



TEXAS A&M  
FOREST SERVICE

# Tree Biology

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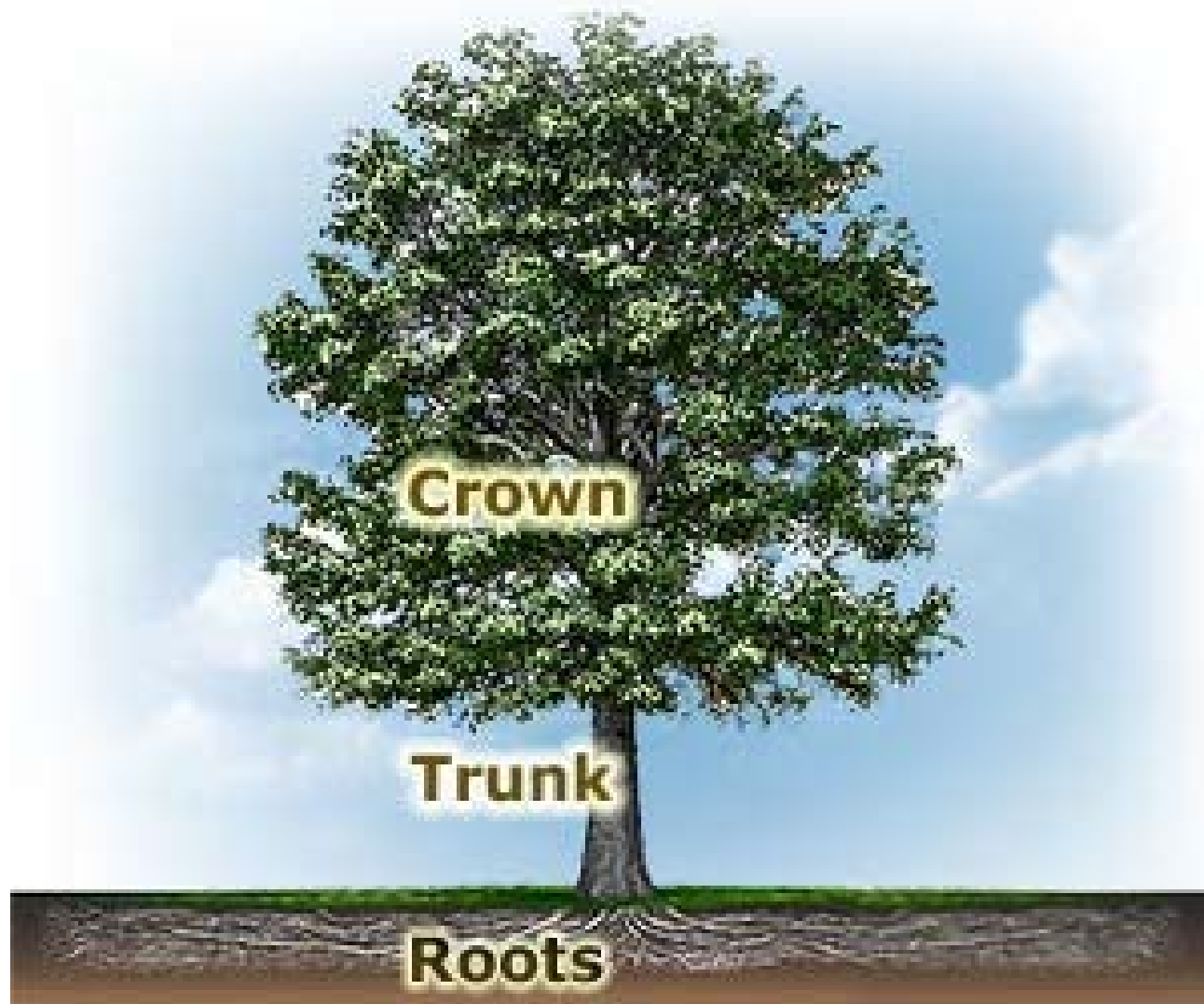
# Tree Biology

- **“If you can work on CARS, you can work on ANYTHING.”**

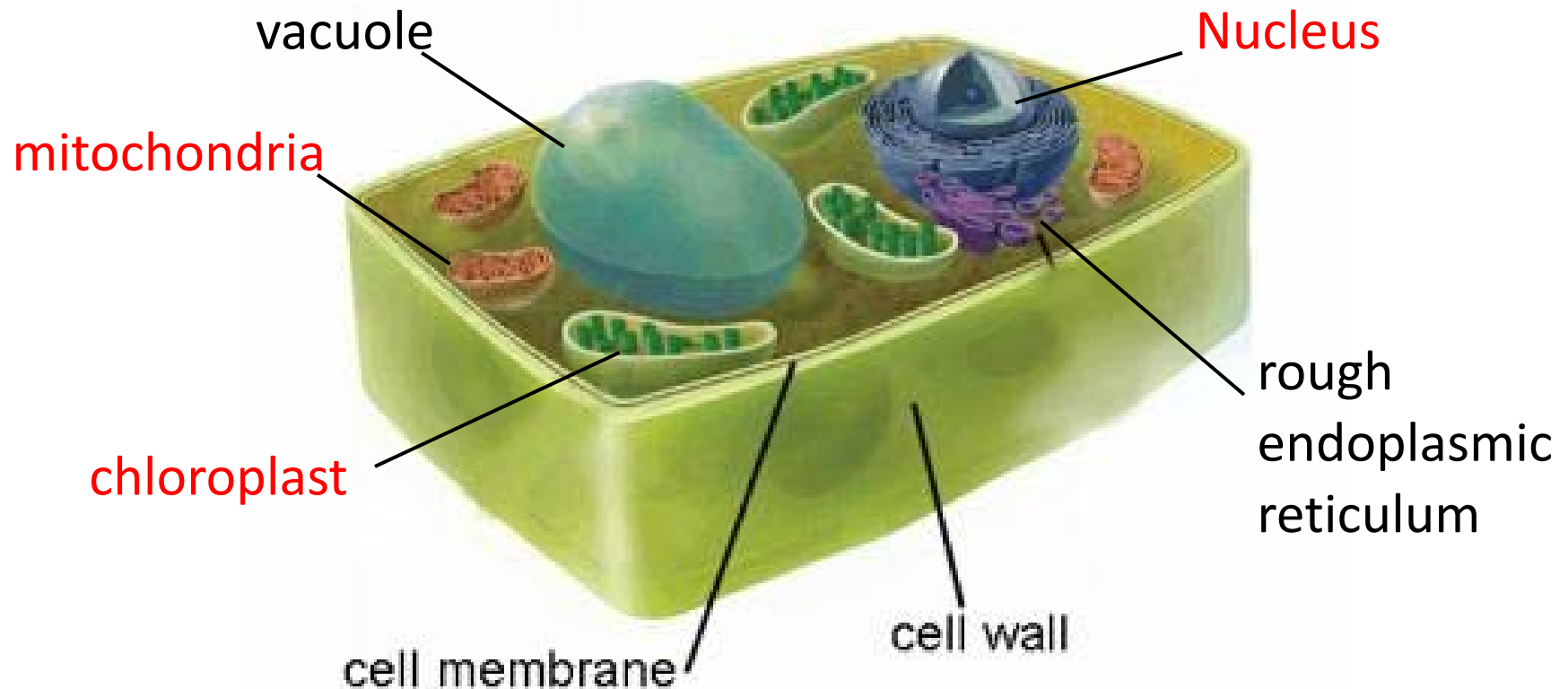
# Tree Biology

- **“If you can work on CARS, you can work on ANYTHING.”**
  - **“If you can work on ANYTHING, then you can figure out how TREES WORK.”**

# Tree Biology

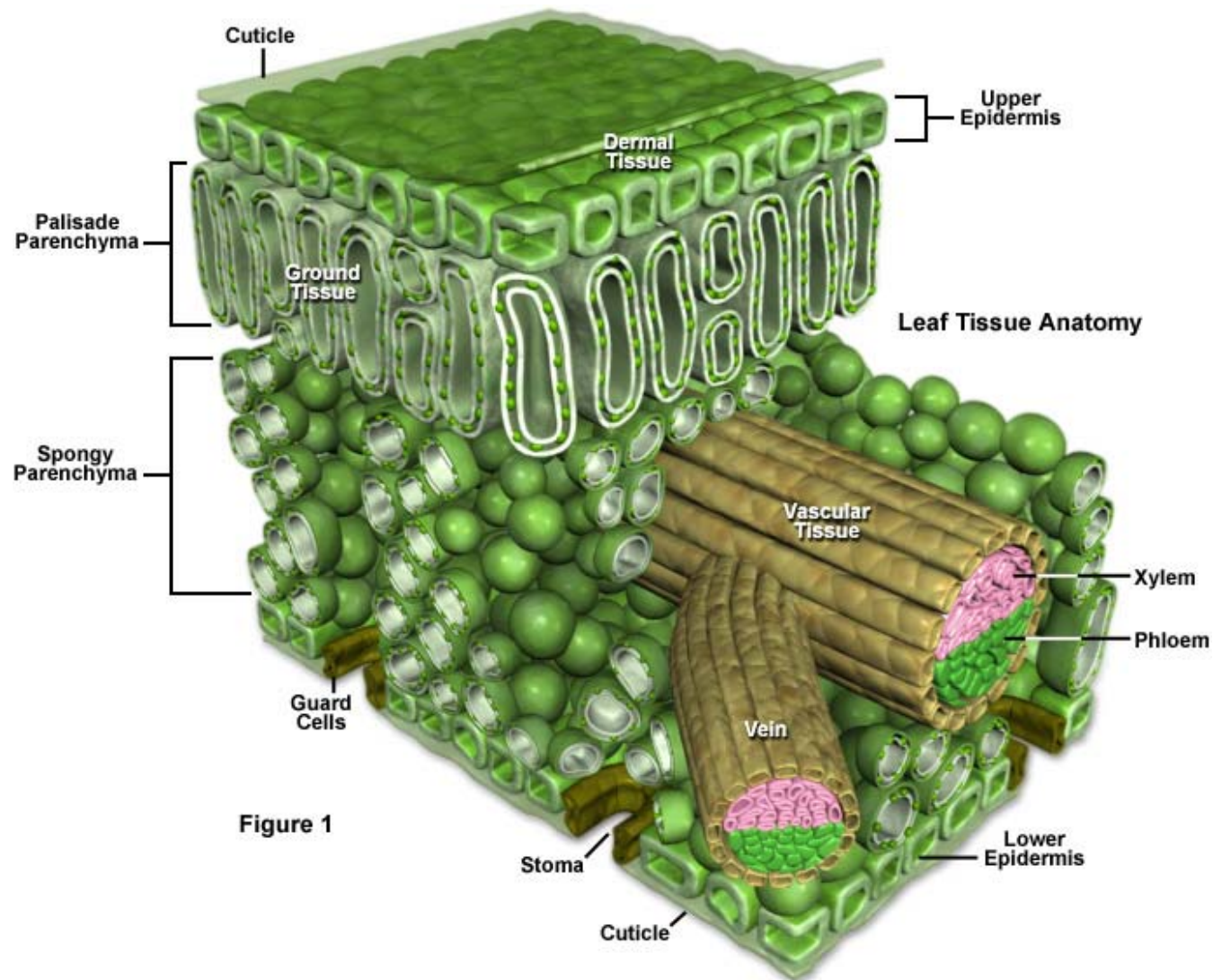


# Tree Biology



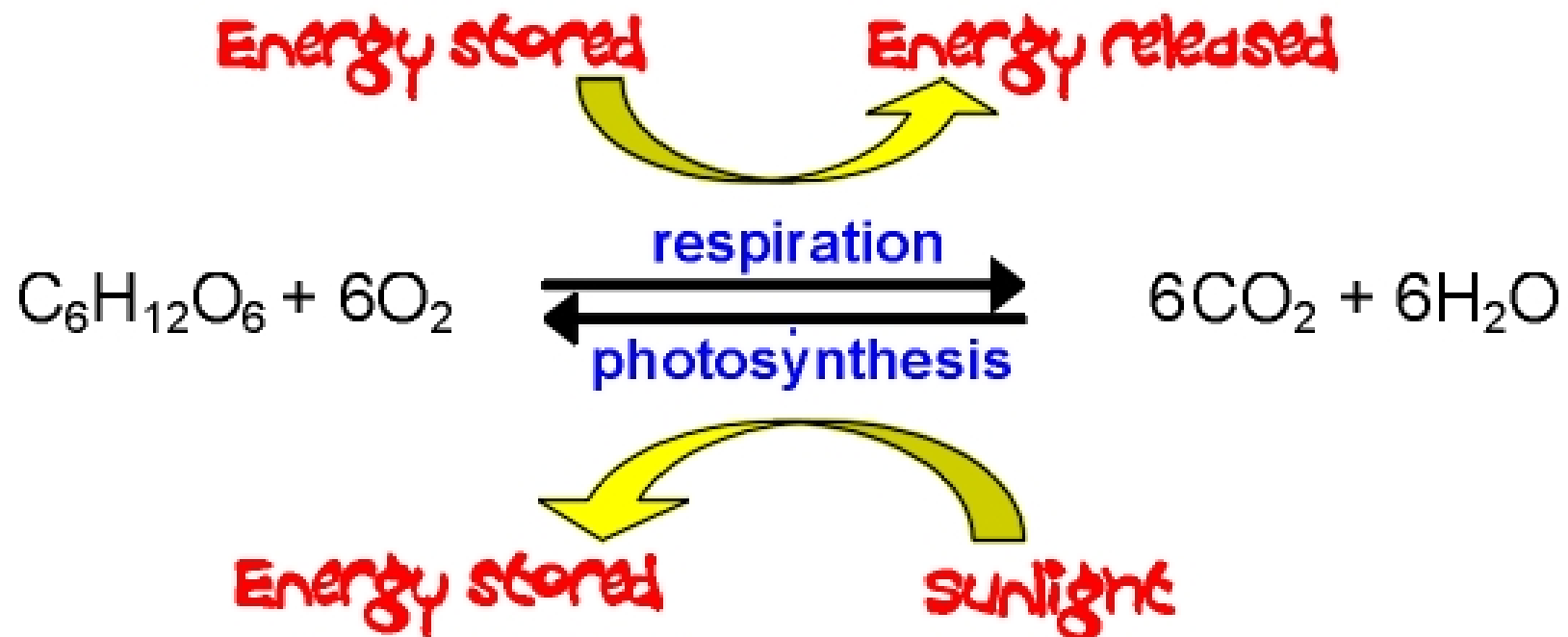
Cell => Tissue => Organ => Organism  
Cell Wall, Cellulose, Lignin

# Tree Biology



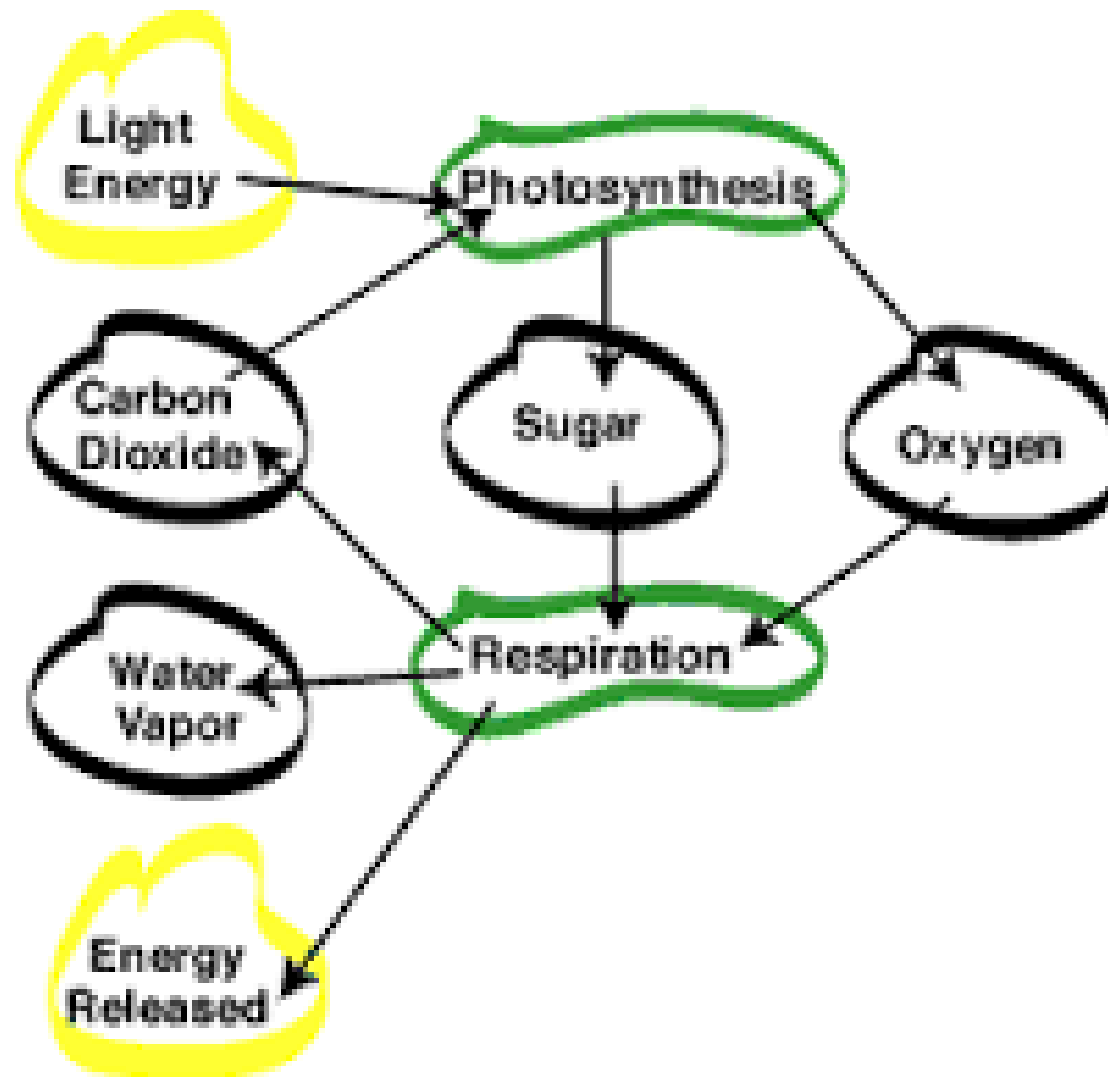
# Tree Biology

Occurs in mitochondria



Occurs in cells that  
contain chloroplasts

# Tree Biology





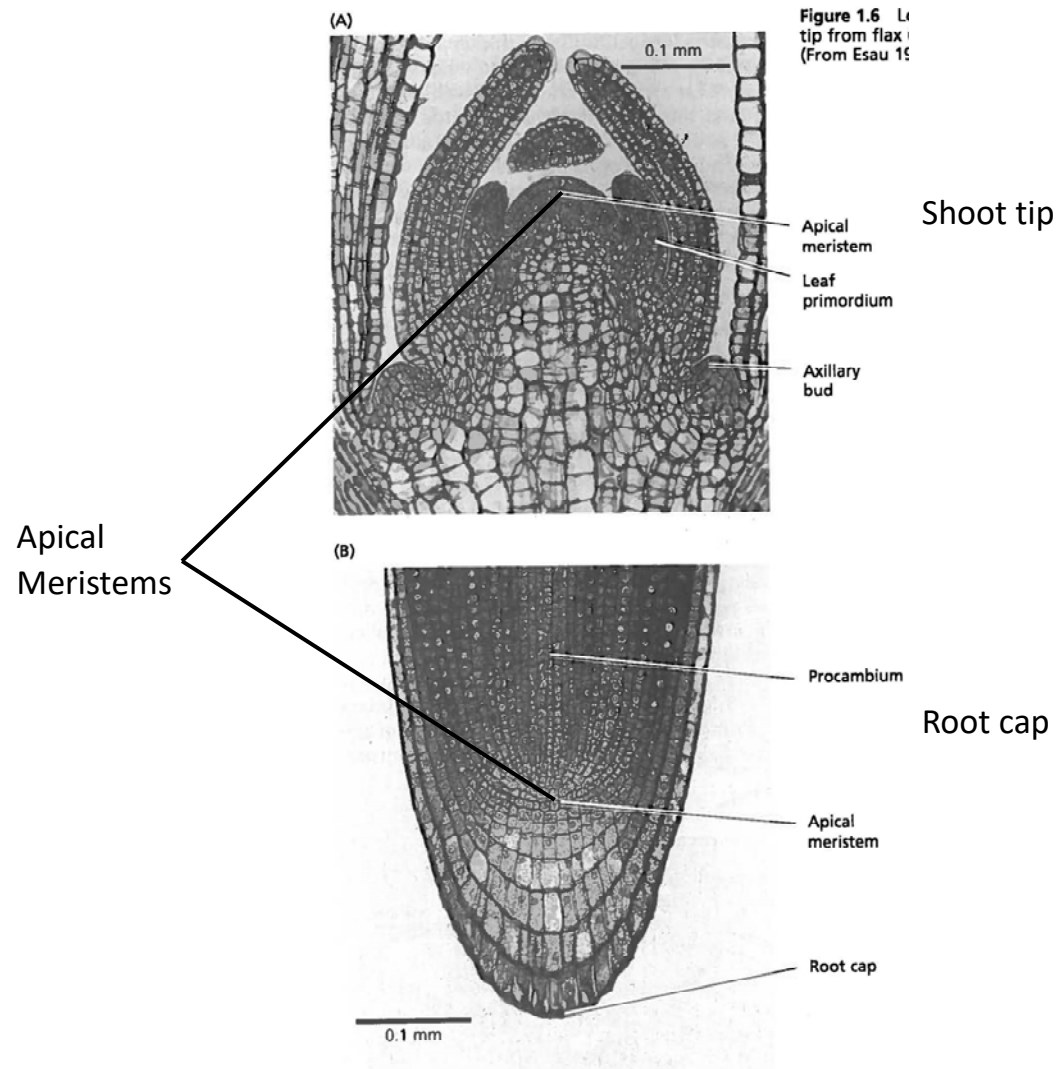
# Tree Biology



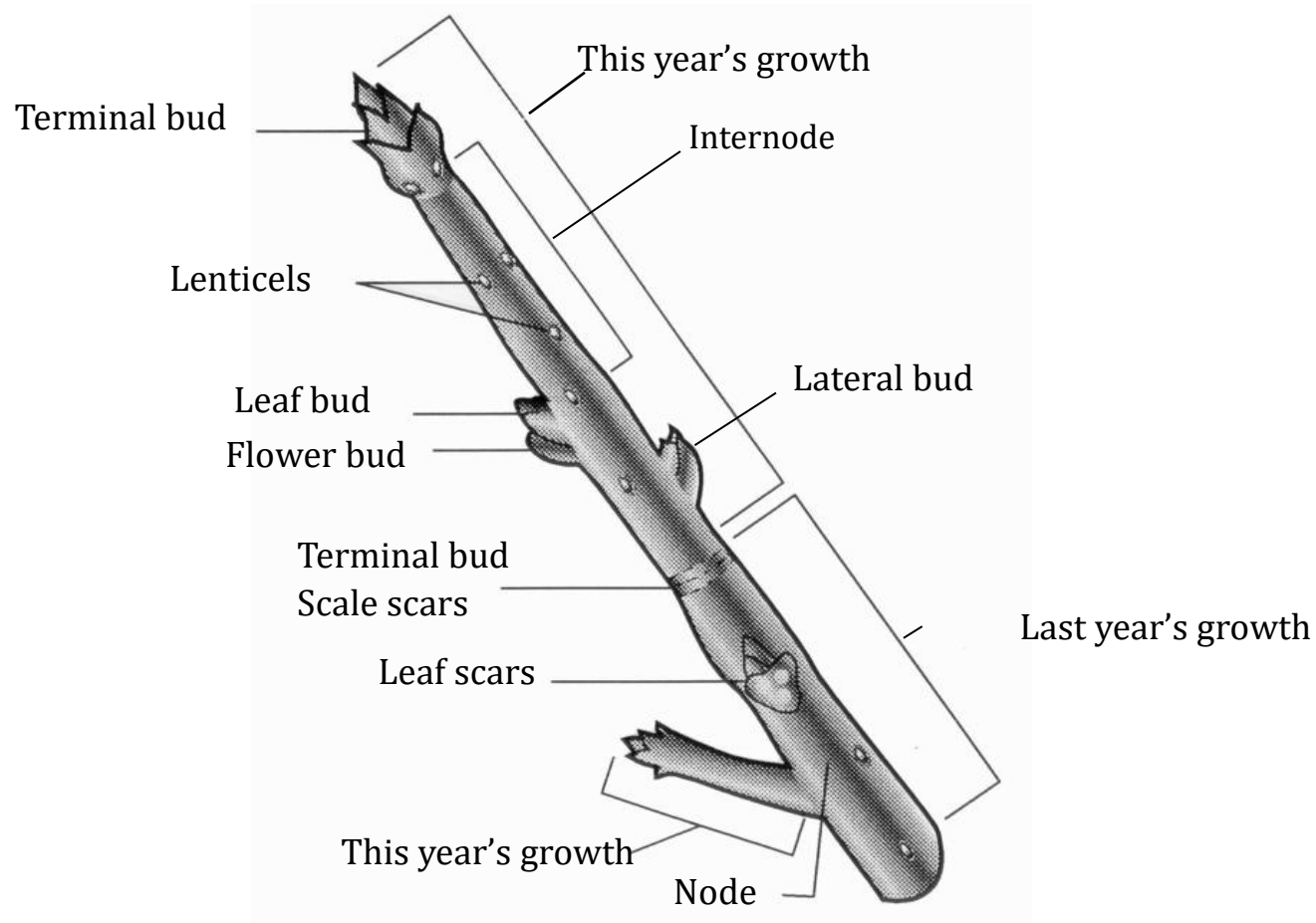
# Tree Biology

- What makes stomata open and close?
  - Responses to signals from the environment
    - Light: stomata are open
    - Dark: stomata are closed
    - High CO<sub>2</sub> inside leaf: stomata are closed
    - Low CO<sub>2</sub> inside leaf: stomata are open
    - Drought stress: stomata are closed

# Tree Biology

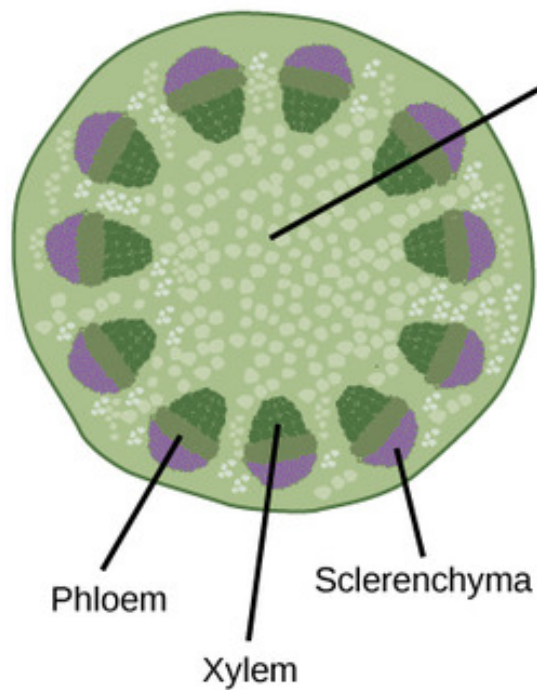


# Tree Biology

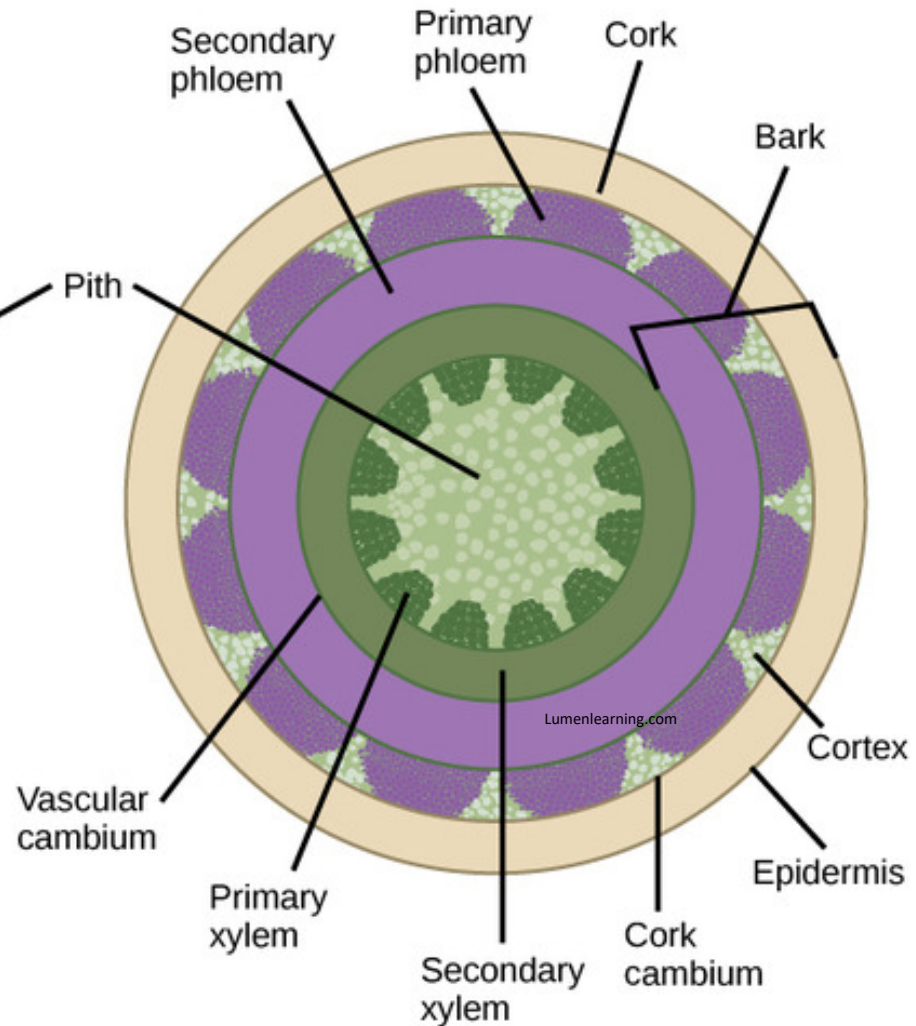


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Primary growth

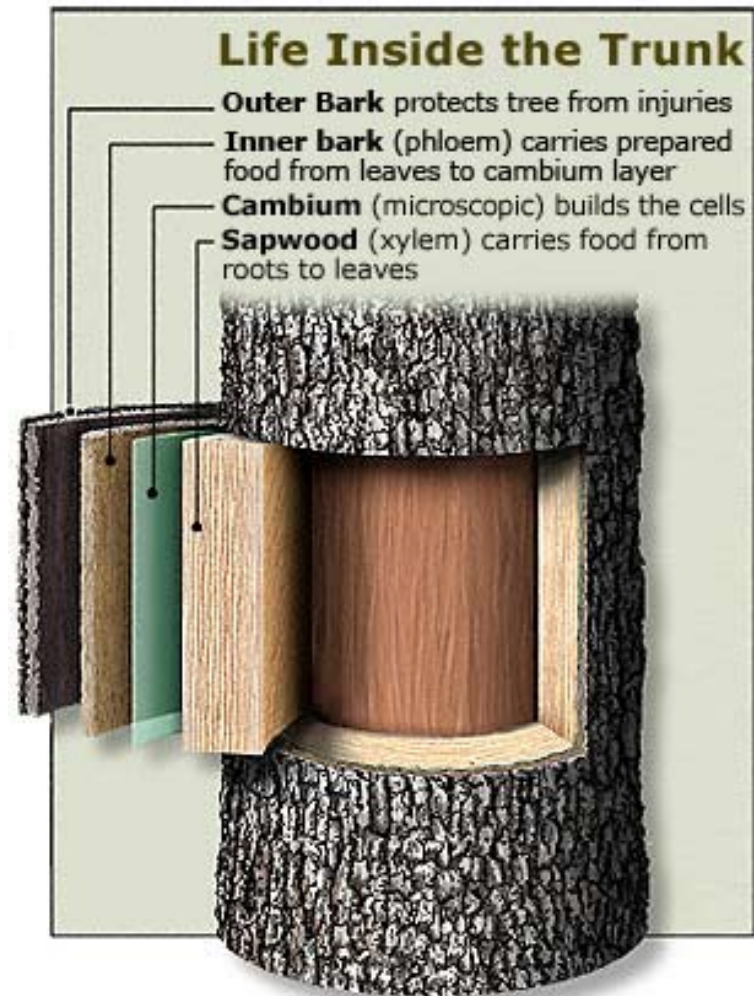


Secondary growth





# Tree Biology



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# Tree Biology



# Tree Biology

- Symplasm (sapwood) vs. Apoplasm (heartwood)
- Xylem of Gymnosperms (pines, spruces)
  - Tracheids (dead)
  - Fibers (sclerenchyma)
  - Parenchyma cells (live)
- Vessels (xylem of hardwoods)
  - Stacks of dead, hollow cells



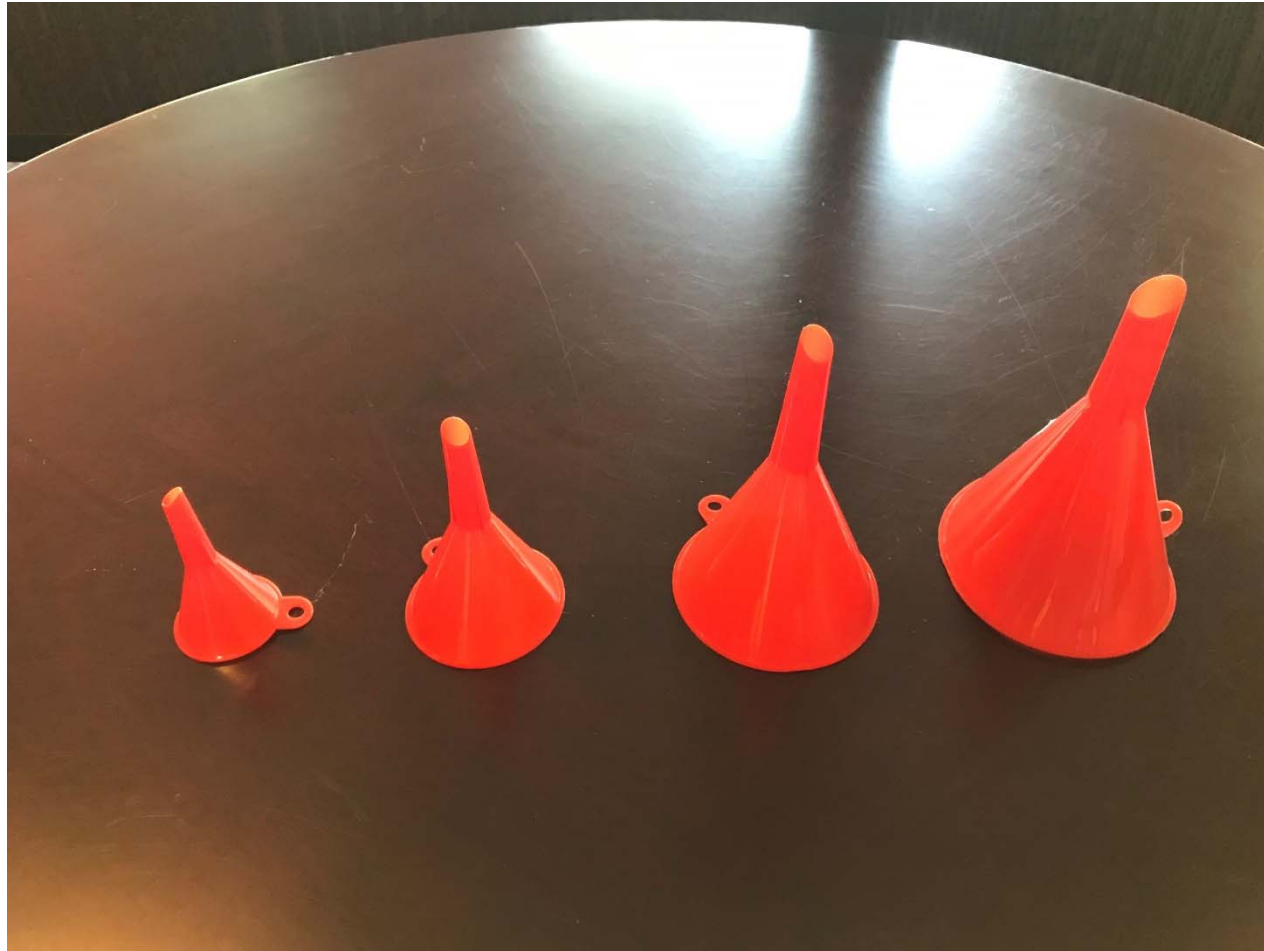
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- Phloem (conifers)
  - Sieve cells
- Phloem (hardwoods)
  - Sieve tube elements
  - Companion cells
- Movement of carbohydrates (sugars) is slow and requires energy

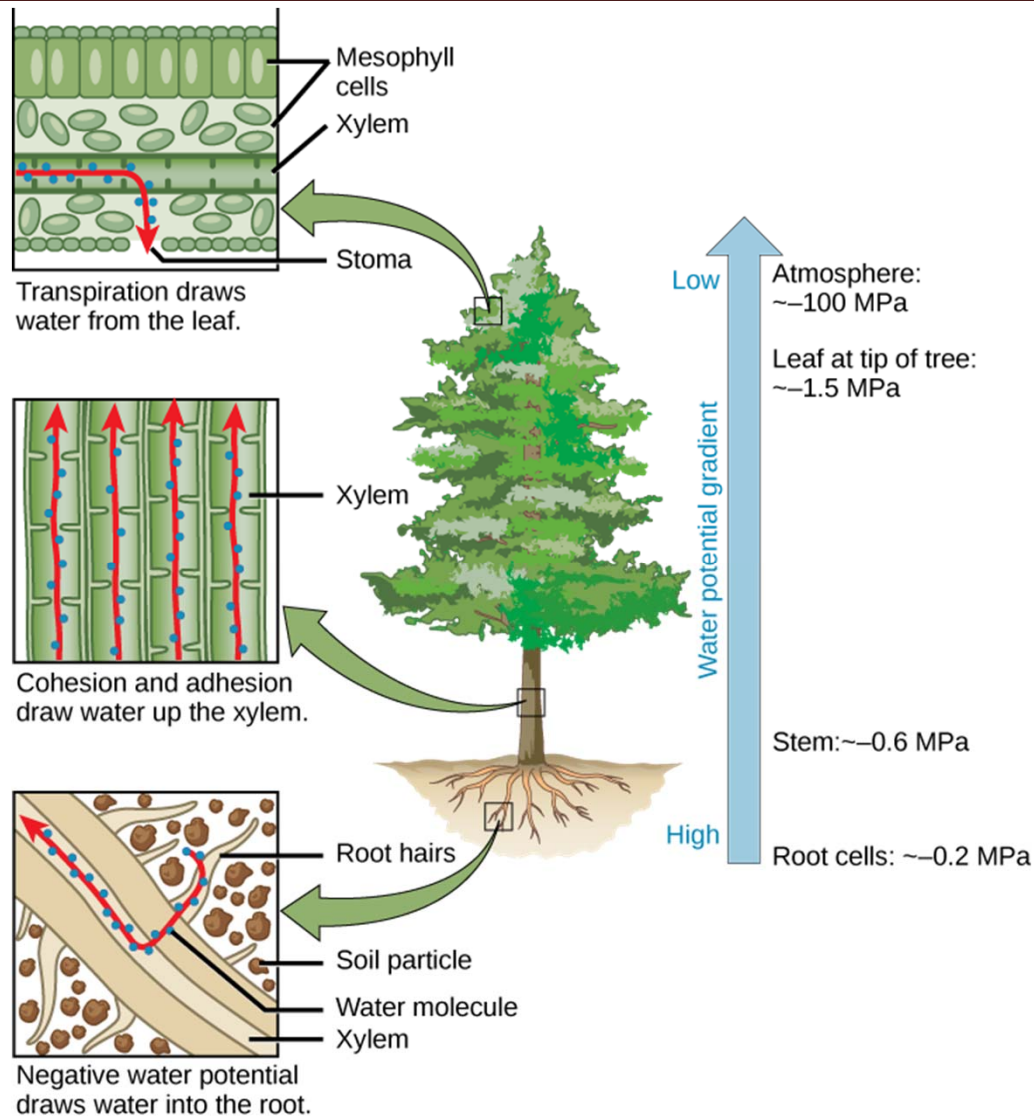
# Tree Biology

- Phloem
  - Rays
    - Transport and store carbohydrates
    - Restrict decay (CODIT)
- Bark
  - Old phloem
    - Crushed & living cells reabsorbed into tree
    - Cell walls incorporated into bark
      - Impregnated with wax and oil
  - Lenticles
    - Gas exchange

# Tree Biology



# Tree Biology

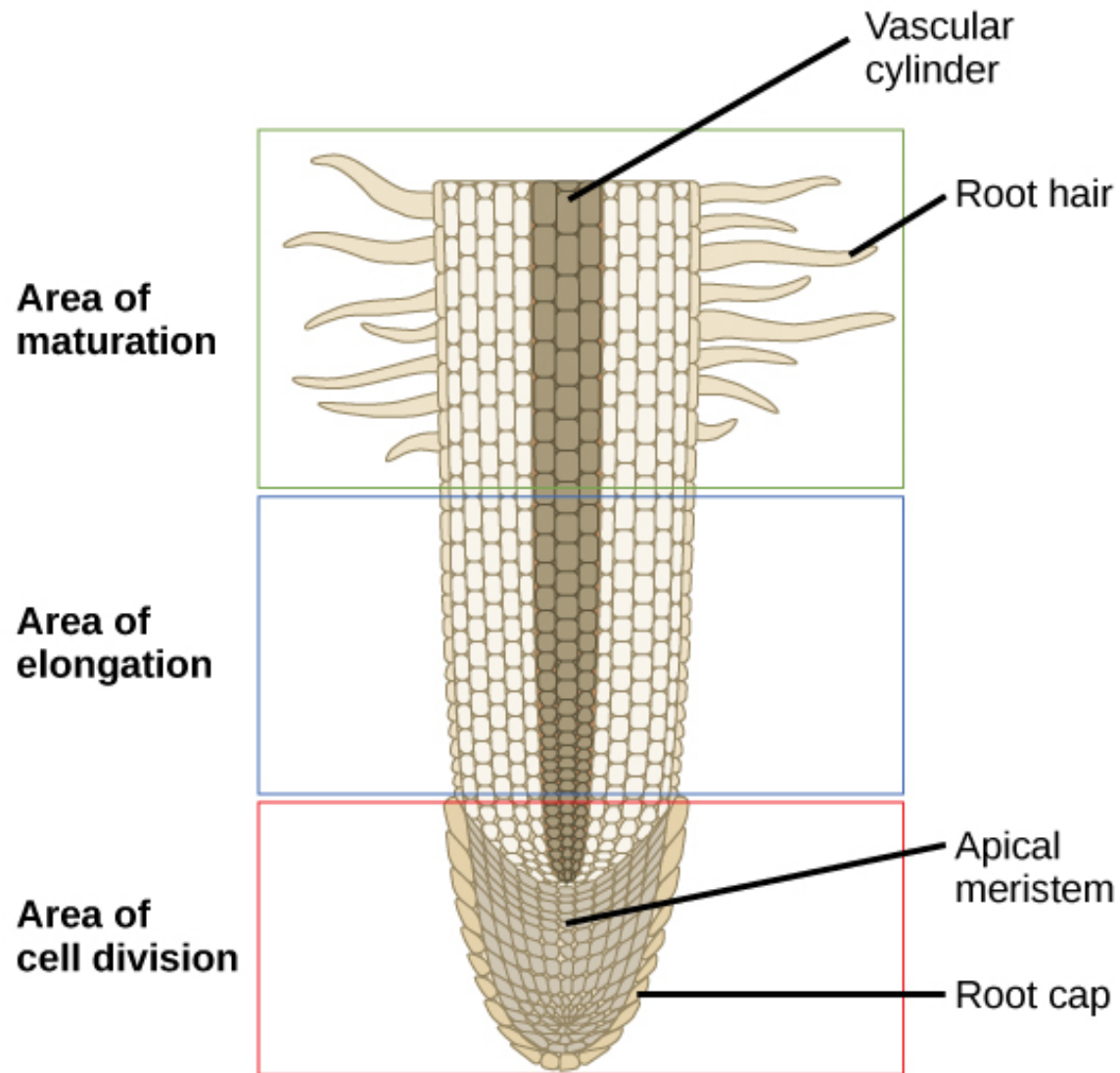


The cohesion-tension theory of sap ascent is shown. Evaporation from the mesophyll cells produces a negative water potential gradient that causes water to move upwards from the roots through the xylem. Image credit: OpenStax Biology

# Tree Biology

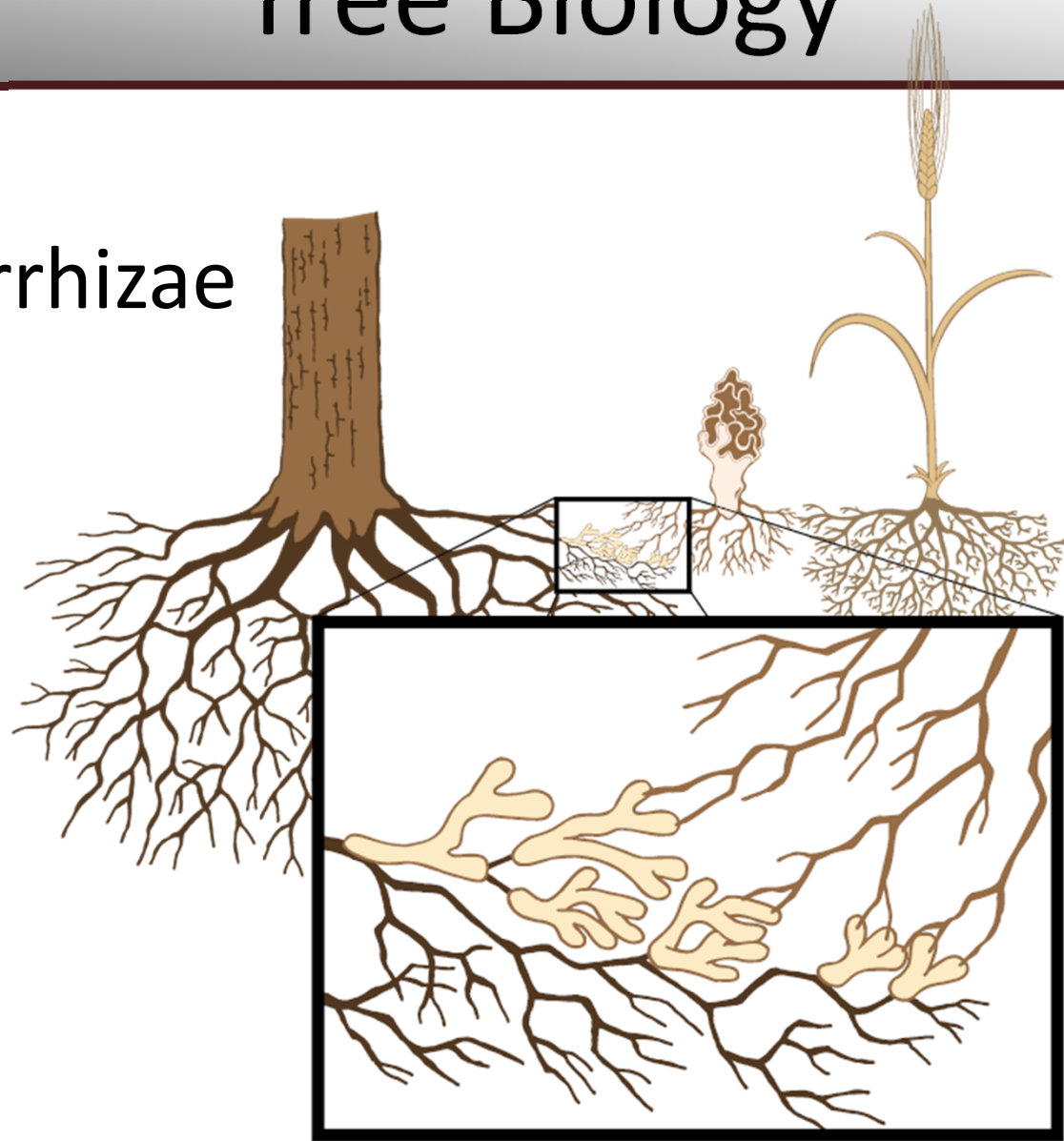


# Tree Biology



# Tree Biology

## Mycorrhizae





# Tree Biology

## Periodic Table of Elements

Periodic Table of Elements																	hydrogen 1 H 1.0079	helium 2 He 4.0026		
lithium 3 Li 6.941		beryllium 4 Be 9.0122													boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180
sodium 11 Na 22.989		magnesium 12 Mg 24.304													aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.887	vanadium 23 V 50.942	chromium 24 Cr 51.993	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80			
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29			
cesium 55 Cs 132.91	barium 56 Ba 137.33	lanthanum 57 La 138.905	cerium 58 Ce 140.12	praseodymium 59 Pr 140.908	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.964	gadolinium 64 Gd 157.25	terbium 65 Tb 158.925	dysprosium 66 Dy 162.50	holmium 67 Hm 164.930	erbium 68 Er 167.259	thulium 69 Th 168.930	ytterbium 70 Yb 173.054	lutetium 71 Lu 174.967	hafnium 72 Hf 178.49			
francium 87 Fr [223]	radium 88 Ra [226]	actinium 89 Ac [227]	thorium 90 Th 232.038	protactinium 91 Pa 231.036	uranium 92 U 238.029	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]	lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]			



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