**Spring 2025-BIOL 2108 (85479)**

Student name

Student number

School

Date

Question to assess your comprehension of the lecture topics. These assessments will be assigned by Thursday and due on Monday by 11:59 pm. You are permitted to use outside resources but must provide proper reference/citation of those resources (citation format does not matter) for full credit. Answers will be checked for plagiarism and use of Al; any evidence of either will result in a zero for the assessment.

*Question 1 (Evolution of Populations):*

*Describe convergent evolution and evolutionary reversal. How can each lead to confusion when studying the evolutionary relationships among organisms*?

**Convergent Evolution.**

 Occurs when unrelated species independently evolve similar traits or characteristics due to analogous environmental pressures or ecological niches. For example, dolphins (mammals) and sharks (fish) both evolved streamlined bodies and fins for swimming, despite their distant evolutionary relationship. This similarity can lead to confusion when studying evolutionary relationships because it may create the illusion of a close evolutionary connection, even though the traits evolved independently (Freeman et al., 2017).

**Evolutionary Reversal.**

Refers to the reversion of a trait to an ancestral state. For instance, some snakes have lost their limbs over evolutionary time, but certain species, like pythons, retain vestigial limb structures. This can obscure the true evolutionary lineage, making it difficult to determine whether a trait is ancestral or derived (Campbell & Reece, 2008).

Both convergent evolution and evolutionary reversal can complicate the study of evolutionary relationships because they create misleading similarities or differences between species. These phenomena can result in incorrect assumptions about common ancestry or the direction of evolutionary change, making it challenging to reconstruct accurate phylogenetic trees.

*Question 2 (Phylogenies and the History of Life):*

*Please describe the definitions and differences of the biological species concept (bsc) and the phylogenetic species concept (psc). When would it be appropriate to use the bsc? The psc?*

**Biological Species Concept (BSC).**

The BSC defines a species as a group of organisms that can interbreed and produce fertile offspring in nature. This concept emphasizes reproductive isolation as the key criterion for defining species. For example, lions and tigers are considered separate species because their offspring (ligers) are typically sterile (Mayr, 1942).

**Phylogenetic Species Concept (PSC).**

The PSC defines a species as the smallest group of individuals that share a common ancestor and form a single branch on the tree of life. This concept focuses on genetic and evolutionary relationships rather than reproductive compatibility. For example, under the PSC, two populations of birds with distinct genetic markers but capable of interbreeding might still be classified as separate species (Cracraft, 1983).

**When to Use Each Concept:**

* The BSC is most appropriate when studying species that reproduce sexually and when reproductive isolation can be easily observed or tested. It is particularly useful in fields like ecology and behavioral biology.
* The PSC is more appropriate when studying asexual organisms, fossils, or cases where reproductive isolation is difficult to assess. It is commonly used in evolutionary biology and systematics, where genetic data is available to construct phylogenetic trees.

*Question 3 (Viruses);*

*What is a virus and what are three reasons we do not currently classify viruses as living organisms? Provide support for your answers.*

A virus is a microscopic infectious agent that consists of genetic material (DNA or RNA) enclosed in a protein coat. Viruses cannot reproduce on their own and must infect a host cell to replicate (Alberts et al., 2002).

Reasons Viruses Are Not Classified as Living Organisms:

1. Lack of Cellular Structure: Viruses do not have cells, which are the basic structural and functional units of all living organisms. They lack organelles, cytoplasm, and a cell membrane, which are essential for independent life (Freeman et al., 2017).
2. Inability to Reproduce Independently: Viruses cannot replicate without hijacking the cellular machinery of a host organism. Unlike living organisms, which can reproduce through processes like mitosis or meiosis, viruses rely entirely on host cells for replication (Campbell & Reece, 2008).
3. No Metabolic Activity: Viruses do not carry out metabolic processes such as energy production, nutrient uptake, or waste elimination. They remain inert outside of a host cell and only become active once they infect a host (Alberts et al., 2002).

**References**

Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2002). *Molecular biology of the cell* (4th ed.). Garland Science.

Campbell, N. A., & Reece, J. B. (2008). *Biology* (8th ed.). Pearson Benjamin Cummings.

Cracraft, J. (1983). Species concepts and speciation analysis. *Current Ornithology, 1*, 159-187.

Freeman, S., Quillin, K., Allison, L., Black, M., Podgorski, G., Taylor, E., & Carmichael, J. (2017). *Biological science* (6th ed.). Pearson.

Mayr, E. (1942). *Systematics and the origin of species*. Columbia University Press.