

Phylogenetic Trees and Cladistics Study Guide

1. Review all assignments, homework, mastering biology, and notes from class.
2. What are the three domains that biologists use to classify organisms? Why did they switch from 5 to 3?
3. What is the order for classifying species? What is different about them? (Why do scientists use so many different levels?)
4. Explain what binomial nomenclature is and how scientists use it to classify organisms.
5. Explain what phylogenetic trees allow scientists to do.
6. What do branches represent on a phylogenetic tree? What do branch points represent?
7. Explain what sister taxa's and basal taxons (outgroups) represent on a phylogenetic tree.
8. When referring to evolutionary histories, what are analogies and homologies? What is the difference between the two?
9. What kinds of evidence do scientists use to make phylogenetic trees?
10. Explain what a monophyletic group, paraphyletic group and polyphyletic groups are. And be able to identify them if given a phylogenetic tree.
11. Explain what parsimony is and why scientists strive for the most parsimonious phylogenetic tree.
12. Answer the questions (1-10) from the chapter review on page 555.

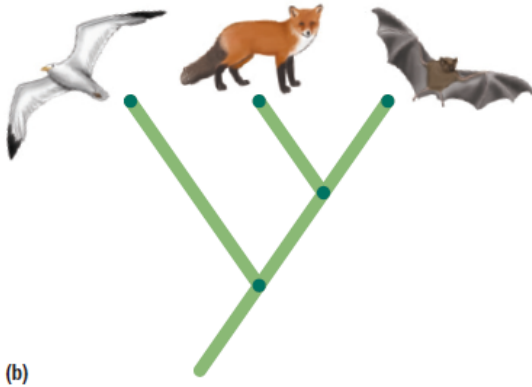
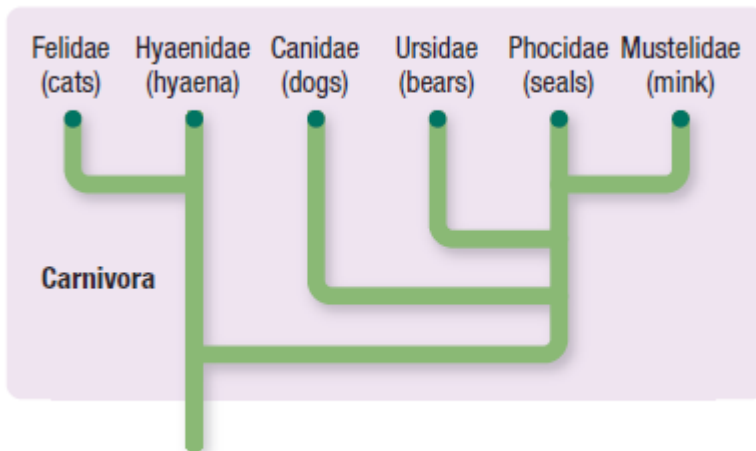


Figure 1(b) *phylogenetic tree of bird, fox and bat*

1. Using figure 1b (phylogenetic tree of bird, fox and bat)
 - a) Indicate the location of the species that is:
 - i) The most recent common ancestry of foxes and bats
 - ii) The most common recent ancestor of all three species
 - b) Based on this tree, is a bird more closely related to a fox or to a bat? Explain your reasoning.



- a) The Mustelidae family includes both mink and otters. Both of these species spend most of their time in the water. Using evidence from the phylogenetic tree, explain why this makes sense.
- b) In your opinion, does a bear seem more similar to a dog or to a seal? Consider its physical appearance, ecological niche, and behaviour.

- c) Is a bear more closely related to a seal or to a dog? How do you know?
 d) Evolutionary changes do not occur at the same rate in different groups. How might this help explain your answer to (c)?

6. From the diagram below you can conclude that

- a) A is ancestral to B, C, and D.
 b) B is more closely related to A than to C and D.
 c) C is more closely related to B than to A
 d) B is the sister group to A
 e) A is older than B, C and D.

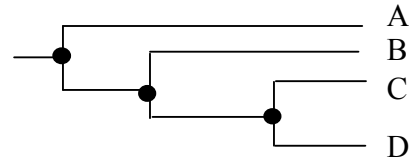
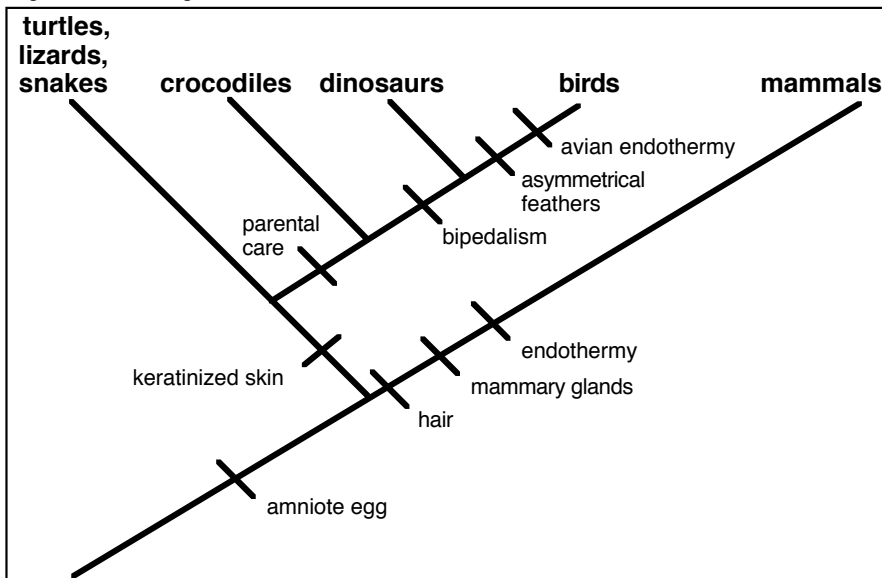


Figure P. A cladogram of the amniotes with characters shown.



1. Name 5 characteristics that birds possess.
2. Name 4 characteristics that mammals possess.
3. Which evolved first, the amniote egg or keratinized skin?
4. How many ancestors are there on this diagram?
5. Identify a monophyletic group on this cladogram.
6. Identify a paraphyletic group on this cladogram.
7. Identify a polyphyletic group on this cladogram.

Animals

SETS	TRAITS	Kangaroo	Lamprey	Rhesus Monkey	Bullfrog	Human	Snapping Turtle	Tuna
SET 1	Dorsal Nerve Cord Notochord	X	X	X	X	X	X	X
SET 2	Paired Appendages Vertebral column	X		X	X	X	X	X
SET 3	Paired legs	X		X	X	X	X	
SET 4	Amnion (Amniotic sac)	X		X		X	X	
SET 5	Mammary Glands	X		X		X		
SET 6	Placenta			X		X		
SET 7	Canine teeth short Foramen magnum fwd					X		
	TOTALS of Xs----->	5	1	6	3	7	4	2

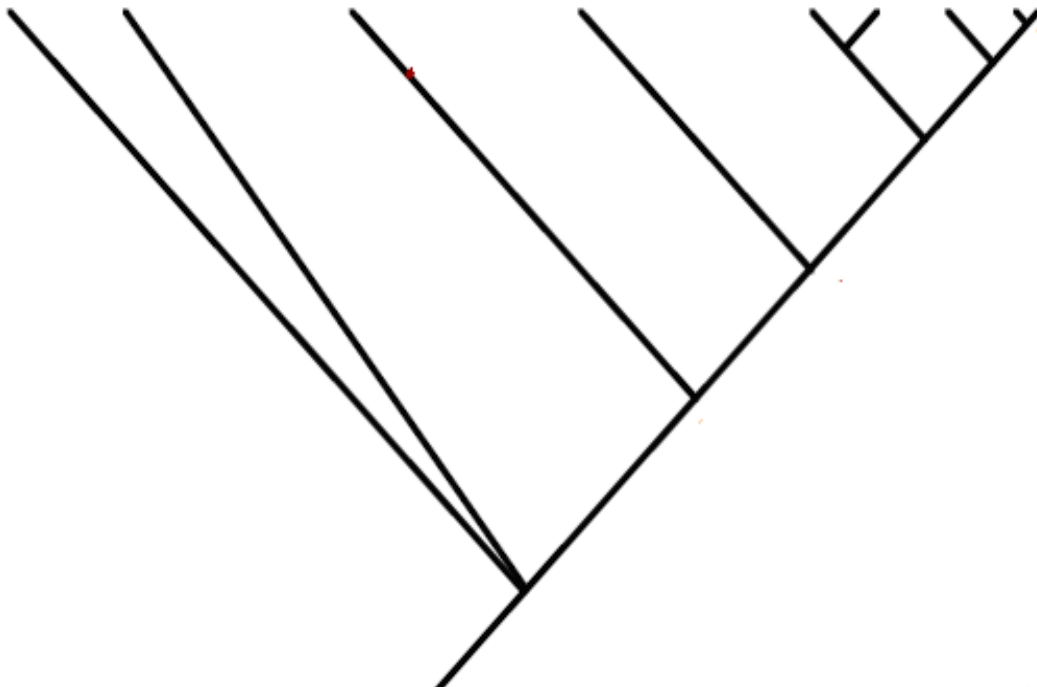
Draw a cladogram of the characteristic table above.

Now we will make a phylogenetic tree for eight different species using the differences in amino acid sequences in Cytochrome c protein.

Method:

	horse	donkey	whale	chicken	penguin	snake	moth	yeast	wheat
horse	0	1	5	11	13	21	29	45	46
donkey		0	4	10	12	20	28	46	45
whale			0	9	10	18	27	45	44
chicken				0	3	18	29	46	46
penguin					0	17	27	45	46
snake						0	29	46	46
moth							0	48	45
yeast								0	47
wheat									0

Use the data you collected to complete the cladogram which follows.



**THE NUMBER OF AMINO ACID DIFFERENCES IN CYTOCHROME *c*
AMONG VARIOUS ORGANISMS**

	Horse	Donkey	Chicken	Penguin	Snake
Horse	0	1	11	13	21
Donkey		0	10	12	20
Chicken			0	3	18
Penguin				0	17
Snake					0

Draw a phylogenetic tree that shows the evolutionary relationships of the organisms above based on the differences of the cytochrome *c* amino acid sequence.

Use Figure 26.1 to answer the following questions.

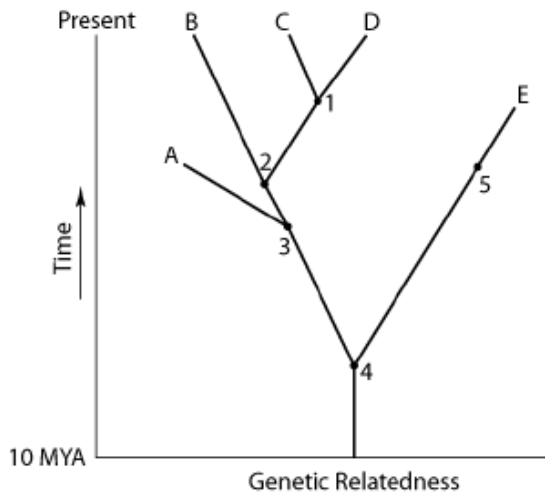


Figure 26.1

Which extinct species should be the best candidate to serve as the outgroup for the clade whose common ancestor occurs at position 2 in Figure 26.1?

- A) A
- B) B
- C) C
- D) D
- E) E

If Figure 26.1 is an accurate depiction of relatedness, then which of the following should be correct?

1. The entire tree is based on maximum parsimony.
2. If all species depicted here make up a taxon, this taxon is monophyletic.
3. The last common ancestor of species B and C occurred more recently than the last common ancestor of species D and E.
4. Species A is the direct ancestor of both species B and species C.
5. The species present at position 3 is ancestral to C, D, and E.

- A) 1 and 3
- B) 3 and 4
- C) 2, 3, and 4
- D) 1, 2, and 3

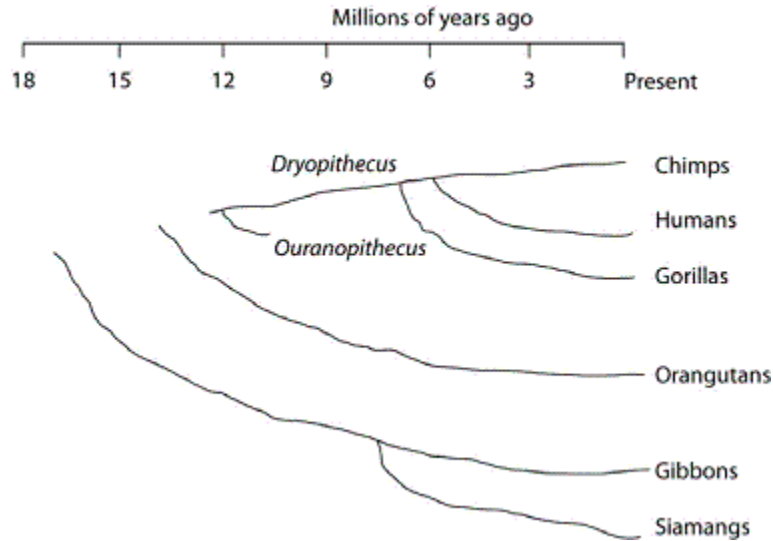


Figure 26.5. Humans, chimpanzees, gorillas, and orangutans are members of a clade called the great apes, which shared a common ancestor about 18 million years ago (Figure 26.4). Gibbons and siamangs comprise a clade called the lesser apes. Tree-branch lengths indicate elapsed time.

From Figure 26.5, to which of the extant apes are orangutans most closely related?

- A) gibbons and siamangs
- B) *Dryopithecus* and *Ouranopithecus*
- C) gorillas
- D) chimps
- E) chimps, gorillas, and humans

Assuming chimps and gorillas are humans' closest relatives, removing humans from the great ape clade and placing them in a different clade has the effect of making the phylogenetic tree of the great apes

- A) polyphyletic.
- B) paraphyletic.
- C) monophyletic.
- D) conform with Linnaeus' view of great ape phylogeny.

Which of these can be properly inferred from the phylogeny in Figure 26.5?

- A) Chimps and humans evolved from gorillas.
- B) The lesser apes are genetically more distinct from each other than the members of the great apes are from each other.
- C) Orangutans have existed for about 14 million years.
- D) Chimps and humans should share more homoplasies than should chimps and gorillas.
- E) Together, the lesser apes and great apes form a clade.