AP Biology **Name:** **P:**

Chapter 20 Reading Guide: Phylogeny

How to use this reading guide: Look over the entire reading guide—read each question to prepare yourself for reading the chapter. Read the chapter carefully and thoroughly. Make sure to look at all of the figures and pictures and read their captions. Then…answer the questions posed below.

Investigating the Tree of Life

1. What is phylogeny?
    a. What do scientists use to study phylogeny?
    b. How is systematics related to this study?

Phylogenetic systematics connects classification with evolutionary history

1. Who was Carolus Linnaeus? What did he do? What did he publish?

2. Taxonomy is the ordered division of organisms into categories based on a set of characteristics used to assess similarities and differences.
    a. Describe "binomial nomenclature"

    b. What is "hierarchical classification?"
        i. Classify human beings!!!

3. What does a phylogenetic tree depict? How does it link classification with phylogeny?

4. What is a "dichotomy"? What do they represent? How are they used to construct phylogenetic trees?

Phylogenies are based on common ancestries inferred from fossil, morphological, and molecular evidence

5. How do morphological and molecular homologies contribute to phylogenies?

6. Let's review (a little…)-what is convergent evolution? What does it produce?
    a. Why is this a problem when trying to construct phylogenies? Use the mole example.

7. How do we distinguish between homologies and analogies? In general, is there a "rule" you can use to guide sorting process?

8. What challenges are inherent in comparing the nucleic acid sequences of two or more species?

    a. Study figure 20.8…How are computers assisting in matching up related sequences?

    b. How do scientists distinguish between molecular homologies and molecular analogies?

CONCEPT CHECK!!! Okay, let's try 'em…

9. Suggest whether each of the following pairs of structures more likely represents analogy or homology and explain your reasoning.
    a. A porcupines's quills and a cactus's spine

    b. a cat's paw and a human's hand

c. an owl's wing and a hornet's wing.

10. Which of the following are more likely to be closely related: two species with similar appearances but very divergent gene sequences, or two species with very different appearances but nearly identical genes? Explain.

Phylogenetic systematics informs the construction of phylogenetic trees cased on shared characteristics

11. How are clades nested within other clades?
    a. Compare monophyletic, paraphyletic, and polyphyletic groupings. What does each indicate about evolutionary history and relatedness.

12. Phylogenetic trees are based on shared characteristics. These relationships are shown in diagrams called cladograms. Study Figure 20.11 (on p. 388). Draw this cladogram and use it to describe how a cladogram is constructed. In your description include the terms: clade, shared primitive character, shared derived character, outgroup, and ingroup.

13. How do scientists relate time to phylogenies?
    b. What information can be conveyed with branch length in cladograms?

14. Read and STUDY Figure 20.14. How How is the Principle of Maximum Parsimony used to develop phylogenetic trees?

15. Remember that phylogenies represent hypotheses!!! These can be tested with evidence (fossils, embryology etc…) and while parsimony will often likely lead to a supported phylogeny (hypothesis), sometimes parsimony can be "confounded" by distinguishing between analogy and homology.
    c. Explain the parsimony vs. analogy/homology pitfall in relation to the four-chambered heart of birds and mammals.

Molecular clocks help track evolutionary time

16. A molecular clock is a yardstick for measuring the absolute time of evolutionary change. On what are molecular clocks based? What assumption underlies molecular clocks?

    d. How are molecular clocks calibrated?

    e. How does the "neutral theory" play into the idea of molecular clocks?

    f. What are some of the difficulties with molecular clocks?

Much of an organism's evolutionary history is documented in its genome

17. How did the study of entire genomes of organisms change the classification of all known species on Earth? What is the role of horizontal gene transfer?

18. Why might Fig. 20.21 be a better representation of the "Universal Tree of Life" than Figure 20.21?