Density and porosity of wood in trees of different successional status: a botany lab project

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Hypothesis: early-successional trees have wood that is:

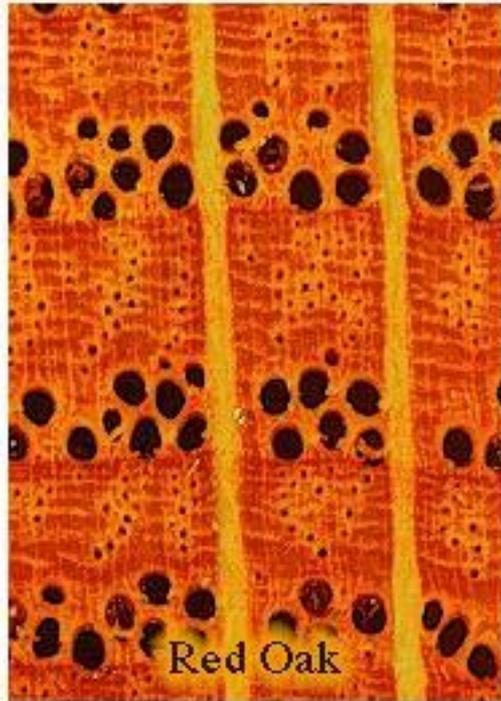   *Less dense*

       Less porous

Why?

       Less long-term investment
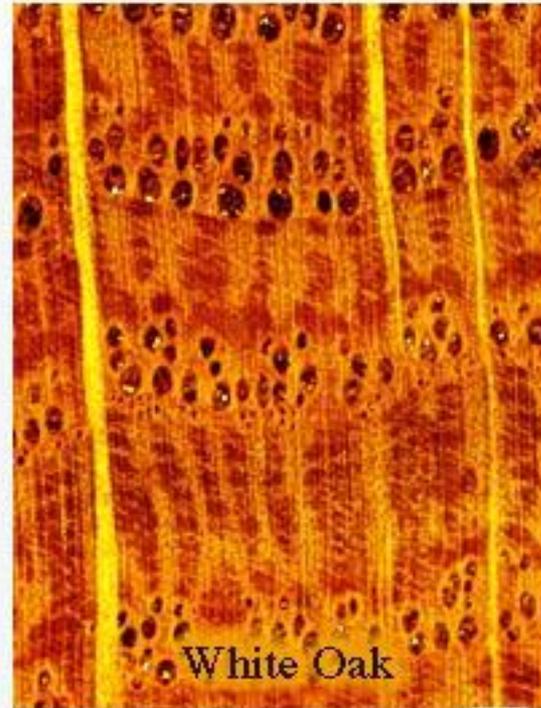
       Faster growth requires more porosity

       More porosity means less density

These are good concepts for basic courses

Ring-porous wood:

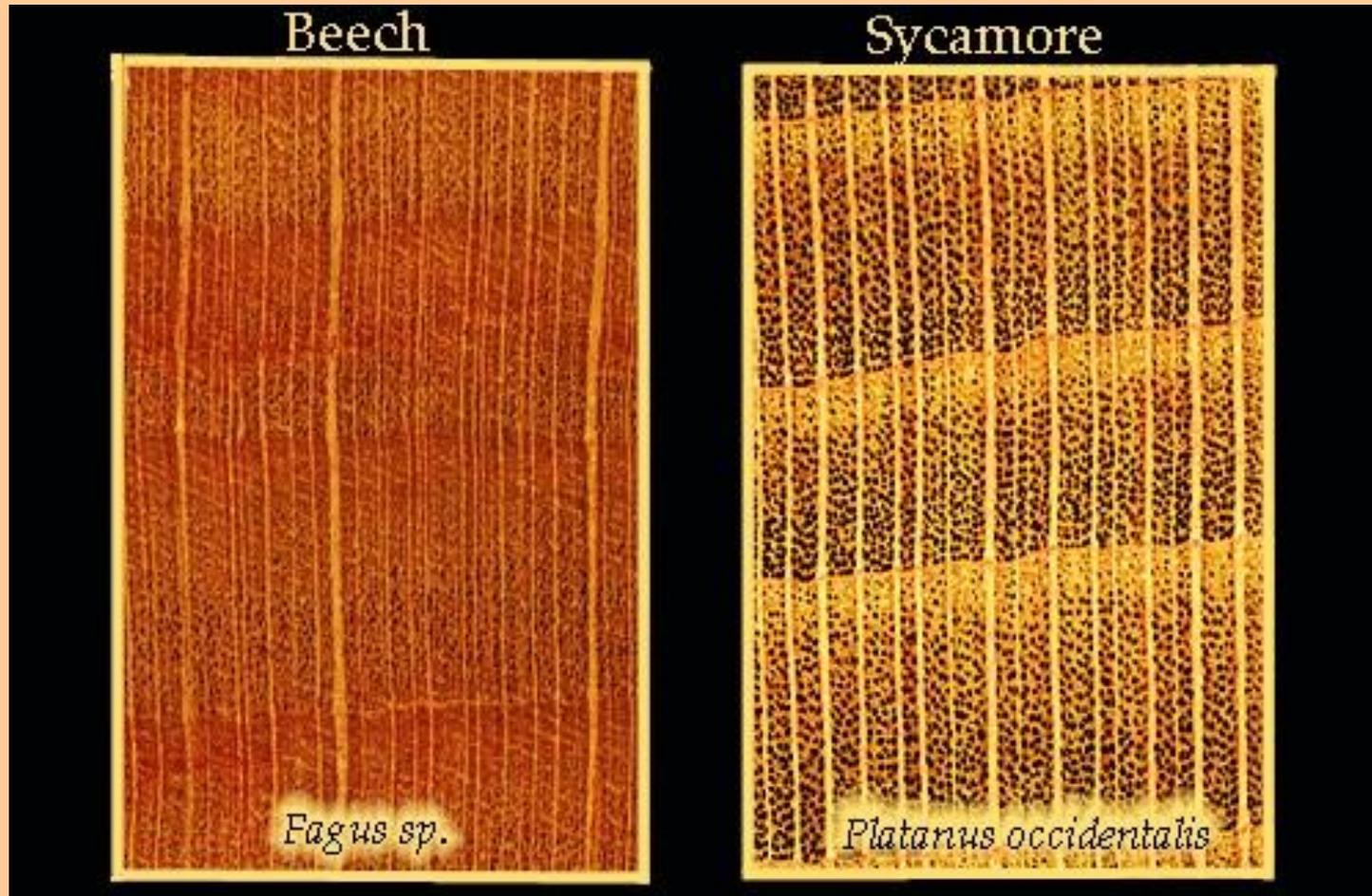
Red Oak — Latewood pores visible with handlens

White Oak — Latewood pores not visible or barely visible with handlens

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Diffuse-porous wood:

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Botany laboratory project:

I collected stems from two individuals of

Early successional trees on campus:

Boxelder *(Acer negundo)*

Cottonwood *(Populus deltoides)*

Sycamore *(Platanus occidentalis)*

Sweetgum *(Liquidambar styraciflua)*

Pines *(Pinus echinata, P. taeda)*

Late successional trees on campus:

Water oak *(Quercus nigra)*

Post oak *(Quercus stellata)*

Black oak *(Quercus velutina)*

Pecan *(Carya illinoensis)*

Black hickory *(Carya texana)*

Laboratory estimates of:

Density: weight divided by water displacement (g per cubic cm)

Porosity: counting the number of large pores relative to the microscopic field of view (pores per square mm)

Density results:

Early successional:		Late successional:	
Boxelder	0.80	Pecan	0.92
Sweetgum	1.00	Black hickory	0.94
Sycamore	1.21	Water oak	0.84
Cottonwood	0.96	Post oak	0.90
Pines	0.82	Black oak	0.94

$P = 0.422$ no significant difference

Porosity results:

Early successional		Late successional	
Boxelder	101	Pecan	33
Sweetgum	129	Black hickory	33
Sycamore	174	Water oak	50
Cottonwood	95	Post oak	27
Pines*	--	Black oak	58

$P < 0.0001$ with higher porosity in early successional trees

*pines do not have vessels

Discussion:

Density problems:

      1. Need dry wood

      2. Twigs are mostly tissues other than xylem

Porosity problems:

      1. Inconsistent work among groups

      2. Conductivity proportional to fourth power

Field botany project, Black Hills:

Early successional stems:

Boxelder *(Acer negundo)*

Cottonwood *(Populus deltoides)*

Aspen *(Populus tremuloides)*

Chokecherry *(Prunus virginiana)*

Late successional stems:

Bur oak *(Quercus macrocarpa)*

Ninebark *(Physocarpus opulifolius)*

Elm *(Ulmus americana)*

Ironwood *(Ostrya americana)*

Density results:

Early successional:		Late successional:	
Boxelder	0.22	Bur oak	0.24
Cottonwood	1.19	Ninebark	0.32
Aspen	0.81	Elm	0.54
Chokecherry	0.91	Ironwood	0.54

No consistent differences

This time we dried the stems first

Porosity results

Early successional		Late successional	
Boxelder	127	Bur oak	115
Cottonwood	188	Ninebark	117
Aspen	245	Elm	100
Chokecherry	73	Ironwood	71

General trend for early successional trees to have more porous wood, but much variation

Alternative:

    Look for standardized wood blocks or standardized density and porosity measures

    But then, would it be a laboratory activity?