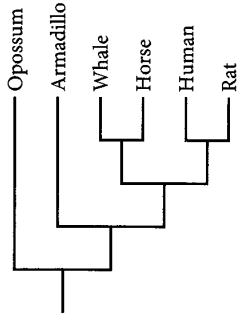
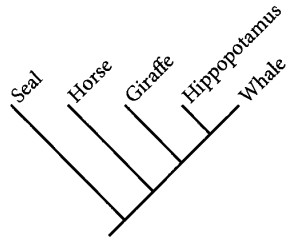
CHAPTER 5 QUIZ

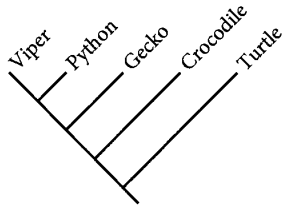
1. Given the tree, which is a correct statement of relationships?
   a. An armadillo is more closely related to a human than to an opossum
   b. An armadillo is more closely related to an opossum than to a human
   c. An armadillo is equally closely related to an opossum and a human
   d. A whale is more closely related to an armadillo than to a human
   e. A whale is equally related to an armadillo and an opossum



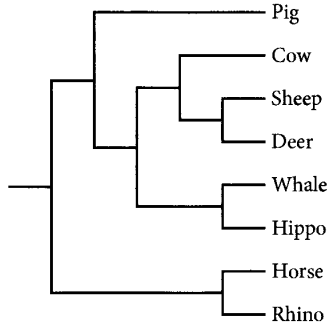
2. By reference to the tree, which of the following is an accurate statement of relationships?
   a. A seal is more closely related to a horse than to a whale
   b. A seal is more closely related to a whale than to a horse
   c. A seal is equally related to a horse and a whale
   d. A seal is related to a whale, but is not related to a horse
   e. A seal is related to neither a whale nor a horse



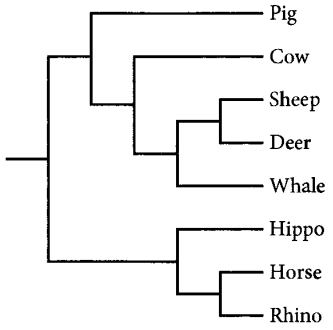
3. Considering the tree, why is a gecko more closely related to a viper than to a crocodile?
   a. Because the gecko and the viper are separated by only two nodes
   b. Because the common ancestor of the gecko and the viper lived before (in the more distant past than) the common ancestor of the gecko and the crocodile
   c. Because the gecko and the viper have a more recent common ancestor than the gecko and the crocodile
   d. Because the gecko and the crocodile have a more recent common ancestor than the gecko and the viper
   e. Because the gecko and the viper are more similar to one another than either is to the crocodile



4. Given the following facts, which of the four trees is correct?
   - A whale is more closely related to a deer than to a pig.
   - A cow is more closely related to a pig than to a horse.
   - A hippo is more closely related to a sheep than to a rhino.



a



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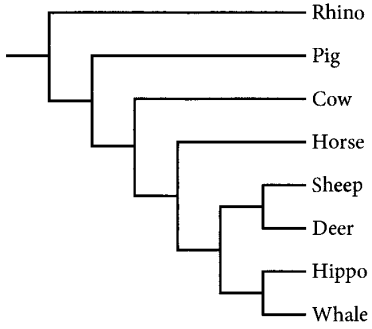

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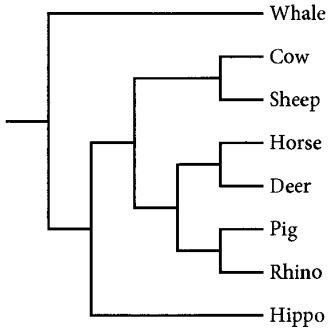


d

5. What is a basic difference between a phylum and a class?
   a. A phylum contains more diversity than a class
   b. A phylum includes more species than a class
   c. A phylum can include one or more classes, but a class cannot contain a phylum
   d. A phylum contains ancestral organisms whereas as class contains advanced organisms

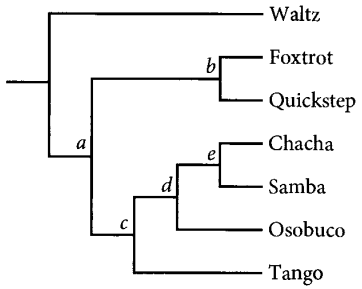
6. The insect family, Curculionidae (the weevils), contains about 40,000 living species, whereas the plant order Amborellales contains just one. Which of the following (if any) can be assumed?
   a. Curculionidae are within the Amborellales
   b. Amborellales are older than Curculionidae
   c. Amborellales is misclassified—the clade should be treated as a genus
   d. Two of the above
   e. None of the above

7. The Tetrapods are a group of vertebrates that includes amphibians, reptiles, and mammals. The last common ancestor of this group had four limbs, hence the name (tetra = four; poda = foot). Is a snake, a reptile that lacks limbs, a member of Tetrapoda, and why/why not?
   a. Yes, because its ancestors had four fins
   b. Yes, because membership is defined by common ancestry
   c. No, because Tetrapoda is *defined* as the group of four limbed animals
   d. No, because snakes are more closely related to non-tetrapods than to tetrapods
   e. It would depend upon whether snakes have limbs as embryos

8. Which of the following is a difference between monophyletic and paraphyletic groups?
   a. Members of monophyletic groups, but not paraphyletic groups, trace to a single ancestor
   b. Members of monophyletic groups, but not paraphyletic groups, can be identified based on homologous traits
   c. Monophyletic groups have shared ancestral characters; paraphyletic groups have shared derived characters
   d. Unlike paraphyletic groups, some members of monophyletic groups are more closely related to species outside the group than to other members of the group.
   e. Unlike paraphyletic groups, all members of a monophyletic group share the same degree of relationship with any species outside the group

9. Which clade corresponds to the node-based definition based on three internal specifiers: Quickstep, Samba, and Foxtrot?

10. Which clade corresponds to the branch-based definition based on the internal specifier Foxtrot and the external specifier Samba?



11. The table shows a classification of the land plants in indented form. The terminal taxa (tips) are not in bold font. The remaining taxa (in bold) correspond to clades. Traits that characterize certain clades are listed on the right. Draw a tree that corresponds to this information with clades labeled and traits marked on the branches on which they evolved.

Taxa	Traits
Embryophyta	Embryo, invasion of land
Liverwort	
Stomatophyta	Stomates
Moss	
Tracheophyta	Vascular system, branching
Clubmoss	Microphylls
Euphyllophyta	-
Moniliformopses	Moniliform spore
Fern	
Horsetail	
Spermatophyta	Seeds
Angiospermae	Flowers, fruit
Grass	
Eudicot	Three-furrowed pollen
Rose	
Pondweed	
Gymnospermae	-
Pine	
Cycad	

12. Convert the tree you created in question 11 into Venn diagram format.

13. It is generally held that a chimpanzee is more similar to a gorilla than it is to a human. However, molecular phylogenetic studies have convincingly shown that a chimpanzee is more closely related to a human than to a gorilla. How can we reconcile these two facts?

14. Traditionally, the "dinosaurs" are considered to have gone extinct at the end of the Cretaceous. Some "dinosaur" groups, for example *Tyrannosaurus,* are more closely related to birds than they are to some other "dinosaurs," for example *Brachiosaurus*. What arguments could be used to suggest that birds are members of Dinosauria and, hence, that dinosaurs are not extinct?

15. Why have some scientists attempted to develop phylogenetic nomenclature, as illustrated by the PhyloCode?

CHAPTER SIX

Gene Trees and Species Trees

The lines of organismal descent that form the tree of life serve as conduits for the passage of genetic material from generation to generation. An ability to visualize the passage of genes through lines of descent is needed to fully understand how traits are transmitted down evolutionary lineages. Furthermore, with gene sequence data emerging as the main tool for reconstructing phylogenetic relationships, it is important to understand the structure of gene histories and how they relate to the histories of populations and species.

This chapter explores the complexities that arise when we consider the ways that genes may be transmitted from generation to generation. This analysis will force us to abandon the simplifying assumption made so far in this book: that there is one true tree relating any given set of tips. As you will see, phenomena such as incomplete lineage sorting, introgression, lateral gene transfer, and gene duplication can result in individual genes tracking trees that differ from the history of the population. These phenomena can cause ***genealogical discordance***, wherein different genes sampled from the same set of tips have different trees. While these phenomena certainly make the interpretation of phylogenetic results more challenging, they also expand the value of phylogenetic data. By looking simultaneously at multiple gene trees, we can gain insights into the evolutionary mechanisms that have acted in the past.

We begin by clarifying the shape of gene trees as they relate to organismal pedigrees and population trees. We move on to examine the effects of gene duplication, and how gene trees can be used to elucidate the history of gene duplication and extinction. Then we consider cases in which population histories are not treelike (due to introgression, hybrid speciation, or lateral gene transfer). This last topic leads naturally into the controversial issue of how the concept of "species" fits into phylogenetic theory.