# BIOL 112 – OUTLINE #5 – PLANT TRANSPORT PROCESSES –

# expanded with extra detail on phloem transport

1. Why water?
2. required resource for metabolism
3. nutrients are taken up and transported in water-based solution
4. metabolic products are transported in water-based solution
5. water movement through the plant affects gas exchange, leaf temperature
6. Water potential (Ψ)
7. water movement = high water potential 🡪 low water potential
8. major components
9. pressure (turgid, plasmolyzed, flaccid)
10. solute concentration (always reduces Ψ)
11. Ψ = P - S
12. Water movement
13. osmosis
14. semi-permeable membrane results in concentration gradient
15. water moves from high Ψ 🡪 low Ψ, across membrane
16. also influenced by pressure gradients
17. bulk flow
18. occurs in the absence of a membrane
19. water moves from high Ψ 🡪 low Ψ, gradient is controlled by pressure
20. Pathways for water movement
21. apoplast = through cell walls until Casparian strip
22. symplast = cell to cell, through plasmodesmata
23. transmembrane = cell to cell, through both symplast and cell membranes
24. Casparian strip
25. movement of solutes
26. Transpiration
27. effect of solar heating on atmospheric Ψ
28. compare to soil Ψ
29. very steep Ψ gradient produces extreme tension (gradient is controlled by P)
30. adhesion / cohesion
31. lignified xylem cell walls
32. contribution of transpiration to the hydrological cycle
33. stomata / guard cell function
34. other mechanisms to limit water loss
35. Phloem transport
36. contents of phloem sap
37. water
38. sucrose
39. other solutes (hormones, secondary metabolites, ATP, some nutrients, etc)
40. multi-directional transport
41. source to sink
42. driven by P dominated Ψ gradient
43. pressure is developed due to active transport (uses ATP)
44. pressure-flow model
45. active transport pump builds high concentration of sucrose (for example) in sieve cells adjacent to the source
46. high solute concentration decreases Ψ at source end
47. lower Ψ results in water transport into sieve cells at source end – water is supplied by adjacent xylem
48. increased water volume raises pressure at source end
49. phloem sap starts to move through open sieve cells
50. direction of movement is determined by location of sink
51. at the sink end, sucrose is removed by metabolism, by conversion to starch or some other molecule, or by active transport (process varies depending on solute and sink)
52. as solutes (sucrose molecules) are removed at sink end of phloem, local Ψ increases
53. as Ψ increases, water moves out of sieve cells at the sink end – water is transferred to adjacent xylem
54. as water leaves the sieve cells, pressure goes down – thus developing an area of lower pressure at the sink end
55. phloem sap moves along this gradient – from high pressure at source end to low pressure at sink end
    1. direction of phloem sap movement depends on location of sources and sinks
56. source is any area producing solute to be transported – leaves and storage roots are common sources
57. sink is any area using that solute – leaves, roots, flowers, fruits…..any area of active metabolism or storage
58. sources and sinks change during the growing season as metabolic activity changes
59. most sources supply the nearest sinks, but some sinks take priority (especially fruits)
    1. remember, open structure of sieve elements facilitates the transport of phloem sap
       1. fewer organelles
       2. organelles arranged near cell membrane
       3. open sieve plates at the ends of the cells – nearly continuous cytoplasm between cells