9

"Biology gives you a brain. Life turns it into a mind."

– Jeffrey Eugenides

Life Processes in Animals

The Big Question

Have you ever wondered how your body gets the energy to run, play, and even think? Or how a cow can spend hours chewing grass, and a fish can breathe underwater? All living beings, from the smallest insect to the largest whale, perform essential activities to stay alive. These activities are called life processes. What are these amazing processes, and how do different animals carry them out? Let's embark on a fascinating journey to discover the secrets of life!

Meet EeeBee.AI

Hello, young scientists! I'm EeeBee, your curious companion for this chapter. I love exploring how things work, especially in the living world. I'll be here to ask questions, share interesting facts, and help you understand the amazing life processes that keep us all going. **Let's dive in!**

Learning Outcomes

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

- **Describe:** The process of digestion in humans, identifying the organs involved and their functions.
- **Explain:** How different animals, like ruminants and birds, adapt their digestive systems to their diet.
- **Analyze:** The importance of a healthy digestive and respiratory system for overall well-being.

From Last Year

- The Digestive System

Science Around You

From the food we eat to the air we breathe, life processes are happening all around us, every second of every day. Understanding these processes helps us appreciate the complexity of living organisms, including ourselves. It also helps us understand health issues, develop new medicines, and even design technologies inspired by nature, like artificial organs or advanced filtration systems.

NCF Curricular Goals and Competencies

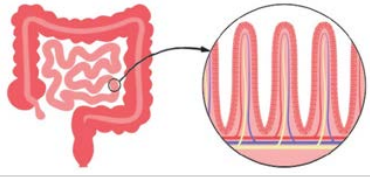
CG 9.1 – Identify key processes like digestion, respiration, circulation, and excretion.
CG 9.2 – Understand the structure and function of human organ systems involved in these processes.

Life Processes in Animals

Mind Map

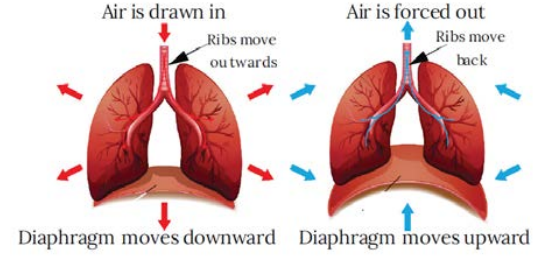
Nutrition in Animals

- **Digestion: Food** → simple absorbable form.
- **Humans:**
  - ✓ **Mouth:** chewing, salivary amylase.
  - ✓ **Oesophagus:** peristalsis.
  - ✓ **Stomach:** churns, gastric juice (HCl, pepsin, mucus).
  - ✓ **Small intestine:** bile (fats), pancreatic juice (carbs, proteins, fats), villi absorb.
  - ✓ **Large intestine:** absorbs water & salts.
  - ✓ Rectum/Anus: egestion.
- **Other Animals:**
  - ✓ **Ruminants:** 4-chambered stomach, cud chewing.
  - ✓ **Birds:** gizzard grinds food.



Respiration in Animals

- **Breathing:** Inhale O_2, exhale CO_2.
- **Cellular Respiration:** Glucose + O_2 → CO_2 + H_2O + Energy (ATP).
- **Humans:**
  - ✓ Nostrils filter, trachea with cartilage, lungs → bronchi → bronchioles → alveoli.
  - ✓ **Inhalation:** diaphragm ↓, ribs up/out → air in.
  - ✓ **Exhalation:** diaphragm ↑, ribs in/down → air out.
- **Other Animals:**
  - ✓ **Lungs:** mammals, birds, reptiles.
  - ✓ **Gills:** fish.
  - ✓ **Moist skin:** earthworms, frogs.
  - ✓ **Tracheae:** insects.



In Focus

- Nutrition in Animals
- Respiration in Animals

Introduction

Nutrition is the process by which living organisms obtain and use food for energy, growth, and repair. Unlike plants, animals cannot make their own food and depend on other organisms for nutrition. The food they eat contains complex substances like carbohydrates, proteins, and fats, which cannot be used directly. These must be broken down into simpler forms through a process called digestion. This section explores how different animals, especially humans, digest food to extract energy and nutrients.

From History's Pages

About 200 years ago, scientists started to clearly study the difference between living and non-living things. In the early 1800s, they used better microscopes to see that all living things are made of tiny parts called cells. At the same time, they observed that non-living things like stones and water do not have cells and do not grow or reproduce. A scientist named Lamarck also began to talk about how living things can change over time. These studies helped people understand that movement alone does not mean something is alive. This was the beginning of how we now classify and study the living world in science.

Nutrition in Animals

Digestion in Human Beings

The human digestive system is a long, muscular tube called the **alimentary canal**, extending from the mouth to the anus. It is supported by several associated glands that secrete digestive juices. The process of digestion involves both mechanical and chemical breakdown of food.

- **Mouth and Buccal Cavity:** Digestion begins here.

  The mouth is where food is ingested. Teeth perform **mechanical digestion** by chewing and grinding food into smaller pieces. The tongue helps in mixing food with saliva.
- **Saliva:** Secreted by salivary glands, saliva contains an enzyme called salivary amylase (or ptyalin) which begins the

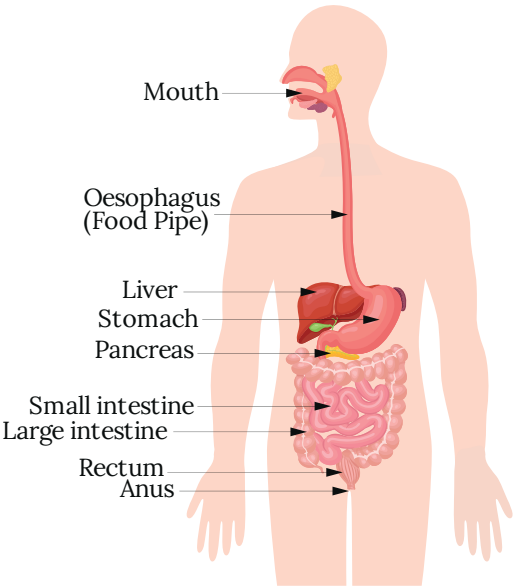


Fig. 9.1 Digestion in Human Beings

chemical digestion of carbohydrates (starch) into simpler sugars. Saliva also moistens food, making it easier to swallow.

- **Oesophagus (Food Pipe):** A muscular tube connecting the mouth to the stomach.

  Food moves down the oesophagus not by gravity alone, but by a wave-like muscular contraction called **peristalsis**. This ensures food moves even if you eat while standing on your head!

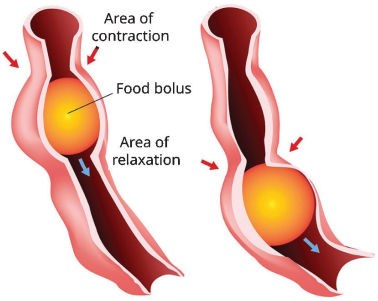


Fig. 9.2 Peristalsis (Food Pipe)

- **Stomach:** A J-shaped muscular bag.

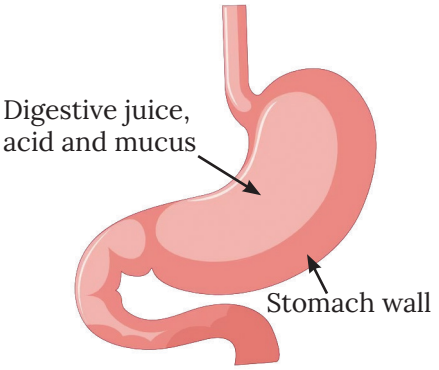


Fig. 9.3 Stomach

The stomach churns food, mixing it thoroughly with gastric juices. Gastric juice contains hydrochloric acid (HCl), pepsin (an enzyme), and mucus. HCl kills harmful bacteria, activates pepsin, and provides an acidic medium for pepsin to act. Pepsin begins the digestion of proteins. Mucus protects the stomach lining from the strong acid.

- **Bile (from Liver):** Stored in the gallbladder, bile emulsifies fats (breaks large fat globules into smaller ones), making them easier for enzymes to digest. It also neutralizes the acidic chyme from the stomach.

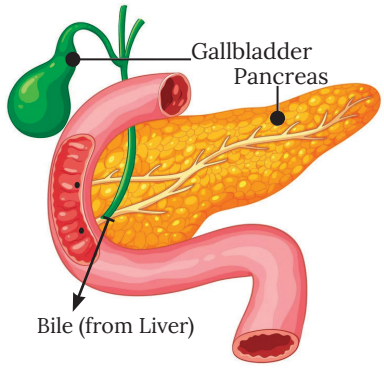


Fig. 9.4 Pancreas

- **Pancreatic Juice (from Pancreas):** Contains enzymes for digesting carbohydrates (amylase), proteins (trypsin), and fats (lipase).

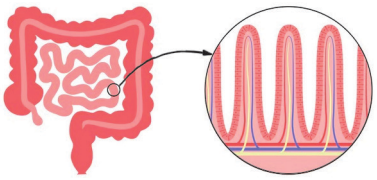


Fig. 9.5 Villi in Small Intestine

- **Small Intestine:** The longest part of the alimentary canal (about 6 meters in adults).

  This is the primary site for complete digestion and absorption of nutrients. It receives secretions from the liver (bile) and pancreas (pancreatic juice), as well as intestinal juice from its own walls.

  Intestinal Juice: Contains enzymes that complete the digestion of carbohydrates into glucose, proteins into amino acids, and fats into fatty acids and glycerol.

  Absorption: The inner lining of the small intestine has millions of tiny, finger-like projections called **villi** (singular: villus). Villi greatly increase the surface area for efficient absorption of digested nutrients into the bloodstream.

- **Large Intestine:** Wider and shorter than the small intestine (about 1.5 meters).

  Its main function is to absorb water and some salts from the undigested food material. This process converts the liquid waste into semi-solid **stool**.

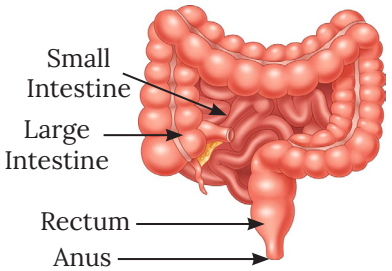


Fig. 9.6 Large Intestine

- **Rectum and Anus:**

  The rectum stores the semi-solid stool temporarily. The anus is the opening through which the undigested waste material (faeces) is expelled from the body, a process called **egestion**.

Digestion in Ruminants

Ruminants are herbivorous animals like cows, buffaloes, and goats that primarily eat grass. Grass is rich in cellulose, a complex carbohydrate that is difficult to digest. Ruminants have a specialized four-chambered stomach, the largest chamber being the **rumen**.

- **Rumination:** Ruminants first partially chew their food and swallow it into the rumen. In the rumen, bacteria and other microorganisms partially digest the cellulose. This partially digested food, called **cud**, is then brought back to the mouth for thorough chewing (rumination). After re-chewing, the cud is swallowed again, passing to other stomach chambers for further digestion.

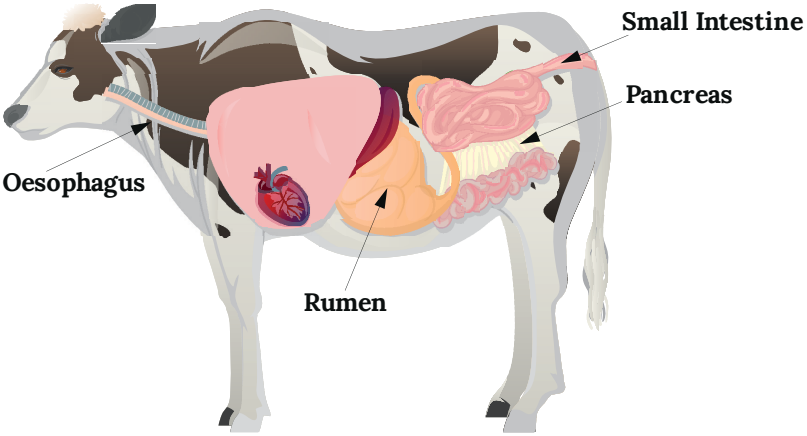


Fig. 9.7 Digestion in Ruminants

Digestion in Birds

Birds lack teeth, so their digestive system is adapted for processing unchewed food. They have a specialized structure called a **gizzard**.

- **Gizzard:** A muscular organ with thick walls, often containing grit (small stones) swallowed by the bird. The gizzard mechanically grinds and crushes food, compensating for the absence of teeth.

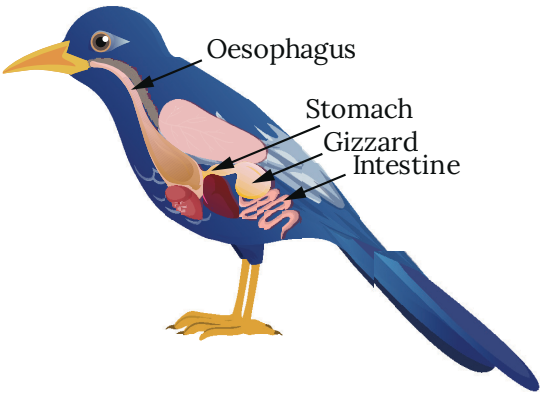


Fig. 9.8 Digestion in Birds

Examples and Applications

1. **Lactose Intolerance:** Many individuals experience discomfort after consuming milk products. This is often due to **lactose intolerance**, a condition where their small intestine does not produce enough of the enzyme lactase. Lactase is responsible for breaking down lactose (milk sugar) into simpler sugars, glucose and galactose, which can then be absorbed. When lactase is deficient, undigested lactose passes into the large intestine, where bacteria ferment it, leading to symptoms like bloating, gas, and diarrhea. This illustrates the critical role of specific enzymes in digestion and how their absence can impact nutrient absorption.

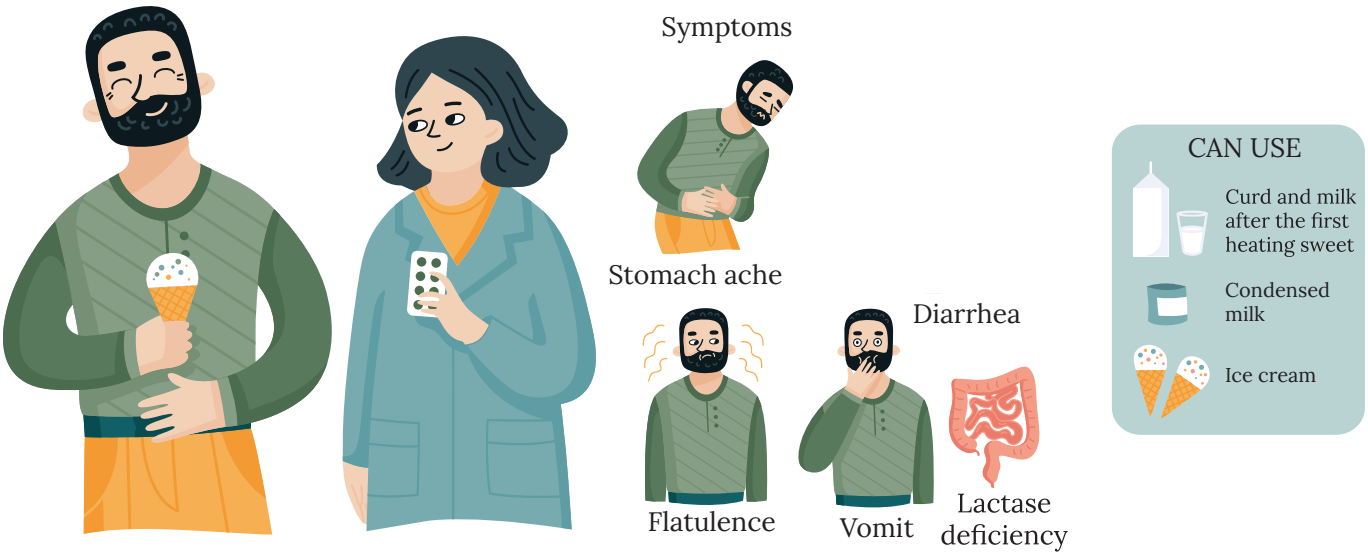


Fig. 9.9 Lactose Intolerance

2. **Dietary Fibre and Digestive Health:** Fibre, found in fruits, vegetables, and whole grains, is largely indigestible by human enzymes. However, it plays a crucial role in maintaining digestive health. In the large intestine, fibre adds bulk to the stool, making it softer and easier to pass. This prevents constipation and promotes regular bowel movements. Some types of fibre also act as prebiotics, feeding beneficial bacteria in the large intestine, which can produce short-chain fatty acids beneficial for gut health. This demonstrates how even "undigested" components of food are vital for the proper functioning of the digestive system.

Fig. 9.10 Dietary Fibre and Digestive Health

3. **Digestive Adaptations in Carnivores vs. Herbivores:** Consider the difference between a lion (carnivore) and a cow (herbivore). A lion's digestive system is relatively short and simple, designed for rapid digestion of protein and fat from meat. They have sharp teeth for tearing and a strong acidic stomach. A cow, as a ruminant, has a much longer and more complex digestive system with multiple stomach chambers, adapted for the slow, microbial digestion of tough plant material. This comparison clearly shows how the structure of the digestive system is directly linked to the animal's diet and evolutionary adaptations.

Fig. 9.11 Carnivores vs. Herbivores

4. **Role of Probiotics:** Probiotics are live microorganisms, often bacteria, that are beneficial to digestive health. Found in **fermented foods** like yogurt and kimchi, or in supplements, they help maintain a healthy balance of gut flora. These beneficial bacteria aid in the breakdown of certain indigestible compounds, synthesize vitamins (like Vitamin K and some B vitamins), and can even help protect against harmful pathogens. This illustrates the symbiotic relationship between humans and the microorganisms in their gut, emphasizing that digestion is not solely an internal enzymatic process but also involves a microbial ecosystem.

Fig. 9.12 Role of Probiotics

Fact Flash

The total surface area of the small intestine, thanks to its folds, villi, and microvilli, is roughly equivalent to the size of a tennis court! This enormous surface area is crucial for maximizing nutrient absorption.

Common Misconceptions

× **Misconception:** Digestion only happens in the stomach.

✓ **Correction:** Digestion begins in the mouth with the mechanical breakdown of food and the chemical digestion of starch by salivary amylase. It continues in the stomach (protein digestion) and is completed in the small intestine (carbohydrates, proteins, fats).

× **Misconception:** The small intestine is "small" because it's short.

✓ **Correction:** The small intestine is called "small" because of its narrower diameter compared to the large intestine, not its length. In fact, it is the longest part of the alimentary canal.

Science Around You

Understanding digestion is fundamental to nutrition and health. Dietitians and nutritionists use this knowledge to design healthy eating plans and manage dietary conditions. Medical professionals, especially gastroenterologists, specialize in diagnosing and treating digestive disorders. Food scientists apply principles of digestion to develop easily digestible foods or modify food properties. In technology, advancements in endoscopy allow doctors to visualize the alimentary canal, while probiotic supplements are developed based on understanding the gut microbiome. Research into artificial digestive systems could lead to new ways of processing waste or even creating synthetic food.

Activity

Investigating the Action of Saliva on Starch

Objective: To demonstrate the breakdown of starch by salivary amylase.

- **Materials:** Two test tubes (labeled A and B), Boiled rice, Chewed boiled rice (chew a small piece of boiled rice for 30-60 seconds), Water, Iodine solution (diluted), Dropper
- **Procedure:**
  1. Take two clean test tubes and label them 'A' and 'B'.
  2. In test tube A, place one teaspoonful of plain boiled rice.
  3. In test tube B, place one teaspoonful of boiled rice that you have chewed thoroughly for 30-60 seconds.
  4. Add 3-4 mL of water to both test tubes. Shake gently to mix.
  5. Note the initial appearance of the contents in both test tubes.

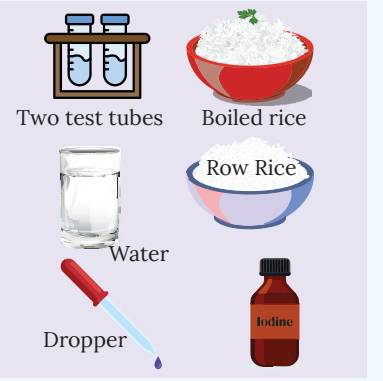


Fig. 9.13 Materials Required

- **Observations:**
  - Test tube A (boiled rice + iodine): The solution will turn blue-black.
  - Test tube B (chewed boiled rice + iodine): The solution will either remain yellowish-brown (color of iodine) or turn a very light blue.

Knowledge Checkpoint

Gap Analyzer™ Homework | Watch Remedial

Remembering

Multiple Choice Questions:

1. Which of the following organs is primarily responsible for the absorption of water from undigested food?

   a) Stomach ☐ b) Small intestine ☐

   c) Large intestine ☐ d) Liver ☐

Understanding

2. The process by which complex food components are broken down into simpler forms is called:

   a) Respiration ☐ b) Egestion ☐

   c) Digestion ☐ d) Absorption ☐

3. Ruminants are able to digest cellulose due to the presence of:

   a) Strong acids in their stomach ☐ b) A gizzard for grinding ☐

   c) Symbiotic bacteria in their rumen ☐ d) Very long small intestines ☐

Short Answer Question:

4. Explain the role of villi in the small intestine.
5. Why do birds swallow small stones?

Applying

Long Answer Question:

6. Describe the journey of a piece of chapati (rich in starch) through the human digestive system, explaining the key digestive processes and organs involved at each stage.

Respiration in Animals

Have you ever held your breath? It's incredibly difficult, isn't it? That's because breathing is essential for life. But breathing is just one part of a larger, more fundamental process called **respiration**. Respiration is the process by which living organisms break down food (like the glucose obtained from digestion) to release energy for all life activities. This energy powers everything from muscle movement to thinking. While breathing involves the physical exchange of gases (inhaling oxygen, exhaling carbon dioxide), respiration is a chemical process that occurs inside our cells. In this section, we will delve into the human respiratory system, understand the mechanics of breathing, and explore how different animals have adapted unique ways to respire in their diverse environments. We will cover the subconcepts of human respiration, mechanism of breathing, gas exchange, and respiration in other animals.

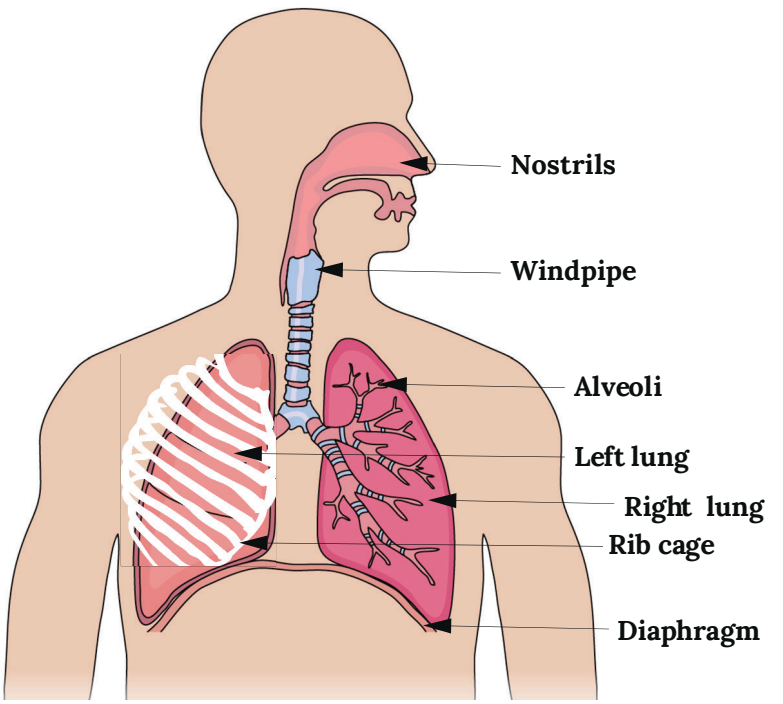


Fig. 9.14 Breathing in Humans

1. Breathing in Humans: Our Amazing Airway System

Our body has a special system, like a set of pipes and sponges, to help us breathe. Let's follow the path of air as it enters our body:

- **Nostrils and Nasal Passages:** Our Body's Air Cleaner Air usually enters our body through our nostrils (the openings of our nose). Inside our nose, there are small hairs and a sticky liquid called mucus. These act like a natural filter, catching dust, tiny germs, and other unwanted particles in the air, stopping them from going into our lungs. The air also gets warmed up and moistened in our nose, which is good for our lungs. So, our nose isn't just for smelling; it's also a very important air filter!
- **The Windpipe (Trachea):** The Airway That Stays Open From the nose, air travels down a tube called the trachea, or windpipe. This tube goes from your throat down into your chest. The windpipe has special rings made of a soft bone-like material called cartilage. These rings are like tiny springs that keep the windpipe open all the time, making sure air can always pass through easily. It's important not to confuse the windpipe with the food pipe, which is a different tube for food.
- **The Lungs:** Our Spongy Air Bags Inside your chest, protected by your strong rib cage, are your two lungs. These are soft, spongy organs that fill up with air. The windpipe splits into two smaller tubes called bronchi (one for each lung). Inside the lungs, these bronchi keep branching into even smaller tubes, like the branches of a tree. These tiny tubes finally end in millions of very small air sacs.
- **Air Sacs (Alveoli):** Where Air Meets Blood At the end of the tiniest tubes in your lungs are millions of tiny, balloon-like air sacs. Each of these air sacs is surrounded by a network of very thin blood vessels. This is where the real work happens: oxygen from the air you breathe in moves from these air sacs into your blood, and carbon dioxide (a waste gas from your body) moves from your blood into the air sacs to be breathed out.

How We Breathe: The Mechanics of Inhaling and Exhaling

Breathing is a physical movement that brings air into and out of our lungs. This movement happens because of two main parts: our rib cage and a big muscle called the diaphragm.

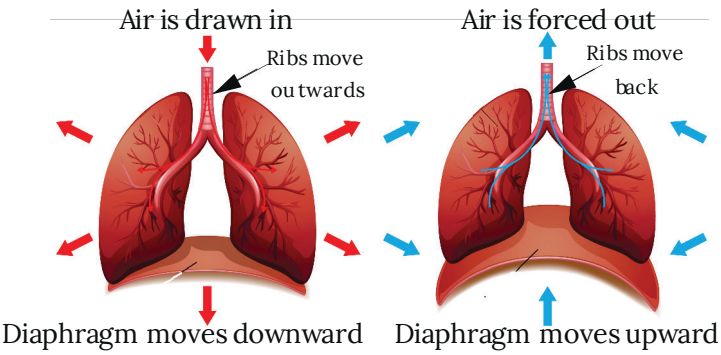


Fig. 9.15 Mechanism of Breathing

- **Inhaling (Breathing In):** Making More Space When you breathe in, two things happen:
  1. The muscles between your ribs pull your rib cage upwards and outwards.
  2. At the same time, the diaphragm, a large, dome-shaped muscle located just below your lungs, moves downwards and flattens. These movements make the space inside your chest much bigger. When there's more space, the air pressure inside your lungs becomes lower than the air pressure outside your body. So, air from outside rushes into your lungs to fill up this extra space! This is an active process, meaning it takes a little effort from your muscles.
- **Exhaling (Breathing Out):** Pushing Air Out When you breathe out (at rest), your body usually doesn't need to use much effort.
  1. The muscles between your ribs relax, allowing your rib cage to move downwards and inwards.
  2. The diaphragm also relaxes and moves back up to its original dome shape. These actions make the space inside your chest smaller. When there's less space, the air pressure inside your lungs becomes higher than the air pressure outside. This pushes the air out of your lungs. This is usually a passive process, meaning it happens naturally without much conscious effort.

Gas Exchange and Cellular Respiration: The Energy Story

Now that we know how air gets in and out, let's understand what happens with the gases and how energy is made.

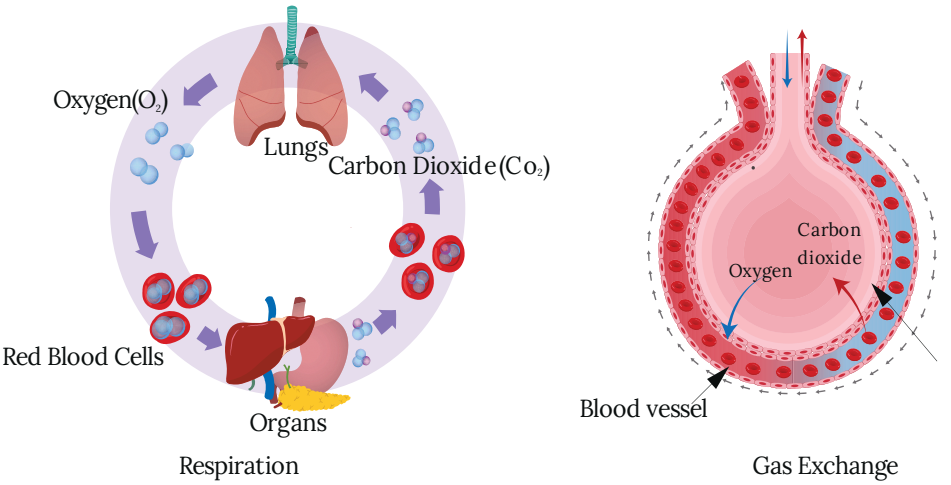


Fig. 9.16 Gas Exchange, Respiration

- **Gas Exchange:** The Big Swap Inside the tiny air sacs of your lungs, a very important swap happens. Oxygen from the air you breathed in goes into your blood. At the same time, carbon dioxide, which is a waste gas produced by your body cells, moves from your blood into the air sacs to be breathed out. Your blood then carries this fresh oxygen to all parts of your body.
- **Respiration (Cellular Respiration):** The Energy Release This is the main "respiration" process! It's a chemical process that happens inside every single cell of your body. When the oxygen-rich blood reaches your cells, the cells use this oxygen to break down the food (like the sugar you got from eating). This breakdown releases a lot of energy. This energy helps your body grow, repair itself, move, and keep warm. The waste products of this process are carbon dioxide and water. The carbon dioxide is then carried by your blood back to your lungs to be breathed out.

Food (Glucose) + Oxygen → Carbon dioxide + Water + Energy

It's very important to remember that breathing is just taking air in and out, while respiration is the chemical process inside your cells that uses oxygen to break down food and release energy. They work together!

To help you remember the difference between breathing and cellular respiration, look at this table:

Breathing vs. Cellular Respiration

Feature	Breathing	Cellular Respiration
What it is	Physical movement of air	Chemical process inside cells
Where it happens	Lungs (and nose, windpipe)	Inside body cells
Energy	No energy made; uses a little energy for muscle movement	Energy is released and used by the body
What goes in	Air (with Oxygen)	Food (Glucose) and Oxygen
What comes out	Air (with Carbon dioxide and water vapor)	Carbon dioxide, Water, and Energy
Main Purpose	To get Oxygen in and Carbon dioxide out	To get energy from food for all body activities

How Other Animals Breathe: Amazing Adaptations!

Animals live in many different places, and because of this, they have developed amazing and unique ways to breathe. Each way is perfectly suited to their home and how they live.

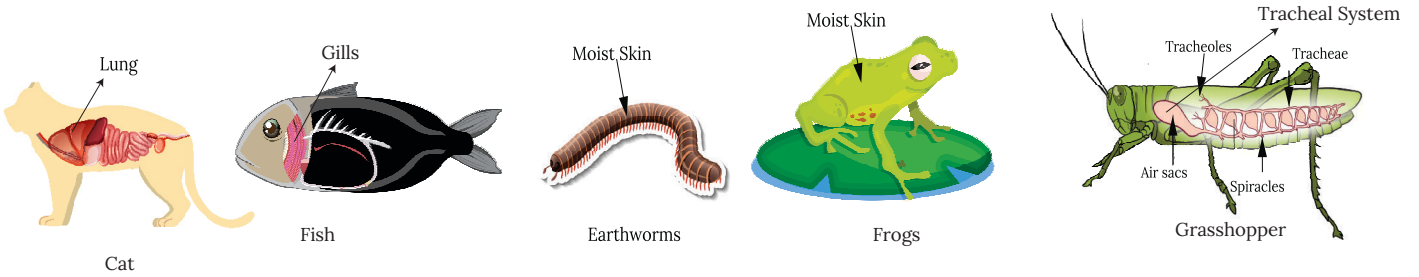


Fig. 9.17 How Other Animals Breathe: Amazing Adaptations

- **Lungs:** For Animals on Land and in the Air Many animals that live on land or fly, like mammals (humans, cows, dogs, cats), birds, and reptiles (lizards, snakes), breathe using lungs. Their lungs work in a similar way to human lungs, taking in air and swapping oxygen for carbon dioxide.
- **Gills:** For Animals in Water Animals that live in water, like fish, have special feathery parts called gills. Gills have lots of tiny blood vessels. As water flows over the gills, oxygen that is dissolved in the water moves into the fish's blood. At the same time, carbon dioxide from the fish's blood moves into the water and is carried away.
- **Moist Skin:** Breathing Through the Skin Some animals can breathe directly through their moist skin! Animals like earthworms and amphibians (like frogs, especially when they are wet) have thin, damp skin with many tiny blood vessels underneath. Oxygen from the air or water goes directly into their blood through their skin, and carbon dioxide comes out.
- **Tracheal System:** Direct Air Delivery for Insects Insects (like cockroaches and grasshoppers) have a very unique breathing system. They have a network of tiny tubes called tracheae that spread throughout their body. These tubes open to the outside through small holes on their body called spiracles. Air goes directly through these tubes to all the cells in their body, delivering oxygen and collecting carbon dioxide.

These different ways of breathing show how animals have adapted to survive in their diverse environments!

How Different Animals Breathe

Animal Group	Main Breathing Part(s)	How they breathe	Where they live
Humans, Mammals, Birds, Reptiles	Lungs	Breathe air in and out; oxygen goes into blood, carbon dioxide comes out.	Land, Air
Fish	Gills	Water flows over gills; oxygen from water goes into blood.	Water
Earthworms, Frogs	Moist Skin	Oxygen goes directly through their wet skin into blood.	Moist land, Water
Insects	Tracheal System	Air goes directly into body through tiny tubes and holes.	Land, Air

Respiration in Our Daily Lives: Real-World Examples

Understanding how we breathe and get energy helps us understand many things around us. Here are some real-world examples:

1. **Breathing Faster When You Exercise:** Have you noticed how you breathe faster and harder when you run or play? This happens because your muscles need a lot more energy when you are active. To get this energy, your cells need more oxygen. So, your body makes you breathe faster to bring in more oxygen and also to remove the extra carbon dioxide produced. This shows how important oxygen is for making energy.

Fig. 9.18 Breathing Faster

2. **Asthma: When Breat-hing Gets Hard:** Asthma is a condition where the tubes in a person's lungs can become tight and swollen, especially when they are around certain things like dust or smoke. This makes it hard for air to go in and out, causing coughing and a whistling sound when they breathe. Doctors can give medicines that help relax these tubes, making it easier to breathe. This shows how knowing about our breathing system helps us find ways to help people.

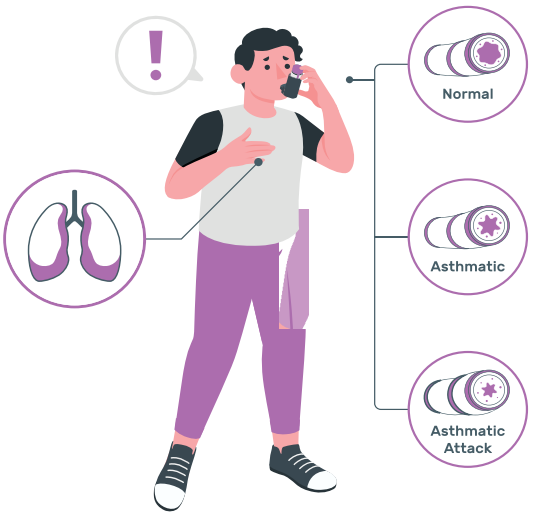


Fig. 9.19 Asthma

3. **Diving Animals:** Holding Their Breath for a Long Time: Whales and seals are amazing marine animals that can stay underwater for a very long time without breathing. They have special adaptations! They can hold a lot of air in their lungs, and their bodies are very good at using oxygen efficiently. They also have special proteins in their muscles that store extra oxygen. This allows them to dive deep and hunt underwater for long periods.

Fig. 9.20 Diving Animals

4. **Helping Someone Breathe (CPR):** In emergencies, if someone stops breathing, people can perform something called CPR (Cardiopulmonary Resuscitation). This involves pushing on their chest and giving rescue breaths. This helps to manually move blood and oxygen around their body, especially to their brain, until medical help arrives. It highlights how immediately vital breathing and oxygen are for keeping a person alive.

Fig. 9.21 Helping Someone Breathe (CPR)

5. **Clean Air is Important:** The air we breathe needs to be clean. When there is a lot of pollution (like smoke from cars or factories), it contains tiny harmful particles and gases. Breathing this polluted air can make our lungs sick, cause coughing, and make it harder for our lungs to work properly. This reminds us why clean air is so important for our health and for our respiratory system to function well.

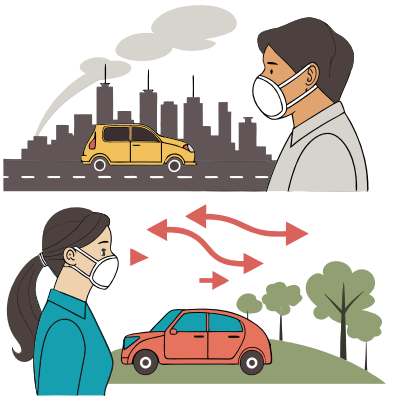


Fig. 9.22 Clean Air is Important

Fact Flash

The total surface area of all the alveoli in your lungs, if spread out flat, would cover an area roughly the size of a badminton court! This massive surface area is crucial for efficient gas exchange.

Common Misconceptions

× **Misconception:** Breathing and respiration are the same thing.

✓ **Correction:** Breathing is a physical process of gas exchange (inhaling and exhaling). Respiration (cellular respiration) is a chemical process that occurs inside cells to release energy from food. Breathing is necessary for respiration, but they are distinct.

× **Misconception:** We inhale pure oxygen and exhale pure carbon dioxide.

✓ **Correction:** Inhaled air is about 21% oxygen and 0.04% carbon dioxide (and mostly nitrogen). Exhaled air is about 16-17% oxygen and 4-5% carbon dioxide. We use some, but not all, of the inhaled oxygen, and we produce some, but not all, of the exhaled carbon dioxide.

Science Around You

Have you noticed how your pet breathes faster after running? That's because animals need more oxygen during activity to release energy. This energy comes from respiration—a process where oxygen breaks down food in cells to produce energy. Even tiny insects and fish respire, using different organs like spiracles or gills. Respiration keeps all animals alive and active, from ants to elephants!

Activity

Observing Carbon Dioxide in Exhaled Air

Objective: To demonstrate that exhaled air contains a higher concentration of carbon dioxide than inhaled air.

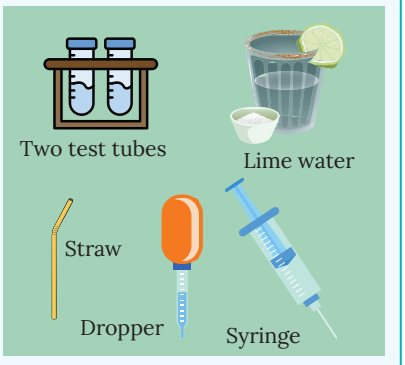


Fig. 9.23 Materials Required

- **Materials:** Two test tubes (labeled A and B), Freshly prepared lime water (calcium hydroxide solution), A straw, A syringe or Dropper (for test tube A)
- **Procedure:**
  1. Pour an equal amount of freshly prepared lime water into both test tubes A and B.
  2. **For Test Tube A (Inhaled Air):** Using a syringe or *pichkari*, gently push air from the surroundings into the lime water in test tube A. Do this for about 1-2 minutes. Observe any changes.
  3. **For Test Tube B (Exhaled Air):** Place one end of the straw into the lime water in test tube B. Gently blow exhaled air through the straw into the lime water for about 1-2 minutes. Be careful not to suck the lime water. Observe any changes.
- **Observations:**
  - **Test tube A (Inhaled air):** The lime water will remain clear or show very little change.
  - **Test tube B (Exhaled air):** The lime water will quickly turn milky or cloudy.

Knowledge Checkpoint

Gap Analyzer™ Homework

Watch Remedial

Remembering

Multiple Choice Questions:

1. Which of the following is the primary site of gas exchange in the human respiratory system?
   a) Trachea ☐ b) Bronchi ☐
   c) Alveoli ☐ d) Nostrils ☐
2. The dome-shaped muscle that plays a crucial role in breathing is the:
   a) Intercostal muscle ☐ b) Diaphragm ☐
   c) Bicep ☐ d) Triceps ☐
3. The chemical process of breaking down glucose to release energy inside cells is called:
   a) Breathing ☐ b) Digestion ☐
   c) Respiration ☐ d) Absorption ☐

Analyzing

Short Answer Question:

4. Differentiate between inhalation and exhalation based on the movement of the diaphragm and rib cage.
5. Why is it important for the nasal passages to have hair and mucus?

Long Answer Question:

6. Explain the difference between breathing and respiration. Why are both processes essential for the survival of living organisms?

SUMMARY

Nutrition in Animals:

Digestion: The process of breaking down complex food components into simpler, absorbable forms.

- **Human Digestive System (Alimentary Canal):** A long tube including the mouth, oesophagus, stomach, small intestine, large intestine, rectum, and anus.
- **Mouth:** Mechanical digestion (chewing) and initial chemical digestion of starch by salivary amylase.
- **Oesophagus:** Food moves by peristalsis.
- Stomach: Churns food, secretes gastric juice (HCl, pepsin, mucus) for protein digestion and killing bacteria.
- **Small Intestine:** Main site for complete digestion (carbohydrates, proteins, fats) and absorption of nutrients. Receives bile from the liver (for fat emulsification) and pancreatic juice from the pancreas. Its inner lining has villi to maximize absorption.
- **Large Intestine:** Absorbs water and some salts from undigested food, forming semi-solid stool.
- **Rectum & Anus:** Stores and expels faeces (egestion).
- **Digestion in Other Animals:**
- **Ruminants (e.g., cows):** Have a four-chambered stomach (rumen) with symbiotic bacteria to digest cellulose. They chew partially, swallow, regurgitate (cud), and re-chew (rumination).
- **Birds:** Lack teeth; use a muscular **gizzard** to grind food, often with swallowed grit.

Respiration in Animals:

Breathing vs. Respiration:

- **Breathing:** A physical process of inhaling oxygen-rich air and exhaling carbon dioxide-rich air.
- **Respiration (Cellular Respiration):** A chemical process occurring in cells where glucose is broken down with oxygen to release energy (ATP), carbon dioxide, and water.
- **Word Equation:** Glucose + Oxygen → Carbon dioxide + Water + Energy
- **Human Respiratory System:**
- **Nostrils & Nasal Passages:** Filter, warm, and moisten inhaled air.
- **Windpipe (Trachea):** Carries air to lungs, supported by cartilage rings.
- **Lungs:** Spongy organs protected by the rib cage, containing bronchi, bronchioles, and alveoli.
- **Alveoli:** Tiny air sacs where gas exchange (O_2 into blood, CO_2 out of blood) occurs across thin walls.
- **Mechanism of Breathing:** Involves the diaphragm and rib cage muscles.
- **Inhalation:** Diaphragm moves down, ribs move up/out, chest volume increases, air rushes in.
- **Exhalation:** Diaphragm moves up, ribs move down/in, chest volume decreases, air is pushed out.

Respiration in Other Animals:

- **Lungs:** Common in terrestrial mammals, birds, reptiles.
- **Gills:** In aquatic animals (e.g., fish) for extracting dissolved oxygen from water.
- **Moist Skin:** In earthworms and amphibians (e.g., frogs in water).
- **Tracheal System:** In insects, for direct gas transport to cells.

Example Based Questions

Multiple Choice Questions

1. Which of the following is an example of an animal with ruminant digestion (chewing cud)?

(a) Lion (b) Cow
(c) Dog (d) Tiger

Answer: (b) Cow

Explanation: Cows and other ruminants (goats, buffaloes, deer) have a four-chambered stomach. They swallow partially chewed food and later bring it back to the mouth to chew again, called rumination.

2. Which gas is released during respiration in animals?

(a) Oxygen (b) Carbon dioxide
(c) Nitrogen (d) Hydrogen

Answer: (b) Carbon dioxide

Explanation: Animals inhale oxygen to break down food and release energy. In this process, carbon dioxide and water are produced as waste products.

3. Which organ is mainly responsible for respiration in fish?

(a) Lungs (b) Gills
(c) Trachea (d) Spiracles

Answer: (b) Gills

Explanation: Fish breathe through gills, which absorb dissolved oxygen from water and release carbon dioxide. Land animals like humans use lungs, and insects use spiracles.

Short Answer Questions

4. How do amoeba and humans differ in their mode of nutrition?

Answer:

- **Amoeba:** Uses pseudopodia (finger-like extensions) to surround food particles and engulf them. Digestion happens inside food vacuoles.
- **Humans:** Have a complex digestive system with organs like mouth, stomach, intestines, and glands for digestion.

Thus, nutrition in amoeba is simple and unicellular, while in humans it is complex and multicellular.

5. Why do animals need to respire?

Answer: Respiration releases energy from food. This energy is needed for:

- Movement and growth
- Repair of body tissues
- Maintaining body temperature
- Performing life activities like reproduction and excretion

Without respiration, animals would not survive because no energy would be available for daily functions.

6. How does respiration in fish differ from that in humans?

Answer:

- **Fish:** Breathe through gills which extract dissolved oxygen from water.
- **Humans:** Breathe through lungs which absorb oxygen from air.

Hence, fish cannot survive long out of water, and humans cannot breathe under water without special equipment.

Long Answer Questions

7. Explain the process of digestion in humans.

Answer:

1. **Mouth:** Teeth break food, saliva digests starch.
2. **Esophagus:** Food moves down by peristaltic movement.
3. **Stomach:** Gastric juices (HCl, enzymes) digest proteins.
4. **Small Intestine:** Digestive juices from pancreas and liver help in breaking down fats, proteins, and carbohydrates. Nutrients are absorbed into the blood through villi.
5. **Large Intestine:** Absorbs water; undigested food forms waste.
6. **Anus:** Removes solid waste.

Conclusion: Human digestion is a complex process that converts food into simple nutrients and energy, essential for survival.

Gap Analyzer™
Complete Chapter Test

EXERCISE

A. Choose the correct answer.

1. Which part of the human digestive system is the primary site for the complete digestion and absorption of nutrients?
   (a) Stomach ☐ (b) Large Intestine ☐
   (c) Small Intestine ☐ (d) Oesophagus ☐
2. What is the main function of the mucus secreted in the stomach?
   (a) To digest proteins ☐ (b) To activate pepsin ☐
   (c) To protect the stomach lining from acid ☐
   (d) To emulsify fats ☐
3. Ruminants like cows re-chew their partially digested food. This process is called:
   (a) Absorption ☐ (b) Peristalsis ☐
   (c) Rumination ☐ (d) Egestion ☐
4. Which part of the human respiratory system warms and moistens the air, and also acts as a filter?
   (a) Trachea ☐ (b) Lungs ☐
   (c) Nostrils and Nasal Passages ☐ (d) Alveoli ☐
5. What is the primary product released during cellular respiration?
   (a) Oxygen ☐ (b) Food ☐
   (c) Energy ☐ (d) Water vapor ☐

B. Fill in the blanks.

1. The wave-like muscular contraction that moves food through the oesophagus is called _____.
2. The stomach secretes hydrochloric acid, pepsin, and _____ to protect its lining.
3. The tiny finger-like projections in the small intestine that increase surface area for absorption are called _____.
4. Birds lack teeth, so their food is mechanically ground in a muscular organ called the _____.
5. The process of releasing energy from food inside cells is called _____ respiration.

C. Write True or False.

1. Digestion is the process of obtaining and utilizing food for growth and energy. _____
2. Bile from the liver contains enzymes that chemically digest fats. _____
3. Ruminants have bacteria in their rumen that help digest cellulose. _____
4. Exhaling (breathing out) is always an active process that requires muscular effort. _____
5. Insects breathe directly through a network of tubes called tracheae, which open to the outside via spiracles. _____

D. Define the following terms.

1. Digestion
2. Peristalsis
3. Villi
4. Rumination
5. Cellular Respiration

E. Match the columns.

	Column A		Column B
1.	Villi	(a)	Connects mouth to stomach
2.	Liver	(b)	Finger-like projections in small intestine
3.	Esophagus	(c)	Temporarily stores food
4.	Stomach	(d)	Produces bile juice
5.	Small Intestine	(e)	Main site of digestion and absorption

F. Assertion and Reason

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is NOT the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

(e) Both A and R are false.

1. **Assertion (A):** Digestion of carbohydrates begins in the mouth.

   Reason (R): Salivary amylase in saliva starts breaking down starch.

2. **Assertion (A):** The large intestine is longer than the small intestine.

   Reason (R): The main function of the large intestine is the absorption of water.

3. **Assertion (A):** Fish use gills for breathing.

   Reason (R): Gills are adapted to extract oxygen dissolved in water.

G. Give reasons for the following statements.

1. Food does not fall down the oesophagus just by gravity.
2. Humans get gas and bloating due to lactose intolerance.
3. Lungs have millions of tiny air sacs (alveoli).
4. Earthworms and frogs have moist skin for breathing.

H. Answer in brief.

1. What happens to food in the mouth during digestion?
2. What are villi and why are they important in the small intestine?
3. How can animals like cows digest grass when humans cannot?
4. How is breathing different from respiration?

I. Answer in detail.

1. Explain how food moves through our body from the mouth to the end. What happens to the food at each step?
2. How are the digestive systems of humans, cows, and birds different? How does each help in digesting their food?
3. Describe how we breathe and how our body uses oxygen to make energy.
4. How do different animals like fish, frogs, and insects breathe in their own way to live in their habitats?

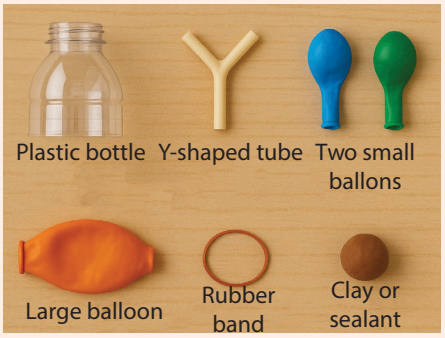
SKILL-BASED PRACTICE

Activity Time

STEM

Modelling the Human Diaphragm

Materials Needed: A plastic bottle (cut in half, top half with neck), A Y-shaped tube (or two straws taped into a Y), Two small balloons, A large balloon or rubber sheet, Rubber band, Clay or sealant



Materials Required

Activity Steps:

1. Attach small balloons to a Y-shaped tube and insert it into the neck of a cut plastic bottle.
2. Seal the neck with clay to make it airtight.
3. Stretch a large balloon over the open bottom of the bottle and secure it.
4. Pull and push the bottom balloon to observe the small balloons inflate and deflate.

Questions:

1. What happened to the small balloons when you pulled the rubber sheet downwards? Why?
2. How does this model demonstrate the action of the diaphragm and rib cage in breathing?

Skills Covered: Model Building, Observation, Understanding Mechanics of Breathing

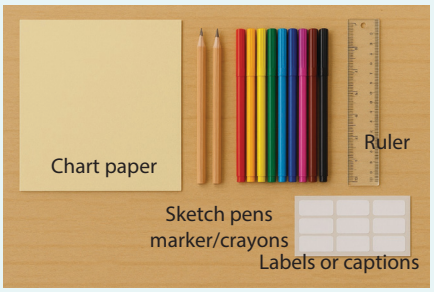
Creativity

Art

Digestive System Journey Storyboard

Task: Create a colourful storyboard (6–8 panels) showing how a bite of food (like an apple slice) travels through the human digestive system. Each panel should focus on one organ and explain simply what happens there.

Materials: Chart paper, pencils, sketch pens/markers/crayons, ruler, labels or captions



Materials Required

Steps

1. Divide the chart into 6–8 panels like a comic strip.
2. Show mouth chewing with saliva, then esophagus carrying food.
3. Draw stomach mixing food with digestive juices.
4. Add small intestine absorbing nutrients and large intestine absorbing water.
5. End with rectum and anus showing undigested food leaving the body, with captions, arrows, and colours.

Questions:

1. How did your drawings and use of colour make the food's journey easy to understand?
2. How does your storyboard explain the purpose of each organ in digestion?

Skills Covered: Scientific Reasoning, Presentation skills, Critical Thinking, Fine Motor skills

Respiration in Seeds

Group Activity

Observing Respiration in Germinating Seeds

Activity Instructions:

Work in a group:

1. Prepare two flasks—one with germinating seeds (Setup A) and one with dry seeds (Setup B); insert thermometers into both and seal them.
2. Record the initial temperatures, leave both flasks undisturbed for 24–48 hours, then note the final temperatures.

Questions:

1. What change in temperature did you observe in Setup A (germinating seeds)?
2. Why was Setup B necessary in this experiment?

Skills Covered: Scientific Testing, Observation, Data Collection, Analysis, Teamwork

Rina's Stomach Ache

Case Study

Rina loves eating spicy food, especially pizza with extra chili flakes. One evening, after eating a large, very spicy pizza, she developed a burning sensation in her stomach, followed by a dull ache. She felt a similar sensation rising up into her chest sometimes. Her mother suggested she might have indigestion due to the acidity.

Questions:

1. Which organ in Rina's digestive system is primarily responsible for holding and churning the food she just ate?
2. The stomach produces an acid. What is its name, and what is its normal function in digestion?
3. What substance does the stomach lining produce to protect itself from this acid?
4. Based on the symptoms, what might be happening in Rina's stomach that is causing the burning sensation and ache? (Hint: Think about the protective layer).
5. Why might the sensation sometimes rise into her chest? (Think about the pipe connecting the mouth to the stomach).

Skills Covered: Classification, Analysis, Teamwork, Communication, Scientific Investigation

Source Based Question

Source Passage (Historical Note, 1822, Dr. William Beaumont):

"In the 1800s, an American army doctor named William Beaumont made an unusual discovery about digestion. A soldier had an injury in his stomach that left a small opening. Beaumont carefully observed how food was broken down inside the man's stomach. He saw that a liquid, called gastric juice, helped to digest the food. Before this, many people thought food was just 'ground up' in the stomach like in a grinder. But Beaumont's experiments proved that digestion is a chemical process, not just a physical one.

This discovery helped scientists understand that digestion changes food into simple substances, like sugars and amino acids, which can then be absorbed by the body. Without proper digestion, the body would not get energy or nutrients to stay alive. Today, we know that different organs—like the stomach, small intestine, and liver—all work together to complete the digestion process."

Image Credit: Wikipedia

Questions:

1. **Understanding the Discovery**
   - Who was William Beaumont, and what did he observe about the stomach?
   - What liquid did he find that helps break down food?
2. **Cause and Effect**
   - Why was Beaumont's discovery important in understanding digestion?
   - How does digestion help animals and humans stay alive?
3. **Thinking Deeper**
   - What might happen if the body could not digest food properly?
   - Can you name one organ (other than the stomach) that helps in digestion and explain its role?

Skills Covered: Observation and analysis, Scientific reasoning, Classification and comparison