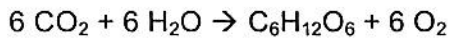


Lodgepole Pine and the Mountain Pine Beetle

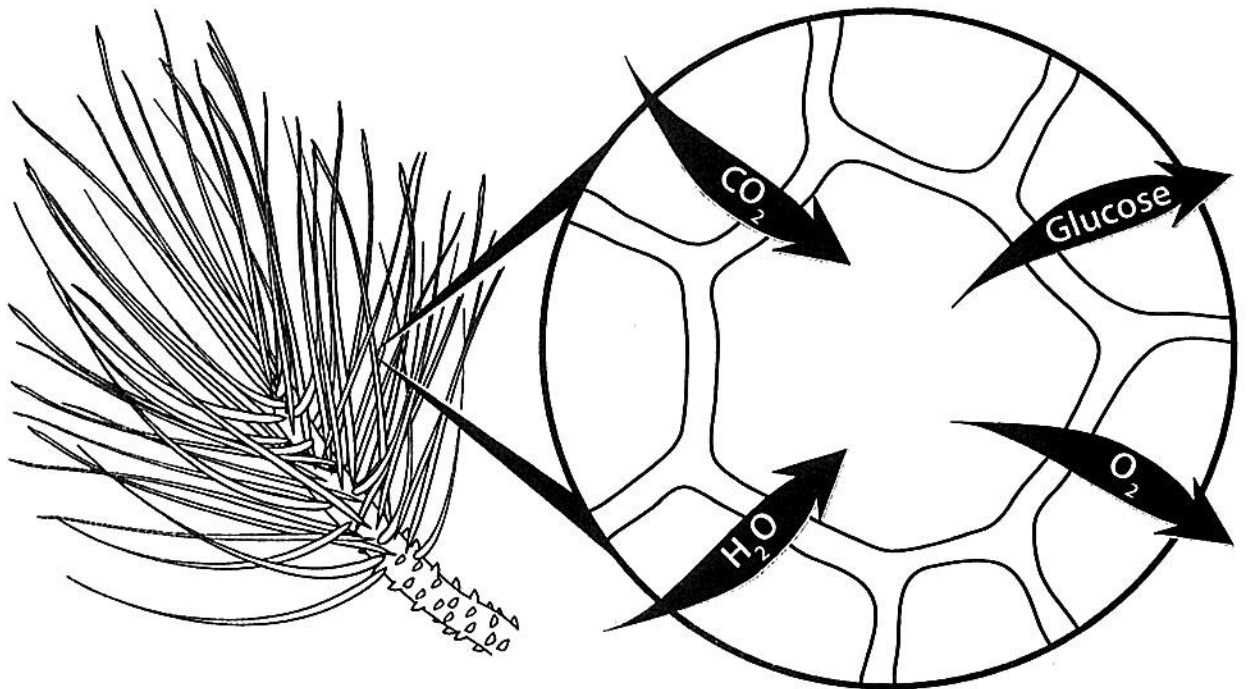
How Do Lodgepole Pines Live and Grow?

Like other plants Lodgepole Pines make their own food (glucose) through the process of photosynthesis, then all the cells in a Lodgepole Pine use that food to live and grow. We can explain how a Lodgepole Pine does this in four steps.

Step 1: Cells in the leaves make sugar through the process of photosynthesis. Lodgepole Pines have needle leaves rather than broad leaves. Needle leaves look different, but they also have special cells that take in carbon dioxide (CO₂) from the air and water from from the tree's roots. These cells use energy from sunlight to combine the CO₂ and water molecules, making glucose, a kind of sugar that stores chemical energy. You are familiar with the chemical equation for photosynthesis:

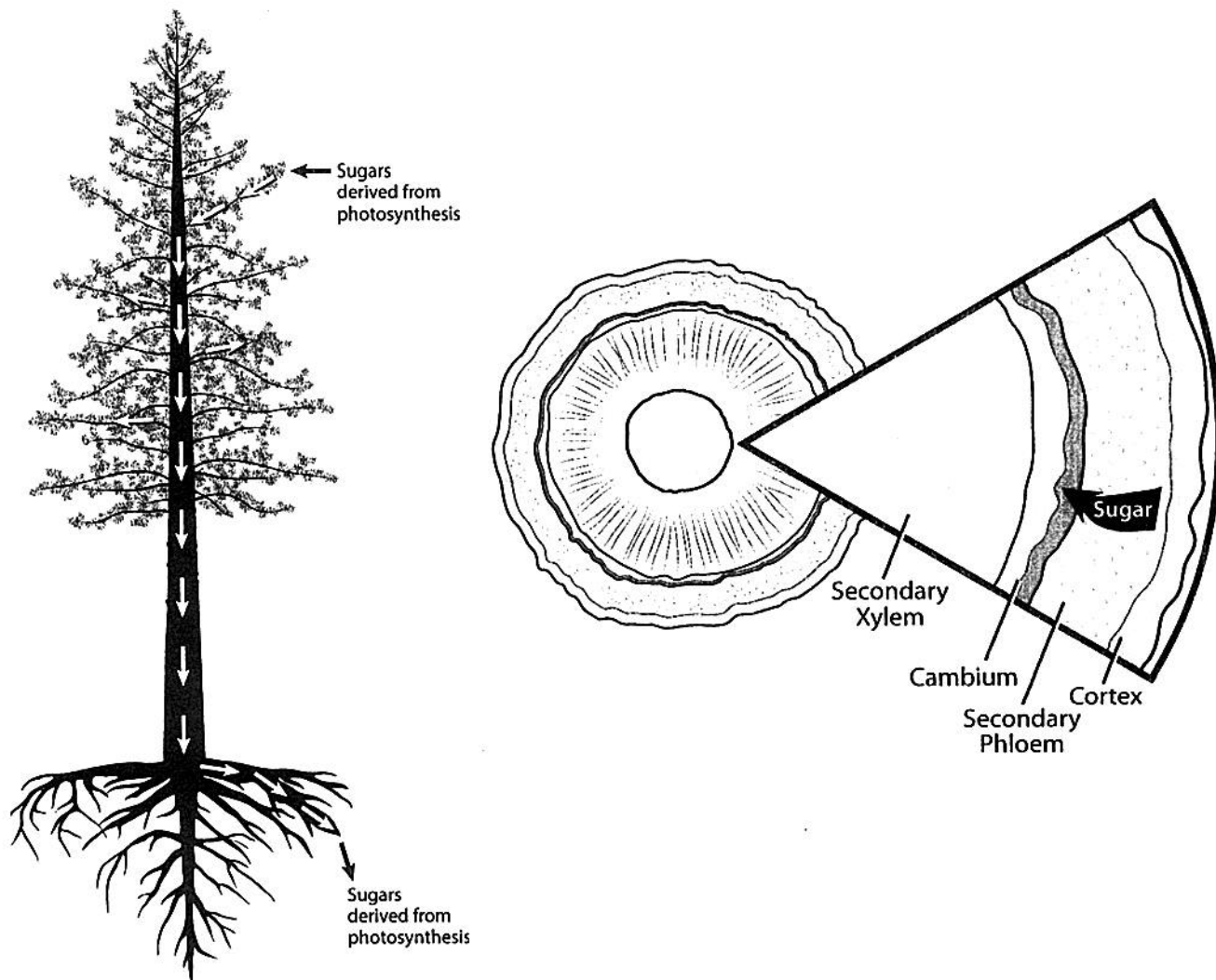


The leaf cells keep some of the glucose for their own energy and growth, but they send most of the sugar to the rest of the plant.

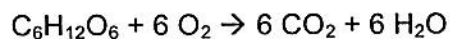


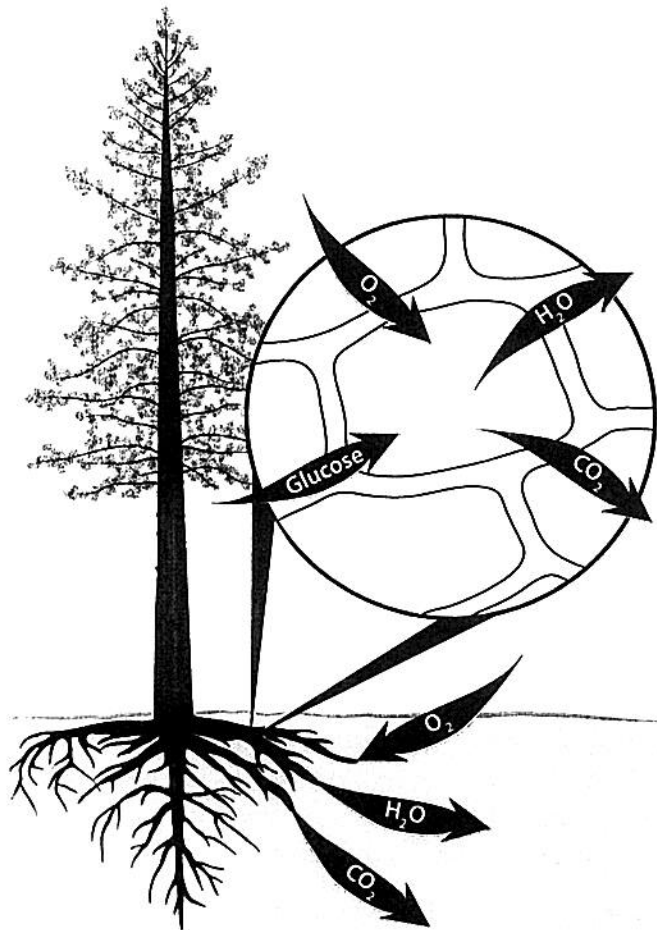
Step 2: Sugar moves to all the cells in the Lodgepole Pine plant. Like other plants the Lodgepole Pine has specialized cells (called phloem) that move sugar from the leaf cells to all the other cells in the stem and roots. The phloem is all in just a small part of the tree's

woody branches—the inner part of the bark. So all the sugar that the pine's root cells need to live and grow flows down the trunk through this thin layer of bark.



Step 3: All the cells get energy by combining sugar with oxygen in the process of cellular respiration. All the cells need energy to carry out their life functions, and they get that energy by combining the sugar with oxygen. You are familiar with the chemical equation for cellular respiration:





Step 4: Cells grow by making large organic molecules from sugar and minerals in the process of biosynthesis. Lodgepole Pines grow by using glucose and minerals that come through the plants from the soil to make all their other small and large organic molecules, including starches, cellulose, fats, proteins and other molecules. Lodgepole Pines in Western Forests

Forests in the western United States are filled with many species of pine trees, including Lodgepole pines. Pine trees can photosynthesize throughout the year with their needle leaves. These needles stay on the tree throughout the year because the sap inside the needles does not freeze even in very cold weather.

Forest fires help to make sure Lodgepole Pine trees continue growing in Western forests. As a fire occurs, the lodgepole pine trees release their seeds to the newly prepared forest floor. The fire also helps to get rid of other species of trees which could compete with Lodgepole Pine trees and prevent them from growing.



Many Lodgepole pines have died in recent years. They have been killed by a little insect called the Mountain Pine Beetle (*Dendroctonus ponderosae*). You can see one hiding inside a bit of pine wood in the picture. Here are some interesting questions to consider about the Lodgepole Pine and the Mountain Pine Beetle.

How can tiny little insects kill such a great big tree? The answer to this question involves what the beetles eat, and why, and how that affects the tree. The beetle larvae live in the bark of the lodgepole pine, and they eat one layer of the bark—the layer that has all the sugar: the glucose-filled phloem in the inner bark.

So what happens then? The beetles kill the trees in a series of steps:

- If there are enough larvae, they can eat all the way around the trunk of the tree, destroying the phloem.
- Without phloem, glucose can no longer get to the root cells.
- Without glucose, the root cells can no longer engage in cellular respiration or biosynthesis, so they die.
- The dead root cells no longer send water and minerals up to the leaf cells, so the leaf cells die, too.

And in this way the larvae of a little beetles kill millions of big Lodgepole Pines!

Why now? Lodgepole Pines and Mountain Pine Beetles have lived together in the forests for thousands of years. Why are beetles killing so many more pine trees now? The answer to this question lies in the changing climate. Cold winters kill beetles and their larvae. Long winters mean the beetles don't have much time to grow and reproduce.

But in recent years winters in the Western forests have been getting warmer and shorter. The higher temperatures in the Western United States are now leading to more mountain pine beetles being active earlier. Lodgepole pine trees are attacked by many mountain pine beetles at once and cannot fight back because of both the high temperatures and lower amount of water.

Digging Deeper: Where You Can Learn More about Lodgepole Pines

There is still a lot to learn about the Lodgepole Pine tree. For more information, this article from the Guardian has more information on the Lodgepole Pine Tree.

<https://www.theguardian.com/environment/2007/mar/19/usnews.conservationandendangeredspecies>

In addition to the Guardian article, the National Parks Service has posted a short reading including some further information for the Lodgepole Pine Tree.

<https://www.nps.gov/yell/learn/nature/lodgepole.htm>

Finally, the University of California has posted some information about the Lodgepole Pine including organisms which damage the Lodgepole Pine Tree.

http://ucanr.edu/sites/forestry/http_uacanrorg_sites_forestry_California_forests_Tree_Identifier/Lodgepole_pine_Pinus_contorta/

Lodgepole pines and mountain pine beetles live in the western United States, but there are related pines and beetles in the East. Read about them at <https://nyti.ms/2wbR3ek>.