Chlorophyll Encyclopedia Article

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All forms of life on the surface of Earth are powered, directly or indirectly, by absorption of the energy in sunlight by chlorophyll molecules in plant cells. The subsequent processes of photosynthesis convert light energy to electrical and then chemical energy, which the cell uses for growth. The minimal absorption of green light by chlorophyll causes plants to have a green color (see accompanying graph).

The absorption spectra of chlorophyll *a* and *b* in methanol.

Chlorophylls are cyclic tetrapyrroles, that is, molecules made by connecting four 5-membered pyrrole rings into a macrocycle. The initial biosynthetic precursor, 5-aminolevulinic acid (ALA), is made from the abundant amino acid glutamic acid. Condensation of two ALA molecules produces the 5-membered ring compound porphobilinogen. Four of these molecules are joined into a large ring structure, some of the side chains are modified, and the compound is oxidized to generate the fully conjugated double-bond arrangement that allows efficient absorption of light energy. At this stage, Mg^{2+} is inserted into the center of the large ring structure, and the fifth ring is formed.

The long hydrocarbon side chain causes chlorophyll to act as a lipid, allowing it to become embedded in thylakoid membranes. Chlorophyll *a* can be oxidized to chlorophyll *b*, which differs only in the presence of an alde-hyde group on ring B. All chlorophyll molecules are bound to protein molecules and incorporated into complexes that allow energy absorbed by the molecules to be trapped in **reaction centers** of photosynthesis. In **eukaryotic** photosynthetic organisms, all these reactions occur in the **chloroplast**.

Other forms of chlorophyll also are found in nature. Some families of algae contain chlorophyll *c*, which does not have a long lipid tail and differs in several other respects. Chlorophyll *d*, which was found recently as the major chlorophyll in a photosynthetic **prokaryote** living inside ascidians in the Pacific Ocean, is similar to chlorophyll *b* but with the aldehyde on ring A. Bacteriochlorophylls, possibly the evolutionary ancestors of chlorophylls, occur in photosynthetic bacteria. Unlike other chlorophylls, bacteriochlorophylls absorb light in the infrared region, near 800 **nanometers** (nm).

See Also

Chloroplasts; Photosynthesis, Light Reactions And; Pigments.

Bibliography

Beale, Samuel I. "Enzymes of Chlorophyll Biosynthesis." *Photosynthesis Research* 60 (1999): 43-73.

Structure of chlorophyll *a.*