Biology: Organisms Exchange Substances with their Environment

1. Surface area to volume ratio

- This is the amount of SA to unit volume. The general rule is the smaller the object the bigger the SA is per unit volume.
- **Eg**: Lung alveoli or gill filaments are microscopic structures with a design that creates a larger SA per unit volume.
- Calculate SA and volume and present the ratio in the simplest form. **SA:V of 4:8 is expressed as 1:2 . Ratios do not have units.**

2. Gas exchange: Insects

1	exoskeleton	outer skeleton made of chitin
2	Spiracles	openings in exoskeleton
3	trachea	tubes leading in from spiracles
4	tracheoles	smaller branches of trachea
5	haemolymph	similar to blood but no haemoglobin

2. Gas exchange: Fish

1	operculum	the cover of the gill
2	gill arch	structure supporting the gill filaments
3	gill filament	short thread like proteins structures that make up the gill
4	gill lamellae	further surface ridge like structures on filaments that increase the SA for diffusion
5	counter current flow	Blood and water flowing in opposite directions to maximise oxygen diffusion into the blood

2. Gas exchange: Dicotyledonous Plant

Stomata and guard cells	Stomata are pores the opening and closing of which is controlled by the WP$^{\Phi}$ of guard cells
Spongy mesophyll	Cells inside the leaf which are arranged to create many air spaces and increased SA for gaseous exchange.

3. Lungs

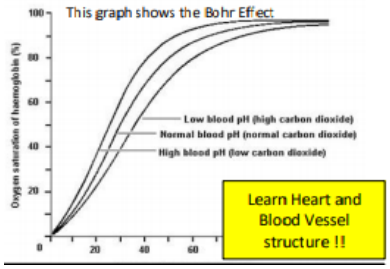
1	trachea	C shaped cartilage, smooth circular muscle, elastic tissue
2	bronchi	2 divided from base of trachea, tissues as above
3	bronchioles	Smaller divisions of bronchi, tissues as above but less
4	alveoli	Large SA:V and large capillary network blood supply, keeps steep diffusion gradients in place
5	Alveolar epithelium	Simple cells, one layer thick, shorter diffusion pathway so more rapid diffusion rate
6	Goblet cells	Specialised epithelium cells that secrete mucus
7	Ciliated epithelium	Hair like villi on surface waft mucus that has trapped dust, MO's etc up to throat.

4. Ventilation

- The internal **intercostal muscles** relax and the external **intercostal muscles** contract,
- pulling the ribcage upwards and outwards.
- the diaphragm contracts and flattens.
- lung volume increases
- and the air pressure inside decreases.
- air is pushed into the lungs.

5. Mass transport of oxygen—Blood

1	Carbon dioxide made by cells diffuses into RBC
2	Enzyme carbonic anhydrase converts the carbon dioxide into carbonic acid
3	Carbonic acid dissociates into H^+ and HCO_3^- ions in solution. High H^+ levels make the blood pH fall (see the graph)
4	The H^+ ions interact with the Hb in the RBC and make it unload the oxygen and give it to the body cells
5	More carbon dioxide = more H^+ ions = more O_2 unloaded from the RBC



Haemoglobin affinity is the relationship between Hb and O_2
Higher affinity means that Hb will get more highly saturated with O_2 when in environments where O_2 pressures are low.
In high carbon dioxide environments the H^+ interact with the Hb molecule, reduce the Hb affinity for O_2 so it unloads it.

Foetal Hb has a higher O_2 affinity than normal adult
so the foetal Hb takes up the O_2 from the mother's blood
Myoglobin (a type of Hb trapped in muscle cells) has an even higher affinity for O_2
so the foetus' muscles take up the O_2 from the foetus blood .

6. Risk factors that reduce gas exchange in lungs

Smoking & pollution	COPD, emphysema, chronic bronchitis
Genetic predisposition	Increased likelihood of above or cancer
Frequent chest infections	Increased likelihood of above
Occupational hazards	Increased exposure to chemical that increase risk

7. Mass transport in plants

Xylem	Water moves - roots to leaves by Cohesion Tension Theory , Transpiration Pull and Root Pressure
Phloem	Mass flow up and down the stem of dissolved sugars Tree ringing Radioactive tracers and aphids