

# Teacher Energized Resource Manual

**Class : 10<sup>th</sup>**  
**Subject : Science**



CENTRAL BOARD OF SECONDARY EDUCATION

## Preface

In consonance with the move towards outcome-based education where focus is on developing competencies in students, the Central Board of Secondary Education is delighted to share the *Teacher Energized Resource Manual* that will aid teachers in aligning their classroom transaction to a competency framework.

Each chapter of the Resource Manual corresponds to the respective chapters in the NCERT textbooks. The chapters have been chunked by concept; these concepts have been linked to the NCERT Learning Outcomes; and an attempt has been made to delineate Learning Objectives for each concept. Every chapter has a set of assessment items, where two items have been provided as examples for each Learning Objective. Teachers can use these to assess if the learner has acquired the related concept. Needless to say, the items are illustrative examples to demonstrate how competency-based items can be prepared to measure Learning Objectives and Outcomes. The variety in item forms is suggestive of the ways in which a particular concept can be assessed to identify if the learner has attained different competencies. We trust and hope that teachers would be able to generate many more similar test items for use in practice.

Your observations, insights and comments as you use this Resource Manual are welcome. Please encourage your students to voice their suggestions as well. These inputs would be helpful to improve this Manual as these are incorporated in the subsequent editions. All possible efforts have been made to remove technical errors and present the Manual in a form that the teachers would find it easy and comfortable to use.

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## HOW TO USE THIS MANUAL

The goal of the Teacher Energized Resource Manual (TERM) is to provide teachers with competency-based education resources aligned to NCERT textbooks that would support them in the attainment of desired Learning Outcomes and development of requisite competencies of the learner. The TERM has equal number of corresponding chapters as NCERT Textbooks with listing of concepts, Learning Outcomes developed by NCERT and Learning Objectives. Competency based test items for each corresponding Learning Objective and sample activities for enrichment have been provided.

### **Learning Objectives:**

Each chapter begins has a *Learning Objectives* table. The table lists the concept covered in the chapter. Learning Objectives are broken down competencies that a learner would have acquired by the end of the chapter. They are a combination of skills and what the learner would use this skill for. For example, the first Learning Objective in the table below relates to the skill of *analysis* and the students will use this competency to identify ingredients in different food items. Teachers can use these specific Learning Objectives to identify if a student has acquired the associated skills and understands how that skill can be used.

| Content area/<br>Concepts | Learning Objectives  |
|---------------------------|--|
| Food variety              | Analyse common food items in order to identify various ingredients for their preparation |
| Food material and sources | Identify the sources of ingredients used to prepare food items                           |

### **Content Area/ Concepts:**

The important concepts and sub-concepts covered in a particular chapter are listed in the first section. Most often, they follow a logical order and present a sequence in which these are likely to be covered while teaching. In case, your teaching strategy is different and presents them in a different order, you need not worry. Teach the way, you consider the best. You only need to ensure their understanding and the attainment of desired Learning Objectives.

### **Learning Outcomes (NCERT):**

NCERT Learning Outcomes are in each chapter along with delineated Learning Objectives. As shown below, each Learning Objective is mapped to NCERT Learning Outcomes and helps teachers to easily identify the larger

outcome that a child must be able to demonstrate at the end of the class/chapter.

As the NCERT LOs are generic, they may relate to many content areas / concepts together. However in the mapped table, they have been reproduced ad verbatim for easy identification.

| Learning Objectives  | Learning Outcomes   |
|--|---|
| Compare the advantages of three major tools used for tilling and ploughing to justify the variety of agricultural practices    | Differentiates materials and organisms, such as, natural and human made fibres; contact and non-contact forces; liquids as electrical conductors and insulators; plant and animal cells; viviparous and oviparous animals, on the basis of their properties, structure and functions. |
| Analyse the quality of seeds with respect to their germinability   |   |
| Compare the advantages of two major tools used for sowing to justify the variety of agricultural practices used in the country |   |
| Distinguish between manure and fertilisers to identify ways in which nutrients in soil is replenished                          |   |
| Evaluate how weeds adversely affects the growth of the plants in order to justify their removal and control                    |   |

### **Test items:**

For each Learning Objective, at least two competency-based test items have been provided. Although, the items in this resource manual are multiple choice questions, which assess developed competencies of a child rather than only knowledge, it must be kept in mind that there can be different kinds of test items that can easily align with competency-based education. Teachers can use these items to assess if a child has achieved a particular learning objective and can take necessary supportive actions. Teachers are also encouraged to form similar questions which assess skills of students.

**LOB:** Recall details/definitions specific to autotrophic mode of nutrition in plants/photosynthesis/detection of photosynthetic activity of plants/nutrients other than carbohydrates, in plants

- 1) Which option correctly lists the nutrients other than carbohydrates, in plants?
- Water, fibres, minerals
  - Fat, proteins, vitamins
  - Fibres, vitamins, water
  - Flavouring agents, water, vitamins

**Correct Answer:**(b)

### **Suggested Teacher Resources**

At the end of each chapter, certain activities have been suggested which can be carried out by the teachers with learners to explain a concept. These are only samples and teachers can use, adapt, as well as, create activities that align to a given concept.

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# 1. Chemical Reactions and Equations

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts   | Learning Objectives   |
|-----------------------------|---|
| Introduction                | Compare the characteristics of initial & final substances in order to check whether the change is physical or chemical.   |
| Chemical Equations          | Relate the substances taking part in the chemical reaction & substances formed in the chemical reaction in order to classify them as reactants & products.                    |
|                             | Use chemical symbols & chemical formulae correctly in order to acquire the skill of writing chemical equations.   |
|                             | Apply Law of Conservation of Mass in order to balance chemical equations.   |
| Types of Chemical Reactions | Categorize the given reactions as (combination/ decomposition) based on the reactants & products of a chemical reaction.  |
|                             | Classify the given reaction as displacement or double displacement based on the type of reactants used & products formed.   |
|                             | Predict the reaction as Oxidation or Reduction based on the addition/ removal of oxygen/ hydrogen/ electrons to the reactants to form products.                               |
| Effects of Oxidation        | Observe colour change in iron, copper and silver articles over time in order to outline the effects of corrosion in our surroundings (real life situations, stating any two). |
| Rancidity                   | Detect changes in smell, colour, taste of food items overtime, in order to explain effects of oxidation on food items   |



**Learning Objectives and Learning Outcomes:**

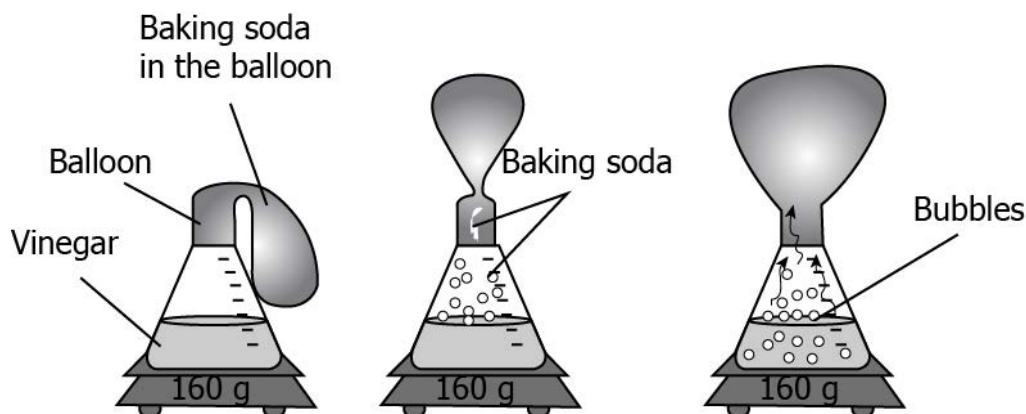
| Learning Objectives   | Learning Outcome  |
|---|---|
| Compare the characteristics of initial & final substances in order to check whether the change is physical or chemical.   | Draws conclusion, such as traits / features are inherited through genes present on chromosomes, a new species originates through evolutionary processes, water is made up of hydrogen and oxygen, properties of elements vary periodically along the groups and periods in periodic table, potential difference across a metal conductor is proportional to the electric current through it, etc.   |
| Relate the substances taking part in the chemical reaction & substances formed in the chemical reaction in order to classify them as reactants & products.                    | Uses scientific conventions to represent units of various quantities / symbols / formulae / equations, such as balanced chemical equation by using symbols and physical states of substances, sign convention in optics, si units, etc.   |
| Use chemical symbols & chemical formulae correctly in order to acquire the skill of writing chemical equations.   | Calculates using the data given, such as number of atoms in reactants and products to balance a chemical equation, resistance of a system of resistors, power of a lens, electric power, etc.   |
| Apply Law of Conservation of Mass in order to balance chemical equations.   |   |
| Categorize the given reactions as (combination / decomposition) based on the reactants & products of a chemical reaction.   | Differentiates materials / objects / organisms / phenomena / processes, based on, properties / characteristics, such as autotrophic and heterotrophic nutrition, biodegradable and non- biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.   |
| Classify the given reaction as displacement or double displacement based on the type of reactants used & products formed.   |   |
| Predict the reaction as Oxidation or Reduction based on the addition/ removal of oxygen/ hydrogen/ electrons to the reactants to form products.                               |   |
| Observe colour change in iron, copper and silver articles over time in order to outline the effects of corrosion in our surroundings (real life situations, stating any two). | Applies scientific concepts in daily life and solving problems, such as takes precautions to prevent sexually transmitted infections, uses appropriate electrical plugs (5 /15a) for different electrical devices, uses vegetative propagation to develop saplings in gardening, performs exercise to keep in good health, avoids using appliances responsible for ozone layer depletion, applies concept of decomposition reaction of baking soda to make spongy cakes, etc. |
| Detect changes in smell, colour, taste of food items overtime, in order to explain effects of oxidation on food items   |   |

# Test items



**LOB:** Compare the characteristics of initial & final substances in order to check whether the change is physical or chemical

- 1) A student poured 100 mL of water in a bottle and added 40 mL vinegar to it. A balloon was filled with 20 g baking soda and was fixed at the mouth of the bottle. Slowly the shape of the balloon changed, as shown.



The student claims that a chemical change happened when the two substances were mixed. Is the claim made by the student correct?

- (a) Yes, as a new substance was formed in the form of a gas.
- (b) Yes, as the mass remains the same throughout the experiment.
- (c) No, as the formation of bubbles in the mixture shows a physical change.
- (d) No, as the change in the shape and size of the balloon shows a physical change.

**Correct Answer:** Option (a)

- 2) A student makes a list of some activities he observes one day.

1. baking a cake in an oven
2. cutting an apple pie into slices
3. crushing the can after drinking a soda
4. carving a wooden log to make a stand

Which activity can the student classify as a chemical change?

- (a) Activity 1, as the properties of the substances in the mixture change.
- (b) Activity 2, as the physical state of the apple pie changes when cut.
- (c) Activity 3, as the shape of the can changes.
- (d) Activity 4, as the shape and size of the wooden log changes.

**Correct Answer:** Option (a)

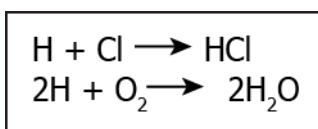
**LOB:** Relate the substances taking part in the chemical reaction & substances formed in the chemical reaction in order to classify them as reactants & products

1) Sodium and chlorine are reacted and as a result, sodium chloride is formed which is also called table salt. What option gives the reactants and products of the reaction?

- (a) reactants-sodium; products- chlorine
- (b) reactants-sodium and table salt; products- chlorine
- (c) reactants-tables salt; products- sodium and chlorine
- (d) reactants-sodium and chlorine; products- sodium chloride

**Correct Answer:** Option (d)

2) The image shows some chemical reactions.



Which option identifies the reactants and products of the reactions?

(a)

| Reactants     | Products                                |
|---------------|---|
| H, Cl and HCl | 2H, O <sub>2</sub> and H <sub>2</sub> O |

(b)

| Reactants                 | Products                     |
|---------------------------|------------------------------|
| HCl and 2H <sub>2</sub> O | H, Cl, 2H and O <sub>2</sub> |

(c)

| Reactants                    | Products                  |
|------------------------------|---------------------------|
| H, Cl, 2H and O <sub>2</sub> | HCl and 2H <sub>2</sub> O |

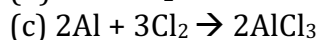
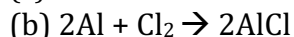
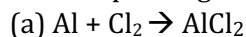
(d)

| Reactants                               | Products      |
|---|---------------|
| 2H, O <sub>2</sub> and H <sub>2</sub> O | H, Cl and HCl |

**Correct Answer:** Option (c)

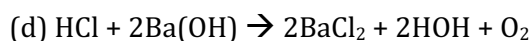
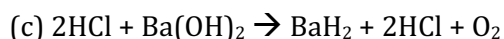
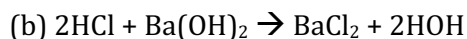
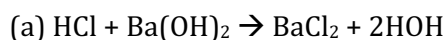
**LOB:** Use chemical symbols & chemical formulae correctly in order to acquire the skill of writing chemical equations

- 1) A student performs an experiment to form aluminium chloride from aluminium and chlorine. Which options gives the chemical equation of the reaction?



**Correct Answer:** Option (c)

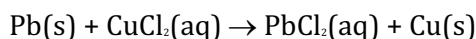
- 2) A researcher adds barium hydroxide to hydrochloric acid to form a white-colored barium chloride. Which option gives the balanced chemical equation of the reaction?



**Correct Answer:** Option (b)

**LOB:** Apply Law of Conservation of Mass in order to balance chemical equations

- 1) A student writes a balanced chemical equation.



Which option gives the number of elements on the LHS and RHS of the chemical equation?

(a)

| Element | Number of Atoms in Reactants (LHS) | Number of Atoms in Reactants (RHS) |
|---------|------------------------------------|------------------------------------|
| Pb      | 1                                  | 1                                  |
| Cu      | 1                                  | 1                                  |
| Cl      | 1/2                                | 1/2                                |

(b)

| Element | Number of Atoms in Reactants (LHS) | Number of Atoms in Reactants (RHS) |
|---------|------------------------------------|------------------------------------|
| Pb      | 1                                  | 1                                  |
| Cu      | 1                                  | 1                                  |
| Cl      | 1                                  | 1                                  |

(c)

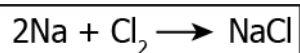
| Element | Number of Atoms in Reactants (LHS) | Number of Atoms in Reactants (RHS) |
|---------|------------------------------------|------------------------------------|
| Pb      | 1                                  | 1                                  |
| Cu      | 1/2                                | 1/2                                |
| Cl      | 2                                  | 2                                  |

(d)

| Element | Number of Atoms in Reactants (LHS) | Number of Atoms in Reactants (RHS) |
|---------|------------------------------------|------------------------------------|
| Pb      | 1                                  | 1                                  |
| Cu      | 1                                  | 1                                  |
| Cl      | 2                                  | 2                                  |

**Correct Answer:** Option (d)

- 2) The image shows a balanced chemical equation of the reaction between sodium and chlorine to form sodium chloride.



Which option shows the number of atoms on both sides of the reaction?

(a)

| Element | Number of Atoms in Reactants (LHS) | Number of Atoms in Reactants (RHS) |
|---------|------------------------------------|------------------------------------|
| Na      | 2                                  | 2                                  |
| Cl      | 1/2                                | 1/2                                |

(b)

| Element | Number of Atoms in Reactants (LHS) | Number of Atoms in Reactants (RHS) |
|---------|------------------------------------|------------------------------------|
| Na      | 2                                  | 2                                  |
| Cl      | 2                                  | 2                                  |

(c)

| Element | Number of Atoms in Reactants (LHS) | Number of Atoms in Reactants (RHS) |
|---------|------------------------------------|------------------------------------|
| Na      | 2                                  | 2                                  |
| Cl      | 1                                  | 1                                  |

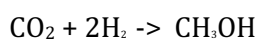
(d)

| Element | Number of Atoms in Reactants (LHS) | Number of Atoms in Reactants (RHS) |
|---------|------------------------------------|------------------------------------|
| Na      | 1                                  | 1                                  |
| Cl      | 2                                  | 2                                  |

**Correct Answer:** Option (b)

**LOB:** Categorize the given reactions as (combination/ decomposition) based on the reactants & products of a chemical reaction

- 1) A student writes a chemical equation of the reaction between carbon monoxide and hydrogen.

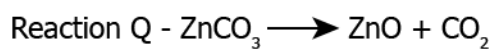
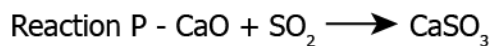


How can the reaction be classified?

- (a) The reaction is an example of a combination reaction as a compound separates into two compounds.
- (b) The reaction is an example of a decomposition reaction as a compound dissociates into two compounds.
- (c) The reaction is an example of a combination reaction as two compounds react to form a single compound.
- (d) The reaction is an example of a decomposition reaction as two compounds react to form a single compound.

**Correct Answer:** Option (c)

- 2) A student learns that some products are formed as a result of combining two compounds while some compounds are formed as a result of dissociation of two compounds. The image shows two reactions.



Which reaction is an example of a combination reaction and a decomposition reaction?

- (a) both the reactions are examples of combination reaction
- (b) both the reactions are examples of a decomposition reaction
- (c) reaction P is an example of a combination reaction while reaction Q is an example of a decomposition reaction
- (d) P is an example of a decomposition reaction while reaction Q is an example of a combination reaction

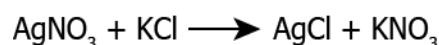
**Correct Answer:** Option (c)

**LOB:** Classify the given reaction as displacement or double displacement based on the type of reactants used & products formed

- 1) A student adds lead and silver to two different test tubes containing an equal amount of copper sulphate solution. The student observes that the color of the solution in the test tube with lead changes. What explains the change in the colour of the solution?
- (a) A displacement reaction takes place as lead replaces copper from the solution.
  - (b) A combination reaction takes place as lead combines with sulphate in the solution.
  - (c) decomposition reaction takes place as copper dissociates from sulphate in the solution.
  - (d) A double displacement reaction takes place as copper dissociates from sulphate and lead combines with sulphate in the solution.

**Correct Answer:** Option (a)

- 2) The chemical reaction between potassium chloride and silver nitrate is given by the chemical equation.



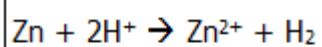
What can be inferred from the chemical equation?

- (a) silver nitrate and potassium undergo a decomposition reaction to form silver chloride and potassium nitrate
- (b) silver nitrate and potassium undergo a displacement reaction to form silver chloride and potassium nitrate
- (c) silver nitrate and potassium undergo a combination reaction to form silver chloride and potassium nitrate
- (d) silver nitrate and potassium undergo double displacement reaction to form silver chloride and potassium nitrate

**Correct Answer:** Option (d)

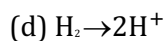
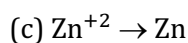
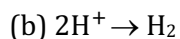
**LOB:** Predict the reaction as Oxidation or Reduction based on the addition/ removal of oxygen/ hydrogen/ electrons to the reactants to form products.

- 1) The image shows a reaction between zinc and hydrogen.

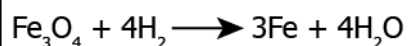


Which option shows oxidation?

- (a)  $\text{Zn} \rightarrow \text{Zn}^{+2}$

**Correct Answer:** Option (a)

2) The image shows a reaction between iron oxide and hydrogen.



Which option shows the compounds undergoing oxidation and reduction?

(a)

| Oxidation     | Reduction    |
|---------------|--------------|
| $4\text{H}_2$ | $3\text{Fe}$ |

(b)

| Oxidation    | Reduction     |
|--------------|---------------|
| $3\text{Fe}$ | $4\text{H}_2$ |

(c)

| Oxidation               | Reduction             |
|-------------------------|-----------------------|
| $\text{Fe}_3\text{O}_4$ | $4\text{H}_2\text{O}$ |

(d)

| Oxidation             | Reduction               |
|-----------------------|-------------------------|
| $4\text{H}_2\text{O}$ | $\text{Fe}_3\text{O}_4$ |

**Correct Answer:** Option (a)**LOB:** Observe colour change in iron, copper and silver articles over time in order to outline the effects of corrosion in our surroundings (real life situations, stating any two)

- 1) A student notices that a new hammer made of iron is shiny while an old one kept in the toolbox for long has a reddish-brown powder deposit over it. What does the change in colour of the hammer indicate?
- effect of moisture on metals
  - iron hammer turns brown after some time
  - effects of kept in a box for a longer duration
  - iron changes colour when kept with other tools

**Correct Answer:** Option (a)

- 2) A student notices that her silver jewellery turned dull and had a gray-black film over it after wearing for a few months. What results in the change in colour of the silver metal?
- dust deposits over the jewellery which changes its colour



- (b) the jewellery comes in contact with air, moisture, and acids and corrodes
- (c) the polish over the jewellery was removed after wearing for a few months
- (d) silver breaks due to wear and tear and turns its colour changes due to rusting

**Correct Answer:** Option (b)

**LOB:** Detect changes in smell, colour, taste of food items overtime, in order to explain effects of oxidation on food items

- 1) A student learns that food companies fill bags of chips with nitrogen gas. What is the purpose packing it with nitrogen?
- (a) it prevents rancidity of chips
  - (b) it keeps the mosquitoes away from chips
  - (c) it keeps the chips dry if the pack falls in water
  - (d) prevents chips from spilling out when the pack is opened

**Correct Answer:** Option (a)

- 2) A student notices that the bread kept out has a green coloured coating over it after a few days. What explains the reason for the student's observation?
- (a) the oils in the bread oxidises and causes rancidity
  - (b) bread comes in contact with atmospheric moisture and corrodes
  - (c) the oils in the bread reduces and cause the change in the colour of the bread
  - (d) comes in contact with the atmospheric nitrogen and a layer deposit over it

**Correct Answer:** Option (a)


## Suggested Teacher Resources



### Activity



|                   |   |
|-------------------|---|
| Objective         | Categorize the given reactions as (combination/ decomposition) based on the reactants & products of a chemical reaction.  |
| Prerequisite      | Identify the changes that a reaction mixture undergoes during a chemical reaction, what are reactants, what are products  |
| Material Required | Test tubes, boiling tube, distilled water, burner, sugar, iron fillings, sulphur powder   |
| Vocabulary        | <p>Combination Reaction: A reaction in which a single product is formed from two or more reactants is known as a combination reaction.</p> <p>Decomposition Reaction: A reaction in which a single substance decomposes to give two or more substances.</p> |

| Procedure                     | <p>Procedure 1:</p> <ol style="list-style-type: none"> <li>1. Take a small amount of iron fillings and sulphur powder in a boiling tube.</li> <li>2. Heat the boiling tube strongly over the flame of a burner or spirit lamp and observe changes.</li> </ol> <p>Procedure 2:</p> <ol style="list-style-type: none"> <li>1. Take about 2 g sugar crystals in a dry boiling tube. (Note the colour of the crystals.)</li> <li>2. Heat the boiling tube over the flame of a burner or spirit lamp and observe changes.</li> </ol> |                |  |                |  |                  |  |                  |                       |  |  |  |  |  |  |               |  |  |  |  |  |  |
|-------------------------------|---|----------------|--|----------------|--|------------------|--|------------------|-----------------------|--|--|--|--|--|--|---------------|--|--|--|--|--|--|
| Reflection Questions          | <table border="1"> <thead> <tr> <th>Reaction No.</th> <th>Materials used</th> <th>Chemicals used</th> <th>Describe the reactants (number of reactants)</th> <th>Procedure</th> <th>Describe the products (number of products)</th> <th>Type of reaction</th> </tr> </thead> <tbody> <tr> <td>Calcium Oxide + water</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Heating Sugar</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>                       | Reaction No.   | Materials used                               | Chemicals used | Describe the reactants (number of reactants) | Procedure        | Describe the products (number of products) | Type of reaction | Calcium Oxide + water |  |  |  |  |  |  | Heating Sugar |  |  |  |  |  |  |
| Reaction No.                  | Materials used  | Chemicals used | Describe the reactants (number of reactants) | Procedure      | Describe the products (number of products)   | Type of reaction |  |                  |                       |  |  |  |  |  |  |               |  |  |  |  |  |  |
| Calcium Oxide + water         |   |                |  |                |  |                  |  |                  |                       |  |  |  |  |  |  |               |  |  |  |  |  |  |
| Heating Sugar                 |   |                |  |                |  |                  |  |                  |                       |  |  |  |  |  |  |               |  |  |  |  |  |  |
| Text to real world connection | <p>Propane is a fuel used to provide heat for some homes. It is stored in large tanks as shown here. Can you predict the chemical equation for burning of propane?</p>    |                |  |                |  |                  |  |                  |                       |  |  |  |  |  |  |               |  |  |  |  |  |  |
| Beyond the classroom          | What type of reaction takes place inside the human and plant cells?   |                |  |                |  |                  |  |                  |                       |  |  |  |  |  |  |               |  |  |  |  |  |  |

2

## Activity



|                   |   |
|-------------------|---|
| Material required | Fresh potato chips, 2 glass jars with lid, Aluminium foil.  |
| Procedure         | <ol style="list-style-type: none"> <li>1. Wrap the glass jar with aluminium foil. Tape the foil in place so that no light can enter the container.</li> <li>2. Place fresh potato chips in the foil-wrapped jar and in a similar clear jar without foil around it.</li> </ol> |

|                      |   |
|----------------------|---|
|                      | <ol style="list-style-type: none"><li>3. Taste the potato chips and rate their flavour on a 5-point scale, 1 being extremely dislike the flavour and 5 being extremely like the flavour. (Enter your data in a table.)</li><li>4. Place the two jars on a window sill where they will be exposed to sunlight.</li><li>5. Taste potato chips from each jar at intervals of 1-2 days for 1-2 weeks and record the taste of potatoes in both the jars.</li><li>6. Make a graph of your data, noting the flavor of the potato chips stored these two ways versus storage time. The y-axis should be the flavor score and the x-axis the time in days.</li></ol> |
| Reflection questions | <ol style="list-style-type: none"><li>1. What effect does the aluminium foil have on the taste of potatoes after 2 weeks?</li><li>2. Is there anything else that will affect the taste of potatoes over 2 weeks apart from the sunlight?</li></ol>  |

## 2. Acids, Bases and Salts

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts  | Learning Objectives   |
|--|---|
| Introduction   | Recall the tastes of acids and bases in order to point out if given food items contain an acid or a base.   |
| Action of acids and bases on indicators                                | Observe the action of given substances with various indicators, in order to categorize them as acids or bases   |
| Acid/ base + metal > salt + hydrogen gas                               | Detect the formation of hydrogen gas when a metal reacts with an acid or a base, in order to confirm the presence of an acid/ base given an unknown compound  |
| acid + metal carbonates/ bicarbonates > salt + water + CO <sub>2</sub> | Detect the formation of carbon dioxide when a metal carbonate/ bicarbonate reacts with acid, in order to detect the presence of acid given an unknown compound  |
| acid + base > salt + water   | Analyse the reaction taking place between an acid and a base (alkalis, metal oxides) using an indicator.  |
| Acid & base in water solution  | Write down the ions present in aqueous solution of an acid or a base, in order to explain why aqueous acid/ base conduct electricity  |
| How strong are acid or base solutions?                                 | Detect the strength of given substances based on their position in the pH scale.  |
| Importance of pH in everyday life                                      | Explain the effect of pH change in animals, plants and environment in order to learn suitable pH range for survival   |
| More about salts   | Identify the positive and negative radicals present in a salt, in order to predict a salt's family and pH range   |
| Sodium Hydroxide   | Outline the process of formation of sodium hydroxide in order to explain its manufacture using common salt  |
| Bleaching Powder, Baking Soda & Washing Soda                           | List the properties & explain the preparation/ manufacture some important compounds of Sodium. (bleaching powder, baking soda and washing soda) in order to explain their manufacture using common salt |
| Water of crystallisation   | Demonstrate the activity of heating copper sulphate crystals and change in colour, in order to detect the presence of water of crystallisation  |

**Learning Objectives and Learning Outcomes:**

| Learning Objectives  | Learning Outcome  |
|--|---|
| Write down the ions present in aqueous solution of an acid or a base, in order to explain why aqueous acid/ base conduct electricity                           | Differentiates materials / objects / organisms / phenomena / processes, based on, properties / characteristics, such as autotrophic and heterotrophic nutrition, biodegradable and non- biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.   |
| Identify the positive and negative radicals present in a salt, in order to predict a salt's family and pH range  |   |
| Recall the tastes of acids and bases in order to point out if given food items contain an acid or a base.  | Classifies materials / objects / organisms / phenomena / processes, based on, properties / characteristics, such as metals and non-metals on the basis of their physical and chemical properties, acids and bases on the basis of their chemical properties, etc.   |
| Observe the action of given substances with various indicators, in order to categorize them as acids or bases  | Plans and conducts investigations / experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own, such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light? |
| Detect the formation of hydrogen gas when a metal reacts with an acid or a base, in order to confirm the presence of an acid/ base given an unknown compound   |   |
| Detect the formation of carbon dioxide when a metal carbonate/ bicarbonate reacts with acid, in order to detect the presence of acid given an unknown compound |   |
| Demonstrate the activity of heating copper sulphate crystals and change in colour, in order to detect the presence of water of crystallisation                 |   |
| Explain the effect of pH change in animals, plants and environment in order to learn suitable pH range for survival  | Relates processes and phenomena with causes / effects, such as hormones with their functions, tooth decay with pH of saliva, growth of plants with pH of the soil, survival of aquatic life with pH of water, blue colour of sky with scattering of light, deflection of compass needle due to magnetic effect of electric current, etc.  |

|   |  |
|---|--|
| Outline the process of formation of sodium hydroxide in order to explain its manufacture using common salt  | Explains processes and phenomena, such as nutrition in human beings and plants, transportation in plants and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc. |
| List the properties & explain the preparation/ manufacture some important compounds of Sodium. (bleaching powder, baking soda and washing soda) in order to explain their manufacture using common salt |  |
| Detect the strength of given substances based on their position in the pH scale.  | Analyses data/ graph/ figures in order to interpret them: (such as melting and boiling points of substances to differentiate between covalent and ionic compounds, pH of solutions to predict the nature of substances, V-I graphs, ray diagrams, etc.)  |
| Analyse the reaction taking place between an acid and a base (alkalis, metal oxides) using an indicator.  | Analyses and interprets data / graph / figure, such as melting and boiling points of substances to differentiate between covalent and ionic compounds, pH of solutions to predict the nature of substances, v-i graphs, ray diagrams, etc.   |

## Test items



**LOB: Recall the tastes of acids and bases in order to point out if given food items contain an acid or a base**

1) Which fruit is basic in nature?

- a) Apples
- b) Oranges

- c) Strawberries
- d) banana

**Correct Answer:** Option (d)

2) A student listed some food items as shown.

- |                |
|----------------|
| 1. Lemon juice |
| 2. Baking soda |
| 3. Broccoli    |
| 4. Curd        |

Which option classifies the food items on the basis of acidic and basic nature of food?

a) 

| Acid        | Base        |
|-------------|-------------|
| Lemon juice | Baking soda |
| Broccoli    | Curd        |

b) 

| Acid        | Base        |
|-------------|-------------|
| Lemon juice | Baking soda |
| Curd        | Broccoli    |

c) 

| Acid        | Base     |
|-------------|----------|
| Lemon juice | Curd     |
| Baking soda | Broccoli |

d) 

| Acid        | Base        |
|-------------|-------------|
| Broccoli    | Curd        |
| Baking soda | Lemon juice |

**Correct Answer:** Option (b)

**LOB:** Observe the action of given substances with various indicators, in order to categorize them as acids or bases

- 1) A basic solution is added to a test tube. A blue and red litmus paper is dipped into the basic solution. What will happen to both litmus papers?
- blue litmus paper: changes colour; red litmus paper: changes colour
  - blue litmus paper: changes colour; red litmus paper no colour change
  - blue litmus paper: no colour change; red litmus paper: changes color
  - blue litmus paper: no colour change; red litmus paper: no colour change

**Correct Answer:** Option (c)

- 2) A solution of pH 2 is filled in two separate beakers. A few drops of methyl orange and phenolphthalein are added into separate solutions. How will the colour of the indicators change?
- methyl orange: red; phenolphthalein: pink
  - methyl orange: orange; phenolphthalein: pink
  - methyl orange: Red; phenolphthalein: colourless
  - methyl orange: orange; phenolphthalein: colourless

**Correct Answer:** Option (c)

**LOB:**Detect the formation of hydrogen gas when a metal reacts with an acid or a base, in order to confirm the presence of an acid/ base given an unknown compound

- 1) When dilute sulphuric acid is added to a solid X, a gas Y is formed along with the formation of the salt of the solid. What could be X and Y?
- X: zinc; Y: oxygen
  - X: zinc; Y: hydrogen
  - X: copper; Y: oxygen
  - X: carbon; Y: hydrogen

**Correct Answer:** Option (b)

- 2) When a base reacts with a metal, it forms a salt and hydrogen gas is released. By what method the presence of hydrogen can be detected?
- by water
  - by litmus paper
  - by methyl orange
  - by a burning candle

**Correct Answer:** Option (d)

**LOB:** Detect the formation of carbon dioxide when a metal carbonate/ bicarbonate reacts with acid, in order to detect the presence of acid given an unknown compound

- 1) A student did an activity in which he added sodium bicarbonate to hydrochloric acid. It forms the carbon dioxide gas. The gas released is passed through lime water. What change will be observed in lime water
- bubbles are formed
  - white precipitate is formed
  - the solution becomes colourless
  - the colour of solution becomes red

**Correct Answer:** Option (b)

- 2) A metal carbonate reacts with a solution X which forms a salt, water, and a gas Y. What are X and Y?
- X: hydrochloric acid; Y: hydrogen
  - X: sodium hydroxide; Y: hydrogen
  - X: hydrochloric acid; Y: carbon dioxide
  - X: sodium hydroxide; Y: carbon dioxide

**Correct Answer:** Option (c)

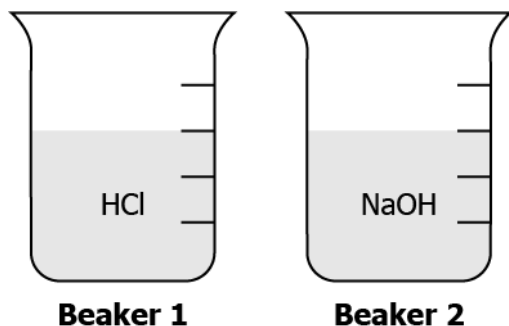


**LOB:** Analyse the reaction taking place between an acid and a base (alkalis, metal oxides) using an indicator

- 1) Which equation for the reaction between hydrochloric acid and sodium hydroxide is correct?
- $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
  - $\text{HCl} + 2\text{NaOH} \rightarrow \text{Na}_2\text{Cl} + \text{H}_2\text{O}$
  - $2\text{HCl} + \text{NaOH} \rightarrow 2\text{NaCl} + \text{H}_2\text{O}$
  - $2\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + 2\text{H}_2\text{O}$

**Correct Answer:** Option (a)

- 2) A student placed 10 mL HCl and NaOH in two separate beakers as shown.



In beaker 1, 4 mL of NaOH is added whereas in beaker 2, 4 mL of HCl is added. The student notes the possible change in pH in both solutions.

|   | Change in pH<br>(Beaker 1) | Change in pH<br>(Beaker 2) |
|---|----------------------------|----------------------------|
| A | increase                   | increase                   |
| B | reduce                     | increase                   |
| C | increase                   | reduce                     |
| D | reduce                     | reduce                     |

Which change in pH is correct?

- |      |      |
|------|------|
| a) A | c) C |
| b) B | d) D |

**Correct Answer:** Option (c)

**LOB:** Analyse the reaction taking place between an acid and a base (alkalis, metal oxides) using an indicator

- 1) The equation shows the reaction of metal oxide with acid.



What is X?

- |         |                   |
|---------|-------------------|
| a) Salt | c) Hydrogen       |
| b) Base | d) Carbon dioxide |

**Correct Answer:** Option (a)

- 2) An oxide of element P is added to an acid where it forms salt and water. The table shows the possible value of pH and the type of element before the reaction.

|   | pH             | Type of Element |
|---|----------------|-----------------|
| A | Less than 7    | Metal           |
| B | Less than 7    | Non-metal       |
| C | Greater than 7 | Metal           |
| D | Greater than 7 | Non-metal       |

Which option is correct?

- (a) A
- (b) B
- (c) C
- (d) D

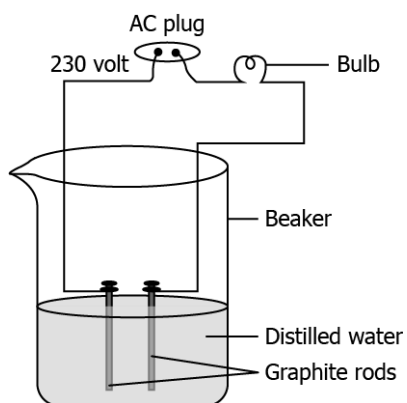
**Correct Answer:** Option (a)

**LOB:** Write down the ions present in aqueous solution of an acid or a base, in order to explain why aqueous acid/ base conduct electricity

- 1) A student learns that acid and base can conduct electricity because they have ions present in it. What are the ions present in acid and base?
- a) acid:  $H^+$ ; base:  $H^-$
  - b) acid:  $H^+$ ; base:  $OH^-$
  - c) acid:  $OH^-$ ; base:  $H^-$
  - d) acid:  $OH^-$ ; base:  $OH^-$

**Correct Answer:** Option (b)

- 2) A student makes an arrangement to test the electrical conductivity of distilled water as shown.



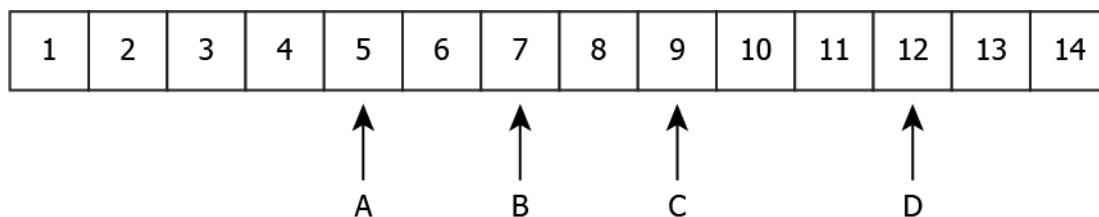
The student observes that the bulb does not glow. What could be the reason the bulb does not glow?

- a) the bulb needs DC source to glow
- b) the water never conducts electricity
- c) the graphite is bad conductor of electricity
- d) the distilled water does not have ions present in it

**Correct Answer:** Option (d)

**LOB:** Detect the strength of given substances based on their position in the pH scale

- 1) The image shows the pH values of four solutions on a pH scale.

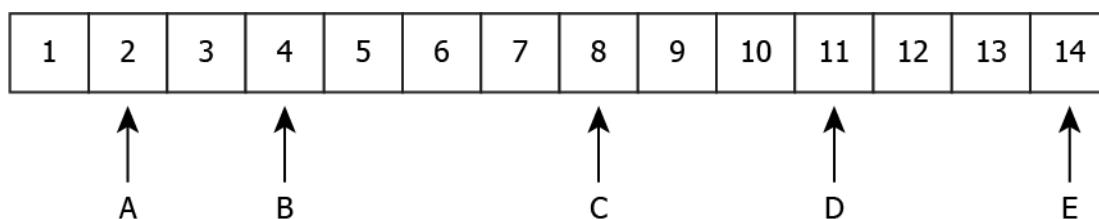


Which solutions are alkaline in nature?

- a) A and B
- b) B and C
- c) C and D
- d) A and D

**Correct Answer:** Option (c)

- 2) The image shows five solutions labelled on a pH scale.



Which classification is correct?

a)

|                       |                       |
|-----------------------|-----------------------|
| <b>Strongest Acid</b> | <b>Strongest Base</b> |
| B                     | E                     |

c)

|                       |                       |
|-----------------------|-----------------------|
| <b>Strongest Acid</b> | <b>Strongest Base</b> |
| A                     | E                     |

b)

|                       |                       |
|-----------------------|-----------------------|
| <b>Strongest Acid</b> | <b>Strongest Base</b> |
| A                     | C                     |

d)

|                       |                       |
|-----------------------|-----------------------|
| <b>Strongest Acid</b> | <b>Strongest Base</b> |
| B                     | C                     |



- 2) A scientist in a chemistry lab wants to make salt of pH 5.5 using acid and base. The table shows the acid and base present in the lab.

|   |                                |
|---|--------------------------------|
| 1 | HCl                            |
| 2 | NaOH                           |
| 3 | H <sub>2</sub> CO <sub>3</sub> |
| 4 | NH <sub>4</sub> OH             |
| 5 | CH <sub>3</sub> COOH           |

Which of the acid and base he should use for the reaction?

- a) HCl and NaOH
- b) H<sub>2</sub>CO<sub>3</sub> and NaOH
- c) HCl and NH<sub>4</sub>OH
- d) CH<sub>3</sub>COOH and NaOH

**Correct Answer:** Option (c)

**LOB:** Outline the process of formation of sodium hydroxide in order to explain its manufacture using common salt

- 1) A student learns that when sodium chloride reacts with water, it forms sodium hydroxide. Which type of reaction results in the formation of sodium hydroxide?

- (a) combination reaction
- (b) displacement reaction
- (c) neutralization reaction
- (d) decomposition reaction

**Correct Answer:** Option (d)

- 1) Which option shows a balance equation of the formation of sodium hydroxide?

- (a)  $\text{Na}_2\text{Cl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + 2\text{HCl}$
- (b)  $2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + 2\text{HCl}$
- (c)  $\text{NaCl} + 2\text{H}_2\text{O} \rightarrow \text{NaOH} + \text{Cl}_2 + \text{H}_2$
- (d)  $2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{Cl}_2 + \text{H}_2$

**Correct Answer:** Option (d)

**LOB:** List the properties & explain the preparation/ manufacture some important compounds of Sodium. (bleaching powder, baking soda and washing soda) in order to explain their manufacture using common salt

- 1) Which of the following is the best possible application of Calcium oxychloride?

- (a) to disinfect the water
- (b) to make the water soft
- (c) to reduce the pH of water
- (d) to change the state of water

**Correct Answer:** Option (d)

2) The chemical reaction shows the reactants for the formation of baking soda.



What are X and Y?

- (a) X: HCl; Y: NaHCO<sub>3</sub>
- (b) X: NH<sub>4</sub>Cl; Y: NaHCO<sub>3</sub>
- (c) X: NH<sub>4</sub>Cl; Y: NaHCO<sub>2</sub>
- (d) X: NH<sub>3</sub>Cl; Y: NaHCO<sub>3</sub>

**Correct Answer:** Option (b)

2) What is the use of washing soda?

- (a) to make the water alkaline
- (b) to change the state of water
- (c) to lower the temperature of the water
- (d) to remove the permanent hardness of water

**Correct Answer:** Option (d)

3) Washing soda is obtained from the recrystallization of sodium carbonate. How is sodium carbonate obtained from baking soda?

- (a) by heating the baking soda
- (b) by adding water to baking soda
- (c) by reacting the baking soda with acid
- (d) by reacting the baking soda with base

**Correct Answer:** Option (a)

**LOB: Demonstrate the activity of heating copper sulphate crystals and change in colour, in order to detect the presence of water of crystallisation**

1) When water of crystallization is removed from copper sulphate solution, how does the colour of the salt change?

- (a) from blue to red
- (b) from white to red
- (c) from white to blue
- (d) from blue to white

**Correct Answer:** Option (d)

2) A student has three sample of copper sulphate crystals in separate test tube X, Y and Z. The colour of copper sulphate in X is blue, in Y is white and in Z is blue. Which test tube require heating to remove water of crystallization?

- (a) only Y
- (b) only Z

**Correct Answer:** Option (c)

(c) both X and Z

(d) both Y and Z

## Suggested Teacher Resources



### Activity



| Objective                     | Detect the strength of given substances based on their position in the pH scale.   |                |                    |                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------------------------|--|----------------|--------------------|----------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Prerequisite                  | Acids and bases, universal indicator, definition of pH.  |                |                    |                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Material Required             | Test tubes, dropper, pH paper, pH scale for reference, solutions for finding out pH (can be altered depending on availability): lemon juice, coffee in water, tap water, soda, vinegar, curd.  |                |                    |                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Vocabulary                    | <p>Acid: A chemical compound which releases hydronium ions in solution.</p> <p>Base: A chemical compound which releases hydroxide ions in solution.</p> <p>pH: Power of Hydrogen; this is the extent to which hydrogen ions can be released in solution and is inversely proportional to the concentration of hydrogen ions in solution.</p>   |                |                    |                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Procedure                     | <p>(This activity can be carried out in groups of 4 students each.)</p> <ol style="list-style-type: none"> <li>1. Take each of these solutions in test tubes.</li> <li>2. Take 6 pH paper strips.</li> <li>3. Using a dropper, put one drop of the first solutions on one strip and note down the colour and compare it with the reference pH scale.</li> <li>4. Clean the dropper and repeat the procedure with other solutions as well.</li> <li>5. Record observations as in the table below.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Solution</th> <th style="width: 33%;">Colour of pH paper</th> <th style="width: 33%;">Approximate pH</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table> | Solution       | Colour of pH paper | Approximate pH |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Solution                      | Colour of pH paper   | Approximate pH |                    |                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                               |  |                |                    |                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                               |  |                |                    |                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                               |  |                |                    |                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                               |  |                |                    |                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                               |  |                |                    |                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Reflection Questions          | <div style="text-align: center;"> <p style="margin: 0;">0 1 2 3 4 5 6 7 8 9 10 11 12 13 14</p> <p style="margin: 0;">acidic                      neutral                      alkaline</p> </div> <p>(Source: <a href="http://acidsandbaseskate.weebly.com/">http://acidsandbaseskate.weebly.com/</a>)</p> <ol style="list-style-type: none"> <li>1. Where do each of the solutions lie on the pH scale?</li> <li>2. Arrange the solutions in increasing order of acidic strength.</li> </ol>  |                |                    |                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Text to real world connection | Milk of Magnesia which is used to treat acidity is basic in nature and hence is able to neutralise the excessive acid in the stomach.  |                |                    |                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

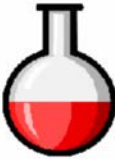
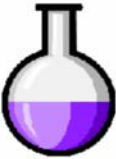

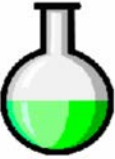
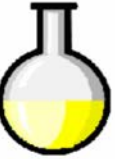
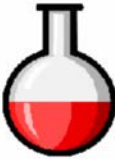
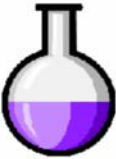

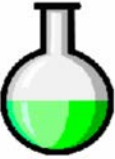
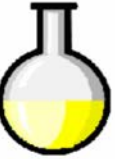
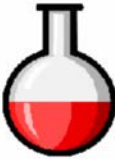
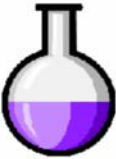

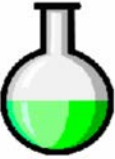
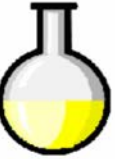
Beyond the classroom

Haldi is another natural indicator of pH. What happens to haldi stains on clothes when washed with soap? Why?

2

## Activity



|   |   |  |   |   |       |        |   |   |  |   |   |                      |      |        |          |          |
|---|---|--|---|---|-------|--------|---|---|--|---|---|----------------------|------|--------|----------|----------|
| Material required   | Red cabbage juice, 10 solutions used in everyday life (vinegar, water, baking soda, soap, bleach, floor cleaner, lemon juice, apple juice-etc.)   |  |   |   |       |        |   |   |  |   |   |                      |      |        |          |          |
| Procedure   | <p><u>Cabbage Juice Rainbow</u></p> <ol style="list-style-type: none"> <li>Pour some cabbage juice in each solution until a colour change is seen. (Acids turn the cabbage juice redder, and bases turn the cabbage juice blue, yellow or green, depending on the pH.)</li> </ol> <p><b>Results of adding cabbage juice to solutions of different pH values:</b></p> <table style="margin-left: auto; margin-right: auto; text-align: center;"> <tr> <td>Red</td> <td>Purple</td> <td>Blue</td> <td>Green</td> <td>Yellow</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Acidic<br/>pH below 7</td> <td>pH 7</td> <td>pH 8-9</td> <td>pH 10-11</td> <td>pH 11-13</td> </tr> </table> <p>(Source: <a href="https://www.teachengineering.org/activities/view/cub_air_lesson06_activity1">https://www.teachengineering.org/activities/view/cub_air_lesson06_activity1</a>)</p> <ol style="list-style-type: none"> <li>Once the colour change is seen, setup the solutions to form a rainbow of solutions.</li> </ol> | Red  | Purple  | Blue  | Green | Yellow |  |  |  |  |  | Acidic<br>pH below 7 | pH 7 | pH 8-9 | pH 10-11 | pH 11-13 |
| Red   | Purple  | Blue   | Green   | Yellow  |       |        |   |   |  |   |   |                      |      |        |          |          |
|  |    |  |  |  |       |        |   |   |  |   |   |                      |      |        |          |          |
| Acidic<br>pH below 7  | pH 7  | pH 8-9   | pH 10-11  | pH 11-13  |       |        |   |   |  |   |   |                      |      |        |          |          |
| Reflection questions  | <ol style="list-style-type: none"> <li>Gather information about other naturally occurring visual and olfactory acid-base indicators.</li> </ol>   |  |   |   |       |        |   |   |  |   |   |                      |      |        |          |          |



# 3. Metals and Non-metals

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts  | Learning Objectives  |
|--|--|
| Physical Properties  | Observe various substances and their physical properties in order to classify them as metals or non-metals                               |
| Chemical Properties of metals<br>Metal + oxygen/<br>water/ dilute acid > | Predict the products when metals & non-metals react with oxygen, water, dilute acids in order to write a balanced chemical equation.     |
| Reaction of metals with other metal salts                                | Identify the product formed when a metal reacts with a metal salt, in order to list the metals in order of their reactivity              |
| Ionic compounds  | Discuss the process of how metals react with non-metals, in order to explain formation & properties of ionic compounds                   |
| Occurrence of metals   | Analyse the process of getting metals from their oxides, sulphides, carbonates in order to extract them from their ores                  |
| Refining of metals   | Explain the process of electrolytic refining in order to assess how to obtain pure metals from impure samples                            |
| Corrosion & prevention   | Observe corrosion in metal articles & its process in order to develop ways to prevent corrosion by forming alloys, painting, galvanising |

**Learning Objectives and Learning Outcomes:**

| Learning Objectives  | Learning Outcome  |
|--|---|
| Observe various substances and their physical properties in order to classify them as metals or non-metals                           | Classifies materials / objects / organisms / phenomena / processes, based on, properties / characteristics, such as metals and non-metals on the basis of their physical and chemical properties, acids and bases on the basis of their chemical properties, etc.   |
| Predict the products when metals & non-metals react with oxygen, water, dilute acids in order to write a balanced chemical equation. | <b>Explains processes and phenomena</b> , such as nutrition in human beings and plants, transportation in plants and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of |
| Identify the product formed when a metal reacts with a metal salt, in order  |   |

|  |   |
|--|---|
| to list the metals in order of their reactivity  | reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.  |
| Analyse the process of getting metals from their oxides, sulphides, carbonates in order to extract them from their ores                  | Draws labelled diagrams / flow charts / concept map /graphs, such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc. |
| Explain the process of electrolytic refining in order to assess how to obtain pure metals from impure samples                            |   |
| Observe corrosion in metal articles & its process in order to develop ways to prevent corrosion by forming alloys, painting, galvanising |   |
| Discuss the process of how metals react with non-metals, in order to explain formation & properties of ionic compounds                   |   |
| Analyse the process of getting metals from their oxides, sulphides, carbonates in order to extract them from their ores                  | Analyses and interprets data / graph / figure, such as melting and boiling points of substances to differentiate between covalent and ionic compounds, pH of solutions to predict the nature of substances, v-i graphs, ray diagrams, etc.  |

## Test items



**LOB:** Observe various substances and their physical properties in order to classify them as metals or non-metals

- 1) A student performs some activities on two substances and records the observations in a table as shown.

| Activity                  | Substance M        | Substance N         |
|---------------------------|--------------------|---------------------|
| cut with a knife          | forms small pieces | forms small pieces  |
| beaten with hammer        | shape changes      | changes into powder |
| stricken with a metal rod | makes a sound      | changes into powder |

Which option classifies the substances into metals and non-metals?

- (a) both the substances are metals
- (b) both the substances are non-metals
- (c) substance M is metal while substance N is non-metal
- (d) substance M is non-metal while substance N is metal

**Correct Answer:** Option (c)

2) Which option classifies the substances based on their physical properties?

(a)

| Lustrous            | Good Conductor of Electricity | Malleable | Bad Conductor of Electricity |
|---------------------|-------------------------------|-----------|------------------------------|
| Graphite and silver | Copper                        | Iron      | Rubber                       |

(b)

| Lustrous | Good Conductor of Electricity | Malleable | Bad Conductor of Electricity |
|----------|-------------------------------|-----------|------------------------------|
| Copper   | Rubber                        | Iron      | Graphite and silver          |

(c)

| Lustrous | Good Conductor of Electricity | Malleable | Bad Conductor of Electricity |
|----------|-------------------------------|-----------|------------------------------|
| Copper   | Graphite and silver           | Iron      | Rubber                       |

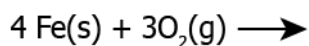
(d)

| Lustrous | Good Conductor of Electricity | Malleable | Bad Conductor of Electricity |
|----------|-------------------------------|-----------|------------------------------|
| Copper   | Graphite and silver           | Rubber    | Iron                         |

**Correct Answer:** Option (c)

**LOB:** Predict the products when metals & non-metals react with oxygen, water, dilute acids in order to write a balanced chemical equation

- 1) The image shows an incomplete chemical equation of the reaction between iron and oxygen.

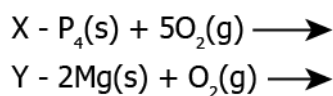


Which option shows the products formed during the reaction?

- (a)  $4\text{FeO}_3\text{(s)}$
- (b)  $12\text{FeO(s)}$
- (c)  $3\text{Fe}_2\text{O}_3\text{(s)}$
- (d)  $2\text{Fe}_2\text{O}_3\text{(s)}$

**Correct Answer:** Option (d)

- 2) A student writes two incomplete chemical reactions.



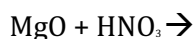
Which option completes the reactions to form a balanced chemical equation?

- (a) X -  $\text{P}_2\text{O}_4\text{(s)}$ ; Y-  $(\text{MgO})_2\text{(s)}$
- (b) X -  $4\text{P}_2\text{O}_5\text{(s)}$ ; Y-  $4\text{MgO(s)}$
- (c) X -  $\text{P}_4\text{O}_{10}\text{(s)}$ ; Y -  $2\text{MgO(s)}$
- (d) X -  $5\text{P}_2\text{O}_5\text{(s)}$ ; Y-  $\text{Mg}_2\text{O}_2\text{(s)}$

**Correct Answer:** Option (c)

**LOB:** Identify the product formed when a metal reacts with a metal salt, in order to list the metals in order of their reactivity

- 1) A student studying the chemical properties of metals finds incomplete chemical reactions in his book, as shown:



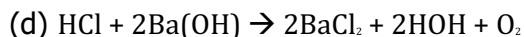
Which option completes the reaction?

- (a)  $\text{MgO} + \text{HNO}_3 \rightarrow \text{Mg}_3\text{N}_2 + 4\text{H}_2\text{O}$
- (b)  $\text{MgO} + \text{HNO}_3 \rightarrow \text{Mg} + \text{NO}_2 + \text{O}_2$
- (c)  $\text{MgO} + \text{HNO}_3 \rightarrow \text{Mg(OH)}_2 + 2\text{NO}_2$
- (d)  $\text{MgO} + \text{HNO}_3 \rightarrow \text{Mg(NO}_3)_2 + \text{H}_2\text{O}$

**Correct Answer:** Option (d)

- 2) When hydrochloric acid is added to barium hydroxide, a white-colored compound is formed. Which option gives the complete chemical reaction?

- (a)  $\text{HCl} + \text{Ba(OH)}_2 \rightarrow \text{BaCl}_2 + 2\text{HOH}$
- (b)  $2\text{HCl} + \text{Ba(OH)}_2 \rightarrow \text{BaCl}_2 + 2\text{HOH}$
- (c)  $2\text{HCl} + \text{Ba(OH)}_2 \rightarrow \text{BaH}_2 + 2\text{HCl} + \text{O}_2$



**Correct Answer:** Option (b)

- 3) When calcium oxide is added to water, it completely dissolves in water without forming bubbles. What products are formed in this reaction?
- Ca and  $\text{H}_2$
  - Ca and  $\text{H}_2\text{O}_2$
  - $\text{Ca}(\text{OH})_2$
  - $\text{CaH}_2$

**Correct Answer:** Option (c)

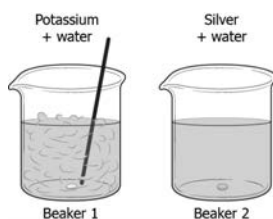
- 4) A student adds some metallic ash in water taken in a test tube. The ash gets completely dissolved in water and the solution changes colour. What should the student do next to test the chemical properties of the product formed?
- Evaporate the solution to get crystals.
  - Test the basicity using a red litmus paper.
  - Test the acidity using a blue litmus paper.
  - Measure the temperature change using a thermometer.

**Correct Answer:** Option (b)

- 5) What happens when a pellet of sodium is dropped in water?
- It catches fire and forms oxide.
  - It absorbs heat and forms oxide.
  - It catches fire and forms hydroxide.
  - It absorbs heat and forms hydroxide.

**Correct Answer:** Option (c)

- 6) A student drops pieces of potassium and silver in beakers containing water. The image shows the reaction.



What are the products formed in each beaker?

- Beaker 1:  $\text{K}_2\text{O}$  and  $\text{H}_2\text{O}$ ; Beaker 2:  $\text{Ag}_2\text{O}$  and  $\text{H}_2\text{O}$
- Beaker 1:  $\text{KOH}$  and  $\text{H}_2\text{O}$ ; Beaker 2:  $\text{Ag}_2\text{O}$  and  $\text{H}_2\text{O}$
- Beaker 1:  $\text{K}_2\text{O}$  and  $\text{H}_2\text{O}$ ; Beaker 2: No reaction takes place
- 1:  $\text{KOH}$  and  $\text{H}_2\text{O}$ ; Beaker 2: No reaction takes place

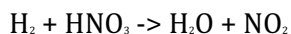
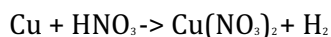
**Correct Answer:** Option (b)

- 7) Which product is formed in the chemical reaction between a small strip of magnesium and nitric acid?
- $\text{MgNO}_3$  and  $2\text{H}_2$
  - $\text{MgNO}_3$  and  $\text{H}_2\text{O}$
  - $\text{Mg}(\text{NO}_3)_2$  and  $2\text{H}_2$

(d)  $\text{Mg}(\text{NO}_3)_2$  and  $\text{H}_2\text{O}$

**Correct Answer:** Option (c)

- 8) The chemical reaction between a piece of copper and nitric acid is given by the chemical equations,



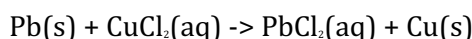
What can be inferred from the chemical equation?

- (a) Copper causes the oxidation of  $\text{HNO}_3$  to form  $\text{NO}_2$ .
- (b) Hydrogen gas gets oxidized by  $\text{HNO}_3$  to form water.
- (c) gas reacts with oxygen in the air to form water.
- (d) Nitrate reacts with hydrogen to form  $\text{NO}_2$  and  $\text{H}_2\text{O}$ .

**Correct Answer:** Option (b)

**LOB:** Identify the product formed when a metal reacts with a metal salt, in order to list the metals in order of their reactivity

- 1) A student writes the chemical equation of the reaction between lead and copper chloride.



Which option explains the reason for the formation of lead chloride?

- (a) copper is more reactive than lead
- (b) is less reactive than copper
- (c) and copper are equally reactive
- (d) lead is more reactive than copper

**Correct Answer:** Option (d)

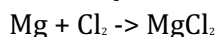
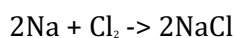
- 2) A student adds an equal amount of copper sulphate solution in two beakers. He adds zinc in beaker P and silver in beaker Q. The student observes that the color of the solution in beaker P changes while no change is observed in beaker Q. Which option arranges the metals in increasing order of reactivity?

- (a) silver-zinc-copper
- (b) zinc-copper- silver
- (c) silver-copper-zinc
- (d) copper-silver-zinc

**Correct Answer:** Option (c)

**LOB:** Discuss the process of how metals react with non-metals, in order to explain formation & properties of ionic compounds

- 1) A student learns that sodium and magnesium react with chloride to form sodium chloride and magnesium chloride, as shown.



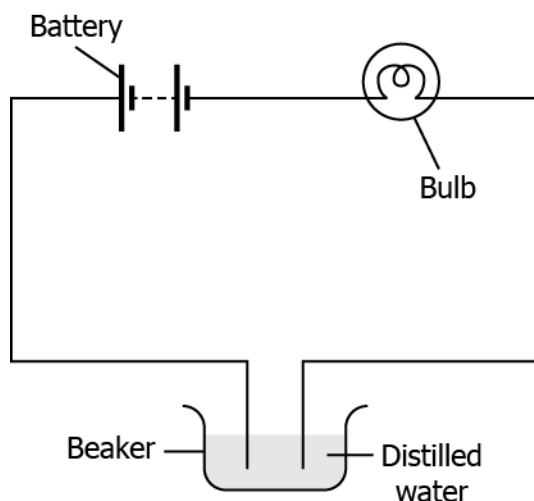
The melting point of sodium chloride is 1074 K while the melting point of magnesium chloride is 981 K. Why does sodium chloride and magnesium chloride have a difference in melting point?

- (a) Magnesium chloride is soluble in kerosene and petrol.

- (b) Sodium chloride is formed by combining with one molecule of chlorine.
- (c) Sodium chloride has strong inter-ionic bonding than magnesium chloride.
- (d) chloride is formed by combining only one molecule of magnesium.

**Correct Answer:** Option (c)

- 2) A student makes an electric circuit using an LED, a battery and connecting wires, as shown.



The student notices that the LED does not glow. He replaces the distilled water with a salt solution and observes that the LED glows. How does the salt solution help the LED to glow?

- (a) Salt solution is covalent in nature and conducts electricity.
- (b) Salt solution has a low melting point which allows the current to flow through it.
- (c) Salt solution has a high boiling point which allows the flow of current in the circuit without getting hot.
- (d) Salt solution contains ions which makes it conductive and allows the electricity to flow through it.

**Correct Answer:** Option (d)

**LOB:** Analyse the process of getting metals from their oxides, sulphides, carbonates in order to extract them from their ores

- 1) Which option gives the process of extraction of mercury from its ore cinnabar?
- (a) cooling cinnabar in the presence of excess air
  - (b) cooling cinnabar to convert it into mercuric oxide and then heating it
  - (c) cinnabar to convert it into mercuric oxide and then heating it again
  - (d) cinnabar in the presence of limited air to and then adding a small amount of water

**Correct Answer:** Option (c)

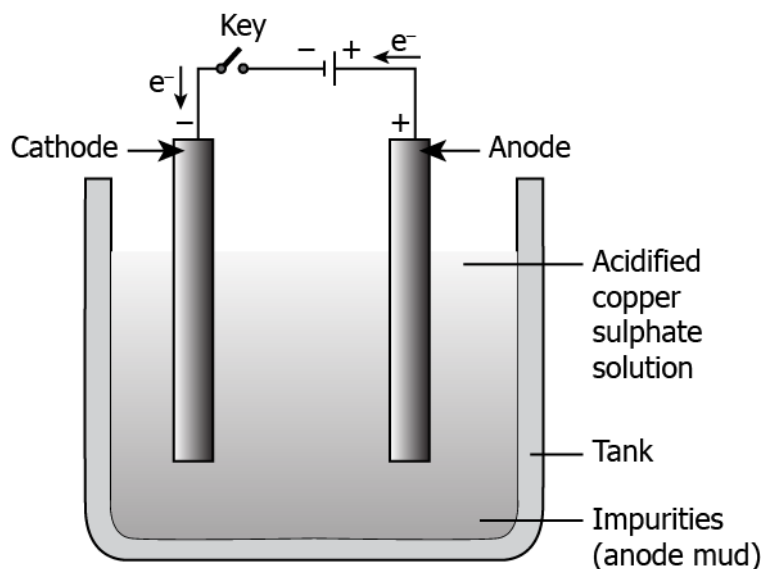
- 2) A researcher conducts an experiment to obtain zinc from its ore. Which option gives the process that the researcher must perform?
- (a) converting metal sulphides into metallic oxides and then using carbon to reduce it to obtain pure metal
  - (b) metal oxides into metallic sulphides and then using carbon to reduce it to obtain pure metal
  - (c) converting metal oxides into metallic carbonates and then using carbon to reduce it to obtain pure metal

(d) metallic sulphides into metallic carbonates and then heating to reduce it to obtain pure metal

**Correct Answer:** Option (a)

**LOB:** Explain the process of electrolytic refining in order to assess how to obtain pure metals from impure samples

1) The image shows the electrolytic refining of copper.



Which option explains the process to obtain pure copper?

- (a) When current is passed, pure copper from anode deposits to the cathode.
- (b) When current is passed, pure copper from anode deposits in the electrolytic solution.
- (c) When current is passed, pure copper from the electrolytic solution deposits at the anode.
- (d) When current is passed, pure copper from the electrolytic solution deposits at the cathode.

**Correct Answer:** Option (d)

2) The table lists the process which explains how pure metals are obtained from impure samples by electrolytic refining.

1. Keep impure metal at anode and pure metal at cathode.
2. Pass current in the electrolytic solution.
3. Insoluble impurities settle in the bottom of the anode as anode mud.
4. Pure metal from anode dissolves in the solution and pure metal from solution deposits on the cathode.

Which option arranges the steps in the appropriate order?



- (a) 2-1-3-4
- (b) 1-2-4-3
- (c) 3-1-4-2
- (d) 4-2-3-2

**Correct Answer:** Option (b)

**LOB:** Observe corrosion in metal articles & its process in order to develop ways to prevent corrosion by forming alloys, painting, galvanising

- 1) A student notices that the surface of the iron swings in his society playground has turned brown over the years. Which process must be done on the swings to save them from corroding?
- (a) putting shades over swings
  - (b) swings from the playground
  - (c) covering the surface of the swings with paint
  - (d) the swings with black paper to protect them from sunlight

**Correct Answer:** Option (d)

- 2) Earlier, every utensil or tool used at homes was made of iron. The image shows an iron bucket that has deposits of rust over it by using over the years.



What must be done to protect objects made of iron from rusting?

- (a) oiling the object after every wash
- (b) covering the object with a layer of zinc
- (c) cleaning the object with chromium powder regularly
- (d) heating and cooling object in cycles to form a thick layer

## Suggested Teacher Resources



### Activity



|              |  |
|--------------|--|
| Objective    | Identify the product formed when a metal reacts with a metal salt, in order to list metals in order of their reactivity. |
| Prerequisite | Changes that take place during a chemical reaction   |

| Material Required    | Metals (Aluminium, Zinc, Iron, Magnesium), Metal Salts (Aluminium Sulphate, Zinc Sulphate, Iron Sulphate, Magnesium Sulphate), test tubes, test tube stands, dropper, observation sheets  |                         |  |  |                      |  |                         |  |  |                    |  |  |  |  |               |  |  |  |  |                  |  |  |  |  |                    |  |  |  |  |
|----------------------|---|-------------------------|--|--|----------------------|--|-------------------------|--|--|--------------------|--|--|--|--|---------------|--|--|--|--|------------------|--|--|--|--|--------------------|--|--|--|--|
| Vocabulary           | <p>Displacement Reaction: A chemical reaction in which a more reactive metal replaces the less reactive metal from its salt solution.</p> <p>Reactivity Series: It is a series of reactivity of metals in order from highest to lowest and is used to predict the products of displacement reactions.</p>   |                         |  |  |                      |  |                         |  |  |                    |  |  |  |  |               |  |  |  |  |                  |  |  |  |  |                    |  |  |  |  |
| Procedure            | <ol style="list-style-type: none"> <li>Set up 4 workstations as follows.</li> <li>Record observations.</li> </ol> <p><b><u>Station 1</u></b></p> <p><b>Aluminium metal</b> is added to all 4 metal salt solutions. Observe the initial state and final state very carefully and hence record observations.</p> <table border="1"> <thead> <tr> <th>Metal Salt Solutions</th> <th>Initial state of the reactants (write colour of reactants in brackets)</th> <th>Final state of products</th> <th>Do you see a colour change/ change of state from reactant to product (If yes, how has it changed?)</th> <th>Do you think a chemical reaction has taken place? What makes you say that?</th> </tr> </thead> <tbody> <tr> <td>Aluminium Sulphate</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Zinc Sulphate</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Ferrous Sulphate</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Magnesium Sulphate</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> |                         |  |  | Metal Salt Solutions | Initial state of the reactants (write colour of reactants in brackets) | Final state of products | Do you see a colour change/ change of state from reactant to product (If yes, how has it changed?) | Do you think a chemical reaction has taken place? What makes you say that? | Aluminium Sulphate |  |  |  |  | Zinc Sulphate |  |  |  |  | Ferrous Sulphate |  |  |  |  | Magnesium Sulphate |  |  |  |  |
| Metal Salt Solutions | Initial state of the reactants (write colour of reactants in brackets)  | Final state of products | Do you see a colour change/ change of state from reactant to product (If yes, how has it changed?) | Do you think a chemical reaction has taken place? What makes you say that? |                      |  |                         |  |  |                    |  |  |  |  |               |  |  |  |  |                  |  |  |  |  |                    |  |  |  |  |
| Aluminium Sulphate   |   |                         |  |  |                      |  |                         |  |  |                    |  |  |  |  |               |  |  |  |  |                  |  |  |  |  |                    |  |  |  |  |
| Zinc Sulphate        |   |                         |  |  |                      |  |                         |  |  |                    |  |  |  |  |               |  |  |  |  |                  |  |  |  |  |                    |  |  |  |  |
| Ferrous Sulphate     |   |                         |  |  |                      |  |                         |  |  |                    |  |  |  |  |               |  |  |  |  |                  |  |  |  |  |                    |  |  |  |  |
| Magnesium Sulphate   |   |                         |  |  |                      |  |                         |  |  |                    |  |  |  |  |               |  |  |  |  |                  |  |  |  |  |                    |  |  |  |  |

**Station 2**

**Zinc metal** is added to all 4 metal salt solutions. Observe the initial state and final state very carefully and hence record observations.

| <b>Metal Salt Solutions</b> | <b>Initial state of the reactants (write colour of reactants in brackets)</b> | <b>Final state of products</b> | <b>Do you see a colour change/ change of state from reactant to product (If yes, how has it changed?)</b> | <b>Do you think a chemical reaction has taken place? What makes you say that?</b> |
|-----------------------------|---|--------------------------------|---|---|
| <b>Aluminium Sulphate</b>   |   |                                |   |   |
| <b>Zinc Sulphate</b>        |   |                                |   |   |
| <b>Ferrous Sulphate</b>     |   |                                |   |   |
| <b>Magnesium Sulphate</b>   |   |                                |   |   |

-

**Station 3**

**Iron metal** is added to all 4 metal salt solutions. Observe the initial state and final state very carefully and hence record observations.

| <b>Metal Salt Solutions</b>  | <b>Initial state of the reactants (write colour of reactants in brackets)</b> | <b>Final state of products</b> | <b>Do you see a colour change/ change of state from reactant to product (If yes, how has it changed?)</b> | <b>Do you think a chemical reaction has taken place? What makes you say that?</b> |
|--|---|--------------------------------|---|---|
| <b>Aluminium Sulphate</b>  |   |                                |   |   |
| <b>Zinc Sulphate</b>   |   |                                |   |   |
| <b>Ferrous Sulphate</b>  |   |                                |   |   |
| <b>Magnesium Sulphate</b>  |   |                                |   |   |
| <p><b><u>Station 4</u></b></p> <p><b>Magnesium metal</b> is added to all 4 metal salt solutions. Observe the initial state and final state very carefully and hence record observations.</p> |   |                                |   |   |
| <b>Metal Salt Solutions</b>  | <b>Initial state of the reactants (write colour of reactants in brackets)</b> | <b>Final state of products</b> | <b>Do you see a colour change/ change of state from reactant to product (If yes, how has it changed?)</b> | <b>Do you think a chemical reaction has taken place? What makes you say that?</b> |

|                               |   |  |  |  |  |
|-------------------------------|---|--|--|--|--|
|                               | <b>Aluminium Sulphate</b>   |  |  |  |  |
|                               | <b>Zinc Sulphate</b>  |  |  |  |  |
|                               | <b>Ferrous Sulphate</b>   |  |  |  |  |
|                               | <b>Magnesium Sulphate</b>   |  |  |  |  |
| Reflection Questions          | <ol style="list-style-type: none"> <li>1. Which metal did react with all the metal salts? Why do you think so?</li> <li>2. Which metal did not react with any of the metal salts? Why do you think so?</li> <li>3. Which metal is hence the most and least reactive?</li> <li>4. Arrange the given metals in decreasing order of their reactivity hence deriving the reactivity series with these four metals.</li> </ol> |  |  |  |  |
| Text to real world connection | Metal salts are present in many natural and processed food items. Can you think of a reason why elders advice not to store semi-solid or liquid food items in metal containers? What could be the possible harms of this?   |  |  |  |  |
| Beyond the classroom          | 2. Where do you think double displacement reactions find their utility?   |  |  |  |  |



|                      |  |
|----------------------|--|
| Material required    | Case study prints  |
| Procedure            | <p><b>Students to read the following case study in pairs:</b></p> <p>No cans currently in wide use are composed primarily or wholly of tin; that term rather reflects the nearly exclusive use in cans, until the second half of the 20th century, of <u>tinplate steel</u>, which combines the physical strength and relatively low price of steel with the <u>corrosion</u> resistance of tin. Depending on contents and available coatings, some canneries still use tin-free steel. In some local dialects, any metal can, even aluminium, might be called a "tin can". Use of <u>aluminium</u> in cans began in 1957. Aluminium is less costly than tin-plated steel but offers the same resistance to corrosion in addition to greater <u>malleability</u>, resulting in ease of manufacture; this gave rise to the two-piece can, where all but the top of the can is simply stamped out of a single piece of aluminium, rather than laboriously constructed from three pieces of steel.</p> <p><b>In modern times, the majority of food cans in the UK have been lined on the inside with a plastic coating. The coating prevents acids and other substances from corroding the tin or aluminium of the can.</b></p> |
| Reflection questions | <p>3. Do you think it is a good idea to coat cans with plastic on the inside? What could be the possible advantages or disadvantages?</p> <p>4. Compare the utility of steel and aluminium cans for food storage in terms of food safety, cost and accessibility.</p>  |

# 4. Carbon and its Compounds

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts                             | Learning Objectives   |
|---|---|
| Bonding in Carbon                                     | Write down electron shell configuration of carbon in order to predict formulae of carbon compounds and illustrate the structure of molecules of carbon compounds with chain, branched & ring structure. |
| Saturated and Unsaturated carbon compounds            | Draw structures of carbon compounds in order to classify them as saturated or unsaturated   |
| Chains branches and rings                             | Draw structures of carbon compounds and show types of bonds (single/ double/ triple) in order to classify them as alkanes/ alkenes/ alkynes   |
| Functional groups                                     | Draw structures of carbon compounds with functional groups, in order to predict their properties due to functional groups and type of bonding present   |
| Homologous Series                                     | Classify carbon compounds in homologous series in order to predict their properties   |
| Nomenclature of carbon compounds                      | Identify the functional group, type of bonding, number of C atoms present in a carbon compound, in order to correctly name them   |
| Chemical properties of carbon compounds<br>Combustion | Observe how carbon compounds burn in oxygen, in order to classify them as saturated or unsaturated  |
| Oxidation   | Illustrate the chemical properties of carbon compounds (like combustion, oxidation, addition & substitution) along with balanced chemical reaction.   |
| Addition  | Identify how carbon compounds react with hydrogen in the presence of nickel catalyst, in order to write a balanced chemical reaction  |
| Substitution  | Identify how carbon compounds react with chlorine in the presence of sunlight, in order to write a balanced chemical reaction   |
| Ethanol & ethanoic acid                               | Perform physical and chemical tests in order to distinguish between Ethanol & Ethanoic acid based on their properties (reaction with other substances)  |

|                      |   |
|----------------------|---|
| Soaps and detergents | Describe the process of micelle formation in order to understand how soaps work |
|----------------------|---|

### Learning Objectives and Learning Outcomes:

| Learning Objectives  | Learning Outcome  |
|--|---|
| Classify carbon compounds in homologous series in order to predict their properties  | Differentiates materials / objects / organisms / phenomena / processes, based on, properties / characteristics, such as autotrophic and heterotrophic nutrition, biodegradable and non-biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.  |
| Illustrate the chemical properties of carbon compounds (like combustion, oxidation, addition & substitution) along with balanced chemical reaction.    |   |
| Identify how carbon compounds react with hydrogen in the presence of nickel catalyst, in order to write a balanced chemical reaction                   |   |
| Identify how carbon compounds react with chlorine in the presence of sunlight, in order to write a balanced chemical reaction                          |   |
| Observe how carbon compounds burn in oxygen, in order to classify them as saturated or unsaturated   | Plans and conducts investigations / experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own, such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light? |
| Perform physical and chemical tests in order to distinguish between Ethanol & Ethanoic acid based on their properties (reaction with other substances) |   |
| Describe the process of micelle formation in order to understand how soaps work  |   |
| Draw structures of carbon compounds and show types of bonds (single/ double/ triple) in order to classify them as alkanes/ alkenes/ alkynes            | Draws labelled diagrams / flow charts / concept map /graphs, such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.   |
| Draw structures of carbon compounds with functional groups, in order to predict their properties due to functional groups and type of bonding present  |   |
| Write down electron shell configuration of carbon in order to predict formulae of carbon   |   |



|   |   |
|---|---|
| compounds and illustrate the structure of molecules of carbon compounds with chain, branched & ring structure.                  |   |
| Draw structures of carbon compounds in order to classify them as saturated or unsaturated                                       |   |
| Identify the functional group, type of bonding, number of C atoms present in a carbon compound, in order to correctly name them | Uses scientific conventions to represent units of various quantities / symbols / formulae / equations, such as balanced chemical equation by using symbols and physical states of substances, sign convention in optics, si units, etc. |

## Test items



**LOB:** Write down electron shell configuration of carbon in order to predict formulae of carbon compounds and illustrate the structure of molecules of carbon compounds with chain, branched & ring structure

- 1) What is the electronic configuration of carbon?
- (a) 2, 4  
 (b) 2, 8  
 (c) 2, 2, 4  
 (d) 2, 4, 4

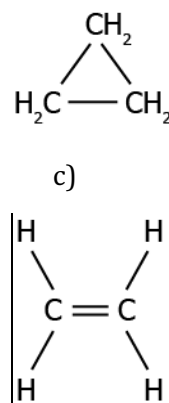
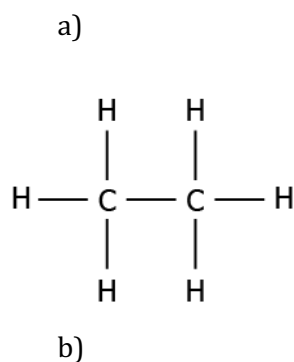
**Correct Answer:** Option (a)

- 2) The electronic configuration of an element is found to be 2, 4. How many bonds can one carbon atom form in a compound?
- (a) 1  
 (b) 2  
 (c) 4  
 (d) 6

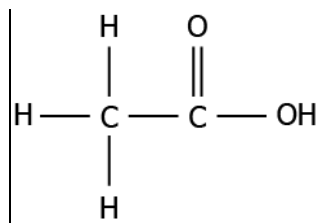
**Correct Answer:** Option (c)

**LOB:** Draw structures of carbon compounds in order to classify them as saturated or unsaturated

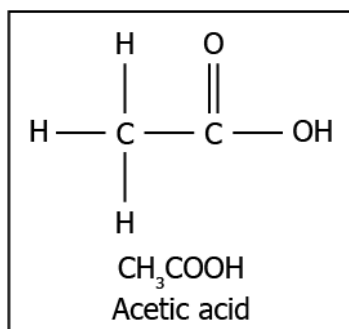
- 1) Which of these compounds can be classified as an unsaturated compound?



d)

**Correct Answer:** Option (c)

- 2) A student studies that acetic acid is a saturated compound. The structure of the compound is shown.



Why is acetic acid classified as a saturated compound?

- a) because there is a the single bond between the carbon atoms
- b) because there is a double bond between the carbon and oxygen atoms
- c) because there is a single bond between the carbon and hydrogen atoms
- d) because there is a single bond between the carbon and hydroxide diatom

**Correct Answer:** Option (a)

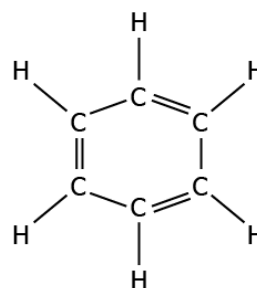
**LOB:** Draw structures of carbon compounds and show types of bonds (single/ double/ triple) in order to classify them as alkanes/ alkenes/ alkynes

- 1) Which of these carbon compounds represents an alkene

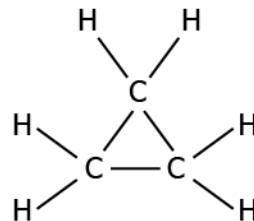
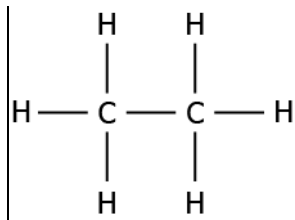
a)



b)



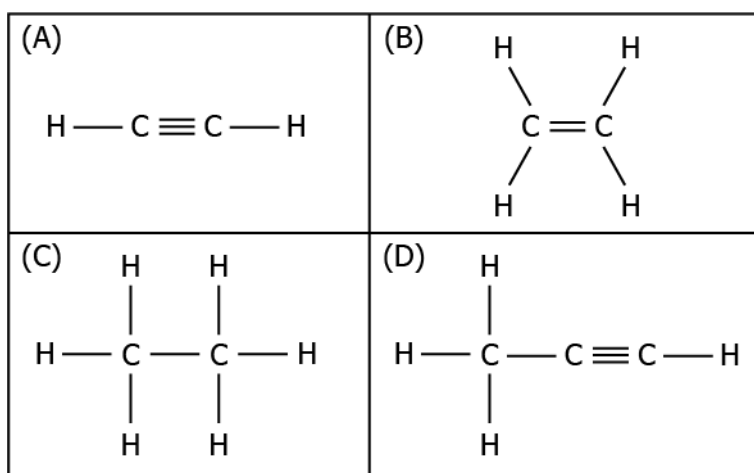
c)



d)

**Correct Answer:** Option (b)

2) The image represents the structure of a few hydrocarbon compounds.

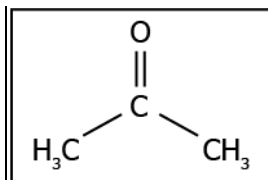


Which of these compounds can be classified as alkynes?

- (a) only (A)  
 (b) only (B)  
 (c) both (A) and (D)  
 (d) both (B) and (C)

**Correct Answer:** Option (c)**LOB:** Draw structures of carbon compounds with functional groups, in order to predict their properties due to functional groups and type of bonding present

1) The image represents a carbon compound.



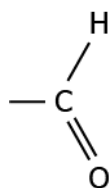
Which functional group is present in the compound?

- (a) alcohol  
 (b) aldehyde  
 (c) carboxylic acid  
 (d) ketone

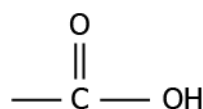
**Correct Answer:** Option (d)

2) Which of these functional groups can combine with carbon to produce alcohol?

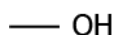
(a)



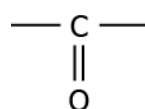
(c)



(b)



(d)



**Correct Answer:** Option (b)

**LOB:** Classify carbon compounds in homologous series in order to predict their properties

1) Which of these series can be classified as homologous series?

- (a)  $\text{CHCl}_3$ ,  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{C}_3\text{H}_7\text{OH}$
- (b)  $\text{CH}_3\text{OH}$ ,  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{C}_3\text{H}_7\text{OH}$
- (c)  $\text{CHCl}_3$ ,  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{CH}_3\text{COOH}$
- (d)  $\text{CH}_3\text{COOH}$ ,  $\text{C}_4\text{H}_9\text{OH}$ ,  $\text{C}_2\text{H}_5\text{OH}$

**Correct Answer:** Option (b)

2) A student studies that the carbon compounds  $\text{CH}_3\text{OH}$ ,  $\text{C}_2\text{H}_5\text{OH}$ ,  $\text{C}_3\text{H}_7\text{OH}$ , and  $\text{C}_4\text{H}_9\text{OH}$  can be group as homologues series. Why are these compounds grouped as homologous series?

- (a) because of an increase in number of carbon atom along the series
- (b) because of an increase in number of hydrogen atom along with the series
- (c) because of the presence of the same functional group substitute for hydrogen in a carbon chain
- (d) because of the presence of the same carbon compounds substitute for hydrogen in a carbon chain

**Correct Answer:** Option (c)

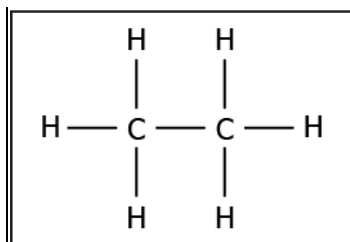
**LOB:** Identify the functional group, type of bonding, number of C atoms present in a carbon compound, in order to correctly name them

1) A carbon compound contains two atoms of carbon. Which name should the carbon compound bear?

- (e) Butane
- (f) Ethane
- (g) Methane
- (h) Propane

**Correct Answer:** Option (b)

2) The image represents the structure of a carbon compound known as ethane.



Which option explains the naming of ethane?

- (a) the presence of functional group connected with a single bond
- (b) as it contains two carbon atoms and a single bond connects the carbon atoms
- (c) carbon compound with a total number of eight atoms are named as ethane
- (d) as it contains six hydrogen atoms and a single bond connects the carbon and hydrogen atom

**Correct Answer:** Option (b)

**LOB:** Observe how carbon compounds burn in oxygen, in order to classify them as saturated or unsaturated

1) A student conducts an activity where he burns methane in the presence of oxygen. What is likely to form?

- (a) Water
- (b) carbon dioxide
- (c) dioxide and water
- (d) carbon dioxide and oxygen

**Correct Answer:** Option (c)

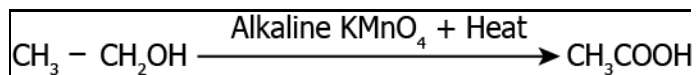
2) A student conducts an activity, where he took a naphthalene ball and burn it. He observed that it gives a yellow flame with lots of black smoke and sooty deposits around it. What type of hydrocarbon does naphthalene contain?

- (a) unsaturated, as black smoke represents complete combustion
- (b) unsaturated, as sooty deposit represents unburnt hydrocarbons
- (c) saturated, as it gives a yellow flame which represents complete combustion
- (d) saturated, as the burning of any substance represents a complete combustion

**Correct Answer:** Option (b)

**LOB:** Illustrate the chemical properties of carbon compounds (like combustion, oxidation, addition & substitution) along with balanced chemical reaction

1) The reaction represents the conversion of alcohol into acids.

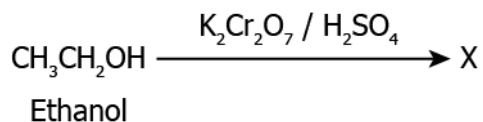


Which of these acts an oxidising agent that helped to complete the reaction?

- (a) Heat
- (b)  $\text{CH}_3\text{COOH}$
- (c)  $\text{CH}_3\text{CH}_2\text{OH}$
- (d) Alkaline  $\text{KMnO}_4$

**Correct Answer:** Option (d)

2) The image represents a chemical reaction where ethanol is oxidised using potassium dichromate and sulphuric acid.



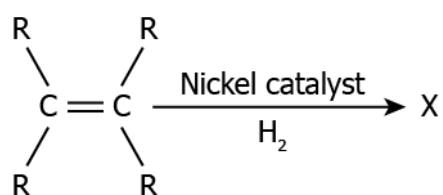
Which option represents the product "X"?

- (a)  $\text{CH}_2\text{O}$
- (b)  $\text{CH}_3\text{CH}$
- (c)  $\text{CH}_3\text{H}_2\text{O}$
- (d)  $\text{CH}_3\text{COOH}$

**Correct Answer:** Option (d)

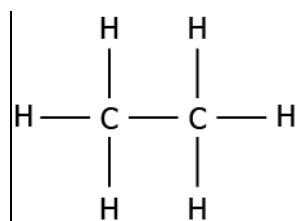
**LOB:** Identify how carbon compounds react with hydrogen in the presence of nickel catalyst, in order to write a balanced chemical reaction

1) The image represents the chemical reaction of an unsaturated hydrocarbon in the presence of nickel.

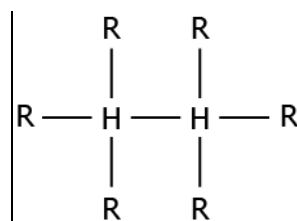


Which option represents the product "X"?

(a)



(b)

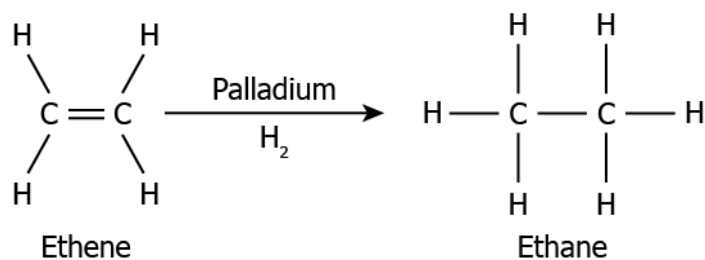


(c)



**Correct Answer:** Option (c)

2) The image represents a chemical reaction where an unsaturated hydrocarbon is converted into a saturated hydrocarbon in the presence of a catalyst.



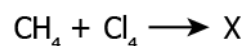
Which option identifies the action of the catalyst?

- (a) it causes a reaction to proceed without the reaction itself being affected
- (b) it causes the removal of all hydrogen atom bonded to the carbon atom
- (c) causes to change the single bonds to double and triple bonds
- (d) causes the production of oxygen during the reaction

**Correct Answer:** Option (a)

**LOB:** Identify how carbon compounds react with chlorine in the presence of sunlight, in order to write a balanced chemical reaction

1) The chemical reaction shows the addition of chlorine to methane in the presence of sunlight.



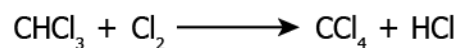
What is likely to be the product of the reaction represented by "X"?

- (a)  $\text{CH}_4 + \text{H}_2\text{SO}_4$
- (b)  $\text{CH}_3\text{Cl} + \text{HCl}$
- (c)  $\text{CHCl}_3 + \text{HCl}$
- (d)  $\text{CH}_3\text{Cl} + \text{H}_2\text{SO}_4$

**Correct Answer:** Option (b)

**LOB:** Identify how carbon compounds react with chlorine in the presence of sunlight, in order to write a balanced chemical reaction

1) The chemical reaction shows the addition of chlorine gas to hydrocarbon in the presence of sunlight.



How does chlorine react to a hydrocarbon compound in the presence of sunlight?

- (a) it adds hydrogen into the compound

- (b) it adds an oxygen atom into the compound
- (c) it substitutes hydrogen atom from the compound
- (d) it breaks double and triple bonds into a single bond

**Correct Answer:** Option (c)

**LOB:** Perform physical and chemical tests in order to distinguish between Ethanol & Ethanoic acid based on their properties (reaction with other substances)

1) A student studies that vinegar, which is a diluted form of ethanoic acid, freezes during winter. What does this suggest about the physical properties of pure ethanoic acid?

- (a) it has a low boiling point
- (b) it has a low melting point
- (c) it has a very high boiling point
- (d) it has a very high melting point

**Correct Answer:** Option (b)

1) A student conducts an activity where he took ethanoic acid and ethanol in the presence of an acid catalyst. He noticed that the resulted product has some sweet-smelling fragrance. What is likely to be the product?

- (a)  $\text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$
- (b)  $\text{CH}_3\text{COOH} + \text{H}_2\text{O}$
- (c)  $\text{C}_2\text{H}_5\text{OH} + \text{H}_2\text{O}$
- (d)  $\text{COOH} + \text{H}_2\text{O}$

**Correct Answer:** Option (a)

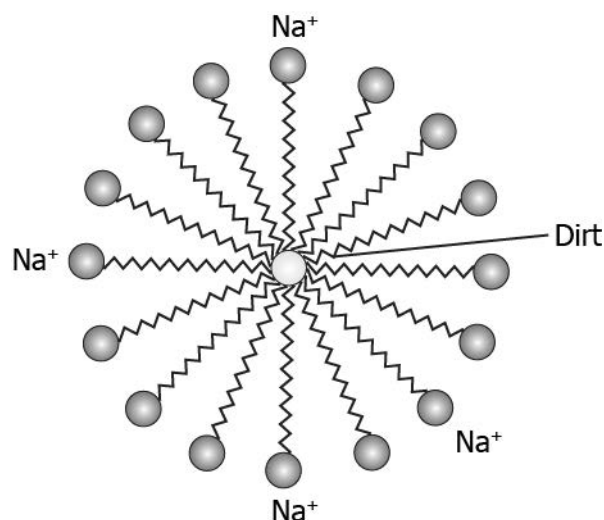
**LOB:** Describe the process of micelle formation in order to understand how soaps work

1) A student studies that a soap molecule has two ends, one of which is an ionic end and the other is the carbonic chain. Which option explains the interaction of a soap molecule with oil?

- (a) ionic end of the soap interacts with the oil
- (b) the closest end of the soap interacts with the oil
- (c) carbonic chain end of the soap interacts with the oil
- (d) ends of the soap randomly interact with the oil

**Correct Answer:** Option (c)

1) A student studies that soap solution results in micelle formation which helps to remove dirt. It has a unique orientation which helps in keeping the dirt out of the water as shown in the image.



What helps the dirt to risen away?

- (a) suspension of the dirt in the micelles



- (b) a collection of water molecules in the centre of the micelle
- (c) attraction between the ionic end and the dirt to remove it
- (d) mixing of the soap molecules along with the dirt to make it heavier

**Correct Answer:** Option (a)

# Suggested Teacher Resources



## Activity



|                   |  |                                 |   |                                |                                      |
|-------------------|--|---------------------------------|---|--------------------------------|--------------------------------------|
| Objective         | Outline physical and chemical properties of ethanol to ethanoic acid, in order to detect their presence given an unknown compound. |                                 |   |                                |                                      |
| Prerequisite      | Solubility, pH   |                                 |   |                                |                                      |
| Material Required | Test tubes, watch glass, distilled water, pH paper, dropper  |                                 |   |                                |                                      |
| Vocabulary        | -  |                                 |   |                                |                                      |
| Procedure         | 1. To determine the physical properties of ethanol and ethanoic acid, carry out the following procedures:                          |                                 |   |                                |                                      |
|                   | <b>S. No.</b>  | <b>Physical characteristics</b> | <b>Procedure</b>  | <b>Observation for Ethanol</b> | <b>Observation for Ethanoic Acid</b> |
|                   | 1.   | <b>Colour</b>                   | Take 2 ml of the sample in a clean test tube and observe the colour from the walls of the test tube.  |                                |                                      |
|                   | 2.   | <b>Odour</b>                    | Take the same sample in a watch glass, bring it close to your nose (at a safe distance) and gently waft to take the odour of the sample.              |                                |                                      |
|                   | 3.   | <b>Solubility in water</b>      | Take 2 ml of the sample in a test tube and add 2 ml of water to it. Gently shake the test tube and observe for homogeneous or heterogeneous solution. |                                |                                      |
|                   | 4.   | <b>pH</b>                       | Take a small amount of sample in a clean test tube and using a dropper, place a drop of sample on the pH paper.                                       |                                |                                      |
|                   | 2. To determine the chemical properties of ethanol and ethanoic acid, carry out the following procedure:                           |                                 |   |                                |                                      |

|                               | S. No.   | Procedure  | Observation for Ethanol | Observation for Ethanoic Acid |
|-------------------------------|--|--|-------------------------|-------------------------------|
|                               | 1  | Take 2ml of the sample in a test tube and add 1 ml of sodium carbonate solution and observe the changes. |                         |                               |
| Reflection Questions          | <ol style="list-style-type: none"> <li>1. What is the distinguishing physical property between ethanol and ethanoic acid?</li> <li>2. What is the distinguishing chemical property between ethanol and ethanoic acid?</li> </ol> |  |                         |                               |
| Text to real world connection | <ol style="list-style-type: none"> <li>1. Both commercially available ethanol and ethanoic acid are solutions of these chemicals in water. Find out for what purpose are each of these used?</li> </ol>                          |  |                         |                               |
| Beyond the classroom          | Acetic acid or ethanoic acid is also used as a very important food preservative. Find out how it is able to preserve food.   |  |                         |                               |

2

## Activity



|                      |   |
|----------------------|---|
| Material required    | Ball and stick models (alternatively, clay balls and toothpicks can be used), paints  |
| Procedure            | <ol style="list-style-type: none"> <li>1. Students should work in teams of 4.</li> <li>2. Provide each team with clay (for atoms), toothpicks that represent bonds between atoms, and paints of suitable colours.</li> <li>3. Each team should be asked to draw electron dot structures of simple compounds such as <math>H_2O</math>, <math>H_2S</math>, <math>NH_3</math>, <math>CH_4</math>, <math>CCl_4</math>, <math>SO_2</math>, <math>CO_2</math> followed by their ball and stick model.</li> <li>4. For each model the team should decide how many atoms and bonds they need, based on the formula of the element or compound.</li> <li>5. Students should then make the model and paint the atoms in appropriate colours.</li> <li>6. Post this the students should be encouraged to form models of atoms with more than one carbon centres.</li> </ol> |
| Reflection questions | <ol style="list-style-type: none"> <li>1. Which value did you practice in your teams today?</li> <li>2. What can be other ways to create three-dimensional models of molecules?</li> </ol>  |

# 5. Periodic Classification of Elements

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts        | Learning Objectives  |
|----------------------------------|--|
| Early attempts at classification | Calculate the average atomic mass given masses of different elements, in order to identify Dobereiner's Triads                 |
|                                  | Arrange elements in order of increasing atomic masses, in order to form Newlands' Octaves                                      |
| Mendeleev's Periodic Table       | Arrange the elements on the basis of their properties like oxides and hydrides, in order to form Mendeleev's Periodic Table    |
|                                  | Identify the achievements and limitations in Mendeleev's periodic table with respect to arrangement of elements.               |
| Modern Periodic Table (MPT)      | Interpret the arrangement of elements in the MPT.  |
|                                  | Compute the group and period number of an element given its atomic number, in order to determine its place in MPT              |
|                                  | Compute the number of shells & valence electrons of an element given its position in MPT, in order to determine its properties |
|                                  | Predict the position of elements in the MPT in order to explain the trends in groups and periods.                              |
|                                  | Predict the trend of atomic size across the period and down the group, in order to explain arrangement of elements in MPT      |
|                                  | Analyse the usefulness of MPT in studying the chemical behaviour of elements.  |

**Learning Objectives and Learning Outcomes:**

| Learning Objectives                               | Learning Outcome  |
|---|---|
| Interpret the arrangement of elements in the MPT. | Explains processes and phenomena, such as nutrition in human beings and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc. |

|   |   |
|---|---|
| Analyse the usefulness of MPT in studying the chemical behaviour of elements.   | Analyses interdependencies in order to draw conclusions: (such as traits/ features are inherited through genes present on chromosomes, a new species originates through evolutionary processes, water is made up of hydrogen and oxygen, properties of elements vary periodically along the groups and periods in periodic table, potential difference across a metal conductor is proportional to the electric current through it, etc.) |
| Arrange the elements on the basis of their properties like oxides and hydrides, in order to form Mendeleev's Periodic Table   |   |
| Compute the group and period number of an element given its atomic number, in order to determine its place in MPT   |   |
| Compute the number of shells & valence electrons of an element given its position in MPT, in order to determine its properties  |   |
| Predict the position of elements in the MPT in order to explain the trends in groups and periods.   |   |
| Predict the trend of atomic size across the period and down the group, in order to explain arrangement of elements in MPT   |   |
| Calculate the average atomic mass given masses of different elements, in order to identify Dobereiner's Triads  |   |
| Arrange elements in order of increasing atomic masses, in order to form Newlands' Octaves   |   |
| Identify the achievements and limitations in Mendeleev's periodic table with respect to arrangement of elements.  |   |
| Takes initiative to know about scientific discoveries / inventions, such as Mendel's contribution in understanding the concept of inheritance, Dobereiner for discovering triads of elements, Mendeleev for the development of the periodic table of elements, Oersted discovery that electricity and magnetism are related, discovery of relation between potential difference across a metal conductor and the electric current through it by ohm, etc. |   |

# Test items



**LOB:** Calculate the average atomic mass given masses of different elements, in order to identify Dobereiner's Triads

- 1) The table lists the symbol and atomic mass of three elements.

| Element   | Symbol | Atomic Mass |
|-----------|--------|-------------|
| Lithium   | Li     | 7           |
| Sodium    | Na     | 23          |
| Potassium | K      | 39          |

Which option gives the average atomic mass of the elements that support Dobereiner's Triads?

- (a) mass of lithium + mass of sodium 2  
 (b) mass of lithium + mass of sodium + mass of potassium 2  
 (c) mass of lithium + mass of potassium 2  
 (d) mass of lithium + mass of potassium - mass of sodium 2

**Correct Answer:** Option (c)

- 2) The image shows three set of elements.

| W      |             | X      |             |
|--------|-------------|--------|-------------|
| Symbol | Atomic Mass | Symbol | Atomic Mass |
| N      | 14.0        | Ca     | 40.1        |
| P      | 31.0        | Sr     | 87.6        |
| As     | 74.9        | Ba     | 137.3       |

| Y      |             | Z      |             |
|--------|-------------|--------|-------------|
| Symbol | Atomic Mass | Symbol | Atomic Mass |
| C      | 12          | Cl     | 35.5        |
| N      | 14          | Br     | 79.9        |
| O      | 16          | I      | 126.9       |

Which set of element follows the rule of Dobereiner's Triads?

- (a) W and X  
 (b) X and Y  
 (c) Y and Z  
 (d) Z and X

**Correct Answer:** Option (d)

**LOB:** Arrange elements in order of increasing atomic masses, in order to form Newlands' Octaves

- 1) Newland arranged some elements in order of increasing atomic masses and formed Newlands' Octaves. Which option arranges the elements in order to form Newlands' Octaves?

(a)

|    |
|----|
| Be |
| Sr |
| Ca |
| Zn |
| Mg |

(c)

|    |
|----|
| Li |
| Na |
| K  |
| Cu |
| Rb |

(b)

|    |
|----|
| Cr |
| Al |
| Y  |
| La |
| B  |

(d)

|    |
|----|
| C  |
| Si |
| Ti |
| In |
| Zr |

**Correct Answer:** Option (c)

2) How Chlorine, Bromine, Fluorine, Cobalt, and Hydrogen be arranged in order to satisfy the concept of Newlands' Octaves?

- (a) Chlorine, Bromine, Fluorine, Cobalt, Hydrogen  
 (b) Hydrogen, Fluorine, Bromine, Cobalt, Bromine  
 (c) Fluorine, Chlorine, Cobalt, Bromine, Hydrogen  
 (d) Cobalt, Bromine, Hydrogen, Fluorine, Chlorine

**Correct Answer:** Option (b)

**LOB:** Arrange the elements on the basis of their properties like oxides and hydrides, in order to form Mendeleev's Periodic Table

1) The image shows the arrangement of the elements in the Mendeleev's Periodic Table done by a student.

| Group            | I            | II                    | III                         | IV                                 | V                           | VI                                 | VII            | VIII                 |
|------------------|--------------|-----------------------|-----------------------------|------------------------------------|-----------------------------|------------------------------------|----------------|----------------------|
| Oxide<br>hydride | $R_2O$<br>RH | RO<br>RH <sub>2</sub> | $R_2O_3$<br>RH <sub>3</sub> | RO <sub>2</sub><br>RH <sub>4</sub> | $R_2O_5$<br>RH <sub>3</sub> | RO <sub>3</sub><br>RH <sub>2</sub> | $R_2O_7$<br>RH | RO <sub>4</sub>      |
| Periods<br>↓     | A B          | A B                   | A B                         | A B                                | A B                         | A B                                | A B            | Transition<br>series |
| 1                | H<br>1.008   |                       |                             |                                    |                             |                                    |                |                      |
| 2                | Na<br>22.99  | Mg<br>24.31           | Al<br>29.98                 | Si<br>28.09                        | P<br>30.974                 | S<br>32.06                         | Cl<br>35.453   |                      |
| 3                | Li<br>6.939  | Be<br>9.012           | B<br>10.81                  | C<br>12.011                        | N<br>14.007                 | O<br>15.999                        | F<br>18.998    |                      |

What is the error done by the student while arranging the elements?

- (a) The student arranged hydrogen in the first group.  
 (b) The student arranged chlorine and fluorine in the seventh period.  
 (c) The student arranged the elements of the third period in the fourth period.

(d) The student arranged the elements of the third group in the second group.

**Correct Answer:** Option (d)

2) Which option arranges the elements of period four in the correct groups?

(a)

|             |             |            |             |             |             |             |
|-------------|-------------|------------|-------------|-------------|-------------|-------------|
| Mn<br>54.94 | Cr<br>50.20 | V<br>50.94 | Ti<br>47.90 | Sc<br>44.96 | Ca<br>40.08 | K<br>39.102 |
|-------------|-------------|------------|-------------|-------------|-------------|-------------|

(b)

|             |             |             |             |            |             |             |
|-------------|-------------|-------------|-------------|------------|-------------|-------------|
| K<br>39.102 | Ca<br>40.08 | Ti<br>47.90 | Sc<br>44.96 | V<br>50.94 | Cr<br>50.20 | Mn<br>54.94 |
|-------------|-------------|-------------|-------------|------------|-------------|-------------|

(c)

|             |             |             |             |            |             |             |
|-------------|-------------|-------------|-------------|------------|-------------|-------------|
| K<br>39.102 | Ca<br>40.08 | Sc<br>44.96 | Ti<br>47.90 | V<br>50.94 | Cr<br>50.20 | Mn<br>54.94 |
|-------------|-------------|-------------|-------------|------------|-------------|-------------|

(d)

|             |             |            |             |             |             |             |
|-------------|-------------|------------|-------------|-------------|-------------|-------------|
| Mn<br>54.94 | Cr<br>50.20 | V<br>50.94 | Sc<br>44.96 | Ti<br>47.90 | Ca<br>40.08 | K<br>39.102 |
|-------------|-------------|------------|-------------|-------------|-------------|-------------|

**Correct Answer:** Option (c)

**LOB:** Identify the achievements and limitations in Mendeleev's periodic table with respect to arrangement of elements

1) Which option describes the achievements of the Mendeleev's Periodic Table?

(a) prediction of noble gases

(b) it eliminated the blank spaces left in the table

(c) predicting that the elements can be arranged based on their properties

(d) an element in a trend has an average atomic mass of the elements above and below it

**Correct Answer:** Option (a)

2) A student studies about Mendeleev's periodic table and lists some statements.

P. No fixed position was given to carbon in the periodic table.

Q. The atomic masses do not increase in a regular manner.

R. Isotopes of an element have different chemical properties but similar atomic masses.

Which option lists the limitations of the Mendeleev's Periodic Table?

(a) only P

(b) only R

(c) both P and Q

(d) both Q and R

**Correct Answer:** Option (a)



**LOB: Interpret the arrangement of elements in the MPT**

1) Which option arranges the elements based on increasing atomic numbers based on the Modern Periodic Table?

- (a) C → N → O → Ne → F
- (b) S → Ar → Cl → Ca → K
- (c) H → Li → He → Be → B
- (d) Na → Mg → Al → Si → P

**Correct Answer:** Option (d)

2) A student studying Modern periodic table arranges some elements in different groups, as shown.

| <b>Group 1</b> |                 | <b>Group 18</b> |
|----------------|-----------------|-----------------|
| H<br>Hydrogen  |                 | He<br>Helium    |
| Li<br>Lithium  | <b>Group 2</b>  | Ne<br>Neon      |
| Na<br>Sodium   | Be<br>Beryllium | Ar<br>Argon     |
| K<br>Potassium | Ca<br>Calcium   | Kr<br>Krypton   |
| Rb<br>Rubidium | Mg<br>Magnesium | Xe<br>Xeon      |
| Cs<br>Caesium  | Sr<br>Strontium | Rn<br>Radon     |
| Fr<br>Francium | Ba<br>Barium    | Og<br>Oganesson |
|                | Ra<br>Radium    |                 |

Which group supports the guidelines of the Modern Periodic table?

- (a) group 1
- (b) group 18
- (c) groups 1 and 2
- (d) groups 1 and 18

**Correct Answer:** Option (d)

**LOB:** Compute the group and period number of an element given its atomic number, in order to determine its place in MPT

- 1) The image shows an element with its atomic number and mass number.

|            |
|------------|
| 15         |
| P          |
| Phosphorus |
| 31.0       |

Which option arranges the element in the periodic table?

- (a) group - 1; period -1  
 (b) group - 5; period -3  
 (c) group - 10; period -1  
 (d) group - 15; period -3

**Correct Answer:** Option (d)

- 2) An element X has atomic number 9. In which period and group, it can be placed in the modern periodic table?

(a)

| Period | Group |
|--------|-------|
| 2      | 17    |

(b)

| Period | Group |
|--------|-------|
| 7      | 17    |

(c)

| Period | Group |
|--------|-------|
| 2      | 7     |

(d)

| Period | Group |
|--------|-------|
| 7      | 7     |

**Correct Answer:** Option (a)

**LOB:** Compute the number of shells & valence electrons of an element given its position in MPT, in order to determine its properties

- 1) Boron is a non-metal and is placed under group 13 and period 2. How can boron form bonds with other elements?

- (a) by sharing 5 electrons  
 (b) by sharing 3 electrons  
 (c) by sharing 2 electrons  
 (d) by sharing 1 electron

**Correct Answer:** Option (b)

- 2) An element has atomic number 20 and in group 2 and period 4. Which option gives the number of valence electrons and shells present in the element?

(a)

| Shells | Valence Electrons |
|--------|-------------------|
| 3      | 8                 |

(b)

| Shells | Valence Electrons |
|--------|-------------------|
| 4      | 2                 |

(c)

| Shells | Valence Electrons |
|--------|-------------------|
| 4      | 6                 |

(d)

| Shells | Valence Electrons |
|--------|-------------------|
| 3      | 2                 |

**Correct Answer:** Option (b)**LOB:** Predict the position of elements in the MPT in order to explain the trends in groups and periods

- 1) What is the trend of valency along the periods in the modern periodic table?
- it increases from left to right
  - it decreases from right to left
  - it increases and then decreases
  - it decreases and then increases

**Correct Answer:** Option (c)

- 2) The image shows the list of elements in group 2.

**Group 2**

|                 |
|-----------------|
| Be<br>Beryllium |
| Mg<br>Magnesium |
| Ca<br>Calcium   |
| Sr<br>Strontium |
| Ba<br>Barium    |
| Ra<br>Radium    |

What will be the trend of valency as one goes from Beryllium to Radium?

- (a) it will remain the same
- (b) it will increase till radium
- (c) it will decrease and then increase after calcium
- (d) it will increase and then decrease after calcium

**Correct Answer:** Option (a)

**LOB:** Predict the trend of atomic size across the period and down the group, in order to explain arrangement of elements in MPT

1) A student learns that the atomic size depends on the atomic radius of the elements. How does the atomic radius of elements in the third-period change as one goes from sodium to argon?

- (a) Option 1: atomic radius increases from sodium to argon
- (b) atomic radius decreases from sodium to argon
- (c) atomic radius increases as new shells are added
- (d) atomic radius decreases due to the addition of new shells

**Correct Answer:** Option (b)

2) A student notices that the atomic mass of elements of group 1 increases as one moves from hydrogen to caesium, as shown.

### Group 1

|                              |
|------------------------------|
| 1<br>H<br>Hydrogen<br>1.0    |
| 3<br>Li<br>Lithium<br>6.9    |
| 11<br>Na<br>Sodium<br>23.0   |
| 19<br>K<br>Potassium<br>39.1 |
| 37<br>Rb<br>Rubidium<br>85.5 |
| 55<br>Cs<br>Caesium<br>132.9 |

Which option gives the reason for the increasing atomic mass?

- (a) addition of shells
- (b) an increase in nuclear charge
- (c) addition of electrons in the same shells

(d) decrease in distance between the outermost electrons and nucleus

**Correct Answer:** Option (a)

**LOB:** Analyse the usefulness of MPT in studying the chemical behaviour of elements

- 1) What is the order of the metallic character down the group?
- Option 1: it decreases as new shells are added to the element
  - it increases as electrons move away from the nucleus
  - increases as new atoms are added in the same shell
  - it decreases as the effective nuclear charge on the electron increases

**Correct Answer:** Option (b)

- 2) Electronegativity is defined as the ability of an element to form bonds by gaining electrons. How does the electronegativity of elements vary across the periods?
- it increases as the number of shells increases
  - decreases as the number of shells decreases
  - increases as the more of electrons are added to the same shell
  - it decreases as the more of electrons are added to the same shell

**Correct Answer:** Option ©

## Suggested Teacher Resources



### Activity



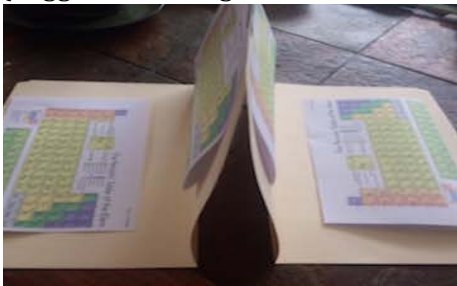
| Objective         | Arrange the elements on the basis of their properties like oxides and hydrides, in order to form Mendeleev's Periodic Table.  |                          |            |                          |  |                         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------------|---|--------------------------|------------|--------------------------|--|-------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Prerequisite      | Writing chemical formulae, valencies of the first 18 elements of the Modern Periodic Table.   |                          |            |                          |  |                         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Material Required | NCERT textbook  |                          |            |                          |  |                         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Vocabulary        | Groups: The vertical columns in Mendeleev's Periodic Table<br>Periods: The horizontal rows in Mendeleev's Periodic Table.   |                          |            |                          |  |                         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Procedure         | Arrange the first 18 elements as in the following table: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Atomic No.</th> <th>Symbol</th> <th>Electronic Configuration</th> <th>Ion Formed</th> <th>Compound with oxide ion</th> <th>Compound with hydrogen proton or hydride ion</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table> | Atomic No.               | Symbol     | Electronic Configuration | Ion Formed                                   | Compound with oxide ion | Compound with hydrogen proton or hydride ion |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Atomic No.        | Symbol  | Electronic Configuration | Ion Formed | Compound with oxide ion  | Compound with hydrogen proton or hydride ion |                         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                   |   |                          |            |                          |  |                         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                   |   |                          |            |                          |  |                         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                   |   |                          |            |                          |  |                         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                   |   |                          |            |                          |  |                         |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

|                               |  |
|-------------------------------|--|
| Reflection Questions          | <ol style="list-style-type: none"> <li>1. What patterns do you observe in the chemical formulas of the elements?</li> <li>2. Club the elements with similar pattern together and map with Mendeleev's Periodic Table to check if you are achieving a similar arrangement.</li> <li>3. What was the basis of classification of elements by Mendeleev?</li> <li>4. Why do you think he chose only compounds of oxygen and hydrogen to define the chemical properties?</li> </ol> |
| Text to real world connection | <ol style="list-style-type: none"> <li>1. Why does a kirana store owner keep similar items together in the store? What disadvantage will they have if all items are jumbled?</li> <li>2. What patterns do you observe in your everyday life and how do you end up mentally sorting items based on those patterns? (think of patterns in vehicle number plates, groceries stored at home, clothes stored at home)</li> </ol>  |
| Beyond the classroom          | If you had to arrange the elements in the periodic table way before any scientists came up with their theories, what basis would you have chosen? (Think of anything and everything under the Sun.)  |

## 2

## Activity



|                      |  |
|----------------------|--|
| Material required    | One print of the periodic table per student  |
| Procedure            | <p>(This activity will be best carried out at the end of the chapter)</p> <p>The Periodic Table Bingo</p> <ol style="list-style-type: none"> <li>1. Students will be seated in pairs.<br/>(Suggested Arrangement, Source: study.com)</li> </ol>  <ol style="list-style-type: none"> <li>2. Player 1 will call out an element not by naming it but by describing a maximum of 4 of its physical or chemical properties.</li> <li>3. Player 2 will guess the element and cancel out the one they think is correct on their periodic table.</li> <li>4. Player 1 will then reveal the element and indicate a "hit" or a "miss".</li> <li>5. The player with the maximum hits at the end of 15 cycles wins the game.</li> </ol> |
| Reflection questions | <ol style="list-style-type: none"> <li>1. What value did you build while playing this game?</li> </ol>   |

# 6. Life Processes

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts | Learning Objectives  |
|---------------------------|--|
| Autotrophic Nutrition     | Explain the process of absorption of CO <sub>2</sub> & H <sub>2</sub> O, in order to understand how autotrophs obtain substances necessary for nutrition |
|                           | Explain the process of conversion of CO <sub>2</sub> & H <sub>2</sub> O into carbohydrates, in order to understand how autotrophs obtain nutrition       |
| Heterotrophic Nutrition   | List and explain the strategies employed by heterotrophs to take up food, in order to understand how heterotrophs obtain nutrition                       |
| Nutrition in Human Beings | Illustrate the process involved in human digestive system, in order to explain how humans obtain nutrients from food                                     |
|                           | List the enzymes & their functions involved in human digestive system, in order to understand breakdown of food in humans                                |
| Respiration               | Outline and explain the ways of breakdown of glucose by various pathways, in order to explain how energy is obtained in organisms                        |
|                           | Illustrate the process involved in human respiratory system, in order to explain how humans take in oxygen and expel CO <sub>2</sub>                     |
| Transportation in Animals | Illustrate the process of transport of oxygenated & de-oxygenated blood by human heart, in order to explain how oxygen is transported to cells           |
|                           | Outline the process of double circulation of blood in fishes, in order to explain how oxygenated & deoxygenated blood is compartmentalized               |
|                           | Describe the function of blood vessels, arteries, platelets & lymph in human body, in order to understand how human transportation system works          |
| Transportation in Plants  | Explain the function of xylem (vessels and tracheids) in plants, in order to explain how plants take up water from soil                                  |
|                           | Explain the function of transpiration in order to explain how water travels up in plants   |
|                           | Explain the function of phloem & ATP, in order to explain how food is transported in plants  |

|                     |   |
|---------------------|---|
| Excretion in Humans | Illustrate the process involved in human excretory system, in order to explain how waste is transported out of humans' body |
| Excretion in Plants | Describe transpiration and other ways in which plants shed extra wastes, in order to explain excretion in plants            |

### **Learning Objectives and Learning Outcomes:**

| <b>Learning Objectives</b>  | <b>Learning Outcomes</b>  |
|---|---|
| List and explain the strategies employed by heterotrophs to take up food, in order to understand how heterotrophs obtain nutrition and differentiate it from autotrophic nutrition. | Differentiates materials / objects / organisms / phenomena / processes, based on, properties / characteristics, such as autotrophic and heterotrophic nutrition, biodegradable and non-biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.  |
| Explain the process of absorption of CO <sub>2</sub> & H <sub>2</sub> O, in order to understand how autotrophs obtain substances necessary for nutrition                            | Plans and conducts investigations / experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own, such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light? |
| Explain the process of conversion of CO <sub>2</sub> & H <sub>2</sub> O into carbohydrates, in order to understand how autotrophs obtain nutrition                                  | Explains processes and phenomena, such as nutrition in human beings and plants, transportation in plants and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.  |
| Illustrate the process involved in human digestive system, in order to explain how humans obtain nutrients from food  |   |
| List the enzymes & their functions involved in human digestive system, in order to understand breakdown of food in humans   |   |
| Outline and explain the ways of breakdown of glucose by various pathways, in order to explain how energy is obtained in organisms   |   |
| Illustrate the process involved in human respiratory system, in order to explain how humans take in oxygen and expel CO <sub>2</sub>  |   |
| Illustrate the process of transport of oxygenated & de-oxygenated blood by  |   |
|   |   |



|   |  |  |
|---|--|--|
| human heart, in order to explain how oxygen is transported to cells   |  |  |
| Outline the process of double circulation of blood in fishes, in order to explain how oxygenated & deoxygenated blood is compartmentalized  |  |  |
| Describe the function of blood vessels, arteries, platelets & lymph in human body, in order to understand how human transportation system works                                     |  |  |
| Explain the function of xylem (vessels and tracheids) in plants, in order to explain how plants take up water from soil   |  |  |
| Explain the function of transpiration in order to explain how water travels up in plants  |  |  |
| Explain the function of phloem & ATP, in order to explain how food is transported in plants   |  |  |
| Illustrate the process involved in human excretory system, in order to explain how waste is transported out of humans' body   |  |  |
| Describe transpiration and other ways in which plants shed extra wastes, in order to explain excretion in plants  |  |  |
| List and explain the strategies employed by heterotrophs to take up food, in order to understand how heterotrophs obtain nutrition and differentiate it from autotrophic nutrition. |  | Draws labelled diagrams / flow charts / concept map / graphs, such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc. |
| Illustrate the process involved in human digestive system, in order to explain how humans obtain nutrients from food  |  |  |
| Illustrate the process involved in human respiratory system, in order to explain how humans take in oxygen and expel CO <sub>2</sub>  |  |  |
| Illustrate the process of transport of oxygenated & de-oxygenated blood by human heart, in order to explain how oxygen is transported to cells                                      |  |  |
| Illustrate the process involved in human excretory system, in order to explain how waste is transported out of humans' body   |  |  |

Illustrate the process involved in human digestive system, in order to explain how humans obtain nutrients from food

Illustrate the process involved in human respiratory system, in order to explain how humans take in oxygen and expel CO<sub>2</sub>

Illustrate the process of transport of oxygenated & de-oxygenated blood by human heart, in order to explain how oxygen is transported to cells

Illustrate the process involved in human excretory system, in order to explain how waste is transported out of humans' body

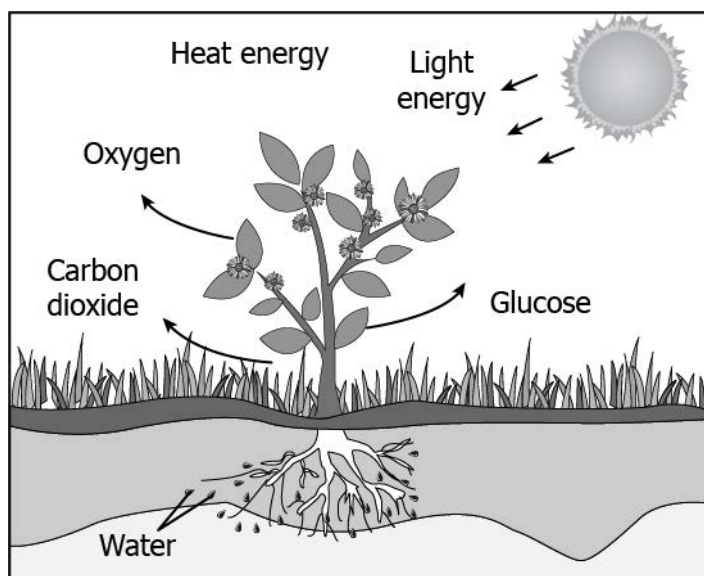
Exhibits creativity in designing models using eco-friendly resources, such as working model of respiratory, digestive and excretory systems, soda acid fire extinguisher, periodic table, micelles formation, diamond / graphite / Buckminster fullerene, human eye, electric motor and generator, etc.

## Test items



**LOB:** Explain the process of absorption of CO<sub>2</sub> & H<sub>2</sub>O, in order to understand how autotrophs obtain substances necessary for nutrition

1) The image shows the process of making food by a plant.



Which statement can be concluded from the image?

- plants absorb CO<sub>2</sub> from air and H<sub>2</sub>O from the soil as raw materials and convert them into glucose
- plants absorb CO<sub>2</sub> from the soil and H<sub>2</sub>O from air as raw materials and convert them into glucose
- plants absorb O<sub>2</sub> from air and glucose from the soil as raw materials and convert them into light energy
- plants absorb O<sub>2</sub> from air and minerals from the soil as raw materials and convert them into heat energy

**Correct Answer:** Option (a)

2) A student sets up an experiment to study the importance of nutrition in plants. The student takes 2 pots, pot 1 and pot 2 each with the same healthy plant. Both the pots were placed in the garden and watered properly. Pot 1 was kept as such, while pot 2 was kept in an air tight glass box with caustic soda. Caustic soda absorbs carbon dioxide present in the surrounding. After 2 days, the student observes that the plant kept in the garden is healthy while the plant placed in container shed leaves and droops. What is the likely reason for this observation?

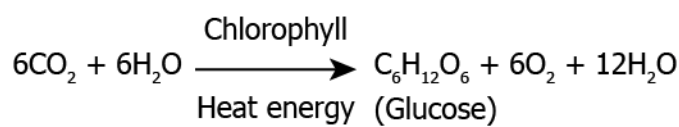
- (a) lack of nutrients in the soil
- (b) absence of oxygen for survival
- (c) inability to perform photosynthesis
- (d) absorption of light by caustic soda restricting growth

**Correct Answer:** Option (c)

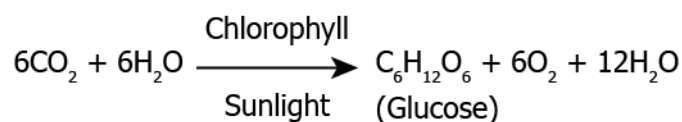
**LOB:** Explain the process of conversion of CO<sub>2</sub> & H<sub>2</sub>O into carbohydrates, in order to understand how autotrophs obtain nutrition

1) Which of the equation show correct conversion of CO<sub>2</sub> and H<sub>2</sub>O into carbohydrates in plants?

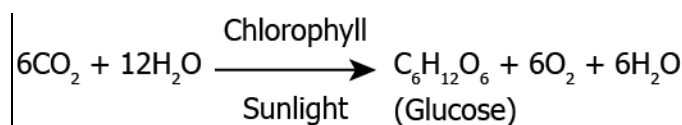
(a)



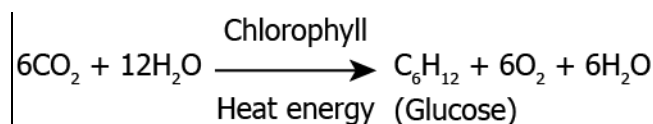
(b)



(c)

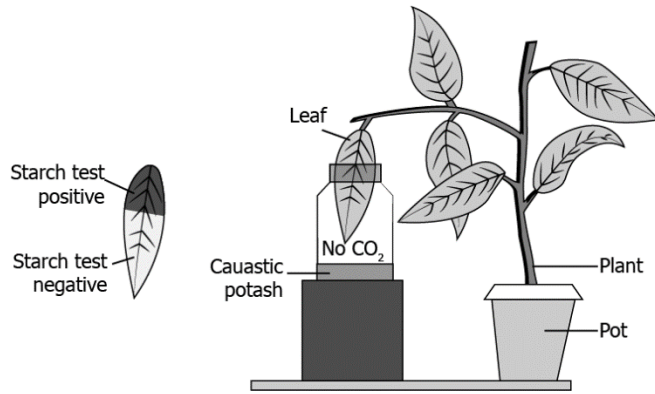


(d)



**Correct Answer:** Option (c)

2) A student sets up an experiment to study the photosynthesis in plants. The student de-starched a potted plant by keeping it in a dark room for 3 days. Half of the portion of de-starched leaf was placed in a bottle containing caustic potash (absorbs CO<sub>2</sub>) as shown.



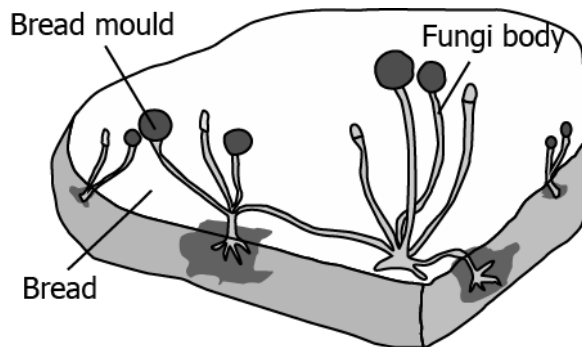
The student then places the plant in light and tests the leaf after 5 hours for the presence of starch. The portions inside the bottle shows negative starch test by reflecting no change in colour when react with iodine, however, other upper portions of the leaf gave positive starch test showing blue-black colour with iodine. What can be evaluated from this experiment?

- (a) carbon dioxide is directly linked with the colour of leaf
- (b) carbon dioxide is necessary for preparing carbohydrate
- (c) lack of carbon dioxide increases amount of starch in plant
- (d) lack of carbon dioxide slows the process of photosynthesis

**Correct Answer:** Option (b)

**LOB:** List and explain the strategies employed by heterotrophs to take up food, in order to understand how heterotrophs obtain nutrition

- 1) The image shows the bread moulds on a bread.

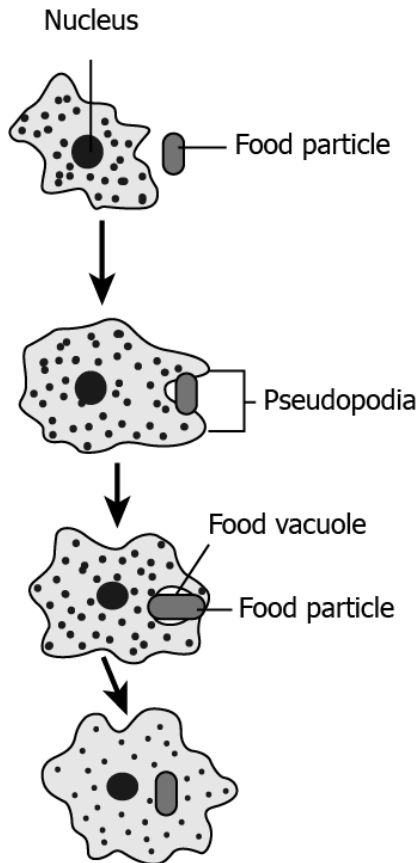


How these fungi obtain nutrition?

- (a) by eating the bread on which it is growing
- (b) by using nutrients from the bread to prepare their own food
- (c) by breaking down the nutrients of bread and then absorbing them
- (d) by allowing other organisms to grow on the bread and then consuming them

**Correct Answer:** Option (c)

2) The image shows how *Amoeba* obtains nutrition.



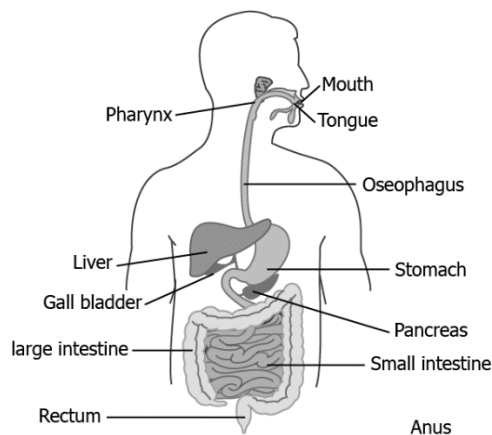
How this process is advantageous for *Amoeba*?

- (a) capturing of food takes less time
- (b) complex food can be digested easily
- (c) more amount of food can be consumed
- (d) fast distribution of nutrition within the body

**Correct Answer:** Option (d)

**LOB:** Illustrate the process involved in human digestive system, in order to explain how humans obtain nutrients from food

1) The image shows the human digestive system.

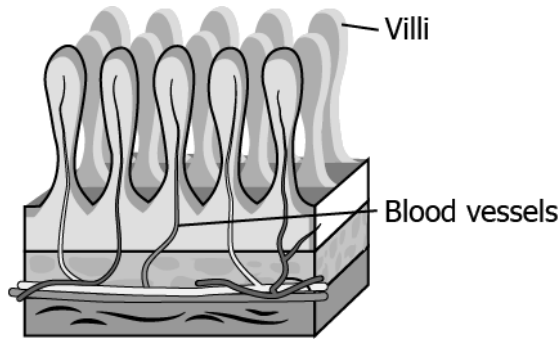


Digestion of food starts from which organ of the digestive system?

- (a) mouth due to the presence of saliva
- (b) oesophagus that moves the food in gut
- (c) that releases juices for fat breakdown
- (d) which helps in mixing food with digestive juices

**Correct Answer:** Option (a)

2) The image shows a cross section of small intestine.



What will be the likely happen if the number of villi increases in the intestine?

- (a) increase in the absorption of food
- (b) fast elimination of waste from the body
- (c) increase in flow of blood in the small intestine
- (d) fast breakdown of larger food particles into smaller ones

**Correct Answer:** Option (a)

**LOB:** List the enzymes & their functions involved in human digestive system, in order to understand breakdown of food in humans

1) An incomplete equation for the digestion of starch using saliva is shown as:

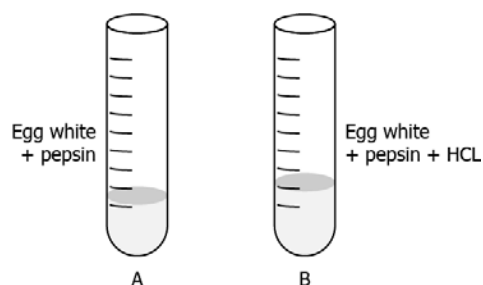
Saliva + Starch (in test tube) →

What will be the likely outcome of this?

- (a) Saliva will convert starch into complex fat molecules.
- (b) Saliva will convert starch into complex sugar molecules.
- (c) Saliva will breakdown starch into simple sugar molecules.
- (d) Saliva will breakdown starch into simple protein molecules.

**Correct Answer:** Option (c)

2) A student sets up an experiment to study the role of enzymes in digestion of food.



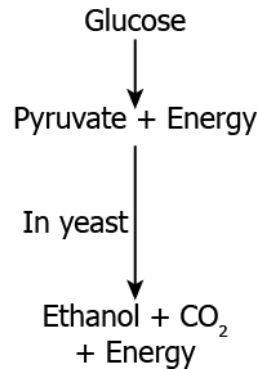
In which test tube, the digestion of protein will occur?

- (a) Test tube A as pepsin will breakdown into simple molecules.
- (b) Test tube B as HCl will breakdown protein into simple molecules.
- (c) Test tubes A as pepsin will breakdown protein into simple molecules.
- (d) Test tube B as HCl will activate pepsin for breakdown of protein into simple molecules.

**Correct Answer:** Option (b)

**LOB:** Outline and explain the ways of breakdown of glucose by various pathways, in order to explain how energy is obtained in organisms

1) The image shows the flow diagram for the breakdown of glucose in yeast.

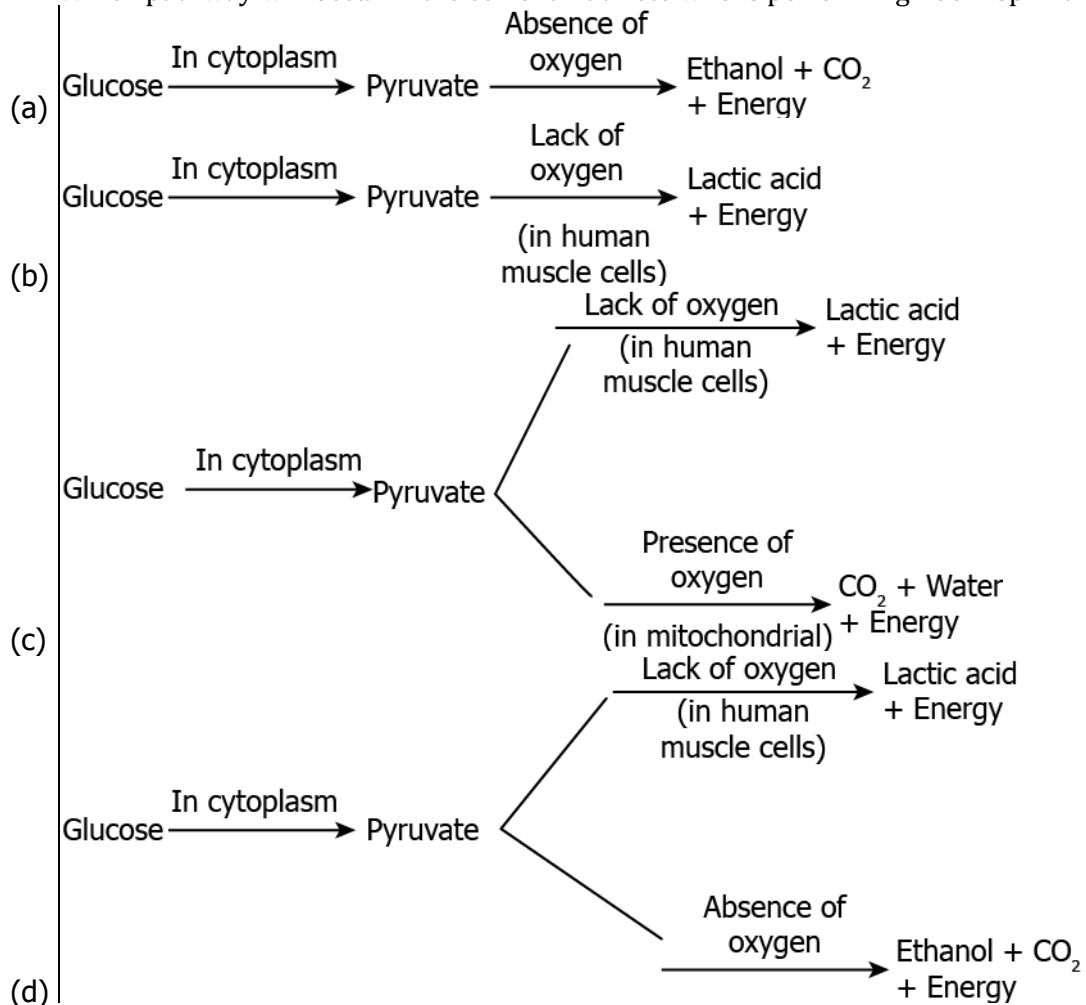


Under which condition these types of products are obtained?

- (a) in the presence of oxygen
- (b) in the absence of oxygen
- (c) the presence of carbon dioxide
- (d) in the absence of carbon dioxide

**Correct Answer:** Option (b)

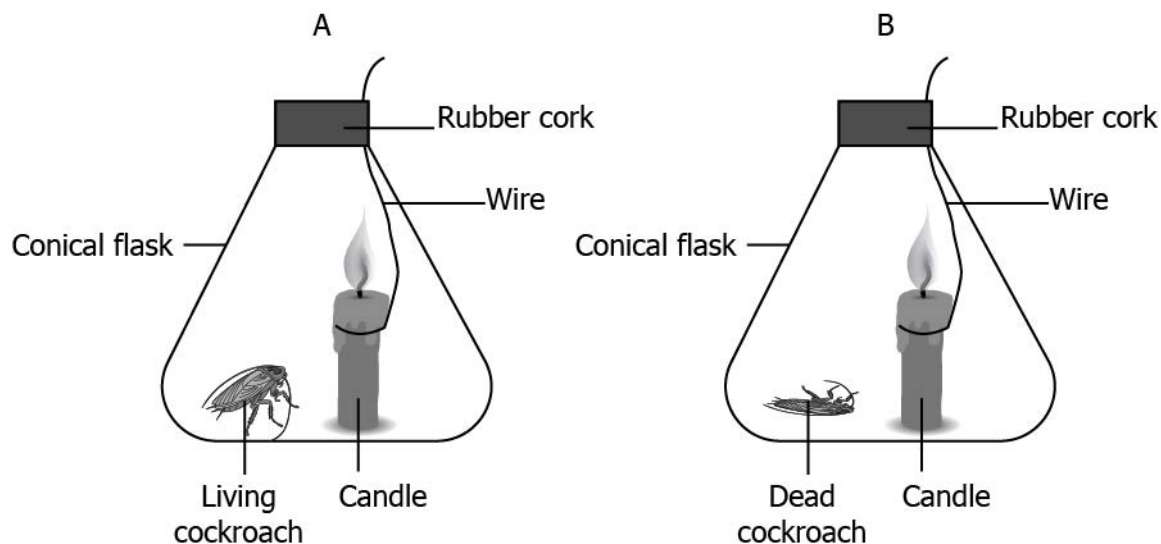
2) Which pathway will occur in the cell of an athlete who is performing 100m sprint?



**Correct Answer:** Option (c)

**LOB:** Illustrate the process involved in human respiratory system, in order to explain how humans take in oxygen and expel CO<sub>2</sub>

1) A student setup an experiment to study the human respiratory system. In the experiment, the student places candle and a living cockroach in the flask A, while a candle and a dead cockroach in flask B. The burning of candle needs oxygen.

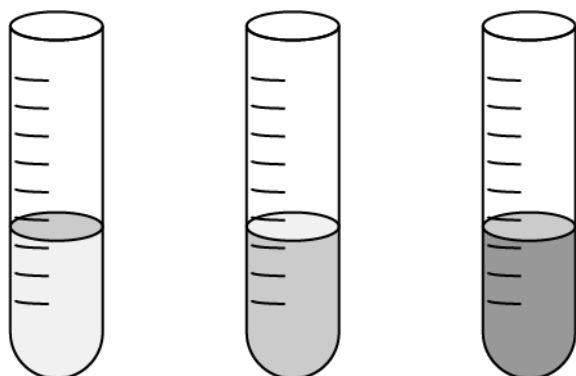


After 10 minutes, the student observes that the candle in flask A extinguish faster while candle in flask B keeps burning for a longer time. What can be evaluated from this experiment?

- (a) candle produces high amount of carbon dioxide
- (b) living beings consumes oxygen during respiration
- (c) burning of candle decreases the life span of cockroach
- (d) water vapours produced by living beings prevents burning of candle

**Correct Answer:** Option (b)

2) A student sets up an experiment to study human respiration using lime water, test tube and a straw. Lime water is colourless in the absence of CO<sub>2</sub> and is milky in its presence. The student fills a freshly prepared limewater in a test tube and blows air through straw into the limewater. It was observed that the solution turns cloudy as shown.



What can be evaluated from this observation?

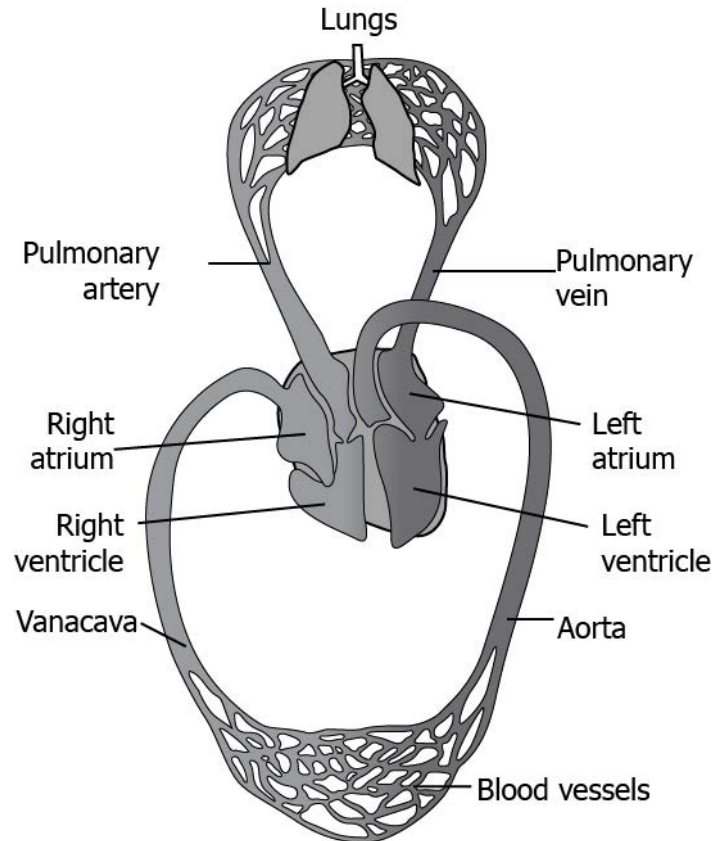
- (a) oxygen is exhaled during respiration
- (b) glucose is produced during respiration
- (c) dioxide is exhaled during respiration
- (d) water vapours are produced during respiration



**Correct Answer:** Option (c)

**LOB:** Illustrate the process of transport of oxygenated & de-oxygenated blood by human heart, in order to explain how oxygen is transported to cells

1) The image shows the transport of gases in body through heart and lungs.

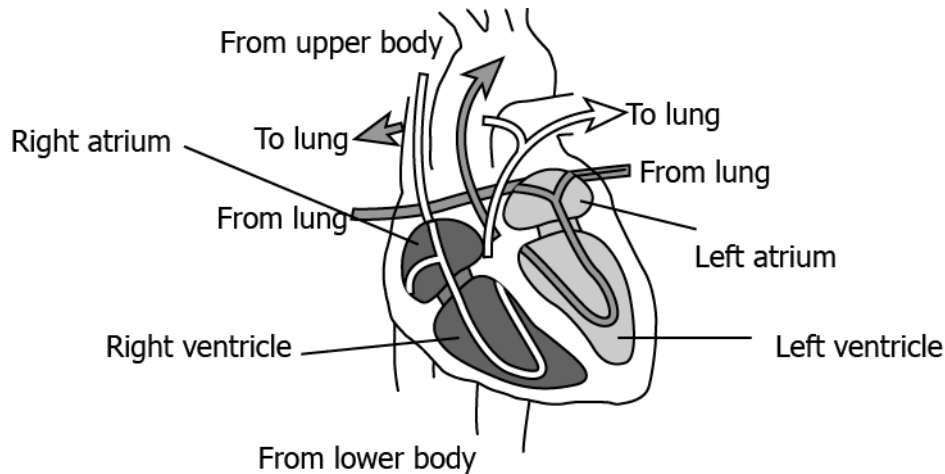


Which option correctly shows the transport of oxygen to the cell?

- (a) Lungs → pulmonary vein → left atrium → left ventricle → aorta → body cells
- (b) Lungs → pulmonary vein → right atrium → right ventricle → aorta → body cells
- (c) Lungs → pulmonary artery → left atrium → left ventricle → vena cava → body cells
- (d) Lungs → pulmonary artery → right atrium → right ventricle → vena cava → body cells

**Correct Answer:** Option (a)

2) The image shows oxygenated and de-oxygenated blood in the human heart.



- Oxygenated blood
- De-oxygenated blood

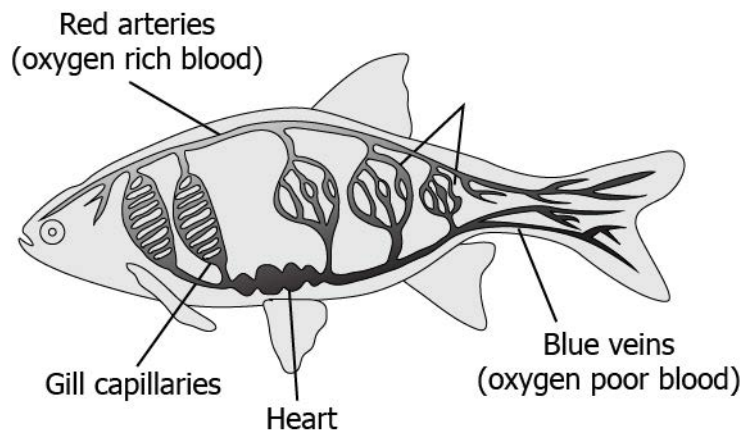
What is the direction of deoxygenated blood from right atrium of the heart?

- (a) towards the lungs
- (b) towards the lower body
- (c) towards the upper body
- (d) towards the left atrium of heart

**Correct Answer:** Option (a)

**LOB:** Outline the process of double circulation of blood in fishes, in order to explain how oxygenated & de-oxygenated blood is compartmentalized

1) The image shows the circulation of blood in fishes.

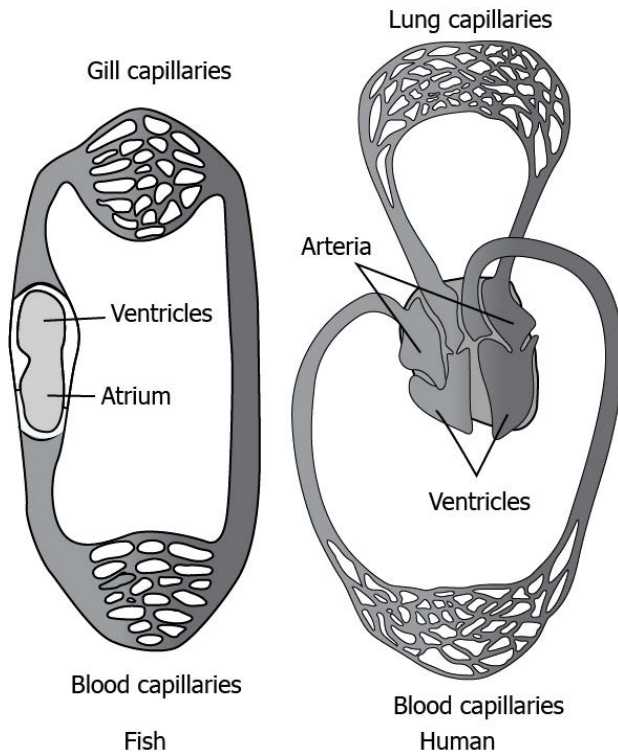


Which option correctly traces the pathway of blood flow in fish body?

- (a) Gill capillaries → oxygenated blood → heart → body cells → deoxygenated blood → gills
- (b) Gill capillaries → oxygenated blood → body cells → deoxygenated blood → heart → gills
- (c) capillaries → heart → oxygenated blood → body cells → deoxygenated blood → heart → gills
- (d) Gill capillaries → oxygenated blood → heart → body cells → deoxygenated blood → heart → gills

**Correct Answer:** Option (b)

2) The image shows the circulation of blood in fishes and humans.



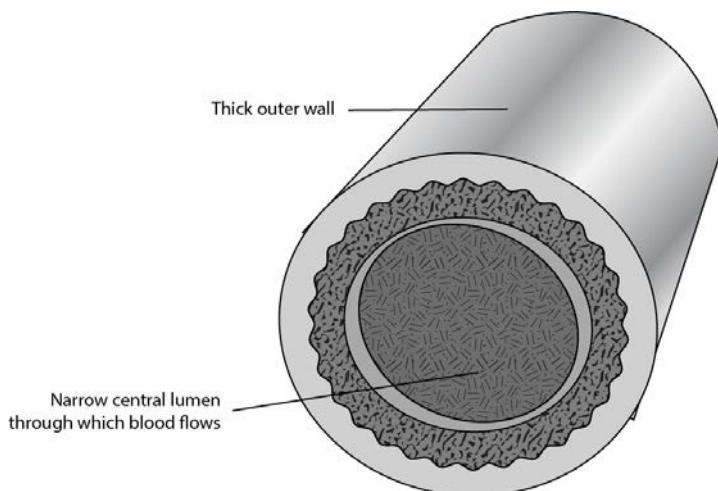
How is the circulations of blood in fish different from that in humans?

- (a) The heart in fish is bigger in size.
- (b) The flow of blood in fish is unidirectional.
- (c) The blood goes through heart only once in fishes.
- (d) The heart of fish has more chambers compared to that of a human.

**Correct Answer:** Option (c)

**LOB:** Describe the function of blood vessels, arteries, platelets & lymph in human body, in order to understand how human transportation system works

1) The image shows the structure of an artery.

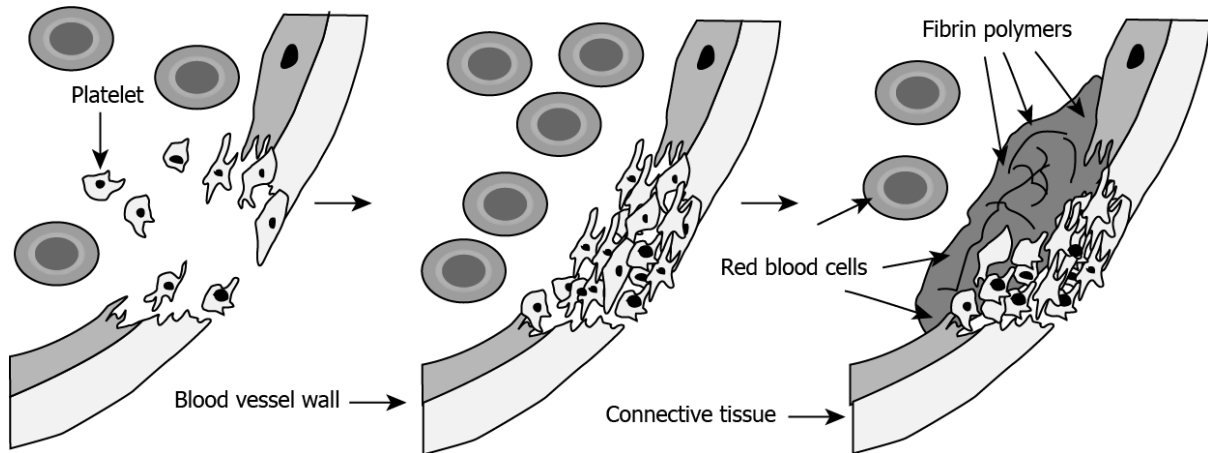


Which statement supports the likely reason for thick walls in arteries?

- (a) to carry large amount of blood
- (b) to allow easy exchange of gases with cells
- (c) to ensure blood flows in only one direction
- (d) to sustain the high-pressure blood from the heart

**Correct Answer:** Option (d)

2) The image shows the healing of a wound.



Based on the image, what explains the process?

- (a) platelets form clot by plugging the site of injury
- (b) platelets uses component of broken vessel to form clot
- (c) red blood cells divide and replace the broken vessel at the site of injury
- (d) red blood cells and platelets migrate to site of injury and secrete substance that forms new vessel

**Correct Answer:** Option (a)

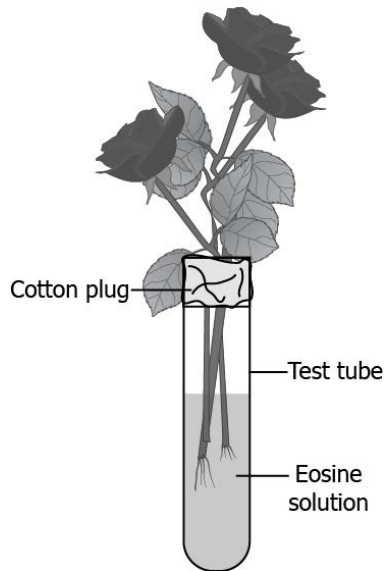
**LOB:** Explain the function of xylem (vessels and tracheids) in plants, in order to explain how plants take up water from soil

1) How water is taken up from soil to the xylem tissue of the plant roots?

- (a) xylem attracts water molecules
- (b) roots act as a suction pump for taking water
- (c) soil expels the water with pressure to the xylem
- (d) difference in the ion concentration creates a gradient for water movement

**Correct Answer:** Option (d)

2) A student performs an experiment using a balsam plant with intact stem, leaves, roots and flowers. The plant was kept in a test tube containing eosin solution (a pink colour dye). The test tube mouth was covered using cotton plug as shown.



The student kept the plant undisturbed in the lab. After 2-3 hours, a transverse section of stem was obtained using sharp scissors and studied under microscope. The studies reveal the presence of pink colour in the vessels of xylem. What does this observation explain?

- (a) eosin solution gets stored in the xylem
- (b) water moves through xylem in the plant
- (c) xylem reacts with eosin and gives colour
- (d) most portion of the plant stem is occupied by xylem

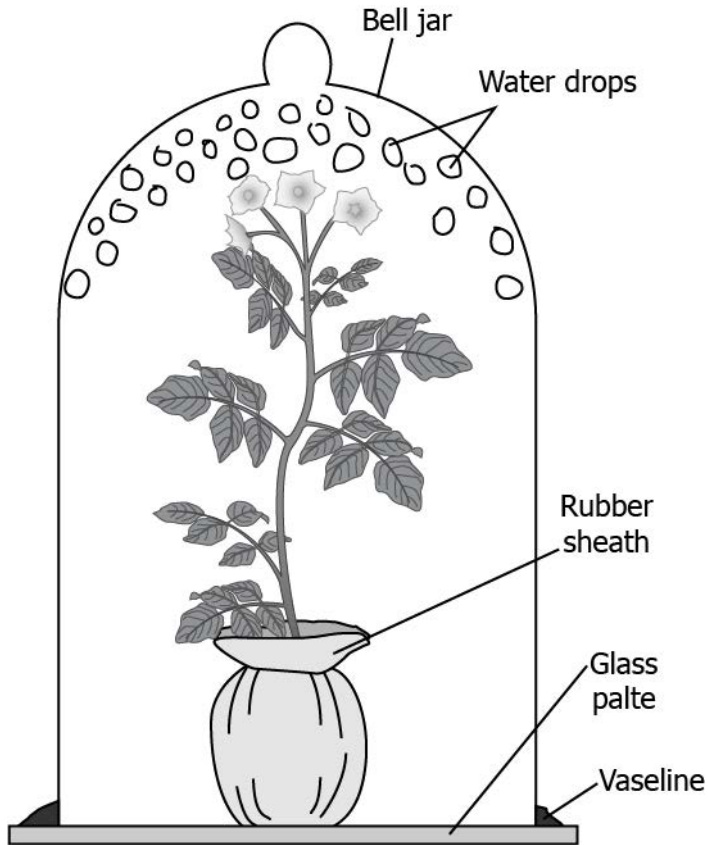
**Correct Answer:** Option (b)

**LOB:** Explain the function of transpiration in order to explain how water travels up in plants

- 1) The loss of water from the leaves of the plant is transpiration. How this process is advantageous for the plant?
- (a) It helps in the downward movement of the water.
  - (b) It helps the plant to maintain temperature in hot sunny days.
  - (c) It acts as a driving force for distribution of food in plant's body.
  - (d) helps maintain a constant level of water in the soil around the plant.

**Correct Answer:** Option (b)

- 2) A student setup an experiment using a well-watered plant. The plant's roots and soil were covered with a rubber sheet. The plant was then kept in a glass bell jar and sealed with Vaseline at the bottom part to prevent the flow of air. The student keeps the apparatus in the light and observes water drops inside the jar after 2 hours as shown in the image.



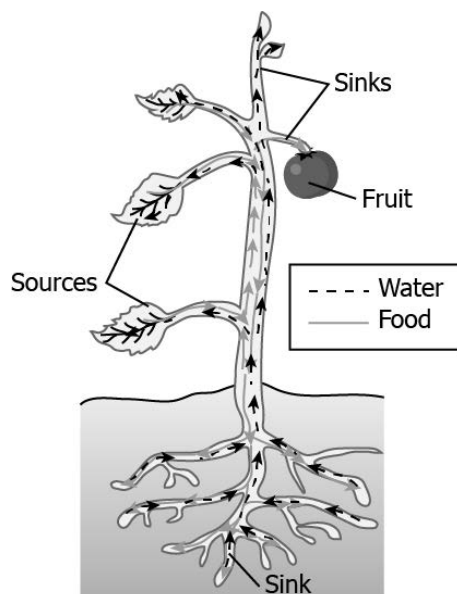
What can be evaluated about transpiration from this experiment?

- (a) Plant leaves give off water in form of vapours.
- (b) Heat from the outside warms the jar which melts the vaseline into vapours.
- (c) Plant absorbs water from environment thus extra water appears on the inside of jar.
- (d) Covered roots and stem of the plant decreases the temperature of jar resulting in condensation of moisture into vapours.

**Correct Answer:** Option (a)

**LOB:** Explain the function of phloem & ATP, in order to explain how food is transported in plants

- 1) The image shows the transport of food material inside plant body with the help of phloem.

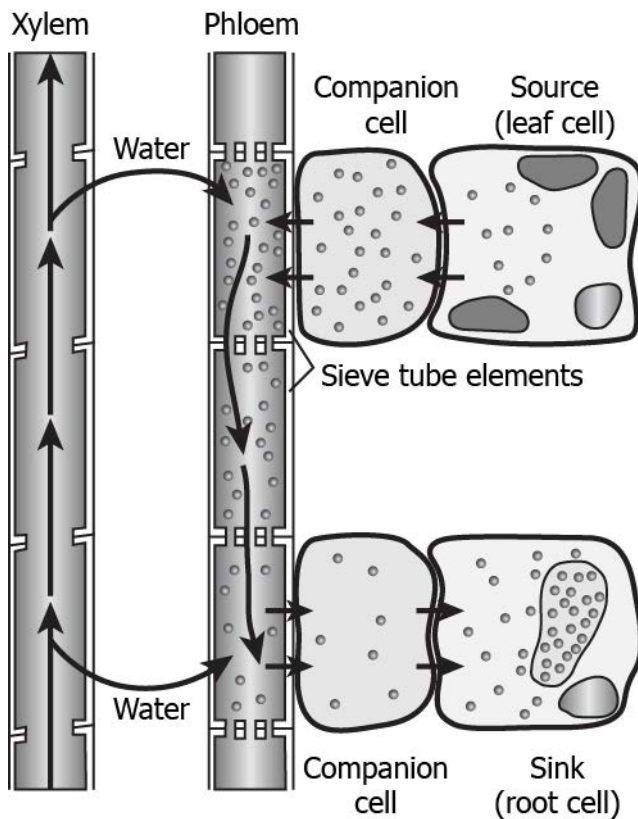


How is food transported from phloem to the tissues according to plants need?

- (a) food is transported along with the water in plant's body.
- (b) food is transported in only direction like water in the plant body through xylem.
- (c) food is transported from a region with low concentration to higher concentration.
- (d) Food is transported from a region where it is produced to other parts of the plants.

**Correct Answer:** Option (d)

2) The image shows the movement of sucrose into phloem against the concentration gradient which also leads to the movement of water due to osmotic difference. This osmotic pressure allows movement of material in plant body.



How the movement of sucrose into phloem takes place initially?

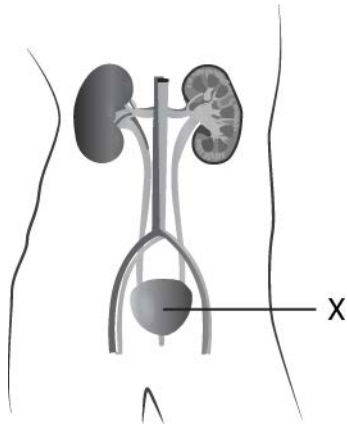
- (a) with the help of transpiration
- (b) with the help of water gradient
- (c) with the help of ATP molecules
- (d) with the help of ADP molecules

**Correct Answer:** Option (c)



**LOB:** Illustrate the process involved in human excretory system, in order to explain how waste is transported out of humans' body

1) The image shows the excretory system in humans.

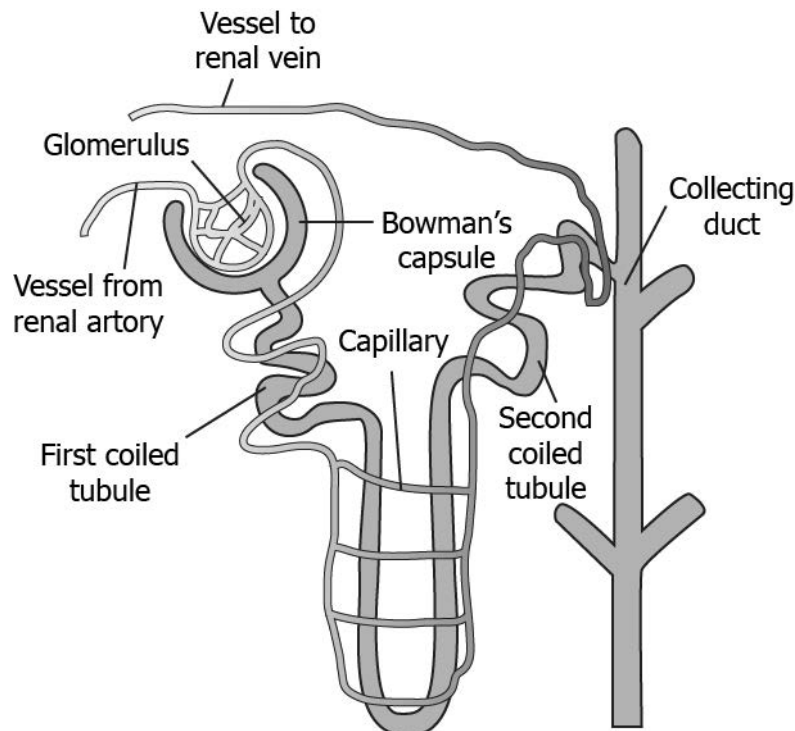


What is the importance of the labelled part in excretory system?

- (a) It produces urine.
- (b) It filters waste from the blood.
- (c) It stores the urine till urination.
- (d) It carries urine from kidney to outside.

**Correct Answer:** Option (c)

2) The image shows the structure of a nephron.



Nephron is a unit of filtration in kidneys that filters waste material. It selectively reabsorbs or excretes water with the help of capillaries that surround it. What is the likely benefit of this?

- (a) It makes the process of filtration at Bowman's capsule easier.
- (b) It helps keep the output of urine constant throughout the day.
- (c) It helps to uptake and store excess amount of water in the body for later use.

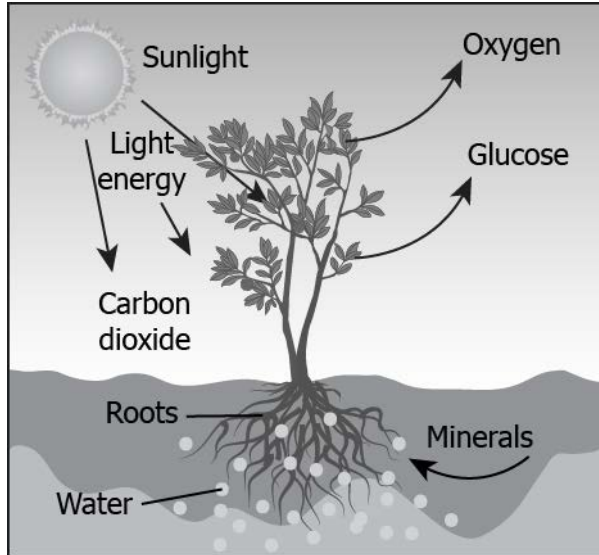


- (d) It maintains the concentration of urine based on the amount of water present in the body.

**Correct Answer:** Option (d)

**LOB:** Describe transpiration and other ways in which plants shed extra wastes, in order to explain excretion in plants

- 1) The image shows the process of photosynthesis in plants



Based on the image, which component is excreted by plants during photosynthesis?

- (a) Carbon dioxide
- (b) Glucose
- (c) Light energy
- (d) Oxygen

**Correct Answer:** Option (d)

- 2) A plant gets rid of excess water through transpiration. Which is a method used by plants to get rid of solid waste products?

- (a) shortening of stem
- (b) dropping down of fruits
- (c) shedding of yellow leaves
- (d) expansion of roots into the soil

**Correct Answer:** Option (c)

# Suggested Teacher Resources



## Activity



|                      |   |
|----------------------|---|
| Objective            | Illustrate the process involved in human excretory system, in order to explain how waste is transported out of humans' body.  |
| Prerequisite         | -   |
| Material Required    | <ul style="list-style-type: none"> <li>• 6-inch square pieces of each of the following:               <ol style="list-style-type: none"> <li>1. plastic window screening</li> <li>2. hardware cloth (½" mesh)</li> <li>3. hardware cloth (¼" mesh)</li> <li>4. hardware cloth (1/ 8" mesh)</li> <li>5. poultry netting (1" holes)</li> </ol> </li> <li>• 1-2 sheets of newspaper (to cover desk)</li> <li>• 2 measuring cups or bowls (about 4 cups each)</li> <li>• large funnel (large enough to have large pebble flow through the neck)</li> <li>• ½ cup sand</li> <li>• ½ cup small pebbles in various sizes from 1/ 8" to &gt;1"</li> <li>• ½ cup water</li> </ul>  |
| Vocabulary           | Nephron: It is the basic unit of structure in the kidney. A nephron is used separate to water, ions and small molecules from the blood, filter out wastes and toxins, and return needed molecules to the blood. The nephron functions through ultrafiltration.  |
| Procedure            | <p><b>Kidney Filtering Activity (Source: <a href="https://www.teachengineering.org/activities/view/cub_human_lesson08_activity1#objectives">https://www.teachengineering.org/activities/view/cub_human_lesson08_activity1#objectives</a>)</b></p> <ol style="list-style-type: none"> <li>1. Students should mix the sand, pebbles, flour and water in the first measuring cup or bowl.</li> <li>2. The students should take turns filtering water mixture through the funnel, poultry netting, different-sized hardware cloth, window screening, from large-filter holes to small-filter holes. The screening should be held over the second measuring cup/ bowl.</li> <li>3. Students should then pour the mixture from the full measuring cup/ bowl onto the screen over the empty container and then back again, using a different screen each time.</li> <li>4. Students to make an observation table in their notebook recording their observations after each cycle of filtration is complete.</li> </ol> |
| Reflection Questions | <ol style="list-style-type: none"> <li>1. Draw a diagram of the human excretory system in the notebook and label the parts.</li> <li>2. Write down the function of each of the parts of the excretory system.</li> <li>3. Which filter size in the above activity turned out to be the best for filtering the given mixture?</li> </ol>   |

|                               |  |
|-------------------------------|--|
| Text to real world connection | 1. Students may discuss how engineered water filters work and how the knowledge for designing such technology is derived from nature and science.  |
| Beyond the classroom          | 1. Discuss the design of the dialysis machine which act as artificial blood filtration units when the human kidney stops functioning properly. ( <a href="https://www.niddk.nih.gov/health-information/kidney-disease/kidney-failure/hemodialysis">https:// www.niddk.nih.gov/ health-information/ kidney-disease/ kidney-failure/ hemodialysis</a> )<br>2. Find out the size of various impurities in blood and hence calculate the required approximate pore size of the natural blood filters present in the nephron, |

2

## Activity



|                      |  |
|----------------------|--|
| Material required    | Large thin plastic bag, newspaper, paper sacks (2 sizes), zip-lock bags, candy, masking tape, markers & paper, sponges, trash can, spray bottles of water  |
| Procedure            | <p><b>A Digestive System Simulation</b></p> <ol style="list-style-type: none"> <li>1. <b>FOOD TUBE:</b> Lay out two parallel lines of tape on the floor, 3' apart and long enough for half the class to stand shoulder to shoulder on one side of the parallel lines.</li> <li>2. <b>FOOD PARTICLE:</b> The food particle consists of M&amp;M's placed in small zip-lock bags. These are placed in wadded newspapers in small paper sacks. Place the small sacks in larger sacks with added newspaper. Place all sacks and add newspaper until the large plastic bag is full. This bag is then taped or tied closed to complete the food particle.</li> </ol> <p>Action:</p> <ol style="list-style-type: none"> <li>1. <b>Peristaltic Movement:</b> Put the food particle to be eaten at one end of the food tube and a large trash can at the other. Have students line up on both sides, facing each other, squeeze the food particle the length of the food tube.</li> <li>2. <b>Digestion:</b> Label and/ or instruct the players. As the food comes to a student they should narrate what they are doing and why. <ul style="list-style-type: none"> <li>• Teeth - tear food apart (break plastic bag)</li> <li>• Saliva - use spray bottles to moisten food particles</li> <li>• Stomach - tear small bags apart</li> <li>• Pancreatic juices - spray food</li> <li>• Small Intestine - absorbs food, find bags of candy and pass to blood (the teacher can play the role of the blood)</li> <li>• Large Intestine - reabsorbs water, sponge up water on the floor</li> <li>• Rectum/ Anus - puts the waste papers in the trash can</li> </ul> </li> </ol> |
| Reflection questions | <ol style="list-style-type: none"> <li>1. Follow the path of the food item in the digestive system and note down the function of each part.</li> <li>2. How do you think astronauts eat and digest food in space?</li> </ol>   |

# 7. Control and Coordination

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts | Learning Objectives  |
|---------------------------|--|
| Animals - Nervous System  | Draw the structure & explain the functioning of a neuron, in order to explain how electrical signals travel in human body          |
| Reflex arc                | Outline the working of a reflex arc, in order to explain how reflex actions take place in humans                                   |
| Human Brain               | Illustrate the location and functions of different parts of human brain, in order to understand working of human brain             |
| Coordination in Plants    | Examine tropic movements in plants, in order to understand how plants respond to environmental triggers like light, gravity, water |
| Hormones                  | Discuss limitations of electrical impulses, in order to outline the importance and use of hormones                                 |
| Hormones in Animals       | Illustrate the function of endocrine glands in human body, in order to understand functioning of hormones                          |

**Learning Objectives and Learning Outcomes:**

| Learning Objectives  | Learning Outcomes  |
|--|--|
| Outline the working of a reflex arc, in order to explain how reflex actions take place in humans                                   | Relates processes and phenomena with causes / effects, such as hormones with their functions, tooth decay with pH of saliva, growth of plants with pH of the soil, survival of aquatic life with pH of water, blue colour of sky with scattering of light, deflection of compass needle due to magnetic effect of electric current, etc. |
| Examine tropic movements in plants, in order to understand how plants respond to environmental triggers like light, gravity, water |  |

|   |   |
|---|---|
| Discuss limitations of electrical impulses, in order to outline the importance and use of hormones                        |   |
| Illustrate the function of endocrine glands in human body, in order to understand functioning of hormones                 |   |
| Draw the structure & explain the functioning of a neuron, in order to explain how electrical signals travel in human body | Explains processes and phenomena, such as nutrition in human beings and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc. |
| Illustrate the location and functions of different parts of human brain, in order to understand working of human brain    |   |
| Draw the structure & explain the functioning of a neuron, in order to explain how electrical signals travel in human body |   |
| Outline the working of a reflex arc, in order to explain how reflex actions take place in humans                          |   |
|   |   |
|   | Draws labelled diagrams / flow charts / concept map / graphs, such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.  |

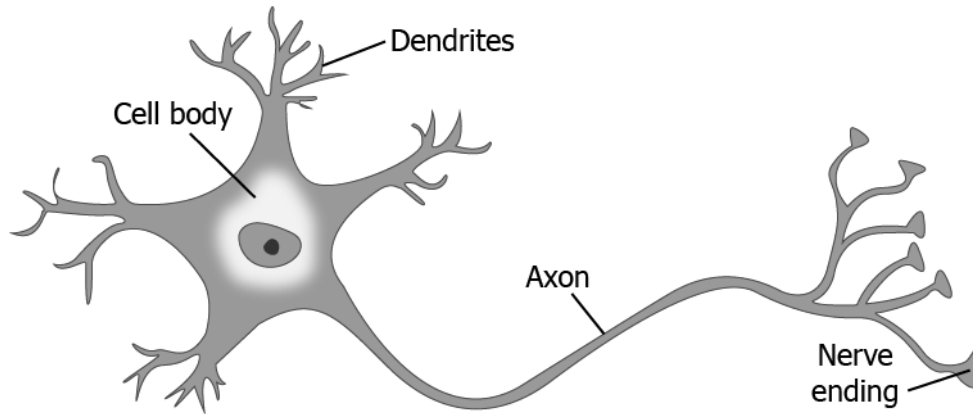
# Test items



**LOB:** Draw the structure & explain the functioning of a neuron, in order to explain how electrical signals travel in human body

- 1) The image shows the structure of a neuron.

## Neuron

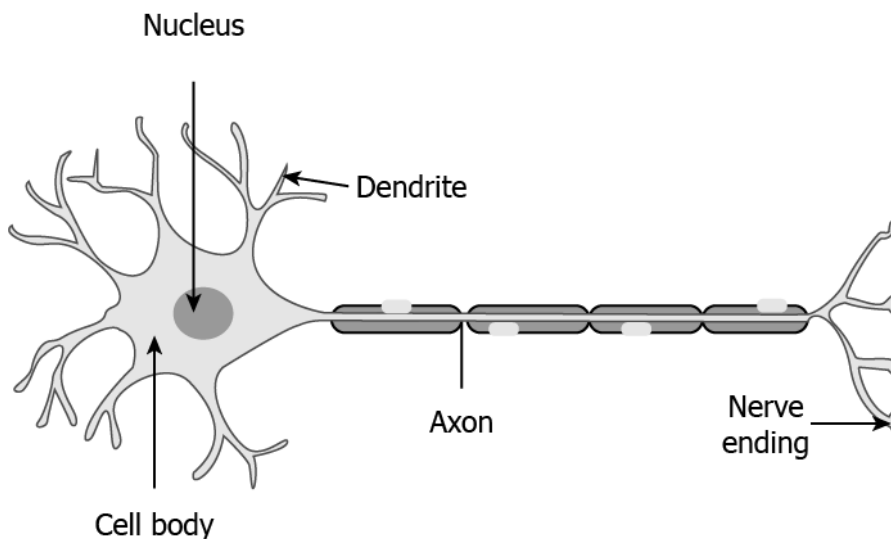


How will information travel within a neuron?

- (e) Dendrite -> cell body -> axon -> nerve ending
- (f) Dendrite -> axon -> cell body -> nerve ending
- (g) Axon -> dendrite -> cell body -> nerve ending
- (h) Axon -> cell body -> dendrite -> nerve ending

**Correct Answer:** Option (a)

- 2) The image shows structure of a neuron.



After our nose senses a smell, which option shows the mechanism of the travelling of sense in our body?

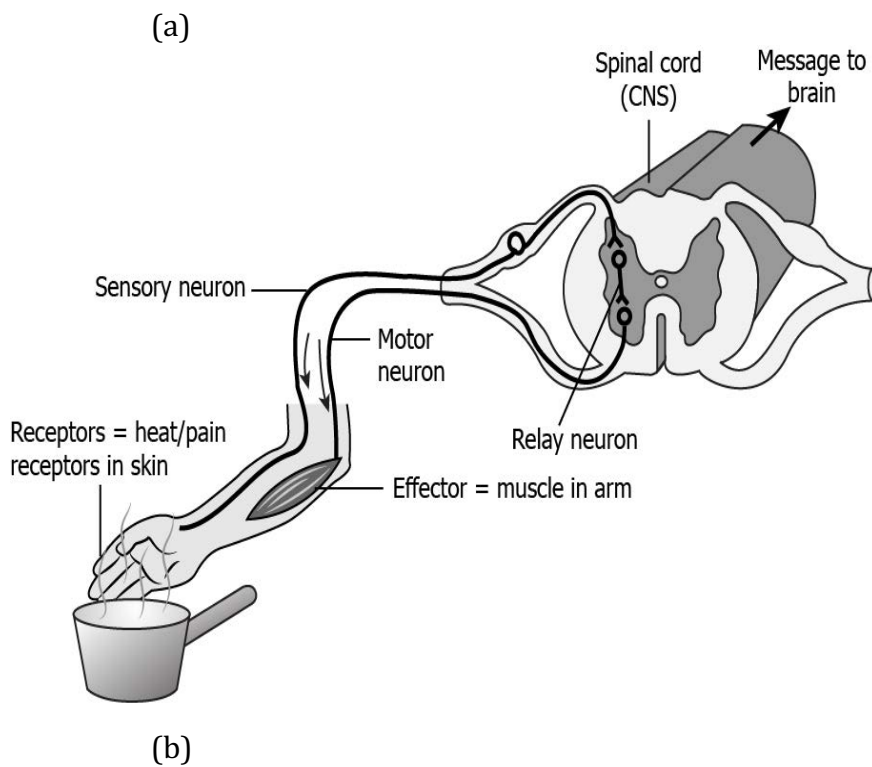
- (a) olfactory receptors- dendritic tip of a nerve cell- - axon- nerve ending-release of signal- dendritic tip of other nerve cell

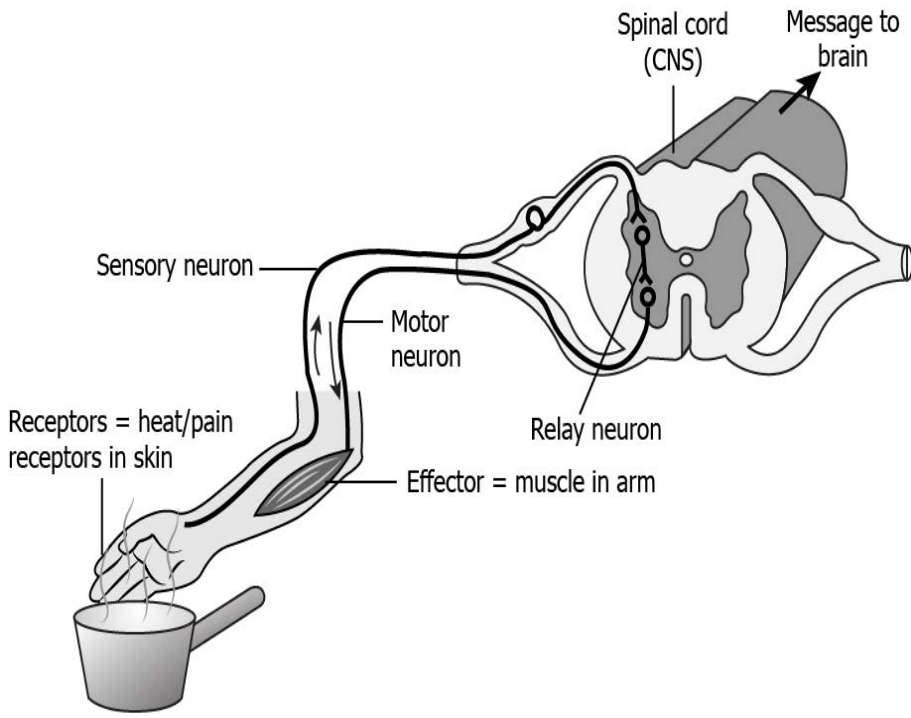
- (b) olfactory receptors- dendritic tip of a nerve cell- axon- cell body- release of signal- dendritic tip of other nerve cell
- (c) gustatory receptors- dendritic tip of a nerve cell- cell body- axon- release of signal- dendritic tip of other nerve cell
- (d) gustatory receptors- dendritic tip of a nerve cell- axon- cell body- release of signal- dendritic tip of other nerve cell

**Correct Answer:** Option (a)

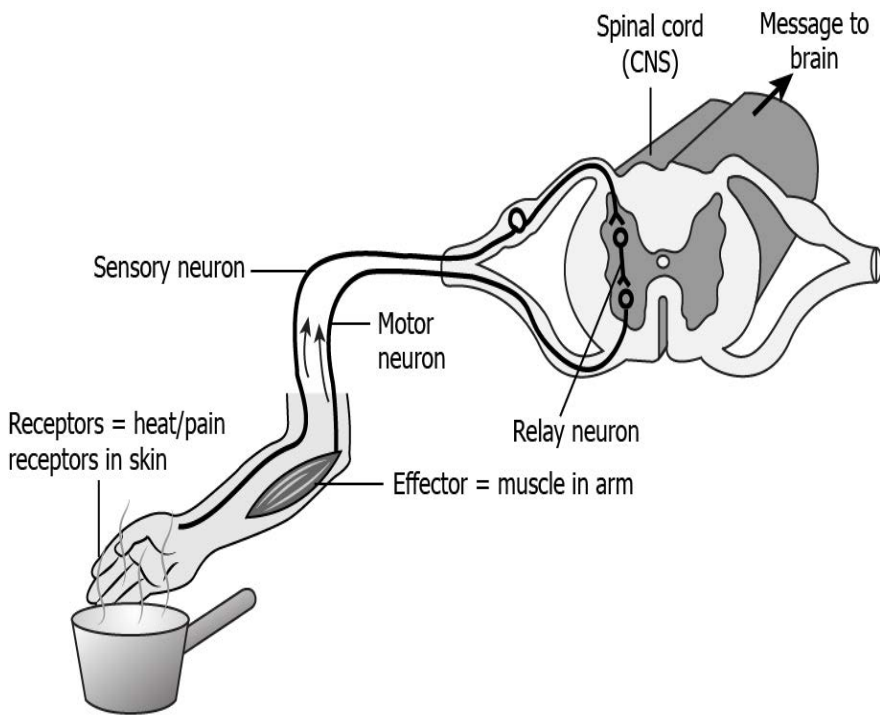
**LOB:** Outline the working of a reflex arc, in order to explain how reflex actions take place in humans

- 1) Which option correctly shows the sequence of events that occur when we touch a hot utensil?



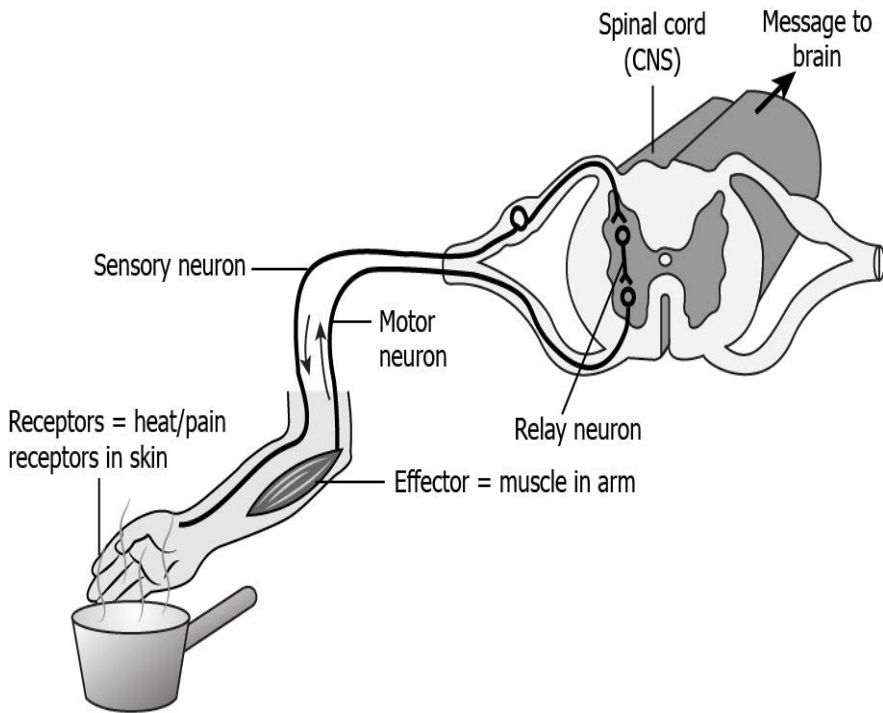


(c)



(d)





**Correct Answer:** Option (b)

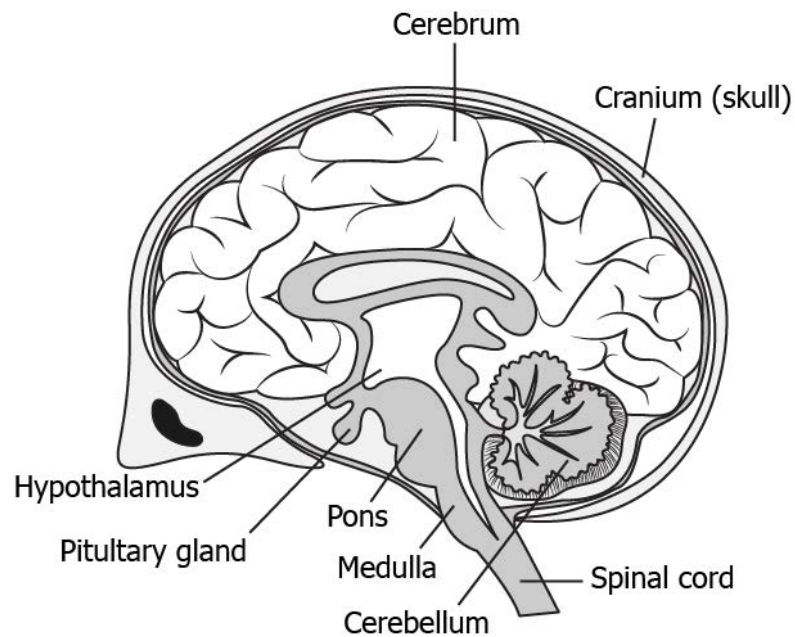
2) Which option correctly shows the order of events when a bright light is focused on our eyes?

- (a) Bright light → receptors in eyes → sensory neuron → spinal cord → motor neurons → eyelid closes
- (b) Bright light → receptors in eyes → spinal cord → sensory neuron → motor neurons → eyelid closes
- (c) Bright light → receptors in eyes → sensory neuron → motor neurons → spinal cord → eyelid closes
- (d) Bright light → receptors in eyes → spinal cord → motor neurons → sensory neuron → eyelid closes

**Correct Answer:** Option (a)

**LOB:** Illustrate the location and functions of different parts of human brain, in order to understand working of human brain

1) The image shows the labelled structure of a brain.



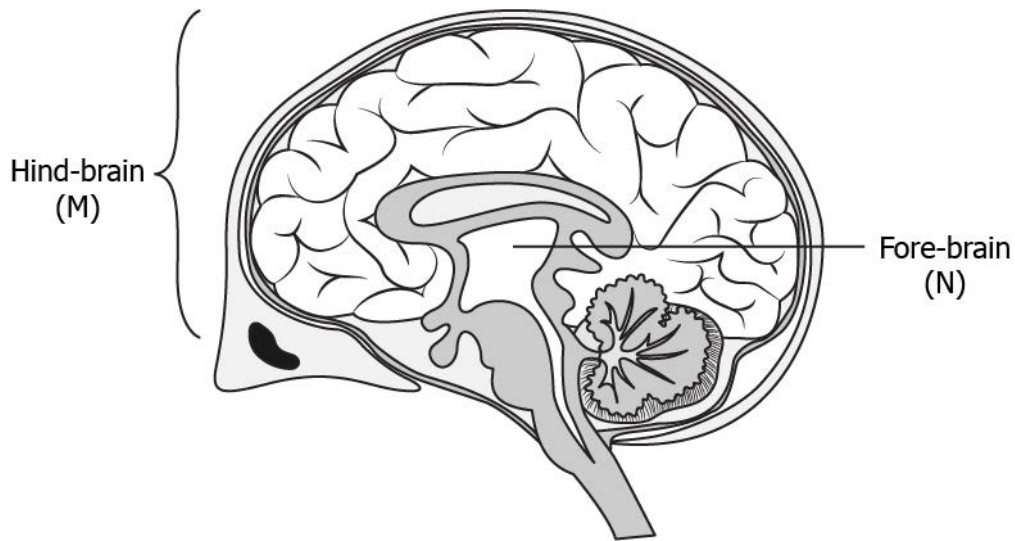
Which parts of the brain controls the blood pressure?

- (a) spinal cord, skull, hypothalamus
- (b) cord, skull, cerebrum
- (c) Pons, medulla, cerebellum
- (d) pons, medulla, pituitary

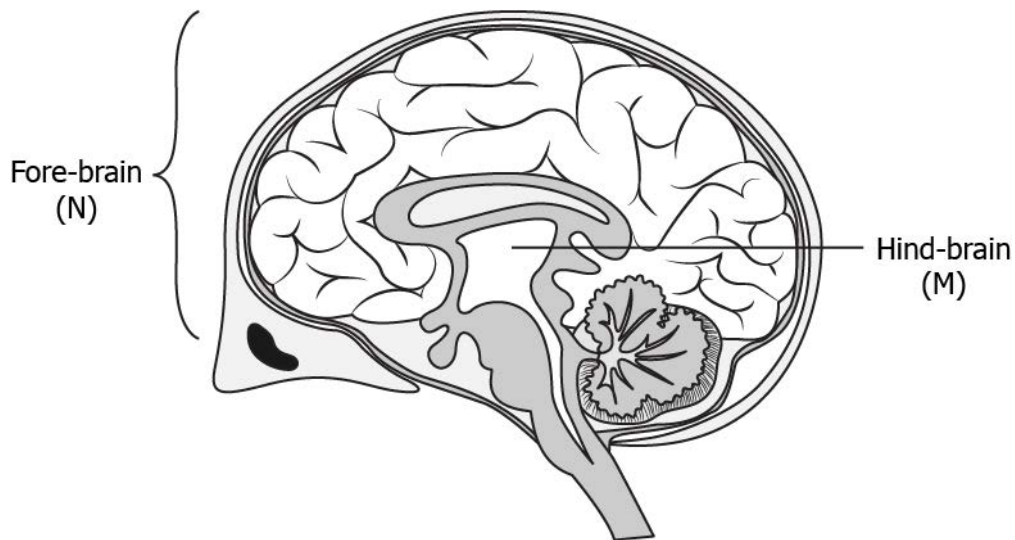
**Correct Answer:** Option (c)

2) Which option illustrates the location of centre that controls the feelings associated with hunger (M) and the centre that allows a person to walk in a straight line (N)?

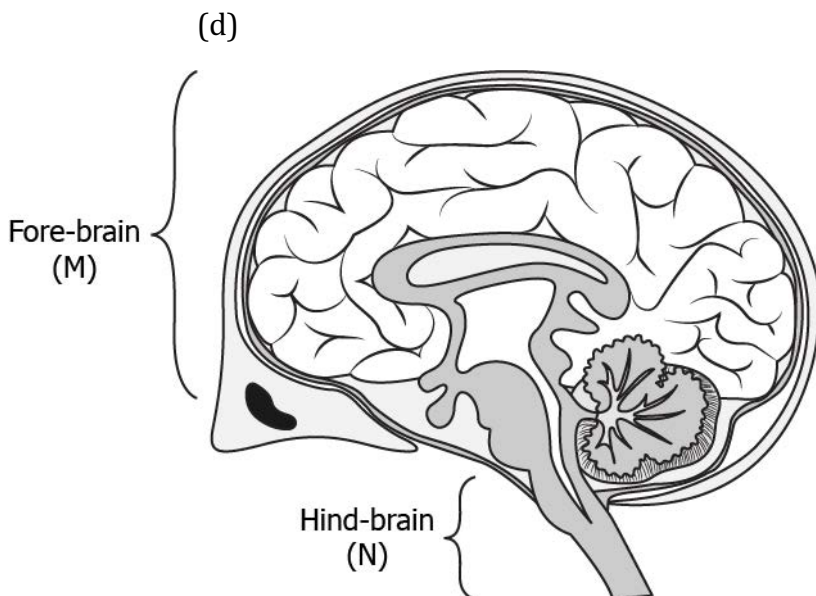
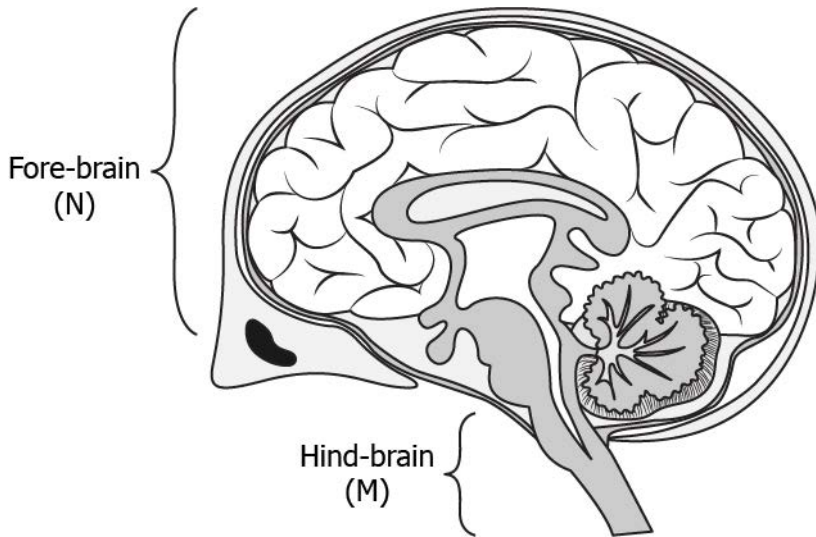
(a)



(b)



(c)



**Correct Answer:** Option (d)

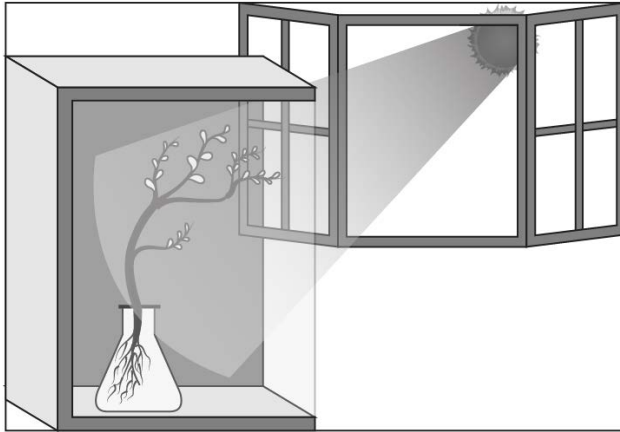
**LOB:** Examine tropic movements in plants, in order to understand how plants respond to environmental triggers like light, gravity, water

1) When we touch the leaves of “touch-me-not” plant, they began to fold up and droop. How does the plant communicate the information of touch?

- (a) The plant uses electrical signals to transfer information from external environment to cells.
- (b) The plant uses electrical- chemical signals to transfer information from cell to cell.
- (c) The plant uses electrical- chemical signals to transfer information from tissue to specialized cells.
- (d) The plant uses electrical signals to transfer information from cell to specialized tissues.

**Correct Answer:** Option (b)

2) Akshay potted some germinated seeds in a pot. He put the pot in a cardboard box that was open from one side. He keeps the box in a way that the open side of box faces sunlight near his window. After 2-3 days he observes the shoot bends towards light as shown in image.



Which type of tropism he observes?

- (a) Geotropism
- (b) Phototropism
- (c) chemotropism
- (d) hydrotropism

**Correct Answer:** Option (b)

**LOB:** Discuss limitations of electrical impulses, in order to outline the importance and use of hormones

1) What is a likely limitation of electric impulses?

- (a) The electric impulses travel slowly between the neurons.
- (b) The electric impulses allow signal transmission in multiple directions.
- (c) The electric impulses are transmitted to only those body parts that are connected to neurons.
- (d) The electric impulses once generated needs to be transmitted quickly within the body.

**Correct Answer:** Option (c)

2) Organisms depend on hormones as well as electric impulses for the transmission of signals from brain to rest of the body. What can be a likely advantage of hormones over electric impulses?

- (a) It is secreted by all types of cells present in the body.
- (b) It is secreted by stimulated cells and reaches all cells of the body.
- (c) It is relayed to the target organ at a faster rate than electric impulses.

(d) It does not depend on an external stimulus to be generated in the cells.

**Correct Answer:** Option (b)

**LOB:** Illustrate the function of endocrine glands in human body, in order to understand functioning of hormones

- 1) What is the function of pituitary gland?
- (a) to develop sex organs in males
  - (b) to stimulate growth in all organs
  - (c) to regulate sugar and salt level in the body
  - (d) to initiate metabolism in the body

**Correct Answer:** Option (b)

- 2) A female is suffering from irregular menstrual cycle. The doctor prescribed her some hormonal tablets. Which option shows the hormone she lacks in her body from the endocrine gland?
- (a) oestrogen
  - (b) testosterone
  - (c) adrenalin
  - (d) thyroxin

**Correct Answer:** Option (a)

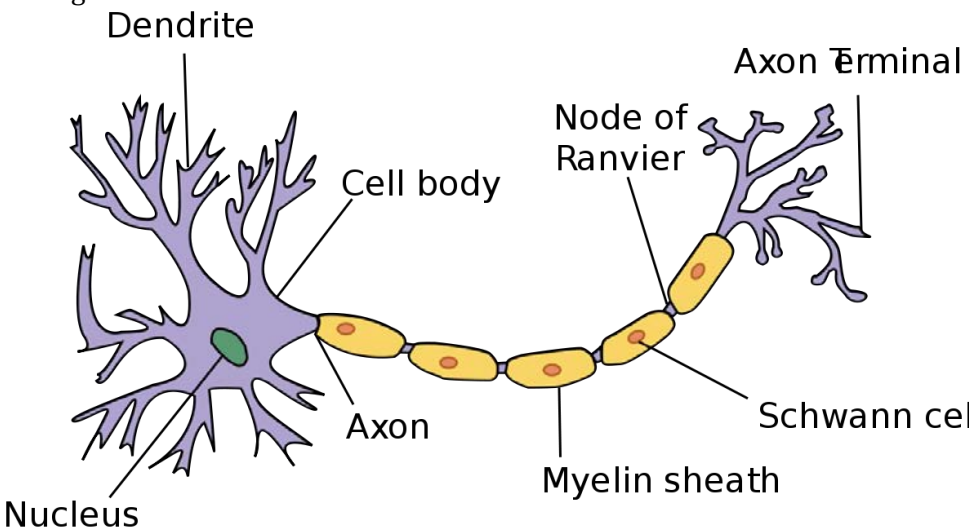
## Suggested Teacher Resources



### Activity



|                   |  |
|-------------------|--|
| Objective         | Draw the structure & explain the functioning of a neuron, in order to explain how electrical signals travel in the human body.   |
| Prerequisite      | -  |
| Material Required | -  |
| Vocabulary        | Neuron: A nerve cell which transfers messages from and to the brain.<br><br>Electrical Impulses: A nerve impulse is an electrical signal that travels along an axon. There is an electrical difference between the inside of the axon and its surroundings, like a tiny battery. |

|                                      |   |
|--------------------------------------|---|
| <p>Procedure</p>                     | <ol style="list-style-type: none"> <li>1. Have all students stand up and tell them they are all neurons and they are each other's "neuron friends".</li> <li>2. The instructor can pretend to give the first student a message and this has to pass on to the end of the class.</li> <li>3. The students can receive the message by holding the hand of the person in front and pass on the message by holding the hand of the person next in line.</li> <li>4. Each time the student receives a message, they should shake their body to mimic it.</li> <li>5. The chain should continue until all students are holding hands.</li> </ol> <p>This is how a neuron chain works. One neuron receives the message from another neuron and sends it to yet another neuron. This is how messages are transferred to and from the brain.</p> <p>At the dendrite tip of the neuron changes the chemical around it which generates an electrical impulse which is how the message is transferred through the chain.</p>  <p>(Source: <a href="https://simple.wikipedia.org/wiki/Neuron">https://simple.wikipedia.org/wiki/Neuron</a>)</p> |
| <p>Reflection Questions</p>          | <ol style="list-style-type: none"> <li>1. What is a neuron/ nerve cell?</li> <li>2. What role do neurons have in our bodies? Why are they so important for the function of our body systems?</li> <li>3. What types of nerve cells are there?</li> <li>4. What parts make up a neuron/ nerve cell?</li> <li>5. How is information transmitted from one nerve cell to another?</li> </ol>  |
| <p>Text to real world connection</p> | <p>This concept can be related to transfer of messages by the postal services or the functioning of machinery in the assembly line production.</p>  |
| <p>Beyond the classroom</p>          | <ol style="list-style-type: none"> <li>1. How do you think our sense organs transfer messages to our brain?</li> <li>2. Do we really need to have a sound in order for us to hear and transfer messages to the brain?</li> </ol>  |

2

**Activity**

|                      |  |
|----------------------|--|
| Material required    | Sheet of paper, straw, soft candies, cotton candy, raisins, strings  |
| Procedure            | <ol style="list-style-type: none"> <li>1. Lay a piece of paper on your table or desk.</li> <li>2. Begin building your nerve cell with the straw as the axon, and add the mini-soft candies to the straw. Leave some space between each candy.. The mini-candies will represent the Schwann Cells/ Myelin sheaths.</li> <li>3. Add the small ball of cotton candy to the end of the fun straw. The cotton candy represents the cell body.</li> <li>4. Add a raisin to the middle of the cotton candy. The raisin represents the nucleus.</li> <li>5. Add small strings to the cotton candy. The Twizzler strings represent the dendrites. You can add small pieces of cotton candy around the strings so there won't be confusion between the dendrites and axon terminal.</li> <li>6. Add small strings to the other end of the fun straw. The strings represent the axon terminal.</li> <li>7. Lay your nerve cell on your on paper and label the parts of the nerve cell on the paper.</li> <li>8. Once your teacher checks your work, you can eat your nerve cell!</li> </ol> |
| Reflection questions | <ol style="list-style-type: none"> <li>1. Label the parts of the neuron.</li> <li>2. What is the function of each part?</li> </ol>   |



# 8. How do Organisms Reproduce?

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts               | Learning Objectives   |
|---|---|
| Intro + The importance of variation     | List down the reasons for changes in DNA copying and their effect on ecosystem, in order to understand importance of variations                                       |
| Fission                                 | Illustrate the process of fission in amoeba, leishmania & plasmodium, in order to understand how unicellular organisms divide   |
| Fragmentation & Spore formation         | Illustrate the process of fragmentation in Spirogyra & spore formation in Rhizopus, in order to understand how multicellular organisms with simple body design divide |
| Regeneration                            | Illustrate the process of regeneration in Planaria, in order to understand how fully differentiated multicellular organisms divide                                    |
| Budding                                 | Illustrate the process of budding in Hydra, in order to understand how fully differentiated multi-cellular organisms use regenerative cells to divide                 |
| Vegetative Propagation                  | Illustrate the process of vegetative propagation in plants like sugarcane, roses, grapes in order to understand how plants reproduce without seeds                    |
| Sexual Reproduction in Flowering Plants | Label the different parts of a flower and explain their functions, in order to understand how flowers reproduce to form fruit   |
| Reproduction in Human Beings            | List down the changes occurring in male and female body in teenage years, in order to understand effects of puberty   |
| Male Reproductive System                | Illustrate the male reproductive system, in order to understand its function in reproduction  |
| Female Reproductive System              | Illustrate the female reproductive system, in order to understand its function in reproduction  |
|   | Describe the changes taking place in female body after/ without fertilization, in order to understand human reproduction  |
| Reproductive health                     | List down the ways to avoid fertilization, in order to avoid pregnancy and maintain reproductive health   |

**Learning Objectives and Learning Outcomes:**

| Learning Objectives   | Learning Outcomes   |
|---|---|
| Describe the changes taking place in female body after/ without fertilization, in order to understand human reproduction  | Relates processes and phenomena with causes / effects, such as hormones with their functions, tooth decay with pH of saliva, growth of plants with pH of the soil, survival of aquatic life with pH of water, blue colour of sky with scattering of light, deflection of compass needle due to magnetic effect of electric current, etc.  |
| Illustrate the process of fission in amoeba, leishmania & plasmodium, in order to understand how unicellular organisms divide   | Explains processes and phenomena, such as nutrition in human beings and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc. |
| Illustrate the process of fragmentation in Spirogyra & spore formation in Rhizopus, in order to understand how multicellular organisms with simple body design divide |   |
| Illustrate the process of regeneration in Planaria, in order to understand how fully differentiated multicellular organisms divide                                    |   |
| Illustrate the process of budding in Hydra, in order to understand how fully differentiated multi-cellular organisms use regenerative cells to divide                 |   |
| Illustrate the process of vegetative propagation in plants like sugarcane, roses, grapes in order to understand how plants reproduce without seeds                    |   |
| Label the different parts of a flower and explain their functions, in order to understand how flowers reproduce to form fruit   |   |
| List down the changes occurring in male and female body in teenage years, in order to understand effects of puberty   |   |
| Illustrate the male reproductive system, in order to understand its function in reproduction  |   |

|   |   |
|---|---|
| Illustrate the female reproductive system, in order to understand its function in reproduction  |   |
| Illustrate the process of fission in amoeba, leishmania & plasmodium, in order to understand how unicellular organisms divide   | Draws labelled diagrams / flow charts / concept map /graphs, such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.   |
| Illustrate the process of fragmentation in Spirogyra & spore formation in Rhizopus, in order to understand how multicellular organisms with simple body design divide |   |
| Illustrate the process of regeneration in Planaria, in order to understand how fully differentiated multicellular organisms divide                                    |   |
| Illustrate the process of budding in Hydra, in order to understand how fully differentiated multi-cellular organisms use regenerative cells to divide                 |   |
| Illustrate the process of vegetative propagation in plants like sugarcane, roses, grapes in order to understand how plants reproduce without seeds                    |   |
| Illustrate the male reproductive system, in order to understand its function in reproduction  |   |
| Illustrate the female reproductive system, in order to understand its function in reproduction  |   |
| List down the ways to avoid fertilization, in order to avoid pregnancy and maintain reproductive health   | Applies scientific concepts in daily life and solving problems, such as takes precautions to prevent sexually transmitted infections, uses appropriate electrical plugs (5 /15a) for different electrical devices, uses vegetative propagation to develop saplings in gardening, performs exercise to keep in good health, avoids using appliances responsible for ozone layer depletion, applies concept of decomposition reaction of baking soda to make spongy cakes, etc. |
| List down the reasons for changes in DNA copying and their effect on ecosystem, in order to understand importance of variations                                       | Draws conclusion, such as traits / features are inherited through genes present on chromosomes, a new species originates through evolutionary processes, water is made up of hydrogen and oxygen, properties of elements vary periodically along the groups and periods in periodic table, potential difference across a metal  |

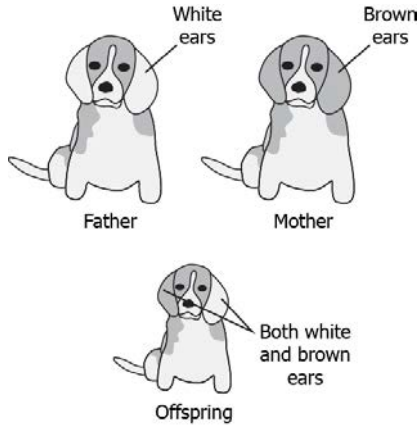
conductor is proportional to the electric current through it, etc.

## Test items



**LOB:** List down the reasons for changes in DNA copying and their effect on ecosystem, in order to understand importance of variations

1) The image shows the model of a family of dogs.



It can be observed that the offspring is similar to the parent but not identical. What is the likely reason for this?

- (a) variation in the genetic material
- (b) fast multiplication of body cells
- (c) asexual mode of reproduction
- (d) effect of environment on the offspring

**Correct Answer:** Option (a)

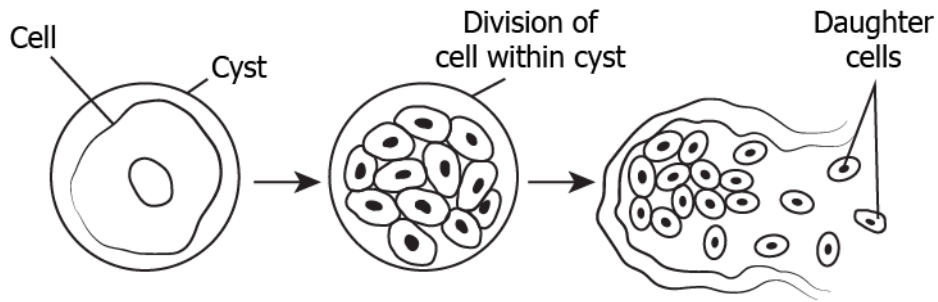
2) A population of thermophilic archaeobacteria are generally found in hot springs. Any change to the temperature of the water affects the survival of the archaeobacteria. If the temperature of hot springs gets reduced, change in which component can allow survival of few members of these archaeobacteria?

- (a) cell wall
- (b) cytoplasm
- (c) DNA
- (d) ribosomes

**Correct Answer:** Option (c)

**LOB:** Illustrate the process of fission in amoeba, leishmania & plasmodium, in order to understand how uni-cellular organisms divide

1) The image shows the process of division in plasmodium.

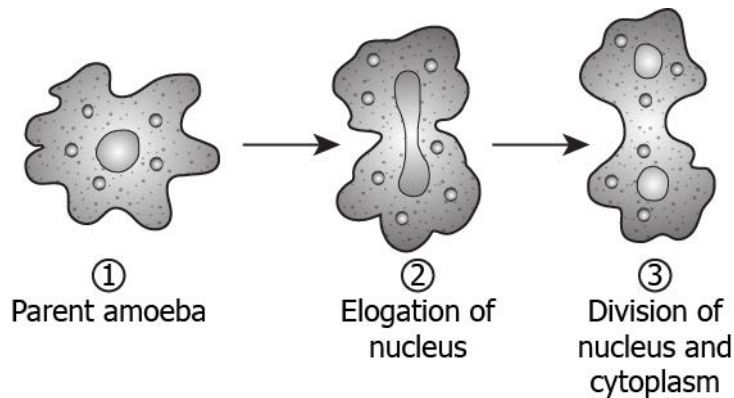


What can be concluded about the division in plasmodium?

- (a) The cyst divides repeatedly to form many daughter cells.
- (b) The cell divides multiple times giving rise to many daughter cells.
- (c) The nucleus divides repeatedly inside the cell to form new daughter cells.
- (d) The cyst enlarges in size and then bursts producing many new daughter cells.

**Correct Answer:** Option (b)

2) The image shows the process of binary fission in amoeba.



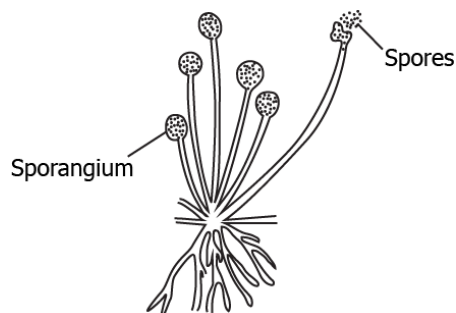
Which option correctly predicts about the daughter cells?

- (a) Parent cell will lead to the formation of four daughter cells of equal sizes.
- (b) Parent cell will lead to the formation of two daughter cells of equal sizes.
- (c) Parent cell will lead to the formation of four daughter cells of different sizes.
- (d) Parent cell will lead to the formation of two daughter cells of different sizes.

**Correct Answer:** Option (b)

**LOB:** Illustrate the process of fragmentation in *Spirogyra* & spore formation in *Rhizopus*, in order to understand how multi-cellular organisms with simple body design divide

1) The image shows the formation of spores in *Rhizopus*.

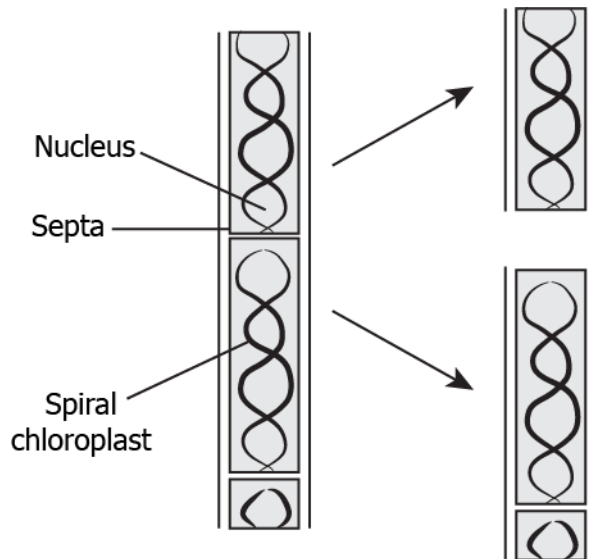


How spores develop into *Rhizopus*?

- (a) spores divide and grow into new individual
- (b) spores combine with other spores and grow
- (c) spores enlarge in size for the growth of new individual
- (d) spores land on other organisms and increase with their growth in size

**Correct Answer:** Option (a)

2) The image shows the division in *Spirogyra*.



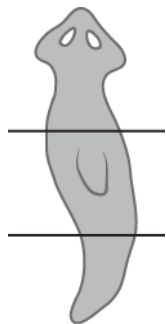
What can be concluded about the *Spirogyra* from this division?

- (a) It is a multicellular organism gives rise to two new equal sized individuals.
- (b) It is a unicellular organism that gives rise to two new equal sized individuals.
- (c) It is a unicellular organism that breaks into pieces that grows into new individuals.
- (d) It is a multicellular organism that breaks into pieces that grows into new individuals.

**Correct Answer:** Option (d)

**LOB:** Illustrate the process of regeneration in *Planaria*, in order to understand how fully differentiated multi-cellular organisms divide

1) A student takes a planaria in the lab and cuts into three parts as shown.

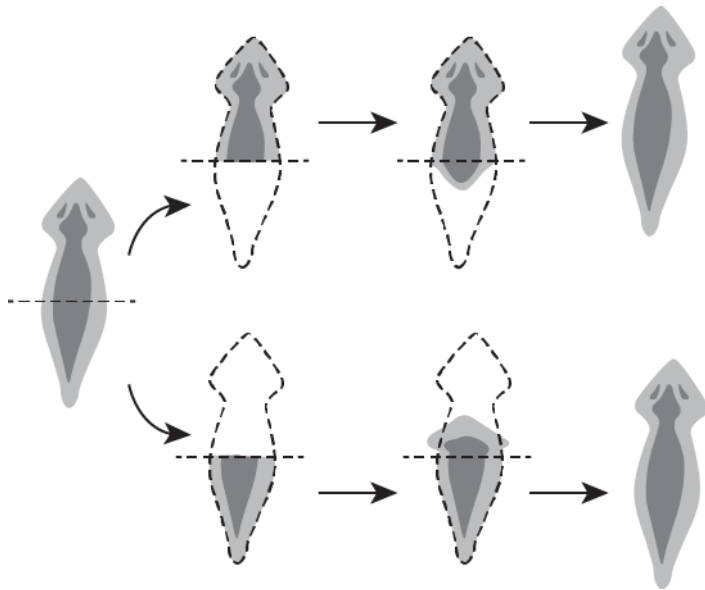


What will likely happen?

- (a) the cells around the cut start to divide to form lost part
- (b) the cells around the cut enlarge to take the shape of lost part
- (c) the cells around the cut start to divide to form a complete organism
- (d) the cells around the cut attracts other planarians to fuse with the separated part

**Correct Answer:** Option (c)

2) A student observes the process of regeneration in *Planaria*.



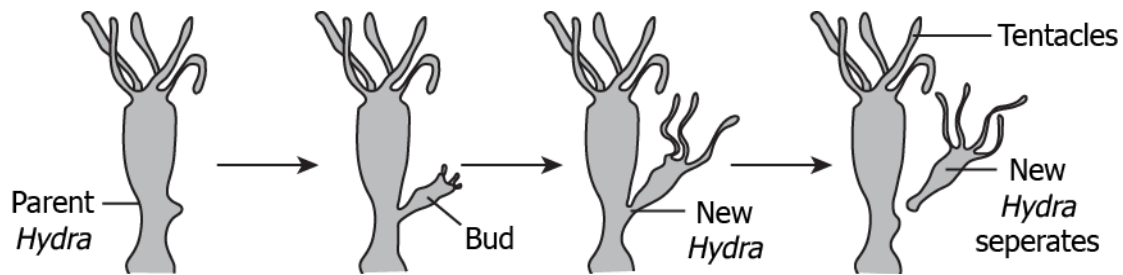
The student claimed that the newly formed planarians have identical genome. Which statement support the claim?

- (a) It is a single celled organism.
- (b) All planarians share the same genome.
- (c) Division in *Planaria* involves a single parent.
- (d) *Planaria* divides only under unfavourable condition.

**Correct Answer:** Option (c)

**LOB:** Illustrate the process of budding in Hydra, in order to understand how fully differentiated multi-cellular organisms use regenerative cells to divide

1) The image shows a bud developing on a *Hydra*.

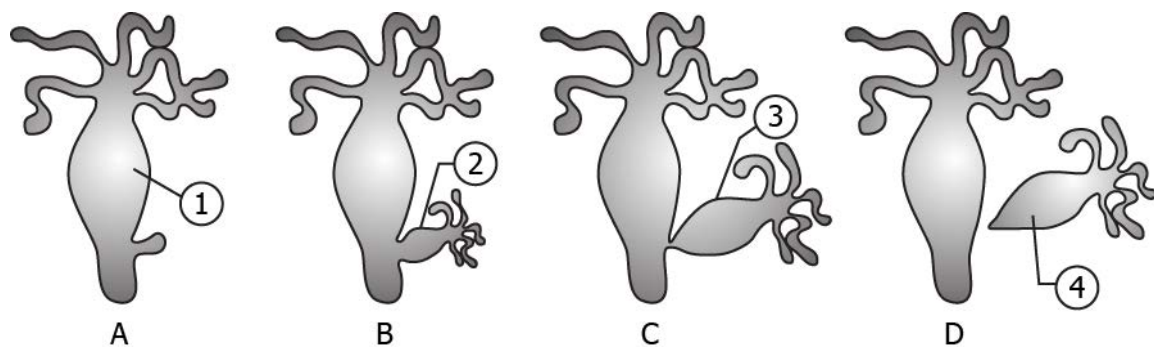


How does the bud develop in the *Hydra*?

- (a) bud develops due to separation of body parts of *Hydra*
- (b) bud develops due to repetitive cell division at a specific site
- (c) bud develops due to change in the environmental conditions
- (d) develops due to attachment of another *Hydra* at a specific site

**Correct Answer:** Option (b)

2) The model shows the process of budding in *Hydra*.



What is the likely purpose of this division in *Hydra*?

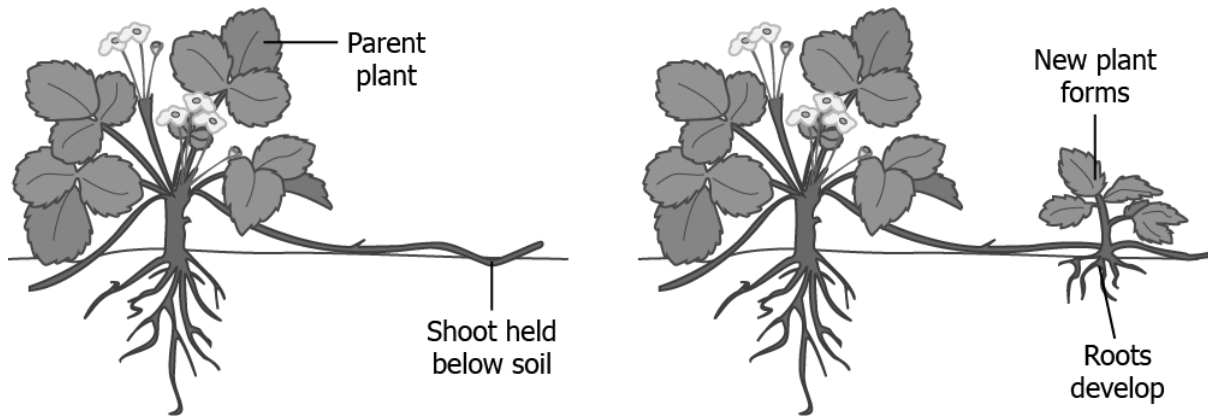
- (a) to increase the body size
- (b) to recover lost body parts
- (c) to induce variation in body
- (d) to develop new independent individual

**Correct Answer:** Option (d)



**LOB:** Illustrate the process of vegetative propagation in plants like sugarcane, roses, grapes in order to understand how plants reproduce without seeds

1) The image shows the process of vegetative propagation in a plant.

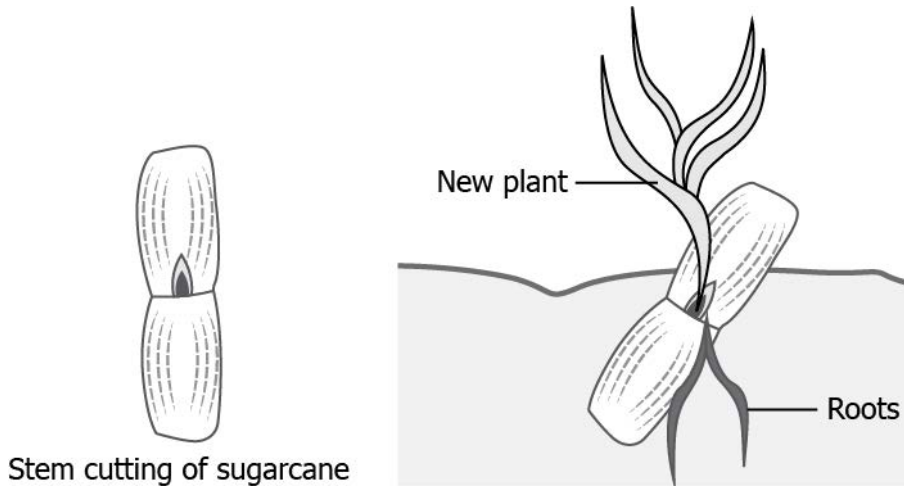


The shoot of the parent plant is pushed below the soil that results in growth of a new plant. What is the advantage of this process?

- (a) this results in plant of different flowers
- (b) this helps grow plants without adding extra manure
- (c) this eliminates the need of producing plant using seeds
- (d) this allows growth of plants with new genetic composition

**Correct Answer:** Option (c)

2) The image shows the production of a new sugarcane from an existing sugarcane plant.



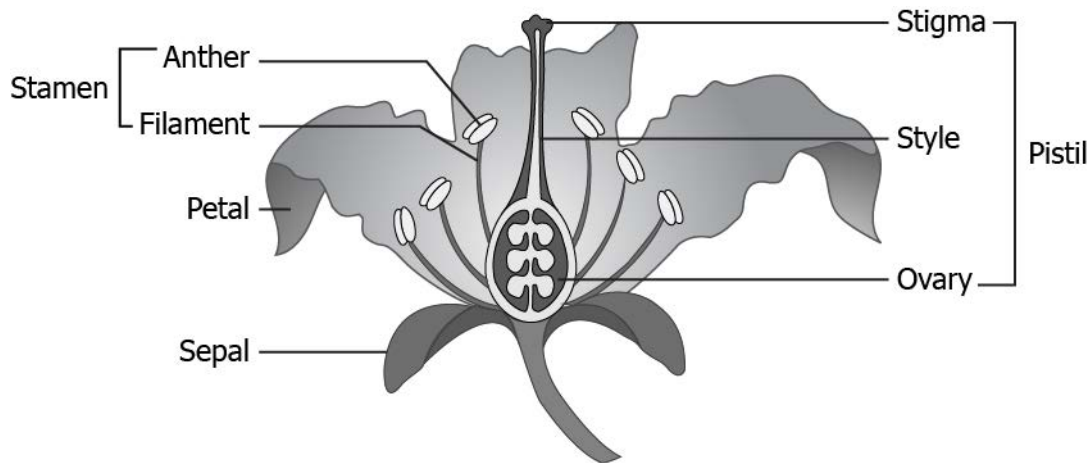
The method is called vegetative propagation. Which option supports the name of this process?

- (a) It is a sexual method of producing new plants.
- (b) It is an asexual method of producing new plants.
- (c) It does not require a parent plant for reproduction.
- (d) It involves fusion two parts of a single parent for reproduction.

**Correct Answer:** Option (b)

**LOB:** Label the different parts of a flower and explain their functions, in order to understand how flowers reproduce to form fruit

1) The image shows the different parts of a flower.

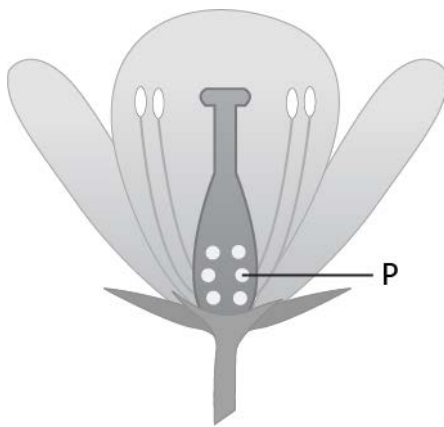


Which part of the pistil is responsible for receiving pollen from stamen in order to perform reproduction?

- (a) anther
- (b) ovary
- (c) petal
- (d) stigma

**Correct Answer:** Option (d)

2) The image shows the structure of a flower.



Which process will likely be disturbed or not occur, if labelled part is removed from the flower?

- (a) formation of fruit
- (b) transport of pollen
- (c) formation of pollen
- (d) development of pollen tube

**Correct Answer:** Option (a)

**E10S080:** List down the changes occurring in male and female body in teenage years, in order to understand effects of puberty

1) Which option correctly lists the changes that occur in males during puberty?

(a)

- thick hairs grow on face
- cracking of voice
- enlargement of reproductive organ

(c)

- reproductive organs enlarge
- size of the breasts increases
- thick hairs grow on the body

(b)

- thin hairs growth occurs on the body
- size of the breasts increases
- pitch of the voice increases

(d)

- size of the breasts increases
- beginning of menstruation
- thick hairs grow on the body

**Correct Answer:** Option (a)

2) The table shows the changes that occur in girls during puberty.

- A. increase in the size of the breasts
- B. beginning of menstruation
- C. darkening of skin around the nipples

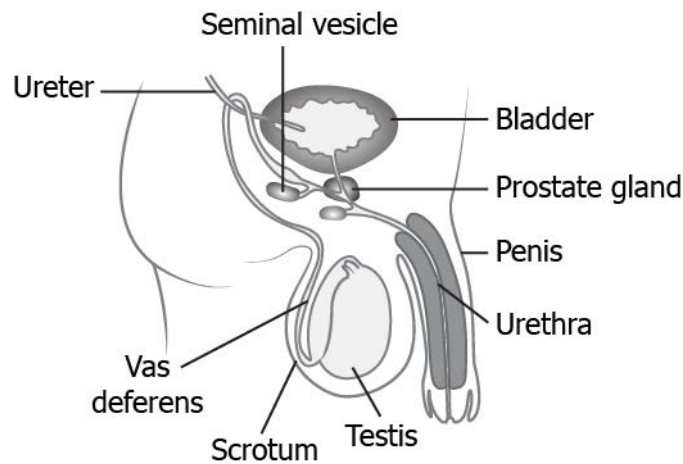
What is the likely significance of these changes?

- (a) aging of the body
- (b) sexual maturation
- (c) production of germ cells
- (d) abnormal division of the cells

**Correct Answer:** Option (b)

**LOB:** Illustrate the male reproductive system, in order to understand its function in reproduction

1) The image shows the male reproductive system.

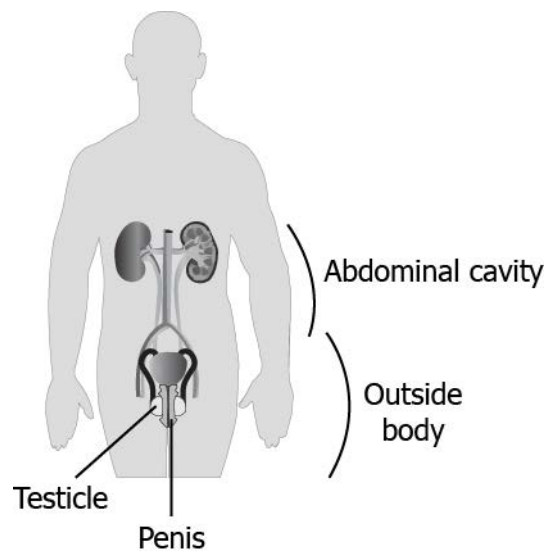


Which option correctly shows the path that the sperms take when they are released from the body?

- (a) testis -> ureter -> urethra -> penis
- (b) testis -> vas deferens -> ureter -> penis
- (c) testis -> ureter -> vas deferens -> penis
- (d) testis -> vas deferens -> urethra -> penis

**Correct Answer:** Option (d)

2) The image shows the male reproductive system outside abdominal cavity.



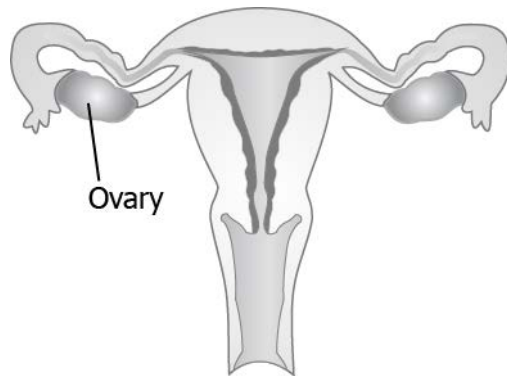
What will likely happen if testes are located inside the abdominal cavity?

- (a) delayed puberty
- (b) sperm formation
- (c) increase in body temperature
- (d) change in genetic composition of sperms

**Correct Answer:** Option (a)

**LOB:** Illustrate the female reproductive system, in order to understand its function in reproduction

1) The image shows the reproductive organ in females.

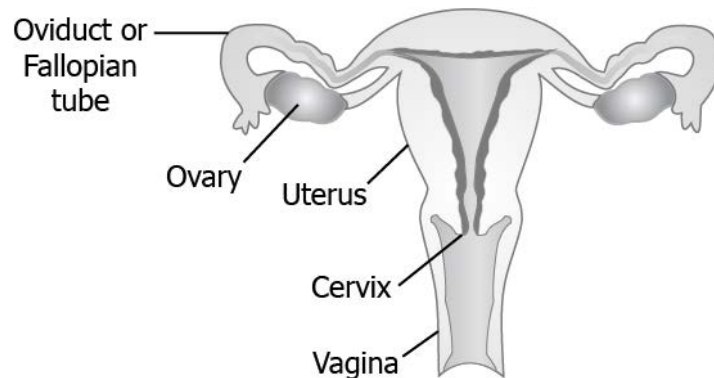


Which event will likely occur in the ovaries of females after attaining puberty?

- (a) fertilisation
- (b) synthesis of eggs
- (c) production of eggs
- (d) growth and development of embryo

**Correct Answer:** Option (c)

2) The image shows the female reproductive system.



Which event will be likely affected, if a female's uterus is implanted with intrauterine device?

- (a) release of eggs
- (b) entering of sperms
- (c) maturation of eggs
- (d) implantation of embryo

**Correct Answer:** Option (d)

**LOB:** Describe the changes taking place in female body after/ without fertilization, in order to understand human reproduction

1) The table lists some changes that occur inside the female body after fertilization of egg with sperm.

- A. Rhythmic contractions of uterus muscle for child birth.
- B. Formation of placenta.
- C. Implantation of embryo.
- D. Development of organs in foetus.
- E. Cell division of zygote.

Which option correctly sequences these events?

- (a) C→B→E→A→D
- (b) E→C→D→B→A
- (c) E→C→B→D→A
- (d) C→E→A→B→D

**Correct Answer:** Option (c)

- 2) After a female attains puberty, the body undergoes many changes for maturation. Which event will likely happen in the female body when there is no fertilization of egg?
- (a) disintegration of uterine wall
  - (b) development of egg into zygote
  - (c) increase in the production of eggs in the ovaries
  - (d) of a mature egg into an immature egg

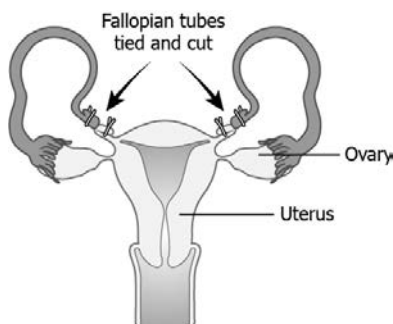
**Correct Answer:** Option (a)

**LOB:** List down the ways to avoid fertilization, in order to avoid pregnancy and maintain reproductive health

- 1) Which contraceptive can be used to prevent the entry of sperm inside the female reproductive organ?
- (a) inserting copper-T inside the uterus
  - (b) wearing condoms on the penis
  - (c) consuming oral pills containing hormones
  - (d) undergoing surgery for blocking fallopian tube

**Correct Answer:** Option (b)

- 2) The image shows a surgical method in females to prevent pregnancy.



Which event will be likely prevented from this method?

- (a) maturation of eggs
- (b) production of eggs
- (c) entry of eggs into the uterus
- (d) entry of sperm into the uterus

**Correct Answer:** Option (c)

# Suggested Teacher Resources



## Activity

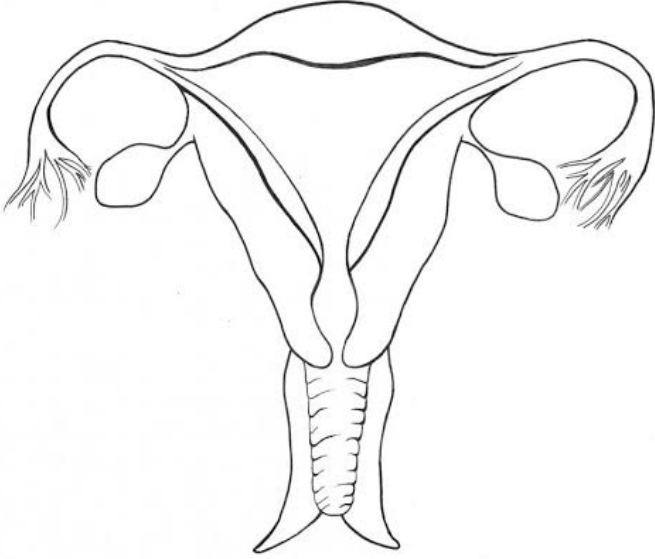
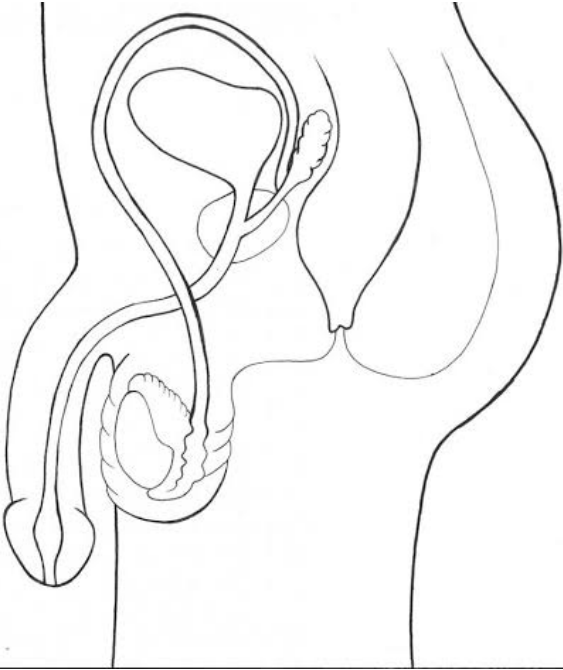


|                               |   |
|-------------------------------|---|
| Objective                     | List down the reasons for changes in DNA copying and their effect on ecosystem, in order to understand the importance of variations.  |
| Prerequisite                  | What is DNA and what is its role in the cell?   |
| Material Required             | -   |
| Vocabulary                    | Variations: It is any difference between cells, individual organisms, or groups of organisms of any species caused by genetic differences during DNA copying.   |
| Procedure                     | <p><b>Evolution 'Telephone' (Source: <a href="https://www.thoughtco.com/classroom-activities-demonstrating-evolution-4169912">https:// www.thoughtco.com/ classroom-activities-demonstrating-evolution-4169912</a>)</b></p> <ol style="list-style-type: none"> <li>1. Make students stand in a line and whisper a complicated message in the ear of the first student.</li> <li>2. Let the process continue till the last student in the line.</li> <li>3. Ask the last student to call out the message.</li> </ol> <p>The message sent through the "telephone" changes as it passes between the students because small mistakes by students accumulate, much like small <u>mutations (changes) in the DNA</u>. In evolution, after enough time passes, mistakes add up to adaptations and can create new species that don't resemble the originals. (Sourced from the above source.)</p> |
| Reflection Questions          | <ol style="list-style-type: none"> <li>1. What causes changes in DNA during copying?</li> <li>2. What importance do variations serve? (Hint: Think of a time of a natural calamity and the survival of the population of a species during that time.)</li> </ol>  |
| Text to real world connection | The teacher can discuss the evolution of the first birds from dinosaurs. ( <a href="https://www.youtube.com/watch?v=0-7iXyYS0uw">https:// www.youtube.com/ watch?v=0-7iXyYS0uw</a> )  |
| Beyond the classroom          | <ol style="list-style-type: none"> <li>1. Which traits in you are the same as your parents, which are different?</li> <li>2. Are there any different traits which give you a survival advantage over your parents? How?</li> </ol>  |

2

## Activity



|                   |  |
|-------------------|--|
| Material required | Cut out of parts of male and female reproductive system for each group of 4 students.  |
| Procedure         | <ol style="list-style-type: none"><li>1. Cut out the reproductive organs onto a blank paper.</li><li>2. Ask the students in groups of 4 to put them in order from the production of sex cells or direction sex cells must travel for reproduction.</li><li>3. Describe the process in words in the notebook.</li></ol> <div data-bbox="469 555 1126 1111"></div> <p data-bbox="724 1128 1107 1160">Female Reproductive System</p> <div data-bbox="552 1232 1117 1899"></div> <p data-bbox="740 1899 1091 1930">Male Reproductive System</p> <p data-bbox="469 1935 1362 1966">(Source: <a href="https://sexinfo.soc.ucsb.edu/article/anatomy-diagrams">https://sexinfo.soc.ucsb.edu/article/anatomy-diagrams</a>)</p> |



Reflection  
questions

1. Where are male and female sex cells formed?
2. What is fertilization and where does it take place?
3. Where does a fertilized egg implant itself?
4. Which parts of the male and female reproductive system can be blocked for contraception?

# 9. Heredity and Evolution

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts      | Learning Objectives  |
|--------------------------------|--|
| Mendel's experiments           | State and explain Mendel's traits of inheritance, in order to understand how traits are inherited from one generation to next                                  |
| Sex determination              | Explain the combination of sex chromosomes, in order to understand how sex is determined in humans   |
| Inherited & Acquired Traits    | Classify the given traits as inherited or acquired, in order to understand which traits cause a change in genes.   |
| Natural selection & speciation | Explain how changes in DNA can lead to stronger/ better species, or formation of new species altogether, in order to understand natural selection & speciation |
| Homologous & analogous organs  | Identify if a given pair of organs is analogous or homologous, in order to find relationship between species   |
| Fossils & Evolution by stages  | Observe different fossils and identify the differences and similarities, in order to understand the timeline of evolution                                      |

**Learning Objectives and Learning Outcomes:**

| Learning Objectives   | Learning Outcomes  |
|---|--|
| Explain the combination of sex chromosomes, in order to understand how sex is determined in humans                            | <b>Explains processes and phenomena</b> , such as nutrition in human beings and plants, transportation in plants and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc. |
| Explain the combination of sex chromosomes, in order to understand how sex is determined in humans                            | <b>Draws labelled diagrams / flow charts / concept map /graphs</b> , such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.  |
| State and explain Mendel's traits of inheritance, in order to understand how traits are inherited from one generation to next |  |

|  |   |
|--|---|
| Classify the given traits as inherited or acquired, in order to understand which traits cause a change in genes.   | <p><b>Draws conclusion</b>, such as traits / features are inherited through genes present on chromosomes, a new species originates through evolutionary processes, water is made up of hydrogen and oxygen, properties of elements vary periodically along the groups and periods in periodic table, potential difference across a metal conductor is proportional to the electric current through it, etc.</p>   |
| Explain how changes in DNA can lead to stronger/ better species, or formation of new species altogether, in order to understand natural selection & speciation |   |
| Identify if a given pair of organs is analogous or homologous, in order to find relationship between species   |   |
| Observe different fossils and identify the differences and similarities, in order to understand the timeline of evolution                                      |   |
| State and explain Mendel's traits of inheritance, in order to understand how traits are inherited from one generation to next                                  |   |
| State and explain Mendel's traits of inheritance, in order to understand how traits are inherited from one generation to next                                  | <p><b>Takes initiative to know about scientific discoveries / inventions</b>, such as Mendel's contribution in understanding the concept of inheritance, Dobereiner for discovering triads of elements, Mendeleev for the development of the periodic table of elements, Oersted discovery that electricity and magnetism are related, discovery of relation between potential difference across a metal conductor and the electric current through it by ohm, etc.</p> |

## Test items



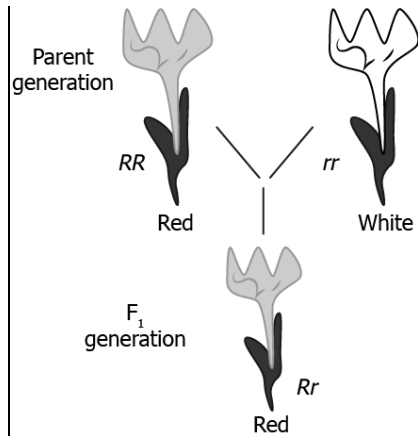
**LOB: State and explain Mendel's traits of inheritance, in order to understand how traits are inherited from one generation to next**

1) Which statement explains the Mendel's law of segregation?

- (a) A trait in an offspring is due to the combination of an allele each from both the parent.
- (b) A trait in an offspring is due to the combination of two alleles each from both the parent.
- (c) A trait in an offspring is due to the combination of two alleles each from either of the parent.
- (d) A trait in an offspring is due to the combination of one allele each from either of the parent.

**Correct Answer:** Option (a)

2) The inheritance of color trait in flower is as shown.



$R$  and  $r$  denote two different genes for color. Which law of Mendel can be explained using the image?

- (a) Only Law of segregation
- (b) Only Law of independent assortment
- (c) Law of segregation and Law of dominance
- (d) Law of segregation and Law of independent assortment

**Correct Answer:** Option (c)

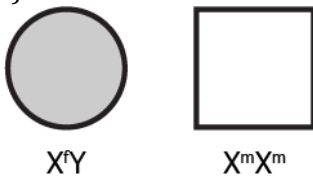
**LOB:** Explain the combination of sex chromosomes, in order to understand how sex is determined in humans

1) Humans have two different sex chromosomes, X and Y. Based on the Mendel's laws, a male offspring will inherit which combination of chromosomes?

- (a) both the X chromosomes from one of its parents
- (b) both the Y chromosomes from one of its parents
- (c) combination of X chromosomes from either of its parents
- (d) combination of X and Y chromosome from either of its parents

**Correct Answer:** Option (d)

2) Two individuals are as shown using geometric shapes.



Their sex chromosomes are respectively denoted by  $X^r$ ,  $X^m$ , and Y. What are the possible combinations of sex chromosomes for their male and female offspring respectively?

- (a)  $XX^m$  and  $X^mX^m$
- (b)  $X^mY$  and  $X^mX^m$
- (c)  $X^rY$  and  $X^mY$
- (d)  $X^mY$  and  $X^mX^r$

**Correct Answer:** Option (d)

**LOB:** Classify the given traits as inherited or acquired, in order to understand which traits cause a change in genes

1) An individual is tall with black hair, and free earlobes. The individual learnt to play football from his father and got a scar on his forearm in a match. Which table shows the correct classification of his traits into acquired traits and inherited traits?

(a)

| Acquired Traits                     | Inherited Traits                  |
|-------------------------------------|-----------------------------------|
| tallness, black hair, free earlobes | ability to play football and scar |

(b)

| Acquired Traits       | Inherited Traits                                  |
|-----------------------|---|
| height and hair color | earlobe shape, ability to play football, and scar |

(c)

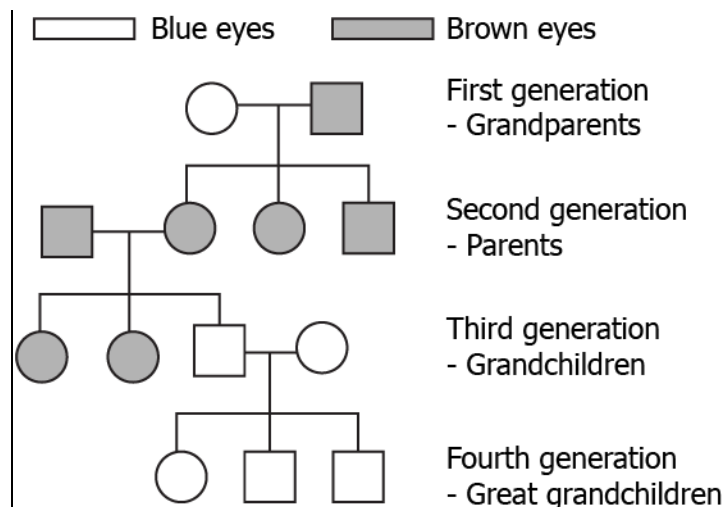
| Acquired Traits                   | Inherited Traits                  |
|-----------------------------------|-----------------------------------|
| ability to play football and scar | height, hair color, earlobe shape |

(d)

| Acquired Traits                            | Inherited Traits             |
|--|------------------------------|
| ability to play football, height, and scar | hair color and earlobe shape |

**Correct Answer:** Option (d)

2) The image shows the traits present across generations of a family.



Based on the image, what can be inferred about the eye color trait?

- (a) Acquired trait because both male and females have it.
- (b) Acquired trait because it is expressed in all the generations.
- (c) Inherited trait because it is expressed in two different colors.
- (d) Inherited trait because it depends on the traits of preceding generation.


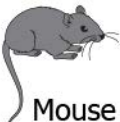


**Correct Answer:** Option (d)

**LOB:** Explain how changes in DNA can lead to stronger/ better species, or formation of new species altogether, in order to understand natural selection & speciation

- 1) In which case does the change in DNA contributes to speciation?
- (a) changes in the DNA of zygote
  - (b) changes in the DNA of brain cells
  - (c) changes in the DNA of bone cells
  - (d) changes in the DNA of sperm cells

**Correct Answer:** Option (d)

- 2) The image shows the extent of similarity in the DNA of humans and the organisms.

|   |  |  |  |   |
|---|--|--|--|---|
| <b>Organism</b>                           | <br>Chimp | <br>Mouse | <br>Chicken | <br>Fruit fly |
| <b>Genetic Similarity with Humans (%)</b> | 99.5   | 88   | 75   | 60  |

Based on the image, what can be inferred about DNA changes in context of speciation?

- (a) Newly evolved species have inactive ancestral genes.
- (b) Species retain their DNA and evolve new proteins with time.
- (c) Some of the genes remain conserved during the evolution of species.
- (d) Species undergo a complete change of DNA sequences as they evolve.

**Correct Answer:** Option (c)

**LOB:** Identify if a given pair of organs is analogous or homologous, in order to find relationship between species

- 1) Which of this is a pair of an analogous organ?
- (a) wings of a pigeon and a bat
  - (b) forelimbs of a frog and a bird
  - (c) forelimbs of a rabbit and a lizard
  - (d) leaves of a pitcher plant and a Venus fly trap

**Correct Answer:** Option (a)

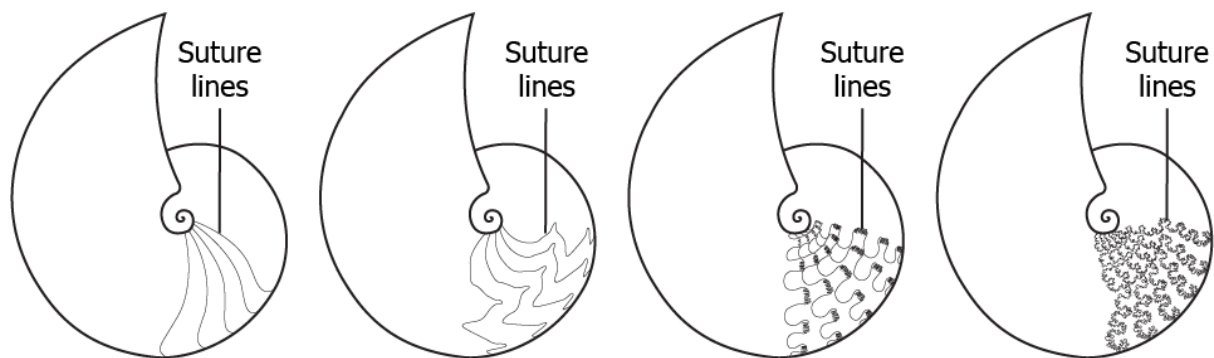
2) A student studies that the wings of birds are covered by feathers whereas that of bats are skins folds stretched mainly between elongated fingers. Their wings vary in design, structure and components and thus they are very different. They look similar only because they both are used for flying. He also studied that their origin is not common. What type of organs are the wings of these two species?

- (a) homologous, as both wings are used for flying
- (b) analogous, as wings of both are similar in design
- (c) analogous, as they do not have a common origin
- (d) homologous, as components of the wings are similar

**Correct Answer:** Option (c)

**LOB:** Observe different fossils and identify the differences and similarities, in order to understand the timeline of evolution

1) The image represents a marine organism that was present 65 million years ago.

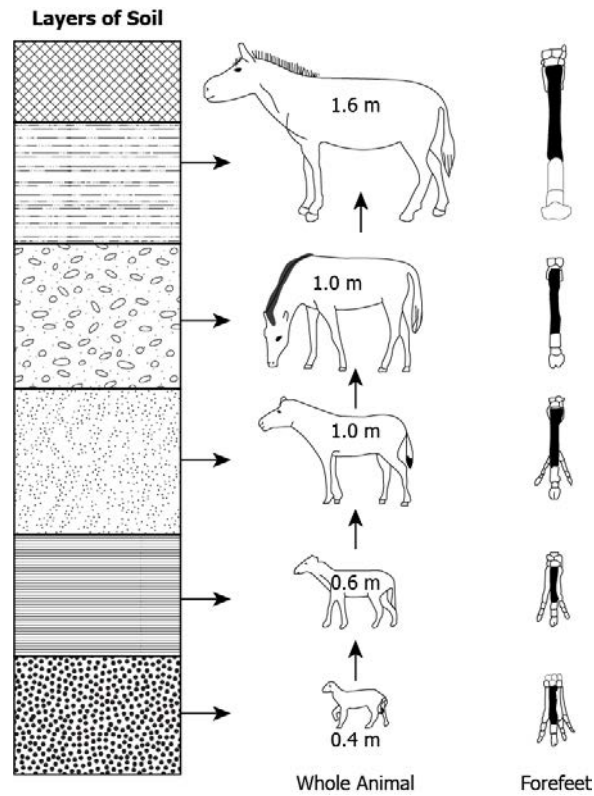


Which option would help to understand the timeline of evolution for the animal?

- (a) the size of the animal increases
- (b) the size of the animal decreases
- (c) the complexity of the suture line increases
- (d) the complexity of the suture line decreases

**Correct Answer:** Option (c)

2) The image represents the fossil record of a species that was found from different layers of the soil along with the possible match animal shape.



What do the changes in its forefeet and size of animal indicate?

- (a) growth of the animal over time
- (b) evolution of the animal over time
- (c) appearances of new form of animal over time
- (d) an increase in the length of the fossils due to weight of the upper layers of rock

**Correct Answer:** Option (b)




# Suggested Teacher Resources



## Activity

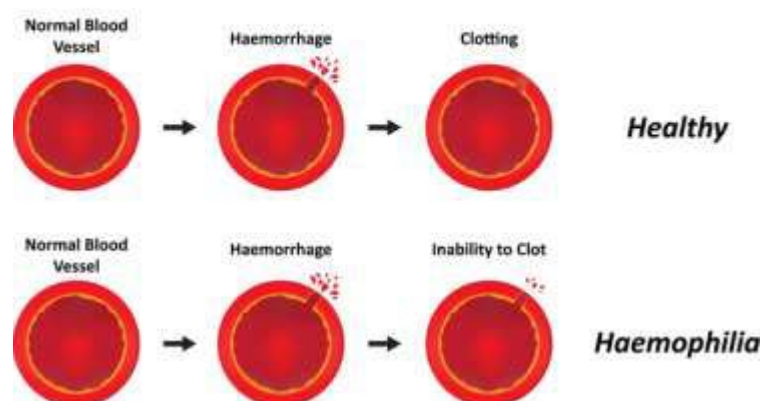


|                   |   |
|-------------------|---|
| Objective         | Classify the given traits as inherited or acquired, in order to understand which traits cause a change in genes.  |
| Prerequisite      | Traits, chromosomes, genes  |
| Material Required | Case study prints   |
| Vocabulary        | <p>Acquired Traits: The traits that a person develops during his lifetime. These are not passed from one generation to another.</p> <p>Inherited Traits: The traits that are present in the person since the time of his birth (coded genetically) and are passed on from one generation to another.</p>  |
| Procedure         | <p><b>Case Study 1: (Source: <a href="https://www.icytales.com/what-ballet-dancers-feet-through/">https:// www.icytales.com/ what-ballet-dancers-feet-through/</a>)</b></p> <p>Peter Norman, a leading UK podiatrist who has been treating the Royal Ballet for 16 years, has seen a lot in his days. He says it's common for dancers to tape their feet simply and go on pointe with broken toes or stress fractures. He says it's due to the pressure and insecurity of their jobs. People push their limits to keep their position. The constant pressure on the tip of their toes and the quick bursts of jumping in the air and landing perfectly, the stretching of their tendons and feet fit into impossible shaped shoes has altered the shape of their feet. But for a lot of dancers, this has become a part of them and a part of how they survive these shoes. Most of them won't allow their doctors to remove the thickened skin at their toe-heads because that is how they survive the shoes. Norman claims he has seen patients whose feet require at least a few weeks to a month's rest, but they refuse to take more than a night.</p> <p>Among men, it's different for they wear soft canvas shoes. There's a lot of jumping and lifting women involved and that results in ankle and tendon injuries.</p>  <p><b>Case Study 2: (Source: <a href="http://sciencecases.lib.buffalo.edu/cs/files/hemo.pdf">http:// sciencecases.lib.buffalo.edu/ cs/ files/ hemo.pdf</a>)</b></p> |

Haemophilia is an X-linked disorder characterized by the inability to properly form blood clots. Until recently, haemophilia was untreatable, and only a few haemophiliacs survived to reproductive age because any small cut or internal haemorrhaging after even a minor bruise were fatal. Now haemophilia is treated with blood transfusions and infusions of a blood derived substance known as antihemophilic factor. However, the treatment is very expensive and occasional problems can arise because of a patient's allergic reactions or other transfer complications.

Haemophilia affects males much more frequently (1 in 10,000) than females (1 in 100,000,000). This occurs because a critical blood clotting gene is carried on the X chromosome. Since males only carry one X chromosome, if that is defective, haemophilia will immediately show up. An early death is likely. Females, on the other hand, carry two X chromosomes. If only one is defective, the other normal X chromosome can compensate. The woman will have normal blood clotting; she will simply be a carrier of the recessive defective gene. This fact will be discovered if some of her children are haemophiliacs. Naturally, women haemophiliacs are rare because it takes two defective X chromosomes in order for the condition to be seen.

### Haemophilia



|                               |  |
|-------------------------------|--|
| Reflection Questions          | <p><b>Case Study 1:</b></p> <ol style="list-style-type: none"> <li>1. Why do you think ballerinas are made to do this to their toes?</li> <li>2. Do you think these injuries will make any changes in their DNA/ genes?</li> <li>3. Will their offspring be born with such feet?</li> <li>4. Is it an acquired or inherited trait?</li> </ol> <p><b>Case Study 2:</b></p> <ol style="list-style-type: none"> <li>1. What are the problems associated with haemophilia?</li> <li>2. How does this disease gets transferred?</li> <li>3. Do you think these will make any changes in the DNA/ genes?</li> <li>4. Can the offspring be born with such a disease? Does the female have more chances to get the disease or the male?</li> <li>5. Is it an acquired or inherited trait?</li> </ol> |
| Text to real world connection | List down inherited and acquired characteristics for yourself by comparing traits of your parents.   |

|                      |   |
|----------------------|---|
| Beyond the classroom | Social topic for discussion in the class (related to ballerinas): <i>"Do beautiful outcomes always have beautiful backstories?"</i> |
|----------------------|---|

2

## Activity



| Material required    | Beans or candies (1 bag), Wooden Knives (9) Forks (9) Chopsticks (9) Spoons (9)  |                     |                                     |  |  |          |                          |                     |                                     |            |  |  |  |       |  |  |  |        |  |  |  |        |  |  |  |
|----------------------|--|---------------------|-------------------------------------|--|--|----------|--------------------------|---------------------|-------------------------------------|------------|--|--|--|-------|--|--|--|--------|--|--|--|--------|--|--|--|
| Procedure            | <p><b>Scavenger Hunt: Simulating Natural Selection (Source: <a href="https://pumas.jpl.nasa.gov/files/09_17_03_1.pdf">https://pumas.jpl.nasa.gov/files/09_17_03_1.pdf</a>)</b></p> <p>(In this simulation, students will take on the roles of crab-like predators that have variations in the shape of their "claws." They catch prey (beans or candies), and their claws are of four types: spoons, forks, knives, and chopsticks. Groups of students go hunting/ scavenging for beans on grass lawns with their claws. The hunt continues for three rounds or "generations," with extinction and reproduction occurring between generations. To study evolution by natural selection in this predator population, the class will track the frequency of each claw type through three generations.)</p> <p>Class Activity:</p> <ol style="list-style-type: none"> <li>1) Start with a population that contains 25% of each of the four variants or "species." Record this number on your data sheet as your Starting Population Size for generation 0.</li> <li>2) The entire experiment will be repeated for each successive generation, starting with the population at the end of the previous generation.</li> <li>3) The teacher randomly throws food (beans) onto the grass. All crabs begin searching for the food and capturing it with their feeding claws. The hunt is over in 30 - 60 seconds).</li> <li>4) Count the number of prey caught by each student, then sum up and tabulate the results by species (or group with the same type of claws). Calculate the average in each species using the formula below:</li> </ol> $\text{Formula for Calculating Average: } \frac{(\text{Total Prey from Forks}) + (\text{**** Spoons}) + (\text{**** Chopsticks}) + (\text{**** Knives})}{\# \text{ of participating students}}$ <ol style="list-style-type: none"> <li>5) All individuals below the average, "die" without reproducing, and must turn in their utensils at that point.</li> <li>6) Record the number of surviving individuals in each species.</li> </ol> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="4">Generation # _____</th> </tr> <tr> <th>Variants</th> <th>Starting Population Size</th> <th>Surviving Pop. Size</th> <th>Final Pop. Size (post reproduction)</th> </tr> </thead> <tbody> <tr> <td>Chopsticks</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Forks</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Knives</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Spoons</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> | Generation # _____  |                                     |  |  | Variants | Starting Population Size | Surviving Pop. Size | Final Pop. Size (post reproduction) | Chopsticks |  |  |  | Forks |  |  |  | Knives |  |  |  | Spoons |  |  |  |
| Generation # _____   |  |                     |                                     |  |  |          |                          |                     |                                     |            |  |  |  |       |  |  |  |        |  |  |  |        |  |  |  |
| Variants             | Starting Population Size   | Surviving Pop. Size | Final Pop. Size (post reproduction) |  |  |          |                          |                     |                                     |            |  |  |  |       |  |  |  |        |  |  |  |        |  |  |  |
| Chopsticks           |  |                     |                                     |  |  |          |                          |                     |                                     |            |  |  |  |       |  |  |  |        |  |  |  |        |  |  |  |
| Forks                |  |                     |                                     |  |  |          |                          |                     |                                     |            |  |  |  |       |  |  |  |        |  |  |  |        |  |  |  |
| Knives               |  |                     |                                     |  |  |          |                          |                     |                                     |            |  |  |  |       |  |  |  |        |  |  |  |        |  |  |  |
| Spoons               |  |                     |                                     |  |  |          |                          |                     |                                     |            |  |  |  |       |  |  |  |        |  |  |  |        |  |  |  |
| Reflection questions | <ol style="list-style-type: none"> <li>1. Which species population had the maximum number at the end of three generations?</li> <li>2. Why do you think that happened?</li> <li>3. What advantage did that species have over other species?</li> </ol>   |                     |                                     |  |  |          |                          |                     |                                     |            |  |  |  |       |  |  |  |        |  |  |  |        |  |  |  |

# 10. Light – Reflection and Rarefaction

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts                       | Learning Objectives  |
|---|--|
| Reflection of light                             | State the laws of reflection of light, in order to understand how light travels in a medium when it encounters another object          |
| Spherical Mirrors                               | Outline the rule of image formation by spherical mirrors in order to complete the ray diagrams by drawing reflected rays.              |
|   | Represent the path of incident ray and reflected ray in order to decipher the position and nature of image formed.                     |
| Mirror Formula & magnification                  | Express $u$ , $v$ , $f$ in the mirror formula in order to apply sign convention in solving word problems to find the unknown variable. |
|   | Deduce the nature and size of image by magnification in order to relate height of object with height of image.                         |
| Refraction of Light                             | Demonstrate the path of light when it travels through a rectangular glass slab, in order to formulate laws of refraction of light.     |
| Refractive Index                                | Compare speed of light in one medium with another in order to calculate refractive index.  |
| Refraction by Spherical Lenses, Image formation | Represent the path of incident & reflected light rays from a concave lens, in order decipher the position and nature of image formed.  |
|   | Illustrate the path of incident & reflected light rays from a convex lens, in order decipher the position and nature of image formed.  |
| Lens formula & magnification                    | Construct the lens formula for a lens relating $v$ , $u$ , $f$ ; in order to find an unknown variable given the other two.             |
|   | State the magnification for a lens, in order to relate height of object with height of image.  |
| Power of a lens                                 | Calculate the power of a lens, in order to determine its power to converge or diverge.   |

**Learning Objectives and Learning Outcomes:**

| Learning Objectives   | Learning Outcomes   |
|---|---|
| Demonstrate the path of light when it travels through a rectangular glass slab, in order to formulate laws of refraction of light.    | Plans and conducts investigations / experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own, such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light? |
| Outline the rule of image formation by spherical mirrors in order to complete the ray diagrams by drawing reflected rays.             |   |
| Represent the path of incident & reflected light rays from a concave lens, in order decipher the position and nature of image formed. |   |
| Compare speed of light in one medium with another in order to calculate refractive index.   | Relates processes and phenomena with causes / effects, such as hormones with their functions, tooth decay with pH of saliva, growth of plants with pH of the soil, survival of aquatic life with pH of water, blue colour of sky with scattering of light, deflection of compass needle due to magnetic effect of electric current, etc.  |
| State the laws of reflection of light, in order to understand how light travels in a medium when it encounters another object         | Explains processes and phenomena, such as nutrition in human beings and plants, transportation in plants and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.  |
| Represent the path of incident ray and reflected ray in order to decipher the position and nature of image formed.                    |   |
| Illustrate the path of incident & reflected light rays from a convex lens, in order decipher the position and nature of image formed. |   |
| Outline the rule of image formation by spherical mirrors in order to complete the ray diagrams by drawing reflected rays.             | Draws labelled diagrams / flow charts / concept map /graphs, such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.   |
| Represent the path of incident ray and reflected ray in order to decipher the position and nature of image formed.                    |   |
| Demonstrate the path of light when it travels through a rectangular glass slab, in order to formulate laws of refraction of light.    |   |

|   |  |
|---|--|
| Represent the path of incident & reflected light rays from a concave lens, in order decipher the position and nature of image formed. |  |
| Illustrate the path of incident & reflected light rays from a convex lens, in order decipher the position and nature of image formed. |  |
| Outline the rule of image formation by spherical mirrors in order to complete the ray diagrams by drawing reflected rays.             | Analyses and interprets data / graph / figure, such as melting and boiling points of substances to differentiate between covalent and ionic compounds, pH of solutions to predict the nature of substances, v-i graphs, ray diagrams, etc. |
| Represent the path of incident & reflected light rays from a concave lens, in order decipher the position and nature of image formed. |  |
| Express u, v, f in the mirror formula in order to apply sign convention in solving word problems to find the unknown variable.        | Calculates using the data given, such as number of atoms in reactants and products to balance a chemical equation, resistance of a system of resistors, power of a lens, electric power, etc.  |
| Deduce the nature and size of image by magnification in order to relate height of object with height of image.                        |  |
| Compare speed of light in one medium with another in order to calculate refractive index.   |  |
| Construct the lens formula for a lens relating v, u, f; in order to find an unknown variable given the other two.                     |  |
| State the magnification for a lens, in order to relate height of object with height of image  |  |
| Calculate the power of a lens, in order to determine its power to converge or diverge   |  |
| Express u, v, f in the mirror formula in order to apply sign convention in solving word problems to find the unknown variable.        |  |
| Construct the lens formula for a lens relating v, u, f; in order to find an unknown variable given the other two.                     |  |

## Test items

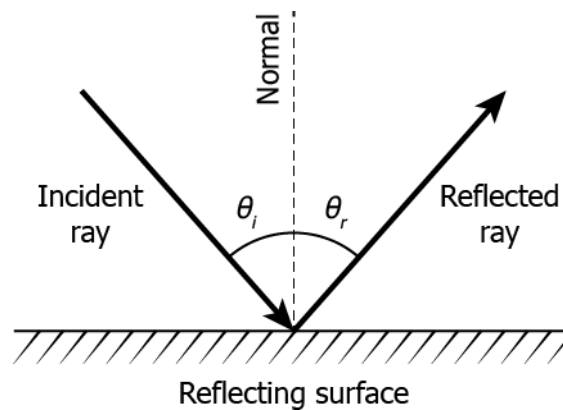


**LOB:** State the laws of reflection of light, in order to understand how light travels in a medium when it encounters another object

- 1) Which statement is true for the reflection of light?
  - (a) The angle of incidence and reflection are equal.
  - (b) The reflected light is less bright than the incident light.
  - (c) The sum of angle of incidence and reflection is always greater than  $90^\circ$ .
  - (d) The beams of incident light after reflection diverges at unequal angles.

**Correct Answer:** Option (a)

- 2) The image shows reflection of light on a mirror.



Based on the image, what can be inferred?

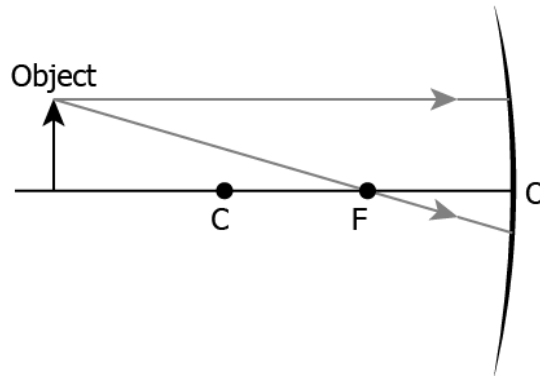
- (a) The incident ray, reflected ray, and normal at the point of reflection lie on a common plane.
- (b) The angle of incidence, angle of reflection, and normal at the point of reflection lie on a common plane.
- (c) The angle between incident ray and normal is greater than the angle between normal and the reflected ray.
- (d) The angle between incident ray and normal is smaller than the angle between normal and the reflected ray.

**Correct Answer:** Option (b)

**LOB:** Outline the rule of image formation by spherical mirrors in order to complete the ray diagrams by drawing reflected rays

- 1) The image shows the path of incident rays to a concave mirror.



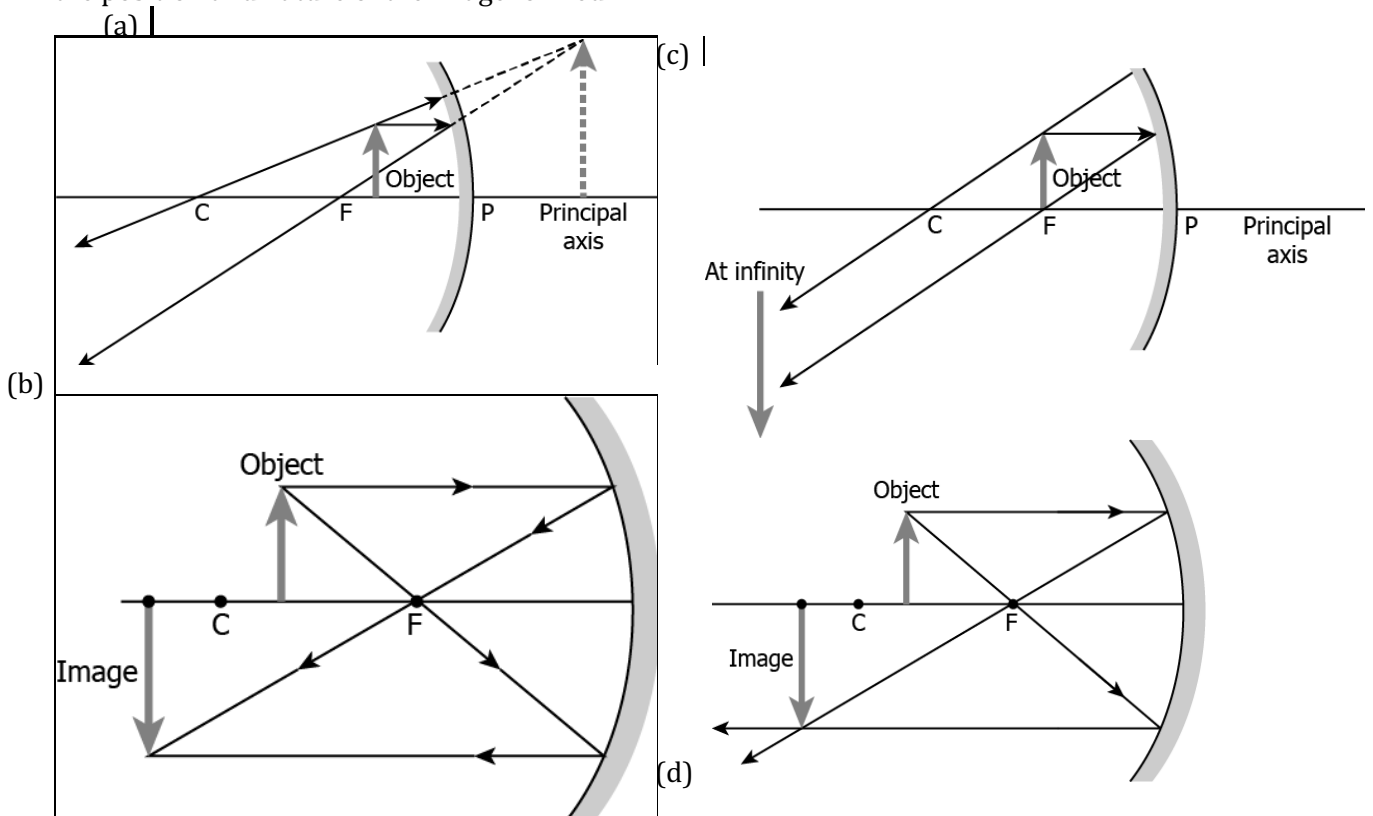


Where would the reflected rays meet for the image formation to take place?

- (a) behind the mirror
- (b) between F and O
- (c) between C and F
- (d) beyond C

**Correct Answer:** Option (c)

2) An object is placed near a concave mirror at a distance of one-fourth the radius of curvature of the concave mirror. Which ray diagram shows the incident rays, reflected rays, and the position and nature of the image formed?



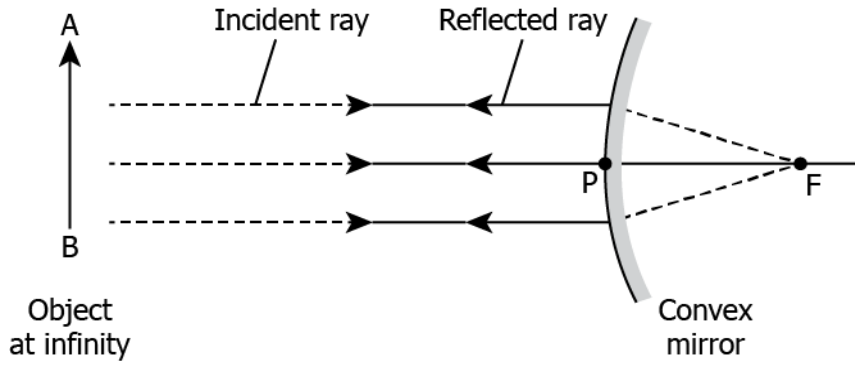
**Correct Answer:** Option (c)

**LOB:** Represent the path of incident ray and reflected ray in order to decipher the position and nature of image formed

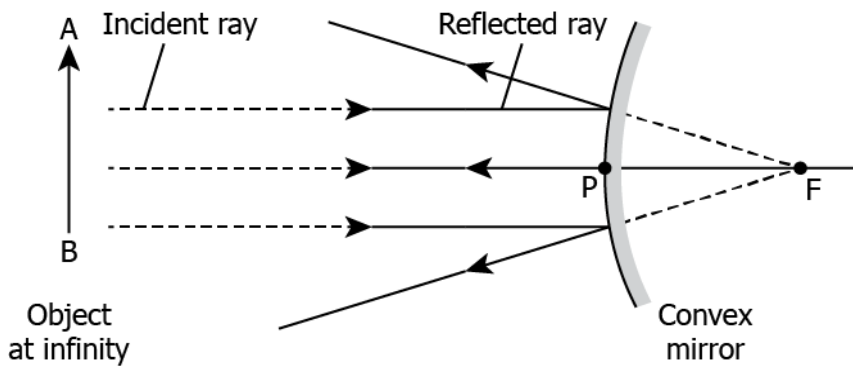
1) Which image represents the path of incident and reflected ray from a convex mirror when an object is placed at infinity?

- (a)

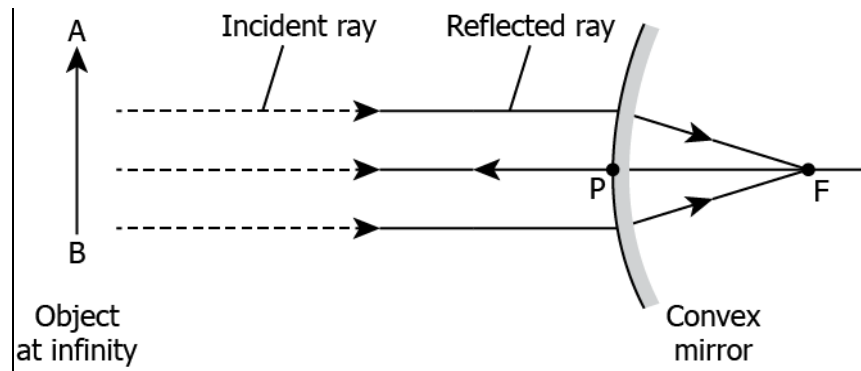




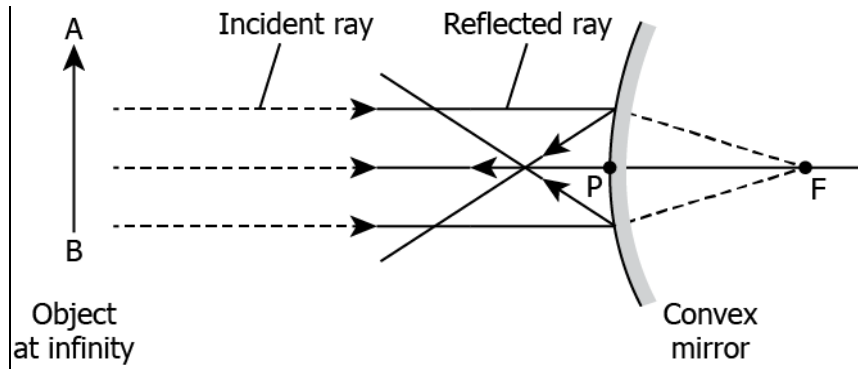
(b)



(c)



(d)



**Correct Answer:** Option (b)

2) A student studies that convex lens always forms virtual image irrespective of its position. What causes the convex mirror to always form a virtual image?

- (a) because the reflected ray never intersects
- (b) because the reflected ray converges at a single point
- (c) because the incident ray traces its path back along the principal axis
- (d) because the incident ray of a convex mirror gets absorbed in the mirror

**Correct Answer:** Option (a)

**LOB:** Express  $u$ ,  $v$ ,  $f$  in the mirror formula in order to apply sign convention in solving word problems to find the unknown variable

1) A student conducts an activity using a concave mirror with focal length of 10 cm. He placed the object 15 cm from the mirror. Where is the image likely to form?

- (a) at 6 cm behind the mirror
- (b) at 30 cm behind the mirror
- (c) at 6 cm in front of the mirror
- (d) at 30 cm in front of the mirror

**Correct Answer:** Option (d)

2) Rekha placed a juice bottle at a distance of 20 cm in front of a convex mirror which has a focal length of 20 cm. Where is the image likely to form?

- (a) at focus behind the mirror
- (b) at focus in front of the mirror
- (c) at a distance of 10 cm behind the mirror
- (d) at a distance of 10 cm in front of the mirror

**Correct Answer:** Option (c)

**LOB:** Deduce the nature and size of image by magnification in order to relate height of object with height of image

1) A student conducts an activity using a flask of height 15 cm and a concave mirror. He finds that the image formed is 45 cm in height. What is the magnification of the image?

- (a) -3 times
- (b)  $-1/3$  times
- (c)  $1/3$  times
- (d) 3 times

**Correct Answer:** Option (d)

2) Sunil conducts an activity using an object of height 10 cm and a convex mirror of focal length 20 cm. He placed the object at a distance of 20 cm in front of the mirror. What is likely to be height of the image produced?

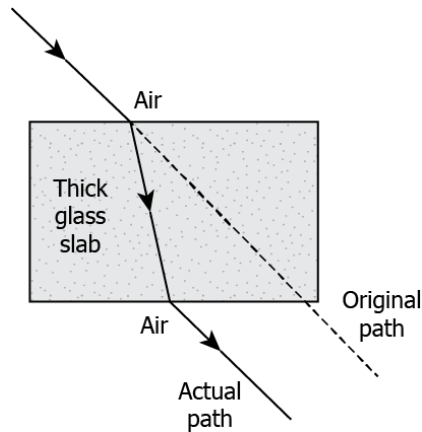
- (a) 1 cm

- (b) 5 cm
- (c) 10 cm
- (d) 20 cm

**Correct Answer:** Option (b)

**LOB:** Demonstrate the path of light when it travels through a rectangular glass slab, in order to formulate laws of refraction of light

- 1) The image shows the path of light travelling through a glass slab.

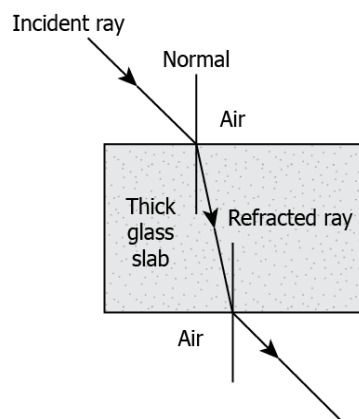


What causes the ray of light to deviate from its original path?

- (a) change in the amount of light
- (b) change in the direction of wind flow
- (c) change in the temperature of the air
- (d) change in the density of the medium

**Correct Answer:** Option (d)

- 2) A student studies that when a ray of light travels from air into the glass slab, the ray of light bends towards the normal. But as refracted ray emerges out of the glass slab to the vacuum, it bends away from the normal, as shown.



Which option explains the law of refraction of light through the glass slab?

- (a) light always bends towards the normal in a glass slab
- (b) ray of light always travels in a straight path irrespective of change in medium
- (c) the incident ray, the refracted ray, and the normal to the interface always lie on the same plane
- (d) ray of light travelling in the air is always considered as the incident ray, and the one in the glass is the refracted ray

**Correct Answer:** Option (c)

**LOB:** Compare speed of light in one medium with another in order to calculate refractive index

1) A student studies that speed of light in air is 300000 kms/ sec where that of speed in a glass slab is about 197000 kms/ sec. What causes the difference in speed of light in these two media?

- (a) difference in density
- (b) difference in temperature
- (c) difference in amount of light
- (d) difference in direction of wind flow

**Correct Answer:** Option (a)

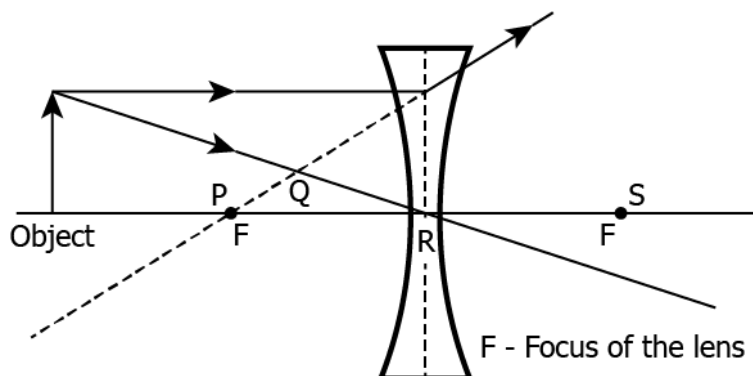
2) The speed of light in air is  $3 \times 10^8$  m s<sup>-1</sup>, whereas that of the speed of light in water is  $2.26 \times 10^8$  m s<sup>-1</sup>. What is the refractive index of water with respect to air?

- (a) 1
- (b) 0.75
- (c) 1.32
- (d) 2.64

**Correct Answer:** Option (c)

**LOB:** Represent the path of incident & reflected light rays from a concave lens, in order decipher the position and nature of image formed

1) The image represents the rays of light travelling through a concave lens.



Where is the image most likely to form?

- (a) P
- (b) Q
- (c) R
- (d) S

**Correct Answer:** Option (b)

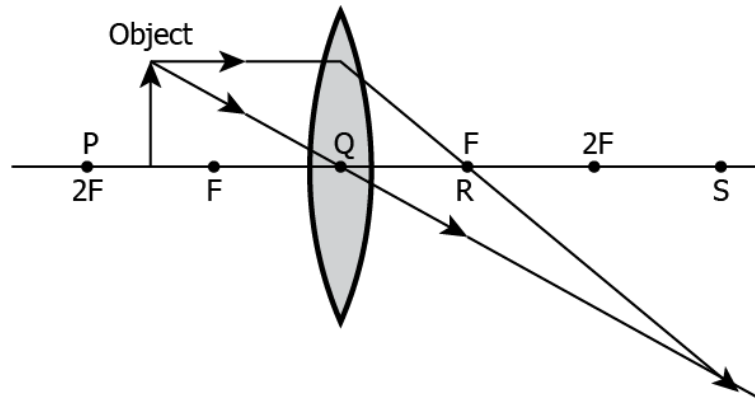
2) Rahul conducts an experiment using an object of height 10 cm and a concave lens with focal length 20 cm. The object is placed at a distance of 25 cm from the lens. Can the image be formed on a screen?

- (a) yes, as the image formed will be real
- (b) yes, as the image formed will be erect
- (c) no, as the image formed will be virtual
- (d) no, as the image formed will be inverted

**Correct Answer:** Option (c)

**LOB:** Illustrate the path of incident & reflected light rays from a convex lens, in order decipher the position and nature of image formed

1) The image represents the rays of light travelling through a convex lens.



Where is the image most likely to form?

- (a) position P
- (b) position Q
- (c) position R
- (d) position S

**Correct Answer:** Option (d)

2) A student conducts an experiment using a convex lens of focal length 20 cm and an object of height 15 cm. He placed the object at 25 cm from the lens. Can the image be formed on a screen?

- (a) yes, because a real image will be formed
- (b) no, because a virtual image will be formed
- (c) yes, because an erect image will be formed
- (d) no, because an inverted image will be formed

**Correct Answer:** Option (a)

**LOB:** Construct the lens formula for a lens relating  $v$ ,  $u$ ,  $f$ ; in order to find an unknown variable given the other two

1) Kumar conducts an experiment using a concave lens with focal length of 20 cm. He places an object at a distance of 30 cm in front of the lens. Where is the image most likely to form?

- (a) 10 cm in front of the lens
- (b) 12 cm in front of the lens
- (c) 30 cm in front of the lens
- (d) 60 cm in front of the lens

**Correct Answer:** Option (b)

2) Rakhi conducts an experiment to produce an image of an object on a screen which is placed at 20 cm from the lens. She uses a convex lens of focal length 15 cm for the experiment. Where should she place the object in order to produce the sharpest image?

- (a) 8 cm in front of the lens
- (b) 15 cm in front of the lens
- (c) 20 cm in front of the lens
- (d) 60 cm in front of the lens

**Correct Answer:** Option (d)

**LOB:** State the magnification for a lens, in order to relate height of object with height of image

- 1) An image of an object produced on a screen which is about 36 cm using a convex lens. The image produced is about 3 times the size of the object. What is the size of the object?
- 12 cm
  - 33 cm
  - 39 cm
  - 108 cm

**Correct Answer:** Option (a)

- 2) An object of height 10 cm is placed in front of a convex lens having focal length of 12 cm. The object is placed at a distance of 36 cm in front of the lens. How many times is the image likely to be magnified?
- $\frac{1}{2}$  times
  - 2 times
  - 3 times
  - 4 times

**Correct Answer:** Option (a)

**LOB:** Calculate the power of a lens, in order to determine its power to converge or diverge

- 1) A concave lens has a focal length of 20 cm. What is the power of the lens?
- 5 dioptre
  - 0.05 dioptre
  - 0.05 dioptre
  - 5 dioptre

**Correct Answer:** Option (a)

- 2) A student conducts an experiment using a convex lens. He places the object at a distance of 60 cm in front of the lens and observed that the image is formed at a distance of 30 cm behind the lens. What is the power of the lens?
- 0.005 dioptre
  - 0.05 dioptre
  - 5 dioptre
  - 50 diptre

**Correct Answer:** Option (c)

## Suggested Teacher Resources



### Activity



|                   |  |
|-------------------|--|
| Objective         | Illustrate the path of incident & reflected light rays from a convex lens, in order to decipher the position and nature of image formed. |
| Prerequisite      | Real and virtual image, erect and inverted image   |
| Material Required | Plastic can with a slit on the cover, convex lens, candle, match box, card or sheet for a screen   |

|                               |   |
|-------------------------------|---|
| Vocabulary                    | -   |
| Procedure                     | <ol style="list-style-type: none"> <li>1. Place a convex lens on the can between the candle and the screen and observe the nature of image formed.</li> <li>2. Now, keep the candle at different distances from the lens to make a note of the size, nature and inversion of the image in your notebook.</li> </ol> |
| Reflection Questions          | <ol style="list-style-type: none"> <li>1. Record the observations of nature of image in your notebook.</li> </ol>   |
| Text to real world connection | <ol style="list-style-type: none"> <li>1. Which lens is used as a magnifying glass? Why?</li> </ol>   |
| Beyond the classroom          | <ol style="list-style-type: none"> <li>1. Our eyes also have a convex lens. How do you think the brain interprets the inverted images of objects to erect as we see them?</li> <li>2. Try burning a piece of paper using a convex lens to focus sunlight on the paper.</li> </ol>                                   |

## 2

## Activity



|                      |  |
|----------------------|--|
| Material required    | Petri dish, cooking oil, water, convex lens, glass slide, glass prism, boiling tube, test tube, glass slab, beaker   |
| Procedure            | <p>Refractive Disappearance</p> <ol style="list-style-type: none"> <li>1. Take water in a petri dish and taking turns put the glass slide and convex lens in it. Observe if they are visible inside water and note down your observations.</li> <li>2. Now, fill the petri dish with cooking oil and taking turns put the glass slide and convex lens in it. Observe if they are visible inside oil and note down your observations.</li> <li>3. Fill a beaker with cooking oil and place a prism inside it. Observe if it is visible inside oil and note down your observations.</li> </ol> |
| Reflection questions | <ol style="list-style-type: none"> <li>1. What caused the objects to be visible in one kind of a liquid and not in the other?</li> <li>2.</li> <li>3. Can some magicians be basing their magic tricks on this science?</li> </ol>  |

# 11. Human Eye and the Colourful World

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts              | Learning Objectives   |
|--|---|
| The Human Eye                          | Illustrate the parts and function of human eye, in order to understand how humans see the objects around them   |
| Power of Accommodation                 | Describe how focal length of eye changes, in order to understand how humans see close and far objects   |
| Defects of vision and their correction | Identify the defects of vision in human eye (myopia, hypermetropia, presbyopia) and their causes, in order to devise a correction method for them                         |
| Refraction of light through a prism    | Examine the path of light rays through a prism, in order to determine how light gets deviated when travelling through a prism   |
| Dispersion                             | Trace the path of white light rays through a prism, in order to determine that white light is made of seven colours   |
| Atmospheric Refraction                 | Elaborate the process of atmospheric refraction, in order to understand natural phenomena, like twinkling of stars and advance sunrise and delayed sunset                 |
| Scattering of Light                    | Explain the process of scattering of light, in order to understand natural phenomena, like tyndall effect, blue colour of the sky & red colour of sun at sunrise & sunset |

**Learning Objectives and Learning Outcomes:**

| Learning Objectives  | Learning Outcomes   |
|--|---|
| Relate changes in focal length of eye lens to vision of distant and nearby objects | Explains processes and phenomena, such as nutrition in human beings and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc. |



|   |   |
|---|---|
| Relate changes in focal length of eye lens to vision of distant and nearby objects                            | Draws labelled diagrams / flow charts / concept map /graphs, such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.   |
| Describe the structure of an eye and functions of various parts that help humans to see.                      |   |
| Identify the causes of defects of vision in human eye and suggest correction procedures.                      | Draws conclusion, such as traits / features are inherited through genes present on chromosomes, a new species originates through evolutionary processes, water is made up of hydrogen and oxygen, properties of elements vary periodically along the groups and periods in periodic table, potential difference across a metal conductor is proportional to the electric current through it, etc.   |
| Examine the path of light rays through a prism and identify various rays and angles formed                    |   |
| Demonstrate that white light is dispersed into seven colours by a prism and explain the reasons for the same. |   |
| Provide scientific explanation for twinkling of stars, advanced sunrise and delayed sunset.                   |   |
| Describe the structure of an eye and functions of various parts that help humans to see.                      |   |
| Describe the structure of an eye and functions of various parts that help humans to see.                      | Takes initiative to know about scientific discoveries / inventions, such as Mendel's contribution in understanding the concept of inheritance, Dobereiner for discovering triads of elements, Mendeleev for the development of the periodic table of elements, Oersted discovery that electricity and magnetism are related, discovery of relation between potential difference across a metal conductor and the electric current through it by ohm, etc. |
| Relate scattering of light to Tyndall effect, blue colour of sky and red colour of sun at sunrise and sunset. |   |

## Test items



**LOB:** Illustrate the parts and function of human eye, in order to understand how humans see the objects around them

- 1) In which part of the human eye the image of an object is formed?
  - (a) iris
  - (b) pupil
  - (c) retina
  - (d) cornea

**Correct Answer:** Option (c)

- 2) A person gets out in the sunlight from a dark room. How does his pupil regulate and controls the light entering in the eye?

- (a) the size of pupil will decrease, and less light will enter the eye
- (b) the size of pupil will decrease, and more light will enter the eye
- (c) the size of pupil will remain same, but more light will enter the eye
- (d) the size of pupil will remain same, but less light will enter the eye

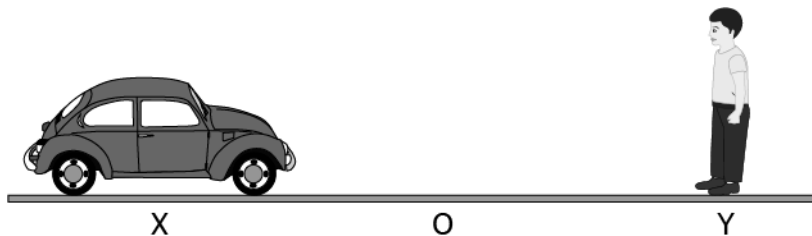
**Correct Answer:** Option (a)

**LOB:** Describe how focal length of eye changes, in order to understand how humans see close and far objects

- 1) A person is seeing an object closer to his eyes. What changes in his eyes will take place?
- (a) the pupil size will expand
  - (b) the ciliary muscles will contract
  - (c) the focal length of eye lens will increase
  - (d) the light entering in the eye will be more

**Correct Answer:** Option (b)

- 2) A person standing at point Y is watching a car coming from a point X to O as shown.



The table shows the variation in the parts of eye while seeing the car at X and O.

1. at X the focal length is higher than at O
2. at O the focal length is higher than at X
3. at X the ciliary muscle is thicker than at O
4. at O the ciliary muscle is thicker than at X

Which change in the person's eye would likely to occur while watching the car?

- (a) 1 and 3
- (b) 1 and 4
- (c) 2 and 3
- (d) 2 and 4

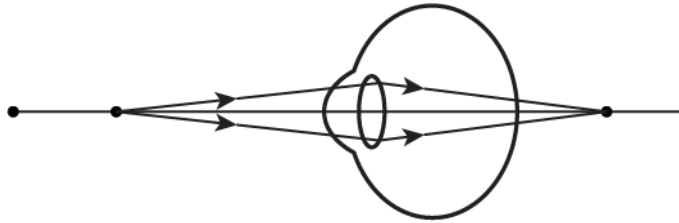
**Correct Answer:** Option (b)

**LOB:** Identify the defects of vision in human eye (myopia, hypermetropia, presbyopia) and their causes, in order to devise a correction method for them

- 1) A person went for a medical check-up and found that the curvature of his eye lens is increasing. Which defects he is likely to suffer from?
- (a) myopia
  - (b) cataract
  - (c) presbyopia
  - (d) hypermetropia

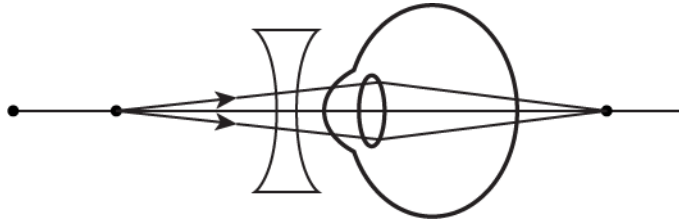
**Correct Answer:** Option (a)

- 2) The image shows the ray diagram of a defected eye.

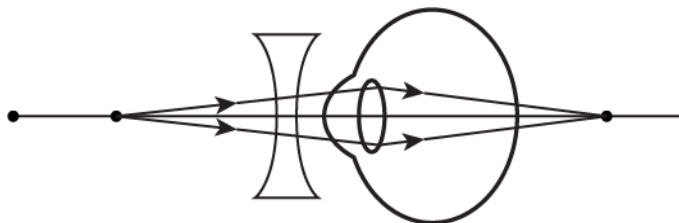


Which option shows the correction of the defect of the eye?

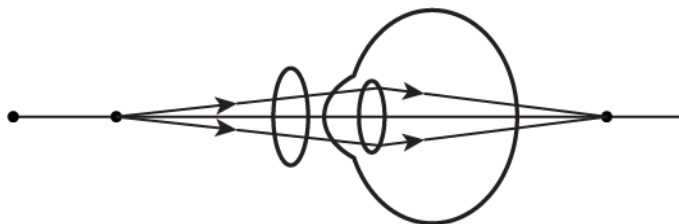
(a)



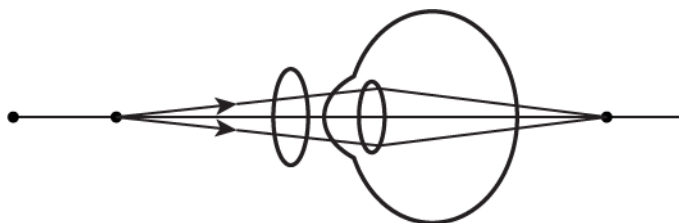
(b)



(c)



(d)

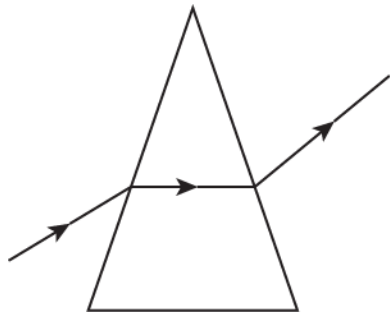


**Correct Answer:** Option (d)

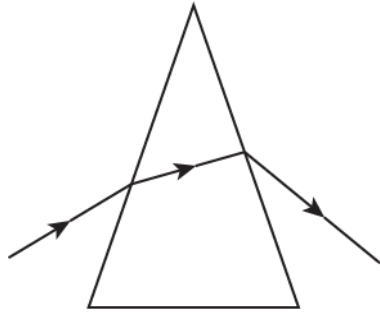
**LOB:** Examine the path of light rays through a prism, in order to determine how light gets deviated when travelling through a prism

1) Which image shows the deviation of light in a prism?

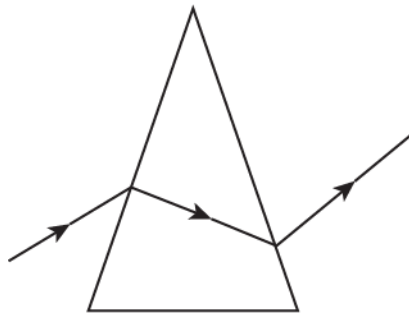
(a)



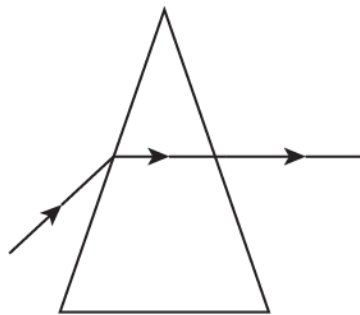
(b)



(c)

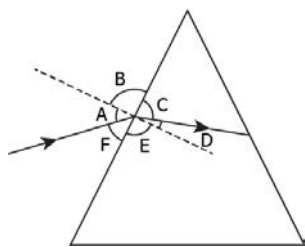


(d)



**Correct Answer:** Option (b)

2) The image shows a light ray incident on a glass prism.



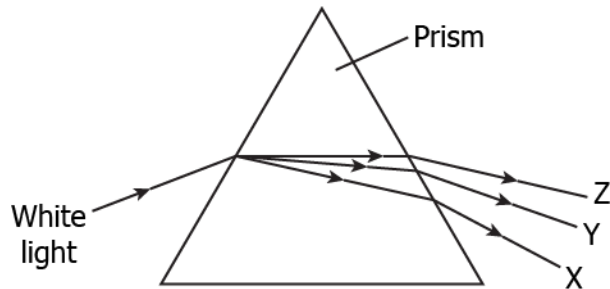
The various angles are labeled in the image. Which angle shows the angle of incidence and angle of refraction, respectively?

- (a) A and D
- (b) B and E
- (c) C and F
- (d) D and F

**Correct Answer:** Option (a)

**LOB:** Trace the path of white light rays through a prism, in order to determine that white light is made of seven colours

1) The image shows the dispersion of the white light in the prism.

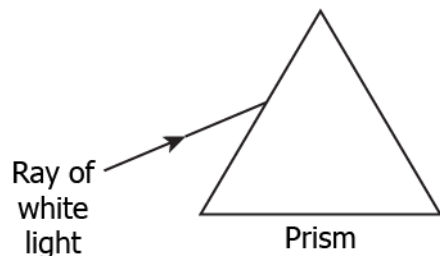


What will be the colours of the X, Y and Z?

- (a) X: red; Y: green; Z: violet
- (b) X: violet; Y: green; Z: red
- (c) X: green; Y: violet; Z: red
- (d) X: red; Y: violet; Z: green

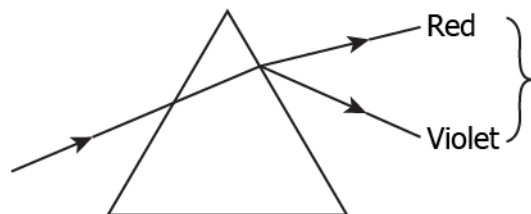
**Correct Answer:** Option (b)

2) A ray of light is incident on one face of the prism, as shown.

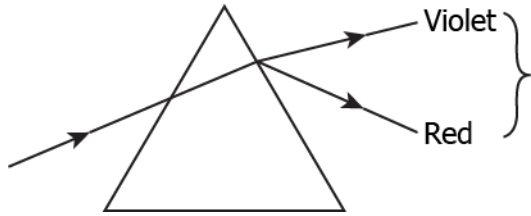


How will the ray of light disperse in the prism?

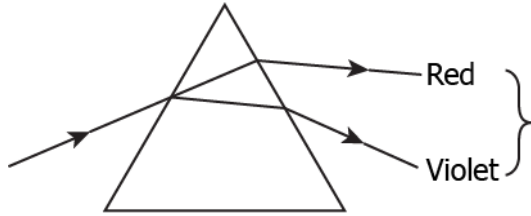
(a)



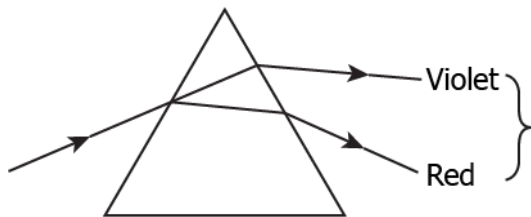
(b)



(c)



(d)



**Correct Answer:** Option (c)

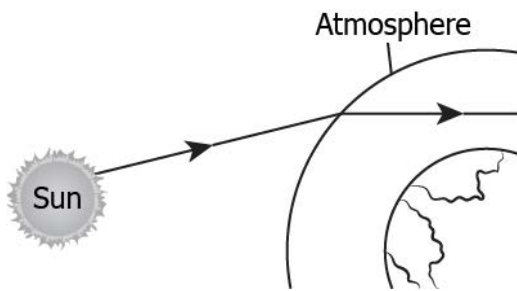
**LOB:** Elaborate the process of atmospheric refraction, in order to understand natural phenomena, like twinkling of stars and advance sunrise and delayed sunset

- 1) Why stars appear to twinkle at night?
  - (a) because the light of stars travels in different medium
  - (b) because the distance of star varies when earth rotates
  - (c) because the star changes its position relative to earth
  - (d) because the atmosphere reflects the light at different angles

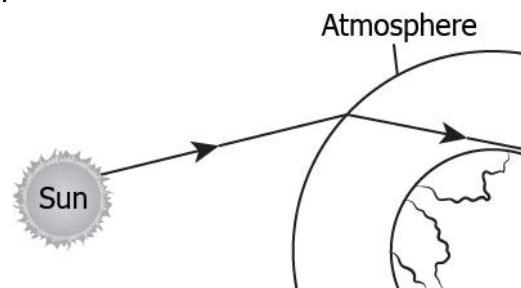
**Correct Answer:** Option (a)

- 2) The sun appears two minutes before the actual sunrise due to atmospheric refraction. How does sunlight travel from space to atmosphere?

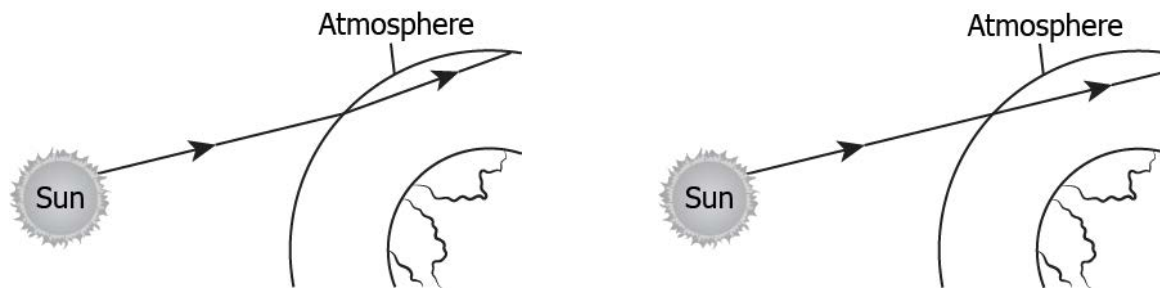
(a)



(b)



(c)



(d)

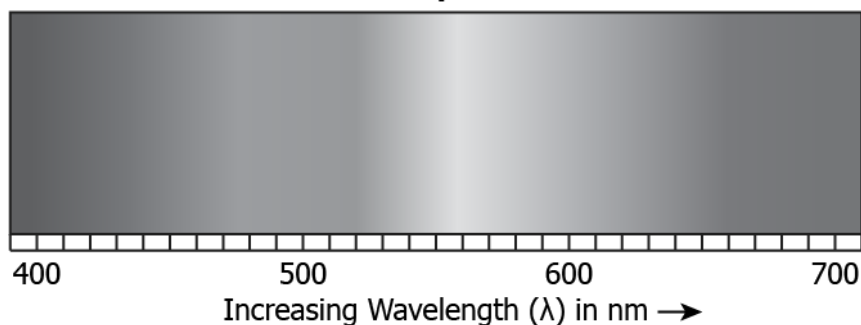
**Correct Answer:** Option (b)

**LOB:** Explain the process of scattering of light, in order to understand natural phenomena, like tyndall effect, blue colour of the sky & red colour of sun at sunrise & sunset

- 1) Which option justifies that the Sun appears red at sunrise and sunset?
- red scatters highest by the atmosphere
  - the distance between the sun and earth reduces
  - red has high wavelength, so it travels longer distance
  - the white light disperses into seven colours, only red enters the atmosphere

**Correct Answer:** Option (c)

- 2) A student learns that the scattering of sunlight depends on the wavelength of the light and size of particles present in the atmosphere. The student collects the data about the wavelength of the visible lights and size of the particle as shown.

**Visible Spectrum**

| Particle | Size (nm) |
|----------|-----------|
| P        | 350       |
| Q        | 430       |
| R        | 520       |
| S        | 650       |

Which particles will scatter blue light?

- P and R
- R and S
- P and Q
- Q and S

**Correct Answer:** Option (c)

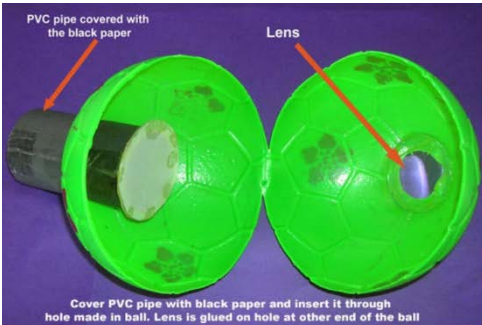



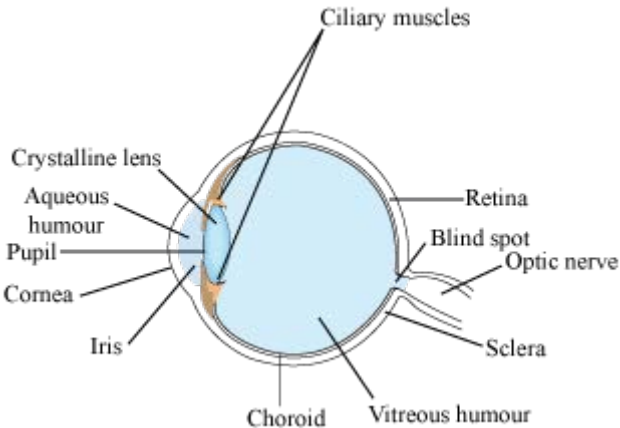
# Suggested Teacher Resources



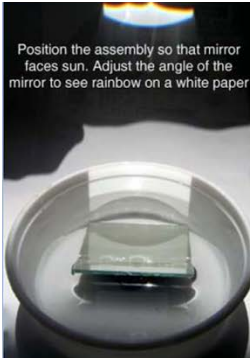
## Activity



|                      |  |
|----------------------|--|
| Objective            | Illustrate the parts and function of human eye, in order to understand how humans see the objects around them.   |
| Prerequisite         | -  |
| Material Required    | Plastic ball (14 cm diameter), convex lens focal length 10 cm, 10 cm long PVC pipe (5 cm diameter), tracing paper circle, glue, tape   |
| Vocabulary           | Parts of the human eye   |
| Procedure            | <ol style="list-style-type: none"> <li>Cut the plastic ball into two hemispheres and cut two circles on both the centres of 5 cm diameter.</li> <li>Stick the convex lens on one of the holes from the inside.</li> <li>Glue tracing paper on one end of PVC pipe for retina.</li> <li>Insert the PVC pipe in the other hole with tracing paper inside.</li> <li>Close the ball and seal its joint with tape.</li> <li>Move pipe in-out to adjust the distance between the lens and tracing paper. Soon you will see a clear image on tracing paper.</li> <li>On viewing through the PVC pipe, an inverted image will appear on the tracing paper retina.</li> </ol> <div style="text-align: center;">   </div> <p>(Source: <a href="http://www.arvindguptatoys.com/toys/eye.html">http://www.arvindguptatoys.com/toys/eye.html</a>)</p> |
| Reflection Questions | <ol style="list-style-type: none"> <li>Observe the diagram of the human eye carefully and describe the function of each of its parts.</li> </ol>   |

|                               |   |
|-------------------------------|---|
|                               |  <p>(Source: <a href="https://www.meritnation.com/">https:// www.meritnation.com/</a>)</p>  |
| Text to real world connection | <ol style="list-style-type: none"> <li>1. Why do we have two eyes?</li> </ol>   |
| Beyond the classroom          | <ol style="list-style-type: none"> <li>1. Why is the lens in the human eye convex and not any other? Try to perform the above activity with other lenses available to answer this question.</li> <li>2. What material is the human lens made up of? How is that different from the artificial lenses which are installed in the eye during an eye surgery?</li> </ol> |

**2**      **Activity**      

|                   |   |
|-------------------|---|
| Material required | Shallow container, small mirror   |
| Procedure         | <p><b>Make your own rainbow</b></p> <ol style="list-style-type: none"> <li>1. Pour some water in a container and dip the mirror in an inclined position in it.</li> <li>2. Position this in such a manner that the mirror faces the sun.</li> <li>3. Adjust the angle of the mirror so as to observe a rainbow on a white sheet of paper.</li> </ol>  <p>(Source: <a href="http://www.arvindguptatoys.com/toys/rainbow.html">http:// www.arvindguptatoys.com/ toys/ rainbow.html</a>)</p> |

Reflection  
questions

1. Which property of light is rainbow formation based on?
2. Why is the rainbow not visible on polluted skies?
3. Sometimes, only three or four colours of the rainbow are visible. Why?

# 12. Electricity

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts                   | Learning Objectives  |
|---|--|
| Electric current & circuit                  | Evaluate the charge flowing through a conductor in a given time, in order to calculate current flowing through it                        |
| Electric Potential and Potential Difference | Determine work done in moving a charge across two points, in order to calculate potential difference between two points                  |
| Circuit Diagram                             | Identify the electrical components and their functions, in order to build a functioning circuit  |
| Ohm's Law                                   | Plot a graph between voltage and current, in order to prove ohm's law & find resistance  |
| Factors on which resistance depends         | Define resistivity and its range for different materials, in order to classify substances as conductors, alloys and insulators           |
| Resistance of a system of resistors         | Determine the resultant resistance in a series and a parallel combination, in order to identify the suitable combination like house, etc |
| Heating effect of electric current          | Explain and calculate the heating effect of electric current, in order to learn working of appliances like heater and iron               |
| Power                                       | Calculate power, in order to represent electric consumption in domestic circuits   |

**Learning Objectives and Learning Outcomes:**

| Learning Objectives   | Learning Outcomes   |
|---|---|
| Plot a graph between voltage and current, in order to prove ohm's law & find resistance | Plans and conducts investigations / experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own, such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light? |

|   |   |
|---|---|
| Define resistivity and its range for different materials, in order to classify substances as conductors, alloys and insulators    | Explains processes and phenomena, such as nutrition in human beings and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.   |
| Explain and calculate the heating effect of electric current, in order to learn working of appliances like heater, iron and fuse. |   |
| Evaluate the charge flowing through a conductor in a given time, in order to calculate current flowing through it                 | Calculates using the data given, such as number of atoms in reactants and products to balance a chemical equation, resistance of a system of resistors, power of a lens, electric power, etc.   |
| Determine work done in moving a charge across two points, in order to calculate potential difference between two points           |   |
| Calculate power, in order to represent electric consumption in domestic circuits  |   |
| Evaluate the charge flowing through a conductor in a given time, in order to calculate current flowing through it                 | Uses scientific conventions to represent units of various quantities / symbols / formulae / equations, such as balanced chemical equation by using symbols and physical states of substances, sign convention in optics, si units, etc.   |
| Determine work done in moving a charge across two points, in order to calculate potential difference between two points           |   |
| Plot a graph between voltage and current, in order to prove ohm's law & find resistance   |   |
| Calculate power, in order to represent electric consumption in domestic circuits  |   |
| Identify the electrical components and their functions, in order to build a functioning circuit                                   | Measures physical quantities using appropriate apparatus / instruments / devices, such as pH of substances using different indicators, electric current and potential difference using ammeter and voltmeter, etc.  |
| Explain and calculate the heating effect of electric current, in order to learn working of appliances like heater, iron and fuse. | Applies scientific concepts in daily life and solving problems, such as takes precautions to prevent sexually transmitted infections, uses appropriate electrical plugs (5 /15A) for different electrical devices, uses vegetative propagation to develop saplings in gardening, performs exercise to keep in good health, avoids using appliances responsible for ozone layer depletion, applies concept of decomposition reaction of baking soda to make spongy cakes, etc. |

Determine the resultant resistance in a series and a parallel combination, in order to identify the suitable combination like house, etc

Derives formulae / equations / laws, such as equivalent resistance of resistors in series and parallel, etc.

## Test items



**LOB:** Evaluate the charge flowing through a conductor in a given time, in order to calculate current flowing through it

- 1) A charge of 100 C flows through a bulb in 5 minutes. How much current is flowing through the bulb?
- (a) 500 A
  - (b) 100 A
  - (c) 20 A
  - (d) 0.3 A

**Correct Answer:** Option (c)

- 2) A conducting wire carries  $10^{21}$  electrons in 4 minutes. What is the current flowing through the wire?
- (a) 40 A
  - (b) 7 A
  - (c) 4 A
  - (d) 0.7 A

**Correct Answer:** Option (d)

**LOB:** Determine work done in moving a charge across two points, in order to calculate potential difference between two points

- 1) Work of 14 J is done to move 2 C charge between two points on a conducting wire. What is the potential difference between the two points?
- (a) 28 V
  - (b) 14 V
  - (c) 7 V
  - (d) 3.5 V

**Correct Answer:** Option (c)

- 2) In order to move a charge of 3 C between two points on a conducting wire, 12 J of work is done. How much increase or decrease in the voltage will increase the work done on the same amount of charge to 36 J?
- (a) -12 V
  - (b) -8 V
  - (c) +8 V
  - (d) +12 V

**Correct Answer:** Option (c)

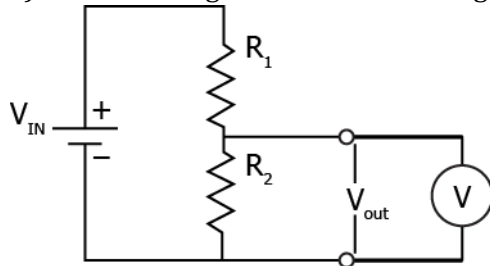
**LOB:** Identify the electrical components and their functions, in order to build a functioning circuit

- 1) A circuit has a charge of 2C moving through it in 3 s. Which electrical component in the circuit, if present, will show the current?

- (a) Voltmeter will show a current of 6 A.
- (b) Ammeter will show a current of 0.7 A.
- (c) Rheostat will show a current of 0.7 A.
- (d) Resistor will show a current of 0.35 A.

**Correct Answer:** Option (b)

2) The image shows a circuit diagram.



What is being measured using the voltmeter?

- (a) current in the circuit
- (b) voltage in the circuit
- (c) voltage across the resistor
- (d) resistance offered by the resistor

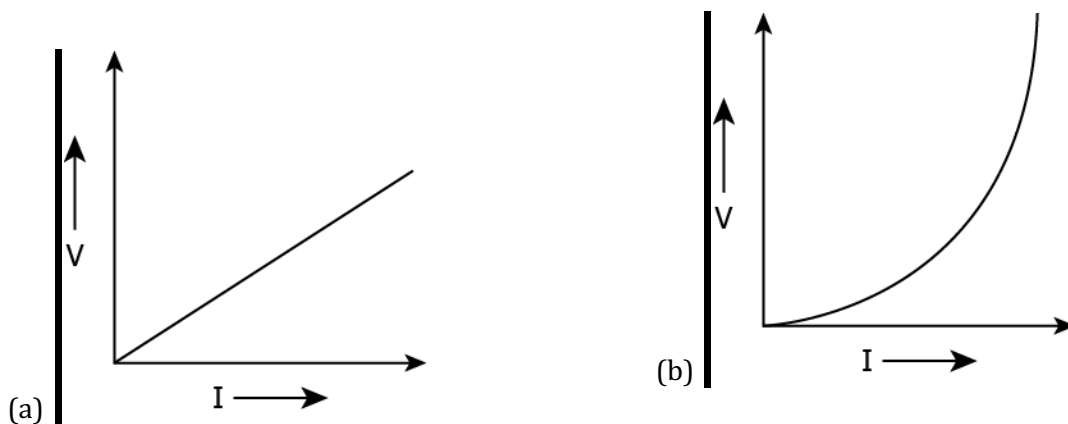
**Correct Answer:** Option (c)

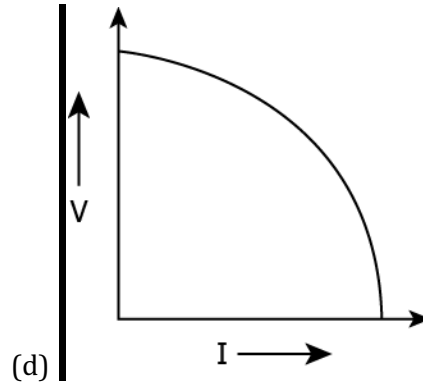
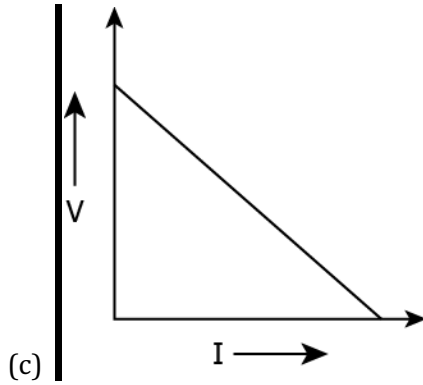
**LOB:** Plot a graph between voltage and current, in order to prove ohm's law & find resistance

- 1) What is the relationship between resistance and current?
  - (a) They are directly related to each other.
  - (b) They are inversely related to each other.
  - (c) The resistance has a greater magnitude than current.
  - (d) The current has a greater magnitude than resistance.

**Correct Answer:** Option (b)

2) Which plot shows the change in voltage when the current is gradually decreased across a resistor?





**Correct Answer:** Option (a)

**LOB:** Define resistivity and its range for different materials, in order to classify substances as conductors, alloys and insulators

- 1) Which one among a bar of an alloy of mass 2 kg and a 3 kg iron bar of same dimension has greater resistivity?
- Iron bar because it has higher mass.
  - Alloy bar because it has lower mass.
  - Iron bar because it has same types of atoms.
  - Alloy bar because it has different types of atoms.

**Correct Answer:** Option (d)

- 2) A piece of wire is measured to have resistivity in the order of  $10^{-9} \Omega \text{ m}$ . What should its material be classified into?
- Alloys
  - Insulators
  - Good conductors
  - Poor conductors

**Correct Answer:** Option (b)

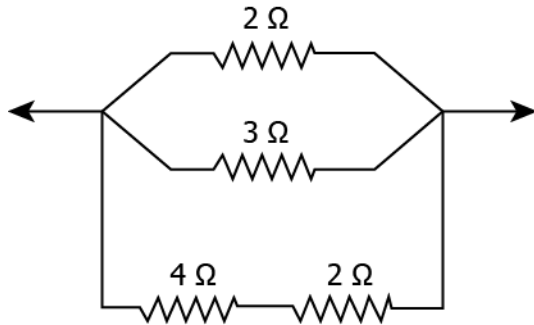
**LOB:** Determine the resultant resistance in a series and a parallel combination, in order to identify the suitable combination like house, etc

- 1) Which combination of a  $2 \Omega$  resistor and  $4 \Omega$  resistor offers the least resistance to current in the circuit?
- Series combination, which results in a net resistance of  $2 \Omega$ .
  - Parallel combination, which results in a net resistance of  $2 \Omega$ .
  - Series combination, which results in a net resistance of  $1.5 \Omega$ .
  - Parallel combination, which results in a net resistance of  $0.5 \Omega$ .

**Correct Answer:** Option (d)

- 2) The image shows a combination of 4 resistors.





What is the net resistance between the two points in the circuit?

- (a)  $0.5 \Omega$
- (b)  $1.0 \Omega$
- (c)  $1.5 \Omega$
- (d)  $2.0 \Omega$

**Correct Answer:** Option (b)

**LOB:** Explain and calculate the heating effect of electric current, in order to learn working of appliances like heater and iron

- 1) How much more heat is produced, if current is doubled?
  - (a) twice the original amount
  - (b) thrice the original amount
  - (c) four times the original amount.
  - (d) five times the original amount.

**Correct Answer:** Option (b)

- 2) A bulb has a resistance of  $5 \Omega$ . If 2 A of current at 200 V flows through the bulb, how much heat is produced by the bulb in 10 minutes?
  - (a)  $2.0 \times 10^5 \text{ J}$
  - (b)  $4.0 \times 10^5 \text{ J}$
  - (c)  $1.2 \times 10^6 \text{ J}$
  - (d)  $2.4 \times 10^6 \text{ J}$

**Correct Answer:** Option (d)

**LOB:** Calculate power, in order to represent electric consumption in domestic circuits

- 1) In order to reduce electricity consumption at home, what kind of appliance should one purchase?
  - (a) one which draws low power
  - (b) one which produces less heat
  - (c) one which operates at a higher voltage
  - (d) one which draws a high amount of current

**Correct Answer:** Option (a)

- 2) An electric toaster has a power rating of 200 W. It operates for 1 hour in the morning and 1 hour in the evening. How much does it cost to operate the toaster for 10 days at Rs 5 per kWh?
  - (a) Rs 20
  - (b) Rs 400

- (c) Rs 5000  
(d) Rs 10000

**Correct Answer:** Option (a)

## Suggested Teacher Resources



### Activity



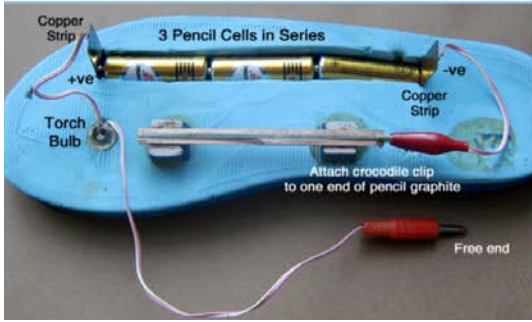
|                   |   |
|-------------------|---|
| Objective         | Plot a graph between voltage and current, in order to prove ohm's law & find resistance.  |
| Prerequisite      | Construction of an electrical circuit.  |
| Material Required | Copper wires, voltmeter, ammeter, key, resistor, rheostat   |
| Vocabulary        | Ohm's Law: It states that the current passing through an electrical circuit is directly proportional to the potential difference applied.   |
| Procedure         | <div style="text-align: center;"> </div> <p>(Source: <a href="https://cdac.olabs.edu.in/?sub=74&amp;brch=9&amp;sim=75&amp;cnt=2">https://cdac.olabs.edu.in/?sub=74&amp;brch=9&amp;sim=75&amp;cnt=2</a>)</p> <ol style="list-style-type: none"> <li>1. Draw the circuit diagram as above and arrange the apparatus.</li> <li>2. Make the connections as per circuit diagram. All connections must be neat and tight. Take care to connect the ammeter and voltmeter with their correct polarity. (+ve to +ve and -ve to -ve).</li> </ol> |

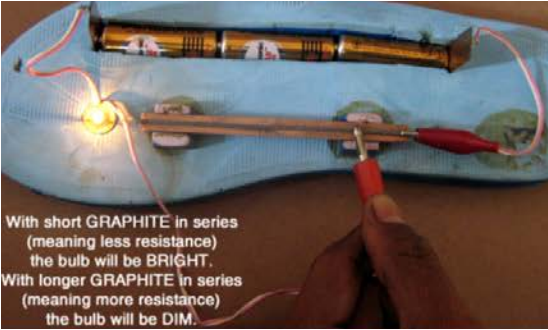
|                               |   |
|-------------------------------|---|
|                               | <ol style="list-style-type: none"> <li>3. Determine the zero error and least count of the ammeter and voltmeter and record them.</li> <li>4. Adjust the rheostat to pass a low current.</li> <li>5. Insert the key K and slide the rheostat contact to see whether the ammeter and voltmeter are showing deflections properly.</li> <li>6. Adjust the rheostat to get a small deflection in ammeter and voltmeter.</li> <li>7. Record the readings of the ammeter and voltmeter.</li> <li>8. Take at least six sets of readings by adjusting the rheostat gradually.</li> <li>9. The graph will be a straight line which verifies Ohm's law.</li> </ol> |
| Reflection Questions          | <ol style="list-style-type: none"> <li>1. Plot a graph with <b>V</b> along x-axis and <b>I</b> along y-axis.</li> <li>2. Determine the slope of the V-I graph. (The reciprocal of the slope gives resistance of the wire.)</li> </ol>   |
| Text to real world connection | <ol style="list-style-type: none"> <li>1. What precautions did you take while performing this experiment? How do you think large electricity connections from point of generation to our homes are maintained?</li> </ol>   |
| Beyond the classroom          | <ol style="list-style-type: none"> <li>1. Use the same circuit to calculate resistance of different types of materials and relate the answers with the different uses these materials are put to.</li> </ol>  |

2

## Activity



|                   |   |
|-------------------|---|
| Material required | Old rubber slipper, 3 pencil cells, 2 rubber stands, slit pencil in half, torch bulb, copper strips   |
| Procedure         | <p>Pencil Resistor<br/>(Source: <a href="http://www.arvindguptatoys.com/toys/resister.html">http:// www.arvindguptatoys.com/ toys/ resister.html</a>)</p> <ol style="list-style-type: none"> <li>1) Take an old rubber slipper and cut a slit to fit three pencil cells and attach the materials according to the setup given below.</li> </ol>  <ol style="list-style-type: none"> <li>2) Slide the free end on the graphite and notice the intensity of the bulb change.</li> </ol> |

|                      |   |
|----------------------|---|
|                      |  <p>With short GRAPHITE in series<br/>(meaning less resistance)<br/>the bulb will be BRIGHT.<br/>With longer GRAPHITE in series<br/>(meaning more resistance)<br/>the bulb will be DIM.</p> |
| Reflection questions | <ol style="list-style-type: none"><li>1. Derive a relation between length of conductor and resistance.</li><li>2. What are the precautions you can take in the above activity?</li></ol>  |

# 13. Magnetic Effects of Electric Current

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts                                     | Learning Objectives   |
|---|---|
| Magnetic field and field lines                                | Draw magnetic field lines for a bar magnet, in order to identify the magnetic field strength at different points around a magnet                          |
| Magnetic field due to a straight current carrying conductor   | Represent magnetic field lines for a straight current carrying conductor, in order to identify the magnetic field strength at different points around it. |
| Magnetic field due to a current carrying circular loop        | Draw magnetic field lines for at current carrying circular loop, in order to identify the magnetic field strength at different points around it.          |
| Magnetic field due to a current carrying solenoid             | Outline magnetic field lines for at current carrying solenoid, in order to identify the magnetic field strength at different points around it.            |
| Force carrying conductor in a magnetic field + Electric motor | State Fleming's Left-Hand rule, in order to understand the working of an electric motor   |
| Electromagnetic induction                                     | Discuss electromagnetic induction, in order to understand how a moving magnet can be used to generate electric currents.                                  |
| Electric Generator  | Explain Fleming's right hand rule, in order to understand the working of an electric generator  |
| Domestic Electric circuits                                    | Analyse the significance of neutral, earth and live wire, in order to understand formation of a domestic electrical circuit                               |

**Learning Objectives and Learning Outcomes:**

| Learning Objectives   | Learning Outcomes  |
|---|--|
| Draw magnetic field lines for a bar magnet, in order to identify the magnetic field strength at different points around a magnet                          | Relates processes and phenomena with causes / effects, such as hormones with their functions, tooth decay with pH of saliva, growth of plants with pH of the soil, survival of aquatic life with pH of water, blue colour of sky with scattering of light, deflection of compass needle due to magnetic effect of electric current, etc.   |
| Represent magnetic field lines for a straight current carrying conductor, in order to identify the magnetic field strength at different points around it. |  |
| Draw magnetic field lines for at current carrying circular loop, in order to identify the magnetic field strength at different points around it           |  |
| Outline magnetic field lines for at current carrying solenoid, in order to identify the magnetic field strength at different points around it.            |  |
| Discuss electromagnetic induction, in order to understand how a moving magnet can be used to generate electric currents.                                  |  |
| State Fleming's Left-Hand rule, in order to understand the working of an electric motor   | Explains processes and phenomena, such as nutrition in human beings and plants, transportation in plants and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc. |
| Explain Fleming's right hand rule, in order to understand the working of an electric generator  |  |
| Analyse the significance of neutral, earth and live wire, in order to understand formation of a domestic electrical circuit                               | Measures physical quantities using appropriate apparatus / instruments / devices, such as ph of substances using different indicators, electric current and potential difference using ammeter and voltmeter, etc.   |
| Represent magnetic field lines for a straight current carrying conductor, in order to identify the magnetic field strength at different points around it. | Takes initiative to know about scientific discoveries / inventions, such as Mendel's contribution in understanding the concept of inheritance, Dobereiner for discovering triads of elements, Mendeleev for the development of the periodic table of elements, Oersted discovery that electricity and magnetism are related, discovery of relation between potential difference across a metal conductor and the electric current through it by ohm, etc.  |

State Fleming's Left-Hand rule, in order to understand the working of an electric motor

Explain Fleming's right hand rule, in order to understand the working of an electric generator

**Exhibits creativity in designing models using eco-friendly resources**, such as working model of respiratory, digestive and excretory systems, soda acid fire extinguisher, periodic table, micelles formation, diamond / graphite / Buckminster fullerene, human eye, electric motor and generator, etc.

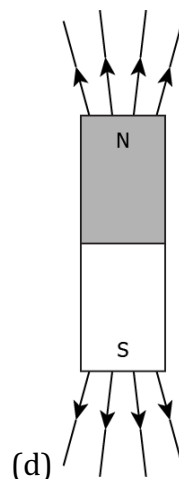
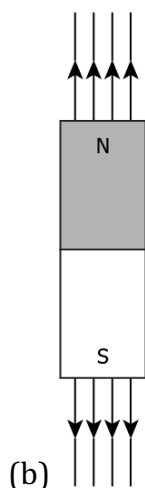
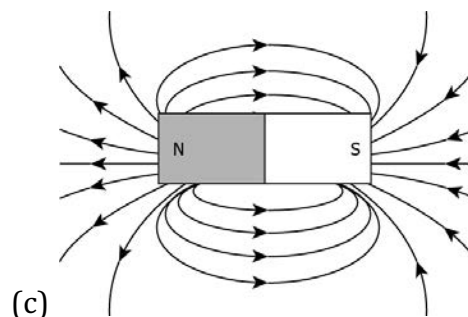
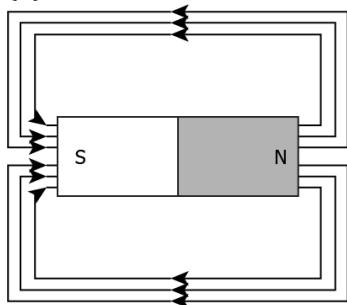
## Test items



**LOB:** Draw magnetic field lines for a bar magnet, in order to identify the magnetic field strength at different points around a magnet

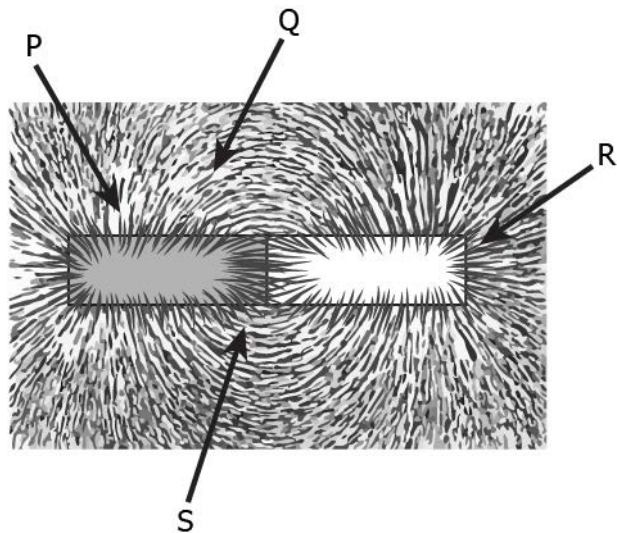
- 1) A student learns that magnetic field strength around a bar magnet is different at every point. Which diagram shows the correct magnetic field lines around a bar magnet?

(a)



**Correct Answer:** Option (c)

- 2) A student places some iron fillings around a magnet. The iron fillings arrange themselves as shown in image.



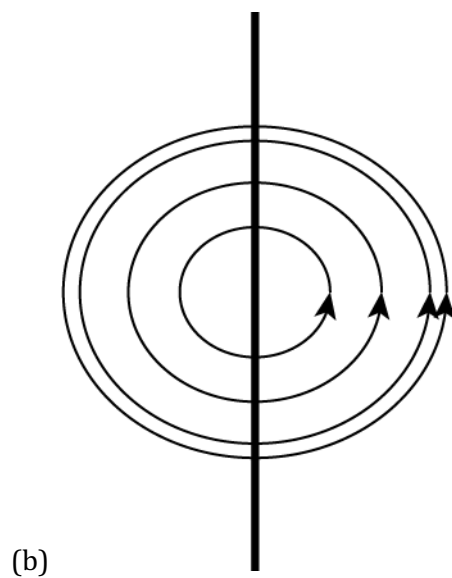
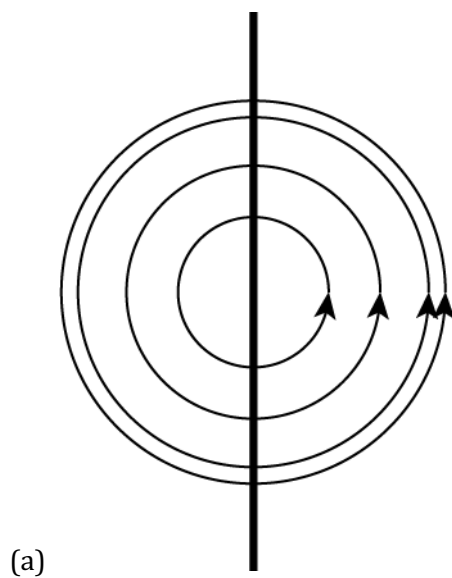
The student labelled four different regions around the magnet. Where would be the magnetic field the strongest?

- (a) P
- (b) Q
- (c) R
- (d) S

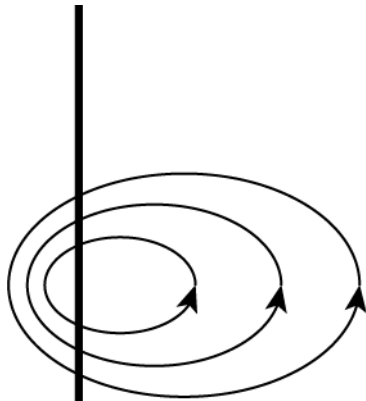
**Correct Answer:** Option (c)

**LOB:** Represent magnetic field lines for a straight current carrying conductor, in order to identify the magnetic field strength at different points around it

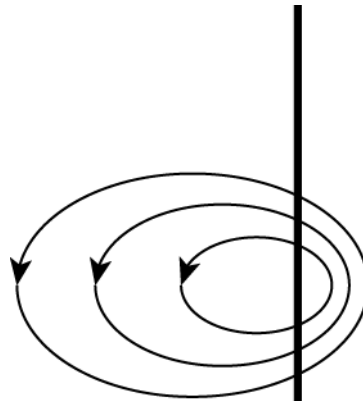
1) A student placed a magnetic compass around a straight current carrying wire. The student noticed when he moved the compass away from the wire, the deflection in compass decreases. How would be the magnetic field lines around the conductor?







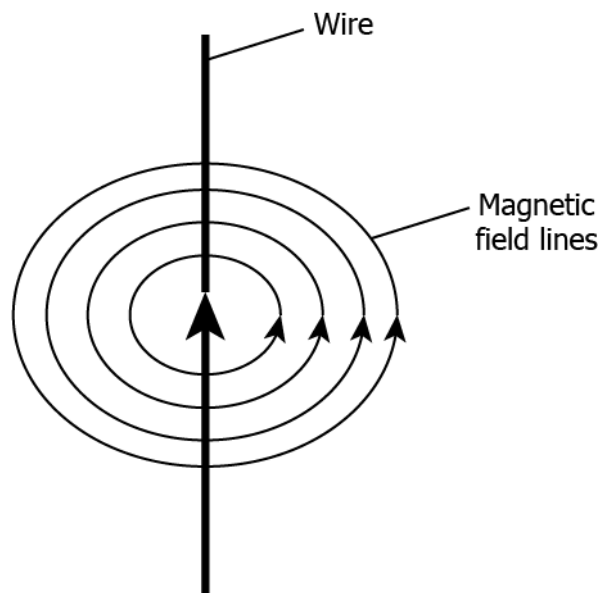
(c)



(d)

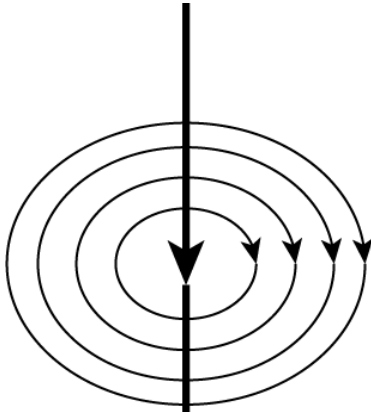
**Correct Answer:** Option (b)

2) The image shows the magnetic field lines around a straight current carrying conductor.

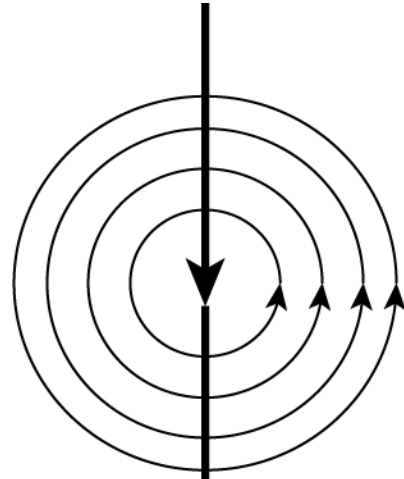


If the direction of the current in the straight wire is changed, what change in the magnetic field line will be observed?

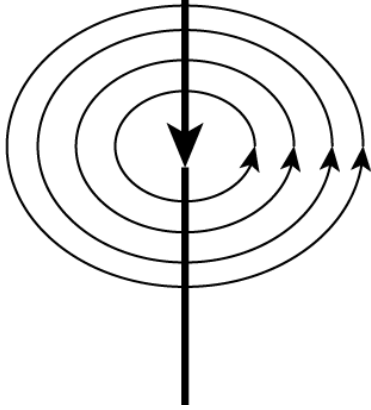
(a)



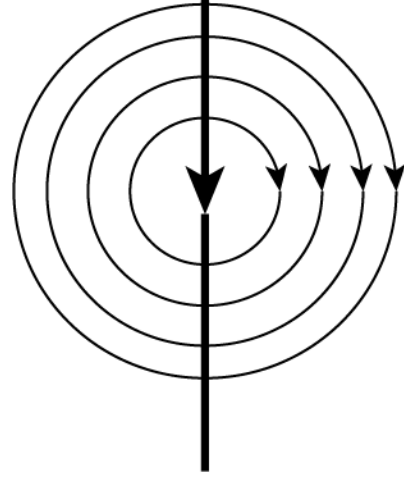
(c)



(b)



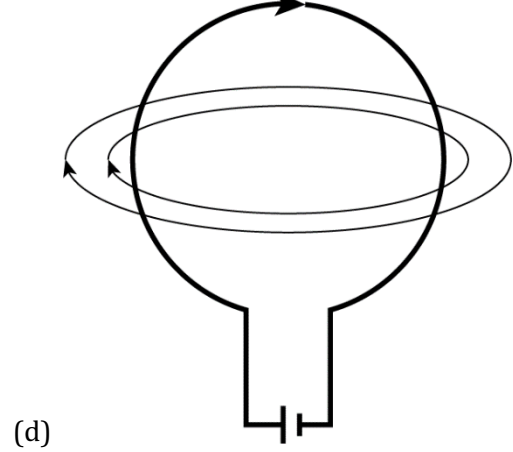
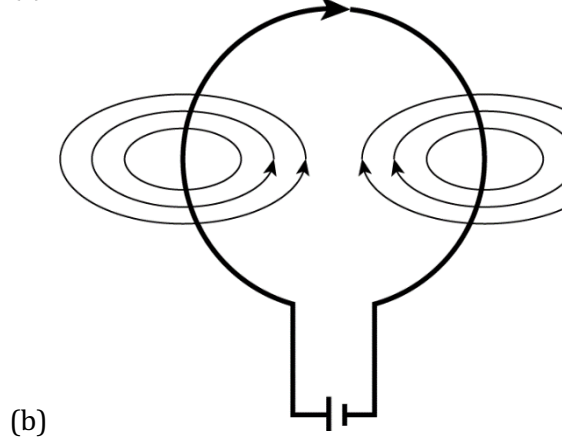
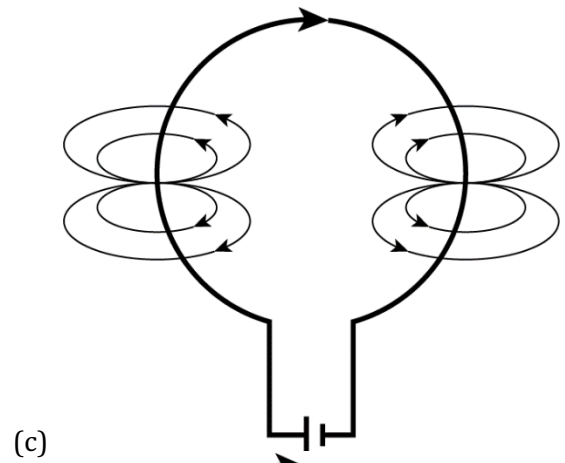
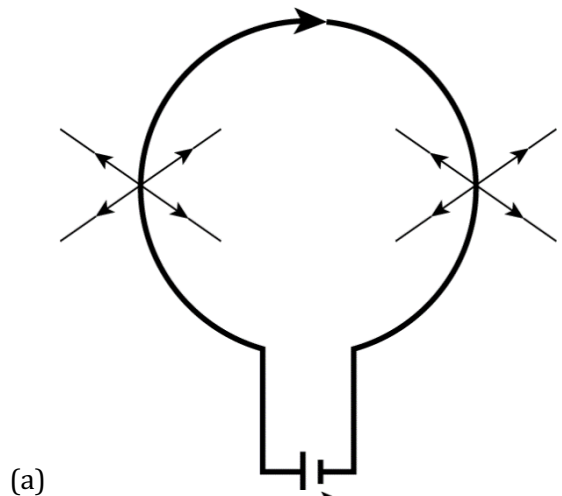
(d)



**Correct Answer:** Option (a)

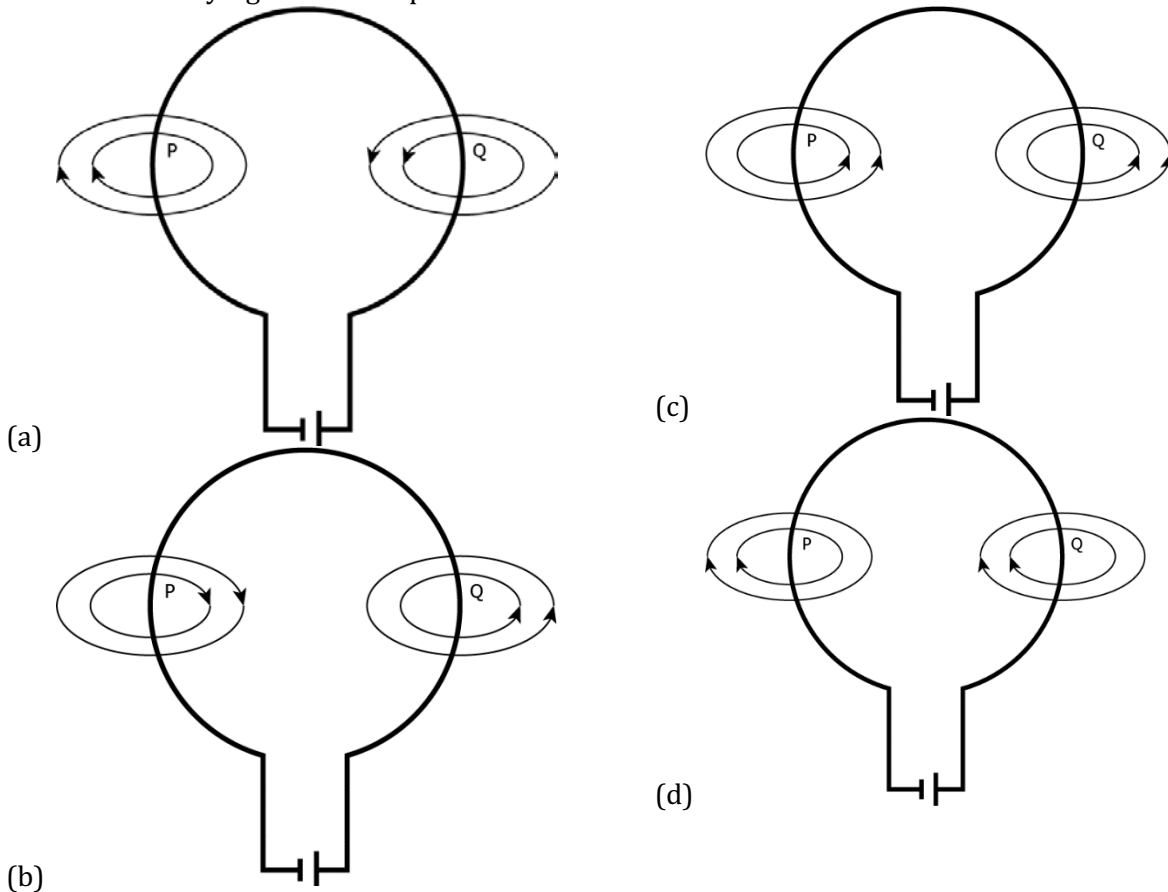
**LOB:** Draw magnetic field lines for at current carrying circular loop, in order to identify the magnetic field strength at different points around it

1) Which diagram shows the magnetic field lines around a current carrying circular loop?



**Correct Answer:** Option (b)

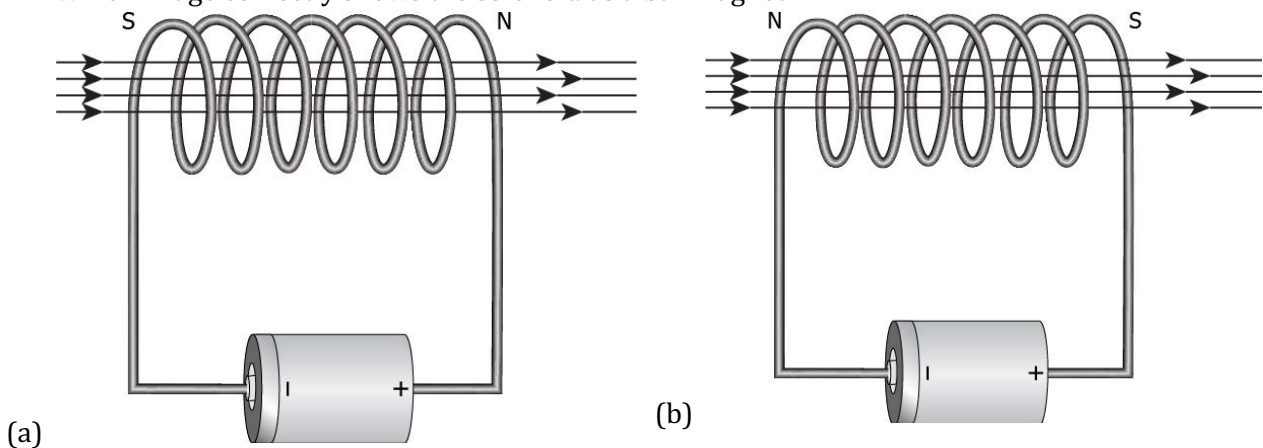
2) Which diagram shows the correct direction of the magnetic field lines at point P and Q in current carrying circular loop?

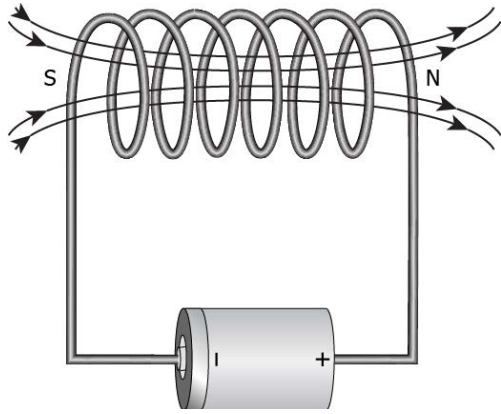


**Correct Answer:** Option (b)

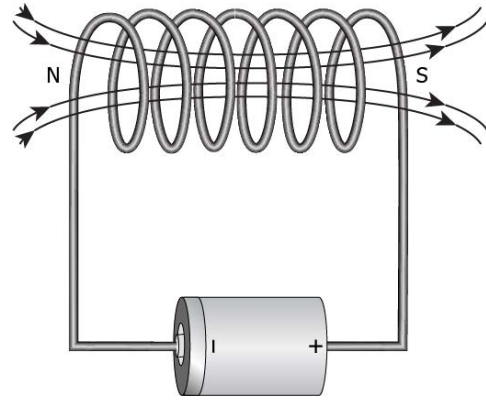
**LOB:** Outline magnetic field lines for at current carrying solenoid, in order to identify the magnetic field strength at different points around it

1) The magnetic field lines of solenoid are similar to the magnetic field lines of bar magnet. Which image correctly shows the solenoid as a bar magnet?





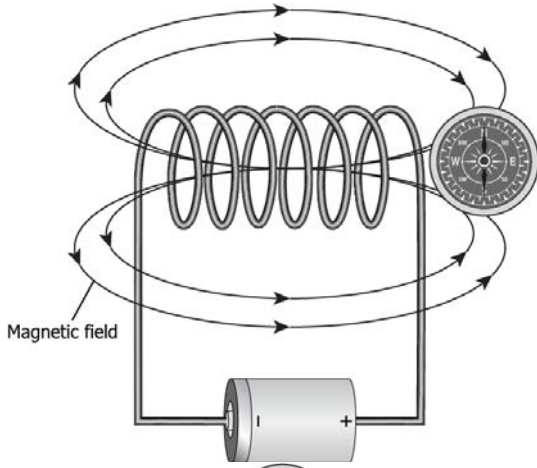
(c)



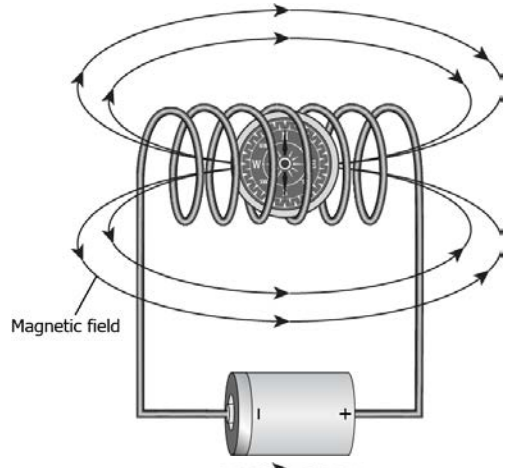
(d)

**Correct Answer:** Option (c)

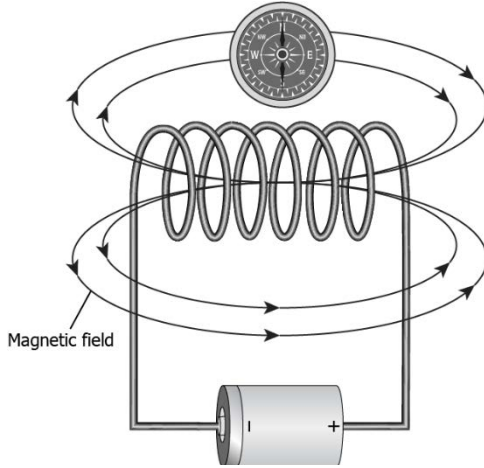
1) Where should the magnetic compass be placed in solenoid to get maximum deflection in the magnetic compass?



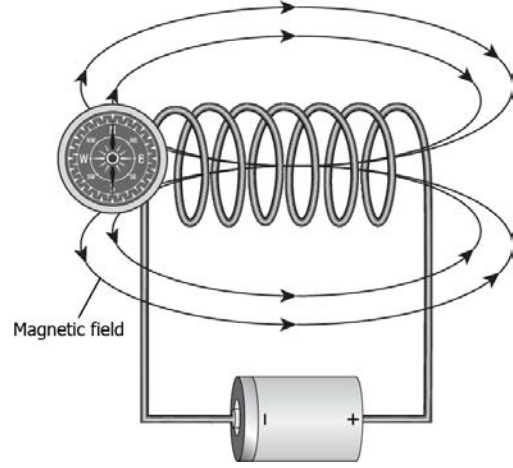
(a)



(c)



(b)

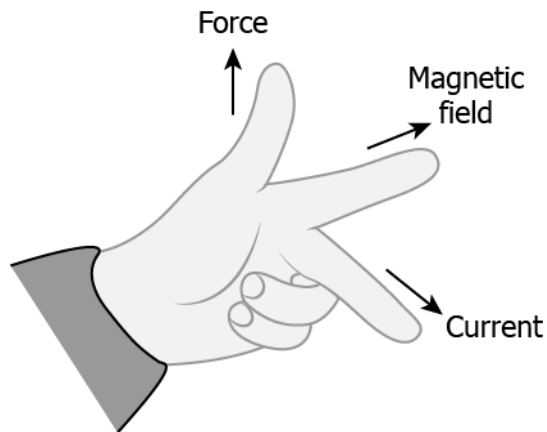


(d)

**Correct Answer:** Option (c)

**LOB:** State Fleming's left-hand rule, in order to understand the working of an electric motor

1) The image shows the Fleming's left-hand rule.

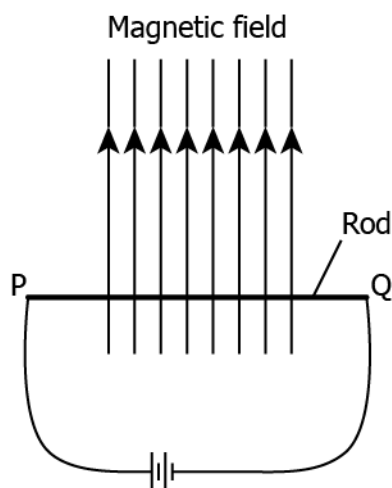


Which option explains the rule to understand the working of motor?

- (a) When a current carrying conductor is moved with a force, it creates the magnetic field.
- (b) When a conductor is moved inside a magnetic field, current is produced in the conductor.
- (c) When magnetic field is moved relative to the conductor, current is produced in the conductor.
- (d) When a current carrying conductor placed in a magnetic field, it experiences a force by magnetic field.

**Correct Answer:** Option (d)

2) A metal rod PQ is placed in the magnetic field. The ends of the rod are connected with a battery using wires.



Where will the rod move?

- (a) upward
- (b) downwards
- (c) into the field
- (d) out of the field

**Correct Answer:** Option (d)

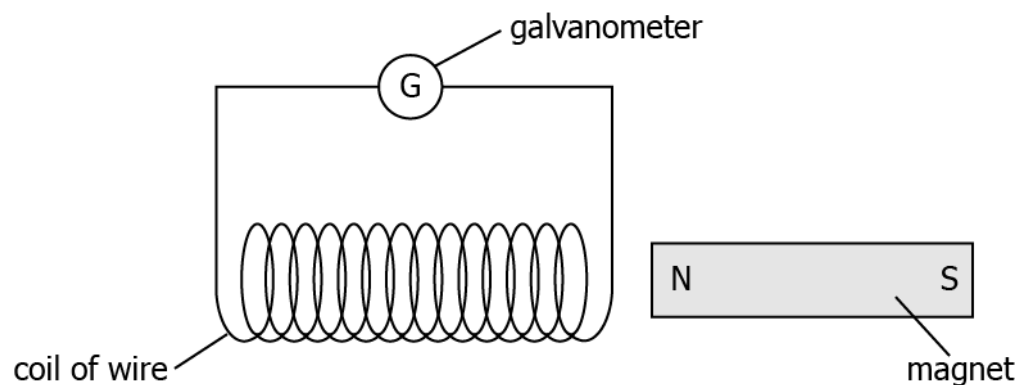
**LOB:** Discuss electromagnetic induction, in order to understand how a moving magnet can be used to generate electric currents

1) A student inserts a bar magnet in the coil. The student observes deflection in the galvanometer connected to the coil. What will happen if the magnet is continuously getting in and out of the coil?

- (a) the current induced in the coil will increase
- (b) the current will change its direction continuously
- (c) the magnetic field will create a motion in the coil
- (d) the magnetic field of the bar magnet would keep decreasing

**Correct Answer:** Option (b)

2) A student makes an arrangement to study electromagnetic induction, as shown.



She changes the arrangement in four different ways.

| Trial |  |
|-------|--|
| 1     | moves the coil in left away from the magnet                |
| 2     | moves the magnet in right away from the coil               |
| 3     | moves both coil and magnet towards each other              |
| 4     | moves both coil and magnet in same direction at same speed |

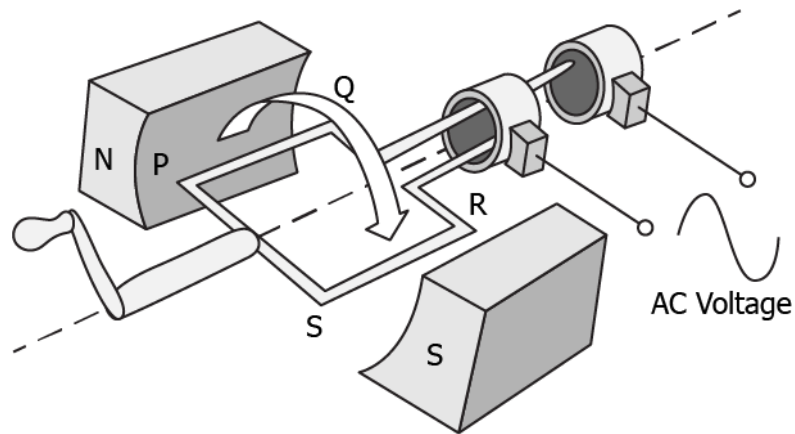
In which trial the galvanometer would remain undeflected?

- (a) trial 1
- (b) trial 2
- (c) trial 3
- (d) trial 4

**Correct Answer:** Option (d)

**LOB:** Explain Fleming's right-hand rule, in order to understand the working of an electric generator

1) The image shows the components of an electric generator.



When the coil PQRS is rotated as shown. What is the direction of electric current when coil completes half cycle of the rotation?

(a)

| PQ     | RS     |
|--------|--------|
| Q to P | R to S |

(c)

| PQ     | RS     |
|--------|--------|
| P to Q | S to R |

(b)

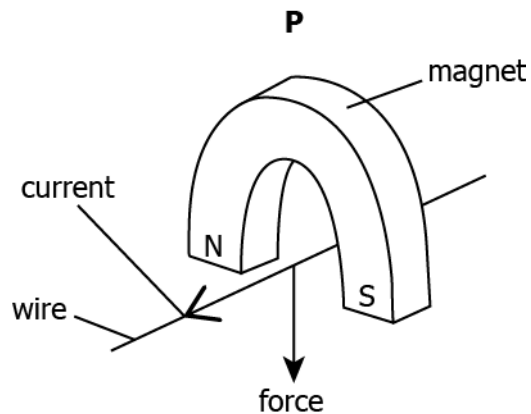
| PQ     | RS     |
|--------|--------|
| P to Q | R to S |

(d)

| PQ     | RS     |
|--------|--------|
| Q to P | S to R |

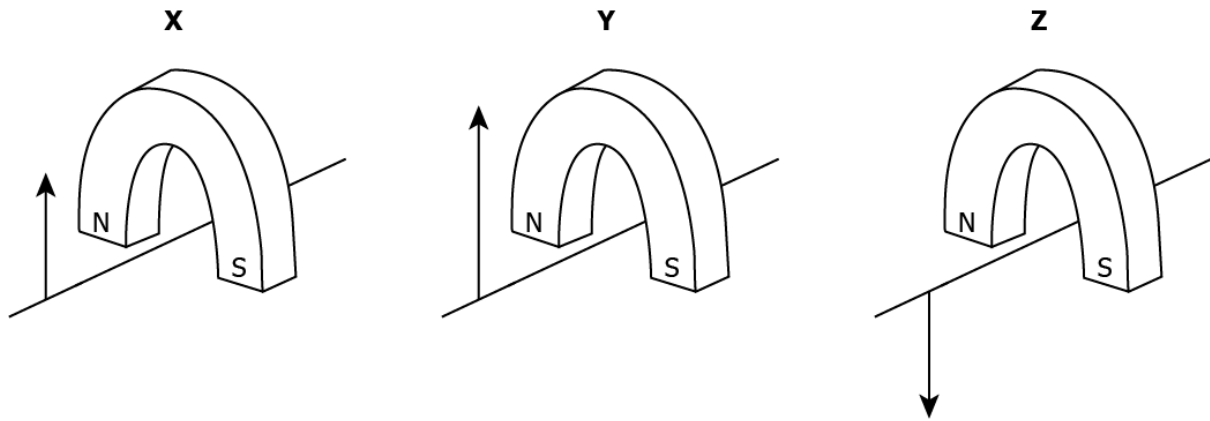
**Correct Answer:** Option (b)

2) A force is applied to a wire inside a horse shoe magnet. The current induced in the wire as shown.



Three other arrangement X, Y and Z are setup as shown.





In which arrangement/ s, the direction of induced current will be the same as the direction of current in arrangement P?

- (a) only X
- (b) only Y
- (c) both X and Y
- (d) both Y and Z

**Correct Answer:** Option (a)

**LOB:** Analyse the significance of neutral, earth and live wire, in order to understand formation of a domestic electrical circuit

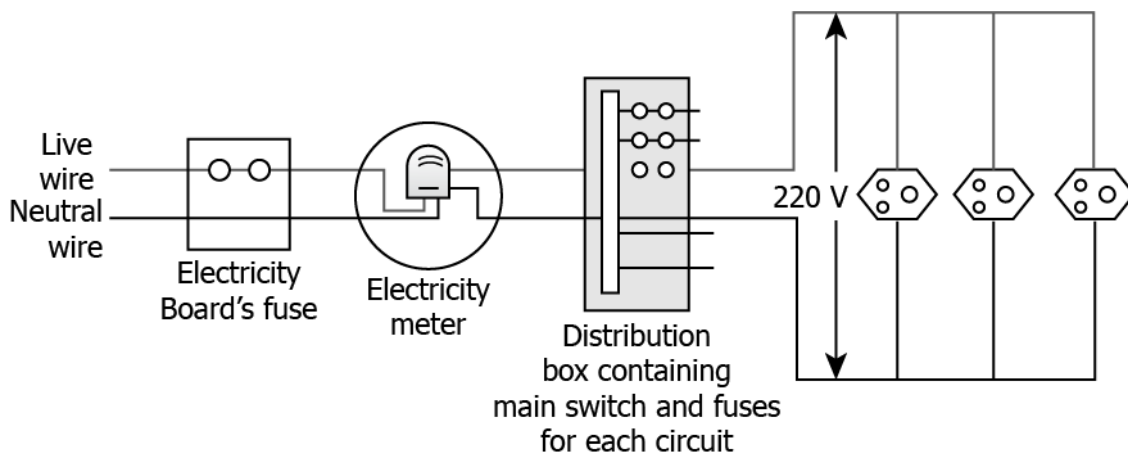
1) Appliances that have metal body are generally connected to the earthing wire. What is the reason to earth these wires?

- (a) to prevent excess of current
- (b) to prevent the leakage of current
- (c) to provide extra current to appliance
- (d) to provide high resistance to the appliance

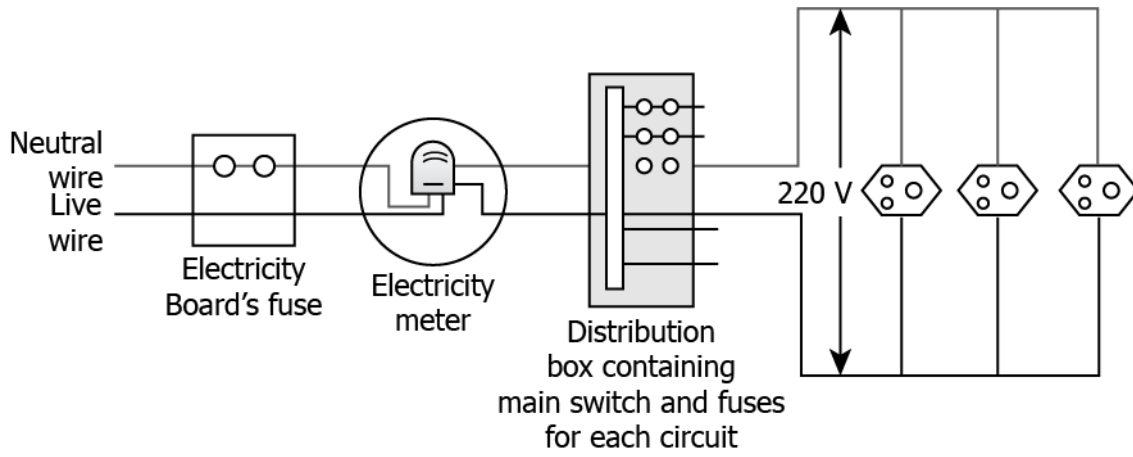
**Correct Answer:** Option (b)

2) Which diagram shows the domestic electric circuit?

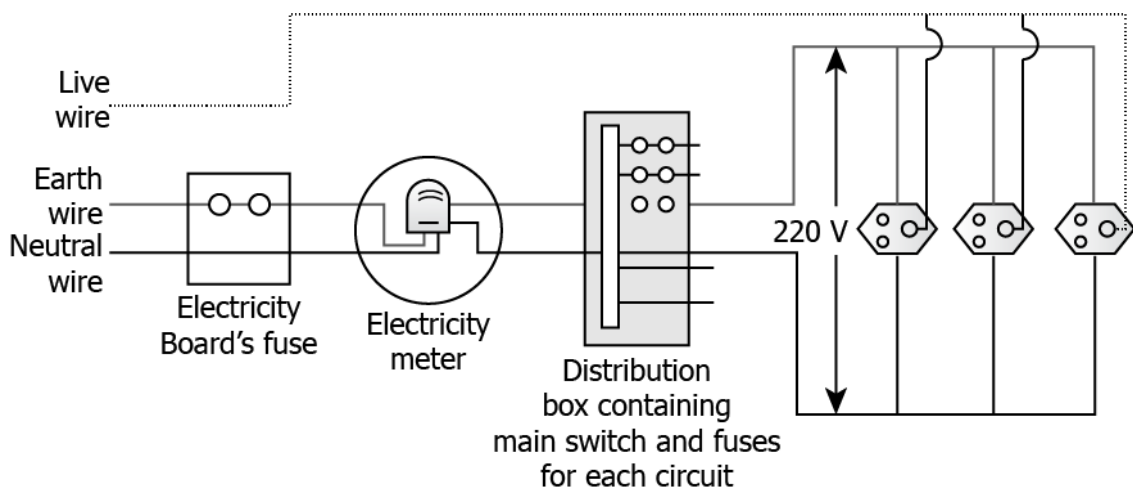
(a)



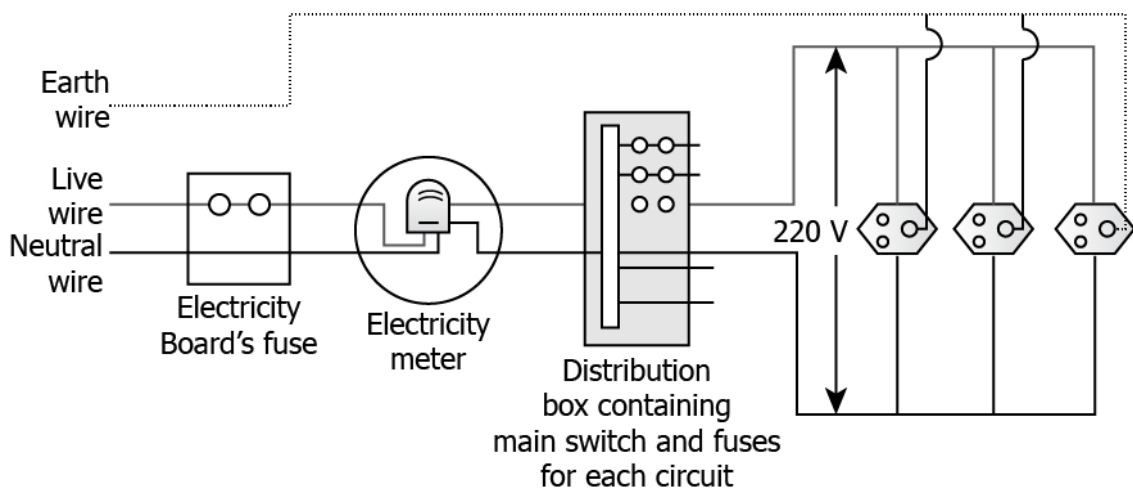
(b)



(c)



(d)



**Correct Answer:** Option (d)

# Suggested Teacher Resources



1

## Activity



|                               |   |
|-------------------------------|---|
| Objective                     | Draw magnetic field lines for a bar magnet, in order to identify the magnetic field strength at different points around a magnet.   |
| Prerequisite                  | -   |
| Material Required             | A bar magnet, a sheet of paper or plastic, iron filings   |
| Vocabulary                    | Magnetic Field: The area around the magnet where its force can be felt.<br><br>Magnetic Lines of Force: The curved lines representing the magnetic field around a magnet.   |
| Procedure                     | <ol style="list-style-type: none"> <li>1. Keep a bar magnet under the sheet of plastic or paper on a desk.</li> <li>2. Sprinkle iron filings on top of the sheet just to cover the magnet and some area surrounding it.</li> <li>3. Draw the pattern you observe in your notebook.</li> </ol> |
| Reflection Questions          | <ol style="list-style-type: none"> <li>1. Were the iron filings evenly distributed around the magnet? Why or why not?</li> <li>2. Are the magnetic field lines around the bar magnet straight? What do you observe?</li> </ol>  |
| Text to real world connection | <ol style="list-style-type: none"> <li>1. Where are magnets used in our everyday life?</li> <li>2. Can you see magnetism?</li> </ol>  |
| Beyond the classroom          | <ol style="list-style-type: none"> <li>1. Create a magic trick to surprise your friends using magnets.</li> </ol>   |

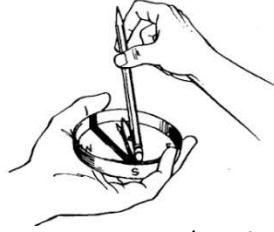
2

## Activity



|                   |  |
|-------------------|--|
| Material required | Compass, Pencil  |
| Procedure         | <p><b>HOW CAN YOU TELL TIME WITH A COMPASS?</b></p> <ol style="list-style-type: none"> <li>1. Take the equipment outdoors on a sunny day.</li> <li>2. Stand facing north. Hold the pencil in line with the compass needle, but at an upward angle of 45 degrees; the bottom end of the pencil should rest on the glass directly above the "S" on the face of the compass.</li> </ol> |

3. The pencil casts a shadow over the compass. If you regard the "N" on the compass as 12 o'clock, the "W" as 9 o'clock, the "E" as 3 o'clock, and the "S" as 6 o'clock, the shadow gives you the approximate time.



(Source: <http://www.arvindguptatoys.com/arvindgupta/electricity-dover.pdf>)

Reflection  
questions

1. How did people tell time before the invention of the clock?
2. How does a sundial work?

# 14. Sources of Energy

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts       | Learning Objectives  |
|---------------------------------|--|
| What is a good source of energy | Classify different sources of energy on the basis of accessibility, cost, transportation and storage, in order to identify a 'good' source of energy |
| Fossil fuels                    | Understand the process of extracting energy from fossil fuels, in order to develop its efficiency  |
| Thermal and hydro power plants  | Compare the process of energy consumption through thermal and hydro power plants, in order to classify them as 'good' or 'bad' sources of energy.    |
| Biomass                         | Explain the formation of biomass, in order to classify it as 'good' or 'bad' sources of energy   |
| Wind-energy                     | Outline the process of extracting energy from wind, in order to assess it as a conventional source of energy   |
| Solar energy                    | Describe the process of extracting energy from sun's rays, in order to assess it as a non-conventional source of energy                              |
| Energy from the sea             | Infer the process of extracting energy from the sea (tidal, wave, ocean thermal), in order to assess it as a non-conventional source of energy       |
| Geothermal & nuclear energy     | Elaborate the process of extracting geothermal and nuclear energy, in order to assess it as a non-conventional source of energy                      |

**Learning Objectives and Learning Outcomes:**

| Learning Objectives  | Learning Outcomes   |
|--|---|
| Classify different sources of energy on the basis of accessibility, cost, transportation and storage, in order to identify a 'good' source of energy | Classifies materials / objects / organisms / phenomena / processes, based on, properties / characteristics, such as metals and non-metals on the basis of their physical and chemical properties, acids and bases on the basis of their chemical properties, etc. |
| Understand the process of extracting energy from fossil fuels, in order to develop its efficiency  | Explains processes and phenomena, such as nutrition in human beings and plants, transportation in plants and plants,  |

|   |   |
|---|---|
| Compare the process of energy consumption through thermal and hydro power plants, in order to classify them as 'good' or 'bad' sources of energy.     | transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.   |
| Explain the formation of biomass, in order to classify it as 'good' or 'bad' sources of energy  |   |
| Outline the process of extracting energy from wind, in order to assess it as a conventional source of energy  |   |
| Describe the process of extracting energy from sun's rays, in order to assess it as a non-conventional source of energy                               |   |
| Infer the process of extracting energy from the sea (tidal, wave, ocean thermal), in order to assess it as a non-conventional source of energy        |   |
| Elaborate the process of extracting geothermal and nuclear energy, in order to assess it as a non-conventional source of energy                       |   |
| Understand the process of extracting energy from fossil fuels, in order to develop its efficiency   | Applies learning to hypothetical situations, such as what happens if all herbivores removed from an ecosystem? What will happen if all non-renewable sources of energy are exhausted?   |
| Describe the process of extracting energy from sun's rays, in order to assess it as a non-conventional source of energy                               | Applies scientific concepts in daily life and solving problems, such as takes precautions to prevent sexually transmitted infections, uses appropriate electrical plugs (5 /15a) for different electrical devices, uses vegetative propagation to develop saplings in gardening, performs exercise to keep in good health, avoids using appliances responsible for ozone layer depletion, applies concept of decomposition reaction of baking soda to make spongy cakes, etc. |
| Infer the process of extracting energy from the sea (tidal, wave, ocean thermal), in order to assess it as a non-conventional source of energy        |   |
| Elaborate the process of extracting geothermal and nuclear energy, in order to assess it as a non-conventional source of energy                       |   |
| Classify difference sources of energy on the basis of accessibility, cost, transportation and storage, in order to identify a 'good' source of energy | Makes efforts to conserve environment realizing the inter- dependency and interrelationship in the biotic and abiotic factors of environment, such as appreciates and promotes segregation of biodegradable and non - biodegradable wastes, takes steps to promote sustainable management of resources in day to day life, advocates use of fuels which produces less pollutants, uses energy efficient electric devices, uses fossil fuels judiciously, etc.                 |
| Understand the process of extracting energy from fossil fuels, in order to develop its efficiency   |   |

## Test items



**LOB: Classify different sources of energy on the basis of accessibility, cost, transportation and storage, in order to identify a 'good' source of energy**

1) Which of these characteristics can help us recognize a good source of fuel?

- (e) physical state
- (f) availability in all regions
- (g) cost effective for all countries
- (h) produces large amount of energy

**Correct Answer:** Option (d)

2) Rahul can use any source of energy for cooking, but he wants to avoid production of smoke from the source. Which of these sources should he use for cooking?

- (a) coal
- (b) electricity
- (c) petroleum
- (d) wood

**Correct Answer:** Option (b)

**LOB: Understand the process of extracting energy from fossil fuels, in order to develop its efficiency**

1) A student wants to extract energy from a fossil fuel. Which process would help him to extract the energy from a fossil fuel?

- (a) burning
- (b) crystallization
- (c) condensation
- (d) distillation

**Correct Answer:** Option (a)

2) A student studies that efficiency of a fuel can be increased using new technologies. How does increased efficiency benefit humans and environment?

- (a) production of fuel will increase
- (b) cost of fuel production will decrease
- (c) amount of fuel in reservoirs will increase
- (d) pollution and consumption will decrease

**Correct Answer:** Option (d)

**LOB: Compare the process of energy consumption through thermal and hydro power plants, in order to classify them as 'good' or 'bad' sources of energy**

1) A student studies that generation of electricity in a thermal power plant is done by burning of a large amount of fossil fuels. He also studies that thermal power plant is considered as bad source of energy. Why?

- (a) as it uses very less amount of fossil fuels
- (b) as burning of fossil fuel releases harmful gases
- (c) as electricity is harmful and pollutes the environment
- (d) as thermal power plants produce less amount of electricity

**Correct Answer:** Option (b)

2) A student studies hydro power plants can produce electricity by using the kinetic energy of the stored water in dams. Thus, water can be refilled again and again to produce electricity. As it doesn't require burning of fossil fuel, oxides of carbon, nitrogen and sulphur gases are not released into the atmosphere. Should hydro power plant consider as a 'good' or 'bad' source of energy?

- (a) good, as it uses releases oxides of carbon
- (b) bad, as it uses water as a source of energy
- (c) good, as it does not pollute the atmosphere
- (d) bad, as no ashes is produces while burning of fossil fuels

**Correct Answer:** Option (c)

**LOB:** Explain the formation of bio-mass, in order to classify it as 'good' or 'bad' sources of energy

1) A student studies that bio-gas is produced from the residue left after harvesting of crops, produces methane, which burns without releasing smoke and leaves no ashes. He also studied that it is considered as 'good' source of energy. Why is it considered as a 'good' source of energy?

- (a) as it produces ashes
- (b) as it produces methane
- (c) as it burns without releasing smoke
- (d) as it decomposes in the absence of oxygen

**Correct Answer:** Option (c)

2) A student studies that bio-gas contains a large amount of methane which can be used as a fuel for various uses. It burns without releasing smoke and leaving no residue like ash in other fossil fuel. Should bio-mass be consider as a 'good' or 'bad' source of energy?

- (a) bad, as it does not release smoke
- (b) good, as it produces methane gas
- (c) bad, as it burns without releasing smoke
- (d) good, as it does not cause any harm to the environment

**Correct Answer:** Option (d)



**LOB: Outline the process of extracting energy from wind, in order to assess it as a conventional source of energy**

1) Which of these processes explains the extraction of energy from wind to generate energy for a water-lifting pump?

- (a) conversion of mechanical energy of wind into kinetic energy
- (b) conversion of kinetic energy of wind into mechanical energy
- (c) conversion of mechanical energy of wind into potential energy
- (d) conversion of potential energy of wind into mechanical energy

**Correct Answer:** Option (b)

2) A student studies that the movement of the wind is caused due to uneven heating of the Earth surface. This helps in rotating a windmill which can be used to lift water from a well. He also studied that wind energy is considered as a conventional source of energy. Why is it considered as conventional source of energy?

- (a) as it can rotate a windmill
- (b) as it can help in lifting water
- (c) as it is readily available and used for a long time
- (d) as it produced due to uneven heating of the Earth

**Correct Answer:** Option (c)

**LOB: Describe the process of extracting energy from sun's rays, in order to assess it as a non-conventional source of energy**

1) Which of these processes explains the extraction of Sun's energy to generate energy to light a bulb?

- (a) conversion of electric energy into solar energy
- (b) conversion of solar energy into electric energy
- (c) conversion of solar energy into kinetic energy
- (d) conversion of kinetic energy into solar energy

**Correct Answer:** Option (b)

2) A student studies that solar energy can be used to generate electricity by using solar cells. It has been possible to use this energy due to technological advancement. It can generate electricity when exposed to the Sun. He also studied that solar energy is considered as a conventional source of energy. Why is it considered as a conventional source of energy?

- (a) as use of this energy have been possible due to advancement of technology
- (b) as it generates electricity which is a clean source of energy
- (c) as it has been used form ancient times
- (d) as it uses Sun as a source of energy

**Correct Answer:** Option (a)

**LOB: Infer the process of extracting energy from the sea (tidal, wave, ocean thermal), in order to assess it as a non-conventional source of energy**

1) Which process explains the energy extraction from a sea wave?

- (a) using kinetic energy of the waves to produce electricity
- (b) using thermal energy of the waves to produce electricity
- (c) using chemical energy of the waves to generate electricity
- (d) using electrical energy of the waves to generate electricity

**Correct Answer:** Option (a)

2) Ravi studies that due to gravitational pull, level of water in the sea rises and falls. With the advancement of technology generation of electricity has been made possible. This type of energy is known as tidal energy. Should tidal energy be considered as conventional or non-conventional source of energy?

- (a) conventional, as it uses water as source of energy
- (b) non-conventional, as gravitational energy is converted to electrical energy
- (c) conventional, as the resulted product is electricity which can be used as fuel
- (d) non-conventional, as extraction of this energy is possible with advance in technology

**Correct Answer:** Option (d)

**LOB: Elaborate the process of extracting geothermal and nuclear energy, in order to assess it as a non-conventional source of energy**

1) Which of these processes explains the working of a geothermal power plant?

- (a) use of potential energy to produce electricity
- (b) use of thermal energy to produce electricity
- (c) use of kinetic energy to produce electricity
- (d) use of tidal energy to produce electricity

**Correct Answer:** Option (b)

2) A student studies that energy can be produced by splitting a heavy atom when bombarded with low energy neutron. This can be done in nuclear reactor which is designed for generation of power. This form of energy known as nuclear energy. He also studies that this nuclear energy is considered as non-conventional source of energy. Why is it considered as non-conventional source of energy?

- (a) as it splits a heavy atom to produce energy
- (b) as a low energy neutron is involved in the process as bombardment results in the
- (c) production of energy
- (d) as energy can be extracted only through a nuclear reactor

**Correct Answer:** Option (d)

# Suggested Teacher Resources



## Activity



|                   |  |
|-------------------|--|
| Objective         | Explain the formation of biomass, in order to classify it as 'good' or 'bad' sources of energy.  |
| Prerequisite      | The qualities of a good energy source, knowledge of gases, combustion, aerobic and anaerobic fermentation, and biomass feedstock.  |
| Material Required | Case Study prints  |
| Vocabulary        | Accessibility: The ease of obtaining or using of a resource.   |
| Procedure         | <p>Read the case study below:</p> <p>(Source: <a href="https://www.nationalgeographic.org/encyclopedia/biomass-energy/">https://www.nationalgeographic.org/encyclopedia/biomass-energy/</a>)</p> <p>People have used biomass energy—energy from living things—since the earliest “cave men” first made wood fires for cooking or keeping warm.</p> <p>Biomass is organic, meaning it is made of material that comes from living organisms, such as plants and animals. The most common biomass materials used for energy are plants, wood, and waste. These are called biomass feedstocks. Biomass energy can also be a non-renewable energy source.</p> <p>Biomass contains energy first derived from the sun: Plants absorb the sun’s energy through photosynthesis, and convert carbon dioxide and water into nutrients (carbohydrates).</p> <p>The energy from these organisms can be transformed into usable energy through direct and indirect means. Biomass can be burned to create heat (direct), converted into electricity (direct), or processed into biofuel (indirect).</p> <p>Biomass can be burned by thermal conversion and used for energy. Thermal conversion involves heating the biomass feedstock in order to burn, dehydrate, or stabilize it. The most familiar biomass feedstocks for thermal conversion are raw materials such as municipal solid waste (MSW) and scraps from paper or lumber mills.</p> <p>Different types of energy are created through direct firing, co-firing, pyrolysis, gasification, and anaerobic decomposition.</p> <p>Before biomass can be burned, however, it must be dried. This chemical process is called torrefaction. During torrefaction, biomass is heated to about 200° to 320° Celsius (390° to 610° Fahrenheit). The biomass dries out so completely that it loses the ability to absorb moisture, or rot. It loses about 20% of its original mass, but retains 90% of its energy. The lost energy and mass can be used to fuel the torrefaction process.</p> |

|                               | <p>During torrefaction, biomass becomes a dry, blackened material. It is then compressed into briquettes. Biomass briquettes are very hydrophobic, meaning they repel water. This makes it possible to store them in moist areas. The briquettes have high energy density and are easy to burn during direct or co-firing.</p> <p>Biomass is the only renewable energy source that can be converted into liquid biofuels such as ethanol and biodiesel. Biofuel is used to power vehicles, and is being produced by gasification in countries such as Sweden, Austria, and the United States.</p> <p>Ethanol is made by fermenting biomass that is high in carbohydrates, such as sugar cane, wheat, or corn. Biodiesel is made from combining ethanol with animal fat, recycled cooking fat, or vegetable oil.</p> <p>Biofuels do not operate as efficiently as gasoline. However, they can be blended with gasoline to efficiently power vehicles and machinery, and do not release the emissions associated with fossil fuels.</p> |                       |                    |                       |                              |                  |                              |  |  |  |  |  |  |
|-------------------------------|---|-----------------------|--------------------|-----------------------|------------------------------|------------------|------------------------------|--|--|--|--|--|--|
| Reflection Questions          | <table border="1"> <thead> <tr> <th>Energy Source.</th> <th>Accessibility</th> <th>Storage and Transport</th> <th>Economic Viability</th> <th>Pollution Caused</th> <th>Good or Bad Source of Energy</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>   | Energy Source.        | Accessibility      | Storage and Transport | Economic Viability           | Pollution Caused | Good or Bad Source of Energy |  |  |  |  |  |  |
| Energy Source.                | Accessibility   | Storage and Transport | Economic Viability | Pollution Caused      | Good or Bad Source of Energy |                  |                              |  |  |  |  |  |  |
|                               |   |                       |                    |                       |                              |                  |                              |  |  |  |  |  |  |
| Text to real world connection | 1) Find out about the different sources of energy which are used in your city to provide electricity. How many of them are renewable and fit in as good energy sources?   |                       |                    |                       |                              |                  |                              |  |  |  |  |  |  |
| Beyond the classroom          | 1) Read and find out about other forms in which biomass can be used as a rich source of energy.   |                       |                    |                       |                              |                  |                              |  |  |  |  |  |  |

2

## Activity



|                      |   |
|----------------------|---|
| Material required    | 36 dried peas or beans, 6 airtight clear plastic bags , Water, Bowl,  |
| Procedure            | <p>(Source: WebQuest)</p> <ol style="list-style-type: none"> <li>1. Soak the beans or peas in water overnight.</li> <li>2. Place 6 beans or peas into each bag and squeeze out all the air before you sealing.</li> <li>3. Put 2 bags in a warm, sunny place. Put 2 bags in a warm, shady place. Put 2 bags in a dark place. Leave the bags overnight.</li> <li>4. Check the bags the next day.</li> <li>5. Record your observations in a table.</li> </ol> |
| Reflection questions | <ol style="list-style-type: none"> <li>1. What did you observe?</li> <li>2. Did the decaying beans produce gas?</li> <li>3. In which environment did they produce the maximum gas?</li> <li>4. How do you think this gas can be used as a source of energy?</li> </ol>  |



# 15. Our Environment

## QR Code:



## Learning Objectives:

| Content area/<br>Concepts | Learning Objectives   |
|---------------------------|---|
| Ecosystem                 | Classify biotic and abiotic components and their interaction with each other, in order to describe an ecosystem   |
| Food chains and webs      | Tabulate the organisms feeding on one another (producers, consumers, decomposers) and energy transfer between them, in order to form a food chain or a food web |
| Ozone depletion           | Describe the formation & properties of ozone, in order to identify ways to protect it from depletion  |
| Managing garbage          | Classify different waste products as biodegradable or non-biodegradable, in order to assess their effect on environment   |

## Learning Objectives and Learning Outcomes:

| Learning Objectives   | Learning Outcomes   |
|---|---|
| Classify different waste products as biodegradable or non-biodegradable, in order to assess their effect on environment   | Differentiates materials / objects / organisms / phenomena / processes, based on, properties / characteristics, such as autotrophic and heterotrophic nutrition, biodegradable and non-biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.  |
| Tabulate the organisms feeding on one another (producers, consumers, decomposers) and energy transfer between them, in order to form a food chain or a food web | Applies learning to hypothetical situations, such as what happens if all herbivores removed from an ecosystem? What will happen if all non-renewable sources of energy are exhausted?   |
| Describe the formation & properties of ozone, in order to identify ways to protect it from depletion  | Applies scientific concepts in daily life and solving problems, such as takes precautions to prevent sexually transmitted infections, uses appropriate electrical plugs (5 /15a) for different electrical devices, uses vegetative propagation to develop saplings in gardening, performs exercise to keep in good health, avoids using appliances responsible for ozone layer depletion, applies concept of decomposition reaction of baking soda to make spongy cakes, etc. |

Classify biotic and abiotic components and their interaction with each other, in order to describe an ecosystem

Tabulate the organisms feeding on one another (producers, consumers, decomposers) and energy transfer between them, in order to form a food chain or a food web

Makes efforts to conserve environment realizing the inter-dependency and interrelationship in the biotic and abiotic factors of environment, such as appreciates and promotes segregation of biodegradable and non - biodegradable wastes, takes steps to promote sustainable management of resources in day to day life, advocates use of fuels which produces less pollutants, uses energy efficient electric devices, uses fossil fuels judiciously, etc.

## Test items



**LOB:** Classify biotic and abiotic components and their interaction with each other, in order to describe an ecosystem

1) The table lists some components of an ecosystem.

- Rain
- Water
- Butterfly
- Air
- Grass
- Bacteria
- Fungi
- Sunlight

A student wants to classify these into abiotic components from biotic components separately. Which option correctly shows the classification done by the student?

(e)

| Biotic Component             | Abiotic Component           |
|------------------------------|-----------------------------|
| Rain, grass, bacteria, fungi | Water, fungi, sunlight, air |

(f)

| Biotic Component             | Abiotic Component            |
|------------------------------|------------------------------|
| Air, grass, butterfly, fungi | Water, fungi, sunlight, rain |

(g)

| Biotic Component                  | Abiotic Component          |
|-----------------------------------|----------------------------|
| Grass, bacteria, fungi, butterfly | Water, rain, sunlight, air |

| Biotic Component             | Abiotic Component               |
|------------------------------|---------------------------------|
| Rain, grass, bacteria, fungi | Water, butterfly, sunlight, Air |

(h)

**Correct Answer:** Option (c)

2) Which statement shows interaction of an abiotic component with a biotic component in an ecosystem?

- (a) A grasshopper feeding on a leaf.
- (b) Rainwater running down into the lake.
- (c) An earthworm making a burrow in the soil.
- (d) A mouse fighting with another mouse for food.

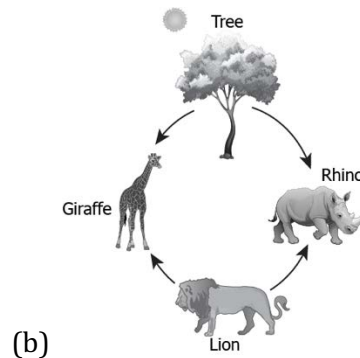
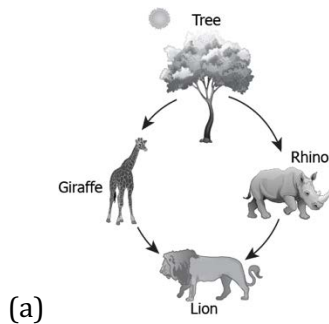
**Correct Answer:** Option (c)

**LOB:** Tabulate the organisms feeding on one another (producers, consumers, decomposers) and energy transfer between them, in order to form a food chain or a food web

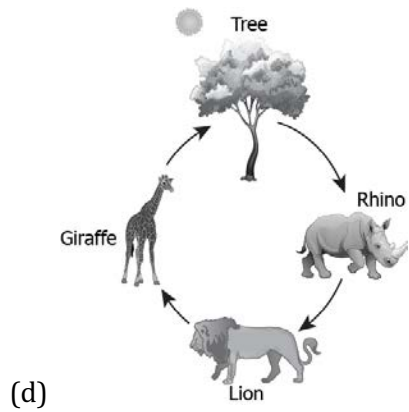
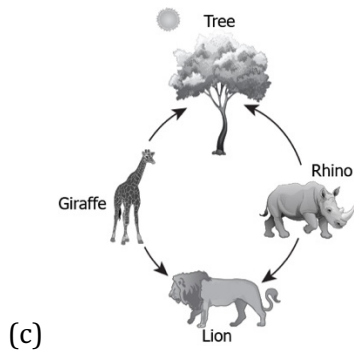
1) The table shows some organisms including plants, animals and how they get energy.

| Organism | How the organism gets energy |
|----------|------------------------------|
| Tree     | Sunlight                     |
| Lion     | Giraffe, rhino               |
| Rhino    | Tree                         |
| Giraffe  | Tree                         |

Which option shows the correct model made based on the table?

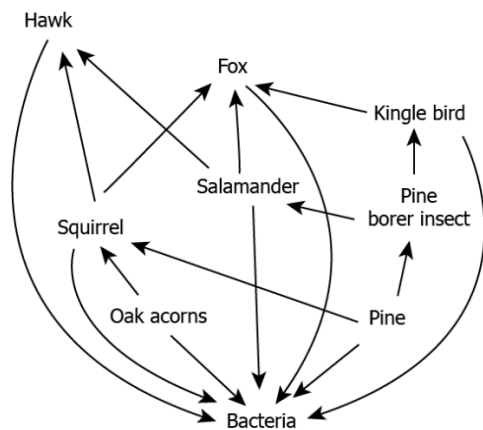






**Correct Answer:** Option (a)

2) The image shows a food web.



- (a) Fox feeds on hawk obtain energy.
- (b) Hawk feeds on oak acorn to obtain energy.
- (c) Squirrel feeds on pine borer to obtain energy.
- (d) Salamander feeds on pine borer to obtain energy.

**Correct Answer:** Option (d)

**LOB:** Describe the formation & properties of ozone, in order to identify ways to protect it from depletion

1) The manufacturing of Chlorofluorocarbons free refrigerators is mandatory throughout the world. How this help prevent ozone depletion?

- (a) This will help convert oxygen molecules into ozone.
- (b) This will help convert the CFCs into ozone molecules.
- (c) This will reduce the production of CFC from oxygen molecules.
- (d) This will reduce the release of CFCs that reacts with ozone molecules

**Correct Answer:** Option (d)

2) Ozone forms by combination of free oxygen atoms and oxygen molecules. How do free oxygen atoms form at higher levels of atmosphere?

(a) by splitting of molecular oxygen into free oxygen atoms in the presence of low energy UV radiations

(c) by the combination of two molecular oxygen in the presence of high energy UV radiations

(b) by splitting of a molecular oxygen into free oxygen atoms in presence of high energy UV radiations

(d) by the combination of two free oxygen atoms in the presence of lower energy UV radiations

**Correct Answer:** Option (b)

**LOB:** Classify different waste products as biodegradable or non-biodegradable, in order to assess their effect on environment

1) The table lists some waste products.

- grass cutting
- polythene bags
- plastic toys
- used tea bags
- paper straw
- old clothes

Which group of waste materials can be classified as non-biodegradable?

(a) plant waste, used tea bags

(b) polyethene bags, plastic toys

(c) used tea bags, paper straw

(d) old clothes, broken footwear

**Correct Answer:** Option (b)

2) The table shows some waste materials that changed and remain unchanged when buried in the soil.

- plastic box
- bubble wrap
- vegetable peels
- rubber tyre
- empty carton

What materials correctly classified biodegradable and non-biodegradable materials?

| Biodegradable                   | Non-biodegradable            |
|---------------------------------|------------------------------|
| Vegetable peels,<br>bubble wrap | Plastic box,<br>empty carton |

(a)

| Biodegradable                                | Non-biodegradable           |
|--|-----------------------------|
| empty carton,<br>rubber tyre,<br>bubble wrap | Plastic box,<br>tree leaves |

(c)

| Biodegradable                    | Non-biodegradable           |
|----------------------------------|-----------------------------|
| Vegetable peels,<br>empty carton | Plastic box,<br>bubble wrap |

(b)

| Biodegradable               | Non-biodegradable               |
|-----------------------------|---------------------------------|
| Rubber tyre,<br>bubble wrap | Plastic box,<br>vegetable peels |

(d)

## Suggested Teacher Resources



### Activity





|                   |   |
|-------------------|---|
| Objective         | Classify biotic and abiotic components and their interaction with each other, in order to describe an ecosystem.  |
| Prerequisite      | Living and non-living species   |
| Material Required | School yard, notebook   |
| Vocabulary        | <p>Biotic: The living components of an ecosystem</p> <p>Abiotic: The non-living components of an ecosystem</p> <p>Ecosystem: A biological community of interacting living organisms and their non-living physical environment.</p>  |
| Procedure         | <ol style="list-style-type: none"> <li>Look at the following image carefully and identify living and non-living species.</li> </ol> <div data-bbox="764 1592 1153 1924" data-label="Image"> </div> <ol style="list-style-type: none"> <li>Divide a page of the notebook into two sections and name it living and non-living.</li> </ol> |

|                               |   |
|-------------------------------|---|
|                               | <ol style="list-style-type: none"> <li>Take a walk outside in the school yard and identify as many living and non-living components around in 5 minutes.</li> <li>Share that living components are called biotic and non-living components are called abiotic.</li> </ol> |
| Reflection Questions          | <ol style="list-style-type: none"> <li>List 5 biotic and abiotic factors each and derive how they are related to each other.</li> <li>What is an ecosystem? Can it exist without either its biotic or abiotic components?</li> </ol>                                      |
| Text to real world connection | <ol style="list-style-type: none"> <li>If there is no water...can anything grow or survive? Why?</li> <li>If it is extremely cold one winter, will that affect whether an animal is able to survive till spring? How?</li> </ol>  |
| Beyond the classroom          | Identify the biotic and abiotic components in your neighbourhood ecosystem. What factors lead to an imbalance in these two?   |

2

## Activity



|                      |  |
|----------------------|--|
| Material required    | Two pots, soil, plastic, polythene, aluminium foil, cans, plant and animal waste, waste papers   |
| Procedure            | <ol style="list-style-type: none"> <li>Take two pots half filled with soil and label them A and B.</li> <li>Put aluminium foil, cans, polythene and plastic in pot A and plant and animal waste in pot B and cover both with some soil.</li> <li>Record changes in the pots for the next six days in an observation table.</li> </ol> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(Non-biodegradable waste)</p> </div> <div style="text-align: center;">  <p>(Biodegradable waste)</p> </div> </div> |
| Reflection questions | <ol style="list-style-type: none"> <li>Define the term biodegradable.</li> <li>Explain what a compost pile is.</li> <li>Describe what happens to their garbage after it is thrown away.</li> <li>Identify what types of materials are biodegradable, and what types are not.</li> <li>What kind of changes do biodegradable and non-biodegradable wastes have on the surrounding environment?</li> <li>Create a compost pit for the classroom (if open space and soil is available in the school).</li> <li>Create a waste management plan for your community or neighbourhood.</li> </ol>   |

# 16. Sustainable Management of Natural Resources

**QR Code:**



**Learning Objectives:**

| Content area/<br>Concepts               | Learning Objectives  |
|---|--|
| Introduction                            | Identify the 5 R's (refuse, reduce, reuse, repurpose, recycle), in order to employ one of these methods to make environment-friendly choices |
| Why do we need to manage our resources? | Explain sustainable development, in order to conserve natural resources for future generations   |
| Stakeholders                            | Identify different stakeholders involved in a forest, in order to prepare a conservation plan for forests                                    |
| Water for all                           | Explain the construction and use of dams and water harvesting, in order to devise an efficient plan to conserve water                        |
| Coal and petroleum                      | List down the disadvantages of using coal and petroleum as energy sources, in order to develop a better plan of generating energy            |

**Learning Objectives and Learning Outcomes:**

| Learning Objectives   | Learning Outcomes  |
|---|--|
| Explain the construction and use of dams and water harvesting, in order to devise an efficient plan to conserve water             | Relates processes and phenomena with causes / effects, such as hormones with their functions, tooth decay with pH of saliva, growth of plants with pH of the soil, survival of aquatic life with pH of water, blue colour of sky with scattering of light, deflection of compass needle due to magnetic effect of electric current, etc. |
| Explain sustainable development, in order to conserve natural resources for future generations                                    | Applies learning to hypothetical situations, such as what happens if all herbivores removed from an ecosystem? What will happen if all non-renewable sources of energy are exhausted?  |
| List down the disadvantages of using coal and petroleum as energy sources, in order to develop a better plan of generating energy |  |
| Identify the 5 R's (refuse, reduce, reuse, repurpose, recycle), in order to employ one  | Applies scientific concepts in daily life and solving problems, such as takes precautions to prevent sexually transmitted infections, uses appropriate electrical plugs (5   |

|   |  |
|---|--|
| of these methods to make environment-friendly choices   | /15a) for different electrical devices, uses vegetative propagation to develop saplings in gardening, performs exercise to keep in good health, avoids using appliances responsible for ozone layer depletion, applies concept of decomposition reaction of baking soda to make spongy cakes, etc.   |
| Identify different stakeholders involved in a forest, in order to prepare a conservation plan for forests | Makes efforts to conserve environment realizing the inter-dependency and interrelationship in the biotic and abiotic factors of environment, such as appreciates and promotes segregation of biodegradable and non-biodegradable wastes, takes steps to promote sustainable management of resources in day to day life, advocates use of fuels which produces less pollutants, uses energy efficient electric devices, uses fossil fuels judiciously, etc. |

## Test items



**LOB:** Identify the 5 R's (refuse, reduce, reuse, repurpose, recycle), in order to employ one of these methods to make environment-friendly choices

1) Which of these practices can be adopted to save the environment?

- (e) refuse the use of single-use plastic bags
- (f) reduce the use of paper bags
- (g) recycle single-use bags
- (h) reuse waste food

**Correct Answer:** Option (a)

2) A student studies that we should switch off unnecessary lights and fans in order to save the environment. How does switching off unnecessary electrical appliances help the environment?

- (a) it reduces the wastage of energy
- (b) it generates electricity when switched off
- (c) it recycles the amount of energy used
- (d) it increases the efficiency of the electrical appliances

**Correct Answer:** Option (a)

**LOB:** Explain sustainable development, in order to conserve natural resources for future generations

1) What is the main significance of sustainable development?

- (a) to preserve the natural resources for the needs of the future generation
- (b) to exploit the available resource for rapid improvement
- (c) to increase the cost of available natural resources
- (d) to increase the reservoirs of natural resources

**Correct Answer:** Option (a)

- 2) Which of these is an example of sustainable development in order to conserve natural resources for the future generation?
- (a) cleaning water resources
  - (b) finding alternate fuel reservoirs
  - (c) clearing forests to set up new industries
  - (d) planning for safe disposal of wastes after mining

**Correct Answer:** Option (d)

**LOB: Identify different stakeholders involved in a forest, in order to prepare a conservation plan for forests**

- 1) Which of these would be identified as a stakeholder involved in a forest?
- (a) industries who make ceramic products using clay
  - (b) industries who make papers using wood products
  - (c) industries who make clothes using synthetic materials
  - (d) industries who make devices that generate electricity using solar energy

**Correct Answer:** Option (b)

- 2) A student studies that conservation of forest is necessary to maintain ecological stability. This can only be maintained if forests are conserved. Which of these practices will help to conserve the forest?
- (a) practice of deforestation
  - (b) putting a ban on deforestation
  - (c) an increase in use of firewood by local people
  - (d) an increase in use of forest product by industries

**Correct Answer:** Option (b)

**LOB: Explain the construction and use of dams and water harvesting, in order to devise an efficient plan to conserve water**

- 1) Which of these explains the use of dams?
- (a) to replenish underground water resources
  - (b) to provide irrigation and generate electricity
  - (c) to produce steady supply of water in hilly regions
  - (d) to provide water for conservation of biological diversity

**Correct Answer:** Option (b)

- 2) A student studies that construction of a water harvesting system in a region can help conserve water. How can construction of this system help a region?

- (a) it will reduce the occurrence of droughts
- (b) it will reduce the percolation of rainwater
- (c) it will replenish surface water like rivers
- (d) it will increase the speed of flow of surface runoff

**Correct Answer:** Option (a)

**LOB:** List down the disadvantages of using coal and petroleum as energy sources, in order to develop a better plan of generating energy

1) Which option explains the disadvantage of using fossil fuel as energy sources?

- (a) it releases harmful gases into the atmosphere when they burn
- (b) it is extracted from deep inside the Earth
- (c) it uses oxygen in the process of burning
- (d) it is hard to transport

**Correct Answer:** Option (a)

2) A student studies that using coal and petroleum as a source of energy emits carbon dioxide and ash that pollutes environment. Which step should be adopted in order to save the environment?

- (a) replace coal to firewood for cooking food
- (b) replace petroleum to coal in vehicles for transportation
- (c) replace thermal power with solar power to generate electricity
- (d) replace the use of coal to petroleum for melting metals in a furnace

**Correct Answer:** Option (c)

## Suggested Teacher Resources



### Activity



|                   |  |
|-------------------|--|
| Objective         | Identify different stakeholders involved in a forest, in order to prepare a conservation plan for forests. |
| Prerequisite      | Forest Ecosystem   |
| Material Required | Case study prints  |



|            |   |
|------------|---|
| Vocabulary | Stakeholders: People with an interest or concern in something, especially a business.   |
| Procedure  | <p><b>Case Study:</b><br/> <b>(Source: <a href="https://www.iwgia.org/images/documents/briefings/Case-Study-India.pdf">https://www.iwgia.org/images/documents/briefings/Case-Study-India.pdf</a>)</b></p> <p>Jharkhand is a state in central India, and is home to numerous indigenous peoples (Adivasi). Jharkhand literally means “the land of forests”. In-migration from other parts of India, mining, construction of large dams, industrialization, and urbanization gradually led to the Adivasi's economic, cultural and political marginalization. A majority of the Adivasi depend on forests and forest resources for their livelihoods and cultural identity. Throughout central India, forests provide the Adivasi with food, fodder for their animals, building material and cash income through the sale of non-timber forest products. A study on hunger in Adivasi areas showed that in Jharkhand, 75% of the surveyed Adivasi households partly depended on forest food products throughout the year (Centre for Environment and Food Security 2005: 52) and they considered the loss of income from the sale of minor forest products due to forest depletion as the second most important reason for increased food insecurity (Ibid.: 56). The Adivasi are entirely dependent on agriculture and forest resources for their livelihoods. Over the years, they have increasingly been deprived of forest resources and agricultural land. Under British colonial rule, Indian forest policy vested all forest lands in the State. Independent India inherited this forest policy and the State continues to own all forests in India. As an exception, the common property rights over forest land (Khunkatti) in 446 Munda villages were recognized under the Chotanagpur Tenancy Act of 1908. The Act resulted from a protracted rebellion between 1895 and 1900 under the leadership of Birsa Munda. In subsequent decades, many Khunkatti villages lost their status as communal lands: only 156 officially recognized Khunkatti villages remain. GOOD PRACTICES Towards making land governance more people-centred This case study is part of the ILC's Database of Good Practices, an initiative that documents and systematises ILC members and partners' experience in promoting people-centred land governance, as defined in the Antigua Declaration of the ILC Assembly of Members. Further information at <a href="http://www.landcoalition.org/what-we-do">www.landcoalition.org/what-we-do</a> This case study supports people-centred land governance as it contributes to: Commitment 3 recognize and protect the diverse tenure and production systems upon which people's livelihoods depend Commitment 5 respect and protect the inherent land and territorial rights of indigenous peoples Commitment 6 enable the role of local land users in territorial and ecosystem management The remaining 156 forests were not spared from the Forest Department's overreach. The Forest Department took control over them 'for scientific management', resulting in land loss by the Adivasi villagers, mismanagement by the Department and destruction of forests. 25% of India's land area is classified as public forests, yet only 8% is not denuded (Poffenberger 1996: 1). The Forest Department whose mandate includes the management and conservation of forests, has ignored the fact that the Adivasi depend on forests and forest resources for their livelihoods, and has introduced a licence system for non-timber forest products. The licencing system has further entrenched the asymmetries in control over forest resources and corruption in the issuing of licences.</p> <ol style="list-style-type: none"> <li>1. What is the reason for cutting down the forest?</li> <li>2. Who does that act benefit?</li> <li>3. What would happen to the environment around the area where the forests are uprooted?</li> </ol> |

|                               |   |
|-------------------------------|---|
|                               | <ol style="list-style-type: none"> <li>4. What would happen to the people and other living species in and around the forest area?</li> <li>5. Come up with a list of all people who should be involved in the decision to uproot the forests? (These people are called stakeholders.)</li> <li>6. Divide yourself in 3 to 4 stakeholder groups and come up with a decision statement giving at least three reasons to your assertion of whether you wish to cut the forest or not.</li> </ol> |
| Reflection Questions          | <ol style="list-style-type: none"> <li>1. What were some of the roadblocks you experienced in making your decision?</li> <li>2. Was there anything you considered but was not necessary in your discussions during your decision-making process? Explain.</li> <li>3. How did your group weigh the different consequences when making your decision statement?</li> <li>4. Did you feel that all stakeholders got a fair voice in the process? Why or why not?</li> </ol>                     |
| Text to real world connection | When was the last time you made a decision? What was the decision about? How did you go about making your decision? What steps did you take? Who was involved in the process of making the decision? Did you seek any outside information to influence the decision you made?   |
| Beyond the classroom          | Think of other ecosystems and the stakeholders directly and indirectly impacted by important environmental decisions.   |

## 2

## Activity



|                   |  |        |       |           |         |
|-------------------|--|--------|-------|-----------|---------|
| Material required | Eight to ten items from home that were destined for the garbage, recycling, or composting bin.   |        |       |           |         |
| Procedure         | <ol style="list-style-type: none"> <li>1. Ask the students what the 5Rs are and whether one is more important to practice than another.</li> <li>2. Discuss with the students that many items of waste need not be discarded in landfills. Some items may be reused for the same or different purpose; other items can be recycled. Gardens can be greatly improved by using compost as a natural fertilizer to amend the soil. Compost is made by decomposing organic materials.</li> <li>3. Discuss why it's important to practice the 5Rs (conservation of natural resources)</li> <li>4. Bring out all the materials the students have brought from home in groups of 4.</li> <li>5. Group the items as in the following table:</li> </ol> |        |       |           |         |
|                   | Refuse   | Reduce | Reuse | Repurpose | Recycle |
|                   | 1.   | 1.     | 1.    | 1.        | 1.      |
|                   | 2.   | 2.     | 2.    | 2.        | 2.      |

|                      |  |    |    |    |    |
|----------------------|--|----|----|----|----|
|                      | 3.   | 3. | 3. | 3. | 3. |
|                      | <p>6. In their groups students to also fill a "Highest and Best Use" sheet the format of which is as follows:</p> <p>a. We placed _____ in the refuse category because _____.</p> <p>b. _____ were in the reduce category because _____.</p> <p>c. _____ were in the reuse category because _____.</p> <p>d. _____ were in the repurpose category because _____.</p> <p>e. _____ were in the recycle category because _____.</p>   |    |    |    |    |
| Reflection questions | <ol style="list-style-type: none"> <li>1. Brainstorm ways to reduce the amount of items by practicing the 5Rs in class. (If there is a lot of scrap paper, create a scrap paper bin for the classroom that can be used for art projects, etc.)</li> <li>2. Groups may discuss that if items could not be reused, recycled or repurposed, what were the resources these items were made of? Discuss the value of these natural resources. Brainstorm ways to save resources by buying differently and making choices that help reduce waste.</li> </ol> |    |    |    |    |

