Introductory Plant Biology **Model Exam V**

Name__*Key to Model Exam*_____SSN___________________________

Grade: Bonus________ Exam Proper______ Total_______

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☐ Check here if you wish to **withdraw permission** to have your grade posted by PIN.

☐ Check here if you have written **a detailed explanation** by a question. This is your **only** opportunity to challenge a question if you believe it to have two correct responses with neither substantially better than the other or if you believe that no answer is correct. Start your explanation with "I chose answer 'D' instead of answer 'B' because . . . ." Only challenges started thus will be considered, and in some cases, credit will be given even if you mark an answer that does not correspond to the key. Identify the question that you challenge: ________________.

I understand that it is a violation of the Honor Code to refer to **any** information not specifically condoned by the instructor or to receive **any** information from a source that is not specifically authorized during an exam. I also understand that I should report to the instructor any violation of the Honor Code unless the person who violates the code reports himself or herself. In this course, an additional example of a violation of the Honor Code is to divulge information about exam content to anyone who has not taken the exam or to receive unauthorized information about the contents of an exam before taking the exam.

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Signature

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Bonus Section (Optional Reading)

1. (2 pts) Give the approximate value of leather-leaf fern production in Florida (within 3-fold for full credit, within 10-fold for half credit).

$64 million

2. (2 pts) Give the approximate value of a single large redwood tree on the stump (within 5-fold for full credit, within 10-fold for half credit).

$50,000

3. (2 pts) Name four major products produced from gymnosperms. Exclude paper products and building and structural materials (one-half point for each *unique* application).

a. *cigarette filters* b. *sausage casing* c. *naval stores* d. *automobile tires (and any other correct answers)*

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Exam Proper

1. Select the best statement.
   xxxa. All seed plants must be heterosporous.
   b. Gymnosperms are homosporous, but angiosperms are heterosporous.
   c. All seed plants are heterosporous, and all nonseed plants are homosporous.
   d. There is no relationship between heterospory and seed formation.

Heterospory is a necessary condition for seed development, making answer a good and answers b and d incorrect. Some nonseed plants are heterosporous (see table), making answer c incorrect.

2. Select the answer that **only** includes **advanced floral** characteristics.
   a. fusion of parts, presence of both anthers and carpels, irregularity
   b. free-central placentation, heterospory, reduction in number of parts
   c. double fertilization, basal placentation, free-central placentation
   xxxd. fusion of parts, irregularity, reduction in number of parts

Heterospory is characteristic of all seed plants, including angiosperms (see previous answer), so answer b is incorrect. Double fertilization is a feature of all angiosperms, making answer c incorrect. Answers a and d are similar, except that answer a indicates a complete flower, whereas answer d indicates a reduction in the number of parts, which is correct.

3. Select the answer that lists attributes in which the primary growth of roots **differs** from the primary growth of shoots in angiosperms.
   a. presence of root cap, presence of secondary growth, presence of lateral appendages
   xxxb. arrangement of vascular anatomy, presence of collenchyma, origin of lateral appendages
   c. presence of plastids, arrangement of vascular anatomy, presence of parenchyma
   d. presence of plastids, presence of secondary growth, origin of lateral appendages

Answers a and d are nonsense answers that require you to know the definitions of and difference between primary and secondary growth. Answer c is incorrect because both roots and shoots have plastids and parenchyma.

4. Select the best statement **true of Archaea** but **not generally true of Eubacteria and Eukarya**.
   a. Glucose is not oxidized as a source of energy.
   b. Glucose is oxidized as a source of energy.
   xxxc. ATP-dependent phosphofructokinase (ATP-PFK) is not an essential enzyme.
   d. One of the first steps in the metabolism of glucose is its conversion to a hexose-P.

Glucose is an energy source in all organisms, making answers a and b incorrect. Before its utilization as an energy source in all organisms, glucose must be phosphorylated, making answer d incorrect.

5. Select the statement that is **true of cyanobacteria and red algae** but **not true of plants**.

xxxa. Photosynthetic light-harvesting pigments are complexed with proteins in structures called phycobilisomes that sit on the membrane.
b. Chlorophyll a plays an essential role in photosynthesis.
c. The first step in CO_2 fixation involves the production of a 4-carbon compound.
d. The chloroplasts have a bluish cast because of the presence of similar light-harvesting pigments.

Chlorophyll a plays an essential role in all organisms that carry out oxygenic photosynthesis; therefore, answer b is incorrect. The first product of photosynthesis in all algae and most plants is a C_3 compound, 3-PGA, making answer c incorrect. Phycocyanin and phycoerythrin are major light-harvesting pigments in cyanobacteria and red algae but are lacking in plants. Cyanobacteria do not have chloroplasts, however, so answer d is incorrect.

6. Select the best statement **true of chloroplasts of green algae and of plants**, but **not true of at least some other chloroplasts**.
   a. They were derived by way of a secondary endosymbiotic process.
   b. They contain chlorophyll *a*, they are enclosed by a double membrane, and starch is generally the carbohydrate storage product.
   xxxc. They contain chlorophyll *b*, they have membranes organized into stacks, and starch is generally the carbohydrate storage product.
   d. None of the above is true; green algae do not have chloroplasts.

Green algae do have chloroplasts (invalidating answer d) similar to those of plants. These plastids are derived by primary endosymbiosis, rendering answer a wrong. As stated earlier, all organisms that conduct oxygenic photosynthesis have chlorophyll a, so answer b does not distinguish the different plastids.

7. Select the best statement.
   xxxa. The first organisms appear in the fossil record at about the same time as astronomical and geological processes permitted Earth to be hospitable to life.
   b. The first organisms must have had mechanisms that permitted their survival in the presence of very high levels of atmospheric O_2.
   c. The three domains of life appeared in the fossil record simultaneously and seem to have evolved independently, although some genes have been shared through lateral gene transfer.
   d. A primitive form of sex evolved first in plants, but within 6 billion years this trait spread to most other eukaryotes.

Earth was devoid of molecular oxygen until it accumulated as a result of photosynthesis, making answer b incorrect. Eukaryotes appeared nearly 2 billion years later than prokaryotes, making answer c incorrect. Answer d is incorrect because sex came before plants and the Earth is not yet 6 billion years old.

8. Select the best statement about fungi.
   a. They have a larger genome than other eukaryotes.
   xxxb. Their nuclear membrane may not degrade during mitosis.
   c. They are filamentous, lack cellular connections, and have a level of cellular differentiation ("division of labor") similar to that of prokaryotes.
   d. They are strictly haploid, except for the zygote, and monokaryotic.

A perspective value (with exceptions!) for the fungal genome is 40 Mb (~ 10× that of a typical prokaryote and >1/10 that of a typical eukaryote), so answer a is incorrect. (The fungal genome is compact, though, and contains more genes/bp than that of higher eukaryotes.) Answer c is incorrect because cellular connections exist; indeed, zygomycetes are coenocytic. Answer c is also incorrect because the level of cellular organization in fungi is high. Dikaryotic mycelia are the norm during sexual reproduction of Ascomycetes and Basidiomycetes, so answer d is incorrect.

9. Select the statement that is generally **true of Basidiomycetes** but generally **not true of Ascomycetes**.
   xxxa. Sexual spores are formed by meiosis.
   b. Sexual spores are formed by mitosis.
   c. Sexual spores are diploid.
   d. Formation of spores is not part of sexual reproduction.

Sexual spores are formed by a round of mitosis (following meiosis) in Ascomycetes, but the round of mitosis is absent in Basidiomycetes. Therefore, answer a is correct and answer b is incorrect. Haploid sexual spores are the norm in all fungi, making answer d incorrect.

10. Select the statement that best describes how fungi acquire nutrients.
    a. An extremely large family of membrane-bound ATPases has hundreds of individual members, each specialized for the uptake of a specific nutrient.
    b. Ions are acquired primarily through endocytosis (engulfing).
    c. A membrane sodium ATPase pumps sodium into the cell, and the sodium attracts other nutrients into the cell.
    xxxd. Mechanistically, the fungal process is similar to the way that plants acquire nutrients.

ATPases do comprise families (though not nearly so large*) and expression is cell specific. In most cases, the ATPases poise the membrane for secondary active or passive transport, making answer a incorrect. Ions are acquired by primary active transport (e.g., the Na^+-K^+ ATPase), by symport, or by channels. Answer b is thus incorrect. Answer c is incorrect; this ATPase extrudes sodium, which drives secondary active transport.*

11. Select the trait **characteristic of all plants** but **not characteristic of many green algae**.
    xxxa. oogamy
    b. biflagellate sperm
    c. oxygenic photosynthesis
    d. double fertilization

Answer b is incorrect, as most plants, and all the angiosperms, lack flagella. Answer c is incorrect as both plants and green algae conduct oxygenic photosynthesis. Answer d is incorrect because only the flowering plants undergo double fertilization.

12. Select the trait **characteristic of some vascular seedless plants** but **not characteristic of bryophytes**..
    a. heteromorphic alternation of generations
    b. abundance of stomata on the gametophyte
    c. external fertilization
    xxxd. vascular tissue arranged into a protostele

Answer a is incorrect because all extant plants undergo heteromorphic alternation of generations. Although there are exceptions (based on fossil plants or on the definition of "stoma"), gametophytes lack stomata, so answer b is incorrect. Internal fertilization is an attribute of all plants ("embryophytes"), making answer c incorrect.

13. Select the best definition of protonema.
    a. a multicellular structure that is exclusively involved in asexual reproduction in some groups of bryophytes.
    xxxb. a haploid green-alga-like filament that is the direct result of spore germination
    c. a capsule that becomes inflated; its "explosion" results in spore dispersal
    d. the first true root formed on the moss sporophyte

Answer b is correct, thus eliminating all the others.

14. Select the trait **characteristic of bryophytes** but **not characteristic of other plants**.
    a. one egg per gametophyte
    xxxb. one sporangium per sporophyte
    c. release of egg before fertilization
    d. zygotic meiosis

Bryophytes produce many eggs per gametophyte, making answer a incorrect. All plants have internal fertilization (see above), making answer c incorrect. Plants reproduce by alternation of generations (also, see above), making answer d incorrect.

15. Select thebest statement.
    a. The sporophytes of all homosporous plants are homozygous because of the fusion of genetically identical gametes.
    b. The evolutionary ancestor of plants, a green alga (or green-alga-like organism) had a thick cuticle to protect it from ozone damage.
    xxxc. The sporophyte of *Psilotum* consists essentially of a stem.
    d. The gametophyte of ferns and fern allies develops entirely within the walls of the megaspore.

Homospory need not result in the fusion of gametes produced by a single haploid individual, so answer a is incorrect. (Each gametophyte is genetically different, as the gametophyte develops from spores that are formed meiotically.) Acquisition of a cuticle occurred as plants made the transition to land (ferns and higher), so answer b incorrect. Answer d describes the situation with seed plants and is incorrect for nonseed plants.

16. Select the best description of the evolution of the megaphyll.
    a. fusion of several microphylls
    b. adventitious growths on the sporophyll
    c. enlargement of a microphyll
    xxxd. fusion of dermal and ground tissues of a planar branching system

Answer d is correct, thus excluding the others.

17. Select the trait **characteristic of ferns** but **not characteristic of mosses**.
    a. absence of external swimming by male gamete
    b. presence of stomata on gametophyte
    xxxc. presence of megaphylls
    d. homospory

Answer a is incorrect as the male gamete swims in both cases. Answer b is incorrect as stomata are generally absent on gametophytes (see qualification in earlier answer). Answer d is incorrect—both taxa exhibit homospory, although some ferns are heterosporous.

18. Select the best statement.
    xxxa. A few extant and many fossil seedless vascular plants have a vascular cambium and, hence, secondary growth.
    b. Fern leaves are either fertile nonphotosynthetic spore-bearing organs or sterile photosynthetic organs.
    c. Fern pollen is always dispersed by wind.
    d. Ferns have microphylls, and seed plants have megaphylls.

Photosynthetic fern leaves often bear sori on the lower surface, and ferns produce no nonphotosynthetic spore-bearing organs to my knowledge, so answer b is incorrect. Pollen is not formed by ferns, so answer c is incorrect. Answer d is incorrect because both ferns and seed plants have megaphylls.

19. Select the best statement concerning **ferns,** as studied in this course.
    a. Vessel elements are generally not lignified.
    b. Symbiotic relationships with fungi are not found.
    xxxc. Roots, when present, are usually adventitious.
    d. Xylem is present, but phloem is not.

Lignin is an important component of all tracheary elements, making answer a incorrect. Mycorrhizae are characteristic of most vascular plants, making answer b incorrect. (This latter statement has exceptions; e.g. the mustards and proteas do not have mycorrhizal associations.) Answer d is incorrect because phloem and xylem are essential elements of the vascular system.

20. Select the statement most nearly true of the prototypical fern life cycle.
    a. Mature eggs and sperm are released into a droplet of liquid water on the underside of the gametophyte.
    b. Precise development programs the eggs and sperm of a gametophyte to mature simultaneously.
    c. The gametophytes are strictly unisexual.
    xxxd. Free flagellated sperm swim to the egg.

Answer a is incorrect because all plants have internal fertilization. Staggered development of the eggs and sperms of an individual gametophyte is a mechanismfor avoidance of inbreeding, so answer b incorrect. In homosporous plants, such as most ferns, the gametophyte is bisexual, making answer c incorrect.

21. Select the statement that best describes the flagellation pattern in gymnosperms.
    a. The sperm of all taxa have flagella.
    xxxb. Flagellated sperm only swim internally.
    c. Pollen grains in some rare taxa are flagellated.
    d. Both gametes of many gymnosperms are flagellated, but the flagella of the female gamete are only sufficent to propel the gamete from the archegonium.

The conifers and Gnetales lack flagellated sperm, so answer a is incorrect. Pollen grains are never flagellated, so answer c is incorrect. Answer d is incorrect because all plants are oogamous.

22. Select the response that includes attributes all of which are **required** for seed formation and **none** of which are found in seedless plants.

a. retention of the megaspore on the sporophyte, heterospory, formation of endosperm
b. oogamy, motile male gametophyte, formation of only a single egg on each female gametophyte
xxxc. retention of the female gametophyte on the sporophyte, complete development of female gametophyte within the megaspore wall, motile male gametophyte
d. nonflagellated male gametes, delayed karyogamy, internal fertilization

Answer a is doubly incorrect—some nonseed plants are heterosporous, and endosperm is only formed in angiosperms. Answer b is doubly wrong—oogamy is a feature of all plants, and in some gymnosperms several eggs are formed by the female gametophyte. Answer d is wrong—internal fertilization occurs in all plants, "delayed karyogamy" swooped down out of no place, and some seed plants (ginkgos and cycads) have flagellated male gametes.

23. Select the statement **true of multiple fertilization** but **not true of double fertilization**.
a. Female gametes are genetically identical to each other, and male gametes are genetically identical to each other.
b. Female and male gametes are all genetically identical.
xxxc. Female gametes are genetically identical to each other, but male gametes are not genetically identical to each other.
d. None of the gametes involved are genetically identical to each other.

In multiple fertilization and in double fertilization, all the eggs are produced by the same female gametophyte. In double fertilization, both sperm are formed from the same male gametophyte (pollen grain) and are therefore genetically identical. In multiple fertilization, the sperm come from different male gametophytes and therefore are not genetically identical. Answer c is correct, and the others are not.

24. Select the best description of the ginkgo.
a. small, annual herb with very limited secondary growth
b. fan-shaped deciduous leaves on a moderate-sized tree
xxxc. difficult to distinguish from a palm tree
d. high ornamental value a result of persistent decorative fruits

Answer b is correct, eliminating the others.

25. Select the statement most nearly true of the pine tree.
a. The seed coat, present in angiosperms, is lacking.
xxxb. Similar to the situation in angiosperms, three of the four megaspores resulting from meiosis abort.
c. The gametophytes are bisexual.
d. The separate events of double fertilization are separated by months.

Seed coats are an invariant feature of all seeds, making answer a incorrect. Answer c is incorrect—the female gametophyte produces eggs, and the male gametophyte produces sperm. Double fertilization only occurs in angiosperms, making answer d incorrect.