INSIDE OLDER PLANTS

Plants which live for many years, such as trees, form new tissue to support their original primary tissue. This process is known as **secondary thickening**. The new tissue is made up of more fluid-carrying tissue, formed toward the middle of the plant, and protective tissue, formed on the outside.

TISSUE GROWTH

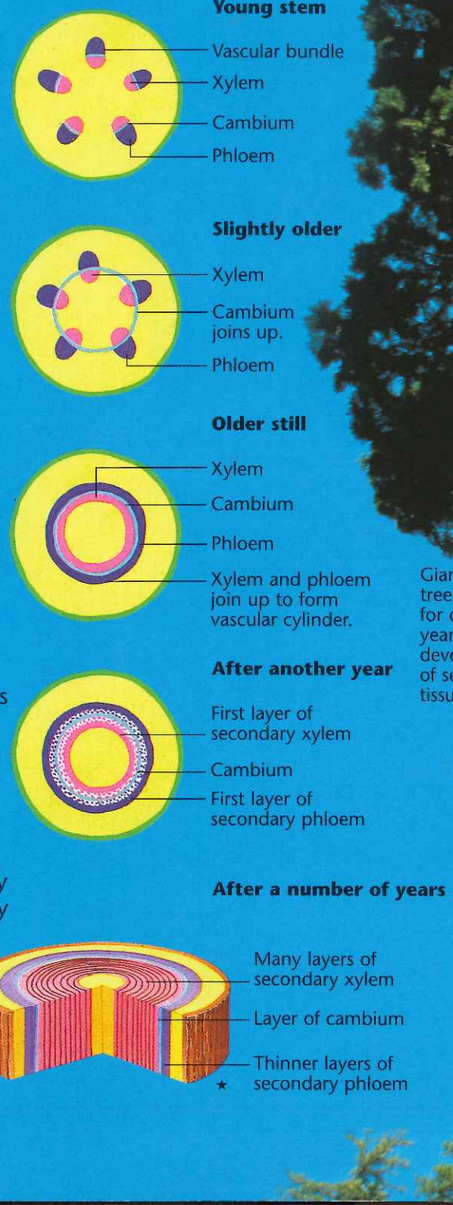
The production of new tissue in young stems, called **secondary tissue**, happens in stages. The process is slightly different in roots, but the overall result is the same.

In a stem, secondary thickening starts when more cambium (growth tissue) forms between the vascular bundles*. This joins up to form a continuous cylinder of tissue.

The cambium starts to produce more xylem and phloem. These join up to form a **vascular cylinder**. Each year, new layers of xylem and phloem are produced.

Over time, the stem and roots thicken, and the plant becomes known as a **woody plant**. The new xylem is **secondary xylem**, and the new phloem is **secondary phloem**.

The core of vascular tissue, which is mostly xylem, gets bigger. By this stage, the xylem is also called **wood**. The phloem does not widen as much because the xylem pushes it outward.



Giant sequoia trees may live for over 2,500 years. They develop lots of secondary tissue.

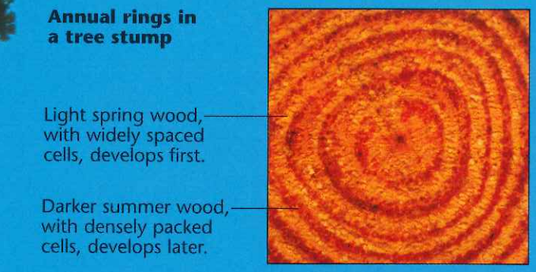
* *Vascular bundles, 13.*

TYPES OF WOOD

A single ring of xylem in a cross section of an older plant shows one year's growth and is called an **annual ring**. Each ring has two separate areas – **spring wood** and **summer wood**.

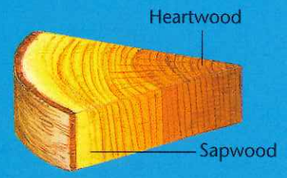
Soft spring wood (also called **early wood**) forms rapidly early in the growing season. It has large cells. Harder summer wood, or **late wood**, is produced later on. Its cells are smaller and more closely packed together.

Annual rings in a tree stump



After a number of years, the annual rings themselves can also be divided into two separate areas. The area nearest the middle, where the rings are older, is called **heartwood**. Its vessels* have become solid and can no longer transport fluids, but they still provide the plant with support.

The outer area of rings is called **sapwood**. Its vessels are still able to carry fluid. Sapwood also helps to support the tree.



See for yourself

You can count the rings in a tree stump to discover the tree's age. For example, fifty rings show that the tree was fifty years old when it was cut down.

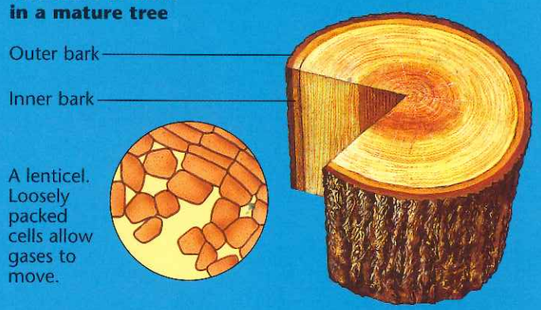
* *Vessels, 12.*

OUTER TISSUE

As well as new vascular tissue, an older plant also forms extra layers of protective tissue around its outside. These develop from a single layer of constantly dividing cells called **phellogen** or **cork cambium**.

As each new outer layer formed by the phellogen is pushed further out by new layers on its inside, it dies away to become waterproof **bark**. This contains tiny raised openings called **lenticels**, through which oxygen and carbon dioxide are exchanged. As a tree gets older, the layers of bark build up, making the trunk thicker and stronger.

Structure of bark in a mature tree



Bark stops the tree from drying out and helps to protect it from disease. It cannot grow or stretch, so it splits or peels as the trunk gets wider, and new layers of bark develop underneath.

Some types of bark

Silver birches have tough, papery bark.

English oak bark develops deep cracks.

Scots pine bark flakes off in small pieces.

Beech trees have very thin bark.

Internet links

Go to **www.usborne-quicklinks.com** for links to the following Web sites:

Web site 1 Design your own tree, and find out how it would cope in different climates.

Web site 2 Fascinating information about trees, with a variety of games and experiments.

Web site 3 See more about annual rings and how they form.

Web site 4 An illustrated look at bark, wood, roots and leaves.