

Part I: _____ / 25
Part II: _____ / 75
TOTAL: _____ / 100

**Part I: Short answer (25 points)**

1. “Stick insects” resemble twigs or leaves, and this camouflage makes it difficult for predators to see them. Describe how natural selection could produce insects that look like twigs from ancestors that did not have this adaptation. Your answer should include the three requirements for natural selection and explain how each could apply to the ancestors of today’s stick insects (6 points).

2. How can a mutation in bacterial DNA lead to an entire population of antibiotic-resistant bacteria? Use the following words in your answer: *DNA, mutation, protein, genetic variability, antibiotic, evolution* (6 points).

3. Name the two kinds of genetic drift (2 points).

- (1)
- (2)

What do they have in common with each other? (1 point)

How do they differ? (1 point)

4. Researchers recently found fossil evidence of woolly mammoths on a small island near Alaska. They used radiometric dating to show that the fossil was about 7000 years old. This was an important finding because mammoth fossils from North America’s mainland are dated at about 12,000 years old.

a. This research combines two of the five lines of evidence for evolution: what are they? (2 points)

- (1)
- (2)

b. The half-life of <sup>14</sup>C is 5730 years. In the space at right, draw a graph showing the decay of <sup>14</sup>C over time (3 points).

c. Use the graph to estimate what % of the original amount of <sup>14</sup>C would remain in island mammoth fossils and in mainland mammoth fossils. Show your work for full credit (4 points).

Island: \_\_\_\_\_%      Mainland: \_\_\_\_\_%

**Part II: 75 points (38 questions; each question except the last one is worth 2 points)**

**True-false (mark A for true, B for false):**

1. Evolution improves each species so that it will survive, even if conditions change in the future.
2. Artificial selection is similar to natural selection, except that artificial selection requires a human “supervisor” to decide which specific individuals will breed and which will not.
3. A weak and slow lion that fathers many surviving offspring throughout its life has high fitness.
4. Two of the three domains consist of organisms with cells that lack nuclei.

**Multiple choice / matching:**

5. Ferns are seedless vascular plants, and they are confined to \_\_\_ habitats because they have \_\_\_\_.  
a. moist ... swimming sperm                      d. moist ... pollen  
b. dry ... swimming sperm                         e. dry ... pollen  
c. O<sub>2</sub>-rich ... no stomata
6. Fungi and animals are heterotrophs, so they have to absorb digested organic compounds to stay alive. Which best describes how this occurs?  
a. Fungi carry out photosynthesis to get food; animals digest the dead organic matter that accumulates in all plants.  
b. Fungi engulf bacteria; animals have bacteria in their digestive tracts.  
c. Fungi move molecules from digested food across a cell wall made of cellulose; animals move molecules from digested food across a cell wall made of glycogen.  
d. Fungi use their hyphae to trap and consume small prey; animals do the same thing.  
e. Fungi secrete digestive enzymes into the environment; most animals secrete digestive enzymes into a digestive tract inside their bodies.
7. Until recently, people debated whether the closest relatives of humans were gorillas or chimpanzees. The answer turned out to be \_\_\_\_\_, and data from \_\_\_\_\_ were the key to determining the answer.  
a. gorillas ... new fossils discovered in Africa  
b. gorillas ... DNA sequences  
c. chimpanzees ... new fossils discovered in Africa  
d. chimpanzees ... DNA sequences
8. Which of the following statements is TRUE?  
a. Crayfish are amphibians.  
b. Flatworms have a complete digestive tract.  
c. Jellyfish have hollow bodies; the body is perforated with pores, and it has radial symmetry.  
d. Leeches are annelids, so they have segmented bodies.  
e. Chordates, nematodes, and snails all have bilateral symmetry.

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For the next two questions, mark your scantron as follows (answers may be used more than once or not at all):

**Mark “a” if the first item occurred BEFORE the second**

**Mark “b” if the first item occurred AFTER the second**

**Mark “c” if the two items occurred at the same time**

9. First reptile ... first amphibian
  10. First cyanobacteria ... first O<sub>2</sub> in atmosphere
-

11. In the evolutionary tree at right, which is the most recent common ancestor of sting rays and eagles?
- A
  - B
  - C
  - D
  - E

12. How many clades are depicted in the tree at right?
- One
  - Two
  - Five
  - Six
  - Eleven

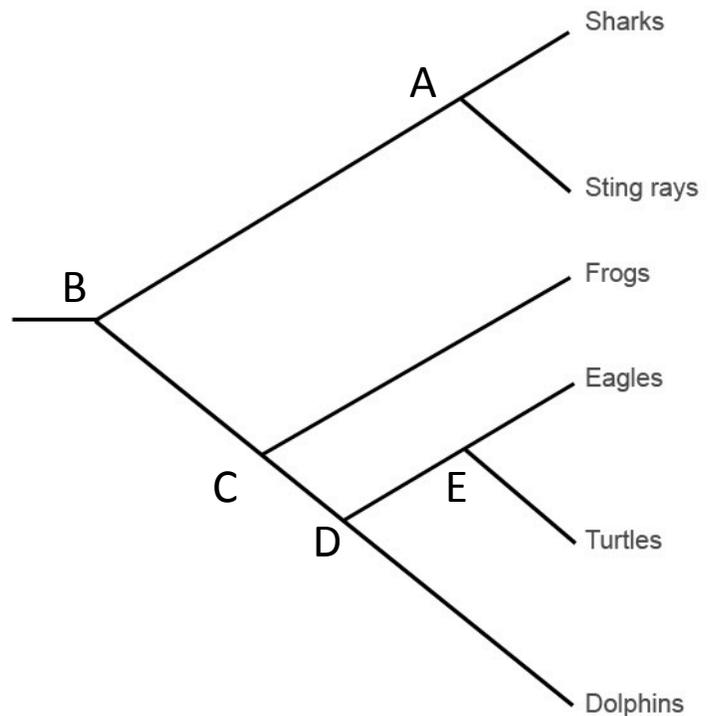
13. In the Lizards movie, the males display their colored dewlaps (flaps of skin on the neck) to attract female mates. If a female of one species does not respond to the colored dewlap from another species, that would be an example of a \_\_\_\_\_ reproductive barrier.
- behavioral
  - temporal
  - mechanical
  - gametic
  - postzygotic

14. Which of the following statements about protists is FALSE?
- The term “protist” is an informal grouping that unites a collection of distantly related organisms.
  - The protists must have evolved *before* the membrane infolding/endosymbiosis events.
  - Some, but not all, protists are autotrophs.
  - Some, but not all, protists are one-celled.
  - Slime molds, red algae, and amoebas are all examples of protists.

15. Male bighorn sheep fight each other to determine which male will mate with females. The male with the bigger set of horns usually wins. From this description, you would expect horn size in male bighorn sheep to be affected by:
- artificial selection.
  - sexual selection.
  - genetic drift.
  - biogeography.
  - postzygotic barriers.



16. How does water move through a plant’s vascular tissue?
- Water enters the plant at leaves, and gravity pulls it down to the roots in the vascular tissue “pipes.”
  - Water enters the plant at leaves, and tiny muscles in the vascular tissue help push it to the roots.
  - Evaporation of water through open stomata “tugs” on water molecules inside the vascular tissue, forming a moving column that extends all the way down to the roots.
  - Water enters the plant at roots, and tiny muscles in the vascular tissue help push it to the leaves.
  - Energy in sunlight fuels the movement of water in both directions, from leaves to roots and from roots to leaves.



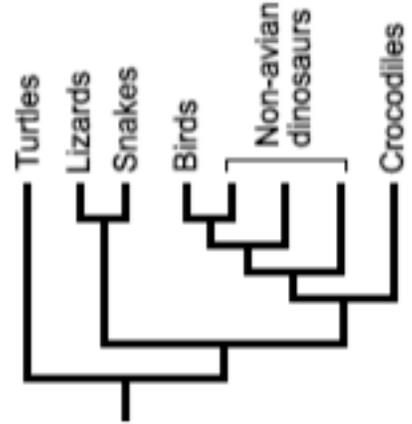
17. Arrange these in order by size, from smallest to largest. Which item is fourth on your list?

*anther, pollen, sperm, flower, plant, chromosome, nucleus*

- a. anther      b. pollen      c. sperm      d. flower      e. nucleus

18. The evolutionary tree at right depicts ALL of the known species of:

- a. amphibians.      d. amniotes.  
b. mammals.      e. vertebrates.  
c. reptiles.



19. HOW MANY of the following statements about plant reproduction are true?

- A pollen grain develops into a fruit.
- A seed turns into a fruit.
- A flower produces pollen.
- A seed contains a plant embryo.
- Sperm + egg = pollen.
- A fruit becomes a seed.

- a. One      b. Two      c. Three      d. Four      e. None

20. According to the endosymbiosis theory:

- a. lichens consist of algae living among the hyphae of fungi.  
b. humans have trillions of bacteria living in and on our bodies.  
c. the first types of cells on Earth were eukaryotic.  
d. cells became increasingly specialized as colonial species evolved into multicellular ones.  
e. mitochondria and chloroplasts are descended from purple bacteria and cyanobacteria.

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21. Pictured at right is a Teletubby. If it has bilateral symmetry, segmentation, jointed appendages, and an exoskeleton, what phylum does it belong to?

- a. Annelids      d. Arthropods  
b. Mollusks      e. Chordates  
c. Cnidarians



22. Which of the following DOES NOT match a line of evidence for evolution with an accurate observation?

- a. Biogeography: The movement of the continents millions of years ago accounts for the abundance of marsupial mammals on Australia  
b. Comparative anatomy: The arm of a human is homologous to the wing of a bat; the structures have been modified in different ways since humans and bats shared a common ancestor  
c. Fossils: Remains of organisms from the past show that today's species of plants and animals look just as they did billions of years ago  
d. Molecular biology: The amino acid sequence of cytochrome *c* (a protein found in mitochondria) is identical in humans and chimps, but both differ from the yeast version by 38 amino acids  
e. Comparative embryology: The embryos of alligators, chickens, pigs, and humans have very similar features, even if the adults look very different

23. Until the modern evolutionary synthesis in the 1930's/1940's, biologists had no idea:
- how old Earth is.
  - whether natural selection actually occurs.
  - how genes get passed from generation to generation.
  - how genetic mutations relate to natural selection.
  - that humans shared any characteristics with other mammals.
24. Which of the following is NOT one of the roles that fungi play in ecosystems?
- Decay wood and other dead organic matter.
  - Cause disease in living plants and animals.
  - Act as a food source for animals.
  - Form symbiotic relationships with plants, algae, and cyanobacteria.
  - Use energy from sunlight to assemble sugar from  $\text{CO}_2$  and  $\text{H}_2\text{O}$ .
25. In the Lizards movie, the researchers put one male and one female lizard on each of seven islands that had only shrubs (and no lizards). Over many years, they measured the lizard leg lengths and observed that the legs got shorter over time. How did this happen?
- Individual lizards were born with long legs but during their lifetimes the legs got shorter because the islands had only shrubs. They passed their new, shorter legs to the next generation.
  - The lizards evolved shorter legs because they needed to be able to run around on the shrubs.
  - The lizards with shorter legs were more likely than long-legged lizards to catch food and escape predators; the short-legged lizards had greater reproductive success, so subsequent generations had shorter legs.
  - The legs got shorter because of genetic drift (the founder effect).
  - The branches of the shrubs got smaller, which meant that the legs needed to get shorter.
26. Superficially, a slug (mollusk) and a planarian worm (the flatworm you saw in lab) look pretty similar to each other: They're elongated and brown, and they like moisture. If you were to find an animal fitting that description, how would you know whether it was a slug or a flatworm?
- Check if it has true tissues.
  - Check if it has radial symmetry.
  - Watch it reproduce, and check if the embryos go through a gastrula stage.
  - Check if it is segmented.
  - Check if the digestive tract is incomplete or complete.
27. You are hiking and find a small green organism that you think might be a moss or a lichen. You take it to the biology lab and look at it with a microscope. Which of the following would help you decide?
- If it has vascular tissue, it's a moss; if it doesn't, it's a lichen.
  - If it has stomata, it's a lichen; if it doesn't, it's a moss.
  - If it has cellulose cell walls, it's a moss; if it doesn't have cell walls, it's a lichen.
  - If it is mostly made of hyphae, it's a lichen; if it isn't, it's a moss.
  - All of the above would be helpful.
28. Which of the following events occurred AFTER all the others?
- First animals in the ocean.
  - Plants and fungi colonized land.
  - First animals on land.
  - Prokaryotic organisms evolved.
  - First eukaryotes evolved.



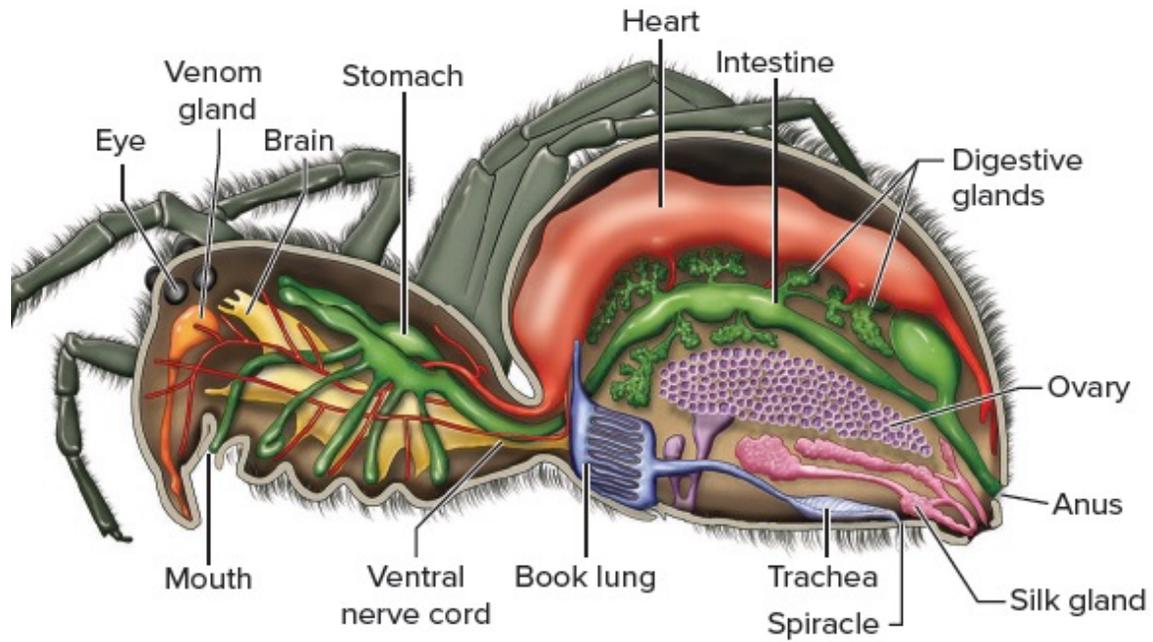
29. We know that evolution has occurred if we can show that:
- individuals become more muscular as they grow from children to adults.
  - a population reproduces sexually, since populations that reproduce asexually cannot evolve.
  - an allele that was rare in one generation is more common in the next generation.
  - seeds from a pine tree that was bent by the wind grew into tall, straight trees in a sheltered valley.
  - allele frequencies remain unchanged from one generation to the next.
30. Modern whales are mammals that lack hindlimbs, but they have tiny bones which are the remnants of pelvic and leg bones. Which of the following is NOT TRUE concerning this information?
- The remnants of pelvic and leg bones in whales are vestigial structures.
  - Modern whales most likely had an ancestor that possessed hindlimbs.
  - This is anatomical evidence in support of the theory of evolution.
  - Since whale limbs are modified into fins, they must be more closely related to fish than to other types of vertebrates.
31. How many of the following are associated with pine trees and other gymnosperms?
- |      |                 |         |                |
|------|-----------------|---------|----------------|
|      | Vascular tissue | Flowers | Cellulose      |
|      | Pollen          | Stomata | Photosynthesis |
|      | Fruits          | Cuticle | Chloroplasts   |
|      | Seeds           | Lignin  | Eukaryotic     |
| a. 7 | b. 8            | c. 9    | d. 10          |
|      |                 |         | e. 11          |

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 Fill out the table below, then answer questions 32-35.

	Snake	Frog (adult)	Kangaroo	Chicken
<b>Vertebrae</b>				W
<b>Lungs</b>	X			
<b>Four limbs</b>		Y		
<b>Placenta</b>			Z	

32. What goes in the space marked W?
- Yes
  - No
  - Depends on the species
33. What goes in the space marked X?
- Yes
  - No
  - Depends on the species
34. What goes in the space marked Y?
- Yes
  - No
  - Depends on the species
35. What goes in the space marked Z?
- Yes
  - No
  - Depends on the species
- 
36. Suppose a plant has a genetic mutation that prevents the stomata from opening. The plant will die because it will:
- lose too much water to the atmosphere.
  - fall over.
  - be unable to acquire CO<sub>2</sub> for photosynthesis.
  - run out of O<sub>2</sub>.
  - have too much starch and not enough cellulose.

37. Does the animal pictured below have a complete or an incomplete digestive tract?
- a. Complete
  - b. Incomplete
  - c. Not enough information to tell



*Don't forget the last question, below!! It's worth a point!*

38. What color is your test form? Choose (a) for blue and (b) for yellow.