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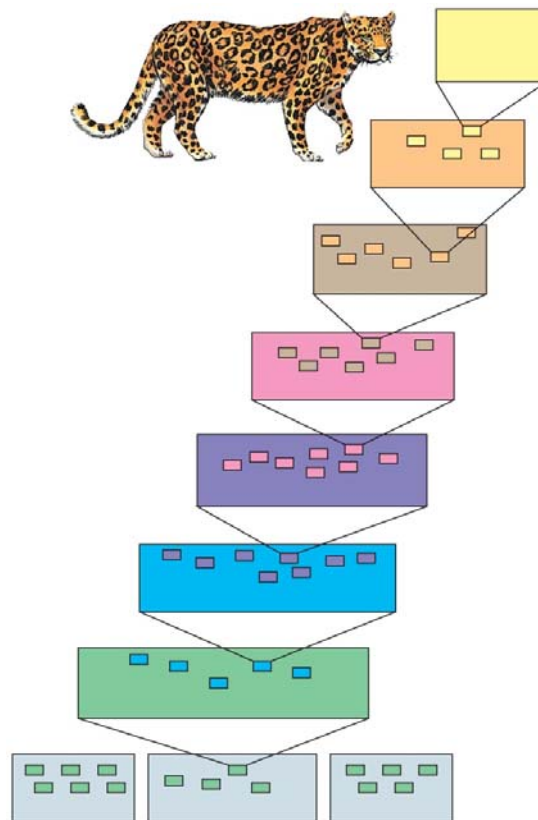
Chapter 26: Phylogeny and the Tree of Life

Overview

1. What is *systematics*? How is it used to develop *phylogenetic trees*?

Concept 26.1 Phylogenies show evolutionary relationships

2. What is *taxonomy*?
3. Every organism on Earth may be referred to by a unique *binomial*, or a two-part name. These are in Latin, or latinized. What is your binomial? What does it mean?
4. What are the two components of every binomial?
5. Taxonomy uses hierarchical categories that nest within each other, like Russian dolls. The figure below shows the categories, each called a *taxon*. Label each taxonomic category, in the boxes, and then give the one that applies exclusively to this panther to the side of each box.



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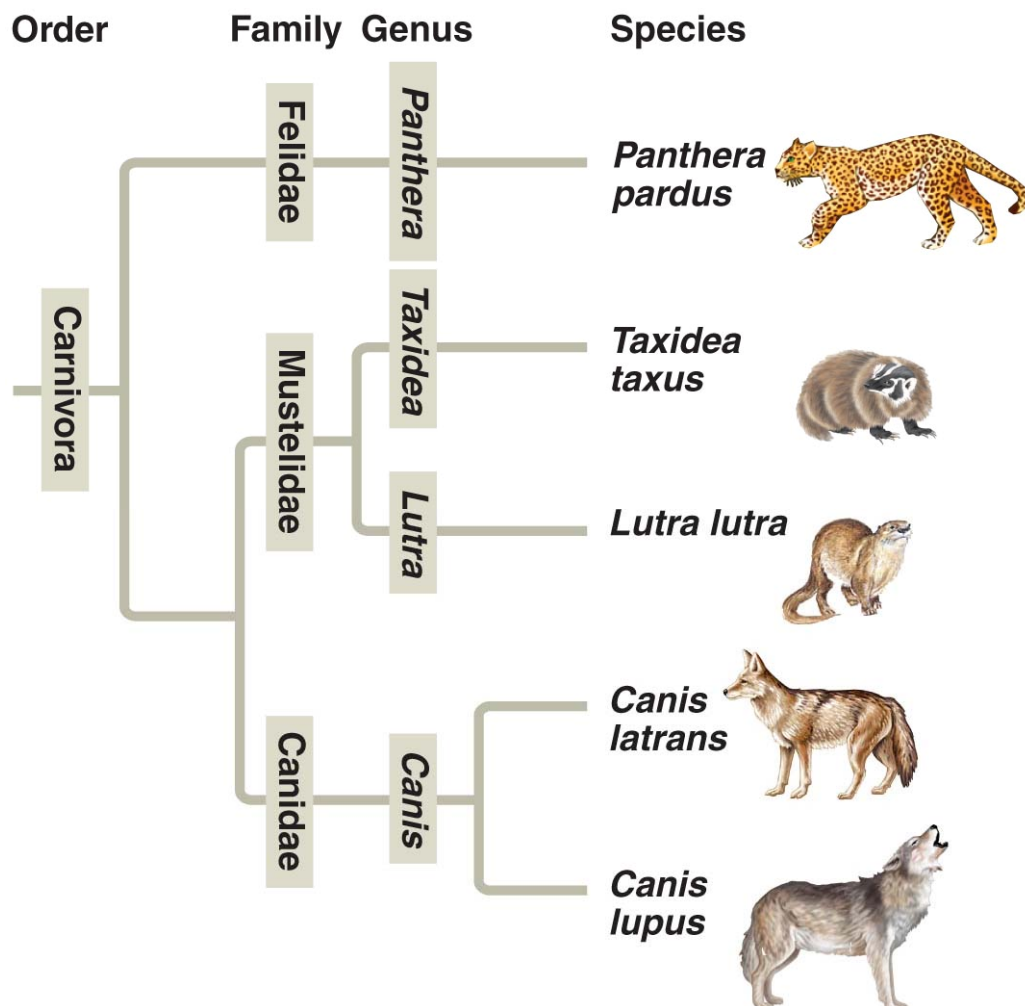
You will notice that the most general category, *domain*, the one that encompasses the most organisms, is shown at the bottom of the figure. As you move up in the figure, the organisms show greater and greater degrees of relatedness. You are expected to memorize these taxonomic categories in order! Most students use a mnemonic device linked to the first letter of each taxon to remember them. Make up your own, or try ours:

D K P C O F G S or Dear King Phillip Comes Over For Good Spaghetti

(You may choose to have King Philip come over for something else—whatever you can remember best!)

6. So, which are more closely related, organisms in the same phylum, or those in the same order?

7. Here is a *phylogenetic tree*. Recall that branch points represent common ancestors of the two lineages beyond the branch or *node*. Circle the common ancestor of badgers and otters, and label it as A. Circle the common ancestor of cats and dogs, and label it as B.



Concept 26.2 Phylogenies are inferred from morphological and molecular data

Let's look back at a Study Tip from Chapter 22. This idea is repeated in our current chapter.

Study Tip

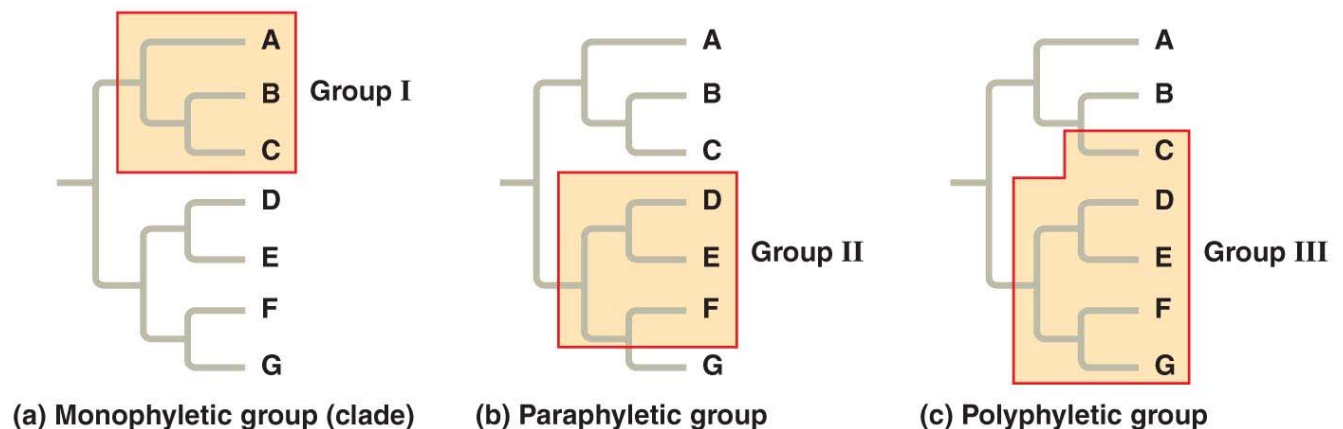
Homologous structures show evidence of relatedness. (whale fin, bat wing)

Analogous structures are similar solutions to similar problems but do *not* indicate close relatedness. (bird wing, butterfly wing)

8. *Molecular systematics* is a valuable tool used today to sort *homology* from *analogy*. What is it?

Concept 26.3 Shared characters are used to construct phylogenetic trees

9. Below are three *cladograms*. What is a *clade*? Circle a clade that is not highlighted below.
10. Why is Group I *monophyletic*?
11. Explain why Group II is *paraphyletic*.
12. What is a *polyphyletic group*?



13. Clades are derived by using *shared derived characters*. What are these?

14. Explain why for mammals, hair is a shared derived character, but a backbone is not.

Concept 26.4 An organism's evolutionary history is documented in its genome

Let's summarize some important information from this section. The rate of evolution of DNA sequences varies from one part of the genome to another; therefore, comparing different sequences helps us to investigate relationships between groups of organisms that diverged a long time ago. For example, DNA that codes for *ribosomal RNA (rRNA)* changes relatively slowly and is useful for investigating relationships between taxa that diverged hundreds of millions of years ago. DNA that codes for *mitochondrial DNA (mtDNA)* evolves rapidly and can be used to explore recent evolutionary events.

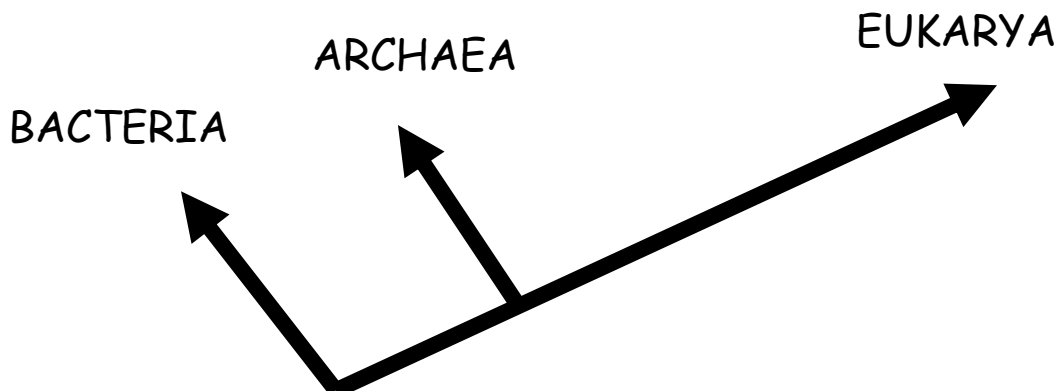
15. Which method reveals that fungi are more closely related to animals than to green plants?
16. Which method reveals that the Pima of Arizona and Yanomami of Venezuela are descendants of the same Native Americans that crossed the Bering Land Bridge 13,000 years ago?

Concept 26.5 Molecular clocks help track evolutionary time

17. What are *molecular clocks*?
18. If we use a *molecular clock*, approximately when did HIV emerge?

Concept 26.6 New information continues to revise our understanding of the tree of life

Taxonomy is in flux! When your authors were in high school, we were taught there were two kingdoms: plants and animals. Then in our college courses, we were introduced to five kingdoms: Monera, Protista, Plantae, Fungi, and Animalia. Now biologists have adopted a **three-domain system**, which consists of the domains Bacteria, Archaea, and Eukarya. This system arose from the finding that there are two distinct lineages of prokaryotes.



19. On the figure above, place an arrow at the point showing the common ancestor of all three domains.
20. What two domains include all prokaryotes? Which two domains are most closely related?
21. Which kingdom is made obsolete by the three-domain system? Why?
22. Which kingdom crumbled because it is polyphyletic?

Testing Your Knowledge: Self-Quiz Answers

Now you should be ready to test your knowledge. Place your answers here:

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____