\_\_\_\_\_

3. How important is the curved surfaces of the lenses?

\_\_\_\_\_

4. Which type of a lens is thicker in the middle and thinner at the edges?

\_\_\_\_\_

5. Name the lens which is thinner in the middle and thicker at the edges.

\_\_\_\_\_

6. State any **two** uses of lenses

\_\_\_\_\_

7. Name the type of lens used in magnifying glasses.

\_\_\_\_\_

8. Why is a concave lens used to correct short sightedness?

\_\_\_\_\_

9. Give any **two** examples of optical instruments

---

10. What happens to light rays when they meet a convex lens?

---

11. Name the type of lens used to correct long sightedness.

---

12. In the space provided below, draw a lens used to correct short sightless.

13. How does the lens shown below affect light rays?

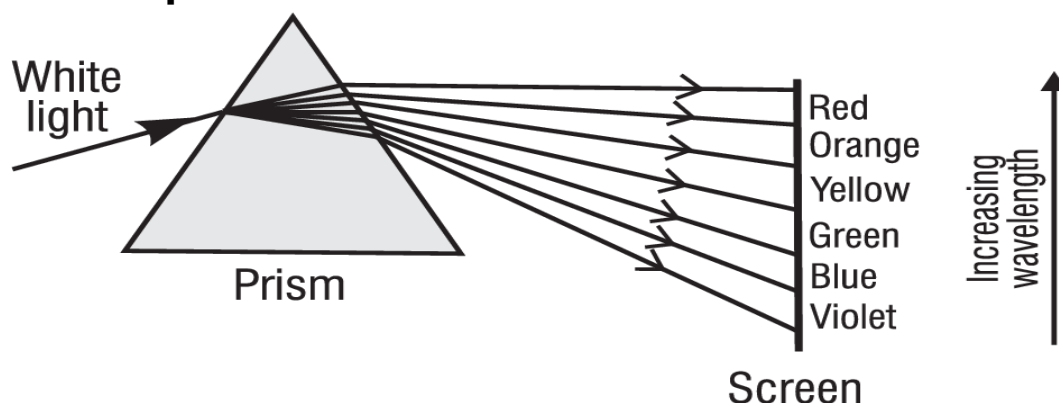
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### Dispersion of light

Dispersion of light is the splitting of white light into the seven colours of the spectrum.

- Dispersion of light is due to refraction of light.
- A spectrum is a band of seven distinct colours.
- A spectrum is formed when white light is split by the act of a prism.
- A prism is a device that splits white light into seven colours.
- An example of a natural light spectrum is a rainbow.

### Colours of the spectrum



### Primary colours and secondary colours

#### Primary colours

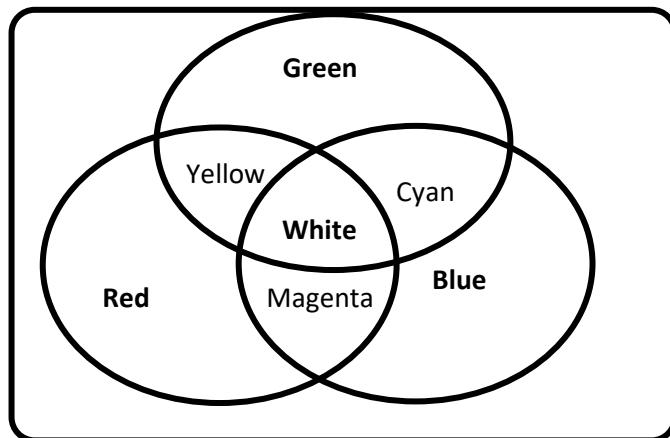
A primary colour is one that cannot be obtained by mixing other colours e.g. red, blue and green.

A secondary colour is colour made by mixing two primary colours e.g. yellow, magenta, peacock blue or cyan.

## How to make secondary colours

- Red + green = Yellow.
- Red + Magenta = white.
- Blue + yellow = Cyan or peacock blue.

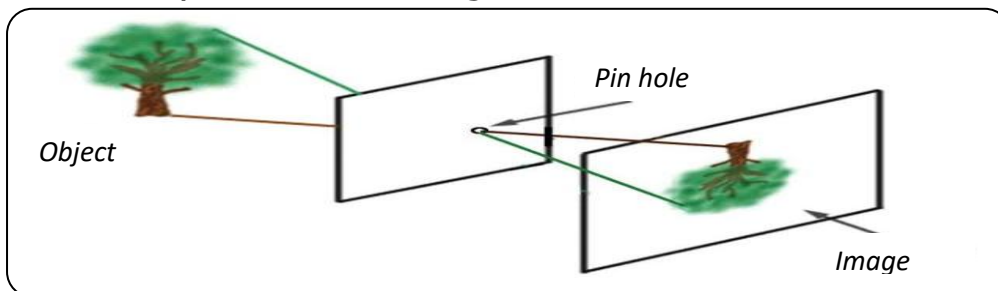
## Illustration of the formation of secondary colours



White is a universal colour.

## A pin hole camera

A pinhole camera works on the principle that light travels in straight lines. That is why an inverted image is formed on the screen.



## Characteristics of images formed by a pinhole camera

1. The image is diminished – smaller than the object.
2. The image is inverted – upside down.
3. The image is real i.e. it can be cast on the screen.

### Activity

1. What causes dispersion of light?

\_\_\_\_\_

2. Name the device that splits white light into seven colours.

\_\_\_\_\_

3. In which way are primary colours different from secondary colours?

\_\_\_\_\_

4. Name the secondary colour got by mixing:

Red + Green \_\_\_\_\_

Red + Magenta \_\_\_\_\_

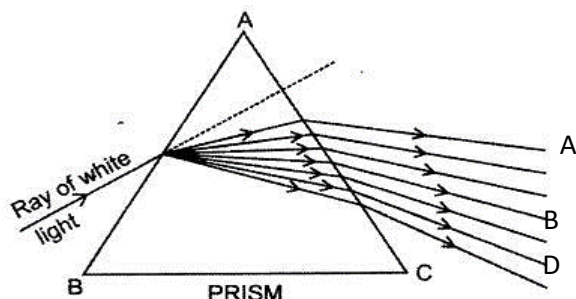
5. State the reason why white is referred to as the universal colour.

\_\_\_\_\_

6. State at least **two** characteristics of an image formed by a pin hole camera.

\_\_\_\_\_

**8. Use the diagram below to answer the questions that follow.**



(a) Name the optical instrument shown above.

\_\_\_\_\_

(b) Name the colors marked with letter

(i) A \_\_\_\_\_

(ii) B \_\_\_\_\_

(c) What type of color is:

(i) B \_\_\_\_\_

(ii) D \_\_\_\_\_

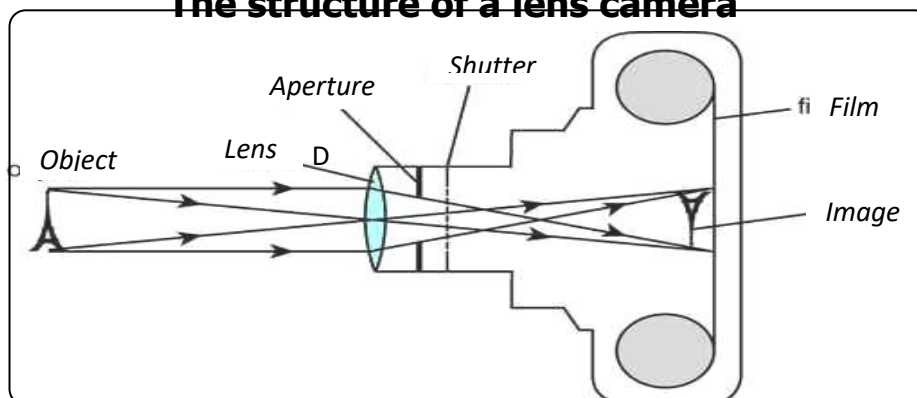
(d) Mention any other **two** colours in the same type with colour B

\_\_\_\_\_

### The lens camera:

- ✓ A camera is an optical instrument because it uses a convex lens.
- ✓ It consists of a light proof box with five functional parts. i.e. the lens, diaphragm, shutter, film and focusing ring.

#### The structure of a lens camera



### Functions of each part

#### ✓ The film

The film is a light sensitive piece of paper on which an inverted image is formed.

✓ **The diaphragm**

It regulates the amount of light energy that has been allowed into the lens. It has the aperture (a circular hole) which can be changed according to the amount of light required.

✓ **The lens**

The lens focuses the image on the film. The film works as a screen. The camera uses a convex lens.

✓ **The shutter**

The shutter uncovers the aperture for a fraction of a second thus admitting light into the camera. This exposes the film.

✓ **The focusing ring.**

This adjusts the distance of the lens from the film i.e. moving the lens forward or backward.

**How the camera works**

1. Light is allowed into the camera by the lens, diaphragm and shutter, it falls on the film and the film is exposed.
2. The exposed film is removed from the camera in a dark place and put a certain chemical to develop it. The result of developing is a negative.
3. It is called a negative because the bright parts of the object photographed appear dark and the dark parts appear bright.
4. The negative is printed to give a positive (photograph) which has the same shades as the object.

**Characteristics of images formed by a camera**

1. The images are real.
2. The images are inverted.
3. The images are diminished.

**Activity**

1. Why is a camera grouped under optical instrument?  
\_\_\_\_\_  
\_\_\_\_\_
2. Apart from camera and microscope, name any **one** other optical instrument that uses a lens.  
\_\_\_\_\_  
\_\_\_\_\_
3. How is the retina of human eye similar to the film of a camera?  
\_\_\_\_\_  
\_\_\_\_\_
4. Which part of camera regulates the amount of light energy entering the lens?  
\_\_\_\_\_  
\_\_\_\_\_

5. Name the type of lens used in a camera.

\_\_\_\_\_

6. Which part of a camera is used for moving the lens forward or backward?

\_\_\_\_\_

7. Which part of the eye functions like a film in a camera?

\_\_\_\_\_

8. State any **two** characteristics of images formed by a camera.

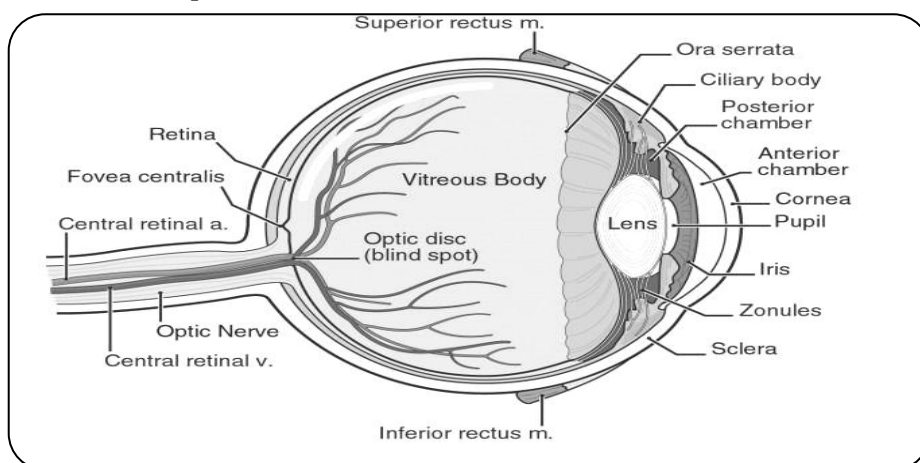
\_\_\_\_\_

## The Human Eye

The eye is an organ of sight.

It is spherical in shape and enclosed in a socket of the skull called the orbit.

### The structure of the eye



#### ✓ Retina.

- This layer contains light sensitive cells called rods and cones.
- Human being sees clearly during day because they have more cones than rods.
- Cones help in day light and colour light.
- Rods help in dim and night vision.
- It is on the retina when the images are formed.

#### ✓ Fovea (yellow spot)

- It has the highest concentration of cones.
- It gives accurate interpretation of the image and is where the sharpest image is formed.

#### ✓ Blind spot.

- This spot doesn't have any light sensitive cell.
- It is where the optic nerve leaves the eye and also where blood vessels and nerves join the optic nerves.

#### ✓ Lens

- Refracts light rays and focus the image on the retina.

✓ **Suspensory ligament**

- Holds the lens in position by attaching it to the ciliary body.

✓ **Aqueous and virtuous humour.**

- These are salt solutions, sugar solution and proteins in water.
- They refract light to produce an image on the retina.
- They help to maintain the shape of the eye.

✓ **The optic nerve**

- Transports nerve signals to the brain for interpretation.

✓ **Eyelashes.**

- They help to trap large air borne particles.

✓ **Tear glands.**

- They lie under the eyelids.
- They secrete a solution of sodium hydrogen carbonate and sodium chloride (Tear).
- They have an enzyme which kills bacteria.

**NB:**

The eye has the ability to focus near and far objects on the retina by changing the shape of the lens. This focusing of near and far objects by the lens is called accommodation.

**Activity**

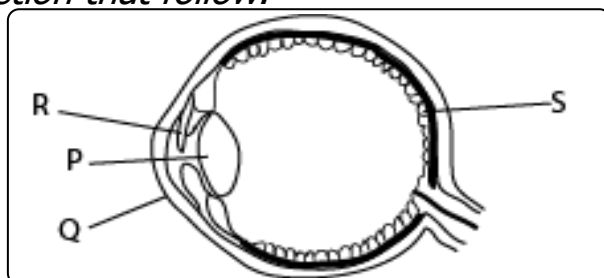
**1. The table below shows part of human eye in A and that of a lens camera in B.**

<b>A</b>	<b>B</b>
Iris	Shutter
Pupil	Film
Eye lid	Diaphragm
Retina	Aperture

For each of the parts of the human eye, write the part of the lens camera from B which performs a similar function.

- (a) Iris .....
- (b) Pupil .....
- (c) Eye lid .....
- (d) Retina.....

**2. The diagram below shows a human eye. Study it and use it to answer question that follow.**



(a) Name the part marked:

(i) P \_\_\_\_\_

(ii) Q \_\_\_\_\_

(c) What is the function of the part marked R?

\_\_\_\_\_

3. Name the part of skeleton which protects the eyes

\_\_\_\_\_

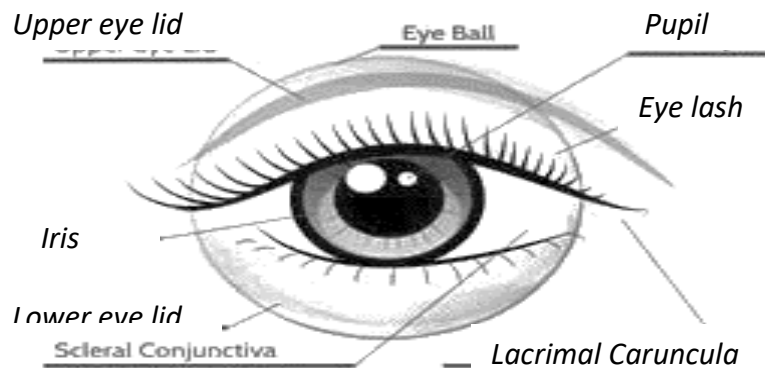
4. Name the sense organ for sight.

\_\_\_\_\_

5. Name the part of the eye where images are formed.

\_\_\_\_\_

### Front view of the eye



### Functions of parts of the eye

#### 1. The eyelids.

- ✓ They cover and protect the eye.
- ✓ Blinking can be voluntary or by reflex action.
- ✓ Blinking distributes a fluid (tears) over the surface of the eye to prevent it from drying.
- ✓ Tears clean up the eye and kill some germs which enter the eye.

#### 2. Conjunctiva.

- Is a thin layer which lies inside the eyelid.
- It is kept moist and clean by a slow continuous stream of liquid from the tear glands.

#### 3. Sclerotic.

- It is a tough non-elastic coat around the eyeball.
- It supports and maintains the shape of the eyeball.

#### 4. Cornea.

- It is a transparent part of the sclerotic. It helps to refract and converge light.

#### 5. Choroid



- ✓ It has a dense network of blood capillaries supplying food and oxygen to the eye.
- ✓ It is pigmented black to reduce internal reflection of light within the eye.

## 6. Iris

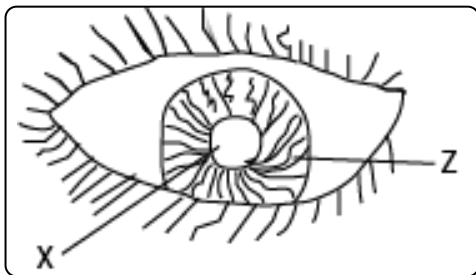
It regulates the size of the pupil and controls the amount of light entering the eye.

It also determines the colour of the eye.

**Pupil.** Admits light into the eye.

### Activity

The diagram below is of a human eye. Use it to answer question 1 and 2.



1. Name the part marked with letter X

\_\_\_\_\_

2. Give the use of the part marked with letter Z.

\_\_\_\_\_

1. Name the part that cover and protect the eyes.

\_\_\_\_\_

2. Apart from cleaning up eyes, mention any **one** other importance of tears in the eyes.

\_\_\_\_\_

3. What name is given to the thin layer which lies inside the eyelid?

\_\_\_\_\_

4. Mention **two** importance of iris to the eyes.

\_\_\_\_\_

**In the space below, draw a structure of a human eye and name the following parts**

- The eyelids.
- Cornea.
- Choroid
- Iris

## Characteristics of images formed by the eyes

1. The images are real.
2. The images are inverted.
3. The images are diminished.

## Similarities between the eye and camera

The human eye	The photographic camera
<ol style="list-style-type: none"><li>1. Image falls on the light sensitive retina</li><li>2. Has a convex lens.</li><li>3. It is covered by a black layer choroid.</li><li>4. Iris controls the amount of light by regulating the size of the pupil.</li><li>5. The image is real, inverted and diminished.</li><li>6. The eyelids keep out light.</li><li>7. The ciliary muscles determine accommodation of the lens.</li></ol>	<ol style="list-style-type: none"><li>1. Image falls on a light sensitive film.</li><li>2. Has a convex lens.</li><li>3. It is covered by a light proof box.</li><li>4. The diaphragm controls the amount of light by regulating the size of the aperture.</li><li>5. The image is real, inverted and diminished.</li><li>6. The shutter keeps out light.</li><li>7. Focusing ring determines the distance of the lens from the film.</li></ol>

## Difference between a human eye and camera

The human eye	The photographic camera
<ol style="list-style-type: none"><li>1. Distance between the lens and retina is fixed.</li><li>2. Shape of lens can easily change to focus at different distances.</li><li>3. Lens is soft and elastic.</li><li>4. Image is focused by making lens thicker.</li><li>5. Aqueous and vitreous humor refracts light.</li><li>6. The iris adjusts itself.</li></ol>	<ol style="list-style-type: none"><li>1. The distance between the lens and film changes.</li><li>2. The shape of the lens does not change.</li><li>3. The lens is hard.</li><li>4. The image is focused by moving lens.</li><li>5. Only the lenses refract light.</li><li>6. The diaphragm can be adjusted.</li></ol>

## Activity

1. Name the type of lens found in both the human eyes and the photographic camera.  
\_\_\_\_\_  
\_\_\_\_\_
2. Mention **two** similarities between human eyes and photographic camera.

- 
- 
3. Mention **two** characteristics of images formed by the eyes.
  4. Write down **two** similarities between human eyes and photographic camera.
  5. In which way does the diaphragm control the amount of light entering in the camera?
  6. Name the part of a human eye which plays the same role as shutter of camera.
- 
- 

### Eye defects

It is the inability for an eye to focus certain distance normally.

#### Cause

- The eye ball being too long or eye lens being too thick.
- This causes the image from distant objects be brought to focus in front of the retina.
- Short sightedness can be corrected by wearing spectacles with diverging lens (concave lenses).

#### Eye strain

1. Abnormal shape of the eye ball.
2. Abnormal shape of the lens.
3. Colour blindness.

### Examples of eye defects

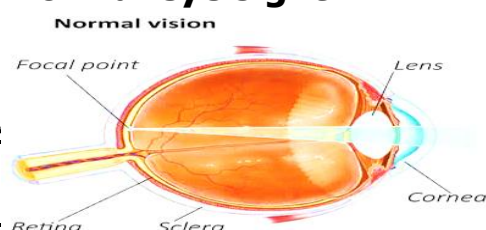
There are four eye defects in common in humans namely.

- a) Short sightedness (myopia)
- b) Long sightedness (hypermetropia)
- c) Old age sight (presbyopia)
- d) Astigmatism.

### Short sightedness

Short sightedness is a condition when a person can only see near objects clearly but cannot see distant objects.

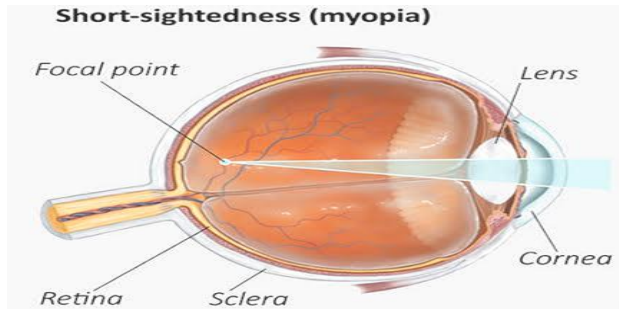
### Normal eye sight



Both near and distant objects can be focused on the yellow spot on the retina.

## Short sightedness (myopia)

This occurs when the eye ball is longer than the normal or when the lens is too thick and the objects close to the eye can be focused properly but the point of focus for distant objects is In front of the retina.



## Correction of short sightedness

Short sightedness is corrected by wearing spectacles with diverging lenses (concave lenses).

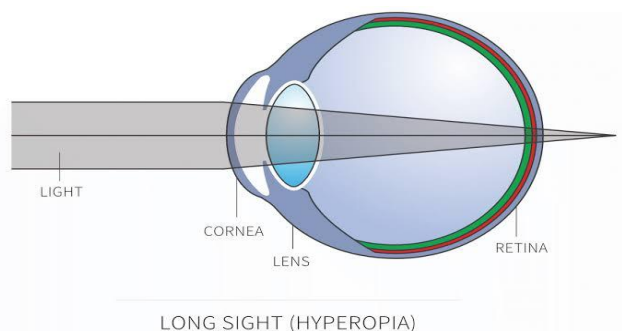
## Long sightedness:

Long sight is a condition when certain people can see distant objects clearly but cannot see nearby objects.

Small or short eye ball or too thin eye lens.

The above causes the image from close objects be brought to focus behind the retina.

## Illustration



This occurs when the eyeball is shorter than the normal or when the eyeball is small or the lens is too thin.

Distance objects can be focused properly but the point of focus for close objects is behind the retina.

## Correction of long sightedness

Long sightedness is corrected by wearing spectacles with convex lenses.

## Old age sight (presbyopia)

When the lens loses its elasticity it can no longer change in shape.

It becomes suitable for only distant vision (long sight). Old age sight people usually require reading glasses which have converging lenses. This happens in old age above sixty years.

## Astigmatism

It is the most common of all eye defects.

It is caused by the surface of the cornea not being perfectly smooth or spherical.

This result is blurred vision.

Astigmatism is corrected by wearing spectacles with cylindrical lenses.

### Activity

1. What term is used to mean the inability for an eye to focus certain distance normally?  
\_\_\_\_\_  
\_\_\_\_\_
2. What do you understand by the word short sightedness?  
\_\_\_\_\_  
\_\_\_\_\_
3. Why are some people able to see only near objects clearly but cannot see distant objects?  
\_\_\_\_\_  
\_\_\_\_\_
4. State any **one** way of correcting short sightedness.  
\_\_\_\_\_  
\_\_\_\_\_
5. Name the type of lens used in the wearing spectacles for correcting short sightedness.  
\_\_\_\_\_  
\_\_\_\_\_
6. What name is given to a condition when certain people can see distant objects clearly but cannot see nearby objects?  
\_\_\_\_\_  
\_\_\_\_\_
7. Why are long sightedness corrected by wearing spectacles with convex lenses instead of concave lenses?  
\_\_\_\_\_  
\_\_\_\_\_

8. What is astigmatism?

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9. How can the above eye defect be corrected?

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## **DISEASES OF THE EYE**

### **Conjunctivitis**

- It causes the swelling of conjunctiva.
- It is caused by Gonorrhoea.

#### **There are three types of conjunctivitis.**

1. Acute conjunctivitis.
2. Chronic conjunctivitis.
3. Gonorrhoea conjunctivitis.

### **Signs of conjunctivitis**

1. The white part of eye becomes pink.
2. Watery discharge from the eyelid with mucus and pus.
3. Scratching and burning sensation in the eyelid.
4. Looking at light cause pain.

### **Trachoma**

Caused by bacteria

- It is highly contagious and infectious disease.
- It is common in places with poor hygiene and overcrowding where water is scarce and people don't wash hands and their eyes.

#### **How trachoma spread**

- 1 By houseflies.
- 2 Sharing hands with an infected person.
- 3 Sharing of the same basin with an infected person.
- 4 Shaking hands with another infected person.

### **Signs and symptoms**

- 1 Redness and itching on the eye.
- 2 Watery discharge from the eyelids.
- 3 Swelling of the eyelids.
- 4 Pain while looking at light.

### **River blindness**

- It is caused by a tiny filaria worm (onchocerca vulvulus).
- It is carried by a small hump known as a black fly or simulium fly.
- This fly breeds in fast flowing rivers.

### **Signs and symptoms**

- Itching skin rashes.
- Severe skin itching.

### Prevention and control

- Spraying using insecticides against the adult fly.
- Treatment of the infected person.

### Activity

1. State any **one** eye disease which is spread by houseflies.  
\_\_\_\_\_
2. Name the eye infection which causes blindness in young children.  
\_\_\_\_\_
3. State **three** types of conjunctivitis.  
\_\_\_\_\_
4. Suggest **two** signs of conjunctivitis in children.  
\_\_\_\_\_
5. Name the germ which causes trachoma.  
\_\_\_\_\_
6. State **two** ways in which trachoma is spread  
\_\_\_\_\_
7. Mention **two** signs and symptoms of trachoma.  
\_\_\_\_\_
8. Name the eye infection caused by a tiny filaria worm.  
\_\_\_\_\_
9. Mention **two** signs and symptoms of the above infection.  
\_\_\_\_\_
10. State **two** ways of preventing and controlling the above infection.  
\_\_\_\_\_

### Other diseases which affect eyes

#### Blepharitis

- This is an inflammation of the margin of the eyelid.
- The eyes itch, burn and swell.

#### Cataracts

- This is when the lens of the eye becomes grey and opaque.
- They are caused by an injury or continued exposure of the eye to high temperature.

## **Glaucoma**

- Caused by increased internal pressure of fluids.
- It can come about by itself or progress from another disease.

## **Iritis**

The swelling caused by other diseases or injury to eye

## **Eye Sty**

- This is a small inflammation on the eyelid. It looks like a small boil.
- It is usually a sign of poor general health, anemia or diabetes.

## **Corneal ulcer**

It is caused by an injury to the cornea.

## **Night blindness**

It is also known as Nyctalopia.

Night blindness is caused by the near sightedness or lack of vitamin A in the body.

## **Symptoms of night blindness**

Headache

Red eye

## **Care of the eye.**

- Don't rub your eyes with dirty fingers.
- Don't strain your eyes by reading;
  - a) Very small prints with too little or direct sunlight.
  - b) In moving vehicles.
  - c) In wrong postures like in bed.
- Don't expose your eyes to very bright or glaring light.
- Always wash your eye with clean water and soap, every morning and evening.
- Never look directly at the sun; it may spoil your retina.
- If there is anything wrong with your eyes visit an eye specialist.
- When reading use a correct distance of about 30cm.
- Don't share towels or clothes with people who have sick eyes.

## **Activity**

1. What term is used to mean the inflammation of the margin of the eyelid?

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2. Name the disease that causes the lens of the eye to become grey and opaque.

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3. Name the deficiency disease that affects the human eye.

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4. Which eye problem is caused by the above deficiency disease?

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5. Name the eye problem caused by an injury to the cornea.

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6. State **two** characteristics of images formed by the eye.

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7. Name the eye defect which is caused by:

a) An elongated eyeball and a too thick lens.

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b) A short eyeball and a too thin lens.

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8. Give any **two** diseases that affect the human eye.

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9. State any **two** ways you would care for your eyes.

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