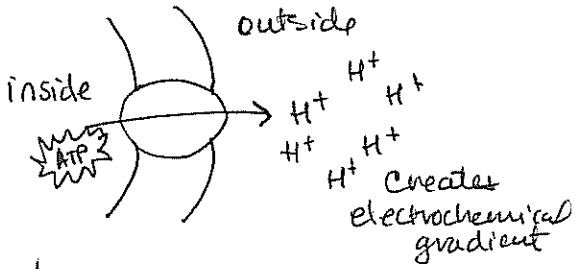
Plant Transport

1. Define "passive transport" and the role of carrier proteins.

2. Define "active transport."

3. Explain how the proton pump works with a diagram and give some examples of what the proton pump is used for in plants.

- accumulation of minerals in root
- allows K^+ to enter guard cells when stomata open
- allows co-transport of sugars during phloem loading



4. Water potential (Ψ) measures the tendency of water to leave (enter/leave) an area.

   - If pressure is not a factor, water will go from an area of low (solute concentration) to an area of high (solute concentration.)
   - Water will go from an area of high Ψ to an area of low Ψ.
   - Pure water has 0 Ψ. A solution has a negative (positive/negative Ψ).

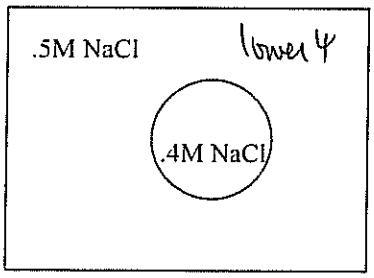
What does this equation mean? $\Psi = \Psi p + \Psi s$

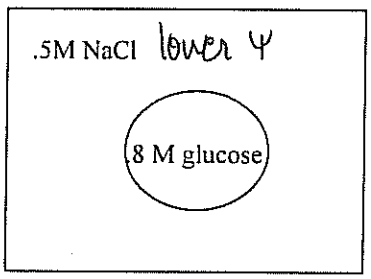
Ψ = water potential

Ψ_p = pressure potential - can be positive or negative value

Ψ_s = solute potential - always neg. in a solution

On the diagrams below, indicate which solutions would have the greater or lower Ψ.



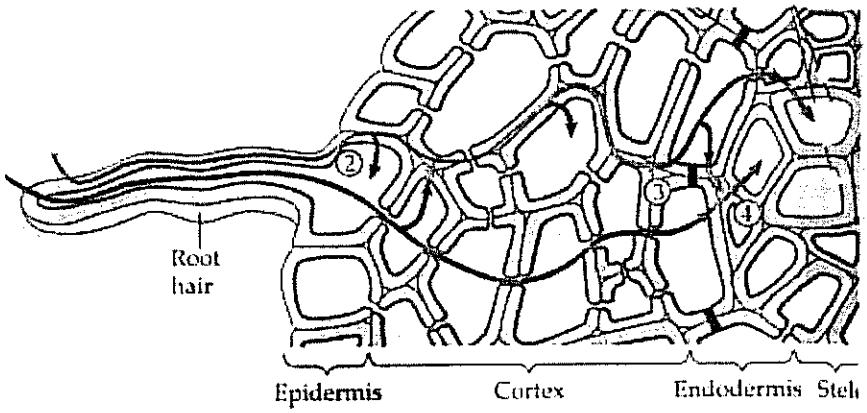


Aquaporins

5. Explain the structure and function of aquaporins:
membrane protein channels that allow rapid diffusion of water

Lateral Transport of Water and Minerals

7. In the diagram below, color code the symplast route in **blue** and the apoplast route in **red**.



8. Minerals traveling through the symplast go through plasmodesmata as they pass from cell to cell.

9. Explain what mycorrhizae are and how they aid the root in its job:
symbiotic fungi that grow in plant roots – increase surface area for absorption

10. Minerals traveling through the apoplast will eventually encounter the endodermis with its waxy Casparian strip which ensures that the material must pass through the symplast of the endodermis.

Ascent of Xylem

11. What causes root pressure? due to active uptake of minerals in the roots, water passively enters root, creating root pressure

12. Under what environmental conditions might you observe guttation?
humid mornings, before droplets evaporate

13. What effect does tension have on water potential? Why?
lowers Ψ because tension is negative Ψ_p

14. What is "bulk flow" and how does it differ from osmosis?
movement of water and solutes due to a pressure gradient rather than a concentration gradient.
15. Is the movement of xylem sap active or passive? Explain.

16. Summarize the "Transpiration-Cohesion-Tension Model." explains movement of xylem sap due to tension created by evaporating water + the adhesion / cohesion of water molecules. Water is "pulled" up a plant.

How Stomata Open and Close

17. Complete the flow chart that shows how stomata open and close.

- Guard Cells → H+ is pumped out of cells and K+ is pumped in cell→ H_2O enters cell → guard cells become turgid → stomata open.
- Guard cells lose K+ → water leaves cells → guard cells lose turgor → stomata close.

18. Name three things that cause stomata to open:
light
low CO_2
Circadian rhythms
19. Name two things that cause stomata to close:
stress due to high wind, temp, drought

Translocation: "Source-to-Sink"

20. What is phloem sap? ~30% sugar, water, other nutrients

21. What is a sugar source? part of a plant that is producing sugar (or releasing stored sugar). Ex: leaves that are photosynthesizing, or roots in early spring.
22. What is a sugar sink?
Part of plant that is consuming more sugar than producing
Ex: growing parts, developing fruit.
23. In the early spring, is a bulb a source or a sink?
source, b/c leaves are not present yet. Energy is released from sugars stored in the bulb.

24. Explain how the proton pump works in the process of phloem loading? Creates an electrochemical gradient that allows the cotransport of sugars into phloem cells.

25. Phloem unloading is a(n) passive (active/passive) process.

26. Phloem pressure is greatest at the source and lower at the sink.

Water Potential (Ψ)

$\Psi = \Psi p + \Psi s$

- Ψp = pressure potential
- Ψs = solute potential
- The water potential will be equal to the solute potential of a solution in an open container, since the pressure potential of the solution in an open container is zero.

The Solute Potential of the Solution

$\Psi s = -iCRT$

- i = ionization constant (For sucrose this is 1.0 because sucrose does not ionize in water)
- C= molar concentration
- R= pressure constant (R = 0.0831 liter bars/mole K)
- T = temperature in Kelvin (273 + °C)