NATURE'S LABORATORY

"*The Tree of Knowledge is not that of Life*."
-- Lord Byron

While historians turn to archeological remains, oral histories, and historical accounts to piece together a complete history of civilizations and cultures, scientists can turn to tree trunks to unravel our planet's environmental history. Dendrochronology is the science of calculating the age of a tree based on the accumulation of annual growth rings, and using that information in the study and analysis of how these rings correlate to their environment.

The term dendrochronology stems from *dendron* = "tree," *chronos* = "time," and *logos* = "the science of." Simply put, dendrochronologists use tree rings to tell time. Within dendrochronology, there exist a number of more specialized fields. Dendroarchaeologists can determine when timber used in buildings or artifacts was felled; dendroclimatologists can reconstruct historical climate conditions; and dendroecologists can determine how different environmental factors affected ecosystems.

Other events that dendrochronology can provide insight into are the movements of glaciers (dendroglaciology), geological processes that alter, create, or shape the landscape (dendrogeomorphology), changes in river flows, lake levels, and runoff (dendrohydrology), insect population dynamics (dendroentochronology), and frequency and timing of wildfires (dendropyrochronology).

At the onset of spring, trees undergo a period of growth, adding a layer of wood between the past year's growth and the protective bark. During this growth spurt, a layer of earlywood (spring wood) develops. Following this period of growth, a layer of latewood (summer wood) develops. By winter, trees become dormant and sleep off the cold winter, but not without leaving behind a history of the environmental conditions within which they grew.

Looking at a stump, the earlywood appears as the thicker bands of lighter wood, while the latewood appears as the thin, dark bands of wood. Combined, the early- and latewoods form annual rings that encircle the tree branches and trunk. Wet years typically result in wider rings of earlywood, while dry years result in narrower rings.

The variation between ring widths over a span of years is referred to as sensitivity, while the lack of ring width variability is called complacency. Sensitivity is a result of

variations in slope gradients, soils, moisture, and other environmental factors. Complacency is a result of constant environmental conditions that vary little over the years.

Although a tree's history lies at its core, scientists can't very well cut down every tree to uncover a forest's secrets. Instead, they use a hollow, auger-like tool known as an increment borer to extract an increment core, or tree core, a cross-section of the tree trunk that extends from the bark to the tree's heartwood. When extracted, scientists are left with a plug of wood with a story to tell.

Unlike a watch face, there are no simple tell-tale minute or second hands that point scientists to answers. Instead, dendrochronologists must tease the past out of the properties of the rings, clues such as ring-widths, density, and burn marks. In the proper context, these clues can allow scientists to look back in time.

To confirm the correct chronology of environmental conditions or events, dendrochronologists can compare two different sample increment bores. If the outer growth ring patterns of one core sample from an older, deceased tree are found to be identical to the inner growth rings of a second sample from a younger, living tree, scientists can work backwards to determine the age of the older tree. In this manner, scientists can work backwards hundreds of years to age older and older trees, even timber felled years ago to construct buildings and tools.

To date, the oldest known living tree today - not to mention to oldest known living thing on earth - is "Methuselah," a bristlecone pine tree surviving at an elevation of 10,00 feet in the White Mountains of California. Bristlecones (*Pinus longaeva* and *Pinus aristata*) grow no more than 60 feet tall, but specimens like Methuselah are more than 46 centuries old. Methuselah had already set seed when the pyramids of Egypt were being constructed.

Hands On*:* All you need is a woodpile to begin an amateur career in dendrochronology. If you or someone you know cut the firewood, make a note of when the tree was cut down or, if it was already dead, when the tree died. Starting from the heart of the tree, count the number of dark rings of latewood, each of which indicates the end of the growing season and, thus, the end of a growing year.

To apply your dendrochronology skills, it's important to learn your trees - some trees are easier to read than others. Exemplary tree species for dating include Douglas fir, white fir, ponderosa pine, oaks, sugar maples, and birches.

An alternative to the wood pile is Lab-Aids Inc.'s (*www.lab-aids.com*) Dendrochronology Tree-Ring Dating Kit. The kit provides simulated tree and lumber cores, giving students the opportunity to establish the age of trees, as well as the year in which trees were felled for lumber.

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