**Midterm #2 study guide**

**Midterm #2** is **Monday October 29**

Prior to Midterm #2, you should be able to answer the questions below without looking at your notes. That is to say, you should work through this study guide after considerable studying, and as a test of your knowledge – it is not meant to be a worksheet that you complete casually and then assume preparedness for the midterm. For each of the questions, don't just understand the information. Rather, be able to articulate your explanations using the vocabulary of a professional biologist (i.e., you!). Remember:

**Study often, study actively, study alone, study in groups. Repeat.**

**October 1 lecture - 1° Tissues and Leaves**

1) Which meristems give rise to primary (herbaceous) tissues, and which give rise to secondary tissues (wood and bark)?

2) Name and identify the three types of organs, tissues, and cells that we studied.

3) What is ground tissue?

4) What do 2° xylem, fibers, and sclereids have in common? How are they different?

5) What's a vascular bundle?

6) What is xylem? Phloem?

7) What is the fundamental trade-off in the size or a foliage leaf vs. its ability to function?

8) What are leaf adaptations for avoiding: 1) water loss/ overheating; 2) predation; 3) physical damage due to wind

9) What is a tendril? A bud scale? A sclerophyllous leaf (sclerophyll)? A spine?

10) Draw the cross section of a typical foliage leaf and clearly label: Palisade mesophyll (parenchyma), spongy mesophyll (parenchyma), stomata (including guard cells and stomatal pore or opening), cuticle, epidermis, xylem, phloem, trichomes, the vein.

11) What gives pears their gritty texture?

12) What cells are found in the shells of walnuts and other nuts and makes them resistant to deformation?

13) What is a petiole?

14) What is the meaning of the word root "phyll"

15) What is a cotyledon?

16) In addition to cotyledons, what are the two differences we discussed in the leaves of monocots vs. dicots?

17) Draw the three types of carnivorous plants we discussed, and emphasize the role of trichomes and how the leaf blades have been adapted for their role in catching prey items.

18) Why do some plants trap animals?

19) Describe the soils in which carnivorous plants grow. Is what you've just described a selective pressure? Explain.

20) Why does the closing motion of sundews (*Drosera* spp.) not need to be rapid as in Venus' flytrap?

21) In pitcher plants (*Darlingtonia* spp.) why might a flying insect remain in flight in an attempt to escape, but ultimately not find its way out even though flying until exhausted?

22) In pitcher plants (*Darlingtonia* spp.), what is inside the base of the plant that helps to finally kill a trapped prey item?

23) In pitcher plants (*Darlingtonia* spp.) that do not produce their own digestive enzymes, how do they digest the bodies of prey?

24) Using the language and concepts of natural selection, explain how a population of non-carnivorous plants might have evolved the ability to capture prey. Successful answers will identify the key structures and tissues of leaves that are involved, the environmental conditions that act as a selective pressure for plant carnivory, and the vocabulary that is critical to natural selection. Be sure that the key concepts of natural selection are identified (named in your response) and explained. You should be able to do this readily for any organism or adaptation that you encounter in your career. If you can't, I will find you…and suspend your biologist card!!

**October 3 lecture – 1$^{o}$ Tissues; roots**

1) What two functions do typical roots serve?

2) Define the following: radicle, taproot, fibrous root.

3) What type of roots do most monocots have? Dicots?

4) What are the roots called that extend "sideways" off of a taproot?

5) Be able to draw a taproot vs. fibrous root system.

6) Define and describe the function of the various specialized roots that we discussed: storage roots, pneumatophores, aerial roots, prop roots, buttress roots.

7) Provide an example of a plant that produces storage roots, pneumatophores, aerial roots.

8) What is a velamen and why is it important for epiphytes such as orchids?

9) What is an epiphyte?

10) What is the meaning of the word root "phyte".

**October 8: Cell division; mitosis and meiosis (this material also supported in our meiosis/genetics lab)**

1) Define and understand the following terms (have a DEATH GRIP on these – if you have to hesitate to define these, the midterm will not go well for you…):

DNA
Gene
Chromosome
Chromatid
Sister chromatid
Homologous chromosomes
Mitosis
Meiosis
tetrad
Haploid
Diploid
1n
2n
Gamete
Zygote
Sexual reproduction
Mutation (deleterious vs beneficial)

2) Starting with a 2n parent cell, sketch out the stages (prophase, metaphase, anaphase, telophase/cytokinesis) and the final products of meiosis and mitosis. What are the two important fundamental differences in the products, and what is the great importance of these differences in biology?

3) Expanding upon and using your work for #2 as a basis, explain Down syndrome.

4) What is taxol? In what organism is it found? How is it used by humans?

**October 10: Mendelian genetics (this material also supported in our meiosis/genetics lab)**

1) Define and understand the following terms (have a DEATH GRIP on these – if you have to hesitate to define these, the midterm will not go well for you…):

Allele
Dominant allele
Recessive allele
Homozygous
Heterozygous
Hybrid
F1 generation, F2 generation, etc
Phenotype
Genotype
True breeding

2) Compare contrast selective breeding and natural selection. What are the fundamental similarities and differences?

3) Be able to make monohybrid crosses to the F2 generation.

4) Be prepared to make crosses, for a single gene, with parents of any genotype (homozygous dominant, homozygous recessive or heterozygous).

5) What was Mendel's experimental organism?

**October 15 lecture - Stems**

1) On a stem, be able to identify: leaf, node, internode, axil, axillary bud, apical meristem location, thorn, spine, prickle.

2) What does "apical dominance" refer to?

3) Be able to describe the distribution/gradient of auxin in the distal region of a stem where apical dominance is operative. What is the effect of auxin at [High],[Low], and [Very low/0]?

4) What two events in the life of a plant stem can result in [Very low/0] auxin at axillary buds? How is the development of [Very low/0] of auxin in response to these two event adaptive for

the plant? Be prepared to speak accurately and eloquently, and of course from an evolutionary perspective (i.e., using the language of natural selection), about this signaling system inside plant stems.

5) Why does pruning of a dominant stem (one containing an active apical meristem) cause axillary buds to develop into lateral branches?

6) How specifically does the herbicide 2,4 D work? How was it discovered, and why was it used in Vietnam?

7) Why are dicots but not monocots such as grasses affected by 2,4 D? (i.e., why is 2,4 D referred to as a "selective" herbicide?)

8) Diagram the distribution of auxin in a stem experiencing phototropism. What is phototropism, anyways?!

9) We identified many specialized stems – you should be familiar with them all! Be able to draw, identify, and compare/contrast the structure and role of: stolons, rhizomes, corms, bulbs, succulent stems, thorns.

10) Explain the role of auxin in inhibiting and stimulating axillary bud development.

11) What is a meristem?

**October 17 lecture – xylem and phloem structure and function**

1) Have a death grip on the following vocab and structures (death grip = know where they are, what they do, be able to draw them or ID them in a photograph…)

- vessel cell (element)
- vessel
- tracheid
- pit/ pit pair
- bordered pit
- torus
- perforation plate
- sieve cell (element)
- companion cell
- sieve tube
- P-protein (we didn't cover this – perhaps it will appear as extra credit).

2) What material in secondary cell walls makes them highly durable and hydrophobic?

3) Diagram the pathway that a water molecule takes from the soil to the leaf and then into the atmosphere as it moves through plant tissues. On your diagram, label the pertinent strucutres and physical processes by which water enters the root, moves upwards through the trunk/stem, and exits the leaf. (I am 99.9% certain this question will appear on the exam as a ~10 point question!)

4) What type of injury do tori (tori = plural of torus) help to minimize, and how do they work (i.e., what force moves them into place)? Be able to draw a torus in a bordered pit pair and explain this…).

5) What does pectin do in plants, and how do humans use it in preparing food items?

6) Explain the relationship between aphids, ants, and ladybugs. Be SPECIFIC!!! What do aphids provide, and where/how do they get it?!!

**Questions #7 will not appear on the exam other than as extra credit!! Consult the lecture notes!!**

*7) Using a diagram, explain the pressure-flow hypothesis for sugar transport in phloem. Label your diagram – labeled structures should include: sieve cells/sieve tube, companion cells, source, sink, osmosis, xylem, water, phloem loading (I am 99.9% certain that this question will appear on the exam as a 6-8 point question!)*

**October 22 lecture – 2° tissues – wood and bark**

1) I <u>will</u> provide you with a cross section of a woody stem, or perhaps I will ask you to draw one, and you will need to identify the following structures/features:

- outer bark
- cork cambium
- secondary phloem (inner bark)
- secondary xylem (wood)
- annual growth rings
- vascular cambium
- rays
- heartwood
- sapwood

Also – be able to identify a year in which growth was rapid (a wide growth ring) vs slow (a narrow growth ring). I might ask you to identify a fire scar from a cross section…but I haven't decided yet! (I am 99.9% certain that this question will appear on the exam as an 8-10 point question!)

2) Using a diagram of the cellular structure of a woody stem, explain the difference between a hardwood tree and a softwood tree. Provide an example (i.e., common name) of a tree of each type.

3) Do hardwoods or softwoods have vessels?

4) Do flowering plants have vessels in their wood?

5) What is another name for "wood"?

6) what is another name for “inner bark”?

7) Using a diagram of a woody stem, explain the difference between spring wood (aka early wood) and summer wood (aka late wood).

8) What is girdling?

9) Why does harvest of the outer bark of *Quercus suber* not kill the tree, and why does the outer bark regrow?

10) Why does harvest of cinnamon kill cinnamon trees?

**The following content might have been covered in lab (if we ran out of time in lecture) and you need to know this for lecture assessments…**

11) List 3 applications of dendrochronology.

13) What is the scientific name of the tree species that has the oldest individual trees on Earth? Approximately how old are the oldest individual trees of this species?

14) What is establishment growth?

15) Are palm trees monocots or dicots?

16) Do palm trees make growth rings in their wood?

17) Do palm trees have a vascular cambium?

**October 24 lecture – secondary metabolites**

Overall: study the posted lecture notes – these are very detailed and straight-forward for this lecture. These notes serve as the study guide for this lecture. Sample questions follow below (I will draw heavily from this list of questions, but other material on the lecture notes is fair game).

1) Define the difference between primary and a secondary metabolite. Provide an example of each.

2) What are the three classes of secondary metabolites?

3) From which class of secondary metabolites have humans manufactured many well-known pharmaceutical and “recreational” drugs?

4) What is the defining or characteristic basic molecular structure of the alkaloids and terpenoids? (alkaloids = N atom in a ring – usually!; terpenoids = isoprene subunits; phenolics = phenol subunits.)

5) What’s the oldest known record of opium poppy production; from what plant is morphine derived, from what plant is cocaine derived?

6) Which class of secondary metabolites have names that typically end in "–ine".

7) What are the characteristics of alkaloids?

8) What is latex?

9) What is the longest terpenoid molecule?

10) What is vulcanization? Who pioneered this chemical process? Is he (and his heirs…) rich?

11) What is allelopathy?

12) Essential oils are what type of secondary metabolite?

13) Essential oils have two fundamental roles in plant/animal interactions. What are these two roles?

14) What chemical property of essential oils helps them accomplish the functions that you identified in the above question?

15) What was the link we discussed between essential oils and bee-keeping (aside from pollinator attraction).

16) Bayer pharmaceutical company developed and sold what two important drugs in the late 1800's/ early 1900's?

17) Cocaine and morphine have been used medicinally for what purposes?

18) What role do most alkaloids, such as cocaine, nicotine, morphine, theobromine, and caffeine have in plants? That is to say, how do they increase a plant's survival and reproduction?

19) Why is your veterinarian keenly aware of theobromine?

20) What is "Black leaf 40"? From what plant species is the active ingredient isolated?

21) For cocaine, morphine, theobromine, know the following:
A) the plant/plants from which each is isolated (by humans)
B) the region of the world in which each is native (where each plant naturally occurs), and
C) know the important products (many of which are historical) that humans harvest or make from each plant.

22) Why do plants make capsaicin in the fruits if the purpose of a fruit is to attract a seed disperser?

23) What is the Scoville scale?

24) Salicylic acid was first isolated from what type of tree?

25) Salicylic acid is the chemical precursor of what important human pharmaceutical drug?

26) What gives creeks and streams in forests/jungles their “tea-colored” water?
27) What is an LD50?

28) Alkaloids excite or inhibit what cells in animals? How do they “gain entry” into these specific cells?

29) “Plant are like castles”. Explain.

For the secondary metabolite lecture – know the three classes of secondary metabolites, and know the basic molecular structure that defines each group. (alkaloids = N atom in a ring – usually!; terpenoids = isoprene subunits; phenolics = phenol subunits.) Review the lecture notes for this lecture – they are three pages and bulleted with facts and bits of trivia. Know details such as: what’s the oldest known record of opium poppy production; from what plant is morphine derived, from what plant is cocaine derived, what role does morphine, cocaine, and caffeine play in plants, why do plants make capsaicin in the fruits if the purpose of a fruit is to attract a seed disperser, what is the Scoville scale, which class of secondary metabolites have names that typically end in “–ine”. I am likely to roll these bits of information into multiple choice questions and matching questions for the *Scantron* portion of the exam – so be sure to have a command of this info as it is presented on the lecture notes.