Possible Long Free-Response Questions

The first unit exam will consist of one of the following long free-response questions. This shall be worth 40% of your exam grade.

Prompt #1:

Biologists are interested in preserving the diversity of living organisms on the planet.

(a) **Explain** THREE of the following processes or phenomena, using an appropriate example for each.

- mutation
- adaptive radiation
- polyploidy
- population bottlenecks
- growth of the human population

(b) For each process or phenomenon you selected in (a), **discuss** its impact on the diversity of life on Earth.

Prompt #2:

Darwin is considered the “father of modern evolutionary biology.” Four of his contributions to the field of evolutionary biology are listed below.

- The nonconstancy of species
- Branching evolution, which implies the common descent of all species
- Occurrence of gradual changes in species
- Natural selection as the mechanism for evolution

(a) For EACH of the four contributions listed above, **discuss** one example of supporting evidence.

(b) Darwin’s ideas have been enhanced and modified as new knowledge and technologies have become available. **Discuss** how TWO of the following have modified biologists’ interpretation of Darwin’s original contributions.

- Hardy-Weinberg equilibrium
- Punctuated equilibrium
- Genetic engineering

Prompt #3:

Phylogeny reflects the evolutionary history of organisms.

(a) **Discuss** TWO mechanisms of speciation that lead to the development of separate species from a common ancestor.

(b) **Explain** THREE methods that have been used to investigate the phylogeny of organisms. **Describe** a strength or weakness of each method.

*(continued on the back)*
(c) The two phylogenetic trees below represent the relationship of whales to six other mammals. All of the organisms shown have a pulley-shaped astragalus bone in the ankle except for the whale.

- For each tree, **describe** a monophyletic group, the closest relative to the whale, and the point at which the pulley astragalus was lost or gained.
- Based on the principle of parsimony (the simplest explanation is the best) and the genomic information in the table shown, **identify** which tree is the best representation of the evolutionary relationship of these animals, and **justify** your answer.

**Prompt #4:**

Scientists recently proposed a reorganization of the phylogenetic system of classification to include the domain, a new taxonomic category higher (more inclusive) than the Kingdom category, as shown in the following diagram.

- **Describe** how this classification scheme presents different conclusions about the relationships among living organisms than those presented by the previous five-kingdom system of classification.
- **Describe** three kinds of evidence that were used to develop the taxonomic scheme above, and **explain** how this evidence was used. The evidence may be structural, physiological, molecular, and/or genetic.
- **Describe** four of the characteristics of the universal ancestor.
Prompt #5:

(a) **Describe** the differences between the terms in each of the following pairs.
   
   (1) Coelomate *versus* acoelomate body plan
   (2) Protostome *versus* deuterostome development
   (3) Radial *versus* bilateral symmetry

(b) **Explain** how each of these pair of features was important in constructing the phylogenetic tree shown below. Use specific examples from the tree in your discussion.