BIOLOGY 432 **Name _____**
Midterm I - 30 April 2012

PART I. Multiple choice questions – (3 points each, 42 points total). Single best answer.

1. Over time even the most highly conserved gene sequence will fix mutations. Eventually, given sufficient time what will the probability of identical nucleotides be at any given position?

A. 25%
B. 50%
C. 75%
D. 100%
E. none of the above

2. Natural Selection is the driving force behind evolution. Which of the following is **NOT** a correct concept related to natural selection?

A. change in the trait distribution of populations
B. acts at the level of the individual
C. forward looking process
D. operates on existing traits or phenotypes
E. has no ultimate goal

3. Which of the following evolutionary forces occurs strictly by **chance**?

A. migration
B. speciation
C. adaptation
D. natural selection
E. genetic drift

4. Charles Darwin described the theory of evolution through the process of natural selection in his book, "The Origin of Species," but what he did not yet understand (and hopefully you do) was the underlying molecular **mechanism**?

A. extinction
B. adaptation
C. mutation
D. phylogeny
E. genetic drift

5. Consider the **maximum parsimony** method. Which of the following does NOT apply to this molecular phylogenetic approach?

A. Uses Ocham's Razor as fundamental assumption
B. Relies upon synapomorphies to minimize homoplasy
C. Estimates the probability of the data given the tree
D. Used character state data
E. Employs an exhaustive examination of all possible trees

6. In order to make the leap from abiotic chemicals to life, four major steps must be overcome, which of the following is NOT one of these steps?

A. Abiotic synthesis of monomers such as amino and nucleic acids
B. Polymerization of monomers into polymers such as proteins and DNA
C. Transference of heredity from one generation to the next
D. Development of the electron transport system
E. Formation of protobionts through the aggregation of a membrane

7. Paedomorphosis or the retention of juvenile features in the reproductive adult is considered a form of which of the following?

A. Heterotopy
B. Heterometry
C. Heterotypy
D. Heterochrony
E. Heteromorphy

8. The fossil record is great, but it has certain biases associated with it. Which of the following is NOT one of these biases?

A. Hard parts over soft parts (construction bias)
B. More rocks of recent age (temporal bias)
C. Simpler forms before complex forms (temporal bias)
D. More fossils formed in mountains over shallow marine regions (geographic bias)
E. Sedimentary over metamorphic rocks (construction bias)

9. What was the first Eukaryotic fossil to be discovered at around 2.1 billion years ago from the Empire iron mine located in the upper peninsula of Michigan?

A. Hallucigenia B. Archaeopteryx C. LUCA D. Grypania E. Stromatolites

10. When choosing different types of characters to use in phylogenetic inference, the best choices would NOT include which one of the following types of characters?

A. Independent
B. Heritable
C. Variable
D. Synapomorphies
E. Analogies

11. Of the following, which is NOT a lesson from the BIG TREE of life?

A. Indicates photosynthesis occurred near the earliest ancestor (LUCA)
B. Demonstrates that there are three domains regarding genetic diversity
C. Points to a single source for the origin of life (or at least a single bottleneck)
D. Indicates Bacteria and Archaea had a thermophilic origin (Hot Start)
E. Shows that each domain is evolving at different rates (not a constant clock)

12. Which following date is erroneous as described by the fossil record?

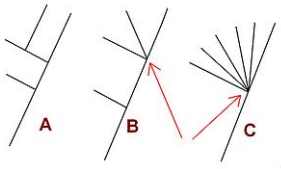
A. The end of the ammonites @ 65 Mya
B. The end of the trilobites @ 250 Mya
C. The first fossils of living organisms @ 6.5 Bya
D. The end of the Ediacara biota @ 550 Mya
E. The first Eucarya algae @ 2.1 Bya

13. One of the reoccurring patterns seen in the fossil record describing that multiple lineages evolve through similar stages refers to which of the following?

A. Drake's Rule
B. Dollo's Law
C. Wallace's Line
D. Cope's Rule
E. Chargaff's Rules

14. A phylogenetic tree that has an internal node with more than two divergent branches, i.e., more than a simple bifurcation, represents which of the following?

A. Monophyly
B. Paraphyly
C. Polyphyly
D. Homoplasy
E. Polytomy



PART II. <u>Short</u> answer questions – (Number of points in parentheses, 78 points total).

15. (10 points) The previous multiple choice question represents an analytical problem regarding the construction of a phylogenetic tree, how might you (simply) go about solving this problem, in an effort to make a tree that more accurately represents a particular evolutionary history?

16. (10 points) Sabertooth tiger and sabertooth salmon, analogy or homology? Give a single specific reason to justify your choice.

17. (10 points) When considering the understanding of animal behaviors, compare and contrast the concepts of **proximate** and **ultimate** causation.

18. (8 points) Why was the porphyrin ring such a versatile molecule when considering its impact on metabolic pathways? Name at least two key molecules and their respective pathways that were integral for getting us to multicellularity?

19. (10 points) Point mutations are a major source of genetic change. List and describe <u>three different conceptual types</u> of point mutations (i.e., how do we categorize point mutations)?

20. (10 points) What is the primary pattern predicted by the **punctuated equilibrium** hypothesis in terms of the occurrence of various species in the fossil record? Why are Bryozoans a good indicator of this hypothesis as opposed to Foraminifera?

21. (10 points) According to Stephen J. Gould (a noted paleontologist), "Evolution is the summation of fortuitous contingency." Briefly, what does he mean by this statement, i.e., what point is he driving home?

22. (10 points) Discuss in some detail (preferably using examples from class) the idea that the endosymbiosis of bacteria lead to the development of multicellularity. Which endosymbiotic relationship occurred first in Eukaryotes? What is at least one line of evidence for this claim? Why are Eukaryotes considered genomic chimeras?

PART III. Short Essay – (Number of points in parentheses, 30 points total).

23. (15 points) Describe the role that **oxygen** has played regarding the evolution of multicellular organisms. **(A)** What is thought to have caused multicellularity to get "put off" for such a long time? **(B)** What were the sources and the sinks for oxygen over the history of the Earth? **(C)** Now that an excess of oxygen has occurred, what are the feedback mechanisms that control its level in terms of upper AND lower limits in the atmosphere?

24. (15 points) Consider the notion of an **RNA World** in terms of the origins of life. **(A)** describe why this might be possible, what is it about RNA that make it a candidate for this role? **(B)** What is the speciality role of DNA and why would this be considered as more complex? **(C)** What is the speciality role of proteins and why would this be considered as more complex?