6
Chapter

Respiration in Organisms

We'll cover the following key points:

- Respiration and its types
- Respiration in Humans
- Respiration in Animals
- Respiration in Plants

Hi, I'm EeeBee

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Learning Outcomes

By the end of this chapter, students will be able to:

- Understand the concept of respiration and its role in providing energy for living organisms.
- Explain the types of respiration, including aerobic and anaerobic respiration, and their differences.
- Describe the process of respiration in humans, focusing on the mechanism of breathing and gas exchange.
- Identify how respiration occurs in animals, highlighting unique adaptations in various species.

Guidelines for Teachers

The teacher can begin the chapter by explaining why organisms need energy and how respiration supports life processes. Use diagrams or models to demonstrate the human respiratory system and explain the differences between aerobic and anaerobic respiration with real-life examples like muscle cramps or fermentation. Encourage students to compare respiration in plants and animals to highlight similarities and differences. Simple experiments, such as observing oxygen release in aquatic plants, can make the concept engaging and relatable.

NCF Curricular Goals and Competencies

This chapter addresses the following learning objectives:

- CG-1 (C 1.4): Understands the role of respiration in releasing energy required for various life processes.
- CG-4 (C 4.6): Analyzes the significance of aerobic and anaerobic respiration in different organisms and scenarios.
- CG-6 (C 6.5 and C 6.6): Investigates the respiration processes in humans, animals, and plants, promoting inquiry-based learning and critical thinking.

Mind Map

RESPIRATION IN ORGANISMS

Types of respiration

Cellular respiration : Breakdown of food in the cells with the release of energy.

Aerobic respiration : Complete combustion of food in presence of oxygen.

Anaerobic respiration : Incomplete combustion of food in absence of oxygen.

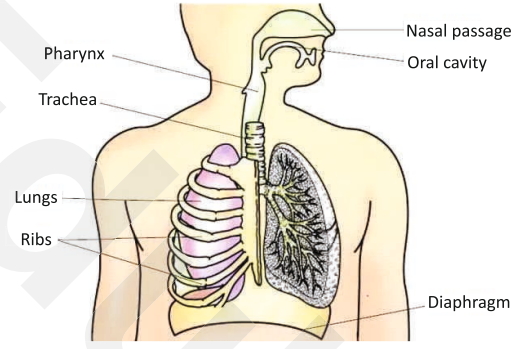
Breathing

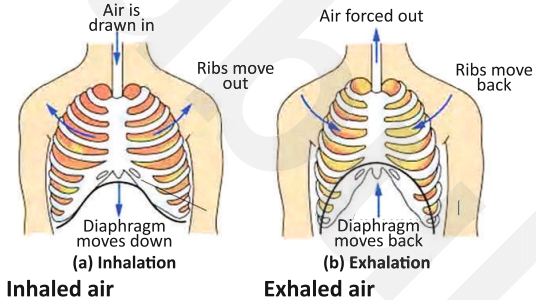
Taking in air rich in oxygen and giving out air rich in carbon dioxide.

Inhalation : The ribs move up and outwards increases the space of chest and air rushes into the lungs.

Exhalation : The ribs move down and inwards, reduces the size of chest cavity and air is pushed out of the lungs.

How do we breathe





Inhaled air

21% oxygen

0.04% carbon dioxide

Lungs

Exhaled air

16.4% oxygen

4.4% carbon dioxide

Breathing in other animals

Fish : Gills helps to use dissolve O_2 from water.

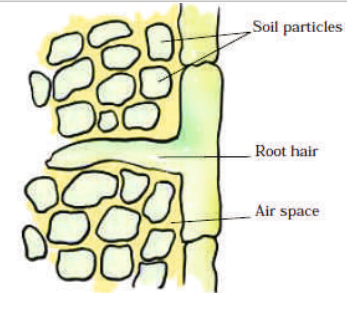
Earthworm : The skin is moist and slimy and gases can easily be exchanged.

Frog : Pair of lungs present. They can also breathe through skin which is moist and slippery.

Cockroach : Through small openings on the side of body called spiracles.

Respiration in Plants

The root cells also need oxygen to generate energy. Roots take up air from soil particles.



Based on NCERT*

Introduction

All of us need food to get energy. The body requires energy to perform physical activities as well us other metabolic processes. In fact, the body requires energy even when we are fast asleep. Let us read about the processes by which we get energy forces body.

In History...

- **Antoine Lavoisier's Experiment (18th Century):** Antoine Lavoisier discovered the process of respiration and its connection to oxygen, laying the foundation for understanding cellular respiration. He described how animals take in oxygen and release carbon dioxide, linking respiration to energy production in organisms.
- **Discovery of Anaerobic Respiration (19th Century):** Louis Pasteur discovered anaerobic respiration while studying yeast and fermentation. His work revealed that respiration could occur without oxygen, allowing certain organisms to survive in low-oxygen environments.

Respiration And Its Types

Riya and Kabir are walking in a park.

Respiration is a fundamental process by which energy is released/obtained by the breakdown of digested food. Respiration occurs in all the living cells. The process of respiration involves taking in oxygen (of air) into the cells, using it for releasing energy by burning food, and then eliminating the waste products (carbon dioxide and water) from the body. Most living things need oxygen to obtain energy from food. This oxygen reacts with the food (like glucose) present in the body cells and burns them slowly to release energy. This energy is used by the living things. The process of respiration can be written in the form of a word equation as follows:

$$\underset{\text{(food)}}{\textit{Glucose}} + \underset{\text{(form air)}}{\textit{Oxygen}} \xrightarrow[\text{(in body cells)}]{\textit{Respiration}} \textit{Carbon dioxide + Water + Energy}$$

During respiration, the energy-rich food stuffs such as **glucose and fructose** (called respiratory substrates) are changed in water and carbon dioxide, accompanied with the release of usable energy (**ATP** or adenosine triphosphate).

In fact, respiration is a kind of slow burning (or slow **combustion**) of food at ordinary temperature to produce energy.

There are two main parts in the process of respiration:

- Breathing (taking in oxygen from air and releasing carbon dioxide).
- Using oxygen in the cells of the organism for releasing energy from food (like two types of respiration: Aerobic respiration and anaerobic respiration.

The air which we 'breathe in' is transported to all the parts of the body and ultimately to each cell of the body. In the cells, oxygen (or air) brings about the breakdown of glucose (food). Since the process of respiration releases energy from food, takes place inside the cells of the body, it is also called cellular respiration. The process of cellular respiration is common to all the living organisms (humans, other animals as well as plants). It takes place in all the cells of an organism.

Aerobic and Anaerobic Respiration

Respiration usually takes place in the presence of oxygen. Respiration can, however, also take place in the absence of oxygen, though it is very rare. Based on whether oxygen is used up or not, there are two types of respiration: **Aerobic respiration and anaerobic respiration**.

These two types of respirations are discussed below:

Aerobic Respiration

Breakdown of food (glucose) into carbon dioxide and water to release energy using oxygen is called aerobic respiration. It is called aerobic respiration, because it uses 'air' which contains oxygen (aerobic means with air). In aerobic respiration, the glucose food is completely broken down into carbon dioxide and water with the use of oxygen, to release energy. It can be represented by the word equation as follows:

$$\text{Glucose (food)} \xrightarrow[\text{(Aerobic respiration)}]{\text{Oxygen}} \text{Carbon dioxide + water + energy}$$

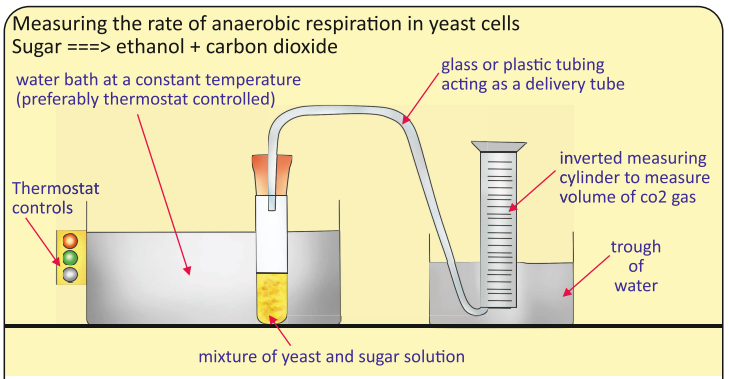
KEYWORDS

Glucose and Fructose: Glucose and fructose are simple sugars that serve as vital energy sources in biological systems.

ATP: ATP (adenosine triphosphate) is the primary energy carrier in cells, powering various metabolic processes.

Combustion: Combustion is a chemical reaction between a fuel and oxygen, releasing energy in the form of heat and light.

The energy released during aerobic respiration is used by the organisms. Most of the living organisms carry out aerobic respiration (by using oxygen of air), and such organisms are called aerobes. For example, humans, dogs, cats, lions, elephants, cows, buffaloes, goats, deer, birds, lizards, snakes, earthworms, frogs, fish and insects (such as cockroach, grasshopper, houseflies, mosquitoes. Humans and most of the plants carry out aerobic respiration by using oxygen of air (to obtain energy). Aerobic respiration produces much more energy because complete breakdown of glucose (food) occurs during aerobic respiration by the use of oxygen.



Energy through anaerobic respiration

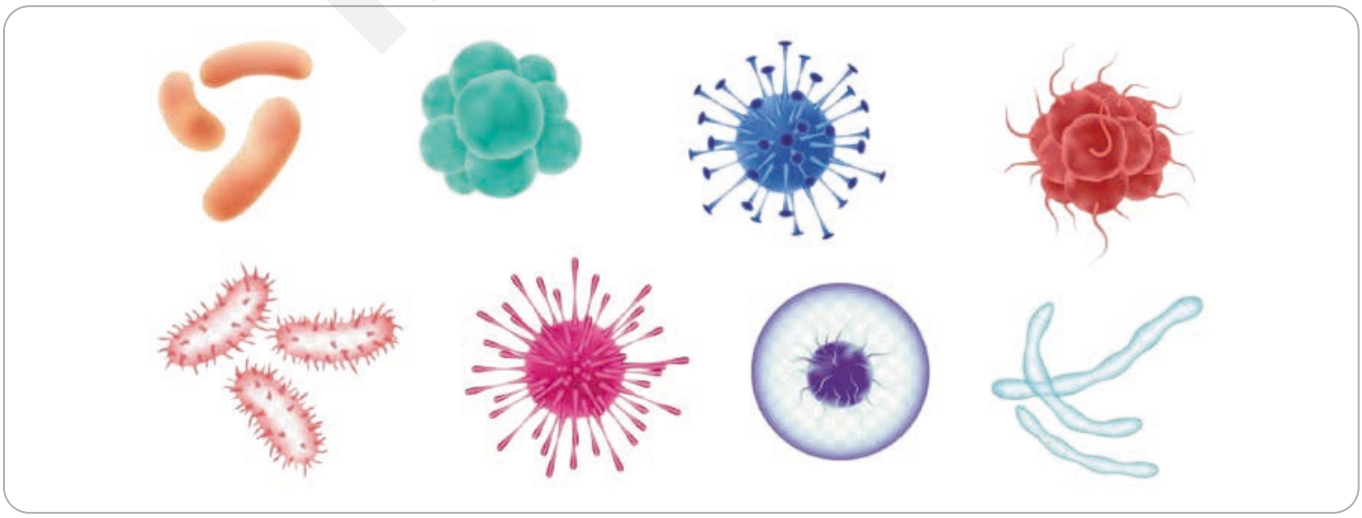
Anaerobic Respiration

When glucose is broken down in the absence of oxygen, it is called anaerobic respiration.

The animals and plants that can survive and obtain energy in the absence of oxygen are called anaerobes.

Anaerobic respiration occurs in yeast, some bacteria and some parasitic flatworms. In the absence of oxygen, glucose breaks down into ethyl alcohol and carbon dioxide.

The organisms which obtain energy by the process of anaerobic respiration (without using oxygen) are called anaerobes. Thus, yeast is an anaerobes. Hence, yeast can survive in the absence of oxygen.



Let's recall what we know

SCAN TO ACCESS

Take a Task

Watch Remedial

Apply Concept in Context

Apply

- Explain why respiration is essential for all living organisms.
- How do the two types of respiration (aerobic and anaerobic) differ, and where do they occur?

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking

Examine Further

Analyse

- Research how energy is produced in aerobic and anaerobic respiration. Which type of respiration produces more energy?
- What adaptations help organisms like yeast survive in anaerobic conditions?
- Compare the role of oxygen in aerobic respiration and the role of glucose in anaerobic respiration.

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking, Research

Self-Assessment Questions

Evaluate

- Define aerobic and anaerobic respiration and explain their importance.
- Identify examples of organisms that rely primarily on anaerobic respiration. Why do they use this type of respiration?

Skills Covered: Evaluation, Logical thinking

Creative Insight

Create

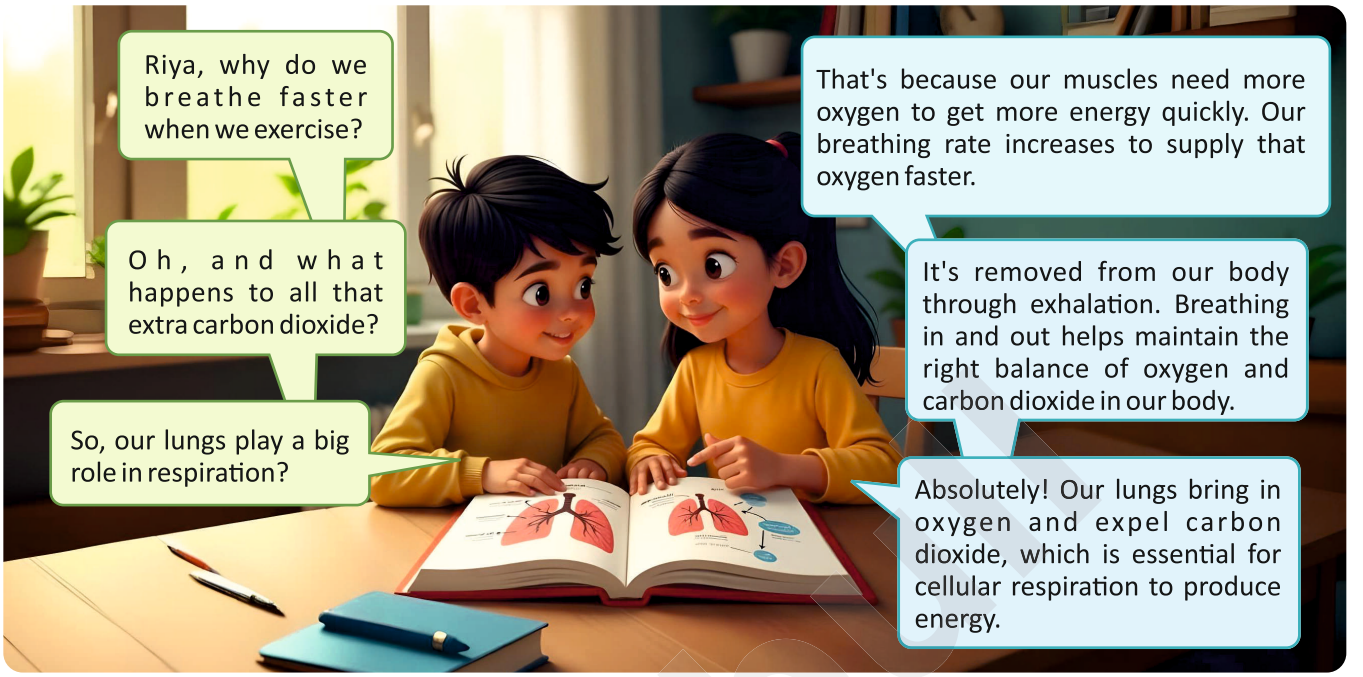
List ten examples of organisms that use aerobic and anaerobic respiration and categorize them. Present this information creatively in a table or chart with columns for organism name, type of respiration, and habitat.

Skills Covered: Creativity, Critical and logical thinking, Brainstorming, Observation, Organization

Bloom's Taxonomy

Respiration in Humans

Riya and Kabir are studying human biology at home.



Breathing

Breathing can be defined as the process by which air, i.e. rich in oxygen is taken inside the body, an organism and air rich in carbon dioxide is expelled from the body (with the help of breathing organs.) Different organisms have different organs for breathing depending on their structure and oxygen requirements. The organ through which breathing in human beings take place is called 'lungs'. The taking in of air rich in oxygen into the body during breathing is called 'inhalation' and giving out (or expelling) the air rich in carbon dioxide is called 'exhalation'. Both, inhalation and exhalation take place regularly during breathing. We know that air contains oxygen, so, when we breathe in air which is utilised by our body (in order to break-down food and produce energy). We breathe air through our nose (or sometimes even through the mouth). Now, if we close our nostrils and mouth tightly, we soon start feeling uneasy and cannot hold our breath even for one minute. This shows how essential breathing of air is to keep us alive and when we release the breath after holding it for sometime, we have to breathe deeply. Breathing is a continous process which goes on all the time and throughout our life and that of other animals as well as plants. The mountaineers carry oxygen cylinders with them for breathing because the amount of air available to a person for breathing at high altitude is much less than that is available on the ground.

Did You Know ?

A breath means 'one inhalation plus one exhalation'.

Breathing Rate

We have just learnt that a breath means 'one inhalation plus one exhalation'. The number of times a person breathes in one minute is called breathing rate. On an average, an adult human being at rest, breathes in and out 15 to 18 times in a minute. So, the average breathing rate in an adult human being at rest is 15-18 times per minute.

The breathing rate of a person changes according to the oxygen requirements of the body. For example, the breathing rate of a person is the slowest when he is sleeping because minimum energy is required by the body during sleep which can be provided by a slow rate of breathing. The breathing rate of a person increases with increased physical activity (like exercise, running, weight lifting, etc.) When the breathig rate increases, greater amount of air goes into the lungs, the blood can absorb oxygen at a faster rate. Thus, faster breathing supplies more oxygen to the body **cells** for producing more energy (by the rapid breakdown of food) needed by doing heavy physical exercise, etc. During heavy physical exercise, the breathing rate is about 25 per minute (or even more).

When we inhale air, it enters our **nostrills**, passes through our nasal passage and windpipe, and reaches our lungs. Our two lungs hang in an airtight space in our body called 'chest cavity'. Around the sides of the chest cavity is the rib cage with sheets of muscles between the ribs. The **rib cage** encloses the lungs in it. At the bottom of the chest cavity is a curved sheet of muscle called diaphragm. Diaphragm forms the floor of the chest cavity. Breathing involves the movements of the rib cage and the diaphragm.

Did You Know ?

Women breathe slightly faster than men. Breathing rate of a person is not constant always.

KEYWORDS

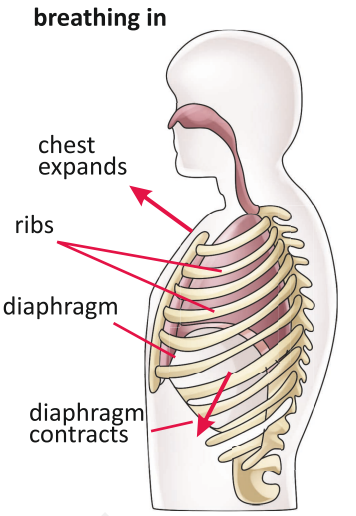
Cells: Cells are the basic building blocks of all living organisms, performing essential life processes.

Nostrils: The nostrils allow air to enter the respiratory system, aiding in breathing and smelling.

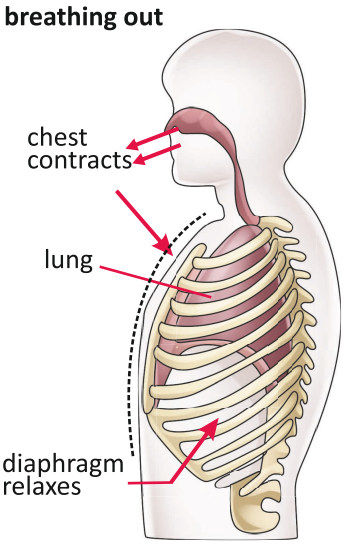
Rib Cage: The rib cage protects vital organs like the heart and lungs while providing structure to the upper body.

Inhalation

During inhalation, the ribs move upwards and outwards and the diaphragm moves down. This increases the volume of thoracic cavity. The lungs being elastic also increase decreases. Air from the atmosphere having higher pressure rushes into lungs through nostrils and air passages and the lungs get filled with fresh air.



(a): Inspiration/Inhalation



(b): Expiration/Exhalation

Exhalation

During exhalation the ribs move downward and inward and the diaphragm moves up. When the ribs and diaphragm return to their original position the volume of thoracic cavity decreases and so also the lungs. This increases the air pressures inside the lungs and the air from the lungs is pushed out.

Activity

Aim : To demostrate the mechanism of breathing:

Materials Required : Transparent plastic bottle, Y-shaped glass or plastic tube, 2 balloons, plasticine, rubber sheet, rubber band.

Method:

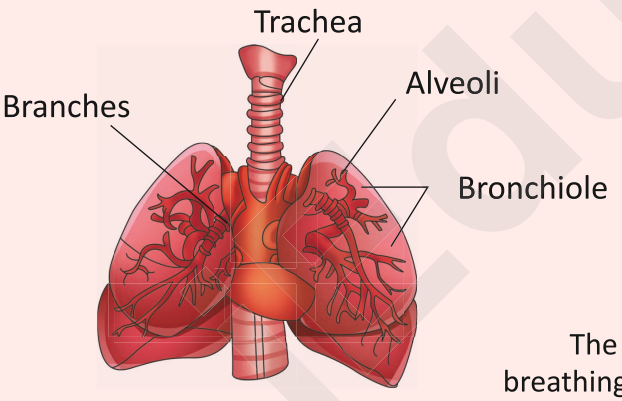
- Take a wide transparent plastic bottle (a soft drink plastic bottle will do) and get someone to cut off its bottom.
- Make a hole through the bottle's cap.
- Fix and tie two deflated balloons at the two forked ends of a y-shaped glass or plastic tube.
- Introduce the tube fitted with the two deflated balloons from cut end of the bottle and pass the tube through the hole in the cap. Use plasticine to seal the cap and make it air tight.
- A thin rubber sheet is tied around the open base of the bottle using a large rubber band. Your apparatus is ready.
- In this apparatus, the space inside the bottle represents the chest cavity, the balloons represent the lungs, whereas the rubber sheet represents the diaphragm.

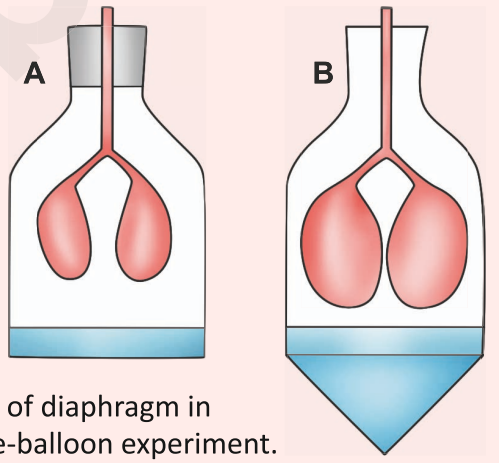
Observation

(i) When you pull the rubber sheet downwards, the space inside the bottle increases lowering the air pressure inside the bottle. The air from outside rushes in through y-shaped tube into balloons, due to which the balloons get inflated (i.e. their size increases). This is how you inhale air during breathing.

(ii) When you push the rubber sheet up, the space inside the bottle decreases. This pushes out the air inside the balloons through the tube, due to which, the balloons get deflated (their size decreases). This is how you exhale air during breathing.

Conclusion : The action of rubber sheet in this activity shows, how we inhale and exhale air during breathing with the help of the downward and upward movement of the diaphragm in our body. When the diaphragm moves downward during inhaling, the lungs are filled with air. But when the diaphragm moves upward during exhaling, then the air is forced to go out of the lungs. During the process of respiration, when glucose (food) is broken down to release energy, then some of the oxygen of inhaled air is used up, whereas carbon dioxide and water are produced. This is why, the exhaled air contains less of oxygen but more of carbon dioxide and more of water vapour. The amount of oxygen, carbon dioxide and water vapour in inhaled air and exhaled air is given below:





The action of diaphragm in breathing bottle-balloon experiment.

Inhaled Air	Exhaled Air
Oxygen : 21%	Oxygen : 16.4%
Carbon dioxide: 0.04%	Carbon dioxide: 4.4%
Water vapour : Little	Water vapour : A lot

Activity

Aim To: show that carbon dioxide is produced during respiration.

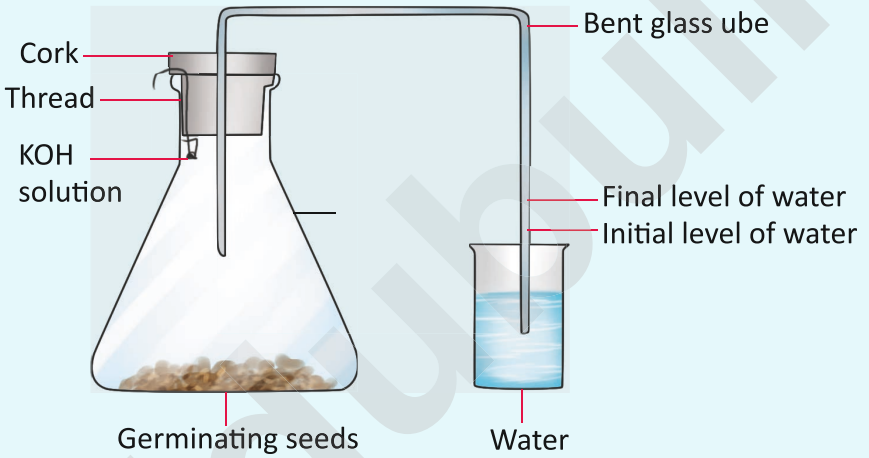
Materials Required: Glass or plastic bottle, lime-water and straw.

Method:

1. Take a slender, clean glass or plastic bottle. Make a hole in its lid and fix it on the bottle.
2. Pour some freshly prepared lime water in the glass or plastic bottle. Insert a plastic straw through the hole in the lid in such a way that it dips in lime water.
3. Blow gently through the straw a few times.

Observation: The lime water in the glass or plastic bottle turns milky.

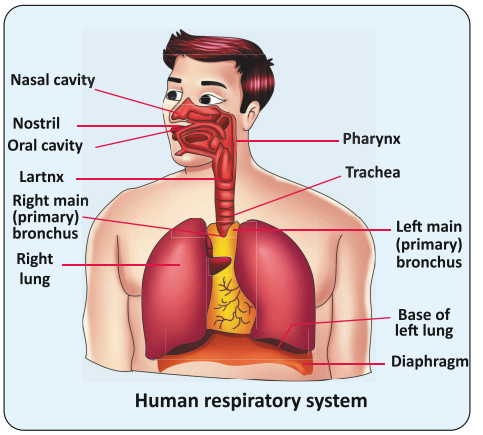
Conclusion: The exhaled air contains carbon dioxide gas because carbon dioxide gas turns lime water milky. So, we conclude that carbon dioxide gas is produced during respiration.



Carbon dioxide is released during respiration.

Respiration in Humans

The respiratory system in human beings consists of the following organs: nose, pharynx, trachea, bronchi and lungs.



Human respiratory system

Nose: Nose encloses a nasal cavity which opens to the outside through two nostrils. Nose has fine hair and a sticky liquid, mucus, produced by the inner lining of the nose, both of the serve to filter the air entering the nasal cavity.

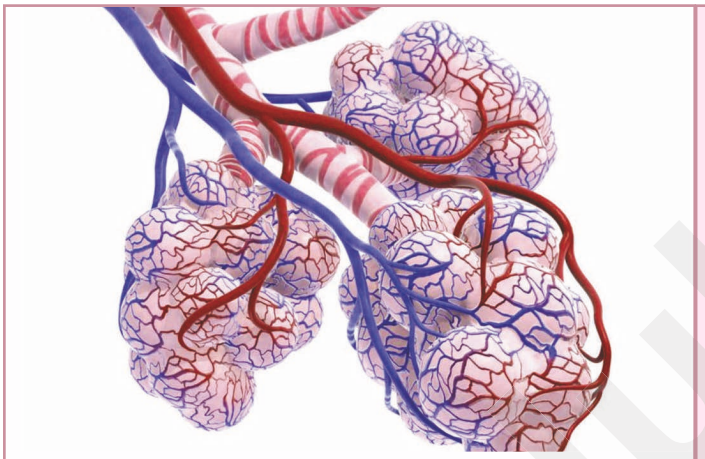
- Fine hair and mucus present in the nose prevent the entry of dust particles and germs into the respiratory system.
- Mucus moistens the air in the nasal cavity.
- Blood circulation in the nose warms the air.

From the nasal cavity air passes into the pharynx which has two openings in its lower part, one opening into the oesophagus and the other into the windpipe or trachea. The opening of the pharynx into the trachea is called glottis.

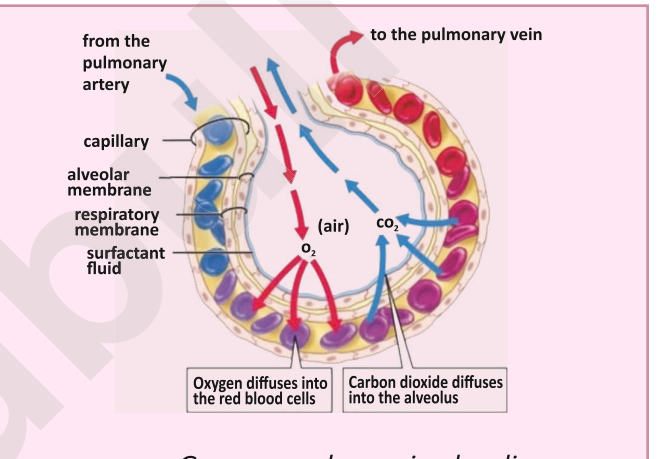
Trachea: Trachea or windpip is a long cylindrical tube supported by cartilaginous rings , which prevent it from collapsing.

Bronchi : Trachea branches into two tubes called bronchi, one of which enters each lungs. Inside the lung, bronchi branch into fine branches called bronchioles.

Lung : A pair of lungs are the organs of gaseous exchange in human beings. Finest branches of bronchioles end in tiny sacs called alveoli or air sacs. Alveoli have a very thin wall and are surrounded by a network of fine capillaries. Exchange of gases between the alveoli and the blood capillaries takes place across their thin walls. Thus, alveoli are the structures responsible for gaseous exchange. Oxygen present inside the alveoli diffuses across the walls of the alveoli and the capillaries into the blood in the capillaries.



The alveoli



Gaseous exchange in alveoli

In a similar manner, carbon dioxide present inside the blood capillaries difusses into the alveoli. The carbon dioxide thus collected is breathed out through the nose. Blood carries the oxygen received from the lungs to different parts of the body. Blood contains Red Blood Cells (RBC) which contain the red pigment called haemoglobin. Haemoglobin gives the blood its red colour. Haemoglobin combines with oxygen and carries it to all the cells.

Sneezing

Air around us is polluted with pollen, smoke particles, dust, etc. Normally when we inhale, these unwanted particles are trapped in the hair present in the nasal passages. Sometimes, these particles are not trapped in the hair and irritate the lining of the passage. This causes sneezing.

Did You Know ?

Smoking tobacco in the form of cigarette, beedi or cigar damages our lungs gradually and causes ill health. Smoking also causes lung cancer.

Let's recall what we know

SCAN TO ACCESS

Take a Task

Watch Remedial

Bloom's Taxonomy

Apply Concept in Context

Apply

- Explain why the human respiratory system is well-adapted for gas exchange.
- How does breathing rate change during exercise, and why?

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking

Examine Further

Analyse

- Research the role of alveoli in the human respiratory system. How do they facilitate gas exchange?
- Compare the breathing processes of humans and aquatic animals like fish.

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking, Research

Self-Assessment Questions

Evaluate

- Define breathing and explain its role in human respiration.
- Identify the main organs involved in the human respiratory system and describe their function.

Skills Covered: Evaluation, Logical thinking

Creative Insight

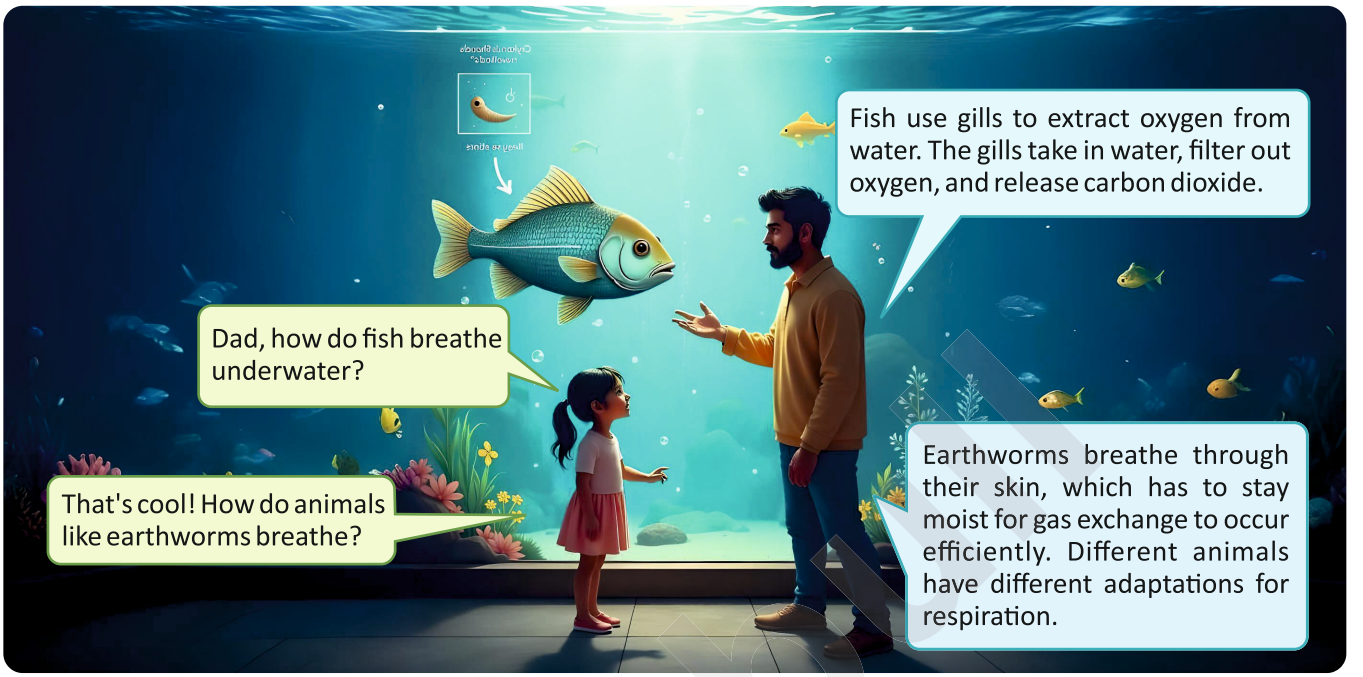
Create

Create a diagram of the human respiratory system. Label each part and explain its function in the process of breathing and respiration.

Skills Covered: Creativity, Critical and logical thinking, Brainstorming, Observation, Organization

Respiration in Animals

Riya and her father are visiting an aquarium.

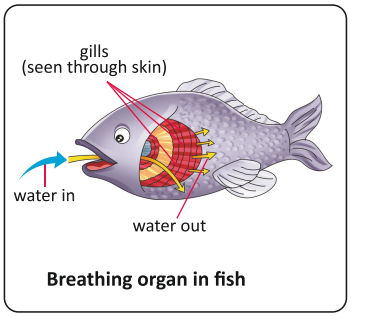


Different animals respire through different parts of their body. Respiration in some common animals is described below:

1. Respiration in Fish

Fish has special organs of breathing called gills found on both the sides of its head. The fish breathes by taking in water through its mouth and sending it over the gills. Gills are well supplied with blood vessels.

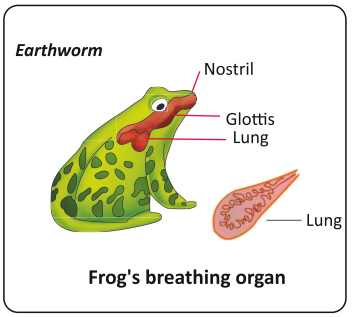
The blood vessels of the gills extract dissolved oxygen from this water and send it to all parts of the body. This oxygen is utilised in respiration to produce energy and carbon dioxide. This carbon dioxide is brought back by the blood into the gills for expelling into the surrounding water. Some other aquatic animals like prawn, crab and fresh water mussel also respire through gills or similar structures.



Breathing organ in fish

2. Respiration in Earthworms and Frogs

The earthworms breathe through their skin. The skin of an earthworm is thin and moist. Thus, gases can easily exchange through the earthworm's body through its skin. The skin of earthworm has a good blood supply so, the earthworm absorbs the oxygen (of air) needed for respiration through its thin and moist skin. Frogs have lungs for breathing. They can also breathe through their moist skin. Thus, frog is an animal which can breathe through lungs as well as its moist skin. They breathe through lungs when on land and through skin when in water.

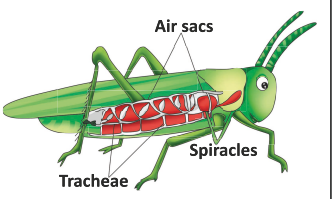


Frog's breathing organ

3. Breathing in cockroach

Insects such as cockroaches and houseflies have small openings, called spiracles, on the side of their body. These spiracles are connected to tubes called tracheae. The tracheae further branch into smaller tubes that are in contact with the body cells. The air enters through the spiracles and passes through tracheae and their branches.

The exchange of gases takes place between the body cells and the smaller tubes.



Tracheal system of an insect

Let's recall what we know

SCAN TO ACCESS

Take a Task

Watch Remedial

Apply Concept in Context

Apply

- Provide two examples of animals with specialized respiratory structures. How do these structures help them survive?
- How does respiration in aquatic animals differ from respiration in land animals?

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking

Examine Further

Analyse

- Research the respiratory process in animals like cockroaches and frogs. How are they adapted for their environments?
- Compare the respiration process in earthworms, frogs, and fish. How do different respiratory systems match the needs of different habitats?

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking, Research

Self-Assessment Questions

Evaluate

- Define the respiration process in fish and explain the role of gills.
- Compare the respiratory adaptations of earthworms and cockroaches.

Skills Covered: Evaluation, Logical thinking

Creative Insight

Create

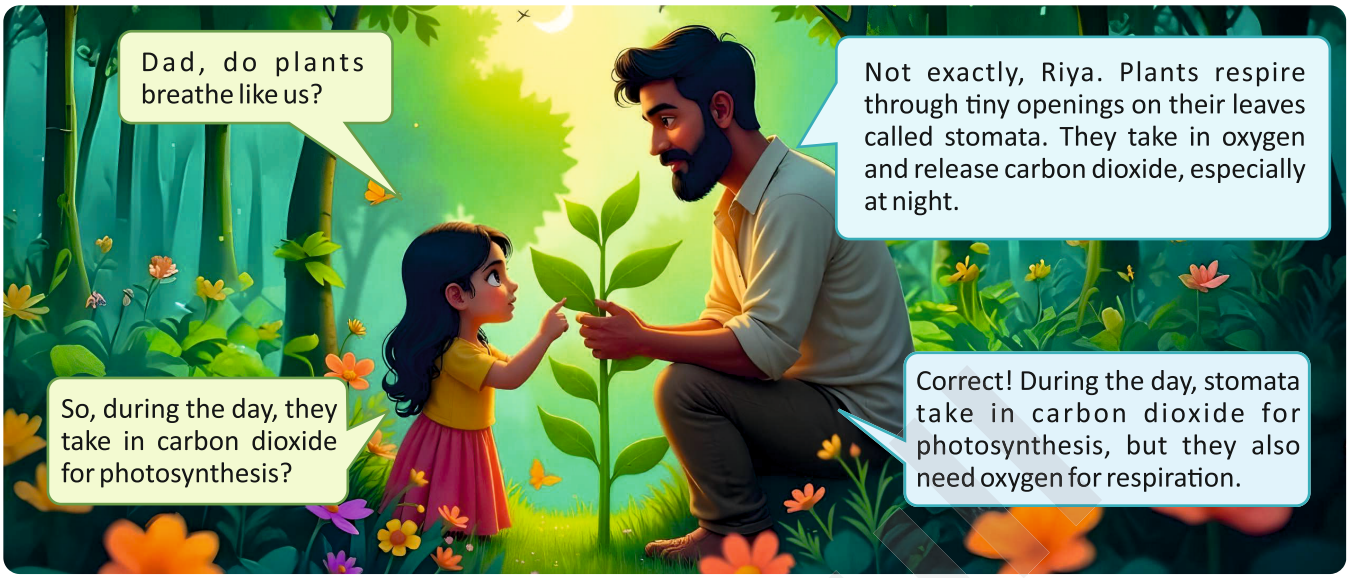
List ten animals with different respiratory adaptations and categorize them (e.g., skin breathing, gills, lungs). Create a table or chart with columns for animal name, habitat, and respiratory adaptation.

Skills Covered: Creativity, Critical and logical thinking, Brainstorming, Observation, Organization

Bloom's Taxonomy

Respiration in Plants

Riya and Karan are in their garden, looking at the leaves of a plant.



Respiration in Plants

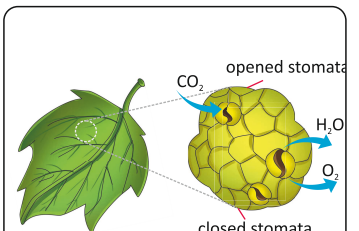
Plants respire like all other organisms. Each plant cell uses glucose and oxygen and releases carbon dioxide, water and energy. But during the daytime, carbon dioxide released by respiration is used for photosynthesis and oxygen produced during photosynthesis is utilised for respiration. So, plants do not take oxygen during the day. But at night, plants also take oxygen from the atmosphere and give out carbon dioxide.

- Plants do not have respiratory organs to obtain oxygen from atmosphere.
- Each part of a plant can independently take in oxygen from the surrounding air and give out carbon dioxide.
- Transport of gases in plants takes place by diffusion only.
- Different parts of a plant have different methods of obtaining oxygen and releasing carbon dioxide.

1. Respiration in Leaves

The exchange of gases (oxygen and carbon dioxide) in the leaves during respiration takes place through stomata. This happens as follows:

Oxygen from air enters into a leaf through stomata and reaches all the cells by the process of diffusion. This oxygen is used in respiration in the cells of the leaf. The carbon dioxide is produced during respiration diffuses out from the leaf into the air through the same stomata. So, we can also say that the plants breathe through the tiny pores in their leaves called stomata.



Stomata in the leaves of leaf surface

2. Respiration in Roots

The roots of a plant have a very large number of tiny hair on them called 'root hair'. Air is present in between the particles of soil. The root hair are in contact with the air in the soil particles.

Oxygen from air in soil particles diffuses into root hair and reaches all the cells of the root, where it is utilized in respiration. Carbon dioxide produced during respiration, goes out through the root hair by the process of diffusion. If a potted plant is overwatered for a long time, then the plant may ultimately die. Too much water expels all the air from in-between the soil particles. Due to this reason, oxygen is not available to the roots for respiration. Due to suffocation, the plant may die.

Let's recall what we know

SCAN TO ACCESS

Take a Task

Watch Remedial

Apply Concept in Context

Apply

- Provide two examples of how stomata help plants in respiration and photosynthesis.
- How do respiration and photosynthesis balance each other in plants?

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking

Examine Further

Analyse

- Research the structure of stomata and how they regulate gas exchange in plants.
- Compare the process of respiration in plants with respiration in animals.
- How does respiration in leaves adapt to different environmental conditions?

Skills Covered: Critical and logical thinking, Brainstorming, Applicative thinking, Research

Self-Assessment Questions

Evaluate

- Define respiration in plants and explain the role of stomata.
- Compare the process of respiration in plants during the day and night.

Skills Covered: Evaluation, Logical thinking

Creative Insight

Create

List ten examples of plants with unique leaf structures. Categorize them based on their stomatal patterns and environmental conditions. Create a table or chart with columns for plant name, habitat, and stomatal adaptation.

Skills Covered: Creativity, Critical and logical thinking, Brainstorming, Observation, Organization

Bloom's Taxonomy

SUMMARY

Respiration is the process of releasing energy from food in all living organisms. It involves gas exchange (oxygen and carbon dioxide) and glucose breakdown. Aerobic respiration occurs with oxygen, breaking down glucose into carbon dioxide and water to produce energy.

Anaerobic Respiration

Anaerobic respiration occurs in the absence of oxygen. It is less efficient than aerobic respiration and produces less energy. Anaerobic respiration takes place in some microorganisms, such as yeast, and in muscle cells during intense exercise when oxygen supply is limited. The process results in the production of lactic acid or alcohol, along with a small amount of energy.

Respiration in Humans

The human respiratory system is responsible for breathing and gas exchange. It includes the nose, trachea, bronchi, lungs, and diaphragm. Breathing involves inhalation (taking in oxygen) and exhalation (releasing carbon dioxide). Oxygen is transported to body cells, where it is used for aerobic respiration to release energy. The lungs contain tiny air sacs called alveoli, which facilitate gas exchange between the air and the blood. During exercise, the breathing rate increases to meet the higher oxygen demand of muscle.

Respiration in Animals

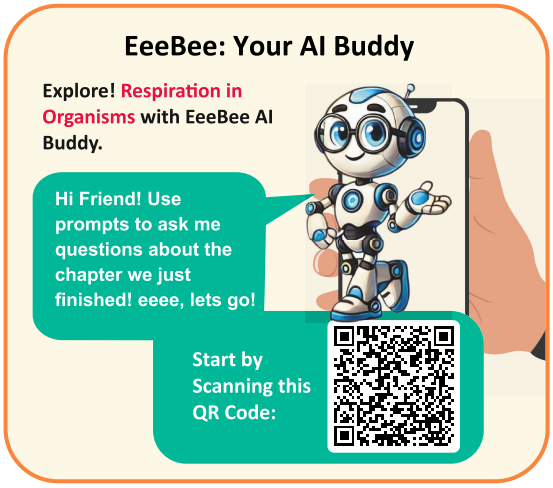
Different animals have different respiratory adaptations based on their habitats. Fish use gills to extract oxygen from water, while earthworms breathe through their moist skin. Frogs use both lungs and skin for respiration, depending on whether they are in water or on land. Cockroaches have a tracheal system that directly delivers oxygen to their cells. These diverse adaptations enable animals to efficiently obtain oxygen and release carbon dioxide, ensuring their survival in various environments.

Respiration in Plants

Plants also undergo respiration to obtain energy. They have tiny openings on their leaves called stomata, which facilitate gas exchange. During the day, plants take in carbon dioxide for photosynthesis and release oxygen, but they also require oxygen for respiration. At night, when photosynthesis stops, plants continue to take in oxygen through stomata for respiration. Respiration in plants occurs in all parts, including leaves, stems, and roots, ensuring that energy is available for growth.

Breathing and Cellular Respiration

Breathing is the physical intake of oxygen and release of carbon dioxide, while cellular respiration breaks down glucose to produce energy. In humans and animals, breathing supplies oxygen for respiration. In plants, respiration and photosynthesis balance oxygen and carbon dioxide. Respiration supports life by providing energy for growth, reproduction, and survival in all organisms.



EXERCISE

That turn curiosity into confidence—let's begin!

Gap Analyzer™
Take a Test

A. Choose the correct answer.

1. Which of the following best describes aerobic respiration?
   (a) Respiration in the absence of oxygen ☐ (b) Respiration in the presence of oxygen ☐
   (c) Producing lactic acid from glucose ☐ (d) Respiration without energy production ☐
2. In humans, which part of the respiratory system is responsible for gas exchange?
   (a) Trachea ☐ (b) Bronchi ☐
   (c) Alveoli ☐ (d) Diaphragm ☐
3. What role do gills play in the respiration of fish?
   (a) Extracting oxygen from water ☐ (b) Breaking down food ☐
   (c) Producing glucose ☐ (d) Storing carbon dioxide ☐
4. Which of the following organisms uses stomata for respiration?
   (a) Human ☐ (b) Amoeba ☐
   (c) Plant ☐ (d) Fish ☐
5. Which type of respiration is less efficient and produces less energy?
   (a) Aerobic respiration ☐ (b) Anaerobic respiration ☐
   (c) Photosynthesis ☐ (d) External respiration ☐

B. Fill in the blanks.

1. The process of obtaining energy from food in the presence of oxygen is called _____ respiration.
2. In humans, gas exchange occurs in tiny air sacs called _____.
3. Fish use _____ to extract oxygen from water.
4. Plants have tiny openings called _____ on their leaves for gas exchange.
5. The type of respiration that takes place without oxygen is called _____ respiration.

C. Write True or False.

1. Aerobic respiration takes place in the presence of oxygen. _____
2. Earthworms use their lungs for respiration. _____
3. Stomata are responsible for gas exchange in plants. _____
4. Anaerobic respiration produces more energy than aerobic respiration. _____
5. Alveoli in humans are involved in gas exchange. _____

D. Define the following terms.

1. Aerobic respiration
2. Anaerobic respiration
3. Alveoli
4. Stomata
5. Gills

E. Match the columns.

Column A	Column B
1. Aerobic respiration	(a) Moist skin breathing
2. Gills	(b) Gas exchange in plants
3. Earthworm	(c) Oxygen needed for energy
4. Stomata	(d) Fish respiration structure
5. Alveoli	(e) Human gas exchange site

F. Give reasons for the following statements.

1. Aerobic respiration is more efficient than anaerobic respiration.
2. Fish use gills to breathe underwater.
3. Stomata are important for gas exchange in plants.
4. Alveoli are well-suited for gas exchange in humans.
5. Earthworms need to keep their skin moist for respiration.

G. Answer in brief.

1. What is aerobic respiration?
2. How do fish extract oxygen from water?
3. Explain the role of stomata in plant respiration.
4. Why is anaerobic respiration less efficient than aerobic respiration?
5. How does breathing help in respiration in humans?

H. Answer in detail.

1. Explain the process of aerobic and anaerobic respiration with examples.
2. Describe the structure and function of the human respiratory system.
3. How do stomata facilitate gas exchange in plants?
4. Discuss the respiratory adaptations in different animals like fish, earthworms, and frogs.
5. Explain how gas exchange occurs in the alveoli of humans.

NEP Corner

Know about NEP 2020

Choose Your Own Path!

No need to worry about being "stuck" in one career. NEP lets you explore multiple entry and exit points in higher education.

Skill-based Activity

Curious Minds at Work

STEM

Observe the breathing process of an animal, such as a fish or earthworm. Write a question about how its respiratory system is adapted to its environment. Using the scientific method, describe the steps you would take to answer your question.

Skills Covered: Critical and logical thinking, Brainstorming, Analytical thinking, Problem-solving, Curiosity, Observation, Decision-making skills

Wonders of Respiration

Art

Create a detailed sketch showing the respiratory system of a fish or a diagram of stomata in leaves. Write a description explaining how gas exchange occurs. Present your work to the class.

Skills Covered: Creativity, Critical and logical thinking, Applicative thinking

Comparing Respiratory Systems

Group Activity

In groups, create a chart comparing the respiratory systems of different organisms (e.g., humans, fish, earthworms, plants). Present your findings, highlighting similarities and differences.

Skills Covered: Critical and logical thinking, Brainstorming, Teamwork, Communication, Applicative thinking, Decision-making skills

Technology in Focus

Case to Investigate

Research how knowledge of respiration is applied in technology, such as in designing better ventilators or improving air quality. Write a short report on how these advancements benefit humans.

Skills Covered: Critical and logical thinking, Brainstorming, Research, Applicative thinking

Sustainable Respiration

Aligning with SDGs

Research a program or initiative that focuses on improving air quality and plant respiration. Highlight its key features and how it aligns with sustainable development goals. Present your findings to the class.

Aligned with: SDG 3 – Good Health and Well-being, SDG 13 – Climate Action

Skills Covered: Critical and logical thinking, Brainstorming, Research, Problem-solving, Ethics

Mapping Respiration

Integrated Learning

Using the Internet, create a map showing regions where different plants and animals have adapted respiratory systems. Explain how these adaptations help them survive in their specific environments.

Integrated Learning: Geography and Biology

Skills Covered: Critical and logical thinking, Brainstorming, Analytical thinking, Applicative thinking