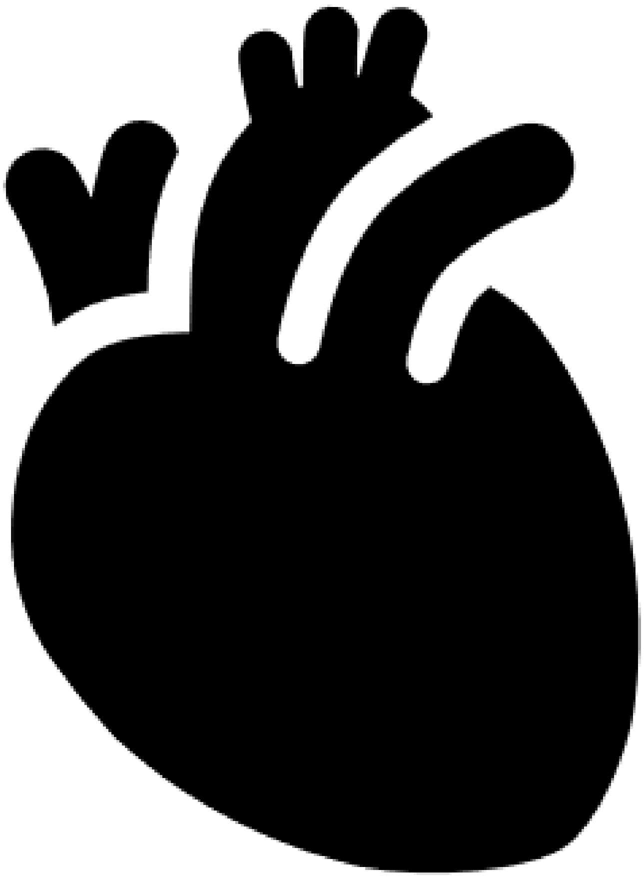
Human Systems



Name ________________________________

Class ________________________________

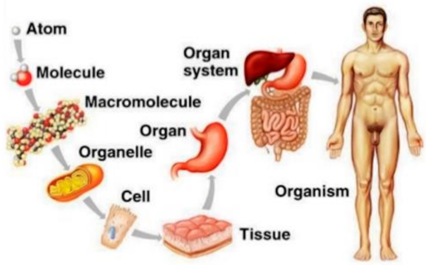
Teacher ________________________________

L1 Principles of organisation

Human organization refers to the structural hierarchy of the human body. At its core, the human body is composed of trillions of tiny building blocks called cells. These cells come together to form tissues, which, in turn, combine to create organs. Organs work together to form organ systems, and all the organ systems collectively make up the human organism.

Cells: The Building Blocks

Let's start with cells. Cells are the smallest unit of life. They are like the Lego bricks that build everything in our body. There are various types of cells with specialized functions, such as muscle cells, nerve cells, and blood cells. Each cell has a specific job to do.



Tissues: Teamwork Among Cells

Cells that have similar functions come together to form tissues. For example, muscle cells create muscle tissue, while nerve cells form nervous tissue. This teamwork among cells allows them to perform their jobs more efficiently.

Organs: Functional Units

When different types of tissues work together, they create organs. Organs have specific functions. For example, the heart is an organ that pumps blood, while the lungs are responsible for breathing. The digestive system includes organs like the stomach and intestines, which work together to break down and absorb nutrients from food.

Organ Systems: Teamwork Among Organs

Organs don't work in isolation; they collaborate to form organ systems. The cardiovascular system, for instance, consists of the heart, blood vessels, and blood. These organs work together to circulate oxygen and nutrients throughout the body. Other vital organ systems include the respiratory, digestive, nervous, and skeletal systems.

The Body as an Organism

When all the organ systems function harmoniously, they create a living, breathing organism – you! Each system has its unique role, but they all depend on each other to keep the body running smoothly.

Independent practice

1. What are cells, and why are they considered the building blocks of life?
2. Give an example of a tissue and explain its function in the body.
3. Define an organ and provide two examples of organs in the human body.
4. Explain why different types of tissues need to work together to form organs.
5. Name three organ systems and briefly describe their functions.
6. How does the circulatory system benefit from the collaboration of the heart, blood vessels, and blood?
7. What is the primary function of the respiratory system, and which organs are involved in it?
8. Describe the role of the nervous system in the human body.
9. Which system is responsible for breaking down food and extracting nutrients?
10. How does the skeletal system support and protect the body?
11. What happens when one organ system fails to work properly? Provide an example.
12. Explain the concept of human organization and why it is important in biology.
13. Can you identify an organ that belongs to more than one organ system? Explain.
14. Imagine you are a cell in the human body. Describe your role and how you interact with other cells.
15. If you could create a new organ system for the human body, what would it do, and how would it benefit the body's overall organization?
16. Matt says “The skin is an organ because it is made from epithelial, muscle and glandular tissue.” Is he correct? Give a reason.

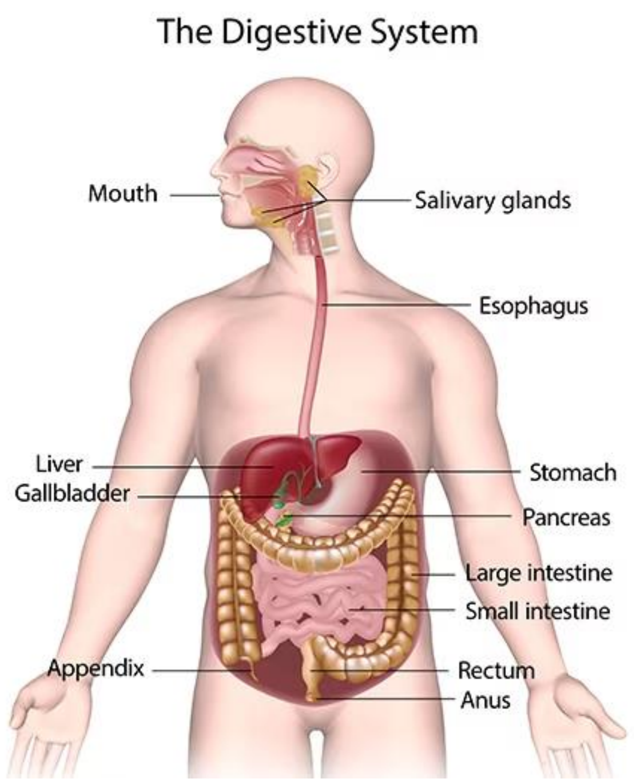
L2 The digestive system

Have you ever wondered why you cannot survive without eating and simply absorb nutrients from the environment around you. You can not do this because it would take a very long time for the tiny substances your cells need to grow and repair themselves to diffuse through the trillions of cells which make up your body. The substances required by your cells need be very tiny to pass into them and the other challenge your body faces is that nutrients are found outside the body as large molecules and substances which can't diffuse. To overcome this challenge the digestive system evolved in some organisms.

The digestive system is a complex network of organs and processes that break down the food we eat into smaller, absorbable nutrients, allowing our bodies to obtain energy and essential substances for growth and repair. This system is crucial for our survival and overall well-being. In this explanation, we'll explore the main components of the digestive system and focus on one important component - bile.

<u>Components of the Digestive System</u>:

- Mouth: Digestion begins in the mouth with the process of mechanical and chemical digestion. Teeth help break down food into smaller pieces, and saliva, which contains enzymes, starts breaking down starches.
- Oesophagus: After chewing, the food is swallowed and enters the oesophagus, a muscular tube that transports it to the stomach through a process called peristalsis.
- Stomach: The stomach is a muscular organ that further breaks down food with gastric juices and enzymes. It also serves as a temporary storage site for food.
- Small Intestine: Most of the digestion and nutrient absorption occur in the small intestine. Here, food is mixed with digestive enzymes from the pancreas and bile from the liver and gallbladder.



- Liver: The liver is a vital organ that produces bile, a greenish fluid necessary for the digestion and absorption of fats.
- Gallbladder: The gallbladder stores and releases bile when needed to help digest fats. Bile is transported to the small intestine through the common bile duct.
- Pancreas: The pancreas produces digestive enzymes and releases them into the small intestine to break down carbohydrates, proteins, and fats.

- Large Intestine: The large intestine absorbs water and electrolytes from undigested food, forming faeces. It also houses beneficial bacteria that aid in digestion.
- Rectum and Anus: These structures control the elimination of waste from the body through the process of defecation.

Function of Bile:

Bile is a yellow-green fluid produced by the liver and stored in the gallbladder. Its primary role is to aid in the digestion and absorption of fats, which are essential for the body's energy and various functions. Here's how bile accomplishes this:

- Emulsification: Bile contains bile salts that break down large fat globules into smaller droplets, a process called emulsification. This increases the surface area of fats, making it easier for digestive enzymes to access and break them down.
- Fat Absorption: Emulsified fats are more accessible to pancreatic lipase, an enzyme that further digests fats into fatty acids and glycerol, allowing for their absorption into the bloodstream.
- Nutrient Transport: Bile also helps in the absorption of fat-soluble vitamins (A, D, E, and K) and other fat-soluble nutrients by enabling them to enter the bloodstream along with the digested fats.
- Waste Elimination: Bile serves as a route for the elimination of waste products produced by the liver.

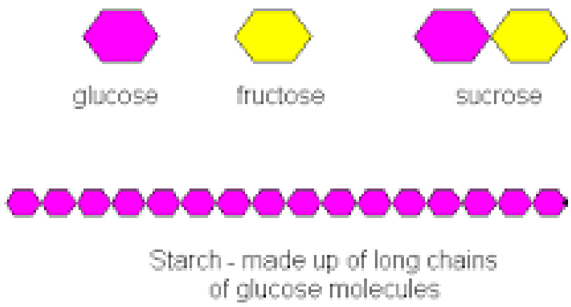
Independent practice

1. What is the digestive system, and why is it essential for our bodies?
2. Describe the functions of the mouth and saliva in digestion.
3. What role does the oesophagus play in the digestive process?
4. How does the stomach contribute to digestion?
5. Where does most of the digestion and nutrient absorption occur in the digestive system?
6. What is the liver's primary function in the digestive system?
7. Explain the role of the gallbladder in the digestion of fats.
8. What are the main digestive enzymes produced by the pancreas?
9. How does the small intestine absorb nutrients?
10. What happens in the large intestine during digestion?
11. How does bile aid in the digestion of fats?
12. What is emulsification, and why is it important in fat digestion?
13. Name some fat-soluble vitamins and explain their importance.
14. Why is bile considered essential for the absorption of certain nutrients?
15. What is the function of the rectum and anus in the digestive process?
16. Describe the roles of the liver and the pancreas in the digestion of fats.

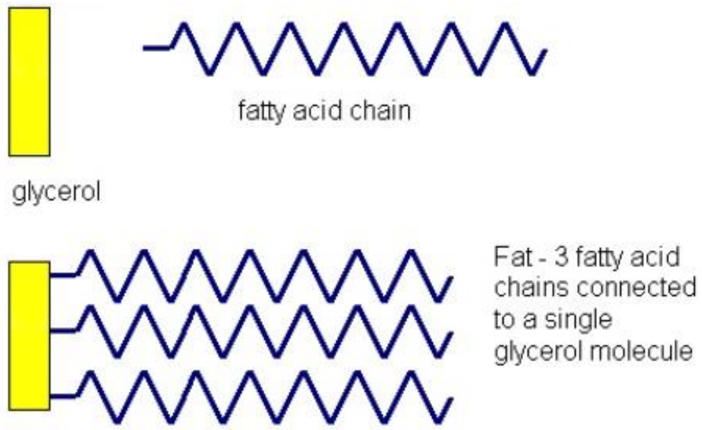
L3 What is in food

Carbohydrates, lipids and protein make up most parts of a cell. Therefore, it is important we have lots of them. This makes them the main parts of our diet.

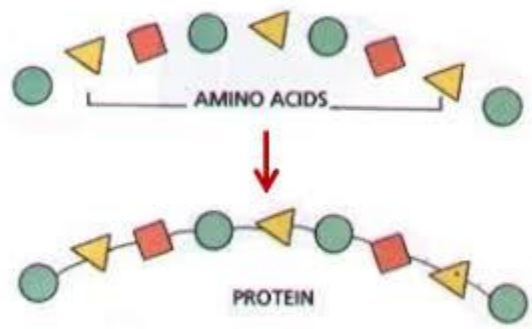
Carbohydrates help provide us with energy. All carbohydrates contain carbon, oxygen and hydrogen. Glucose ($C_6H_{12}O_6$) is a simple carbohydrate made of a single carbohydrate molecule. Sucrose is also a simple carbohydrate made up of two carbohydrate molecules joined together. Glucose molecules can be combined in long chains to form complex carbohydrates. Examples of this include starch and glycogen which act as energy storage molecules in plants and animals respectively. Carbohydrate rich foods include bread, pasta and potatoes.



Lipids are fats and oils. They are an energy store in our cells. When combined with other molecules they can be used to make cell membranes. Like carbohydrates they are made up of carbon, hydrogen and oxygen. They are insoluble in water. Each lipid molecule is made up of three molecules of fatty acids combined with a molecule of glycerol. Olive oil, vegetable oil, cheese, butter and margarine are all sources of lipids.



Proteins are polymers made up of amino acids joined together. There are twenty different amino acids which can be combined in different orders to make new proteins. Proteins are used to build our cells and our enzymes. Protein is made up of carbon, hydrogen, oxygen and nitrogen. Protein rich foods include meat, fish and cheese.



1. Give two functions of carbohydrates.
2. Which atoms make up carbohydrates?
3. State the monomer (the basic unit) of carbohydrates.
4. Glucose is absorbed by the small intestine no matter how low its concentration in the digested food. Which transport process is used?
5. State the chemical formula of glucose.
6. Give two examples of complex carbohydrates.
7. What types of food contain lots of carbohydrates? Give three examples.
8. What are the two types of lipids?
9. Which elements make up lipids?
10. State two functions of lipids.
11. What is the function of the cell membrane?
12. What types of food contain lots of lipids? Give two examples.
13. What process causes water to move across the cell membrane from a dilute solution to a concentrated one?
14. Give two functions of proteins.
15. Which atoms make up proteins?
16. What makes up proteins?
17. Describe how different proteins can be made from the same 3 amino acids
18. If a protein shake is 250g in total advertises it is 40% protein how much protein is in the shake?
19. Whole milk is 4% protein. What mass of whole milk would need to be consumed to get the same amount of protein?

L4 Food tests

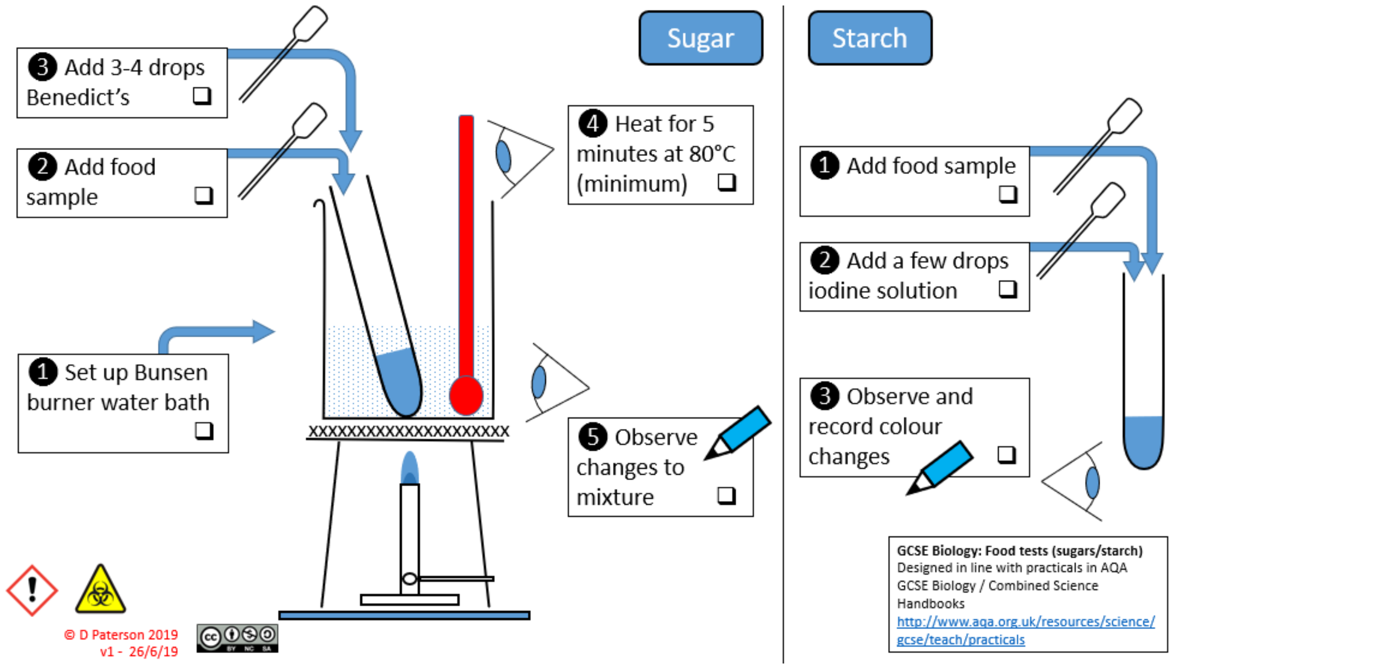
Food tests are analytical procedures that scientists and food experts use to determine the presence of specific nutrients in various food items. These tests help us understand what our food contains and whether it meets our nutritional requirements.

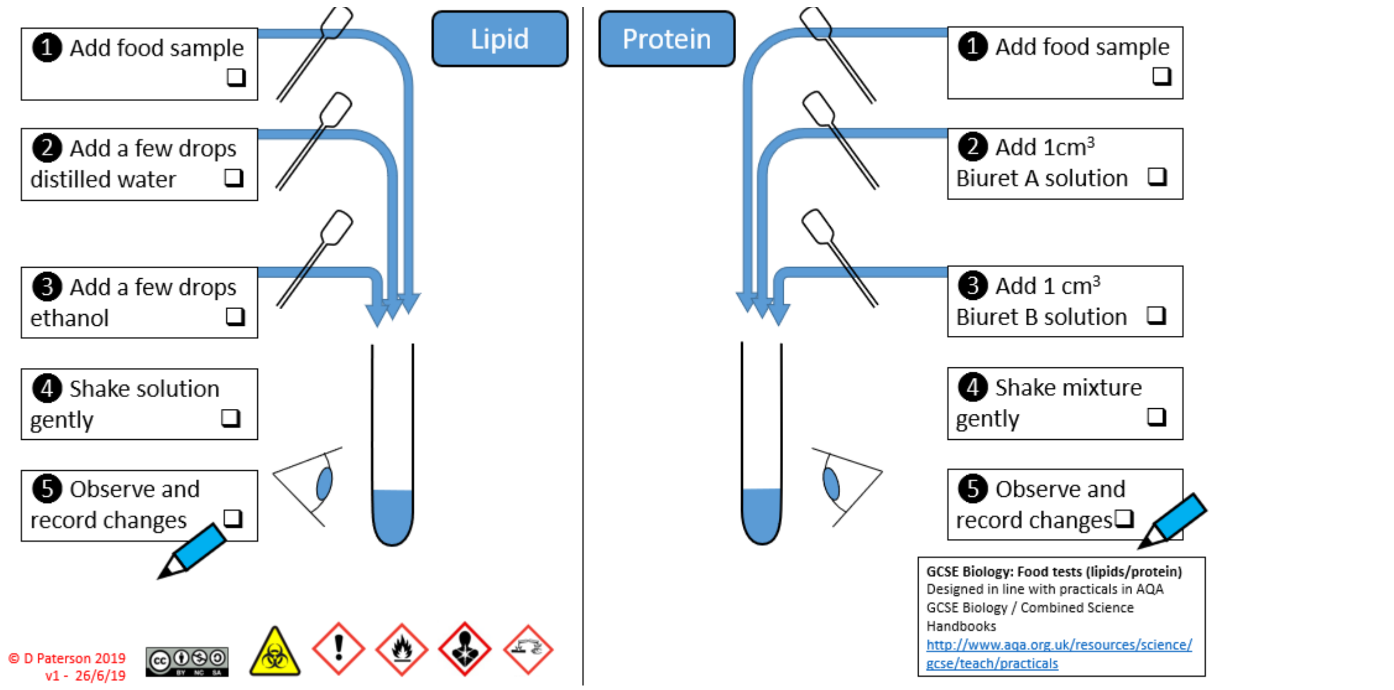
The Four Main Nutrients

Carbohydrates: Carbohydrates are our primary source of energy. They include sugars and starches. To test for carbohydrates, we use Benedict's reagent, which changes color when heated in the presence of reducing sugars. Proteins: Proteins are essential for growth and repair of tissues. Biuret reagent can be used to test for proteins. It turns purple when it reacts with proteins. Fats: Fats provide us with long-term energy storage. To test for fats, we use the emulsion test. When fats are mixed with ethanol and water, a cloudy white emulsion forms. Vitamins and Minerals: These are essential micronutrients that play various roles in our bodies. Testing for vitamins and minerals typically requires more advanced laboratory techniques.

In your GCSE science class, you'll likely perform some food tests yourself. Here's a brief overview of how they are carried out:

- Benedict's Test for Reducing Sugars: You mix the food sample with Benedict's reagent and heat it. If the solution turns from blue to green, yellow, orange, or red, it indicates the presence of reducing sugars.
- Biuret Test for Proteins: You mix the food sample with Biuret reagent. If the solution turns purple, it indicates the presence of proteins.
- Emulsion Test for Fats: You mix the food sample with ethanol and then add water. If a white emulsion forms, it indicates the presence of fats.


Sugar
Starch
3 Add 3-4 drops Benedict's ❑
2 Add food sample ❑
1 Set up Bunsen burner water bath ❑
4 Heat for 5 minutes at 80°C (minimum) ❑
5 Observe changes to mixture ❑
1 Add food sample ❑
2 Add a few drops iodine solution ❑
3 Observe and record colour changes ❑
© D Paterson 2019 v1 - 26/6/19
GCSE Biology: Food tests (sugars/starch)
Designed in line with practicals in AQA GCSE Biology / Combined Science Handbooks
http://www.aqa.org.uk/resources/science/gcse/teach/practicals


Lipid
Protein
1 Add food sample ❑
2 Add a few drops distilled water ❑
3 Add a few drops ethanol ❑
4 Shake solution gently ❑
5 Observe and record changes ❑
1 Add food sample ❑
2 Add 1cm³ Biuret A solution ❑
3 Add 1 cm³ Biuret B solution ❑
4 Shake mixture gently ❑
5 Observe and record changes ❑
GCSE Biology: Food tests (lipids/protein)
Designed in line with practicals in AQA GCSE Biology / Combined Science Handbooks
http://www.aqa.org.uk/resources/science/gcse/teach/practicals
© D Paterson 2019 v1 - 26/6/19

<u>Independent practice</u>

1. What are the four main nutrients found in food, and why are they important for our bodies?
2. Explain the purpose of food testing in the food industry.
3. How does the Benedict's test work, and what does it indicate?
4. Describe the steps involved in the Biuret test for proteins.
5. Why is it important to test for the presence of fats in food?
6. Can you name some other methods or tests used for detecting nutrients in food apart from the ones mentioned in this article?
7. What is the significance of food testing for individuals with food allergies?
8. Why are vitamins and minerals important, and how are they tested for in food?
9. What might happen if a food product contains undeclared allergens?
10. How can food testing help researchers understand the relationship between diet and health?
11. Explain why it's necessary to heat the mixture in the Benedict's test.
12. What are some common sources of carbohydrates in our diet?
13. How can food tests be applied in everyday life to make healthier food choices?
14. What are some limitations or challenges associated with food testing methods?
15. Imagine you are a food scientist. How would you use food tests to develop a nutritious and tasty food product?

L5 Enzymes

Digestive enzymes are the unsung heroes of your digestive system. They are special proteins that help your body break down the food you eat into smaller, more manageable pieces. Think of them as the "culinary chemists" of your stomach and intestines. Their primary job is to ensure that your body can extract all the essential nutrients from the food you consume.

Where Do Digestive Enzymes Come From?

These enzymes are produced by various organs in your body. The salivary glands in your mouth, the stomach lining, the pancreas, and the small intestine all contribute to the production of digestive enzymes. Each type of enzyme has a specific role in the digestive process.

Types of Digestive Enzymes

- Amylase: Found in saliva and pancreatic juices, it breaks down carbohydrates into sugars.
- Protease: Found in the stomach and small intestine, it helps digest proteins into amino acids.
- Lipase: Produced by the pancreas and small intestine, it breaks down fats into fatty acids and glycerol.

The Digestive Process

When you eat, the process begins in your mouth, where salivary amylase starts breaking down carbohydrates into sugars. Then, in the stomach, gastric juices containing protease start breaking down proteins into amino acids. Finally, in the small intestine, lipase takes center stage, breaking down fats into fatty acids and glycerol. These smaller molecules are then absorbed into your bloodstream for energy and growth.

The Importance of Digestive Enzymes

Digestive enzymes are crucial because they allow your body to access the nutrients it needs to function properly. Without them, the food you eat would remain too large and complex for your body to absorb and use effectively.

Common Digestive Problems

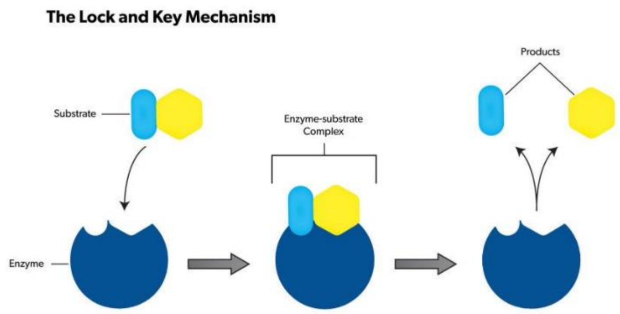
Sometimes, your body may not produce enough digestive enzymes, leading to digestive problems like indigestion, bloating, or diarrhoea. Additionally, conditions like lactose intolerance, where the body lacks the enzyme lactase to digest milk sugar, can also arise.

Independent practice

1. What are digestive enzymes, and what is their role in the digestive system?
2. Which organs in the body produce digestive enzymes?
3. Name three types of digestive enzymes and their functions.
4. Where does the digestion of carbohydrates begin, and which enzyme is responsible for it?
5. Which enzyme helps break down proteins into amino acids?
6. What role does lipase play in digestion?
7. Describe the digestive process from the mouth to the small intestine, including the enzymes involved.
8. Why are digestive enzymes essential for our health?
9. What can happen if your body doesn't produce enough digestive enzymes?
10. Explain the concept of lactose intolerance and the role of lactase enzyme.
11. How does the body absorb nutrients once they are broken down by digestive enzymes?
12. What are some common digestive problems that can occur due to enzyme deficiencies?
13. How can a balanced diet contribute to better digestive enzyme function?
14. Can you think of any real-life scenarios where understanding digestive enzymes is important for health?

L6 Enzyme action

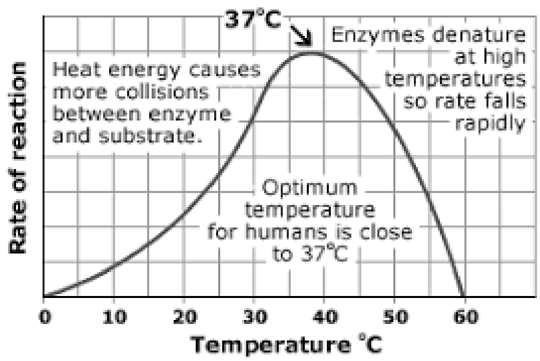
Enzymes are proteins. They are incredibly useful and play a role in every process that keep organisms alive. Enzymes are *biological catalysts*. A *catalyst* is a substance that speeds up a chemical reaction but is not used up. Enzymes can catalyse reactions that break large substances down into smaller ones or build large ones from smaller molecules. Enzyme are incredibly good at doing one specific function. An enzyme is able to bind to only specific molecules (known as the **substrate**). They have an area called the **active site** when the **substrate(s)** bind. This has a very specific shape. A model people use to explain this is the idea of a lock and key. The enzyme is the 'lock' and the substrate is the 'key'. The main role of enzymes in the digestive system is in the breakdown of large insoluble molecules into smaller soluble ones.



Biological reactions are affected by the same factors as any other chemical reaction: concentration, temperature, and surface area. We are going to focus on the effect of two variables on enzyme-controlled reactions: temperature and pH.

An increase in temperature will increase the rate of an enzyme-controlled reaction up to a certain amount. After about 41OC the enzymes will start to become denatured. When an enzyme is denatured it loses its shape, the active site can no longer bind to the substrate and no enzyme-substrate complexes are formed. When temperature is too low the reaction is slow because the enzymes don't have much kinetic energy and so rarely collide with their substrate

The graph to the right shows how enzymes in the human body are affected by temperature. But some extremophiles (organisms that live in extreme environments) have enzymes that work at temperatures up to 80OC.



Each enzyme has an optimum pH, outside of this pH the enzyme becomes less effective and eventually can be denatured. This is because the active site can change shape preventing the formation of enzyme-substrate complexes.

Glands in the stomach release a protease known as pepsin. This pepsin is adapted to work at low pH (acidic). The stomach also produces hydrochloric acid to ensure that pepsin can work most effectively. The stomach produces a thick layer of mucus which coats your stomach and prevents the hydrochloric acid from digesting the walls of the stomach. After being digested in the stomach, food moves into the small intestine. The enzymes in the small intestine, such as pancreatic amylase, prefer an alkaline environment. To produce an alkaline environment bile is produced in the liver. Bile is stored in the gall bladder and is then released into the small intestine to neutralise the acidic solution coming from the stomach. Bile has another job. It emulsifies the fats in our food. This increases the surface area of the fat molecules and allows lipase to break down fats faster.

Independent practice

1. What is the active site of an enzyme?
2. Use the lock and key diagram to explain why lipase will not work on a substrate of starch.
3. What does denatured mean?
4. What happens to enzymes when the temperature is:
   a.) Too low
   b.) Too high
5. Explain the effects of temperature on enzyme action.
6. What does the word optimum mean?
7. What is the optimum temperature for enzymes in the human body?
8. How does a change in pH cause enzymes to denature?
9. Using the graph given, calculate the rate of reaction of the enzyme. Remember to include units.
10. What is pepsin?
11. Where is bile produced?
12. State where bile is stored?
13. What are two differences between pepsin and pancreatic amylase?
14. What is the difference between pepsin and proteases produced by the pancreas?
15. What are the functions of hydrochloric acid in the stomach?
16. How is the stomach adapted to protect itself from pepsin and the hydrochloric acid?
17. Suggest the optimum pH for enzymes to work in the small intestine.
18. Suggest the optimum pH for enzymes to work in the stomach
19. What happens to an enzyme outside its preferred pH?
20. What else can cause enzymes to be denatured?
21. Which organ produces bile?

L7 Blood

Blood is a remarkable fluid that circulates throughout our bodies, delivering essential nutrients, oxygen, and removing waste products. Understanding the composition of blood is crucial in AQA Trilogy GCSE Science as it provides insights into various bodily functions and the importance of maintaining a healthy circulatory system. In this guide, we will delve into the components that make up blood, their functions, and their significance in maintaining overall health.

Blood is composed of four main components:

Red Blood Cells (Erythrocytes):

Red blood cells are the most abundant cells in the blood. Their primary function is to transport oxygen from the lungs to body tissues and remove carbon dioxide. Haemoglobin is a protein within red blood cells, binds to oxygen and gives blood its red color.

White Blood Cells (Leukocytes):

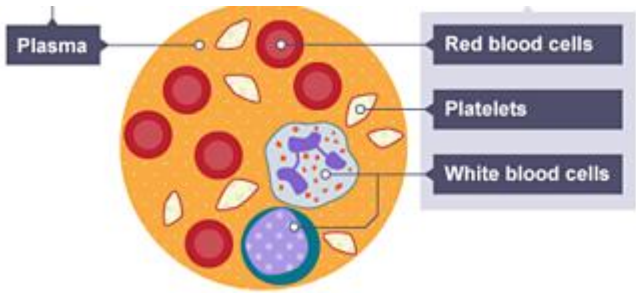
White blood cells play a vital role in the immune system, defending the body against infections and foreign invaders. They come in various types, each with specific functions such as phagocytosis (engulfing and destroying pathogens) and producing antibodies.

Platelets (Thrombocytes):

Platelets are cell fragments responsible for blood clotting and preventing excessive bleeding. When a blood vessel is damaged, platelets gather at the site and form a plug to stop bleeding.

Plasma:

Plasma is the liquid portion of blood, making up about 55% of its volume. It carries various substances, including nutrients, hormones, waste products, and antibodies. Plasma also helps regulate body temperature and maintain blood pressure.

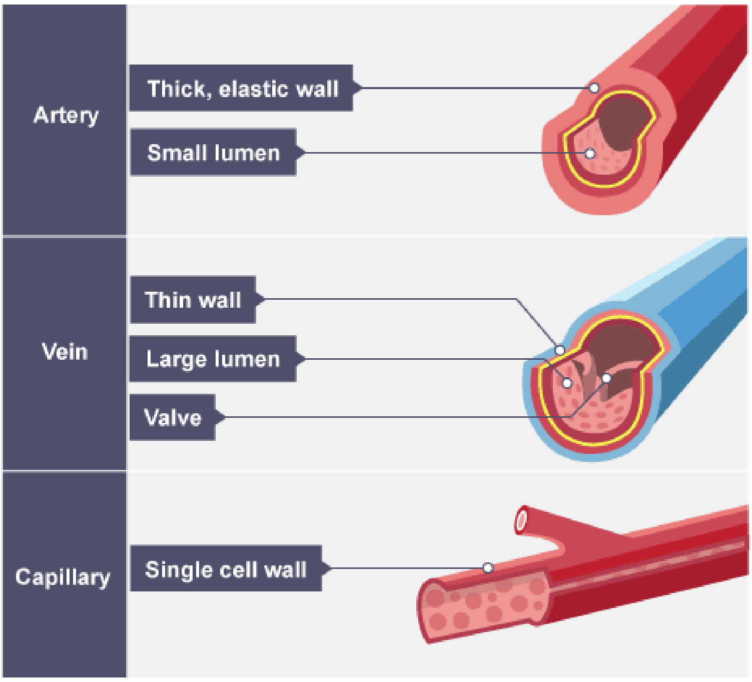


Independent practice

1. What is the primary function of red blood cells, and what gives them their red colour?
2. Explain the role of white blood cells in the immune system.
3. How do platelets contribute to blood clotting?
4. What is plasma, and what substances does it carry in the blood?
5. Which component of blood makes up most of its volume?
6. What is the role of haemoglobin in red blood cells?
7. Why is it essential to have a balanced composition of blood for overall health?
8. How do red blood cells differ from white blood cells in terms of their structure and function?
9. What happens when a blood vessel is damaged, and how do platelets respond?
10. Name at least two types of white blood cells and describe their functions.
11. How does plasma help regulate body temperature?
12. What is the significance of maintaining a healthy circulatory system?
13. Explain how oxygen is transported in the blood.
14. What is the primary function of antibodies produced by white blood cells?

L8 Blood vessels

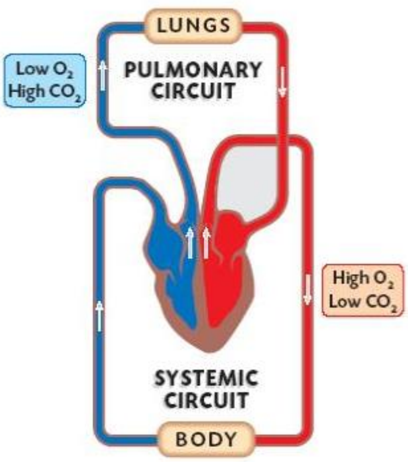
Blood is carried round our body in three main types of vessel. Each vessel is adapted for a different function.



Arteries carry blood away from the heart to the organs or body. The blood is usually oxygenated except for the pulmonary artery. Blood in the arteries is under high pressure. Arteries have a thick layer of muscle and elastic fibres along with thick walls to allow them to withstand the high pressure and to stretch. Arteries have a small lumen.

Veins carry blood away from organs towards the heart. The blood is low in oxygen, except for the pulmonary vein. veins have a larger lumen and relatively thin muscular and elastic walls. This is because the blood is under less pressure. Veins have valves to prevent blood flowing backwards.

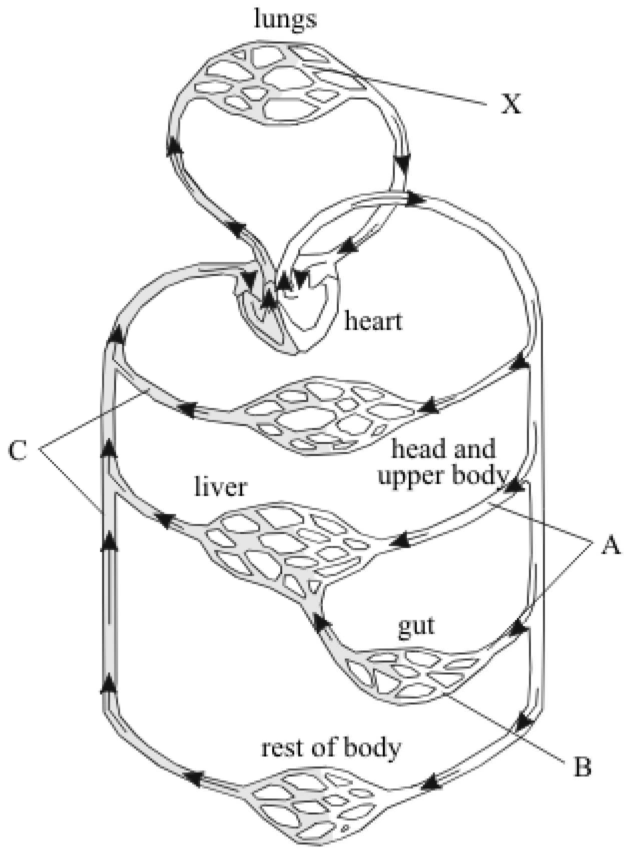
Capillaries connect arteries to veins. Capillaries are very narrow with thin walls. This ensures there is a short diffusion distance the inside of the capillary and surrounding cells. This enables substances such as glucose and oxygen to easily diffuse out of your blood into cells. Conversely carbon dioxide can easily do the opposite. Capillaries have very narrow lumens which only allow 1 cell to pass through at a time and their walls are only 1 cell thick.



Humans have a double circulation system. One transport system carries blood from your heart to the lungs and back again and the other system carries blood from the heart to all other organs of your body and back again. This double circulation system is advantageous to us as we need lots of oxygen and glucose transported round our body. The double circulation system allows lots of oxygenated blood to be transported quickly where it needs to go.

Independent practice

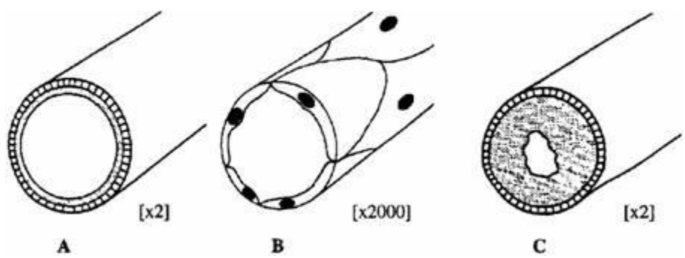
1. What are the three types of blood vessel?
2. What type of blood vessel carries blood away from the heart
3. Why do the arteries have a thick layer of elastic fibres and muscle tissue?
4. What is the pressure like inside the arteries?
5. Red blood cells have no nucleus, What is the function of the nucleus?
6. What do veins have that prevent back flow?
7. How is the pulmonary vein different to other veins?
8. What process will allow oxygen to move from the red blood cells into the muscle cells.
9. Order the blood vessels from largest lumen to smallest lumen
10. What is the benefit of the walls of capillaries only being 1 cell thick
11. Why is our circulation system described as a double circulation system?
12. What diffuses from the capillaries into cells?
13. Name the types of blood vessel labelled A, B and C on the diagram.
14. What is the job of the circulatory system?
15. Give **two** ways in which the composition of blood changes as it flows through the vessels labelled X on the diagram.



16. The drawings show the structure of three types of blood vessel, **A**, **B** and **C**. They are drawn to the scales indicated.

(a) Name the **three** types of blood vessel.

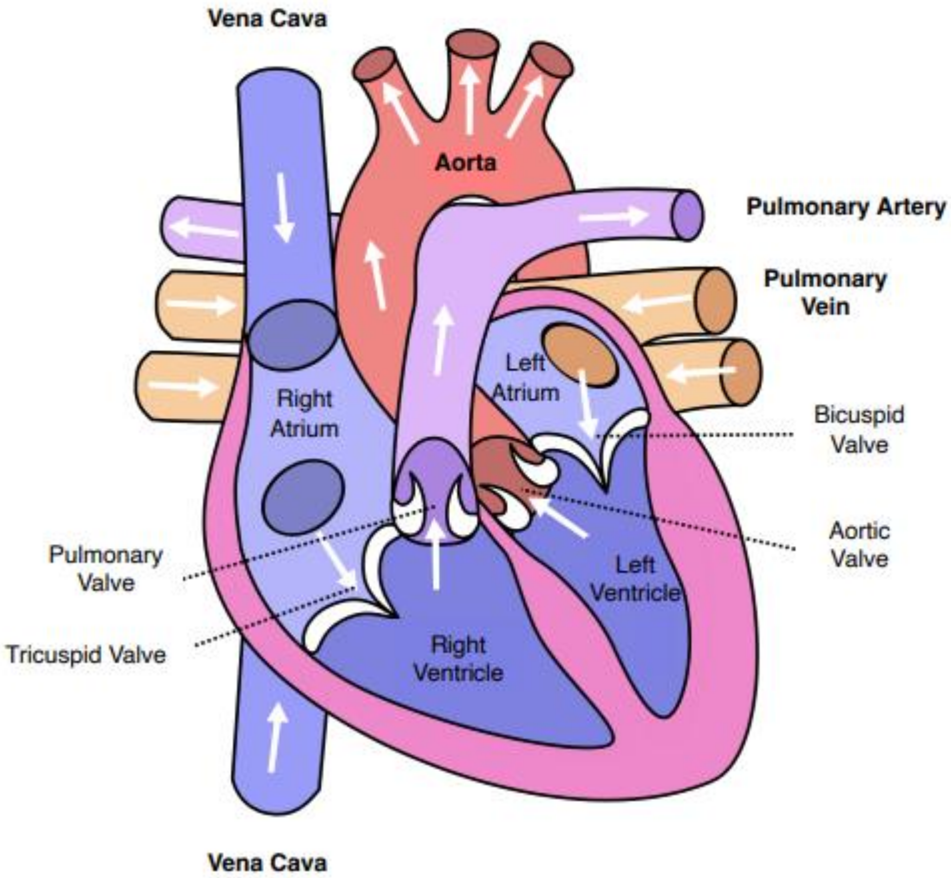
(b) Describe the job of blood vessel **B**.



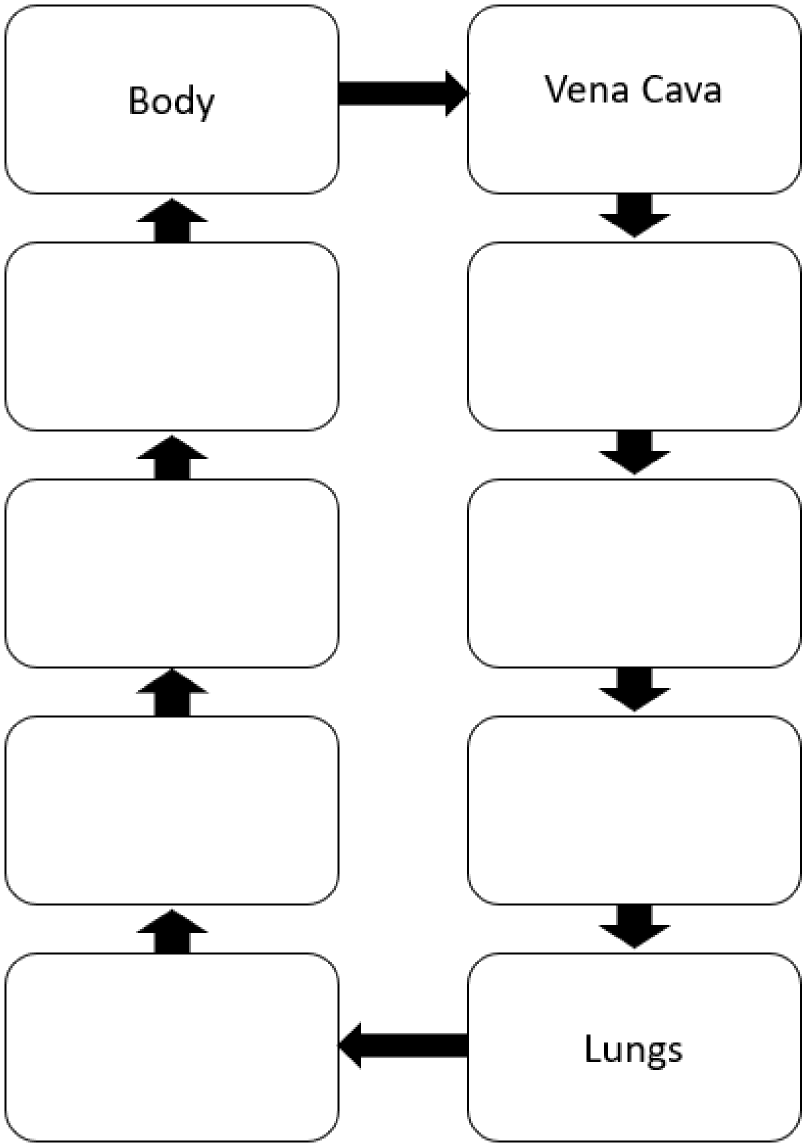
L9 The heart

Your heart is the organ that pumps blood round our body. It is made up of two pumps. The walls of your heart are almost entirely muscle and the blood vessel that supplies the heart with oxygen is called the coronary artery.

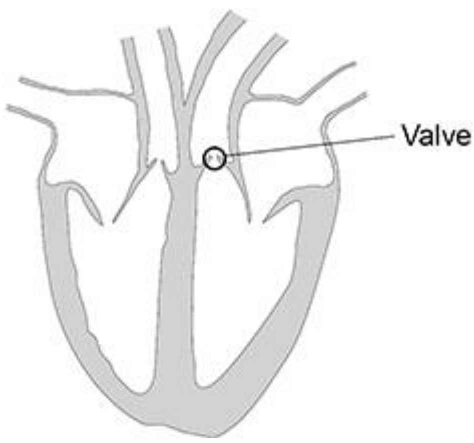
Blood enters the **right atrium** through the **vena cava** (a vein that brings deoxygenated blood back to the heart). Blood will then travel from the **right atrium** to the **right ventricle**. The **tricuspid valve** will then close to prevent backflow. When the **right ventricle** contracts deoxygenated blood is forced into the **pulmonary artery** which travels to the **lungs** to pick up oxygen. This newly oxygenated blood is returned to the heart by the **pulmonary vein** into the **left atrium**. Blood flows into the **left ventricle**, the **bicuspid valve** closes to prevent backflow. The **left ventricle** pumps oxygenated blood around the body via the **aorta**. Whenever blood enters the aorta or pulmonary artery valves at the beginning of these vessels close. The muscle wall of the left ventricle is thicker than elsewhere. This allows the blood leaving the left ventricle to be under the high pressure needed to pump it round the **body**.



1. Add as much detail as possible to this diagram to show the route of the blood.



2. What is the name of the blood vessels that supply the heart with oxygen?
3. What is the name given to the top chambers of the heart?
4. What blood vessel supplies the left atrium with blood?
5. What blood vessel supplies the right atrium with blood?
6. What is special about the pulmonary artery?
7. What type of blood is found in the right ventricle?
8. Why is the heart described as an organ?
9. Valves in the heart keep the blood flowing through the heart in one direction.
10. The diagram shows the heart with one of the valves labelled.



11. Explain the effects on a person if the valve labelled in the figure above developed a leak.

L10 The lungs

The lungs, two spongy organs located in the chest cavity, are a crucial part of the respiratory system. They enable us to breathe, providing our bodies with the oxygen needed for survival and removing carbon dioxide, a waste product produced by our cells.

Structure of the Lungs

The lungs are divided into lobes – three on the right and two on the left. Each lobe is further divided into smaller units called lobules. This branching structure ensures an extensive surface area for efficient gas exchange.

Within the lungs, you'll find millions of tiny air sacs called alveoli. Alveoli are surrounded by capillaries and are the sites where oxygen and carbon dioxide exchange takes place. Imagine them as tiny, elastic balloons that inflate and deflate with every breath.

Function of the Lungs

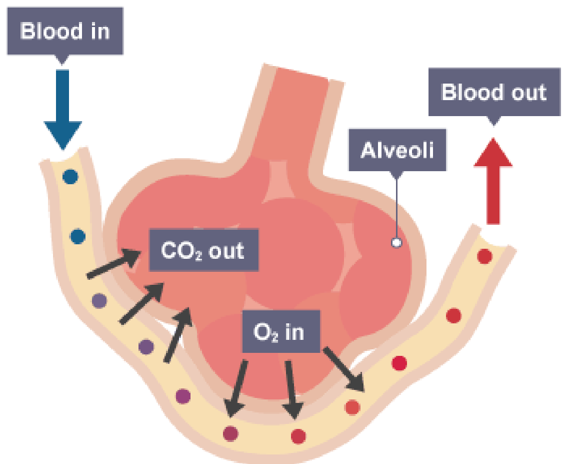
Breathing In: When you inhale, your diaphragm contracts and moves downward, and your ribcage expands. This creates a vacuum in your chest cavity, drawing air into your lungs.

Gas Exchange: In the alveoli, oxygen from the inhaled air passes through the thin walls of the alveoli into the bloodstream, binding to hemoglobin in red blood cells. Simultaneously, carbon dioxide, a waste product from cellular respiration, diffuses from the blood into the alveoli to be exhaled.

Breathing Out: When you exhale, your diaphragm relaxes, your ribcage contracts, and the volume of your chest cavity decreases. This forces carbon dioxide-rich air out of your lungs.

The Alveoli: Where Breathing Meets Blood

The alveoli are tiny, air-filled sacs found in your lungs. They play a crucial role in the respiratory system, allowing your body to get the oxygen it needs and get rid of carbon dioxide, a waste product. Think of them as millions of tiny balloons clustered together inside your lungs.



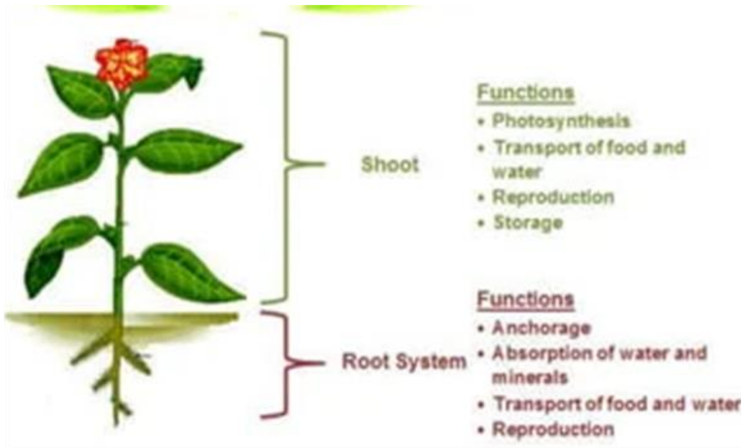
When you breathe in, air containing oxygen enters your lungs through the windpipe and bronchi, finally reaching the alveoli. These microscopic sacs have very thin walls, which are covered in tiny blood vessels called capillaries. This is where the magic happens!

Oxygen from the air in the alveoli diffuses, or moves, into the blood in the capillaries. At the same time, carbon dioxide, which has been carried by the blood from your body's cells, moves into the alveoli to be breathed out. This exchange of gases, called respiration, is essential for survival. The oxygen in your blood is then transported to all your body's cells, providing the energy they need to function.

Independent practice

1. What is the main function of the lungs in the human body?
2. How many lobes are there in the human right lung?
3. Describe the structure of alveoli and their role in gas exchange.
4. Explain how the diaphragm and ribcage work together during inhalation.
5. What is the importance of the branching structure of the lungs?
6. What happens to the air pressure in the chest cavity during inhalation?
7. How does oxygen reach the bloodstream from the alveoli?
8. What is the role of red blood cells in gas exchange?
9. Why is carbon dioxide considered a waste product in the body?
10. What are the alveoli, and where are they located?
11. Describe the process of exhalation.
12. How does the structure of the lung tissue facilitate efficient gas exchange?
13. What happens to the ribcage and diaphragm during exhalation?
14. Why is it crucial for the lungs to have a large surface area for gas exchange?
15. Can you explain the connection between oxygen and hemoglobin in the bloodstream?
16. What is the primary function of the alveoli in the respiratory system?
17. How does oxygen from the air enter the bloodstream in the alveoli?
18. What happens to carbon dioxide in the alveoli?
19. What are capillaries, and how are they related to the alveoli?
20. Why is the exchange of gases in the alveoli crucial for our body?
21. How is oxygen transported from the alveoli to body cells?
22. What happens to the carbon dioxide that leaves the body through the alveoli?
23. Describe the structure of the alveoli that enables efficient gas exchange.
24. Can you explain why the alveoli are often compared to tiny balloons?
25. What is the role of the windpipe and bronchi in the respiratory system?
26. How does the respiratory system work together with the circulatory system?
27. Why is it important for our body to get rid of carbon dioxide?
28. What might happen if the walls of the alveoli were thicker?

L11 How are plants organised.



The basic unit of plant organization is the plant cell. Plant cells have a unique feature called a cell wall, a rigid outer layer that gives the cell its structure and protection. Inside the cell wall is the cell membrane, which controls what enters and exits the cell. Plant cells also contain a large central vacuole, which stores water and other essential substances.

Tissues: Working Together

Plant cells come together to form tissues. Two main types of tissues in plants are:

Epidermal Tissue: This tissue covers the outer surface of the plant and is responsible for protection and water absorption.

Vascular Tissue: Vascular tissue includes xylem and phloem. Xylem transports water and nutrients from the roots to the rest of the plant, while phloem transports sugars produced in the leaves to other parts of the plant.

Organs: Specialized Structures

Organs in plants are specialized structures that perform specific functions. Some essential plant organs include:

- Leaves: Leaves are the primary sites for photosynthesis, where plants convert sunlight, water, and carbon dioxide into sugars and oxygen.
- Stems: Stems provide support for the plant and transport water, nutrients, and sugars between different parts of the plant.
- Roots: Roots anchor the plant in the soil and absorb water and nutrients from the soil.
- Meristem tissue: found in shoots and root tips and are required for growth

When we combine these organs, we get the overall plant body. Plants can be classified into different types based on their structure, such as trees, shrubs, and herbaceous plants. Each type has specific adaptations to its environment.

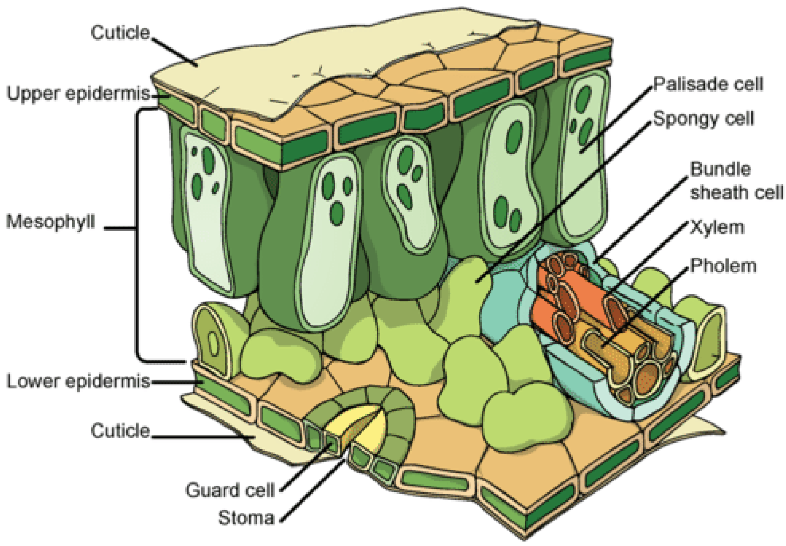
Plant Growth and Development

Plants, unlike animals, continue to grow throughout their lives. They exhibit both primary and secondary growth. Primary growth occurs at the tips of stems and roots, increasing the plant's length. Secondary growth results in the thickening of stems and roots, usually in woody plants.

Independent practice

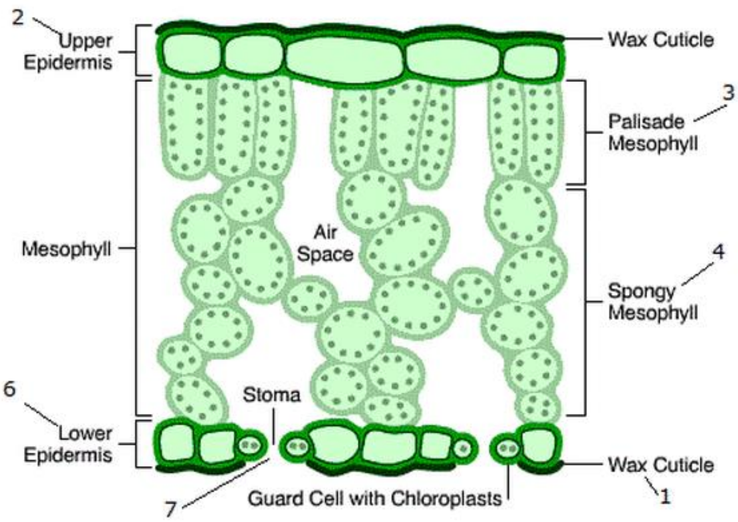
1. What is the fundamental unit of plant organization?
2. What is the function of the cell wall in plant cells?
3. Name two types of plant tissues and describe their functions.
4. Explain the roles of xylem and phloem in plants.
5. List the three primary plant organs and describe their functions.
6. What is the main function of leaves in a plant?
7. How do stems contribute to a plant's growth and survival?
8. What are the functions of roots in plants?
9. What is the function of meristem tissue
10. Differentiate between primary and secondary growth in plants.
11. What are the primary products of photosynthesis?
12. Describe the structure and function of the epidermal tissue.
13. Why is the central vacuole important in plant cells?
14. How do the structures of trees, shrubs, and herbaceous plants differ?
15. Explain why plant organization is essential for plant growth and survival.

L12 Plant leaves



Understanding the intricacies of a leaf's anatomy is crucial because leaves are the primary sites for photosynthesis, a vital process that fuels life on Earth. In this guide, we will simplify the complex world of plant leaf structure, breaking it down into manageable pieces for a 15-year-old student like you. By the end of this explanation, you'll be well-prepared to answer questions about leaf structure confidently.

Plant Leaf Structure



Epidermis: The outermost layer of the leaf, called the epidermis, acts like skin, protecting the leaf. It contains tiny openings called stomata, which allow gases like carbon dioxide and oxygen to enter and exit.

Cuticle: A waxy layer covering the epidermis that reduces water loss by evaporation.

Palisade Mesophyll: Beneath the upper epidermis, you'll find the palisade mesophyll. It's packed with chloroplasts, the sites where photosynthesis occurs.

Spongy Mesophyll: Below the palisade mesophyll, this layer contains air spaces, allowing for the exchange of gases needed for photosynthesis.

Vascular Bundles: These are like the plant's highways. Xylem vessels transport water and minerals from the roots to the leaf, while phloem tubes transport sugars produced during photosynthesis to other parts of the plant.

Guard Cells: Surrounding stomata, these cells control their opening and closing to regulate gas exchange and prevent excessive water loss.

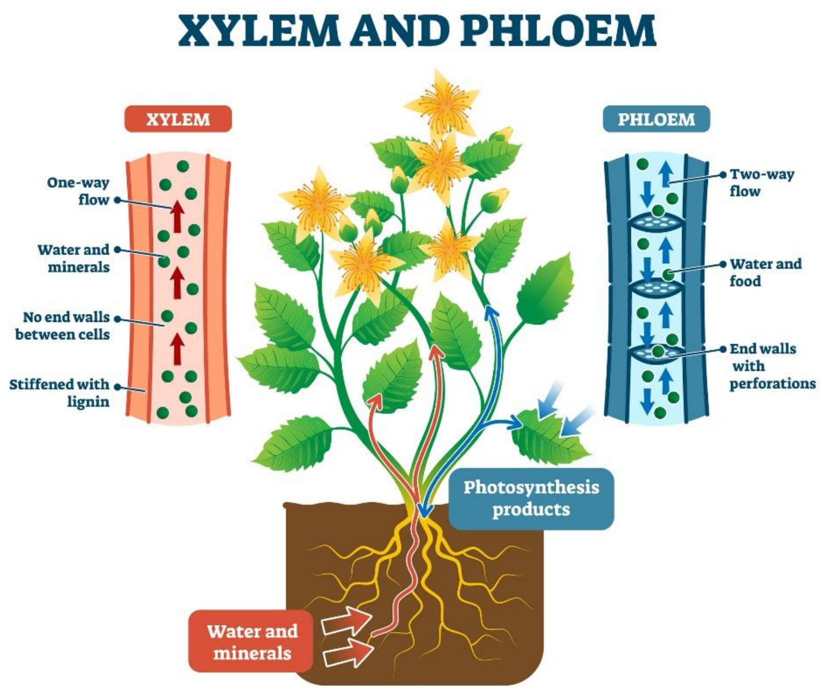
Leaf structure is intimately connected to photosynthesis, the process by which plants convert sunlight, carbon dioxide, and water into glucose and oxygen. The palisade mesophyll, with its abundance of chloroplasts, plays a crucial role in capturing sunlight and converting it into energy. Meanwhile, the stomata on the epidermis permit the entry of carbon dioxide, which is essential for photosynthesis, while releasing oxygen as a byproduct. The vascular bundles ensure a constant supply of water and nutrients, making photosynthesis possible.

Independent practice

1. What is the primary function of the epidermis in a leaf's structure?
2. How does the cuticle contribute to a leaf's survival?
3. Where does photosynthesis primarily take place in a leaf?
4. What are chloroplasts, and what is their role in photosynthesis?
5. What is the significance of air spaces in the spongy mesophyll layer?
6. Explain the function of xylem vessels in a leaf.
7. How do guard cells regulate the opening and closing of stomata?
8. Describe the role of phloem tubes in a plant's leaf structure.
9. What gases are exchanged through stomata during photosynthesis?
10. What is the primary product of photosynthesis?
11. How does a leaf's structure support the process of photosynthesis?
12. Why is photosynthesis crucial for all living organisms on Earth?
13. How does the anatomy of a leaf differ from that of a stem or root?
14. Explain the relationship between vascular bundles and water transport in a plant.

L13 Xylem and Phloem

Xylem and Phloem tissue make up the vascular bundles which run from the roots to the leaf. These tissues are crucial components of plants, enabling them to transport water, nutrients, and food throughout their structures.



Xylem and phloem tissues are specialized plant tissues responsible for the transport of vital substances. Let's break down what each of them does:

1. Xylem Tissue:

Xylem primarily transports water and minerals absorbed by the plant's roots. It consists of hollow, dead cells with thick walls, forming a pipeline-like structure. Xylem also provides structural support to the plant.

2. Phloem Tissue:

Phloem transports the products of photosynthesis, such as sugars, from the leaves to other parts of the plant. Unlike xylem, phloem contains living cells. Phloem's two main cell types are sieve tubes, responsible for transport, and companion cells, which support the sieve tubes.

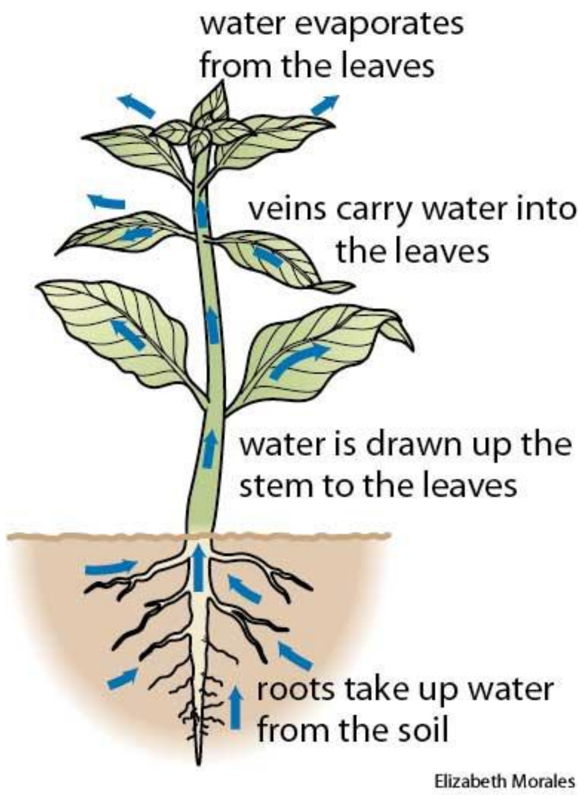
Guard cells and stomata play a vital role in a plant's life by regulating the process of transpiration. Transpiration is the loss of water vapor from the surface of a plant, mainly through small openings called stomata found on the underside of leaves.

Stomata are like tiny pores or mouths of the plant, surrounded by a pair of specialized cells known as guard cells. These guard cells control the opening and closing of stomata. When the plant needs to take in carbon dioxide for photosynthesis or release excess water vapor to cool itself, the guard cells swell with water, causing the stomata to open. Conversely, when the plant needs to conserve water, the guard cells lose water, causing the stomata to close.

Independent practice

1. What is the primary function of xylem tissue in plants?
2. Describe the structure of xylem cells and their role in plant support.
3. Explain how transpiration helps in water transport through xylem tissue.
4. What is lignin, and how does it contribute to xylem's function?
5. How do cohesion and adhesion forces aid in water movement in xylem?
6. What is the driving force for water transport in plants?
7. What is the primary function of phloem tissue in plants?
8. Contrast the characteristics of xylem and phloem cells in terms of living or dead.
9. What is translocation, and why is it crucial for plant survival?
10. What are source tissues and sink tissues in the context of phloem transport?
11. Describe the role of companion cells in the phloem.
12. Why is the balance between xylem and phloem crucial for a plant's health?
13. How would a plant be affected if its xylem tissue were severely damaged?
14. What happens if a plant's phloem tissue is impaired or blocked?
15. What are stomata, and where are they primarily located in a plant?
16. Explain the role of guard cells in controlling stomatal openings.
17. Why is transpiration important for a plant's survival and growth?
18. In what conditions would a plant be more likely to close its stomata?
19. How does the process of transpiration impact the environment and ecosystem around plants?
20. Write a paragraph which compares the structure and functions of the xylem and phloem tissue.

L14 Translocation and transpiration



Transpiration is the process by which water vapor is released from the tiny pores, called stomata, in the leaves of a plant. This process is essential for the plant's survival because it helps in the absorption of water and nutrients from the soil through the roots. It also plays a crucial role in maintaining the plant's shape and structure. Transpiration happens in the xylem tissue.

Translocation refers to the movement of sugars, produced during photosynthesis, from the leaves to other parts of the plant, such as the roots and fruits. This process ensures that all parts of the plant receive the necessary nutrients and energy for growth and development. Translocation happens in the phloem.

Factors Affecting Transpiration:

Understanding the factors that influence transpiration is essential as they directly impact a plant's ability to regulate its water loss. Here are some key factors:

Temperature: Higher temperatures generally lead to increased transpiration rates as they cause water to evaporate more quickly from the leaves.

Humidity: Humidity refers to the amount of moisture in the air. High humidity reduces transpiration because the air is already saturated with water vapor, making it difficult for the plant to release more.

Wind: Wind can increase transpiration rates by removing the layer of humid air surrounding the leaves, allowing for faster water vapor diffusion.

Light: Light is essential for photosynthesis, which in turn affects transpiration. Plants tend to transpire more in the presence of light because they're actively photosynthesizing.

Soil Moisture: Adequate soil moisture ensures that a plant can absorb enough water from the soil. When soil moisture is low, a plant may reduce transpiration to conserve water.

Stomatal Density: The number and size of stomata on leaves can vary between plant species and affect transpiration rates. More stomata generally lead to increased transpiration.

Leaf Surface Area: The total leaf surface area also impacts transpiration. Plants with larger leaves tend to transpire more than those with smaller leaves.

Type of Plant: Different types of plants have different transpiration rates. For example, succulent plants have adaptations to reduce transpiration because they grow in arid environments.

<u>Independent practice:</u>

1. Define transpiration and explain its importance to plants.
2. In which tissue does transpiration occur
3. In which tissue does translocation occurr
4. What is translocation, and why is it necessary for plant growth?
5. How does temperature affect transpiration rates in plants?
6. Describe the impact of high humidity on transpiration.
7. How does wind influence the transpiration process in plants?
8. Explain the relationship between light and transpiration.
9. Why is soil moisture crucial for regulating transpiration?
10. What are stomata, and how do they contribute to transpiration?
11. How does the surface area of leaves affect transpiration?
12. Provide an example of a plant adaptation for reducing transpiration.
13. What is the role of roots in the translocation of nutrients within a plant?
14. Compare and contrast transpiration and translocation in plants.
15. If you were growing a plant in a hot and dry environment, how would you modify its care to reduce transpiration?
16. Imagine you have two identical plants, one in a humid room and one in a dry room. Predict which plant will transpire more and explain why.
17. Viv says transpiration and translocation are the same thing. Explain why she is wrong.
18. Finish the sentences:

a. Transpiration and translocation are different because….
b. Transpiration and translocation are different but...
c. Transpiration and translocation are different and…