Evolution Discussion Questions

If you would like to shoot for a 5, be able to answer all questions in each section; a 4 answer 75% of the questions in each section; a 3 answer 50% of the questions in each section.

1.1. Introduction to Evolutionary Biology

1. Did Darwin develop his theory all by himself?
2. What were the major contributions of scientists that informed Darwin's theory of natural selection?
3. How is the idea of Uniformatarianism demonstrated in Darwin's work?
4. How are Lamarckian ideas of evolution different from Darwinian ideas?
5. What is the theory of natural selection?
    a. Why is variation present in all organisms?
    b. What is the "struggle for existence"? Why does it occur?
    c. What does it mean to be "fit", evolutionarily?
6. How does evolution support the idea of a very old Earth?
7. How does evolution support the idea of common ancestry among all living organisms?
8. Why do we tend to show evolutionary relationships in tree diagrams?
9. Why is the theory of evolution so controversial among certain groups of people?

1.2. Evolutionary Forces

1. How is the modern theory of evolution different from Darwin's conception?
2. Why is it appropriate to define evolution as "change in gene frequencies in a population over time?"
3. How does natural selection change gene frequencies?
4. How does natural selection affect a population?
5. What are some examples of how natural selection has affected populations?
6. How does genetic drift change gene frequencies?
7. How does genetic drift affect a population?
8. What are some examples of how genetic drift has affected populations?
9. How does gene flow change gene frequencies?
10. How does sexual selection change gene frequencies?
11. How does sexual selection affect a population?
12. What are some examples of how sexual selection has affected populations?
13. How can evolution affect the distribution of a particular variation in a

population?
14. What are similar among all modes of evolution?
15. What is different in each mode of evolution?
16. When can evolution not affect the distribution of a particular variation in a population?

1.3. Evidence of Evolution

1. How are we able to make scientific conclusions about events and processes that we are not able to directly witness?
2. How does the fossil record support evolutionary theory?
3. How does morphological analysis of organisms support evolutionary theory?
4. What are homologous structures?
5. What are analogous structures?
6. What are vestigial structures?
7. Why do embryos of different species posses morphological similarities?
8. How does molecular analysis of DNA and protein sequences support evolutionary theory?
9. What is the relationship between molecular similarity and evolutionary relatedness among species?
10. How does biogeography support evolutionary theory?
11. How does artificial selection support evolutionary theory?
12. How is artificial selection different from natural selection?
13. Why is is a misconception of evolutionary theory to thnk that the evolution of life demonstrates a progression towards increasing complexity, or a purpose, or that evolution would require an “intelligent designer”?

1.4. Measuring evolution

1. We can define evolution as “differential reproductive success”. What does this mean? Why is reproductive success not uniform?
2. Where do variations come from?
3. Why are sexually reproducing organisms more varried than asexually reproducing ones?
4. Explain each of the following terms:
    a. Gene
    b. Allele
    c. Dominant
    d. Recessive
    e. Homozygous
    f. Heterozygous
    g. Population

h. Gene Pool

5. If we define evolution as “change in allele frequencies in a population over time”, how does this lead to differential reproductive success?
6. How does each of the following lead to evolution in a population?
    a. Mutation
    b. Gene Flow
    c. Non-Random Mating
    d. Genetic Drift
    e. Natural Selection
7. What would a population need to look like in order for it to not evolve?
8. How does the Hardy-Weinberg Equation work?
9. Is any population actually in HW Equilibrium? Why is HW Equilibrium useful?
10. How do we solve HW problems?
11. What is the square root of .25? Why?
12. How can we use the HW equilibrium to investigate real-world instances of evolution?
13. What is the “heterozygote advantage”?

1.5. Classification

1. How were organisms originally classified?
2. What is the basis of the Linnaean Hierarchy?
3. What is the basis of Binomial Nomenclature?
4. How are organism’s scientific names written?
5. What are the major problems associated with traditional classification schemes?
6. How are organism’s classified now?
7. Why are modern modes of classification more accurate than traditional modes?
8. What is the relationship between DNA sequences and evolutionary relationships? Why does this relationship exist?
9. How is a cladogram constructed?
10. What is the rule of “maximum parsimony”? What is the rule of “maximum likelihood”? Why are these scientifically sound concepts to use when constructing a cladogram?
11. Is a cladogram always indicative of evolutionary relationships?
12. What characteristics are most useful for constructing an evolutionarily accurate cladogram?
13. What are the differences between monophyletic, paraphyletic, and polyphyletic groups in a phylogenetic tree?

14. Why are computers used to compare DNA sequences for homology?

1.6. Speciation

1. How do we define a species? Why is the biological species definition sometimes less than useful?
2. How does speciation happen allopatrically? How does it happen sympatrically?
3. Does isolation always lead to speciation?
4. What are the major prezygotic barriers that contribute to speciation? What are the major postzygotic barriers?
5. What are some of the major, researched, speciation examples?
6. What is the idea of gradualism? How does it compare to the idea of punctuated Equilibrium?

1.7. Origin of Life

1. How can we know anything about the history of life if we were not around to directly observe it?
2. What are the approximate dates of the following "milestones" of life's history:
    a. Creation of the earth
    b. Origin of life
    c. Origin of photosynthesis
    d. Evolution of eukaryotes/ endosymbiosis
    e. Origin of multicelularity
    f. Origin of plants
    g. Origin of land vertebrates
    h. Origin of dinosaurs
    i. Origin of mammals
    j. Origin of humans
3. Why has the diversity of life increased over time?
4. What patterns do we see in the history of life (mass extinctions/ adaptive radiations)?
5. How has the evolution of humans affected terrestrial life?
6. How have recent research into the genetics of development illustrated how diversity of organisms can increase?