# A WALK THROUGH THE WOODS:
# DATA ANALYSIS OF STRUCTURAL ADAPTATIONS IN WOOD

Assignment adapted from:
A walk through the woods: data analysis of structural adaptations in wood
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## BACKGROUND

Plant can grow in length (primary growth) and girth (secondary growth). Primary growth increases the plant height/root length. This growth occurs via cell division at apical meristems located at the tip of shoots and roots. Secondary growth increases the circumference of shoots/roots. This growth occurs via cell division at the lateral meristems (vascular cambium and cork cambium). Only woody plants exhibit secondary growth (herbaceous plants do not).

Plant stems have several functions, including support, transport and storage. Stems are made of a variety of **tissues** that help carry out these functions. The stems of angiosperms (flowering plants) contain several different cells and tissue types including:

- Parenchyma: thin-walled living cells that are responsible for storage and some radial transport over small distances
- Fibres: thick-walled cells with smaller lumens that are responsible for support and
- Vessels: dead cells with large lumens that are responsible for water transport

**The relative amount of specific tissue types varies in different types of plants (and their stems) depending on which functions are most important to survival in a plant's given environment. STRUCTURE = FUNCTION.** Structures used for one function may not be the best for another function and this often results in competing requirements for space and resources within the stem. Thus, there will be trade-offs in tissue allocation in stems. **BALANCE**.

**Fast vs. safe transport:**
A smaller number of large vessels will transport water faster than a large number of small vessels (due to less resistance to the flow of water). However, larger vessels come with their problems as they are at higher risk for embolisms (air bubbles) which block fluid flow. Embolisms can be caused in vessels by freezing (when air bubbles come out of solutions as water thaws) and drought (when air is sucked from one air filled vessel to another via pores between the vessels).

**Transport vs. mechanical support:**
A large number of vessels in a stem allows for a lot of water transport, but this leaves less space for fibres, which provide mechanical support (and vice versa). A stem with more vessels and less fibres would be weaker than a stem with less vessels and more fibres.

**Wood Density:**
Wood density is a function of the amount of different tissue types within the stem and is related to ecological and environmental factors. Wood density typically ranges from 0.1-1.2 $g/cm^3$ (the density of water is 1 $g/cm^3$). A stem with lots of vessels or large vessels would be less dense (as vessels are hollow) then a stem with little vessel tissue (because more fibers).

Dense wood:

- Has better mechanical strength (fewer hollow vessels)
- Is better able to avoid embolisms related to drought (smaller vessels)
- Is found in species with slower growth and lower mortality (slower transport)
- Has a lower decay rate, thus slower carbon turnover rates

**Other relevant considerations:**
Lianas are climbing flowering vines, because they climb and are not free standing, they have less need for mechanical strength and therefore can have more vessels and larger vessels.

Some temperate species are known as ring porous species; as they grow, they make large vessels in the spring when water is abundant and smaller ones in the summer when there is less water. Other temperate species are diffuse porous species with smaller vessels (water abundance is the same year-round, relatively lower than tropical). Tropical species are generally diffuse porous with large vessels (water abundance is the same year-round, relatively higher than tropical).

Which of the above species would be more likely to leaf out earlier in the spring? Why do temperate species have smaller vessels than tropical species? If you are unsure, re-read the background information or ask for clarification.