Photosynthesis Notes

Science Exams Sorted www.scienceexamssorted.co.uk

Without photosynthesis, life as we know it on this planet would not be possible. Photosynthesis is a process that allows the energy of the sun to be made available to other organisms and also produces oxygen gas, a key reactant in respiration. So, what do we need to know? First, let's look at some definitions.

Photosynthesis: a series of enzyme catalysed reactions carried out in green plants.
Carbon dioxide and water react to produce glucose and oxygen. This process requires energy in the form of light.

A photosynthetic organism: an organism that can produce its own food from photosynthesis.

Photosynthetic organisms are the main producers of food in food chains and are therefore, the main producers of biomass.

Producer: an organism that can produce its own food from photosynthesis.

Producers form the first trophic level in a food web or chain.

Photosynthesis

Word equation: carbon dioxide + water → glucose + oxygen

Balanced symbol equation: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Photosynthesis is an endothermic process. It takes in more heat energy than it gives out.

The plant can use the glucose that it makes in photosynthesis in the following ways:

- For respiration.
- Converted into insoluble starch for storage.
- To produce fat or oil for storage.
- To produce cellulose, which strengthens the cell wall.
- To produce amino acids for protein synthesis.

Factors that affect the rate of Photosynthesis

The factors can affect the rate of photosynthesis are:

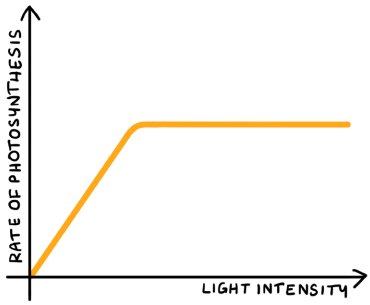
1. Light intensity. 2. Carbon dioxide concentration. 3. Temperature. 4. The amount of chlorophyll

Let's look at each in detail 😊 Please take notice of the shape of the graphs.

Light intensity

Without enough light, a plant cannot photosynthesise very quickly - even if there is plenty of water and carbon dioxide and a suitable temperature.

Increasing the light intensity increases the rate of photosynthesis, until some other factor – a limiting factor – becomes in short supply.

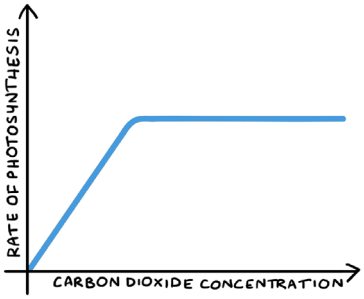


Graph of light intensity against rate of photosynthesis

Carbon dioxide concentration

Carbon dioxide and water are both of the reactants in photosynthesis.

<u>If the concentration of carbon dioxide is increased, the rate of photosynthesis will therefore increase. Again, at some point, a factor may become limiting</u>.



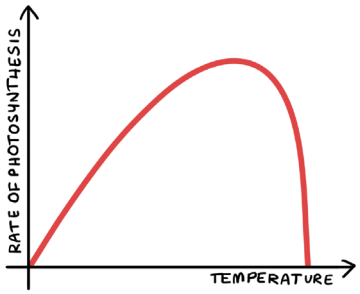
Graph of CO_2 concentration against rate of photosynthesis

Temperature

As with any other enzyme-controlled reaction, the rate of photosynthesis is affected by temperature.

<u>At low temperatures the rate of photosynthesis is limited by the number of molecular collisions between enzymes and substrates</u>.

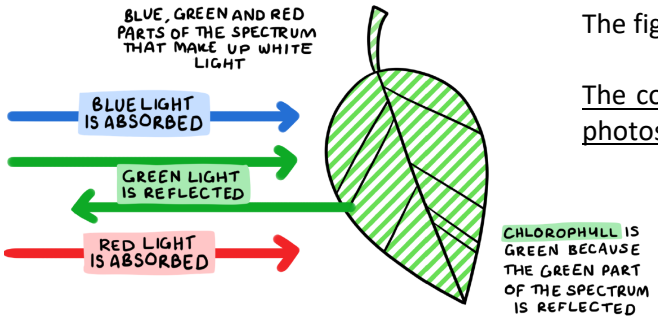
<u>At high temperatures, enzymes are denatured</u>.



Graph of temperature against rate of photosynthesis

Chlorophyll

Chlorophyll absorbs the light energy required to convert carbon dioxide and water into glucose.
Chlorophyll is green - so absorbs the red and blue parts of the electromagnetic spectrum and reflects the green part of the spectrum.



The figure shows the absorption and reflection of light from a leaf.

<u>The compensation point is the light intensity at which the rate of photosynthesis is equal to the rate of respiration</u>.

Note: plants, like all living things respire all of the time. Even when they're doing photosynthesis 😊

Rate of Photosynthesis

The rate of photosynthesis can be both directly and inversely proportional.
If you are increasing the light intensity then the rate of photosynthesis will <u>increase proportionally</u>.

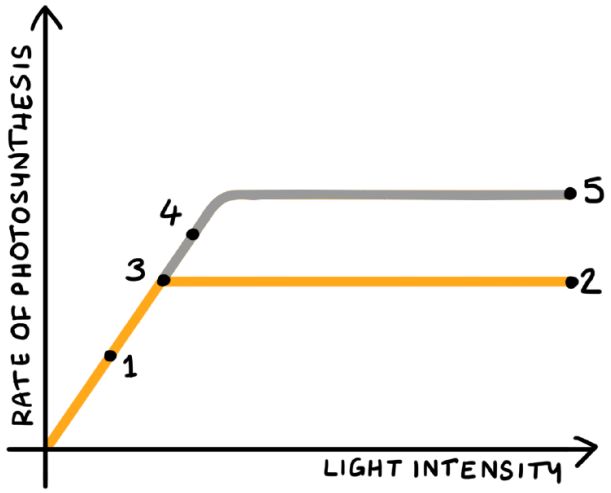
<u>Recall your equation for calculating direct proportion</u>. $$y = kx$$		
y = first value given.	k = the constant.	x = the second value given.

If you increase the distance between the light source and the plant the rate of photosynthesis will decrease of course but it will decrease according to the inverse square law.
<u>This is because as the light source moves further away, the light energy spreads out over a larger area, so the plant receives less of it.</u>

<u>Recall your equation for calculating inverse square law</u>. $$y = \frac{k}{x^2}$$		
y = first value given.	k = the constant.	x = the second value given.

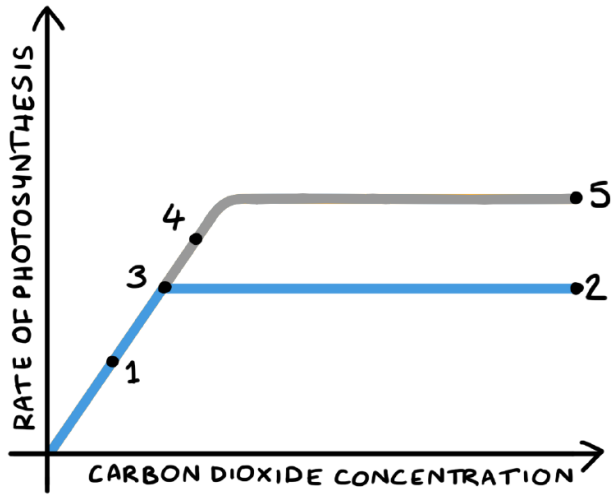
The Law of Limiting Factors

If we look in more detail at the law of limiting factors, for instance, for the relationship between light intensity and the rate of photosynthesis:



1. Increase in light intensity increases the rate of photosynthesis
2. Another factor e.g. Carbon dioxide is limiting any further increase so that the rate remains constant
3. If the carbon dioxide concentration is increased...
4. The rate of photosynthesis will increase again...
5. Until another factor becomes limiting

Or for carbon dioxide concentration.



1. Increase in carbon dioxide concentration increases the rate of photosynthesis
2. Another factor e.g. light intensity is limiting any further increase so that the rate remains constant
3. If the light intensity is increased...
4. The rate of photosynthesis will increase again...
5. Until another factor becomes limiting

With the law of limiting factors, each factor does not work in isolation. Several factors may interact, and it may be any one of them that is limiting photosynthesis.