

What Plants Do for the Planet and for Humans

Study Guide

Ecosystems and the cycling of energy, materials, and nutrients between producers and consumers

Be able to recognize the principal roles of plants for the biosphere and human civilization

No specific Suggested Readings

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Fig. 50.3c **Photosynthesis and Plants - The Foundation of the Biosphere and Human Civilization**

Fig. 50.20 Importance of photosynthetic organisms

Oxygen. Fig. 2.18 Photosynthesis is the source of all atmospheric oxygen on our planet. Without this oxygen, multi-celled organisms (that depend on aerobic respiration) would never have arisen and life would have probably been restricted to single-celled bacteria.

Ozone layer. Fig. 54.28 Without the introduction of oxygen (O₂) into our atmosphere, the ozone (O₃) layer would not have been created: It shields the earth from the most intense ultraviolet (UV) radiation striking the atmosphere. This is a contributing factor that allowed the evolution of life onto the terrestrial environment.

Fig. 54.17 Plants are a **sink for CO₂**. Very important with regard to global warming concerns.

Fig. 54.24 Atmospheric CO₂ levels measured in Hawaii showing the annual winter increase and summer decrease in response to changes in photosynthetic activity.

Food. Figs. 1.4, 54.5. Plants are responsible for the **conversion of solar energy into energy-rich molecules** that serve as the basis of almost all life on our planet.

"Green plants are unique in that they use the energy of sunlight to convert CO₂ from the atmosphere into sugar by the process of photosynthesis. The sugars in turn are the source of thousands of compounds within plants, including the major components of the world's food supply." (Quotes from American Society of Plant Biology = ASPB)

Food. Figs. 37.8, 54.20

Fig. 41.10 Plants are also the ultimate source of **essential amino acids** that we and our relatives in the animal kingdom require, but are incapable of synthesizing, as well as **essential fatty acids** (omega-6 and -3 fatty acids), **vitamins** and other antioxidants / phytochemicals.

Fig. 54.17 "Plants play an essential role in the **circulation of nutrients**. Plants require certain inorganic nutrients for growth and play an essential role in [their] circulation in the biosphere. In some plants, associations with microorganisms allow the conversion of atmospheric N₂ into biologically useful forms." ASPB

Table 41.2 Plants are a source of many essential elements in the diet (e.g. Ca, Mn, Mg).

Figs. 37.6a, 54.17 Plants are a very important **component of the water cycle**.

From which is more water lost? Evaporation from an open body of water or from an irrigated field of grass of the same area?

Plants are very important in the **generation** of rich soil (organic matter) **and** in the **anchoring of soil**.

Plants are important as a **buffer against** the ravages of **wind and water**. Fig. 50.17

Plants serve an important role in **pollution remediation**. When plants are used as the agent for remediation, it is referred to as **phytoremediation**. Phytoremediation can be used to clean up pollutants (e.g. heavy metals, organic contaminants, radioactive wastes) from land, water, and even the atmosphere.

Plants are important for **shading and evaporative cooling**. Important on a global scale (desertification when vegetation is lost), and for human environments (shading of houses, shading and evaporative cooling of outdoor spaces).

Desertification: <http://soils.usda.gov/use/worldsoils/mapindex/desert.html>

Plants provide **information** on **environmental and human-induced change**. Example: Species' distribution (pollen record) has shifted over time. Also dendrochronology and radiocarbon dating.

Climate reconstruction based on species composition over time. <http://esp.cr.usgs.gov/research/alaska/turnarm.html>

Dendrochronology for dating and climate assessment over time.

<http://www.ufrsd.net/staffwww/StefanI/tlrbs2002/treerings/index.htm>

Plants have been a driving force in **evolution**. Figures 37.12, 30.13, 22.11, 37.13, 53.9

Plants provide a habitat for a multitude of animals. "Plants live and adapt to a wide variety of environments. Plants provide a wide variety of environments for birds, insects, and other wildlife in ecosystems." ASPB See also Fig. 55.13

Plants are a **source of materials**. "Cell walls provide structural support for the plant and also provide fibers and building materials for humans, insects, birds, and many other organisms." ASPB

Plastics from fossil fuel. Some plants are being engineered to synthesize biodegradable plastics. See also Figs. 35.20, 35.9, 5.8

Examples for humans include **wood** for houses, furniture, etc., **cellulose** for paper, and **cotton and other fibers** for clothing.

Source of fuel and energy. Wood and peat from living plants. Coal, oil, and natural gas from plants/algae altered over time. See also Fig. 29.10a. Ethanol and biodiesel from living plants.

Table 30.1 Plants are a source of **medicines**. E.g. aspirin from willow trees. Fig. 55.4

Plants are a source for **poisons** for animals and humans.

<http://www.learner.org/jnorth/images/graphics/monarch/monarch43cd1634.jpg>

Milk weed family (*Asclepiadaceae*) contains cardiac glycosides.

http://content.answers.com/main/content/wp/en/thumb/8/8e/220px-Strychnos_Toxifera_by_Koehler_1887.jpg

Strychnos toxifera (source of curare) from Koehler's Medicinal-Plants published in 1887.

Strychnine is a toxic alkaloid. Alkaloids have nitrogen-containing ring structures. Other examples of alkaloids: Quinine, atropine, opium, morphine, codeine, cocaine, nicotine, ephedrine, caffeine

Plants are used for **religious purposes**. Example: Peyote cactus contains hallucinogenic alkaloid mescaline

Plants provide ingredients for **perfumes, lotions, oils, soaps**, etc.

Plants serve as important **model organisms** for research and as **sources of genetic information**. Many basic processes can be studied in plants rather than, or in addition to, animals. Fig. 21.2.

Plants are important for their **aesthetic value** indoors & outdoors.

Plants are important as a source for **jewelry**.