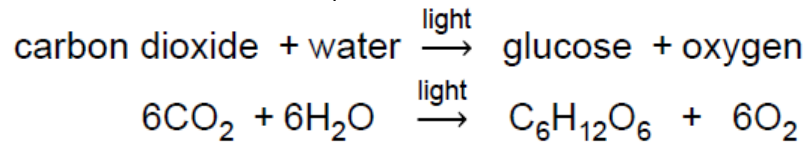# Biology Knowledge Organiser

B8 - Photosynthesis

Photosynthesis.

For us, it is a very good thing that photosynthesis evolved. The process of photosynthesis, carried out by plants and algae, is at the foot of every food chain. It captures light energy from the sun and redistributes it to chemical potential energy – we can make use of chemical potential energy: that's what our food contains! Since photosynthesis involves the transfer of light energy to chemical potential energy in cells, it is an **endothermic** reaction.

The reaction can be shown in these equations:

$$\text{carbon dioxide} + \text{water} \xrightarrow{\text{light}} \text{glucose} + \text{oxygen}$$

$$6CO_2 + 6H_2O \xrightarrow{\text{light}} C_6H_{12}O_6 + 6O_2$$

The oxygen released by photosynthesis has built up in the atmosphere over millions of years – again, good news for us, since we require oxygen for respiration, just like all living organisms.

Photosynthesis occurs in the **chloroplasts** of plant cells. Simple molecules like carbon dioxide and water can't be used as food. However, glucose and other more complex molecules can – so you can think of photosynthesis as a reaction that produces food.

Using The Glucose From Photosynthesis.

Obviously, plants didn't evolve simply for our benefit. They carry out photosynthesis to meet their own needs. The glucose produced in photosynthesis can be:
- Used in respiration in the cells of the plant/algae
- Converted into **starch** for storage. Starch is good for storage as it is *insoluble*, so it doesn't affect the osmosis occurring in the plant, unlike glucose.
- Used to produce **fats or oils (lipids)** for storage. This is particularly noticeable in seeds and nuts.
- Used to produce **cellulose**, which is a component of the cell wall. Cellulose strengthens the cell wall.
- Used to produce **amino acids**, which in turn are used to synthesise proteins (in the ribosomes). To produce amino acids, plants also require **nitrates** from the soil.

Simple lab tests can be used to identify starch, glucose and protein. Starch turns **iodine** a blue-black colour. Glucose turns **Benedict's solution** orange-red when heated with it. Proteins turn **Biuret's reagent** purple.

Key Terms	Definitions
Photosynthesis	The endothermic reaction that transfers light energy to chemical potential energy. In it, simple molecules (CO_2 and H_2O) are converted into more complex molecules (glucose) that can be used for food.
Nitrates	Ions containing nitrogen and oxygen. These are found in the soil; plants need nitrates to produce amino acids.
Rate	As always, rate means how quickly something happens.
Light intensity	The amount/strength of light. Use this term instead of 'amount of light'.
Chlorophyll	The green pigment in leaves that absorbs light for photosynthesis. Chlorophyll is found in **chloroplasts**.

The Rate Of Photosynthesis.

The following factors affect the rate of photosynthesis:
- **Temperature**: because all chemical reactions speed up as the temperature increases. However, as photosynthesis is controlled by enzymes, too high a temperature prevents photosynthesis (more on this in the metabolism section).
- **Carbon dioxide concentration**: the higher the concentration of CO_2 in the air, the more is available for photosynthesis, so the rate of photosynthesis increases as concentration increases.
- **Light intensity**: as the equation shows, photosynthesis requires light energy. So, the higher the light intensity, the higher the rate of photosynthesis.
- **Amount of chlorophyll**: more chlorophyll means more light can be absorbed. Some leaves have pale parts, as you may have seen, due to a lack of chlorophyll. The rate of photosynthesis is obviously much lower in the pale parts compared to the deep green parts.

HT: at any given time, any one of these factors may be **limiting** the rate of photosynthesis. This can be shown on graphs – see example. When it comes to light intensity, it varies with distance according to an *inverse square law*:

$$\text{light intensity} = \frac{1}{distance\ from\ source^2}$$

In commercial growing of plants (e.g. tomatoes in a greenhouse), the conditions are optimised to maximise the rate of photosynthesis and obtain the highest profit.