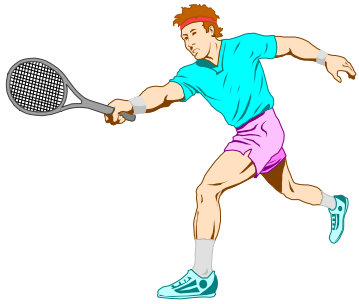

RESPIRATION REACTIONS

AEROBIC RESPIRATION

- Requiring oxygen
- Produces 38 molecules of ATP from 1 glucose molecule

ANAEROBIC RESPIRATION

- Not requiring oxygen
- Produces only 2 ATP from 1 glucose molecule

AEROBIC RESPIRATION

- The overall reaction is:

Glucose + Oxygen → Carbon Dioxide + Water + Energy

$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$ + Energy

- Respiration is an exergonic reaction.
- There are 4 steps in the reaction:

1. Glycolysis
   This occurs in the cytoplasm, where glucose breaks down to pyruvate (also called pyruvic acid), which then enters the mitochondrion. This occurs in both aerobic and anaerobic respiration.
2. First Part of Krebs Citric Acid Cycle
   This occurs in the mitochondrion, where pyruvate is broken down to carbon dioxide in a process that does not use oxygen. A co-enzyme called NAD+ becomes NADH.
3. Second Part of Krebs Citric Acid Cycle
   This occurs on the inner membranes of the mitochondrion. NADH is converted to NAD+ in a process that uses oxygen.
4. ATP Synthesis
   This occurs in the mitochondrion. Hydrogen ions are pumped across the inner membrane of the mitochondrion. Then both the hydrogen ions and an enzyme called ATP Synthetase convert ADP plus a phosphate group to ATP.

ANAEROBIC RESPIRATION

- Anaerobic Respiration is the breakdown of glucose (Glycolysis) to form energy-rich ATP, but does not require oxygen.
- It is less efficient than aerobic respiration.
- It occurs in 2 different ways in different organisms.

ANAEROBIC RESPIRATION

FERMENTATION IN YEAST WITHOUT OXYGEN

Glycolysis occurs to break down glucose to form ethanol and carbon dioxide.

FORMATION OF LACTIC ACID IN MOST ANIMAL MUSCLES

Glycolysis occurs to break glucose down to form lactic acid, which produces tiredness in muscles of athletes in longer events.

Did You Know That…? If a shark and a crocodile were to fight, the shark would probably win. This is because the crocodile cannot metabolise the build-up of lactic acid that causes fatigue as fast as a shark. Hence, the shark has more endurance and would be the likely winner.

PHOTOSYNTHESIS REACTION

$$\text{Carbon Dioxide} + \text{Water} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{Glucose} + \text{Oxygen}$$

$$CO_2 + H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + O_2$$

- Photosynthesis is an endergonic reaction.
- The part of the visible light spectrum that is mostly used is blue and red light. These are absorbed by the green chlorophyll which reflects green light.
- There are 2 photosynthetic reactions:
  1. Photophosphorylation or Light-Dependent Reaction ('Light' Reaction) – This occurs on the membranes in chloroplasts. Light that is 'trapped' by chlorophyll drives reactions that produce ATP and NADPH for the next 'dark' reaction. Oxygen is also produced but is released as a by-product.
  2. Carbon Fixation or Light-Independent Reaction ('Dark' Reaction) – This is also called the Calvin-Benson Cycle, and does not require light. It occurs in the stroma of chloroplasts. The NADPH and ATP from the 'Light' Reaction are used to convert carbon dioxide to glucose.

FACTORS AFFECTING PHOTOSYNTHESIS

- Light Intensity – The rate of photosynthesis increases with light intensity until a certain level is reached.
- Light Wavelengths – Green light is least absorbed, since it is reflected by leaves, which is why leaves appear green. Red-orange and violet colours are those more readily absorbed by chlorophyll.
- Carbon Dioxide Levels – Increases in CO_2 concentration increase the rate of photosynthesis until it levels off.
- Temperature – As the temperature increases slightly, the rate of photosynthesis also increases. However, if the temperature drops too low, plants are unable to make chlorophyll, the leaves turn yellow as in autumn, and they are unable to photosynthesise. If the temperature rises too high, photosynthesis ceases.
- Amount of Water – As the photosynthesis reaction requires water, a lack of water decreases the plant's ability to photosynthesise.
- C_3 and C_4 Plants - In C_3 plants, up to 50% of CO_2 trapped by chlorophyll is released before being converted to sugar. C_4 plants have a different enzyme to trap CO_2 and are more efficient in conditions of higher CO_2 concentrations such as that formed by the Greenhouse Effect. Examples of C_4 plants include corn, sorghum and sugarcane.

Did You Know That…? Green light does not make a plant grow better. It only makes the plant look healthier. In fact, plants appear green to our eyes because they reflect green light. They photosynthesise and therefore grow better with red-orange and violet lights.