

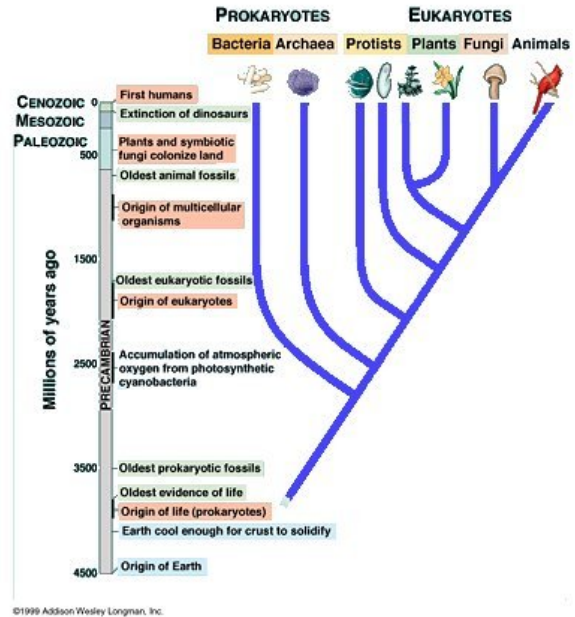
Exam Short Answer Assessment Rubric (assuming a 0-10 point scale)

Criteria for a Grade of:

- “10”** Your response **consists of clear concise and insightful points that are substantiated by details of both content and context.** ALL essential terms relevant to the answer are presented and correctly used. No extraneous material is included. The sequence of phrases and/or sentences flows effortlessly and indicates a high level of organization, preparation, and effort. All words are legible.
- “9-8”** Your response **consists of clear concise and insightful points that are mostly substantiated by details of both content and context.** However, you will receive a “9-8” if essential terms or ideas relevant to the answer are vaguely or incompletely presented, or omitted. Or, if extraneous material or digressions are included, or if the answer is mostly complete, but clearly lacks organization, you will receive a “9-8.” Lastly, if there are illegible words within an otherwise mostly complete answer, you will receive a “9-8,” since one cannot tell if these illegible words contain material that is relevant.
- “7-5”** Your response **includes most of the major points to answer the question, however, critical supportive details, terms, explanations, etc. are incomplete or lacking.** You will also receive a “7-5” if the flow of information is choppy and lacks a rigor of focus and/or contains irrelevant information as filler. You will also receive a “7-5” if basic information is presented accurately but with little synthesis or insight. For example, simply listing terms without explanation when a question asks you to “List AND briefly explain...” will earn you a “7-5” for that response. As another example, omitting a figure when one is asked for will earn you a “7-5.”
- “4-1”** Your response **contains major content, contextural and/or logical flaws, and/or critical components of the answer are omitted.** Key terms, if present, are imbedded in glaring misconceptions. Few points are made beyond the obvious, and/or for essay responses, the flow of information is very choppy, poorly connected, and suggests a lack of preparation for that question.
- “0”** **You did not attempt to answer the question.**

AM Version: Question 1: EVOLUTIONARY BIODIVERSITY

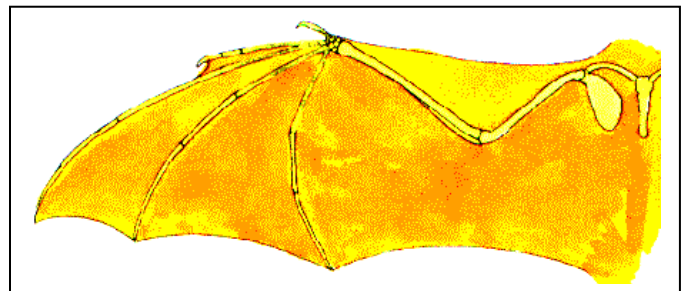
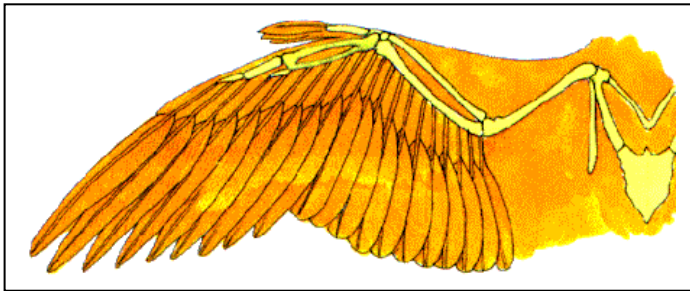
Discuss what are the basic principals of Phylogenetic Systematics? According to these principles, what is the tree diagram at right supposed to show?



(15 pts)

(*** note there are two parts to this question – did you answer BOTH parts? ***)

PM Version: Question 1: EVOLUTIONARY BIODIVERSITY



The figures show the structure of the wings of a bird (left) and bat (right). Note the form and function of the arm and hand bones in these two “wings”. Are these “wings” homologous or analogous? What role does the concept of a “shared derived character” play in these terms?

Please state your choice and write a brief essay including a definition of the terms homologous and analogous and refer to specific details visible in the figures above to support your choice.

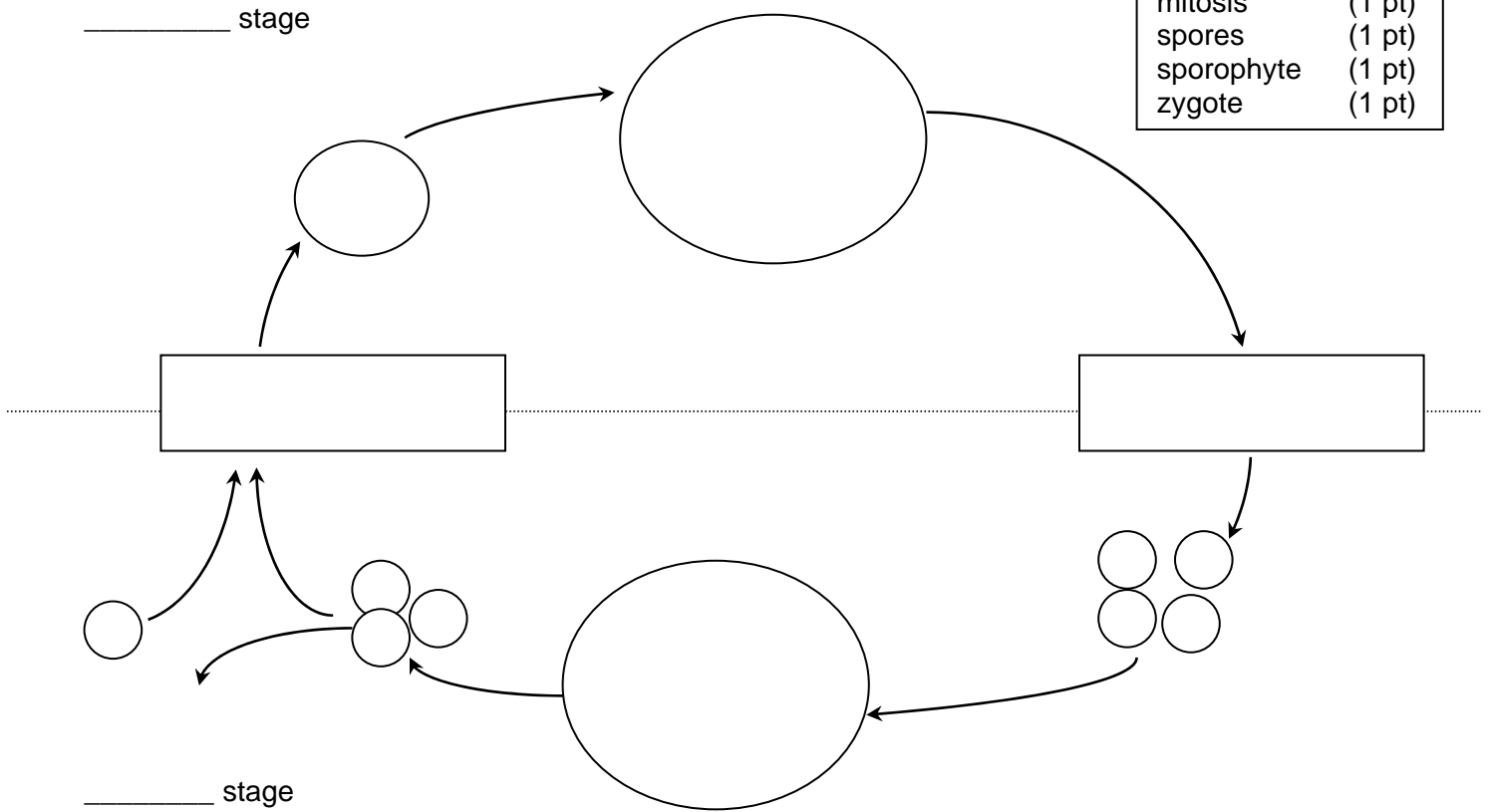
(15 pts)

(*** note there are several parts to this question – did you fully address ALL PARTS? ***)

Question 2: PLANT EVOLUTIONARY BIODIVERSITY

(a). Please clearly document the schematic figure below showing the generalized life cycle for a plant. Include in your figure ALL of the terms in the box at right to label either the appropriate life stage or process:

diploid stage	(1 pt)
fertilization	(1 pt)
gametes	(1 pt)
gametophyte	(1 pt)
haploid stage	(1 pt)
meiosis	(1 pt)
mitosis	(1 pt)
spores	(1 pt)
sporophyte	(1 pt)
zygote	(1 pt)



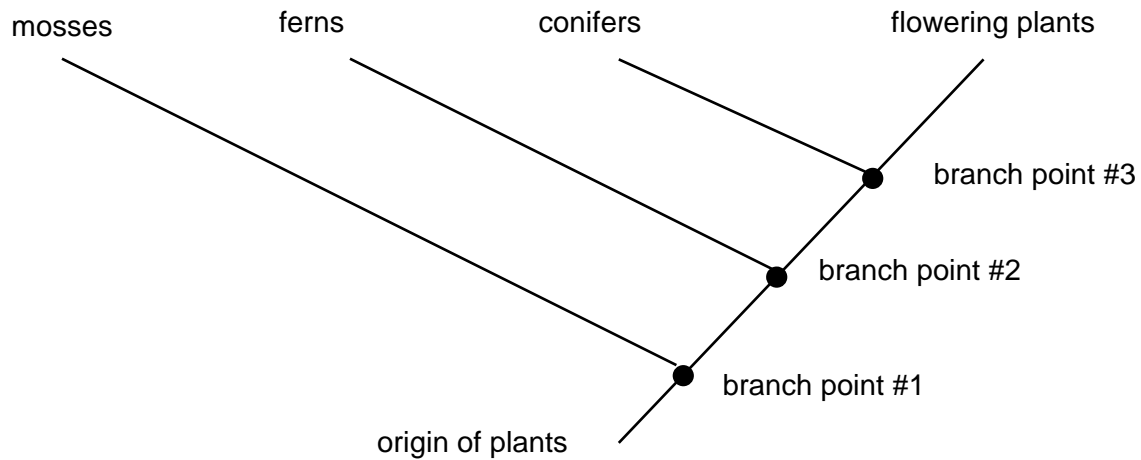
(10 pts)

(b). A major characteristic of plants is the "alternation of generations" during plant life cycles. What exactly alternates?

(3 pts)

Question 2: PLANT EVOLUTIONARY BIODIVERSITY (con.)

Consider the diagram below showing the evolutionary relationships among the major groups of plants:



- (c). Branch point #1 marks the evolution of what major characteristics? These characteristics are found in all plants that derive to the RIGHT and are lacking in mosses that derive to the LEFT.

(3 pts)

- (d). Branch point #2 marks the evolution of what major characteristics? These characteristics are found in all plants that derive to the RIGHT and are lacking in ferns that derive to the LEFT.

(3 pts)

- (e). Branch point #3 marks the evolution of what major characteristics? These characteristics are found in all plants that derive to the RIGHT and are lacking in conifers that derive to the LEFT.

(3 pts)

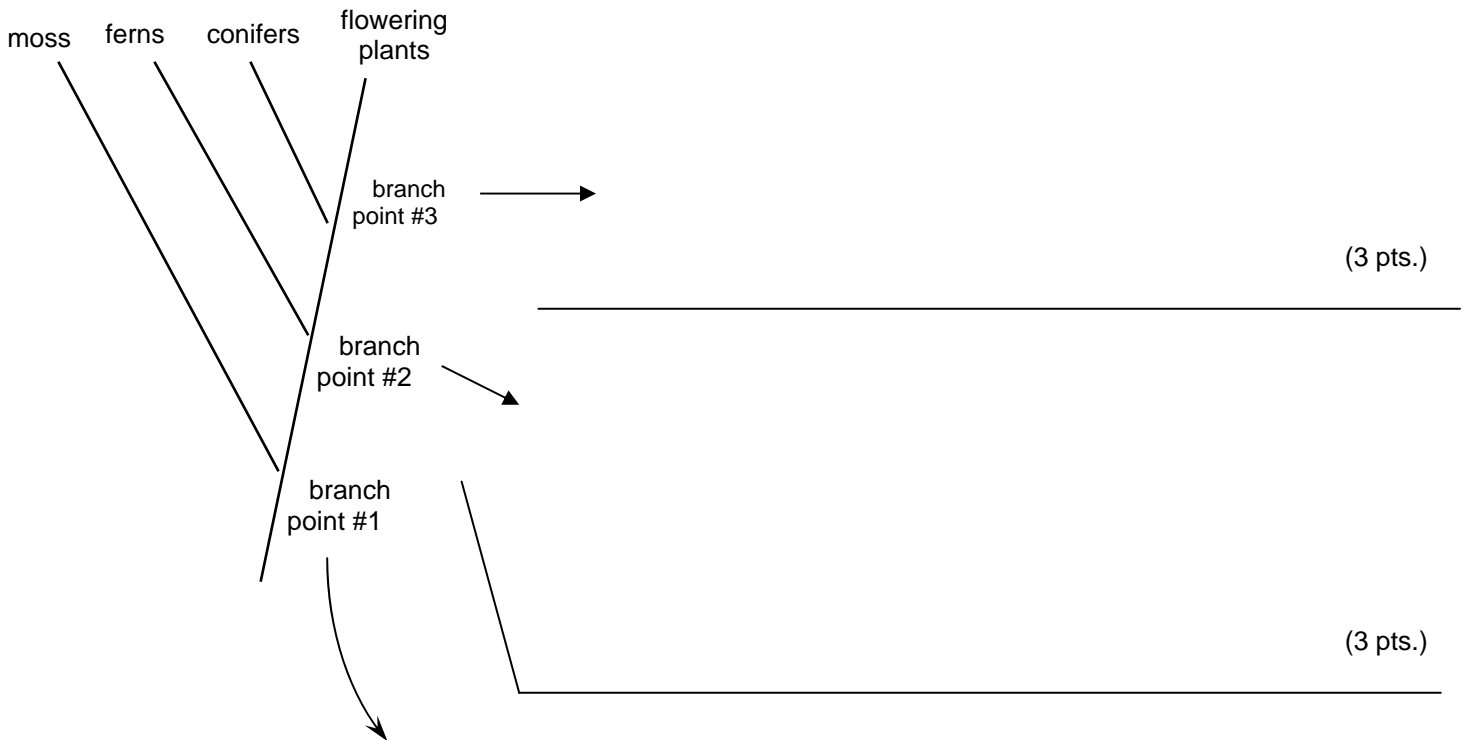
Question 3: PLANT REPRODUCTION

Please fill in the blanks with the appropriate term:

- (a). “The delayed meiosis hypothesis suggests that by delaying meiosis and growing a large multicellular sporophyte many more _____ (1 pt) can be produced per mating.”
- (b). “The condition in which gametes for the mating types are identical is called _____ (1 pt).”
- (c). “The condition in which gametes for the mating types differ is called _____ (1 pt).”

One of the most important trends in the evolution of plants is the colonization of land and the progressive accumulation of terrestrial adaptations.

- (d). Please briefly explain the key terrestrial adaptations of **gamete design, gamete dispersal, fertilization and offspring dispersal** for each of the three branch points below:



(1 pt.)

Question 3: PLANT REPRODUCTION (con.)

(e). Please examine the flower diagram at right and place the appropriate letter next to each of the terms below:

ovary _____ (1 pt)

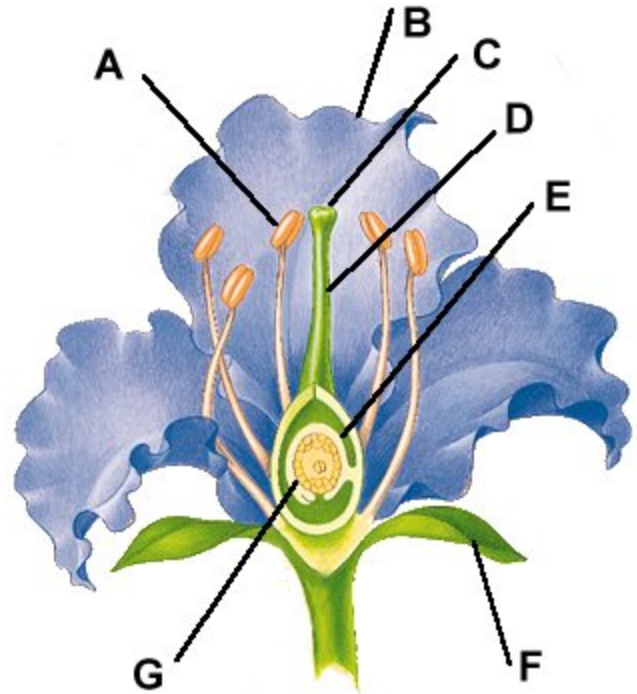
style _____ (1 pt)

anther _____ (1 pt)

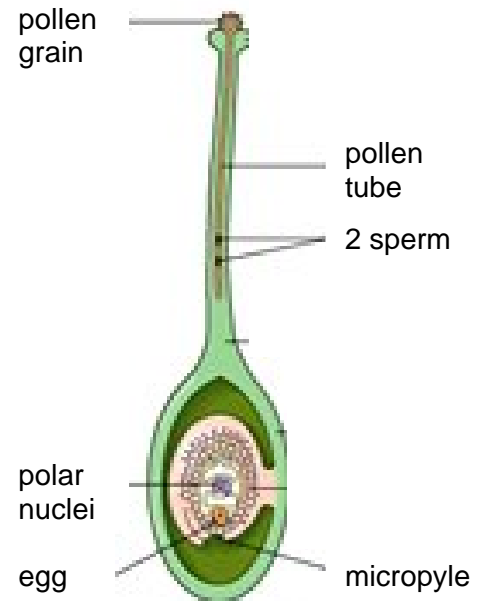
stigma _____ (1 pt)

sepal _____ (1 pt)

petal _____ (1 pt)



(f). Angiosperms are noted for a unique method of ovule fertilization known as “double fertilization” Please refer to the figure at right and briefly explain “double fertilization.”



(5 pts.)

PLEASE DO EITHER QUESTION 4A, 4B, 4C, or 4D, and put a big "X" through those you don't want.

Question 4A: Plant Transport Systems Above and Below Ground.

- (a). What 2 major ecological problems of terrestrial plants were solved by the evolution of vascular systems?

(3 pts)

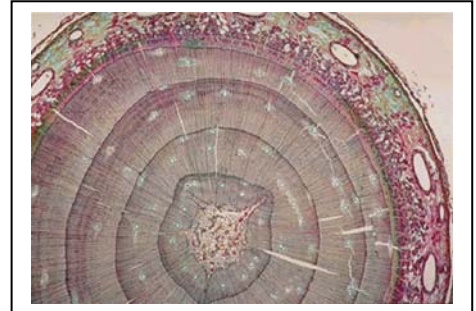
In figure at right show a woody stem crosssection.

- (b). Is this a **monocot** or a **dicot** ? {circle one}

(1 pt)

- (c). Please briefly explain your answer in (b). How can you tell?

(2 pts)



- (d). Assuming that the growth rings represent annual growth, how many years old is this stem?

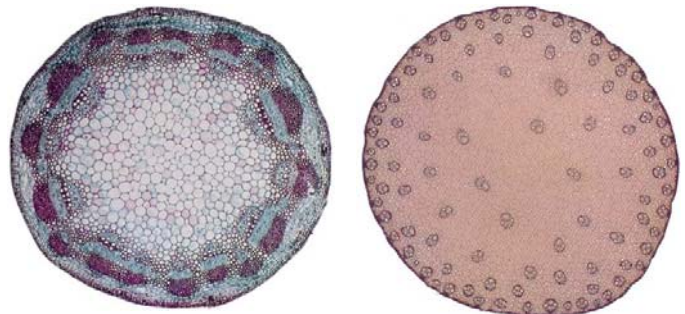
(2 pts)

- (e). Which of the stem crosssections at right is from a monocot? (circle it)

(1 pt)

- (f). Please briefly explain your answer in (e). How can you tell?

(2 pts)



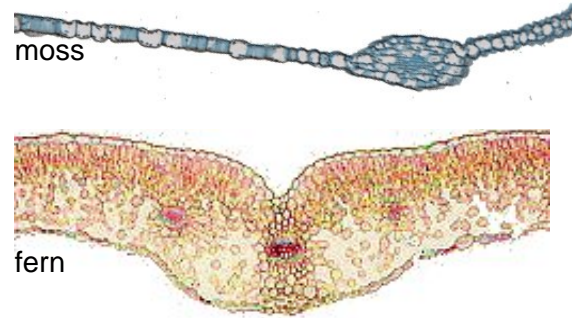
- (g). Briefly describe the major differences (structure/function) between xylem and phloem in angiosperms.

(4 pts)

PLEASE DO EITHER QUESTION 4A, 4B, 4C, or 4D, and put a big "X" through those you don't want.

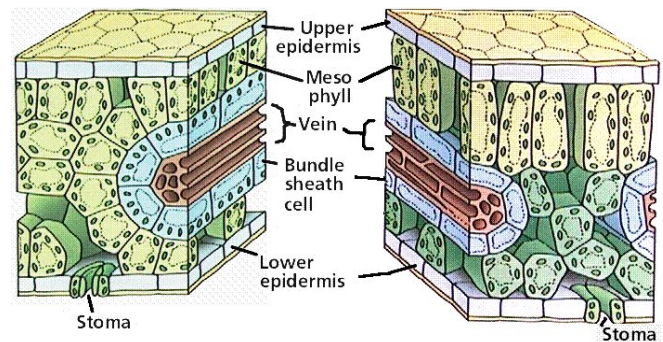
Question 4B: Plant Photosynthetic Adaptation: Leaf and Stem Design, and Novel Pathways.

(a). Please list and briefly explain what are the major novel features in leaf design that occurred with the origin of ferns from moss-like ancestral plants from which ferns evolved? (Hint: examine the figures at right of a moss leaflet and fern leaf cross-section.)



(5 pts)

(b). Examine the leaf cross-sections at right. Which of them is adapted for C₄ metabolism {circle the C₄ leaf}, **and** state how can you tell?



(3 pts)

(c). State what the "4" represents in the alternative carbon fixation mechanism called C₄.

(3 pts)

(d). Briefly explain the principal ways in which the alternative carbon fixation mechanism called CAM, which is found in cacti and other desert plants, differs from the more commonly observed C₃ photosynthetic pathway.

(4 pts)

PLEASE DO EITHER QUESTION 4A, 4B, 4C, or 4D, and put a big "X" through those you don't want.

Question 4C: Plant Nutrient Demand and Mutualisms for Nutrient Acquisition

- (a) List 6 of the major micro- and macro-nutrients required by plants, 3 of each please.

3 micronutrients:

3 macronutrients:

(3 pts.)

- (b) Carnivory has evolved in plants numerous times. Describe one plant that exhibits carnivory (e.g. the pitcher plant at right, and offer an hypotheses that may account for where and why carnivory may have evolved in this type of system.



(5 pts.)

- (c) The relationship between species of plants and their root bacterial or fungal mutualists for nutrient uptake are great examples of so-called "coevolutionary mutualisms." Please offer brief but concise definition of a "coevolutionary mutualism." Please offer an example of root bacterial or fungal mutualists for nutrient uptake.

"coevolutionary mutualism" =

(4 pts.)

example for nutrient uptake -

(3 pts.)

PLEASE DO EITHER QUESTION 4A, 4B, 4C, or 4D, and put a big "X" through those you don't want.

Question 4D: Plant Physiological Regulation and Environmental Response

- (a) List and briefly describe the function of 3 major plant hormones.

1 –

2 –

3 –

(9 pts.)

- (b). How and why do plants move? List and describe the major physiological/ biochemical mechanisms and ecological reasons to account for plant movement.

(6 pts.)

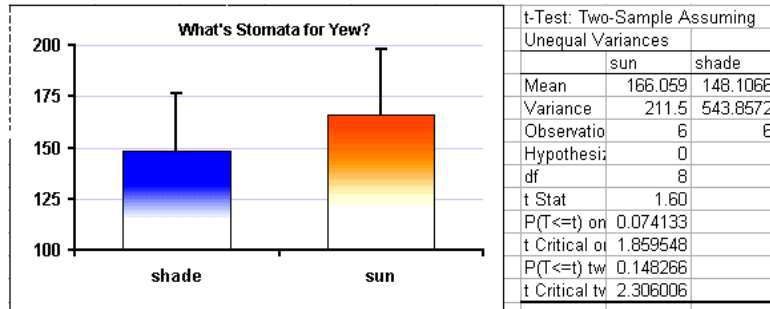
Question 5: STOMATA Experiment

(a) Why might there be a higher density of stomata for leaves in the sun than leaves in the shade?
Please note that you must use all of the terms in the box at right correctly in your response.

carbon dioxide	evaporative cooling	evolution	adaptation
photosynthesis	leaf temperature	natural selection	

(10 points)

(b) At right is an analysis table and graph of stomata data (on a yew plant for the sun versus shade). According to this analysis, is there a significant difference between the density of stomata in the sun versus the shade?



Yes or No ??

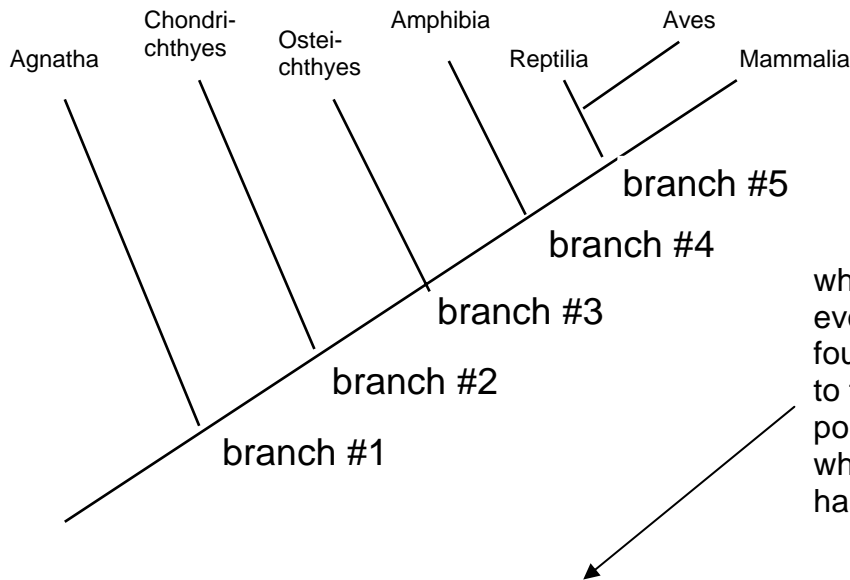
(5 pts)

(c) Explain exactly what information on this printout gives you the answer to the above question? How confident are you about this conclusion? Please use specific numbers from the figure above to justify your response.

(6 pts)

AM version: Question 6: ANIMAL EVOLUTIONARY BIODIVERSITY

(a) Consider the diagram below showing the evolutionary relationships (and branch points) among the major groups of the chordate sub-phylum vertebrata:

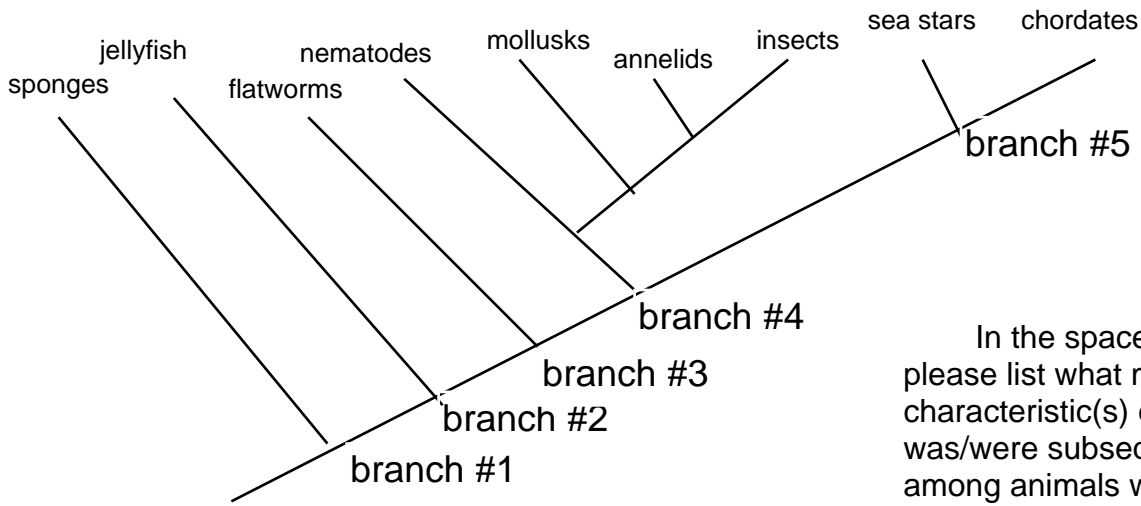


In the spaces below, please list what major new characteristic(s) evolved and was/were subsequently found among animals who derived to the RIGHT at each numbered point #1-#5, and in addition state what major change(s) resulted in habitat and/or way of life

- branch #1 - (3 pts)
- branch #2 - (3 pts)
- branch #3 - (3 pts)
- branch #4 - (3 pts)
- branch #5 - (3 pts)

PM version: Question 6: ANIMAL EVOLUTIONARY BIODIVERSITY

(a) Consider the diagram below showing the evolutionary relationships (and branch points) among the major phyla of the Animal Kingdom:

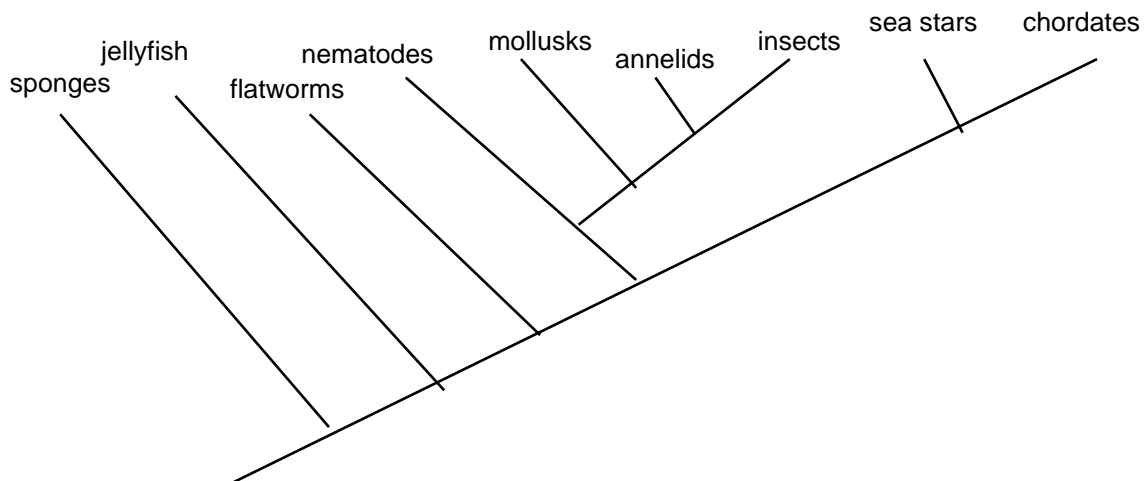


In the spaces below, please list what major new characteristic(s) evolved and was/were subsequently found among animals who derived to the RIGHT at each numbered point #1-#5, and in addition state what major change(s) resulted in habitat and/or way of life

- branch #1 - (3 pts)
- branch #2 - (3 pts)
- branch #3 - (3 pts)
- branch #4 - (3 pts)
- branch #5 - (3 pts)

AM version: Question 6: ANIMAL EVOLUTIONARY BIODIVERSITY (con.)

(b) Consider the diagram below showing the evolutionary relationships (and branch points) among the major phyla of the Animal Kingdom:

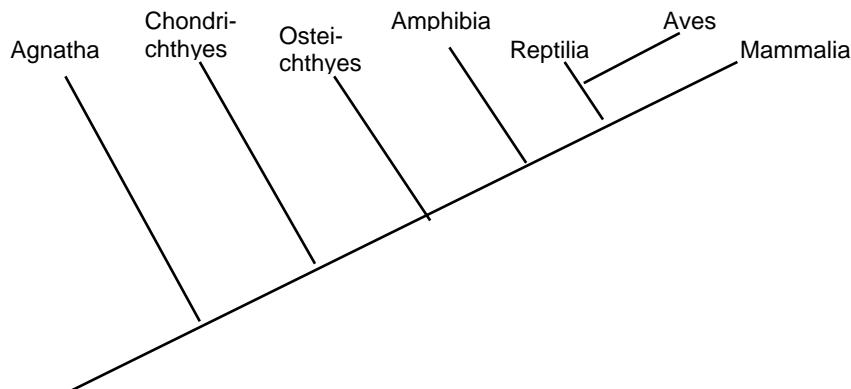


Please explain how the pattern of evolutionary divergence in this lineage illustrates the major evolutionary trend of the “EVOLUTION OF INCREASED COMPLEXITY”? What are the major adaptations illustrating this trend and in whom did these first occur?

(15 pts)

PM version: Question 6: ANIMAL EVOLUTIONARY BIODIVERSITY (con.)

- (b) Consider the diagram below showing the evolutionary relationships (and branch points) among the major groups of the chordate sub-phylum vertebrata:



Please explain how the pattern of evolutionary divergence in this lineage illustrates the major evolutionary trend of the “COLONIZATION OF LAND”? What are the major adaptations enabling the animal exploitation of terrestrial habitats?

(15 pts)

Question 7C: Circulatory System

- (a) What are the two main types of circulatory system in the animal kingdom? Briefly describe how each works.
- system 1 - (3 pts)
- system 2 - (3 pts)
- (b). Describe the main features of the heart in each of the organisms below.
- fishes - (3 pts)
- amphibians - (3 pts)
- birds (Aves) - (3 pts)

Question 7D-PM: Respiratory System PM only

- (a). Please briefly state what is the main “problem” solved by the respiratory system? 5 pts
- (b). Among animals there are at least 5 different respiratory system designs depending in the size of the organism and its habitat. What are these 5 solutions and among whom are these found? 10 pts

Question 7D: Respiratory System

- (a) Describe the mode of oxygen uptake in the following animals. Include a description of the structure and function of the major organs involved in respiration where appropriate.
- flatworm – (3 pts)
- insect – (3 pts)
- fish – (3 pts)
- Humans (3 pts)
- bird – (3 pts)

Question 7E: Digestive System

(a) Describe the structure and function of the digestive system of the animals listed below. Include in your answer the following terms where appropriate: filter feeders, acoelomates, pseudocoelomates, coelomates, ruminants, cecal digestors, herbivores, omnivores, carnivores.

Be sure to mention the name of the organs

- sponges – (3 pts)
- cnidarians – (3 pts)
- cows or rabbits (circle) (3 pts)
- sharks (3 pts)
- humans – (3 pts)

Question 7G: Reproductive System.

(a). The trend from asexual to sexual reproduction has been cited as a major evolutionary trend in reproduction among animals. Why might sexual reproduction be advantageous?

(6 pts)

(b).. Please describe 3 different reproductive modes in 3 different taxa of vertebrates

- 1 - (3 pts)
- 2 - (3pts)
- 3 - (3 pts)

Question 7G-PM: Reproductive System PM Only

(a). Please list three different animal phyla in which fertilization is internal.

(4 pts)

(b). Please three different Classes of the Phylum Chordata in which fertilization is internal.

(4 pts)

(c). Given your answers to Parts A. and B. above, what is the best line of evidence to refute the suggestion that internal fertilization was a necessary evolutionary step in the colonization of land?

(4 pts)

(d). Among chordates, briefly describe what was the key adaptation of reproduction that allowed full terrestrial existence?

(3 pts)

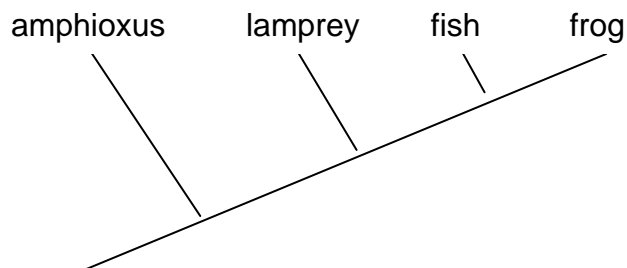
Question 7A: Skeletal Muscular.

(a). Please briefly explain the principal ecological problem(s) that the **skeletal muscular** system evolved to solve (hint: you must use the terms “evolution of complexity”, “colonization of land” and “gravity” in your answer).

(5 pts)

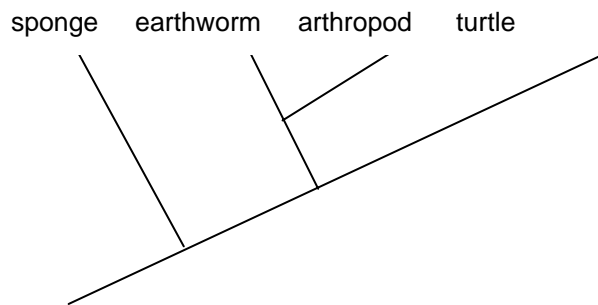
(b). Please briefly explain the major trends in the evolution of the structure and function of the **skeletal** system among the four taxa depicted at right. (amphioxus, agnatha (jawless fish), fish, frog)

(5 pts)



(c). Please briefly explain the major trends in the evolution of the structure and function of the **skeletal** system among the four taxa depicted at right. (sponge, earthworm, arthropod, turtle)

(5 pts)



Question 7F: Excretory System.

(a). Each of the following taxa uses a different type of structure or organ for excretion of nitrogenous waste. Briefly describe this structure or organ and briefly explain how it works.

- Platyhelminthes Class tubelaria- flat worms (3pts)
- Annelida – Class Oligochaeta- Segmented worm (3pts)
- Arthropods Class insecta – insects (3pts)
- Vertebrata Class mammalia - mammals (3pts)

(b). Ammonia is highly toxic. Yet in spite of this fact, some fishes secrete their nitrogenous waste in the form of ammonia. How can they do this?

(3 pts)

Question 7H-1: Neuro-Sensory System.

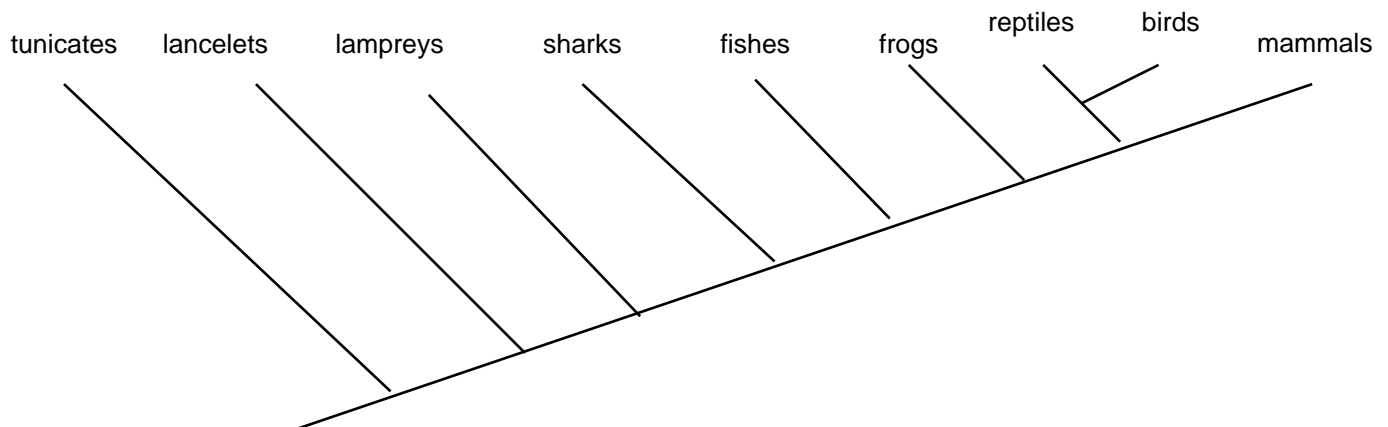
(a). How is the sense of hearing similar and how is it different between humans and fishes?

- similarities - (4 pts)
- differences - (4 pts)

(b). How is the sense of vision similar and how is it different between humans and insects?

- similarities - (3 pts)
- differences – (4 pts)

Question 7H-2: Neuro-Sensory System.



(a). Please explain what are the major evolutionary trends in sensory and nervous system design among chordates?

(8 pts)

PLEASE SELECT ONE OF THE FOLLOWING QUESTIONS AND ANSWER IT IN THE SPACE BELOW.

- (b). Please briefly explain how a nerve axon conducts a nervous signal. You MUST use a sketch of a nerve axon in your answer.
- (c). Please briefly explain how a nervous signal is conducted across a synapse between two nerves. You MUST use a sketch of a nerve synapse in your answer.
- (d). What is a hormone? How do hormonal “messages” differ from nervous signals? Describe the function, source, and target organ(s) of one hormone in detail.

7 pts

Question 7-11. WHAT SYSTEM DID YOU STUDY? _____

What is the one really good question ON YOUR SYSTEM that you were prepared to answer that we did not ask you? And, what is the answer to that question?

(a). the ESSAY question we didn't ask ON YOUR SYSTEM -

(note: think carefully about what question you put down here – it must be a question that warrants a detailed response of at least ½ a page. Your maximum score for part (b) will depend on the degree of difficulty of the question you ask here [just like diving!]) (5 pts)

(b). its answer - (10 pts)

Question 7-12. WHAT SYSTEM DID YOU STUDY? _____

What is the one really good question ON A SYSTEM **OTHER THAN YOUR STUDY SYSTEM** that you were prepared to answer that we did not ask you? And, what is the answer to that question?

(a). the ESSAY question we didn't ask on a DIFFERENT SYSTEM –

(note: think carefully about what question you put down here – it must be a question that warrants a fairly detailed response of at least ½ a page. Your maximum score for part (b) will depend on the degree of difficulty of the question you ask here [just like diving!]) (5 pts)

(b). its answer - (10 pts)

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