- Triple Science Content only in purple
- Triple Science and Higher Content Only in blue

2. Organisation - Topic 2 AQA Biology GCSE

Definitions to know:

- **Cells**: the basic units of all living things.
- **Tissues**: groups of similar cells that work together to do a specific job.
- **Organs**: different types of tissues working together.
- **Organ systems**: groups of organs that work together to perform vital functions in the body.

Human Digestive System

- The digestive system is made up of several **organs** that help break down food so the body can absorb nutrients.

Organs	**Function**
Glands e.g Salivary Glands and Pancreas	Produce **enzymes** that break down food.
Stomach	Makes Hydrochloric acid to **kill bacteria** and provide the **right conditions e.g(pH level) for digestion, and enzymes to work**
Small intestine	Absorbs **soluble nutrients** into the bloodstream.

Large intestine	Absorbs **water** from undigested food, forming faeces, which is expelled through the **rectum** and **anus**.
Liver	Produces **bile**, stored in the **gall bladder**, which helps break down fats. Bile is alkaline, so neutralises the Hydrochloric acid in the stomach.

Enzymes in Digestion

GCSE Enzymes Explained - For The Gen Z's (AQA, OCR, EDEXCEL)

- **Enzymes** are **biological catalysts**, meaning they speed up reactions without being used up.
- Each enzyme has a unique **active site** that fits only specific substances (like a lock and key).

Factors affecting enzyme activity (Temperature, and pH):

Temperature:

- **Optimum Temperature** (the temperature it works best at) enzymes work at in the body is 37 degrees celsius
- Higher the temperature, the rate of reaction and enzyme activity **increases**
- If it becomes **too hot, enzymes denature** (active site changes shape and loses its structure, can not be used anymore)
- If it becomes **too cold, enzymes denature**

pH

- Optimum pH is 7

- If pH is too high, enzymes denature
- If pH is too low, enzymes denature

Practical: Testing pH Effect on an Enzyme

1. Use **amylase breaking down starch** as the reaction (in the syllabus).

2. Set up mixtures with different pH buffers, constant temperature, same concentrations.

3. Periodically sample and use iodine: if starch remains, iodine turns blue-black; if starch is broken down, it stays brown.

4. Record times and calculate **rate = change / time** (or use 1000/time if suitable).

5. Keep all other variables (substrate concentration, temperature) controlled.

Enzyme	What it Breaks Down	Resulting Product
Carbohydrase (e.g., Amylase)	Carbohydrates	Simple sugars (e.g., glucose)
Protease	Proteins	Amino acids
Lipase	Lipids (fats)	Fatty acids and glycerol

The Heart and Blood Vessels

The Double Circulation Pattern

- **Right side** of the heart pumps **deoxygenated blood** to the lungs (pulmonary circuit).

- **Left side** pumps **oxygenated blood** around the rest of the body (systemic circuit).

Heart Anatomy & Flow

- Four chambers: right atrium, right ventricle, left atrium, left ventricle.
- **Valves** ensure blood flows in only one direction (prevent backflow).
- **Coronary arteries** supply oxygenated blood to the heart muscle itself.
- Path of blood:
    1. Deoxygenated blood → right atrium → right ventricle → pulmonary artery to lungs (the blood then becomes oxygenated blood)
    2. Oxygenated blood → pulmonary vein → left atrium → left ventricle → aorta → body.

Blood Vessels:

Vessel	Function	Feature
Arteries	Carry blood **away from the heart**	Thick muscular walls, elastic fibres to absorb pressure
Veins	Carry blood **to the heart**	Valves to prevent backflow, wider lumen, thinner walls
Capillaries	Exchange substances with cells	Thin walls (one cell thick) for fast diffusion.

The Lungs and Gas Exchange

Structure of the Breathing System

- The lungs are in the thorax, protected by the ribcage and separated from the abdomen by the diaphragm.
- Air enters through the trachea, which splits into two bronchi (one to each lung).
- Each bronchus branches into smaller tubes called bronchioles, ending in tiny air sacs called alveoli.

Gas Exchange at the Alveoli

- Alveoli are adapted for rapid diffusion of gases:
    - Very large surface area (millions of alveoli).
    - Thin walls (one cell thick) → short diffusion distance.
    - Surrounded by a dense network of capillaries.
    - Moist lining helps gases dissolve.
- Oxygen diffuses from alveoli into blood; carbon dioxide diffuses from blood into alveoli to be exhaled.

Ventilation (Breathing In and Out)

- **Inhalation:**
    - Intercostal muscles contract, lifting ribcage up and out.
    - Diaphragm contracts and flattens.
    - Volume of thorax increases → pressure decreases → air is drawn into lungs.
- **Exhalation:**
    - Intercostal muscles relax, ribcage moves down and in.
    - Diaphragm relaxes and domes upward.
    - Thorax volume decreases → pressure increases → air is pushed out.

Measuring Lung Function

- Tidal volume: the amount of air in and out during normal breathing.
- Breathing rate: number of breaths per minute.
- Ventilation rate = tidal volume × breathing rate.

Blood

- **Blood** is made up of:

Component	Function
Red Blood Cells	Carry oxygen using **haemoglobin** to form **oxyhaemoglobin**. - Contain a biconcave disc for large surface area - No nucleus to have more space for oxygen - Carry oxygen to all cells in the body
White Blood Cells	Defend the body against infections by producing **antibodies**, **antitoxins**, or **engulfing pathogens**. - Contain a nucleus
Platelets	Help with **blood clotting** to prevent bleeding. - No nucleus - The clot hardens to form a scab for new skin formation and prevents it from being infected.
Plasma	Carries all the components of the blood (Red blood cells, white blood cells, platelets etc.)

Non-communicable Disease

- **Coronary heart disease** happens when **fatty deposits** build up inside the **coronary arteries**, reducing blood flow and oxygen supply to the heart.

Treatments:

Treatment	How it Works	Pros and Cons
Stents	Tubes that keep arteries open.	Quick recovery, effective small risk of heart attack/infection. A chance of thrombosis (blood clot near the stent)
Statins	Drugs that lower cholesterol levels.	Reduces stroke/heart attack risk , increase HDL cholestrol may cause side effects, may be slower

Valve problems: valves may become leaky or stiff; replacements can be mechanical or biological

Mechanical Valves are long-lasting, but require a lot of medication
Biological Valves work well, but only last up to 15 years

Heart failure and transplants: sometimes a transplant or artificial device is needed; long-term care and donor availability is needed.

Pros- Low chance it will be cause an immune system response
Cons- Blood clots could form leading to strokes.

2.2.5 Health Issues

Health: physical, mental, and social well-being (not just absence of disease).

Disease types:

- *Communicable*: infectious, caused by pathogens (e.g. flu).
- *Non-communicable*: non-infectious, cannot be passed person-person (e.g. heart disease).

Interactions:

- Poor immune system increases risk of infections.
- Some viral infections can promote development of cancers (e.g. HPV → cervical cancer).
- Pathogens can trigger allergies (e.g. asthma, rashes).

Lifestyle and disease:

- Diet, stress, exercise, smoking, alcohol, environmental exposures all influence risks of non-communicable diseases.
- Obesity is strongly linked to Type 2 diabetes.
- Carcinogens (radiation, chemicals, smoking cigarettes) increase cancer risk.

Cancer

- **Cancer** happens when cells grow and divide uncontrollably, forming a **tumour**.

Types of Tumours:

- **Benign tumours**: These stay in one place typically growing in a membrane and are less dangerous.
    - Does not have an impact on other tissues

- **Malignant tumours**: These spread to other parts of the body and can be fatal.
    - They can cause cancer
    - They can impact other organs causing secondary tumours

Risk Factors:

- **Lifestyle**: Smoking, obesity, and exposure to UV light can raise the risk of cancer.
- **Genetics**: Some people inherit a higher risk of developing cancer.

2.3 Plant Tissues, Organs, and Systems

2.3.1 Plant Tissues

Tissue	Function	Features
Meristem	Allows plants to grow	Found at tips of roots and shoots, can differentiate into any type of plant cell.
Phloem	Transports food (sugars) around the plant	Has sieve plates for better movement of the food; food moves in both directions.
Xylem	Moves water and minerals through the plant	Made of dead cells, strengthened by lignin. Takes part in the transpiration stream
Spongy Mesophyll	Allows gases to diffuse through the leaf	Contains air spaces to help gas exchange.
Palisade Mesophyll	Where most photosynthesis happens	Contains many chloroplasts; positioned at the top of the leaf to get the most sunlight.
Epidermal Tissue	Reduces water loss from the plant	Covered in a waxy cuticle.

2.3.2 Plant Organ Systems

- Plants have organ systems made up of **roots**, **stems**, and **leaves** to transport substances like water, minerals, and sugars.

Process	Description
Translocation	Movement of sugars (from photosynthesis) through the plant, in both directions.
Transpiration	Movement of water and minerals from roots to leaves. Evaporation of water creates a **transpiration stream**, only up the plant.

Factors Affecting Transpiration:

- **Temperature**: Higher temperatures increase the rate of evaporation as particles have more energy, so it increases the rate of transpiration.
- **Humidity**: Higher humidity slows down transpiration because there's less of a concentration gradient, decreases rate of transpiration.

- **Wind**: More wind increases transpiration by moving water vapour away from the plant, increasing the concentration gradient.
- **Light**: More light opens the stomata, leading to more evaporation and faster transpiration.

Measuring Transpiration:

- A **potometer** can be used to measure how much water a plant takes up, which shows the rate of transpiration.

Stomata & Guard Cells

- Guard cells open/close stomata depending on water status.

- They have **thin outer walls and thick inner walls** so when turgid they bow and open the pore.

- More stomata are often on underside of leaves (cooler, less direct sunlight) to reduce water loss.