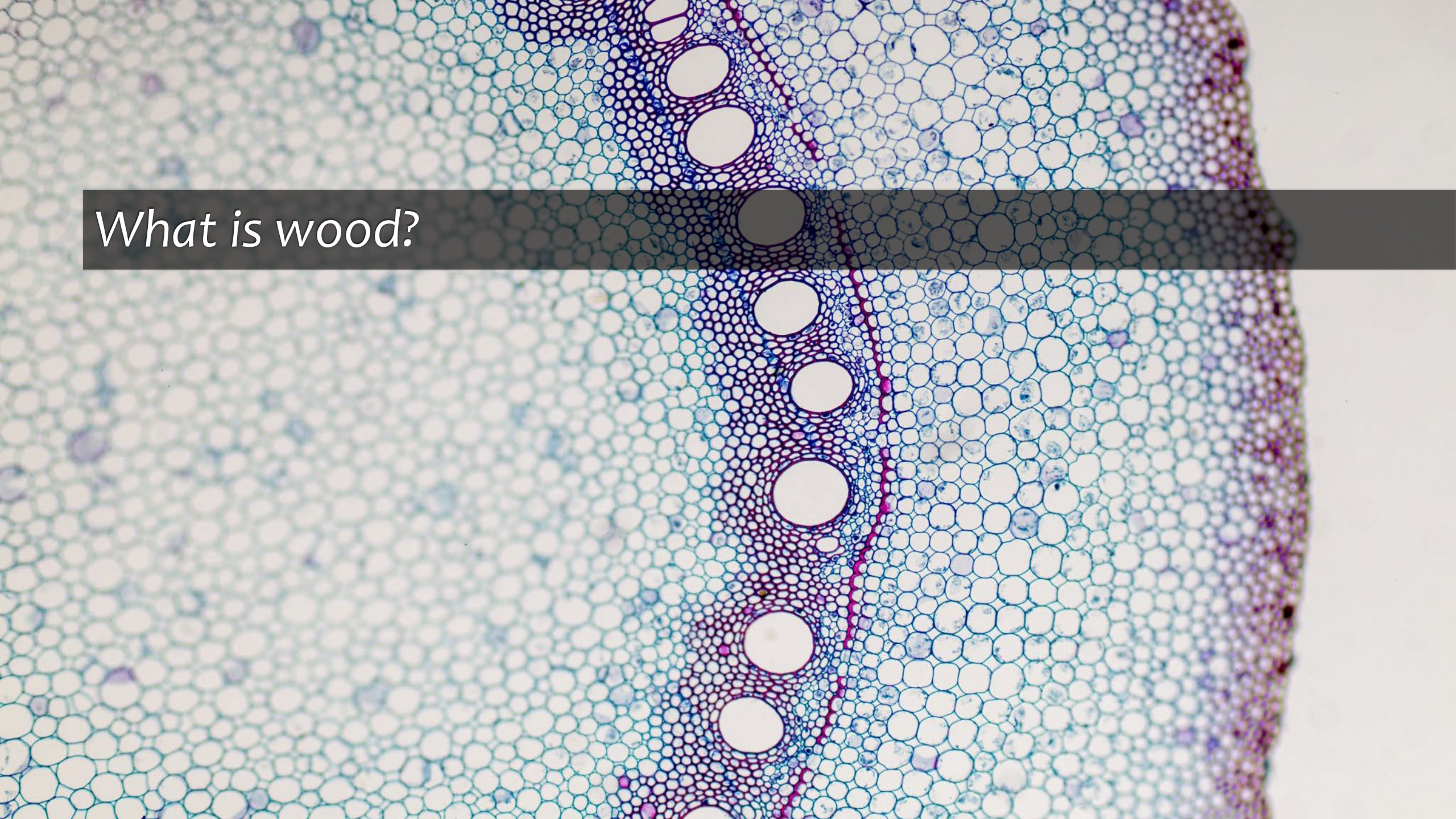
Data hidden in wood

LeeAnn Haaf, PhD

Estuary Science Manager

Partnership for the Delaware Estuary

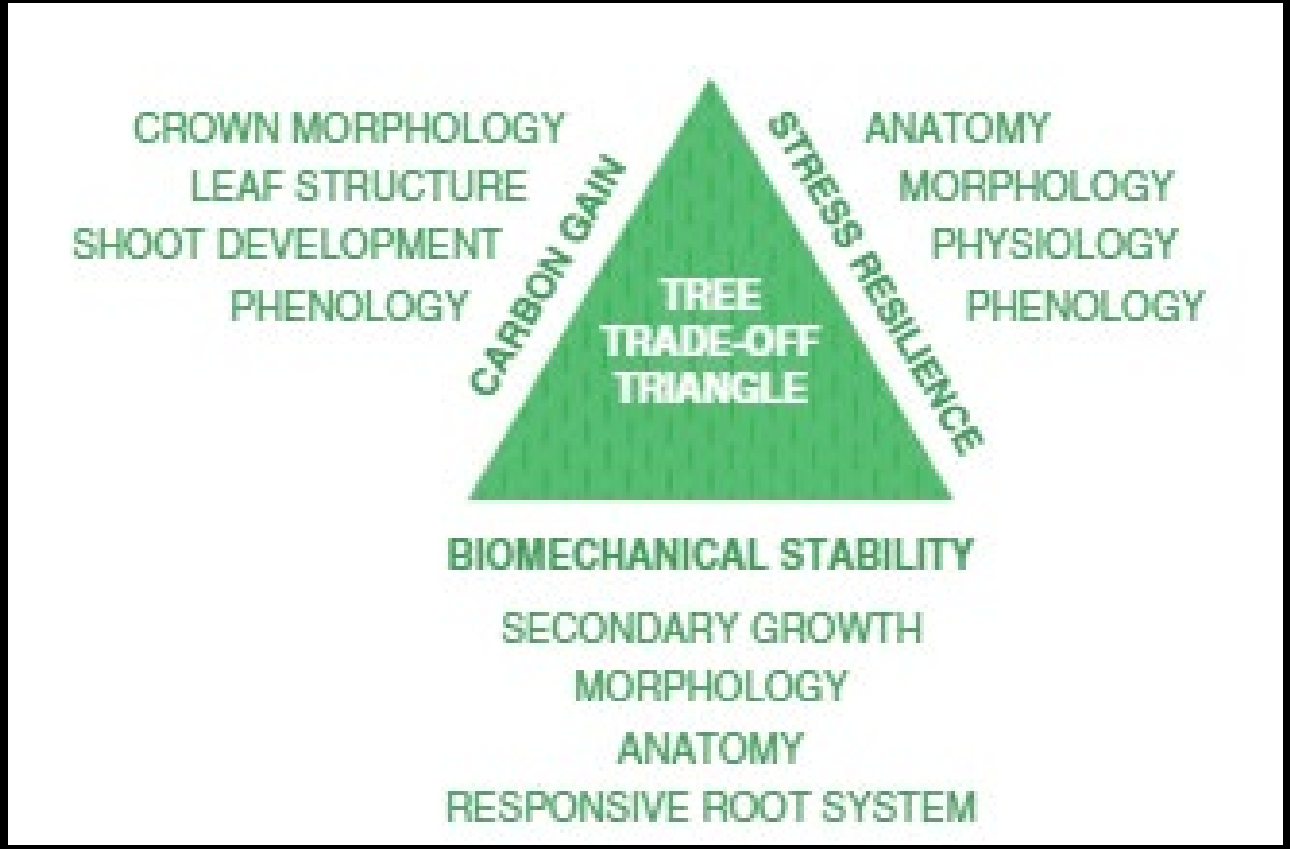
lhaaf@delawareestuary.org



What is wood?

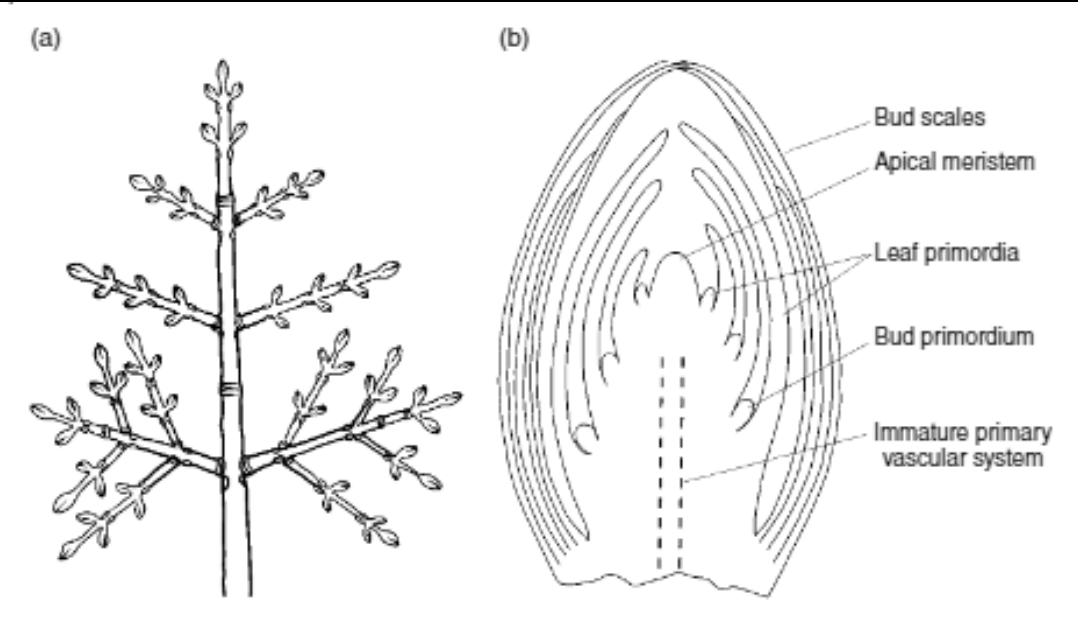
Growth

- In order to grow, a plant must balance:
  - Ways to get carbon
  - Stress
  - Effectively supporting itself



Growth – woody plants

- PRIMARY
  - Meristematic growth, shoots/leaves
  - "Upward" growth



- SECONDARY
  - Wood production or "lateral (outward)" growth

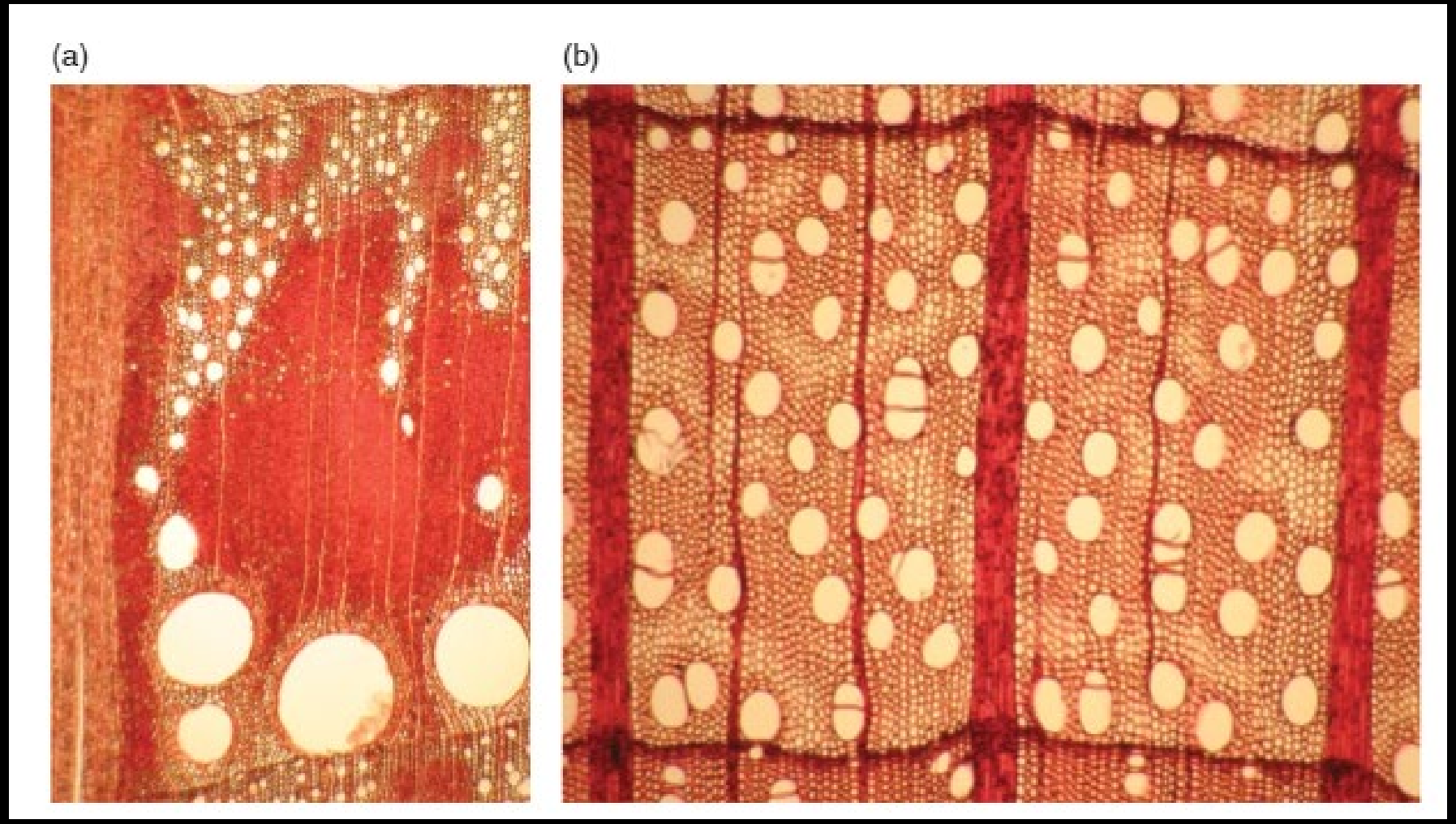
Wood functions

- Transport – water/minerals sap – up *and* down the tree
- Structure
  - Why are trees tall?
  - *How* can they support being tall?
  - What are advantages of being tall and what are the physiological consequences trees must overcome?

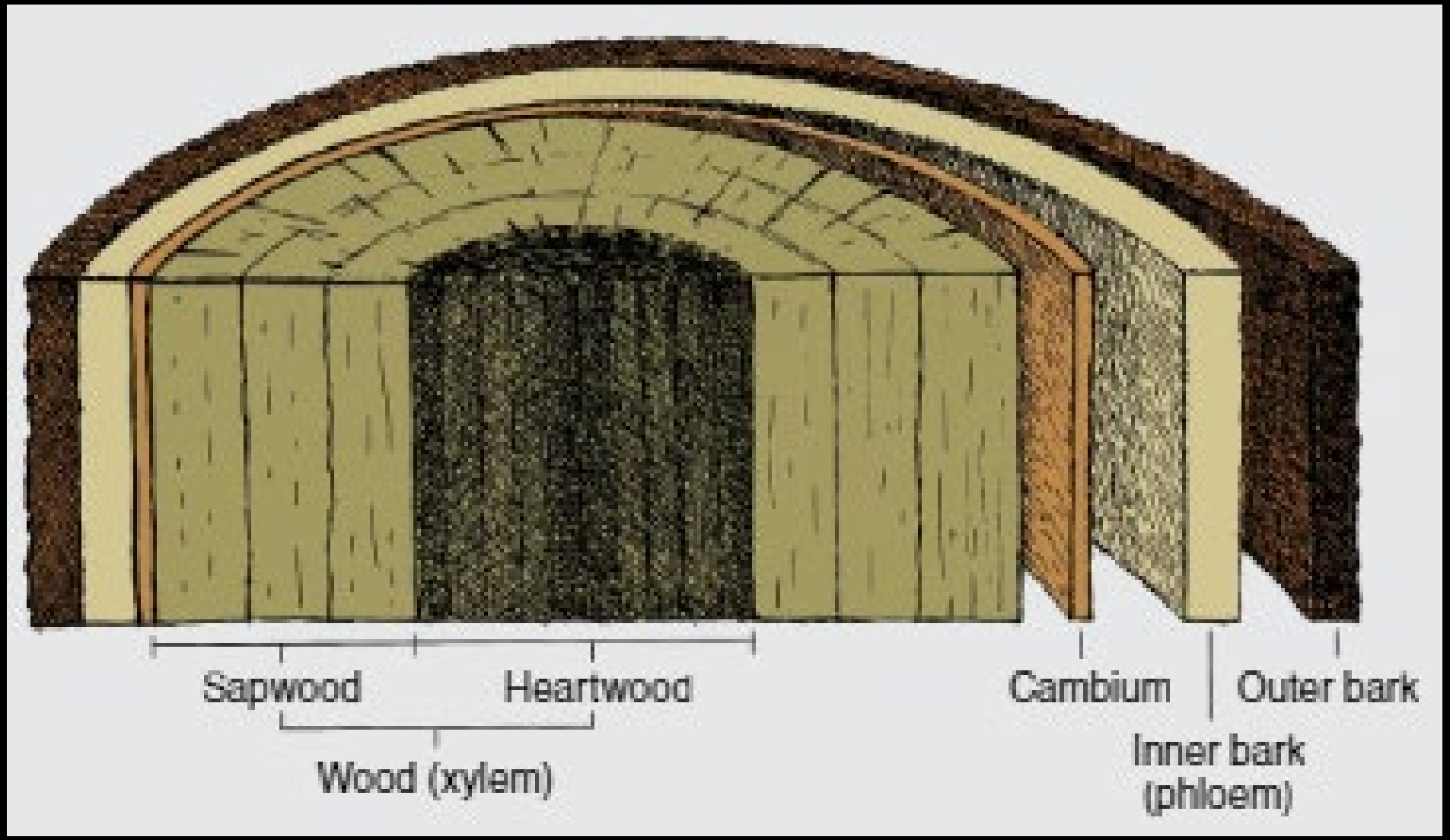
Wood structures

Latewood

Earlywood



Wood structures



Livin' on the edge

Trees tolerate a lot

- Trees are robust plants, they overcome a lot of physiological and mechanical stresses
- They are long-lived, with notable examples being upwards of 4,800 years old (*Methuselah* the bristlecone pine)
- Trees never actually die of old age—it's external factors that lead to their demise (even though the tend to tolerate a lot!)...
- External factors that shape how fast, how big, and successful a tree might be over time

Environmental conditions = annual ring thickness

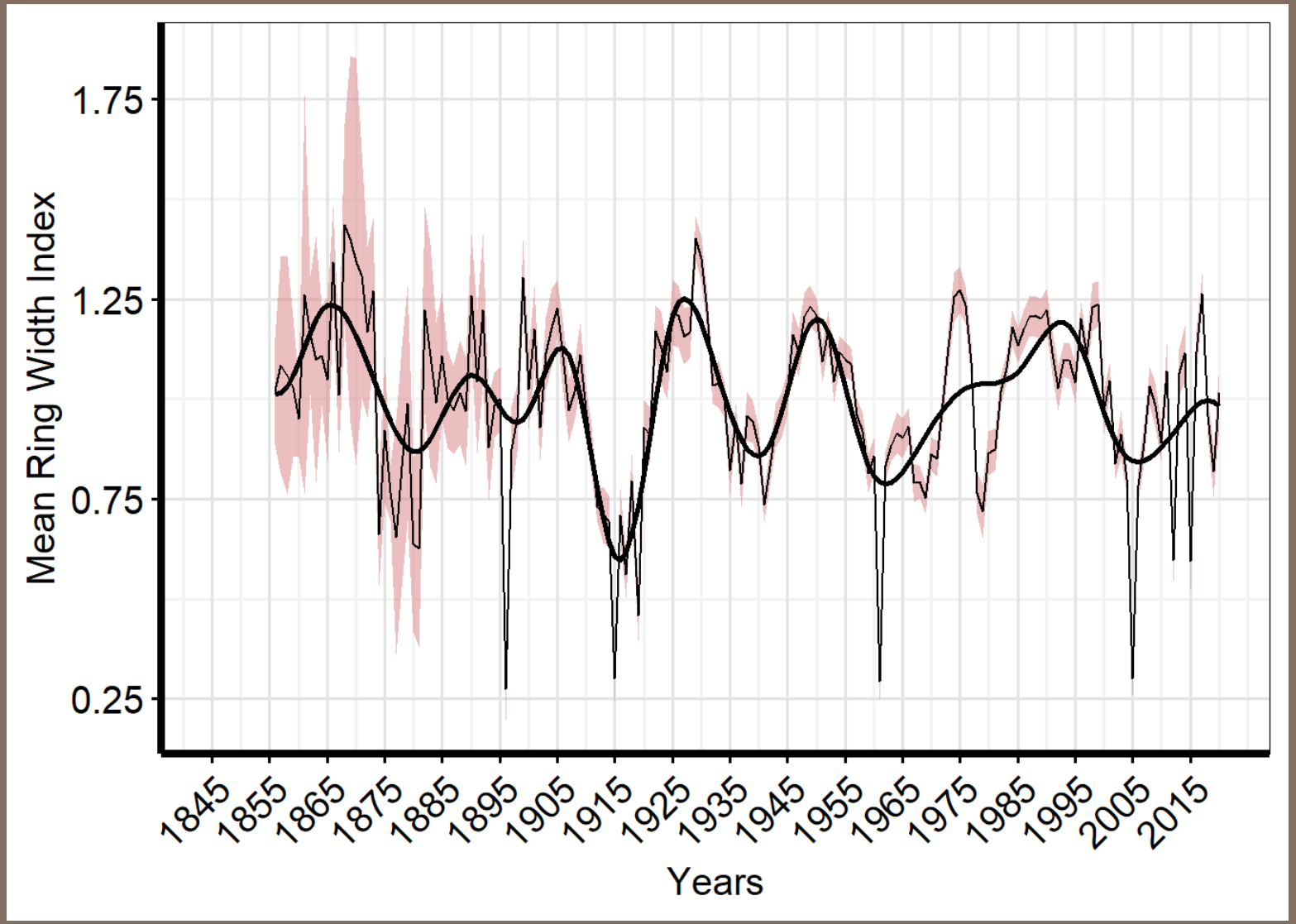
- Annual rings in woody plants occur in temperate environments
  - Latewood forms to limit cold damage in the winter, then growth ceases until spring
- When conditions during the growing seasons are good, annual rings are thicker; thinner rings represent less optimal conditions
  - If conditions are particularly bad, trees might undertake secondary growth at all
- "Optimal conditions" vary by species...

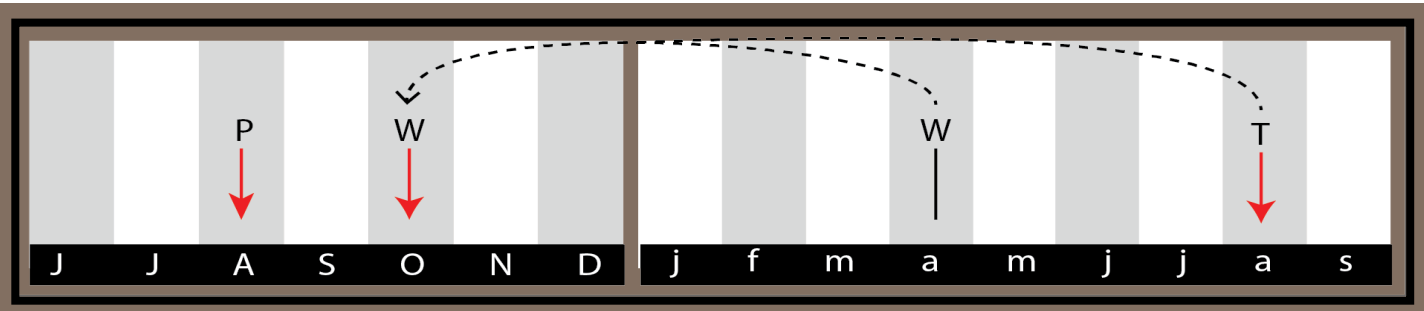
Environmental conditions = annual ring thickness

- Trees are good recorders of their environment because tree ring width will be contrasting when conditions are good vs bad
- Discussion – *why is this important?*
  - Can growth-climate relationships be extrapolated to other areas? And within other species?
  - How can using multiple species paint a fuller picture of past environments?
  - **Hints**: 1) think about the abiotic environment and what it means for individual trees; 2) think about what local conditions are due to larger, continental climate patterns; 3) think about how tree species might respond to different environmental conditions

American holly at the Lighthouse Center

- I analyzed the tree ring patterns of American holly at the Lighthouse Center– here's what I found!


Mean Ring Width Index
1.75
1.25
0.75
0.25
1845
1855
1865
1875
1885
1895
1905
1915
1925
1935
1945
1955
1965
1975
1985
1995
2005
2015
Years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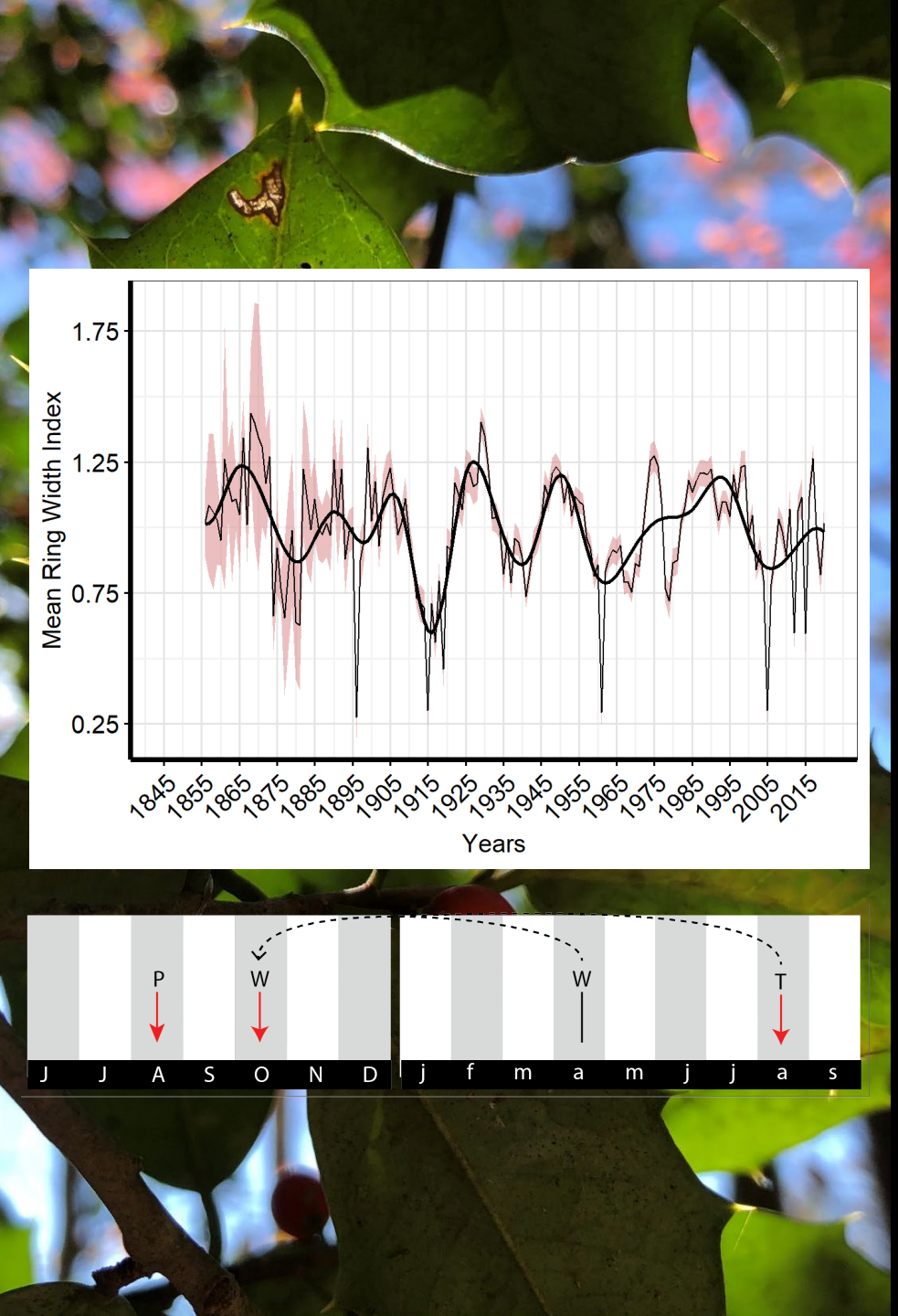

American holly at the Lighthouse Center

- Super old for this area!
  - Many of them are >150 years old
- Between 1905-1920, they all didn't grow so well
- We can see the signature of really bad drought in the early 1960's
- These hollies don't grow as well the year after a rainy August, or when August is hot
  - Waterlogging?
- After we account for April tides and august temperatures, October tides seem to negatively affect their growth
  - October is also when tides are highest and there's a good chance of Nor'easters!

In class exercise - tree rings!

- Dendrochronology can be a fun way to learn about tree growth, time series, and pattern recognition
- I have “tree cookies” (cross sections) from red cedar (*Juniperus virginiana*), sweet gum (*Liquidambar styraciflua*), black cherry (*Prunus serotina*), and red maple (*Acer rubrum*) for you to explore
- Also brought cores of American holly (*Ilex opaca*) from the site

In class exercise - tree rings!

- What features do you see?
  - Is there notable color? Odor? Pores? Rays?
- What is the bark texture? Is the wood soft or hard?
- Are there any features that give you a sense of the angle this tree was growing?
- How old was the tree when felled? Is this similar across species (which is bigger or smaller for its age)?
- Were there any bad years? Particularly good years?
  - If they were felled the same year, can you provide a year number for any of them? Is this year the same *across* species?