KEY

Name

INTRODUCTION TO CLADOGRAMS

Background:

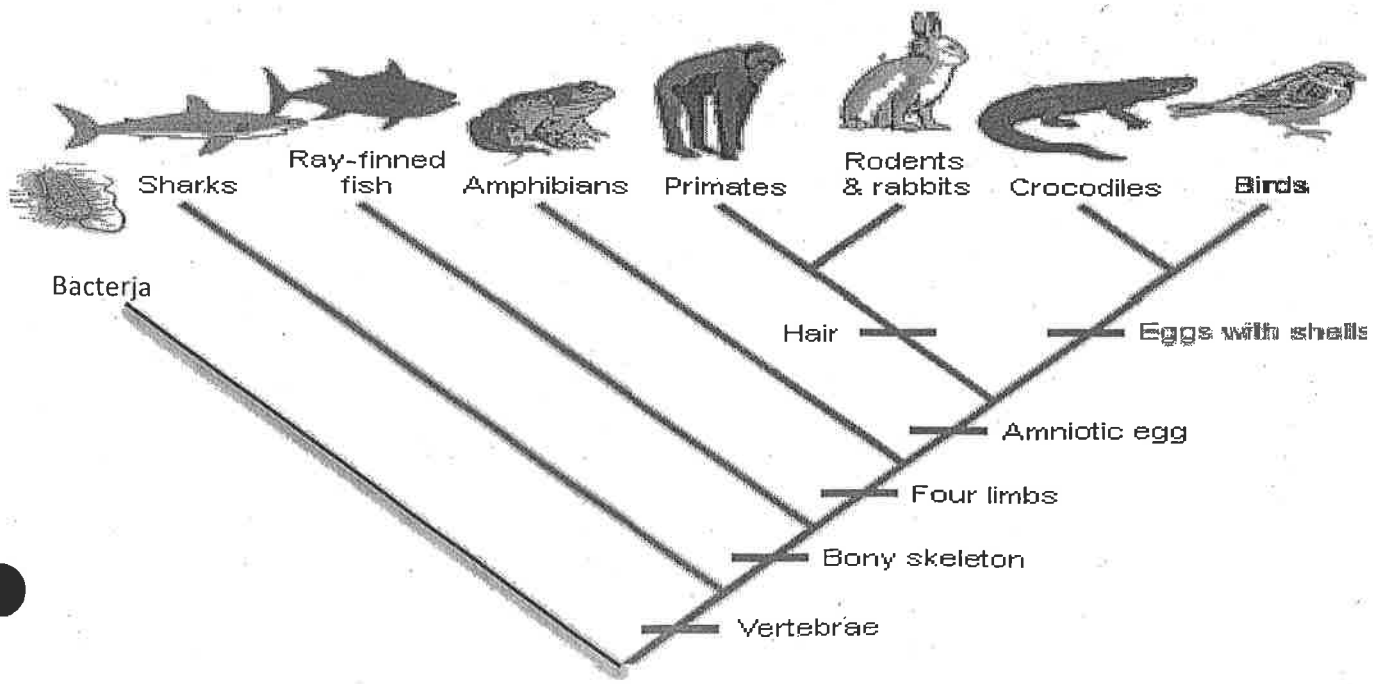
Cladograms are diagrams which depict the relationships between different organisms. By depicting these relationships, cladograms reconstruct the evolutionary history (phylogeny) of the organisms. Cladograms can also be called "phylogenetic trees". Cladograms are constructed by grouping organisms together based on their shared derived characteristics.

When a character is shared by two or more species (taxa) that arose earlier than the last common ancestor of the two species, it is called a **shared primitive character**. It is basically, the oldest characteristic shared by those in the cladogram. For example, there is not a shared primitive character in the cladogram below. No one characteristic is shared by ALL of the organisms.

On the other hand, when a shared character in two or more species is common at their most recent common ancestor, it is called a **shared derived character**. It is basically a characteristic that a particular group of organisms have in common. For example, the shared derived character in the cladogram below for the amphibians, primate, rabbit, crocs, and birds is 4 limbs. The complexity of these characters can vary greatly, from very simplistic to not simplistic at all.

To determine whether or not the characters are primitive or derived, you can compare the group of interest, known as the **ingroup** (which includes the all but the bacteria, as shown below) with the species that lack one or more of the shared characters, known as the **outgroup** (as shown with the bacteria below). Additionally, the use of shared derived characters can be used to analyze sequences of genes.

The cladogram below shows a main line at a diagonal with various organisms branched off of it. They are chosen to show an evolutionary relationship. Those closer on the line are closely related. Various traits are shown also. Any organism that lies above the line has the trait. For example, only the crocodiles and birds have hair. The primate has hair, amniotic egg, 4 limbs, bony skeleton, and vertebrae.



Name: _____

Hour: _____

Cladogram Practice

Textbook Questions – Answer 18.2 Assessment Question #4 on Page 522.

4a. _____

4b. _____

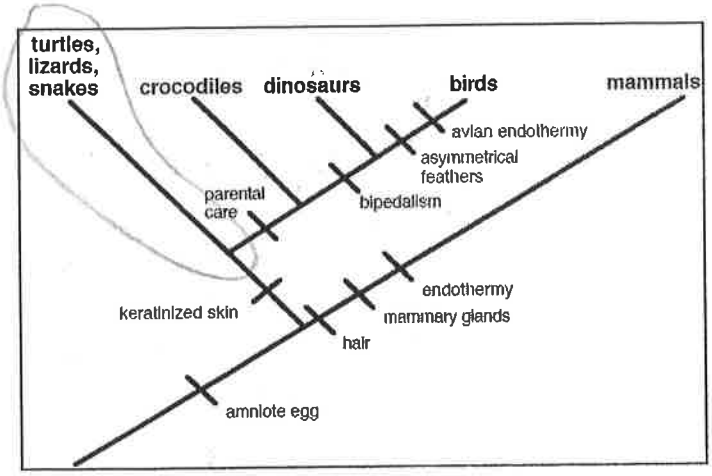
Textbook Questions – Answer Standardized Test Prep Questions 7-9 on Page 535.

7. _____

8. _____

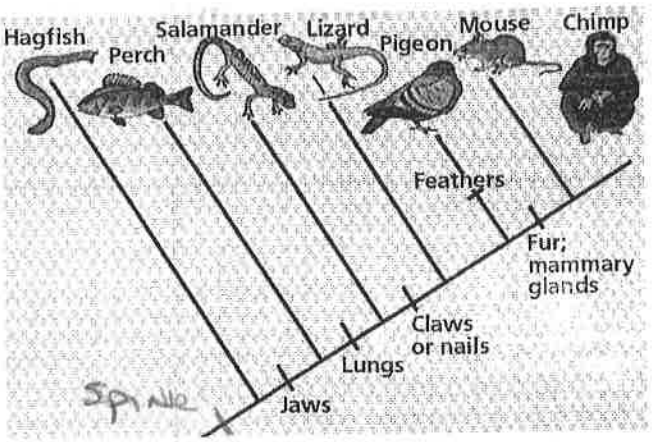
9. _____

Cladogram #1



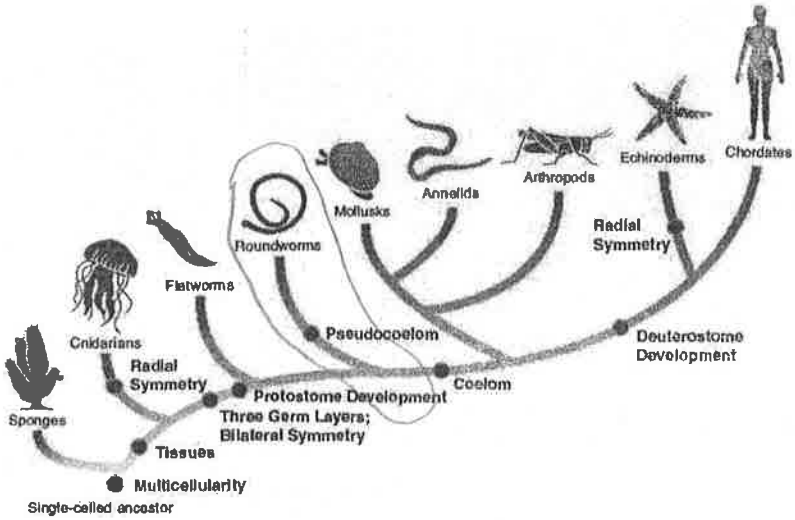
1. Name five characters possessed by birds: AVIAN ENDOTHERMY, ASYM. FEATHS, BIPEDS, PARENTAL CARE, KERATIN
2. Name two characters possessed by reptiles/birds (the group comprised of turtles, lizards, snakes + crocodiles + dinosaurs + birds; including their common ancestors): KERATIN, AMNIOTIC EGG
3. Name four characters possessed by mammals (Note: one of the four has been lost by almost all mammal species): ENDOTHERMS, MAMMARY GLANDS, HAIR, AMNIOTE EGG
4. True or False: On their own, turtles, lizards, snakes, crocodiles, and dinosaurs form a clade. F (NEEDS TO INCLUDE BIRDS)
5. True or False: On their own, crocodiles, dinosaurs, and birds form a clade. T
6. According to the cladogram, which character evolved first: the amniote egg or hair? (circle one)
7. According to the cladogram, which character evolved first: keratinized skin or bipedalism? (circle one)
8. On the cladogram, circle the point (i.e. node) that represents the most recent common ancestor of crocodiles, dinosaurs and birds. Reptiles

Cladogram #2



1. What animal does not have jaws? Hagfish
2. Which animals have lungs? Salamander, Lizard, Pigeon, Mouse, Chimp
3. Which of the following groups, taken by themselves, do NOT form a clade? _____
   a. Pigeon, Mouse, and Chimp
   b. Lizard, Pigeon, and Mouse (NEEDS chimp)
   c. Salamander, Lizard, Pigeon, Mouse, and Chimp
   d. Hagfish, Perch, Salamander, Lizard, Pigeon, Mouse, and Chimp
4. Do you think this cladogram shows an example of convergent evolution or divergent evolution? Getting More Similar
5. What characteristic do all of these organisms share? Spine
6. Is there an outgroup? If so, what is the outgroup? Hagfish (Defined by Jaws)
7. What characteristics does the lizard possess? Jaws, Lungs, Claws
8. Is there a shared primitive character shown for this cladogram? If so, what is it? Spine
9. What is the shared derived character of the lizard, pigeon, mouse, and chimp? Claws
10. What organism is most closely related to the chimp? Mouse

Cladogram #3



1. List the organisms that show multicellularity: All of them
2. List any organisms that lack tissues: Sponges
3. List organisms with radial symmetry: Cnidarians, Echinoderms
4. What organisms have deuterostomic development? Echinoderms, Chordates
5. List protostome organisms that have a coelom (Note: deuterostome development replaces protostome development): Mollusks, Annelids, Arthropods
6. Circle the point (i.e. node) on the cladogram that marks the most recent common ancestor of mollusks, annelids, arthropods, echinoderms and chordates.