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**Photosynthesis**

Meaning and significance  
The structures involved in the process  
The process – 1. Light dependent reaction  
2. Light independent reaction  
Measuring the rate of photosynthesis.

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**Carbon Fixation**

This idea means that the carbon in carbon dioxide from the atmosphere becomes incorporated into the organic chemicals of the plants – it becomes fixed in the plant.  
It has been calculated that  $75 \times 10^{12}$  kg of carbon dioxide fixed each year 80% is fixed in the oceans.  
Maybe only 0.4% of the light energy falling on plants is used by man as food.  
Photosynthesis is also responsible for gas (methane), oil and coal production.

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**Meaning**

Photosynthesis from Greek photo (*φῶς*) = light, and synthesis (*σύνθεσις*) = putting together. So it means making food using light. "Food" in this case is a sufficiently complex molecule that will generate energy (ATP) from the process of respiration e.g. glucose.

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**Oxygen**

Photosynthesis is also responsible for the oxygen that exists in the atmosphere of earth.  
Oxygen concentration does not seem to fluctuate very significantly at 20.93% by volume.

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**Significance**

Photosynthesis occurs in plants, algae and some bacteria.  
In these organisms the products of photosynthesis provide raw materials for growth and repair, and a substrate for respiration to generate energy in the form of ATP.  
These organisms are known as photo-autotrophs as they provide themselves with their own source of energy.

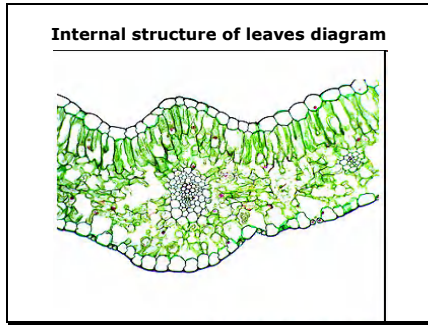
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**Leaves**

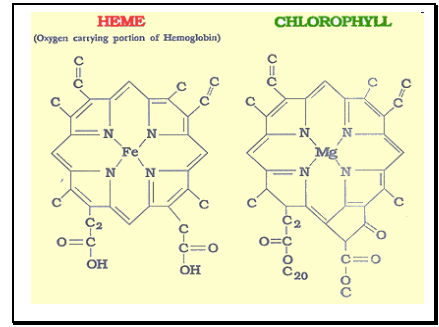
All green parts of a plant are capable of photosynthesis but it is the leaves that are designed for it specifically.



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**Internal structure of leaves**

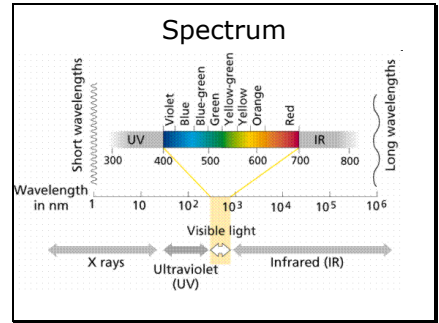
Epidermis, no chloroplasts on upper and lower surface.

Palisade mesophyll, elongated cells with many chloroplasts which can change their position in the cell depending on light conditions.

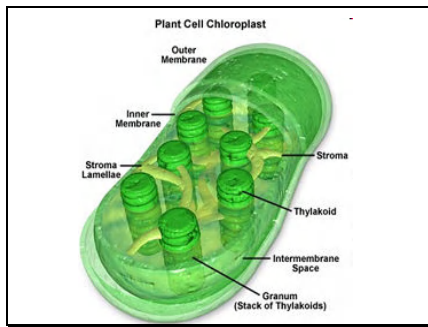
Spongy mesophyll, cells with many air spaces between. Have fewer chloroplast as the palisade cells have absorbed some of the light.

Guard cells control the size of stomata allowing carbon dioxide and oxygen in.

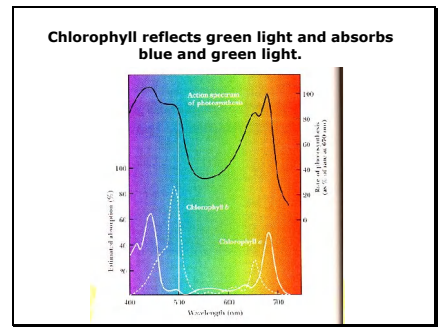
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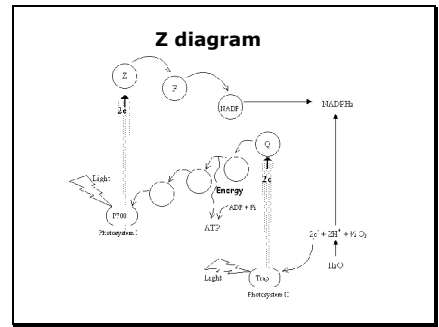


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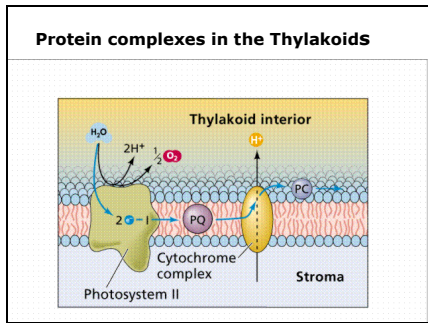
**The process**

Van Helmont (1577-1644) weighed a willow tree seedling (5 lb) and soil (200lb) and watered the tree as it grew. The weight of the tree seedling increased by 164 lb and Van Helmont concluded that the extra plant material came from the water. It is now clear that new plant material comes from carbon dioxide and water and the energy to drive this anabolic process is light.

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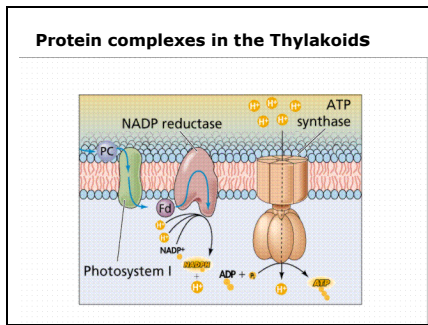


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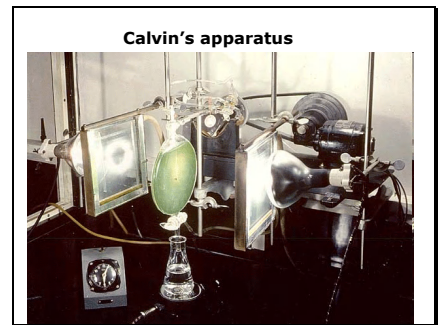
**The results of the light independent reaction**

This part of the process produces –  
 ATP the energy required to fuel the light independent reaction  
 and  
 Hydrogen attached to the hydrogen carrier NADP. This can be used to reduce CO<sub>2</sub>

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**Calvin's other techniques**

The use of radioactive carbon dioxide

2D chromatography to separated sugars produced

Autoradiography to detect the presence of radioactive carbon.

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**LITTLE GREEN MEN - Why do animal cells not photosynthesise ?**

Plant photosynthetic rates	= 20 mg hexose/dm <sup>2</sup> / hr
average human surface area	= 170 dm <sup>2</sup>
hexose productivity	= [170 x 20 = 3.4g/hr] x 12hr = 40.8 g/day
1 mole glucose	= 183 g = 2880KJ
green man productivity	= 41 g = 661 KJ/day
Metabolic rate	= 8400 KJ/day = about 7.8 % of need
We Evolve	= increased surface area, remain sessile, circulation is replaced, etc

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**Calvin's results**

Calvin was looking for C5 compound that carbon dioxide could combine with to make glucose but he found -

After a short time the first product 3C (PGA) was produced, later 4C, C6, C7 and then the C5 compound that CO<sub>2</sub> joins to

How do these fit together?

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