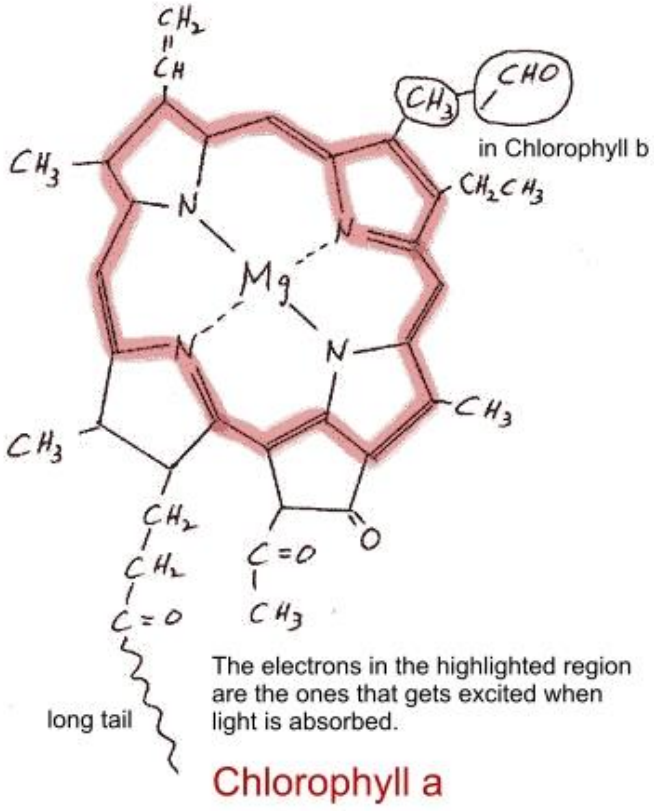
Understanding Photosynthesis: How Does Chlorophyll Absorb Light Energy?

How does chlorophyll absorb light energy and pass it on to the energy-requiring reactions of photosynthesis?

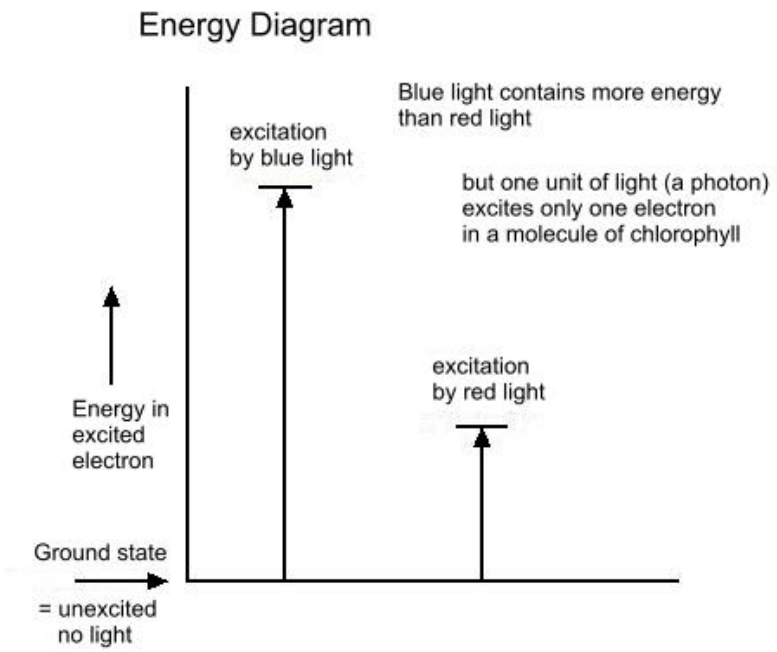
This short article offers an overview for post-16 students of the processes involved in photosynthesis. A Powerpoint is also attached.
Photosynthesis can be divided into the energy-harvesting reactions of chlorophyll and the reduction of carbon dioxide to sugar in the Calvin cycle, making use of the energy absorbed by the chlorophyll.

How are these processes linked?

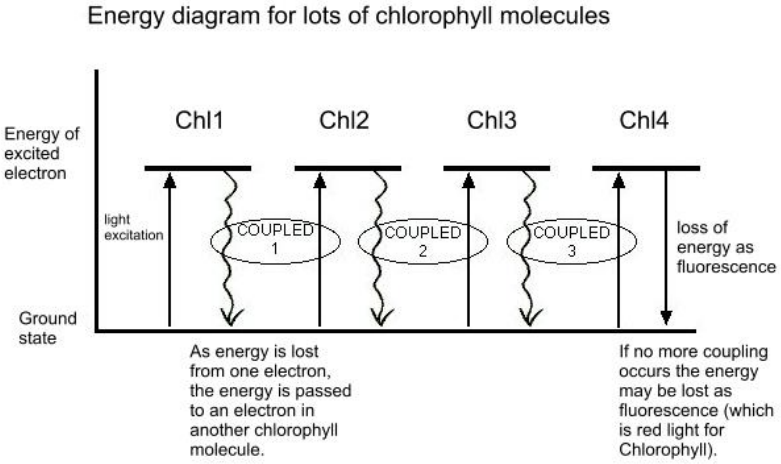
Figure 1. is a diagram of the structure of chlorophyll and some notes on how it absorbs light energy.



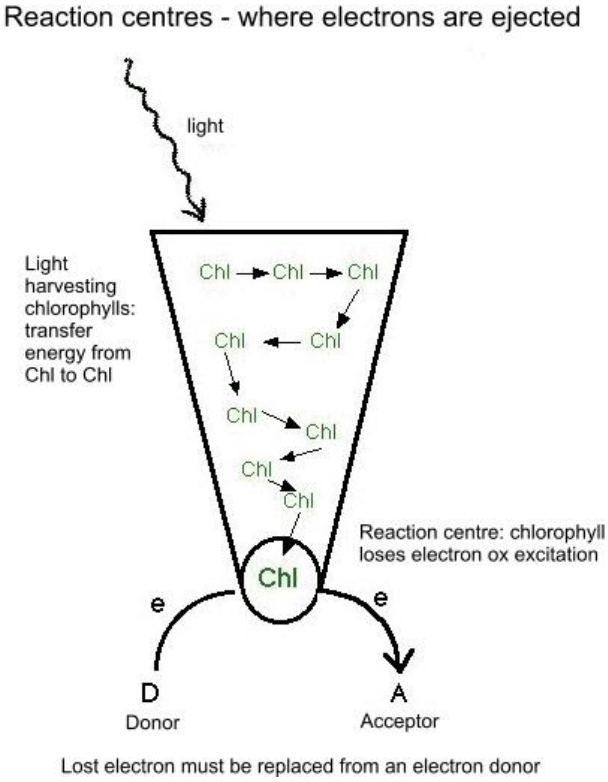
Light absorbed by chlorophyll excites the electrons in the ring as shown above. Different wavelengths of light excite the electrons by different amounts (Figure 2).



The energy in the 'excited electrons' can be passed from one chlorophyll molecule to another, but in the end it will just be lost as fluorescence (Figure 3) (ie the energy will be re-emitted as light), unless the excited electron itself can be ejected from the chlorophyll molecule.



This process of electron ejection takes place only in chlorophyll molecules which are specifically held in a special protein complex called a reaction centre (Figure 4).



There are two different sorts of reaction centres in plants (Figure 5). In each of these reaction centres, the ejected electron is transferred to an acceptor molecule, which can then pass it on to a different molecule and eventually the electron(s) can be used to fix carbon dioxide. However, you can't keep on ejecting electrons from these special chlorophyll molecules, electrons must be fed back in to replace those ejected. These electrons come from water, resulting in oxygen being evolved.