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O' Level Combined Science

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COMBINED SCIENCE

TOPIC ONE

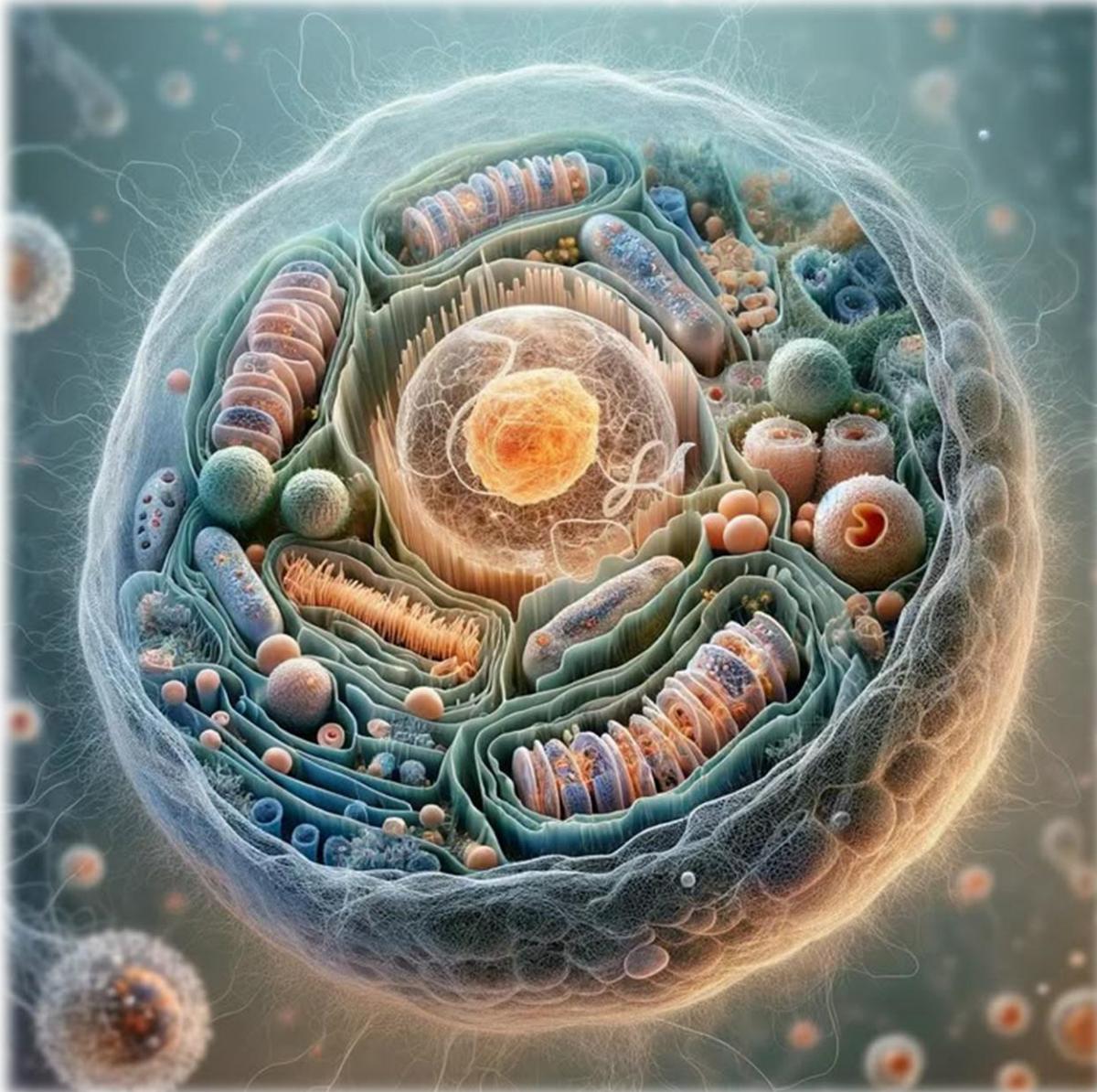
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Structure and Function of a Cell



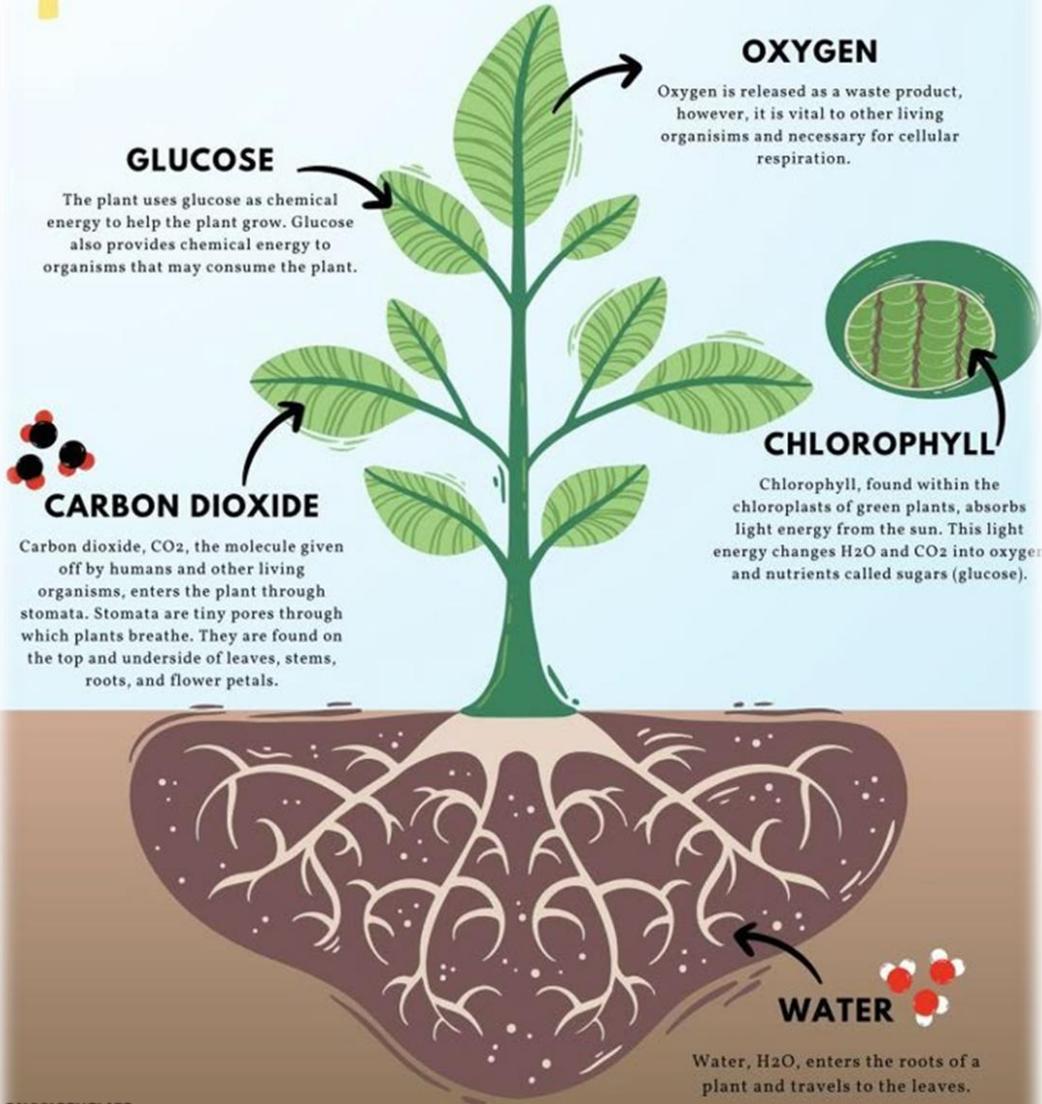
- Learners will study specialized cells—red blood cells, muscle cells, palisade cells, and root hair cells—focusing on their structures and functions.
- They will draw and label cells, observe prepared slides using microscopes and ICT tools, and relate structure to function. Visual aids and accessible tools support inclusive learning.

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PHOTOSYNTHESIS

Carbon Dioxide + Water + Light --> Glucose + Oxygen

Photosynthesis is the process in which green plants, algae, and some bacteria use sunlight, water, and carbon dioxide to make their own food. Herbivores obtain energy by eating these plants and in turn, carnivores eat the herbivores. As a foundational part of the food chain, almost all living organisms rely on photosynthesis.



Nutrition – Photosynthesis

- Learners will explore factors affecting photosynthesis—light, water, carbon dioxide, and chlorophyll—through descriptions and experiments.
- They will test for starch and oxygen, examine leaf structures using microscopes, and understand the roles of carbohydrates and oxygen in plant processes. Resources include leaves, pondweed, light sources, and ICT tools.

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Human Nutrition

- Learners will study the human alimentary canal, its parts and functions, and types of teeth involved in mechanical digestion.
- They will explore mechanical and chemical digestion, enzyme functions, and food breakdown.
- Practical activities include using models, digestion simulations, enzyme experiments, and food tests for glucose, proteins, and fats.

The Digestive System

What is the digestive system?
The digestive system, or **gastrointestinal tract**, is essentially a muscular tube in which intake, digestion and absorption of nutrients takes place. Food, broken down mechanically in the mouth, is propelled through a series of different accessory and absorptive organs. Within these organs, food is broken down further by digestive enzymes into components small enough to be absorbed. The digestive system also uses specialised components used they are finally to be expelled at the end of the gastrointestinal tract.

The mouth & salivary glands
Chewing, the mechanical action of the teeth and tongue, begins the breakdown of solid food. It greatly increases food's surface area and mixes the food with the secretion of the salivary glands, called **saliva**. Saliva acts like a solvent, changing the work and dissolving food molecules so they can be used. Its enzymes also begin the digestion of starch, a form of carbohydrate, and its mucus lubricates the pharynx for swallowing.

The stomach
Swallowed food reaches the stomach after being pushed through the oesophagus by wave-like muscular contractions called **peristalsis**. Once in the stomach, food mixes with hydrochloric acid and mucus produced by the stomach lining to begin the digestion of proteins. This lining produces a layer of mucus to protect itself from the acid. The stomach also functions to store partially digested food, allowing for processing later by the small intestine.

Liver, pancreas & gallbladder
After leaving the stomach, chyme moves into the abdomen, the first part of the small intestine, where it is mixed with bile produced by the liver and pancreatic juice produced by the pancreas. Bile acts as an emulsifying agent on the chyme while the pancreatic juice containing numerous digestive enzymes further breaks down fats, proteins and carbohydrates. Enzyme bile is stored in the **gallbladder**.

Stomach wall
Mucosa
Submucosa
Serosa
Muscularis
Circular
Longitudinal
Single columnar epithelial cells
Gastric pit
Capillary
Parietal cells produce hydrochloric acid
Goblet cells produce mucus
Gastric glands

Small intestine
The small intestine consists of three parts: the **duodenum**, **jejunum** and **ileum**. Digestion occurs throughout the entire length of the small intestine, accompanied by the absorption of the resulting molecules by the intestinal wall. With peristalsis of the lining of the small intestine, gently moving the surface area of the absorptive mucosal cells, the epithelium. Each cell of the epithelium has microvilli, which further increase the absorptive surface area.

Intestinal lining
Microvilli
Absorptive epithelial cells
Absorbed simple sugars and amino acids pass into capillaries
Absorbed fatty acids pass into lacteals
Arteriole
Lymphatic vessel
Vein
Capillary

Large intestine
The large intestine consists of the cecum, caecum, ascending, transverse, descending and sigmoidal and the rectum. An enlarged caecum at the junction of the large intestine, caecum and sigmoidal, are absorbed. The remaining waste is moved, formed and expelled.

Rectum & anal canal
Rectum
External anal sphincter muscle
Internal anal sphincter muscle
Subcutaneous

Absorption
Specialised absorptive cells in the epithelium of the small intestine absorb the small molecules produced by digestion. Once absorbed, simple sugars (like carbohydrates) and amino acids (from proteins) enter the capillaries on their way to the general use. Absorbed fats enter the lymphatic vessels of the milk, called **lacteals**, before eventually entering the blood.

Peristaltic action
Food is moved through the digestive system by a series of muscle contractions called **peristalsis**. The contraction of the muscle behind the food forces it into the next section, where the muscle has relaxed.

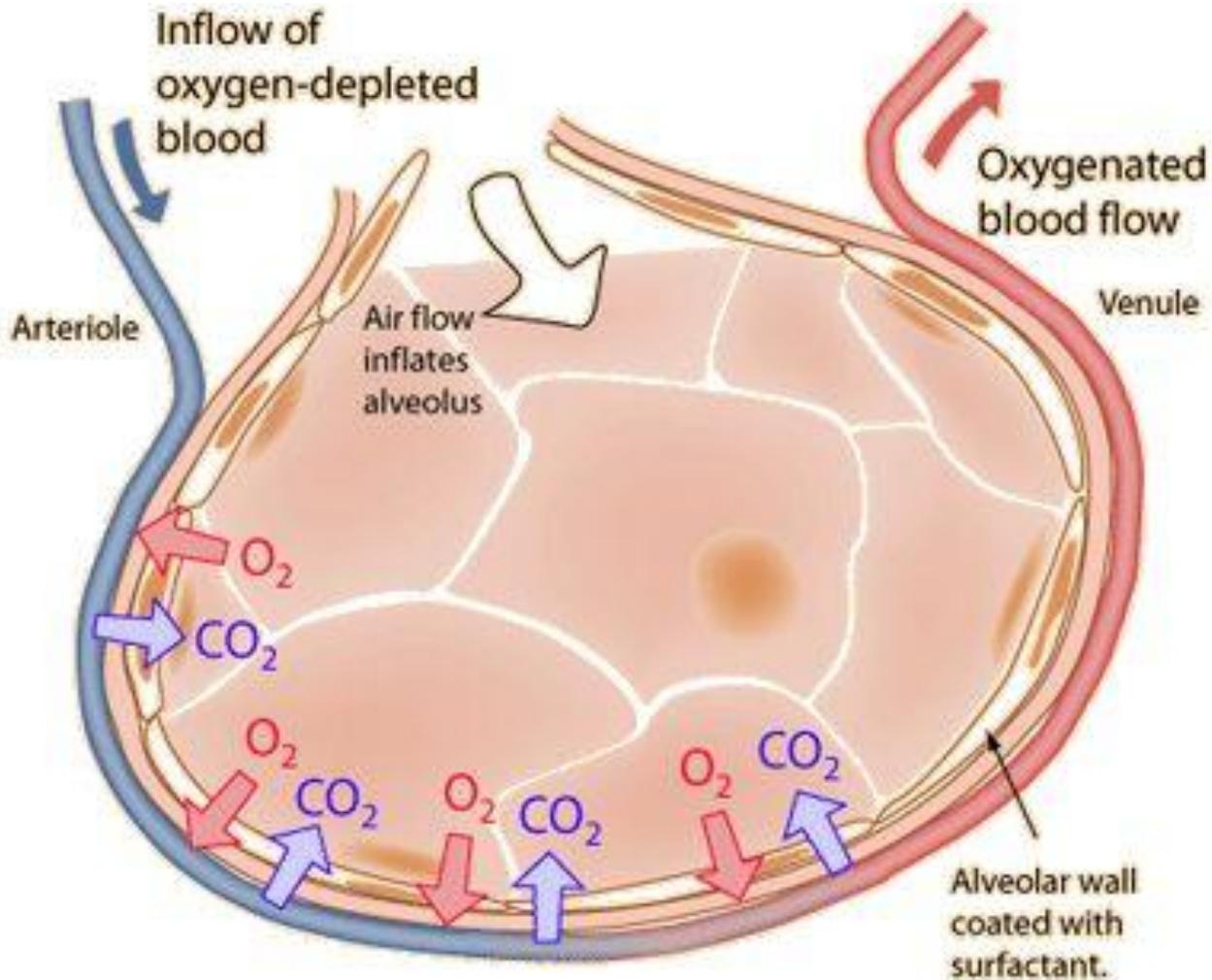
Layers of large intestine
Longitudinal muscle
Circular muscle
Serosa

Large intestine
Free tenia
Hemocolic valve
Sigmoidal fold
Opening of appendix
Cecum

Peristaltic action
Levator ani muscle
Internal anal sphincter muscle
External anal sphincter muscle
Subcutaneous

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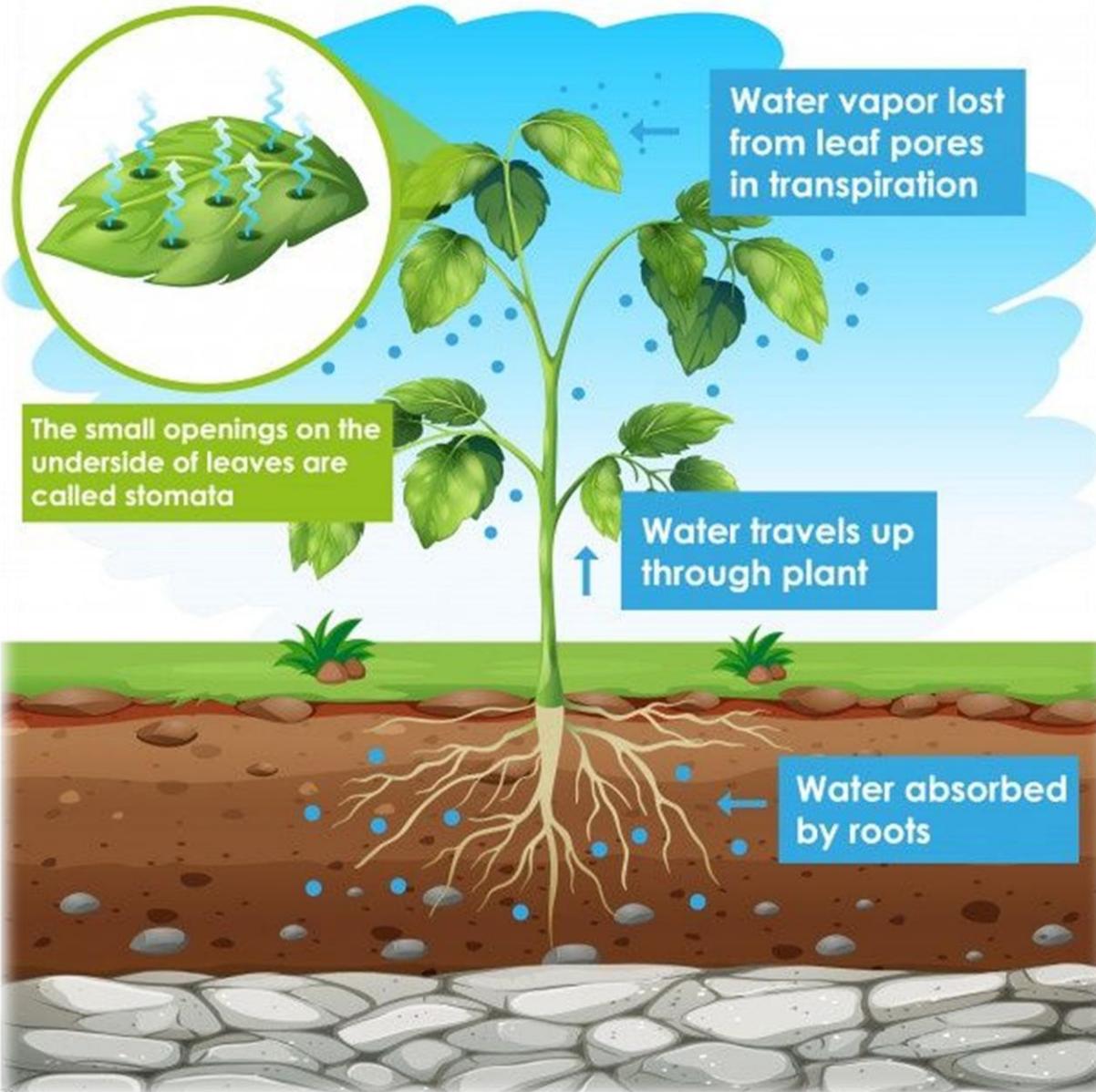
Respiratory Systems – Gaseous Exchange in Alveoli



- Learners will explore gaseous exchange in alveoli, comparing inhaled and exhaled air and explaining oxygen and carbon dioxide diffusion.
- They will examine alveolar adaptations for efficiency.
- Experiments using limewater or bicarbonate indicators will demonstrate air composition differences.

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TRANSPIRATION



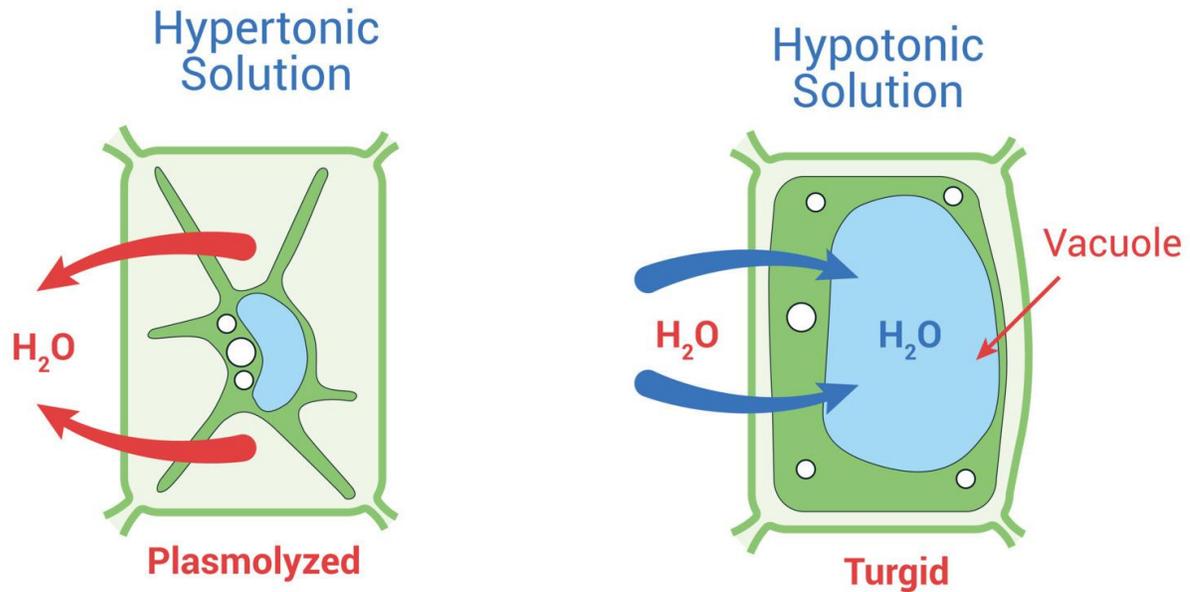
Transport Systems – Transpiration

- Learners will study transpiration in plants, its importance in water and mineral uptake, and cooling.
- They will identify factors affecting transpiration—wind speed, temperature, humidity, surface area, light intensity, and stomata.
- Using a potometer, students will measure transpiration rates, conduct experiments, and discuss its significance to plant health.

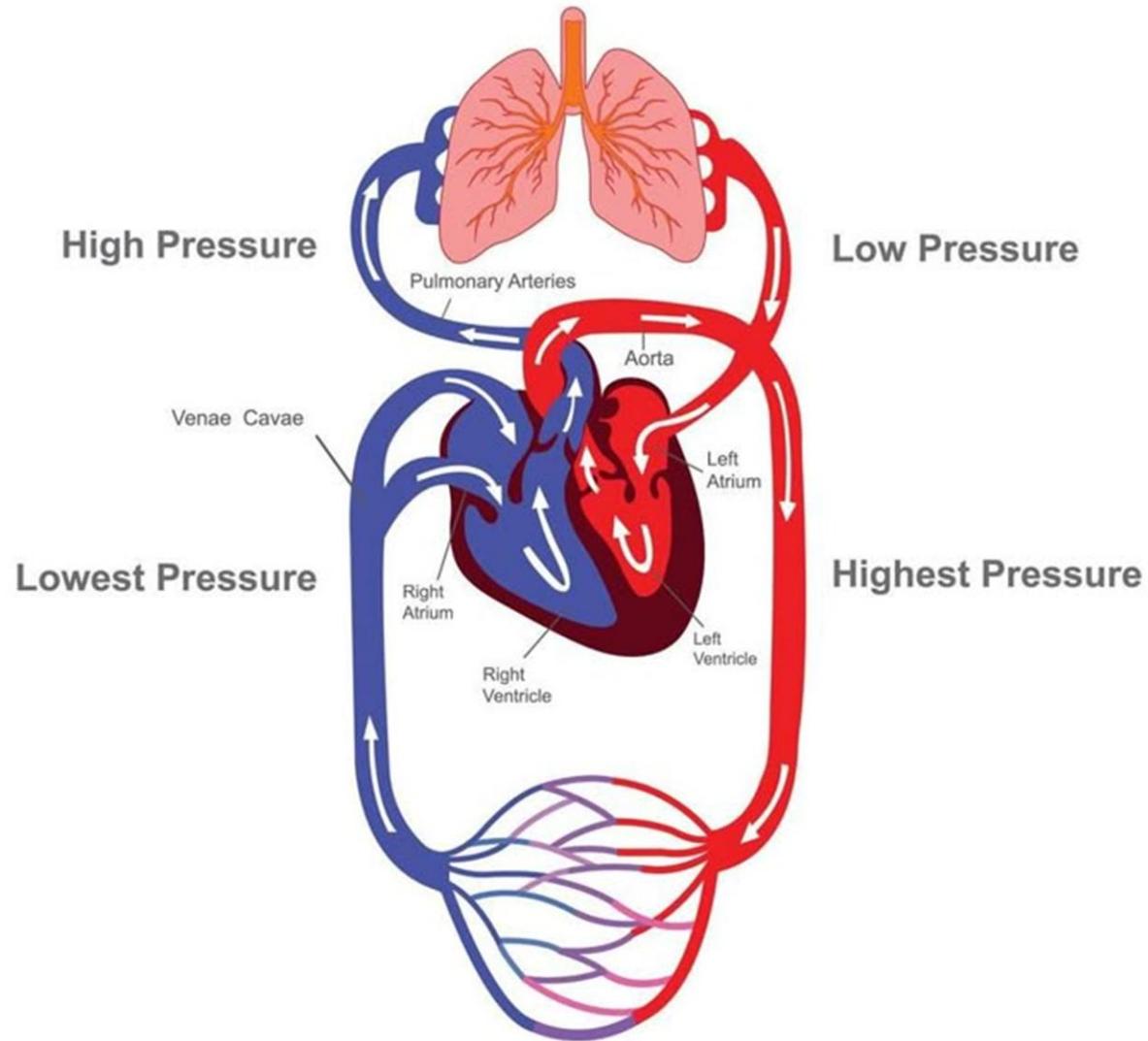
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Plasmolysis and Turgidity

- Learners will define plasmolysis and turgidity and describe the effects of water loss and gain in plant cells.
- Through experiments using potato strips and visking tubing, they will observe the movement of water and the resulting changes in cell structure.
- Video simulations will also help in visualizing these concepts.



Heart and Blood Circulation System



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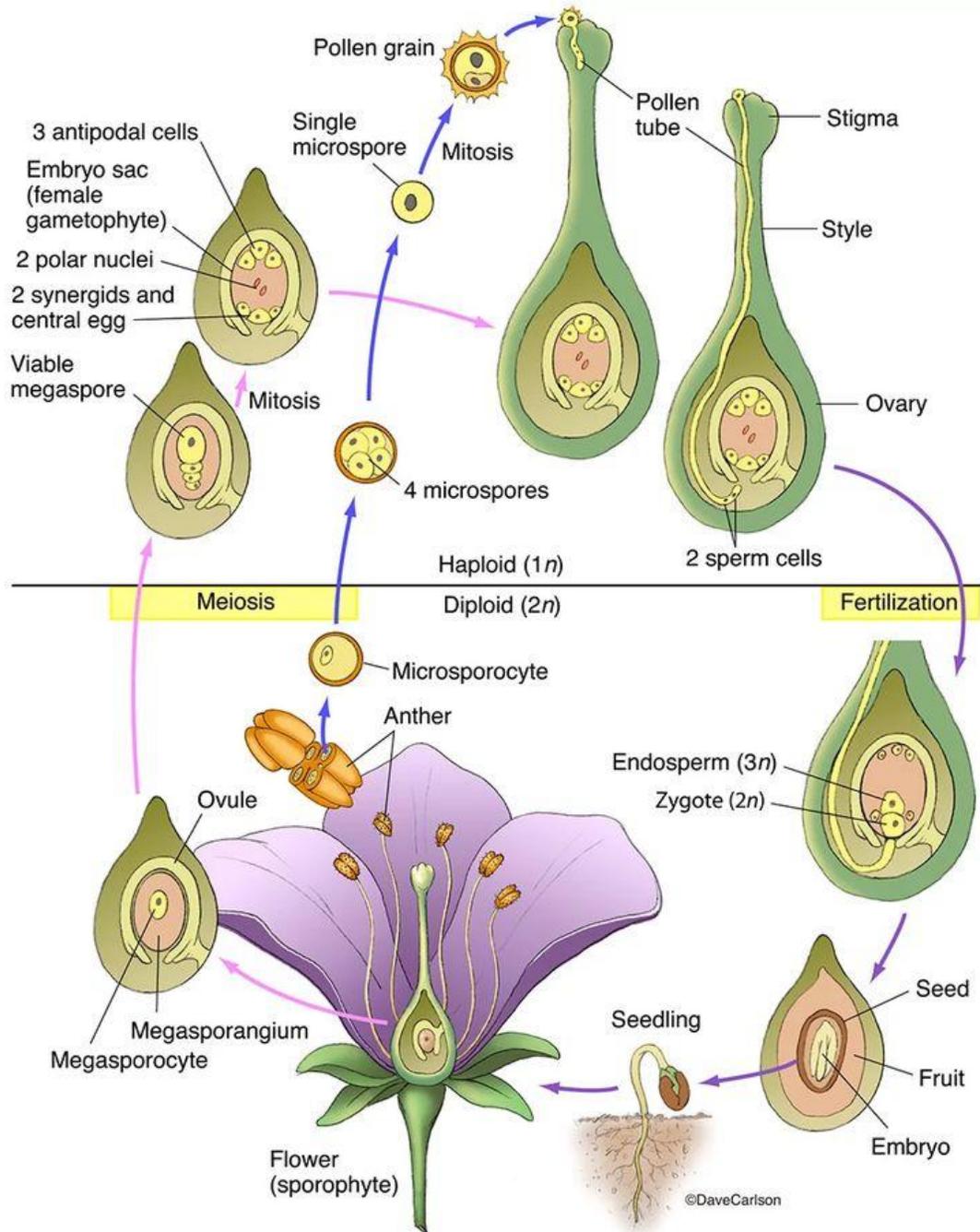
Blood Circulation

- Learners will study the human double circulatory system, understanding blood flow through the heart, lungs, and body, and the transport of oxygen and nutrients.
- Visual aids like video simulations and models will support learning.
- Inclusive access will be ensured through multimedia tools and assistive technologies

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REPRODUCTIVE SYSTEMS IN PLANTS

- Learners will study the reproductive systems in plants by exploring the structures of wind and insect pollinated flowers.
- They will examine, compare, and draw these flower types, identifying key adaptations for each pollination method. Practical activities and observations will enhance understanding of plant reproductive strategies.



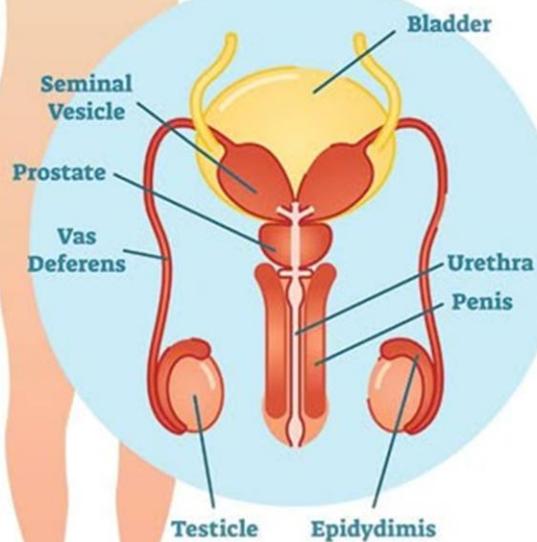
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REPRODUCTIVE SYSTEMS IN HUMANS

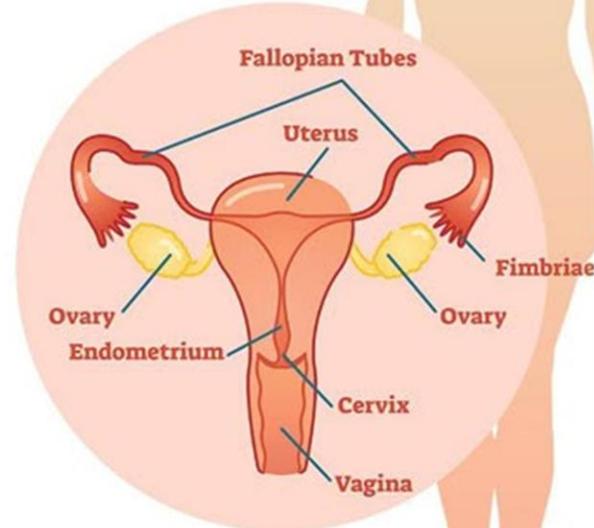
- Learners will explore male and female reproductive systems, their structures, functions, and sex cells.
- They will draw reproductive organs and sex cells, trace the sperm's path to the ovum, and define fertilization.
- The menstrual cycle, including hormones and ovulation, will be covered using models, multimedia, and inclusive ICT tools.

HUMAN REPRODUCTIVE SYSTEM

Male Organs



Female Organs



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HEALTH AND DISEASES

- Learners will study sexually transmitted and communicable diseases, identifying causes, signs, symptoms, and treatments of STIs, malaria, typhoid, Ebola, and cholera.
- They'll explore disease prevention, effects of smoking, alcohol, mandrax, cannabis, and solvents.
- Learning is supported by discussions, videos, charts, print media, and inclusive ICT tools.

