

Chapter 23 Systematics and the Phylogenetic Revolution

Student: _____

Fill in the Blank Questions

1. The biological specialty that deals with the grouping and naming of organisms is called taxonomy or _____.

2. The biological specialty that deals with the study of evolutionary relationships is called _____.

3. The behavior of parental care exhibited by dinosaurs is thought to be _____ to this behavior in crocodiles and birds because phylogeny shows these three groups share a common ancestor.

4. Saber teeth found in different groups of extinct carnivorous mammals are considered _____ structures as the fossil record shows saber teeth evolved independently among the groups.

5. Systematists often use molecular data in _____, the study of the order of evolutionary events within a group sharing derived characters.

6. A _____ group consists of the most recent common ancestor and all of its descendants.

7. A _____ group consists of the most recent common ancestor and some of its descendants.

8. A _____ group does not contain the most recent common ancestor.

9. The principle of _____ favors the hypothesis that requires the fewest assumptions.
- _____
10. A derived character that is shared by all members of a clade is called a _____ of that clade.
- _____

Multiple Choice Questions

11. Characteristics between the branch points of a cladogram that are shared by all organisms above the branch point and are not present in any below it are called
- A. homologous characters.
 - B. homoplastic characters.
 - C. ancestral characters.
 - D. derived characters.
 - E. novel characters.
12. Characteristics that have arisen in organisms as a result of common evolutionary descent are said to be _____ characteristics.
- A. homologous
 - B. homoplastic
 - C. adaptive
 - D. derived
 - E. ancestral
13. One day after a biology class four of your friends argue about the difference between phylogeny and systematics. Which friend is right?
- A. Friend A states that systematics and phylogenies are really the same, one is more recent than the other, but basically they are the same.
 - B. Friend B says that systematics is the same as cladistics and cladistics is reconstructing clades, which ultimately lead to the development of phylogenies.
 - C. Friend C argues that systematics is the actual collecting and cataloguing of specimens into museums that can be used later by scientists to construct clades and phylogenies.
 - D. Friend D says that the way she remembers is that systematics is the reconstruction and study of phylogenies.

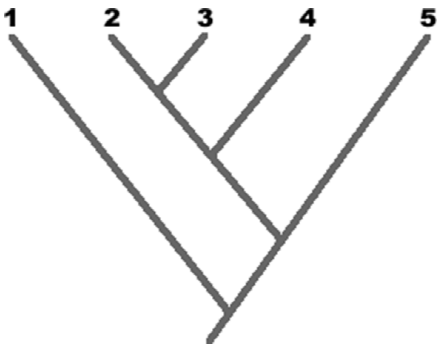
14. The evolutionary sequence in the development of a complex character can be best analyzed through
- homoplasies.
 - phylogenetics.
 - taxonomy.
 - classification.
 - synapomorphies.
15. A phylogenetically based taxonomy is important not only in creating a logical way to name organisms, but also in learning about _____ of organisms using information in related species.
- physiology
 - behavior
 - development
 - physiology, behavior, and development
16. Which of the following statements is accurate about the chart of morphological data? The "1" in the box means the trait is present and the "0" indicates that the trait is absent.

ORGANISM	Jaws	Lungs	TRAITS			
			Amniotic Membrane	Hair	No tail	Bipedal
Lamprey	0	0	0	0	0	0
Shark	1	0	0	0	0	0
Salamander	1	1	0	0	0	0
Lizard	1	1	1	0	0	0
Tiger	1	1	1	1	0	0
Gorilla	1	1	1	1	1	0
Human	1	1	1	1	1	1

- All organisms in this chart share all of the derived characteristics.
- Only the gorilla and humans share all of the derived characteristics.
- The lamprey is the only outgroup since it shares none of the derived characteristics.
- The salamander and the tiger are outgroups because they only share two of the derived characteristics (jaws and lungs).
- The shark is an outgroup since it only has one of the derived characteristics (jaws).

17. The study and reconstruction of evolutionary relationships is

- A. phylogeny.
- B. systematics.
- C. taxonomy.
- D. taxidermy.
- E. cladistics.



18. Based on the phylogeny shown, we can conclude that species 2 is most closely related to species

- A. 1.
- B. 3.
- C. 4.
- D. 5.
- E. 1 or 3 (can't tell).

19. Based on the phylogeny shown, the outgroup would be species

- A. 1.
- B. 2.
- C. 3.
- D. 4.
- E. 5.

20. Based on the phylogeny shown, the group of species including (2-5) can best be described as a(n)

- A. clade.
- B. paraphyletic group.
- C. polyphyletic group.
- D. cladogram.
- E. evolutionary tree.

21. Derived character states shared by clade members are called
- A. ancestral traits.
 - B. homoplasies.
 - C. synapomorphies.
 - D. plesiomorphies.
 - E. symplesiomorphies.
22. The following steps are used to construct a cladogram that best reflects the evolutionary relationships of a group of species. If you arranged these steps from first to last, which step would be last?
- A. polarize the characters
 - B. establish the character states
 - C. gather data on characters to be used
 - D. apply the principle of parsimony
 - E. select an outgroup
23. Character states shared by the ancestor or outgroup of a clade are called
- A. derived traits.
 - B. homoplasies.
 - C. synapomorphies.
 - D. plesiomorphies.
 - E. symplesiomorphies.
24. Homoplasies can result from
- A. convergent evolution.
 - B. evolutionary reversals.
 - C. both convergent evolution and evolutionary reversals.
 - D. divergent evolution.
 - E. adaptive radiations.
25. Birds, snakes, lizards, turtles, and crocodiles are all thought to share a common ancestor and several homologous traits. Assuming that this is true, these groups of animals would best represent
- A. a polyphyletic group.
 - B. a monophyletic group.
 - C. homoplastic convergence.
 - D. several clades.
 - E. a species cluster.

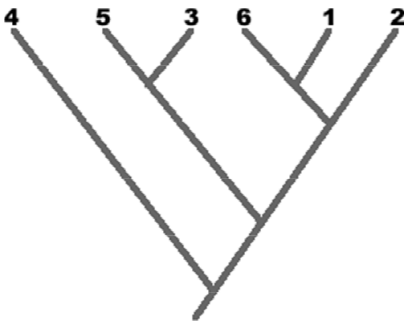
26. Select a false statement describing why cladistics may not always be the best method for reconstructing phylogenies based on data from the DNA genome.
- A. The rate of evolution of the DNA genome is rapid.
 - B. The assumptions of the principle of parsimony are not always met.
 - C. Homoplasy often dominates the data sets.
 - D. The number of character states for DNA is large.
 - E. Much of the DNA does not code for proteins.
27. Assume that evidence suggests that the crocodiles are more closely related to the birds than the turtles and snakes. If so, then including the crocodiles but not the birds in the class reptilia, would make the class reptilia
- A. a monophyletic taxon.
 - B. a paraphyletic taxon.
 - C. a polyphyletic taxon.
 - D. parsimonious.
 - E. not homologous.

Species	TRAIT				
	A	B	C	D	E
1	1	1	0	1	1
2	1	1	0	1	0
3	1	1	1	0	0
4	1	0	0	0	0
5	1	1	1	0	0
6	1	1	0	1	1

28. The table shows the distribution of traits (A-E) in six extant species (1-6). A "0" indicates the ancestral condition; a "1" is the derived condition. Construct a cladogram from these data. Based on this cladogram, which trait is least informative of phylogenetic relationships within the group?
- A. A
 - B. B
 - C. C
 - D. D
 - E. E

29. The table shows the distribution of traits (A-E) in six extant species (1-6). A "0" indicates the ancestral condition; a "1" is the derived condition. Construct a cladogram from these data. Based on this cladogram, which species could be considered the outgroup?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5



30. Consider the cladogram associated with the question. Which pair of species shares the greatest number of derived characters (synapomorphies)?
- A. 4 and 2
 - B. 5 and 3
 - C. 6 and 1
 - D. 6 and 2
 - E. 5 and 2
31. Consider the cladogram associated with the question. Based on this cladogram, which species has the greatest number of ancestral character states?
- A. 1
 - B. 2
 - C. 3
 - D. 4
 - E. 5

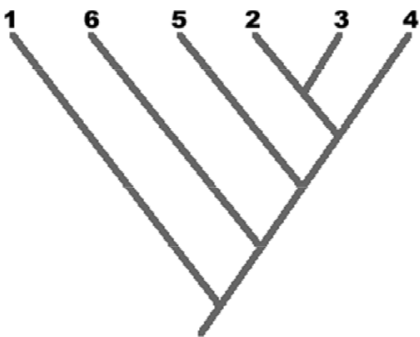
Species	TRAIT				
	A	B	C	D	E
1	1	0	0	0	0
2	1	1	1	1	1
3	1	1	1	1	1
4	1	1	1	1	0
5	1	1	1	0	0
6	1	1	0	0	0

32. The table shows the distribution of traits (A-E) in six extant species (1-6). A "0" indicates the ancestral condition; a "1" is the derived condition. Construct a cladogram from these data. For the species shown, which trait is represented by the greatest number of plesiomorphies?

- A. A
- B. B
- C. C
- D. D
- E. E

33. The table shows the distribution of traits (A-E) in six extant species (1-6). A "0" indicates the ancestral condition; a "1" is the derived condition. Construct a cladogram from these data. Based on this cladogram, which pair of species diverged most recently?

- A. 1 and 4
- B. 2 and 3
- C. 2 and 4
- D. 6 and 4
- E. 6 and 5



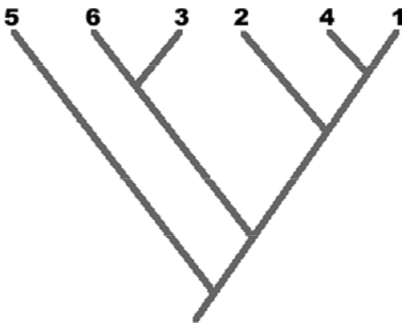
34. Consider the cladogram associated with the question. Which pair of species shares the greatest number of derived characters (synapomorphies)?
- A. 1 and 4
 - B. 2 and 3
 - C. 2 and 4
 - D. 6 and 4
 - E. 6 and 5
35. Consider the cladogram associated with the question. If we designate species 1 as the outgroup, which species has the greatest number of ancestral character states?
- A. 2
 - B. 3
 - C. 4
 - D. 5
 - E. 6

Species	TRAIT				
	A	B	C	D	E
1	0	1	1	1	1
2	0	0	1	1	1
3	1	0	1	0	1
4	0	1	1	1	1
5	0	0	0	0	1
6	1	0	1	0	1

36. The table shows the distribution of traits (A-E) in six extant species (1-6). A "0" indicates the ancestral condition; a "1" is the derived condition. Construct a cladogram from these data. Which trait is least informative of phylogenetic relationships within the group?
- A. A
 - B. B
 - C. C
 - D. D
 - E. E

37. The table shows the distribution of traits (A-E) in six extant species (1-6). A "0" indicates the ancestral condition; a "1" is the derived condition. Construct a cladogram from these data. If we designate species 5 as the outgroup, which species has the greatest number of ancestral character states?

- A. 1
- B. 1 and 4
- C. 2
- D. 3
- E. 6



38. Consider the cladogram associated with the question. Which pair of species shares the greatest number of derived characters (synapomorphies)?
- A. 1 and 4
 - B. 6 and 3
 - C. 6 and 1
 - D. 5 and 6
 - E. 5 and 1
39. Consider the cladogram associated with the question. Based on this cladogram, which species has the greatest number of ancestral character states?
- A. 1
 - B. 2
 - C. 3
 - D. 4
 - E. 5

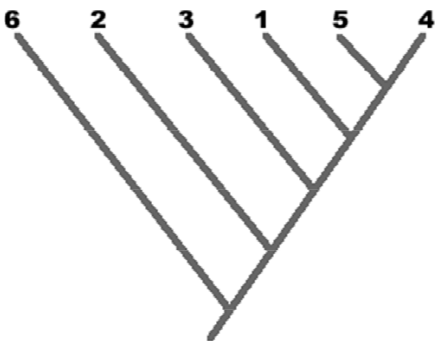
Species	TRAIT				
	A	B	C	D	E
1	1	1	0	1	1
2	1	0	0	1	0
3	1	0	0	1	1
4	1	1	1	1	1
5	1	1	1	1	1
6	0	0	0	1	0

40. The table shows the distribution of traits (A-E) in six extant species (1-6). A "0" indicates the ancestral condition; a "1" is the derived condition. Construct a cladogram from these data. Which pair of species shares the greatest number of derived characters (synapomorphies)?

- A. 1 and 4
- B. 3 and 4
- C. 4 and 5
- D. 2 and 4
- E. 2 and 5

41. The table shows the distribution of traits (A-E) in six extant species (1-6). A "0" indicates the ancestral condition; a "1" is the derived condition. Construct a cladogram from these data. Based on this cladogram, which species has the greatest number of ancestral character states?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 6



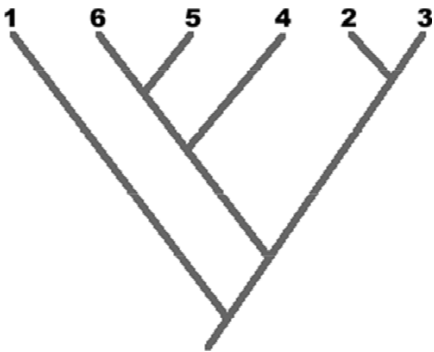
42. Consider the cladogram associated with the question. Which pair of species shares the greatest number of derived characters (synapomorphies)?
- A. 1 and 4
 - B. 3 and 4
 - C. 4 and 5
 - D. 2 and 4
 - E. 2 and 5
43. Consider the cladogram associated with the question. Based on this cladogram, which species has the greatest number of ancestral character states?
- A. 1
 - B. 2
 - C. 3
 - D. 4
 - E. 6

Species	TRAIT				
	A	B	C	D	E
1	0	0	1	0	0
2	1	0	1	0	1
3	1	0	1	0	1
4	1	1	1	0	0
5	1	1	1	1	0
6	1	1	1	1	0

44. The table shows the distribution of traits (A-E) in six extant species (1-6). A "0" indicates the ancestral condition; a "1" is the derived condition. Construct a cladogram from these data. Which pair of species shares the greatest number of derived characters (synapomorphies)?
- A. 1 and 3
 - B. 6 and 4
 - C. 6 and 5
 - D. 2 and 3
 - E. 6 and 3

45. The table shows the distribution of traits (A-E) in six extant species (1-6). A "0" indicates the ancestral condition; a "1" is the derived condition. Construct a cladogram from these data. Which pair of species shares the fewest number of derived characters (synapomorphies)?

- A. 1 and 6
- B. 1 and 4
- C. 4 and 6
- D. 2 and 3
- E. 6 and 3



46. Consider the cladogram associated with the question. Which pair of species shares the greatest number of derived characters (synapomorphies)?
- A. 1 and 3
 - B. 6 and 4
 - C. 6 and 5
 - D. 2 and 3
 - E. 6 and 3
47. Consider the cladogram associated with the question. Based on this cladogram, which species has the greatest number of ancestral character states?
- A. 1 and 6
 - B. 1 and 4
 - C. 4 and 6
 - D. 2 and 3
 - E. 6 and 3

48. A group is considered monophyletic if
- A. all members of the group share a common ancestor that is included in the group.
 - B. not all descendants of the common ancestor are included.
 - C. all members share homoplastic traits.
 - D. the group does not contain the most recent common ancestor.
 - E. it is the most parsimonious grouping.
49. A group is considered paraphyletic if
- A. all members of the group share a common ancestor.
 - B. not all descendants of the common ancestor are included.
 - C. the common ancestor of the group is not included in the group.
 - D. the group does not contain the most recent common ancestor.
 - E. it is the most parsimonious grouping.
50. A group is considered polyphyletic if
- A. all members of the group share a common ancestor.
 - B. not all descendants of the common ancestor are included.
 - C. all members share homoplastic traits.
 - D. the group does not contain the most recent common ancestor.
 - E. it is the most parsimonious grouping.
51. Which one of the following statements about molecular clocks is false?
- A. All molecular clocks tick at the same rate.
 - B. Molecular clocks can be calibrated using fossil evidence.
 - C. The rate of a molecular clock for a given DNA character might vary depending on how constrained the character is by natural selection.
 - D. Ultimately, all molecular clocks depend on the rate of DNA mutation and DNA repair mechanisms.
52. The phylogenetic species concept (PSC) declares that a group is a species if it
- A. is reproductively isolated from other species.
 - B. has evolved one or more of its own derived characters.
 - C. looks different than other species.
 - D. is allopatric.
 - E. has no synapomorphies.

53. Parental care in dinosaurs, crocodiles, and birds is an example of
- A. homoplasy caused by convergence.
 - B. homoplasy caused by common descent.
 - C. homoplasy caused by evolutionary reversal.
 - D. homology caused by convergence.
 - E. homology caused by common descent.
54. The evolution of saber teeth in a number of groups of extinct carnivorous mammals is an example of
- A. homoplasy caused by convergence.
 - B. homoplasy caused by common descent.
 - C. homoplasy caused by evolutionary reversal.
 - D. homology caused by convergence.
 - E. homology caused by common descent.
55. The evolution of plant-conducting tubes (sieve tubes) in land plants and brown algae is an example of
- A. homoplasy caused by convergence.
 - B. homoplasy caused by common descent.
 - C. homoplasy caused by evolutionary reversal.
 - D. homology caused by convergence.
 - E. homology caused by common descent.
56. Which one of the following statements about the evolution of complex characters, such as powered flight, is false?
- A. Phylogenetic analysis using cladistics can help reveal the sequence leading to the evolution of a complex character.
 - B. Usually a single mutation in a key gene controlling development leads to the simultaneous appearance of the complex character.
 - C. Often the initial stage in the evolution of a complex character was an adaptation to some unrelated selection pressure.
 - D. All of the intermediate stages in the evolution of a complex character contributed to the fitness of the species.
 - E. Long periods of time are required for the evolution of complex characters.

57. Which one of the following statements about the evolution of larval dispersal in marine snails is false?
- A. The observation that non-dispersing snails are more sedentary may lead to greater instances of allopatric speciation.
 - B. Clades of non-dispersing snails are less species rich than dispersing snails.
 - C. Loss of structures in the transition from dispersing to non-dispersing may inhibit evolutionary reversal.
 - D. Possession of dispersing larvae is the ancestral state in snails.
 - E. Cladistics shows that there are more instances of the transition from dispersing to non-dispersing larvae than the reverse.
58. Which one of the following statements about the evolution of direct development in limpets is false?
- A. Loss of structures in the transition from presence of a larval stage to direct development may inhibit evolutionary reversal.
 - B. Cladistic analysis suggests that the independent evolution of direct development occurred six times in limpets.
 - C. Cladistic analysis suggests that re-evolution of the larval stage in limpets that have lost it would be the most parsimonious conclusion.
 - D. This study shows that evolution always proceeds parsimoniously.
 - E. Possession of a larval stage is the ancestral state in limpets.
59. Which one of the following statements about the evolution of species richness in herbivorous beetles is false?
- A. The cladogram of the major group of herbivorous beetles, shows that clades specialized for feeding on conifers are located deeper in the cladogram than those specialized for feeding on angiosperms.
 - B. The cladogram of the major group of herbivorous beetles, shows that those clades specialized for feeding on angiosperms are more recent than those specialized for feeding on conifers.
 - C. Many beetle clades have been very conservative in what plants they will consume.
 - D. The great species richness of the angiosperms may have caused the great species richness of herbivorous beetles.
 - E. The multiple, independent evolution of herbivory in beetles is closely linked to their great species richness.
60. Which one of the following statements about the evolution of HIV is false?
- A. All strains of HIV are included within clades of SIV strains.
 - B. Each strain of HIV is more closely related to a strain of SIV than to other HIV strains.
 - C. Humans acquired different subtypes of HIV from different primate hosts.
 - D. AIDS appeared first in Africa, probably prior to 1940.
 - E. Because of the low mutation rate of the HIV virus, it is possible to use phylogenetics to determine the source of infection for specific individuals.

Chapter 23 Systematics and the Phylogenetic Revolution **Key**

- 1.classification
- 2.systematics
- 3.homologous
- 4.homoplastic
- 5.cladistics
- 6.monophyletic
- 7.paraphyletic
- 8.polyphyletic
- 9.parsimony
- 10.synapomorphy
- 11.D
- 12.E
- 13.D
- 14.E
- 15.D
- 16.C
- 17.B
- 18.B
- 19.A
- 20.A
- 21.C
- 22.D
- 23.E
- 24.C
- 25.B
- 26.D

27.B

28.A

29.D

30.C

31.D

32.A

33.B

34.B

35.E

36.E

37.B

38.A

39.E

40.C

41.E

42.C

43.E

44.C

45.A

46.C

47.A

48.A

49.B

50.D

51.A

52.B

53.E

54.A

55.A

56.B

57.B

58.D

59.E

60.E