Background Essay: Photosynthesis

It's not surprising that early scientists hypothesized that plants ate dirt. They didn't know, as we now do, how energy-rich sunlight is. Still, it seems remarkable that plants have evolved photosynthesis--the ability to harness the sun's energy to produce their own food.

Photosynthesis is the process by which plants transform water and carbon dioxide (a gas that's plentiful in the air) into carbohydrates (sugars and starches), using the energy of sunlight. While sunlight provides the energy needed to drive this reaction, a chemical in the leaves of plants makes the reaction possible. That chemical is a green pigment called chlorophyll. Chlorophyll is found inside the photosynthetic cells of plants, attached to the membranes of small, round structures called chloroplasts. Chlorophyll absorbs light in the red and blue-violet portions of the visible spectrum, and reflects the green portion of the spectrum; this is what gives chlorophyll its characteristic green color.

As remarkable as photosynthesis is, the process is not very efficient. Studies show that prairie grasses in the western United States are some of the most efficient plants at harnessing the sun's energy, but even they capture little more than about 3 percent of the energy that reaches the prairie surface. The rest of that energy is reflected away, absorbed by humidity in the air or by the ground, or simply lost in myriad other ways before the plants can use it.

One of the most critical factors influencing the efficiency of photosynthesis is the amount (intensity and duration) of light that hits a leaf. Generally, the more light that strikes a leaf, the greater the rate of photosynthesis in that leaf. For example, a leaf that is exposed to direct sunlight will photosynthesize at the highest rate, while a leaf directly beneath it and in its shadow will photosynthesize at a much lower rate. Because of this, many plants have evolved leaf and branch structures that minimize overlap and shading, and thus maximize the plant's overall rate of photosynthesis.

Source: "Photosynthesis." Teachers' Domain. 26 Sep. 2003. Web. 3. Mar. 2013. < http://wimedialab.pbslearningmedia.org/resource/tdc02.sci.life.stru.photosynth/photosynthesis/>

Background Essay: From Seed to Flower

Nearly every plant you see outdoors had its beginnings as a seed. A plant begins to grow when a seed germinates, usually when water causes the embryo inside the seed to swell and break out of the tough outer seed coat.

During the earliest stages of plant growth, the first root, called the taproot, stretches downward into the soil in search of water and to establish a firm structural foundation for the plant. The root grows both by adding cells and by elongating cells that already exist. Before long, the root forms branches, which improve the plant's support system and its ability to absorb water from the soil.

Not long after the taproot has become established in the soil, the shoot, or stem, of the seedling begins to stretch upward in search of light. The time-lapse video of this reveals the seedlings' need for light: They bend first one way and then the next in what becomes a repetitive waving motion as they follow the sun's movement throughout the day.

So far, all of the energy that the plant requires for growth comes from food stored in the part of the seed called the endosperm. As the stem stretches skyward it carries with it what is left of the food stores in the endosperm. Before long, however, this food will be depleted and the plant will need to create its own food. To do this, the plant must first grow leaves.

Leaves contain a chemical called chlorophyll -- a pigment that gives green leaves their color and allows plants to collect the sun's energy and use it to convert carbon dioxide and water into sugars and other carbohydrates. This chemical conversion, called photosynthesis, is the process the plant will use to produce energy for the rest of its life.

Most plants can survive with a combination of these three parts: roots, stems, and leaves. To reproduce (produce their own seeds and, eventually, their own plant offspring), however, most plants must first produce flowers. Flowers produce the pollen and eggs that, when combined with another flower's pollen or eggs, become seeds that can germinate and grow into a new plant. Many flowers, including the sunflower seen in the video, lure insects and birds to them with rewards of pollen and nectar. In exchange, these animals unwittingly carry pollen to other flowers and fertilize the eggs they contain.

Source: "From Seed to Flower." Teachers' Domain. 26 Sep. 2003. Web. 3 Mar. 2013. < http://wi-medialab.pbslearningmedia.org/resource/tdc02.sci.life.colt.plantsgrow/from-seed-to-flower/>