These notes explain the **why** behind every concept, not just the what. They include **analogies**, **real-life examples**, and explanations of **common mistakes**. Use these alongside your revision notes for full understanding.

Topic 8 Exchange and Transport — Supplying Every Cell

Why Mammals Need a Four-Chambered Heart

A four-chambered heart is necessary for mammals' high metabolic rate. Mammals are endothermic (warm-blooded) — maintaining body temperature requires large amounts of energy, which requires lots of oxygen. A four-chambered heart allows complete separation of oxygenated and deoxygenated blood, maintaining efficient, high-pressure delivery of oxygen to all tissues.

■ **Why does this happen?** Fish have a two-chambered heart and a single circulatory system. Blood loses pressure when it passes through the gills, arriving at the body slowly. This limits their activity levels and is why fish are generally less active than mammals of similar size. The evolution of a four-chambered heart was a key step that enabled the metabolic rate needed for warm-bloodedness.

The Alveoli — Engineering for Gas Exchange

Each lung contains about 300 million alveoli — tiny air sacs that together provide a total surface area of about 70 m² (roughly the size of a tennis court) packed into a space roughly the size of a football. Each alveolus is surrounded by a dense network of capillaries.

- Large surface area: maximises diffusion rate.
- One-cell-thick walls: minimises diffusion distance.
- Good blood supply: maintains steep concentration gradient by continuously removing O■ and delivering CO■.
- Moist lining: gases dissolve before diffusing through the membrane.

Digestion — Breaking Polymers Into Monomers

Starch (a polymer of glucose) is broken into individual glucose molecules by amylase. Proteins (polymers of amino acids) are broken into amino acids by proteases. Lipids (fats and oils) are broken into fatty acids and glycerol by lipase. Each large molecule must be broken into its subunits before it can be absorbed.

Alveolus	Tiny air sac in the lung — site of gas exchange between air and blood
Haemoglobin	Red protein in red blood cells that binds oxygen in the lungs and releases it in tissues
Artery	Blood vessel carrying blood AWAY from heart — thick walls, high pressure
Vein	Blood vessel carrying blood TO heart — valves prevent backflow, lower pressure
Capillary	Tiny blood vessel — one cell thick — site of exchange between blood and tissues
Peristalsis	Wave-like muscle contractions that push food through the digestive system

Villus	Finger-like projection in small intestine lining — increases surface area for absorption