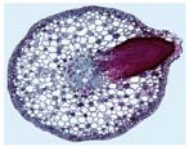
Plant Form & Function

Chs 36 &37

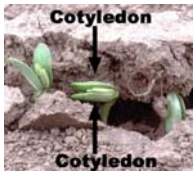


05 March 2009
ECOL 182R UofA
K. E. Bonine

Video 35.2

Focus on Angiosperms

Most (97%) angiosperms are in two clades:

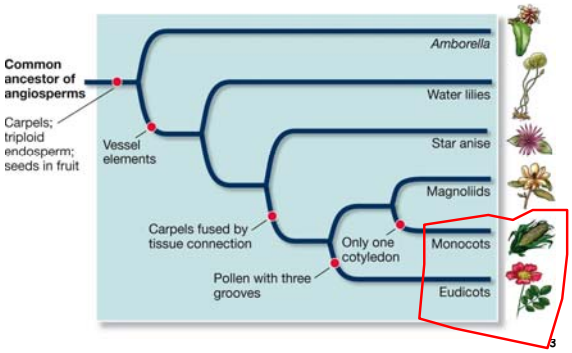


_____ : one cotyledon

_____ : two cotyledons

- Other clades include star anise and relatives, water lilies, and magnoliids.

Angiosperm Diversification



Monocots

LIFE 8e, Figure 29.18


(A) Opuntia sp.


(C) Rosa rugosa

LIFE 8e, Figure 29.19


(B) Cornus florida

Eudicots

Angiosperm Structure

- Shoot System
  - Leaves (petiole & blade), _____
  - Stems, elevate and support

- Root System
  - Anchor
  - Root _____, take up _____ and Minerals

Morphological Adaptations

- Modified Leaves → Spines

- Thick bark

- Waxy cuticle to retard water loss
- Tall stem to avoid herbivory

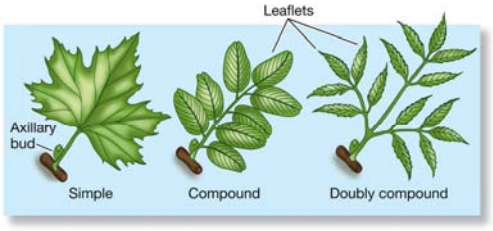
7

Prickly Pear in Galapagos

Tall; Waxy Cuticle

8

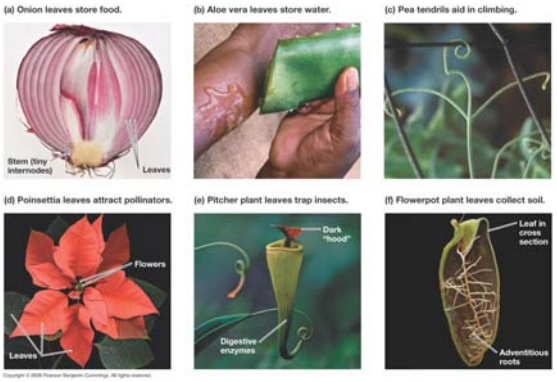
Leaf Types
simple vs. compound



LIFE 8e, Figure 34.5

9

Modified Leaves!

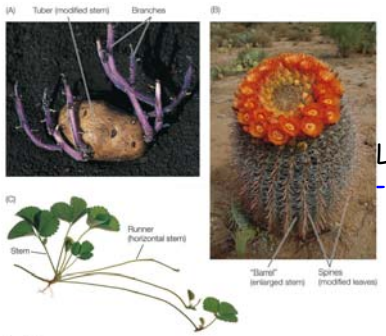


Modified Stems!

11

Modified Stems/Leaves

Stems:
-Tuber
-Runner
-"Barrel"



Leaves:
-Spines

LIFE 8e, Figure 34.4

12

Root Types

1. _____ (w/ Lateral roots)

Figure 34.3

3. Adventitious Roots – from above ground stem

2. Fibrous Roots

13

Mesquite

Roots to 50m !

14

Saguaro Roots?

15

Mangroves

- Live in salty habitat
- Roots in water with low oxygen content

Pneumatophores

Pneumatophores are root extensions that grow out of the water, under which the rest of the roots are submerged.

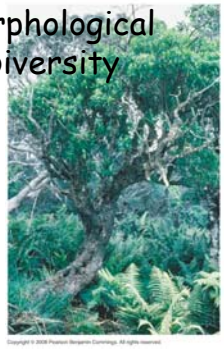
Salt Excretion

16

Adaptive Radiation

Morphological Diversity

(a) Tree-sized silversword



(b) Mat-forming silversword

(c) Rosette-forming silversword

17

Phenotypic Plasticity

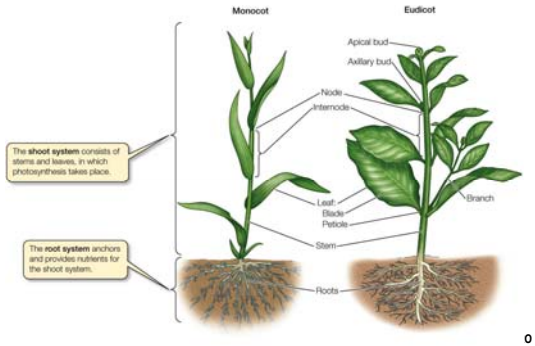
Grown in shade Grown in sun

18

Phenotypic Plasticity

19

Monocot vs. Eudicot



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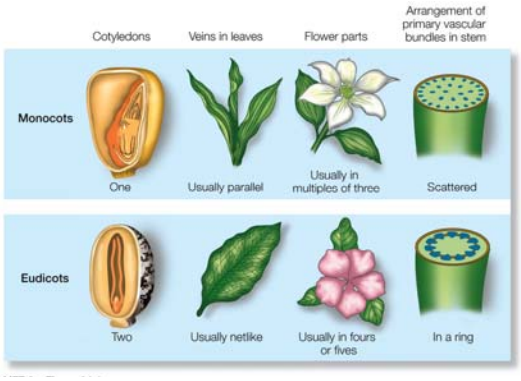
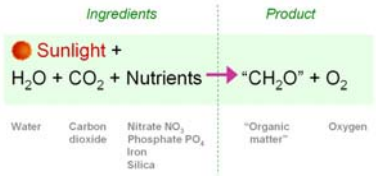
Monocot vs. Eudicot



21

Vascular Tissues

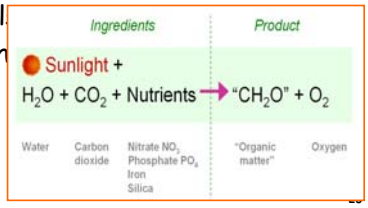
- Distributes water and minerals from roots to rest of plant
- Transports carbohydrates (product of photosynthesis) from leaves to rest of plant

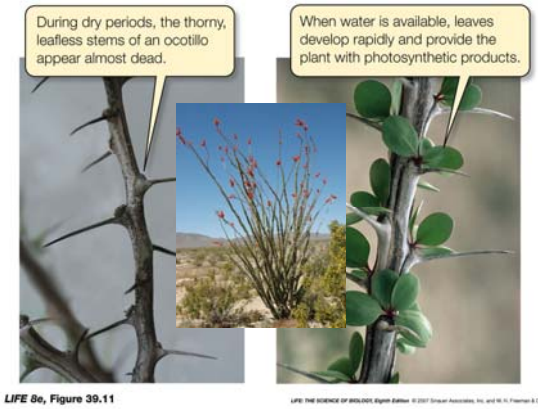


22

Where does the carbon we eat in a salad come from?

A. The Earth
B. The Air
C. The Water
D. Fossil Fuel
E. None of th





LIFE 8e, Figure 39.11

Octotillo

Boojum

same family

25

more about leaves…

Epidermis is important outer layer of leaves and stems:

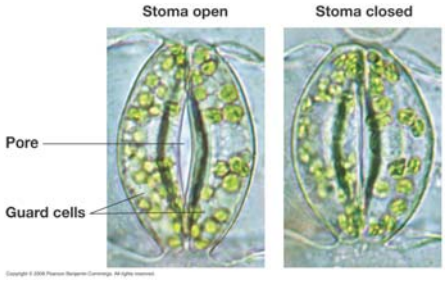
-may contain waxy cuticle layer

-retard water loss

-specialized cells to allow for gas exchange (and water loss)

-guard cells of stomata

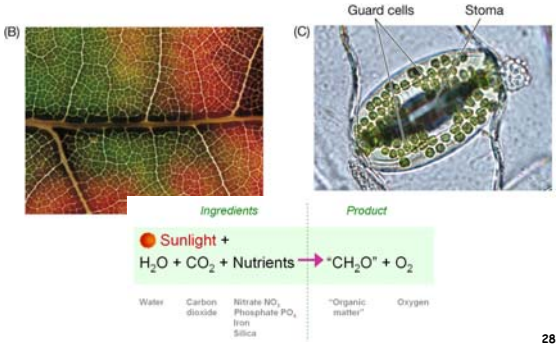
26



guard cells of stomata

27

guard cells of stomata



28

C_3 vs C_4 & CAM (see Ch 10)

- Photosynthesis slightly different among different groups.
- Acted on by natural selection.
- C3 do better in temperate climates.
- C4 do better in hotter climates
  - even with stomata closed can fix carbon.
  - CAM is a form of C4 wherein the initial carbon is incorporated at night and the light reaction takes place the next day.

and help reduce during .

29

C_3 vs C_4 & CAM

Rose

Prickly Pear

If you placed these plants side-by-side at noon in March and then took the temperature of the leaf surface…

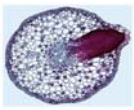
A. they would be same temp
B. rose would be cooler
C. cactus would be cooler
D. need more information

Why?
Because with CAM photosynthesis, stomata closed during day and therefore much less evaporation to cool the leaf

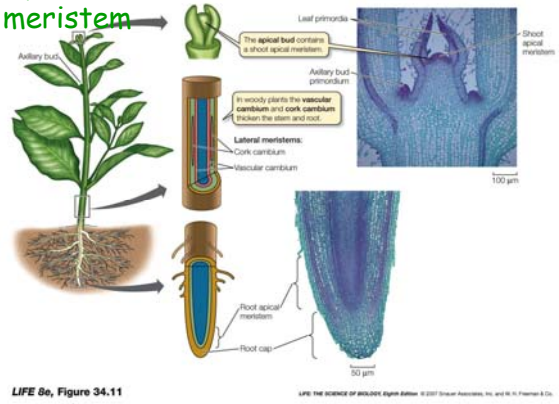
30

Meristems

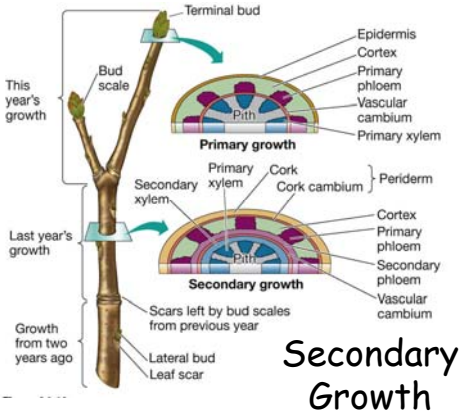
- Apical Meristems
  - Sites of _____ growth
  - Found in tips of roots and stems
  - Found in leaf buds
- Lateral Meristems
  - Generate secondary growth at vascular cambium
    - Including wood (2° xylem) and bark (2° phloem)



Apical meristem



LIFE 8e, Figure 34.11



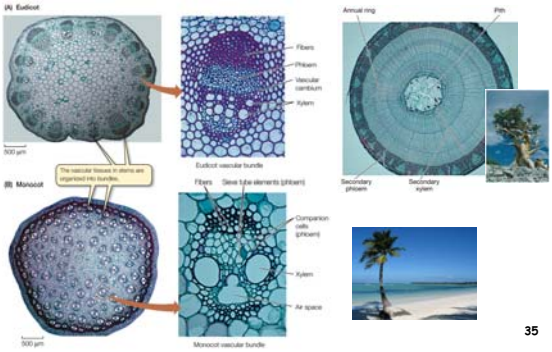
Secondary Growth

Secondary Growth

that arises annually from _____

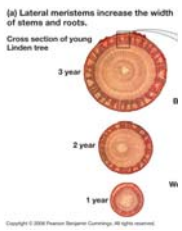
Vascular Bundles

xylem, phloem, (& vascular cambium in eudicots)



Vascular Cambium (for _____)

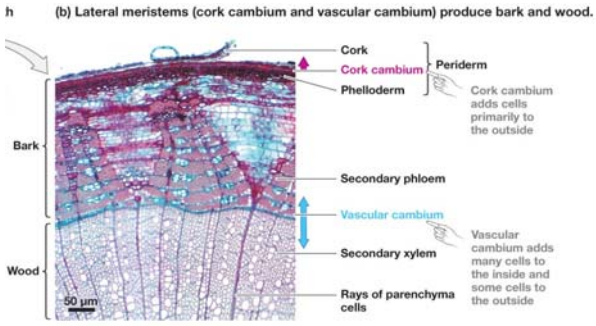
- Meristem Cells Become…
  - 2° Phloem to the outside
  - 2° Xylem to the inside



Cork Cambium

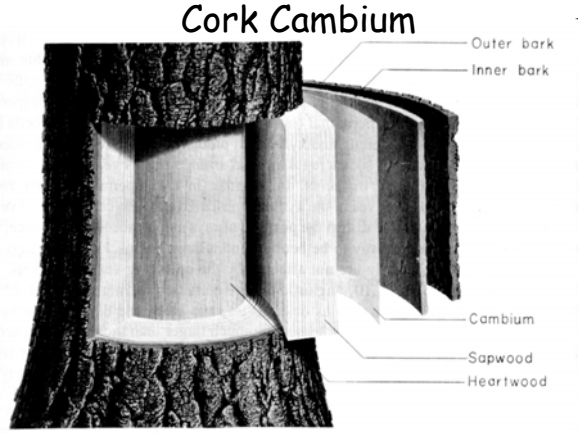
- Mostly produces cells to the outside, comprises most of the BARK

Vascular Cambium



37

Cork Cambium



What is a knot in wood?

39

Plants:
Transport of Water & Sugar+

40

Video 35.2

Recovery in a wilted plant

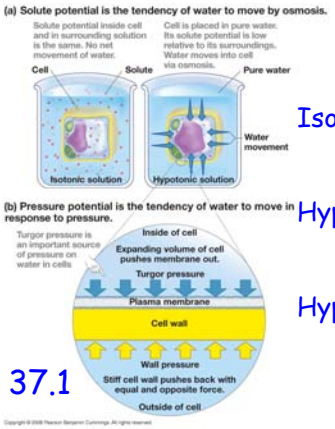
41

Pressure Potential (Ψp)
aka Pressure

Physical force of water either because of gravity or some other push…

In plants, water into cells meets resistance of cell wall, leading to turgor pressure ( ).

42



37.1

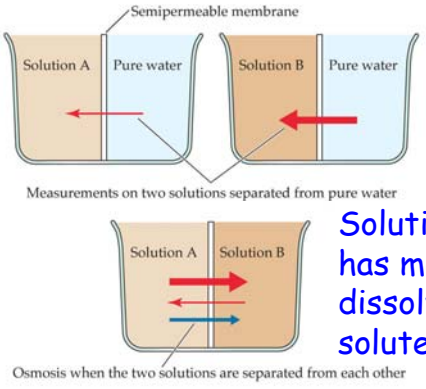
Osmotic Potential

Isotonic
(same solutes)

Hypotonic
(fewer solutes)

Hypertonic
(more solutes)

43



Solution B has more dissolved solutes

Hill et al 2004

44

If you put a cell in a **hypertonic** solution it will

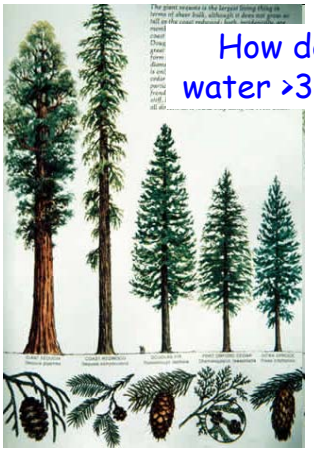
A. Remain unchanged

B. Tend to shrink

C. Tend to swell

D. Depends on the solution

45



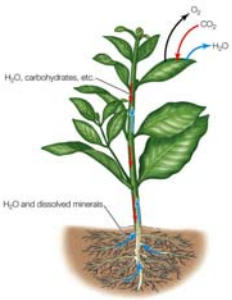
How do plants get water >300' in the air?

from left to right Sequoia Redwood (oldest trees), Coast Redwood (tallest trees), Douglas Fir, Port Orford Cedar, Sitka Spruce

46

Xylem and Phloem

Moving
Water and Solutes



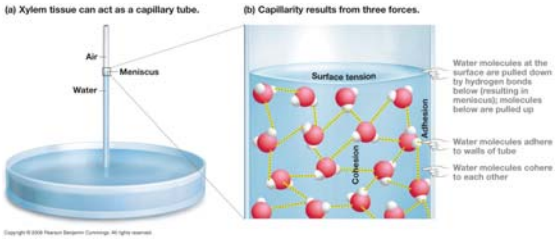
47

37.4

Water moves from high potential to low potential

48

Tension, Cohesion, Adhesion



Result in Capillary Action

37.10

49

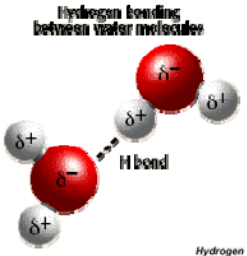
The water only *continues to move* if being pulled by

_____

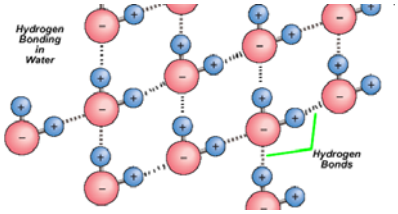
1. Root pressure can move water short distance
2. Capillary action can move water short distance

_____ can pull water from ground to top of Coast Redwood (>300')

50



Water is a _____ molecule and _____ bonds link water molecules



Transpiration (water evaporating from leaf surface) Rates will be highest when

Stomates are open/closed

Humidity in atmosphere is high/low

Temperature around tree is high/low

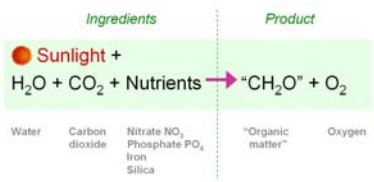
Tree is in shade/sun

What does this tell you about trees living in the desert?

52

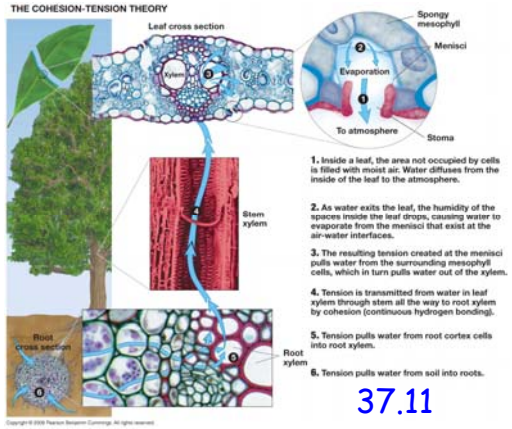
Why is water transpiring?

1. **Stomata open to get CO_2**



2. Stomata open for leaf cooling

53



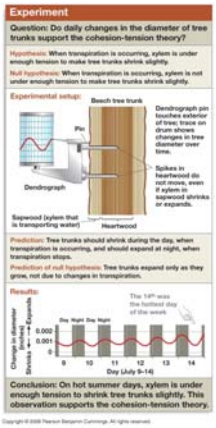
37.11

54

Cohesion-Tension relies on a _____ from soil to atmosphere at leaf surface

Theory only really accepted in 1990s! Relies on very strong surface tension that results from transpiration.

55



Based on your understanding of cohesion-tension theory, why does a tree trunk become slightly narrower during each day?

37.13

56

Adaptations to _____ Living

a. Small or no leaves
b. Thick waxy cuticle
c. Thick epidermis
d. Stomata on underside of leaves
e. Trichomes to increase humidity at leaf surface
f. C4 or CAM photosynthesis

57

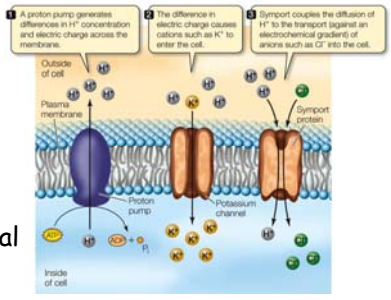
Getting & moving water is "free".

Getting nutrients and moving sugars around _____

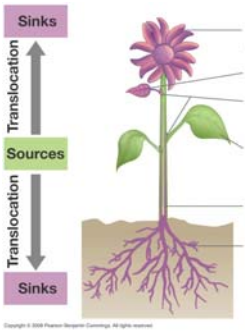
58

Energy to get nutrients etc.

- Plants have a **proton pump** (instead of a NaK-ATPase pump) that creates electrochemical gradient to do work.



59



During middle of growing season, mature leaves provide sugars to rest of plant

37.17 Source vs. Sink

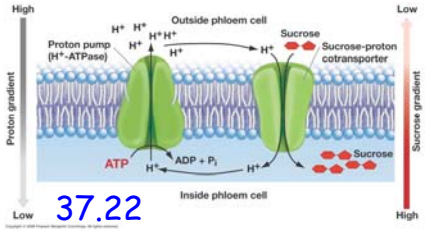
60

What happens differently to movements of sugars in early spring, before there are any leaves?

Source vs. Sink

61

Proton Pump (ATP) needed to move sugars from photosynthesizing leaf (source) into phloem and then also from phloem into storage cells or growing tissues (sinks).

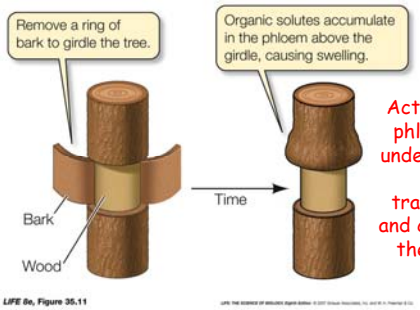


37.22

Move sucrose into cell AGAINST its concentration gradient

62

Why does 'girdling' kill a tree?



Active xylem and phloem are just under the bark. If tree can't transport water and carbohydrates then it will die.

Was this tree girdled in March or in July? 63