Chlorophyll: How Trees Turn Sunlight into Food

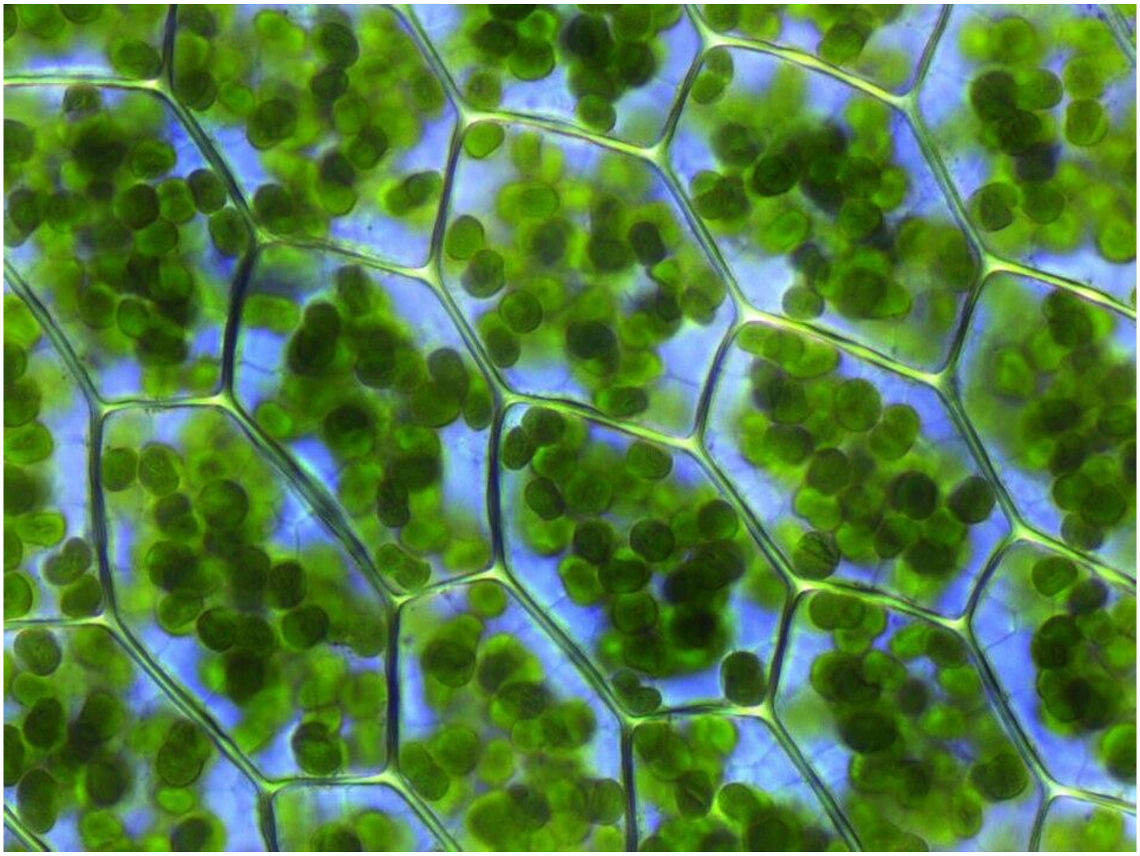


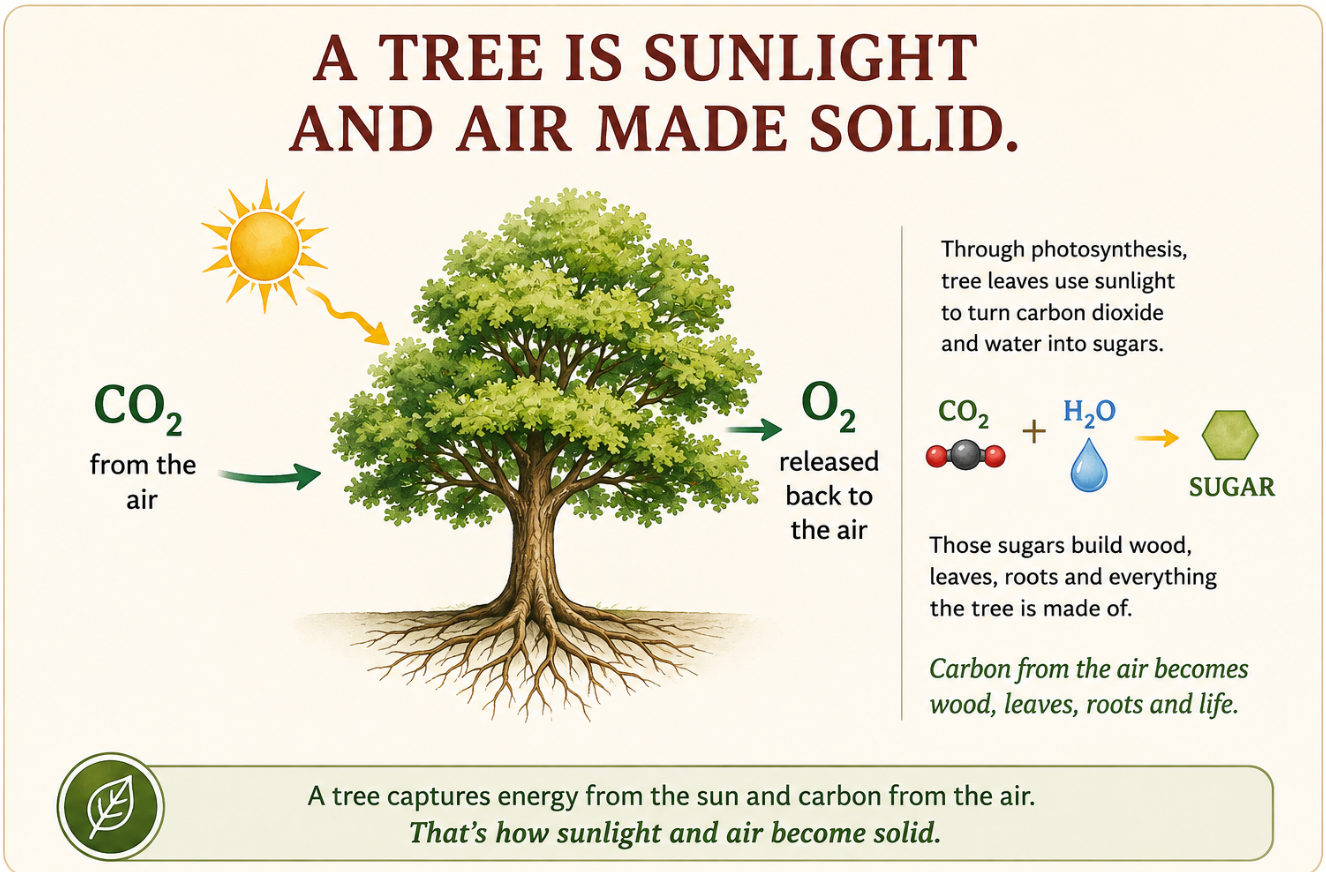
Photo of Chloroplasts in a leaf, Kristian Peters

By Susan Mates

Chlorophyll is the pigment that gives most leaves their familiar green color. It is found inside tiny structures called **chloroplasts** in leaf cells. Its important job is to absorb light.

A tree captures energy from sunlight and stores it as chemical energy.

Energy captured from sunlight starts a sequence of chemical reactions. Using that energy, the tree takes carbon dioxide from the air and water from the soil to build energy-rich carbohydrates. That stored solar energy fuels almost everything the tree does: growing roots and branches, making wood, producing flowers and seeds, repairing damage and defending itself.



A tree is built largely from air.

Perhaps the strangest thing photosynthesis teaches us is where trees come from. Look at the massive trunk of an old oak or Douglas-fir and it seems logical that all that material must have come out of the ground. Surprise! Most of it didn't.

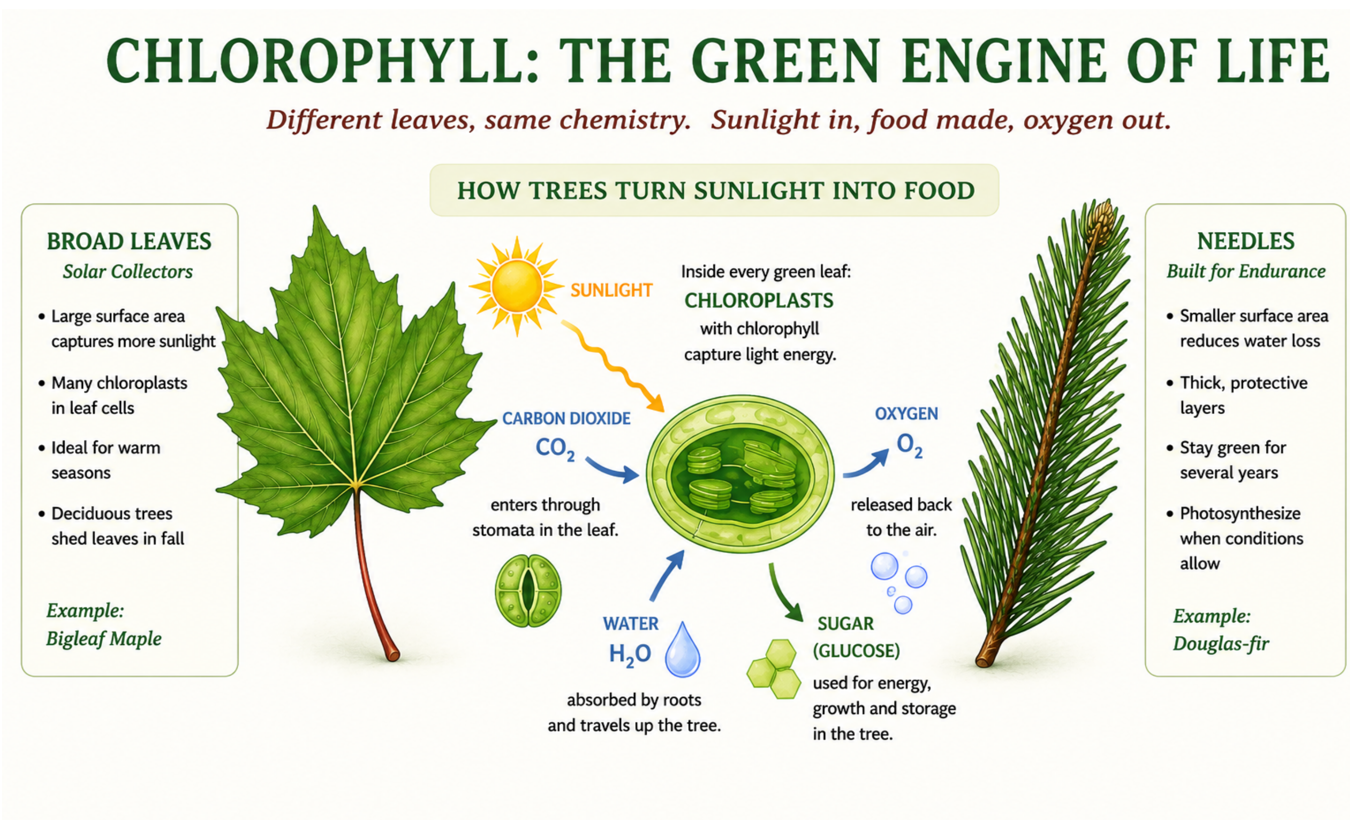
Much of the dry mass of a tree ultimately comes from carbon dioxide taken from the atmosphere. The carbon incorporated into sugars through photosynthesis becomes part of cellulose, lignin, and other compounds from which the tree builds wood, roots, bark, and leaves. In a very real sense, a tree is sunlight and air made solid.

Why are leaves green?

Sunlight looks white, but it's actually made up of a whole rainbow of colors. Chlorophyll is very good at absorbing red and blue light, using that energy to power photosynthesis. Green light, however, mostly bounces off instead of being absorbed. That's the light that reaches our eyes, so a leaf looks green partly because **green is the light chlorophyll doesn’t absorb as effectively.**

Chlorophyll isn’t the only pigment inside a leaf. Some of the other pigments also assist in absorbing light energy. We notice those in the fall, when plants make less chlorophyll and the other colors are no longer hidden beneath green.

If you’re wondering why plants don't have pigments that allow them to capture all wavelengths of light, think of yourself exposed to the sun. Sunlight can be damaging, which is why we protect our skin. The non-chlorophyll pigments in plants provide a 'sunscreen' for leaves.



Broad leaves and needles: different designs, same chemistry

A bigleaf maple leaf and a Douglas-fir needle may not look as though they are built on the same principles, but they are. A needle is a leaf. They both contain chlorophyll, both absorb sunlight, and both carry out photosynthesis.

Broad deciduous leaves have a large surface for intercepting sunlight. A tree such as a bigleaf maple is really an enormous solar-collecting canopy in spring. It uses that capacity to the maximum during the growing season, and then sheds it before winter.

Evergreen conifers follow a different strategy. Douglas-fir and other conifers generally have tougher, narrower foliage that loses less water and can withstand conditions that would damage many broad leaves. Instead of replacing their entire canopy every year, they can retain needles for several years. When winter conditions permit, those green needles are still capable of photosynthesis.

Every breath begins with photosynthesis

The importance of this chemistry extends far beyond trees. Over immense spans of geological time, photosynthetic organisms transformed Earth’s atmosphere by releasing oxygen. Photosynthesis still supports most food webs and continues producing oxygen today. Trees are important participants in that process.

From a bigleaf maple towering over a Washington County stream to microscopic algae floating in the water below it, the basic trick is remarkably similar: **capture sunlight, use its energy to build organic matter, and release oxygen along the way.**

It's easy to take chlorophyll for granted, but it's genuinely one of nature's most important molecules. Every breath of oxygen we take and nearly every calorie of food we eat can be traced back, at some point, to a chlorophyll molecule capturing sunlight. The next time you're admiring a tree's canopy, remember: you're looking at millions of tiny solar panels, quietly converting light into life and producing oxygen for your next breath.

References and further reading

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