Name: _____ **Date:** _____

Answer Key: Systematic Secrets: Sorting Species for Sophomores

Phylogenetic analysis, horizontal gene transfer, and molecular clocks — essential frameworks for evaluating transitionary evolutionary relationships.

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1. A newly discovered unicellular organism lacks a nucleus and possesses membrane lipids with branched hydrocarbons linked to glycerol by ether bonds. In which domain should this organism be classified?

Answer: B) Domain Archaea

Archaea are distinguished from Bacteria and Eukarya by their unique membrane chemistry, specifically ether-linked branched hydrocarbons, which allow them to maintain stability in extreme environments.

2. When constructing a cladogram, biologists focus on _____ characters, which are traits that evolved in the immediate ancestor of a group and were passed down to its descendants.

Answer: C) Derived

Shared derived characters (synapomorphies) are used in cladistics to distinguish specific evolutionary groups from their broader ancestral lineages.

3. Under the Phylogenetic Species Concept, a species is defined as the smallest group of individuals that share a common ancestor and form one branch on the tree of life.

Answer: A) True

Unlike the Biological Species Concept which relies on interbreeding, the Phylogenetic Species Concept uses evolutionary history and genetic clusters to define species boundaries.

4. Two organisms belong to the same Class but different Orders. Which of the following statements regarding their taxonomic relationship is most accurate?

Answer: B) They must belong to the same Phylum.

In the hierarchical system, if organisms share a lower (more specific) level like Class, they must share all higher (broader) levels, including Phylum, Kingdom, and Domain.

5. The process of _____ complicates the 'Tree of Life' model because it involves the movement of genes between different species, particularly among prokaryotes, rather than simple vertical inheritance.

Name: _____ **Date:** _____

Answer: C) Horizontal Gene Transfer

Horizontal Gene Transfer (HGT) allows organisms to acquire genetic material non-reproductively, challenging traditional vertical descent models in taxonomy.

6. Why is the use of 'Kingdom Protista' frequently debated and increasingly replaced by the concept of 'Supergroups' in modern systematic biology?

Answer: B) The kingdom is paraphyletic and lacks a single common ancestor.

Protista is a 'catch-all' group that is paraphyletic, meaning it contains some but not all descendants of a common ancestor, leading taxonomists to favor more precise evolutionary Supergroups.

7. Molecular clocks use the rate of mutations in highly conserved genes, such as those coding for ribosomal RNA, to estimate the time of divergence between two lineages.

Answer: A) True

By comparing the number of genetic differences in stable regions across species, scientists can calibrate a 'clock' to determine when two groups last shared a common ancestor.

8. Organisms like the Venus Flytrap are problematic for simple classification because they are _____; they can produce their own food via photosynthesis but also digest insects for nitrogen.

Answer: B) Mixotrophs

Mixotrophs combine different trophic levels (autotrophy and heterotrophy), showing that biological classification must account for metabolic flexibility.

9. A systematist discovers that a group of organisms has similar body shapes and hunting patterns but lacks a recent common ancestor. This similarity is likely due to:

Answer: B) Convergent Evolution

Convergent evolution produces analogous structures—traits that look and function similarly due to shared environmental pressures rather than shared ancestry.

10. In the Binomial Nomenclature system, the species epithet is always capitalized and can be used alone to identify a specific organism in a scientific paper.

Answer: B) False

Name: _____ Date: _____

The species epithet (second part of the name) is lowercase and must always be preceded by the Genus name to be valid; it is not a unique identifier on its own.