

## What Would Happen to the Photosynthesis Process, and the Plant as a Whole If...

1. The temperature around a C3 plant was raised to 40 °C for one hour, and then increased again to 60 °C for three hours?

Photosynthesis would come to a halt because the enzymes required in the Calvin cycle have optimal temperatures between 10°C and 30°C. As temperatures approach and rise above 40°C the enzymes become denatured and can no longer function. Eventually the plant would die.

2. A C3 plant was exposed to an atmosphere with 78 % oxygen, and 22 % Carbon Dioxide?

Oxygen has an inhibitory effect on photosynthesis. It binds more readily to rubisco. When oxygen binds, photorespiration occurs reducing the rate of photosynthesis. When carbon dioxide binds, it is fixed into carbohydrates by photosynthesis. If exposed to his environment for a long period of time it would die.

3. All of the stomata on a C4 plant closed during the day?

C4 plants have an alternative mechanism of carbon fixation, so they are resistant to lower levels of CO<sub>2</sub> that would occur if the stomata were closed during the day. However, if all stomata were closed there would eventually not be enough CO<sub>2</sub> available to be pumped into the mesophyll to allow this process to continue. Eventually the plant would die.

## Tougher Photosynthesis & the Environment Questions

1. A plant completes the light reactions of photosynthesis and produces ATP and NADPH. However, the enzyme Rubisco is ineffective as it has been denatured. What do you suspect has happened to this plant? What makes you think this? The plant has most likely been exposed to high temperatures which have caused the enzyme to denature. This is because Rubisco is an enzyme which is a protein and is dependent upon its shape to function properly. If proteins are heated they will lose their tertiary (and quaternary if applicable) structure as molecular movement due to increased kinetic energy (from thermal energy) increases and prevents hydrogen bonding from maintaining the structure.
2. There are two plants growing in your backyard. Plant A grows really tall in the spring, and then shrivels during the summer. Plant B grows a little bit in the spring, and then shoots up in the summer. What type of plants do you suspect they are? Plant A is most likely a C3 plant as it grown well in spring conditions. Ideal temperatures for C3 plants is between 10 - 30°C. C3 plants close their stomata in the warmer weather to reduce water loss which will decrease growth due to decreased production of carbohydrates. Plant B is most likely a C4 plant as it grows well in warmer conditions. C4 plants have mechanisms to keep CO<sub>2</sub> concentrations high despite having increased closed stomata in an effort to conserve water.
3. You examine two leaves under a microscope. One has significantly more chlorophyll than the other. What do you suspect about these two plants? The plant with increased chlorophyll is most likely a shade plant. This is because they have more chlorophyll to ensure that they are as efficient as possible with the limited amount of light that does hit the leaves. The other plant is most likely a sun plant. Sun plants do not need as many chlorophyll as the majority of leaves will be exposed to sunlight making the chlorophyll that are present continuously active.