
PLEASE PRINT YOUR NAME ON EVERY PAGE

Total points (of 80) 63.5

1. Drawing upon the material we have covered in class, give a thorough explanation for each of the following (4 pts. each, 24 pts. total):

- a. why plant breeders can produce (closely related) varieties of *Coleus* with very different pigmentation patterns in the leaves. (Hint: what gives the leaves their color? How can that color change?)

chromoplasts give leaves their color in the form of lipid soluble pigments so the reason why leaves can change colors is that certain cells will die and thus the chromoplasts in those dead cells will not be functional. see pg

- b. why giant redwood trees are confined to areas with frequent heavy fogs during the summer months.

redwoods are very tall and without the fogs the redwoods can't obtain a sufficient amount of water why? so with these fogs they can absorb needed H₂O through stomata.

- c. why plants growing on sandy ocean beaches are likely to be adapted for drought tolerance even in climates with frequent rainfall (give 2 reasons for full credit).

Sand particles in soil tend to be very large and can't hold on to water or nutrients very well also if there is frequent rainfall then there will be continuous leaching and thus droughts will be frequent.

- d. why plants growing on clay soils would be more likely to suffer from a sulfur deficiency than from a calcium deficiency.

If a plant is growing on clay soil then the clay particles will bind Ca²⁺ since clay binds to cations and not anions. The Sulfur won't bind to clay and will be in solution which can be washed away easily creating a sulfur deficiency for the plant.

- e. why it makes sense that soybean plants have arbuscular mycorrhizal fungi rather than ectomycorrhizal fungi.

Soybean plants are legumes and legumes are typically have nitrogen fixing bacteria in root nodules so they would have more arbuscular mycorrhizal fungi because it is good at taking up Phosphorus

- f. why biological nitrogen fixation is important, even though most plants get most of their nitrogen from breakdown of organic matter.

It is important because N₂ is one of the most prevalent gases in our atmosphere so when there is little nitrogen in the soil from breakdown of organic matter, the plants can still get enough nitrogen by being involved in a mutualistic situation with a bacteria or that can fix nitrogen. Ultimate source

2. Explain the probable effect of treating the guard cells of a plant with a drug that blocks potassium channels. Be sure to explain *in detail* the effect on the function of the guard cells (including the mechanism), as well as the consequences for the plant (6 pts. total).

Effect on function of guard cells:

4/6 Without the K^+ channel then the ψ_s of the guard cell will increase and thus water will move out of the guard cell when it should be going into the guard cell. If water is leaving the guard cell the ψ_p won't be high enough to keep the guard cell very turgid and thus the stomata will close.

Consequences for plant:

With the stomata closed the plant can't be involved in gas exchange and thus will have a deficiency of CO_2 which is required for photosynthesis.

3. For each of the following, give a clear, concise, complete answer (4 pts each, 8 pts total).

- a. Under what environmental conditions (e.g. time of day, temperature, weather, soil conditions) would you expect the ψ_p of a leaf mesophyll cell to approach zero? Explain.

3/4 It would be when the stomata were open so it would have to be when the sun was out to trigger the stomata to open, the temperature would have to be warm so that the air could be somewhat dry and a water potential gradient could be established between the leaf and air, it wouldn't be too humid or else the plant wouldn't have a good transpiration rate and the soil would have to be moist so that

- b. Where would you expect the ψ_p to be lower, in the cytoplasm of a guard cell in the light or in the dark? Explain.

4/4 In the dark because the light triggers photoreceptors which activate H^+ -ATPases to create a H^+ gradient outside the cell so that K^+ will enter guard cell and Cl^- will also but through co-transporters. The increase of K^+ and Cl^- inside the guard cell lowers the ψ_s so water moves into the cell making it more turgid and thus higher ψ_p . So in the dark you don't have H^+ -ATPases working as much and thus

4. Compare and contrast transport through vessel element and sieve tube (8 pts. total).

	Composition of fluid	Energy source for movement of fluid	Diffusion or bulk flow	Structure of cell
Vessel Element	containing water ions don't contain organic compounds 1/2	H ₂ O - cohesion from evaporation caused but is caused by water potential SUN	Bulk flow drives this only in one direction up.	When stacked end on end forms tube, allows lateral movement IS dead and has no cytoplasm
Sieve Tube	contains water also contains sugar, amino acids, hormones, etc.	uses turgor pressure gradient but is also caused by water potential ATP	Bulk flow drives this can go in either direction	Also forms tube when stacked, allows lateral movement Has a cytoplasm and a companion cell to provide metabolic energy

5. Consider the following two adjacent cells (no cellular detail is shown). One is a parenchyma cell and the other is a vessel element:

$\Psi_s = -0.1 \text{ MPa}$
$\Psi_p = -0.7 \text{ MPa}$
$\Psi = -0.8 \text{ MPa}$

Cell A

$\Psi_s = -1.0 \text{ MPa}$
$\Psi_p = 0.3 \text{ MPa}$
$\Psi = -0.7 \text{ MPa}$

Cell B

- a. Which cell is the parenchyma cell, A or B? (circle your answer). Explain. (4 pts) ² + 2
 Cell B is the parenchyma cell because it should have a positive Ψ_p whereas vessel elements have a negative Ψ_p .
- b. Would you expect water to move from cell A to cell B or from cell B to cell A? Explain (3 pts) + 3
 Based on the water potential of the two cells the water would move from higher Ψ to lower Ψ so from cell B to cell A.
- c. Based on your answer for (b), are these cells located in the root or in the leaf of the plant? Explain. (4 pts) 3 + 3
 They are located in the root because roots take up water and then the water enters the vascular tissue and travels to the upward to the rest of the plant so have Ψ drive water going from cell B, a root parenchyma cell into the vessel element, cell A. Also Ψ_p drives this gradient from roots to tissue. *excellent*
6. Sudden oak death is a fungal disease which has recently begun killing oaks and other trees on the west coast. The fungal hyphae penetrate and proliferate within the vascular tissue of the tree, blocking transport through the xylem and the phloem.

- a. Based on your knowledge of plant physiology, explain why fungal invasion of the vascular tissue can lead to rapid mortality for the tree (i.e., "sudden death") (2 pts). 4 *leaves*

3/4 If the vascular tissue is blocked then the essential consequences will occur and lead to rapid mortality. One is the xylem blockage will not allow water transport through the plant so parts of the plant that rely on this water movement will have no water and the other consequence is with phloem blockage which will not allow organic molecules to travel to locations of the plant where they are essential.

- b. Suppose researchers were to develop a water-soluble chemical which was toxic to the fungus but not essential to the tree, and could be taken up by the plant into the phloem either from the leaves or from the roots. Explain why they would apply the chemical to the roots in the spring, but to the leaves in the summer and fall (assume the tree is newly infected) (3 pts). 4 *roots*

3/4 They would apply the chemical to the roots in the spring because the movement of organic material through the phloem in the spring is from the roots to the newly developing leaves, flowers, ~~fruit~~ etc. Then in the summer and fall applying to the leaves would be correct because during this time the movement of organic materials is from the leaves downward to starch storage areas like the roots in preparation for the next season. *bulk flow*

- 12/12 7. Biology requires us to think at many levels of organization. In the following table, fill in a specific example for each level of organization in plants, and briefly describe how your example's structure controls or impacts its function. The structure (tissue, cell, organelle, molecule) you choose must be found in the structure you chose at the next higher level of organization or you will not receive credit for your answer (12 pts total).

Hierarchical Level	Example (your choice)	How Structure Relates to Function
I. Organ	stem	long, so thin connects roots to leaves so materials can be transported to both
A. Tissue System (in organ chosen above)	vascular	Made up of cells stacked end to end creating tubes
1. Tissue (in tissue system chosen above)	xylem	long thin dead tubes that transport water by tension-cohesion
a. Cell type (in tissue chosen above)	vessel cell	thin dead cell with no cytoplasm so water can move through rapidly
Organelle (in cell chosen above)	cell wall	made of fibers that can resist and create tension
Molecule (in CELL chosen above)	glucose	Type of sugar making the composition of cell wall

8. In the greenhouse, you observed a variety of plants with specialized types of leaves, stems, or roots, which allow the plant to survive in unusual habitats. For each of the following environments, list a plant found in that environment, and describe a modified plant organ which allows the plant to persist (6 pts.).

- a. Acidic temperate bogs:

Name of plant (or type of plant—be as specific as you can): Venus fly trap +1

Description of modified plant organ (leaf, stem or root): leaf modified to catch insects in order to obtain more nitrogen +1

- b. Tropical rainforests:

Name of plant (or type of plant—be as specific as you can): orchid +1

Description of modified plant organ (leaf, stem or root): root is photosynthetic since it grows on other plants +1

- c. Water (i.e., aquatic plants):

Name of plant (or type of plant—be as specific as you can): water lily +1

Description of modified plant organ (leaf, stem or root): leaf large surface area so it can float on water surface +1
~~leaf large surface area so it can float on~~
 won't make it float