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## Photosynthesis light dependent stage

OpenStaxCollege [latexpage] by the end of this section, you will be able to: explain how the works absorb energy from sunlight describe short and long wavelengths of light describe how and where photosynthesis occurs within one Plant How can it be used to make food? When a person turns on a lamp, electricity becomes light energy. Like all other forms of kinetic energy, light can travel, change shape and being harnessed to do the job. In the case of photosynthesis, light energy is converted into chemical energy, which ihoautotrophs use to build carbohydrate molecules ([connection]). However, autotrophes use only some specific components of sunlight. PhotoOutrophs can capture light energy from the sun, converting it into the chemical energy used to build food molecules. (Credit: Gerry Atwell) The Sun Issue a huge amount of electromagnetic radiation (solar energy). Human beings can only see a fraction of this energy, which the portion is therefore indicated as  $\text{\AA}$   $\text{\AA}$ ,  $\sim$   $\text{\AA}$  "Visible Light. $\text{\AA}$   $\text{\AA}$ ,  $\sim$  The way in which solar energy trips are described as waves. Scientists can determine the amount of energy of a wave by measuring its wavelength, the distance between consecutive points of a wave. A single wave is measured by two consecutive points, as per the ridge ridge or from trough to be crank ([connection]). The wavelength of a single wave is the distance between two consecutive points of similar position (two ridges or two troughs) along the wave. The visible light is only one of the many types of electromagnetic radiation emitted by the sun and other stars. Scientists differentiate the various types of radiant energy from the sun within the electromagnetic spectrum. The electromagnetic spectrum is the range of all possible radiation frequencies ([connection]). The difference between wavelengths refers to the amount of energy transported by them. The sun emits energy in the form of electromagnetic radiation. This radiation exists at different wavelengths, each of which has its characteristic energy. All electromagnetic radiation, including visible light, is characterized by its wavelength. Each type of electromagnetic radiation travels to a particular wavelength. Longer the wavelength (or the most relaxed appears in the diagram), less energy is transported. The short and narrow waves carry the largest number of energy. This may seem illogical, but thinks in terms of a piece of movement of a heavy rope. It takes little effort from a person to move a string in long and wide waves. To move a string in short, narrow wave, a person would need to significantly apply more energy. The electromagnetic spectrum ([link]) shows different types of electromagnetic radiation originating from the sun, including X-rays and ultraviolet rays (UV). Upper energy waves can penetrate tissues and damage cells and DNA, explaining why X-rays and UV rays can be harmful to living organisms. The light energy starts the photosynthesis process when the pigments absorb the light. Organic pigments, both in the human retina or in thylakoid chloroplast, have a restricted range of energy levels that can absorb. The energy levels lower than those represented by red light are insufficient to increase an orbital electron to a populated and excited state (quantum). The higher energy levels of those of light blue physically will tear off the molecules aside, called whitening. So the retinal pigments can only "from 700  $\text{\AA}$ ,  $\sim$  (absorb) 700 nm to 400 nm light, which is therefore called visible light. For the same reasons, the molecules of plants pigments absorb only light in the interval wavelength of 700 nm at 400 nm; Plant physiologists refer to this range for plants such as photosynthetically active radiation. The visible light seen by humans as a white light actually exists in a rainbow of colors. Some objects, such as a prism or a drop of water, disperse the white light to reveal the colors to the human eye. The visible light portion of the electromagnetic spectrum shows the rainbow of colors, with purple and blue having having Wavel lengths, and therefore greater energy. At the other end of the spectrum towards red, the wavelengths are longer and have lower energy ([connection]). The colors of visible light do not bring the same amount of energy. Violet has the shortest wavelength and then brings most of the energy, while the red has the longest wavelength and brings the minimum amount of energy. (Credit: Modification of work by NASA) There are different types of pigments, and each has evolved to absorb only some wavelengths (colors) of visible light. The pigments reflect or transmit the wavelengths that cannot absorb, making them appear in the corresponding color. Chlorophiles and carotenoids are the two main classes of photosynthetic pigments found in plants and algae; Each class has more types of pigment molecules. There are five main chlorophiles: A, B, C and D and a molecule related to the procidotes called bacteriaoclorophlorophyll. Chlorophyll A and Chlorophyll B are found in higher vegetable chloroplasts and will be at the center of the following discussion. With dozens of different shapes, carotenoids are a group of much larger pigments. Carotenoids found in fruit - like tomato red (lycopene), corn seeds yellow (zeaxanthin), or orange of an orange peel ( $\beta$ -carotene) - are used as announcements to attract disperserions of seeds. In photosynthesis, carotenoids work as photosynthetic pigments that are very efficient molecules for excess energy disposal. When a leaf is exposed to the sun, light-dependent reactions are necessary to develop a huge amount of energy; If that energy is not managed correctly, it can damage significant. Therefore, many carotenoids reside in the Thylakoid membrane, absorb excess energy, and safely dissipate that energy as heat. Each type of pigment can be identified by the specific model of wavelengths that absorbs from visible light, which is the absorption spectrum. The chart in [Connection] shows the absorption spectra for chlorophyll A, chlorophyl B and a type of carotenoid pigment called  $\beta$ -carotene (which absorbs light blue and green). Note As each pigment has a distinct set of peaks and troughs, revealing a highly specific absorption model. Chlorophyl to absorb wavelengths from both extremities of the visible spectrum (blue and red), but not green. Because the green is reflected or transmitted, the chlorophyl appears green. Carotenoids absorb in the blue region of short wavelength and reflect the longest, red and orange wavelengths longer. (a) chlorophyll a, (b) chlorophyll b, and (c)  $\beta$ -carotene are hydrophobic organic pigments present in the Thylakoid membrane. The chlorophyl A and B, which are identical except for the part indicated in the red box, are responsible for the green color of the leaves.  $\beta$ -Carotene is responsible for orange carrots. Each pigment has (D) a single absorbance spectrum. Many photosynthetic organisms have a mixture of pigments; Using them, the body can absorb energy from a larger range of wavelengths. Not all photosynthetic organisms have full access to sunlight. Some organisms grow underwater where the intensity of light and quality decrease and change with depth. Other organisms grow in competition for light. Plants on the rainforest floor must be able to absorb any bit of light that passes through, because the highest trees absorb most of the sunlight and spreading the remaining solar radiation ([link]). The plants that are commonly growing in the shadows have adapted low levels of light by changing the relative concentrations of their chlorophyll pigments. (Credit: Jason Hollinger) for A photosynthetic organism, scientists can determine the types of pigments present by generating absorption spectra. A tool called spectrophotometer can differentiate which light wavelengths a substance can absorb. Spectrophotometers measure the transmitted light and calculates the absorption. Remove the pigments from the leaves and placing these samples in a spectrophotometer, spectrophotometer, It can identify which light wavelengths an organism can absorb. Additional methods for identifying vegetable pigments include various types of chromatography that separate pigments with their relative similar to solid and mobile phases. The general function of light-dependent reactions is to convert solar energy into chemical energy in the form of NADPH and ATP. This chemical energy supports light-independent reactions and feeds the mounting of sugar molecules. Light dependent reactions are represented in [link]. Protein complexes and pigment molecules work together to produce NADPH and ATP. A photosystem consists of a lightweight collection complex and a reaction center. The pigments in the lightweight collection complex pass bright energy to two special chlorophyll a molecule in the reaction center. The light excites an electron from chlorophyll a couple, which passes to the primary electron acceptor. The excited electron must therefore be replaced. In (a) PhotoSystem II, the electron comes from the subdivision of the water, which releases oxygen as a waste product. In (B) PhotoSystem I, the electron comes from the electron chain of electron chloroplast discussed below. The royal pitch that converts light energy into chemical energy takes place in a multiprotein complex called photosystem, two types of which were found incorporated into the Thylakoid membrane, Photosystem II (PSII) and Photosystem I (PSI) ([link]). The two complexes differ on what is oxidized (ie the source of low energy electron supply) and what they reduce (the place to which they deliver their energized electrons). Both photosystems have the same basic structure: A number of antenna proteins at which the chlorophyll molecules are tied surrounding the center of reaction where photochemistry takes place. Each photosystem is served by the light collection complex, which passes energy from sunlight to the reaction center; It consists of multiple proteins  $\text{\AA}$   $\text{\AA}$  to  $\text{\AA}$   $\text{\AA}$ ,  $\sim$ "> The reaction center contains a pair of chlorophyl a molecule with a special property. These two chlorophyles can undergo the excitement oxidation; They can actually give up an electron in a process called photoact. It is in this step in the reaction center, this step in photosynthesis, that light energy is converted into an excited electron. All subsequent steps involve That electron on the NADPH energy vector for delivery to the Calvin cycle in which the electron is deposited on the carbon for long-term storage in the form of carbohydrates.psil and PSI are two main components of the electron photosynthetic transport chain, which also includes Cytochrome complex. The cytochrome complex, an enzyme composed of two protein complexes, transfers the electrons from the plastoquinone courier molecule (PQ) to protein plastocyanin (PC), thus allowing both proton transfers through the thylakoid membrane and the transfer of electrons from psii to PSI. The PSII reaction center (called P680) offers its high-energy electrons, one at the moment, at the primary electron access, and through the electronc transport chain (PQ at the cytochrome complex for plastocyanine) to PSI. The missing p680 electron is replaced by extracting a low energy electron from the water; Therefore, water is divided and psii is reduced after each photoact. Dividing a H2O molecule releases two electrons, two hydrogen atoms and an oxygen atom. Dividing two molecules is necessary to form a molecule of Diatomic gas O2. About 10% oxygen is used by mitochondria in the leaf to support oxidative phosphorylation. The rest escapes the atmosphere where it is used by aerobic organisms to support breathing. When electrons move through proteins  $\text{\AA}$   $\text{\AA}$







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