BIOLOGY 432 **Name _____**
FINAL - 07 June 2012

PART I. Multiple choice questions – (5 points each, 50 points total). Remember, single best answer only.

1. Male pipefish rear fertilized eggs in a specialized brood pouch. A study has shown that males will selectively abort female eggs based on female quality. Which of the following is the most likely explanation for this behavior?

A. Male pipefish invest more resources into the production of sperm than female pipefish invest into the production of eggs.
B. Certain eggs can endanger a male's survival, so it is not sexual but viability selection.
C. Brood care is costly for the males.
D. A recent population bottleneck caused this maladaptive behavior to reach a high population frequency by chance.
E. An example of random mating.

2. According to our text, the term "hominins" currently refers to the group consisting of modern humans, extinct human species and all our immediate ancestors. Which of the following would NOT be considered as a **hominin**?

A. Chimpanzees
B. Neanderthals
C. Hobbits (*H. floresiensis*)
D. Australopithecus
E. Ardipithecus

3. The advent of land animals is associated with the wrist-like fin bones of the lobe-finned fishes. When did these fish first crawl "out of the ooze"?

A. Precambrian
B. Devonian
C. Silurian
D. Archean
E. Holocene

4. When considering the types of gene expression used during the development of animal body plans, which of the following would be considered most important for this process?

A. Lac operon
B. Hom/Hox genes
C. Pax genes
D. Heat shock genes
E. mtDNA

5. **Mass extinction events** are thought to be associated with a number of possible catastrophes. In addition to the ever-popular asteroid impact scenario, which of the following are also possible extinction causing catastrophes?

A. Human population explosion
B. Ocean Acidification
C. Extreme volcanic activity
D. Drop in sea level (regression) followed by a rise in sea level (transgression)
E. All of the above

6. Consider the evolutionary comparison between the vertebrate eye (e.g., human) and the cephalopod eye (e.g., octopus). Remember that vertebrates have a blind spot, whereas cephalopods do not. This scenario can best be described as:

A. Homology
B. Homoplasy
C. Synapomorphy
D. Analogy
E. Parsimony

7. When considering the various methods of phylogeny, which of the following seeks to specifically group organisms based solely on their related similarities?

A. Ocham's Razor
B. Maximum Likelihood
C. Cladistics
D. Parsimony
E. Phenetics

8. Consider when sexual and natural selection collide regarding the túngara frogs of Panama. Which of the following was the conclusion made about the evolution between the male call (a distinctive whine followed by multiple "chucks") and the associated female preference due to a sensory bias?

A. The multi-chuck male behavior and the female preference evolved multiple times
B. The female preference evolved first and then the male multi-chuck later
C. Multi-chuck first and then the preference evolved later
D. There was no definitive conclusion made about the order...
E. This is really about the coevolution of frogs as bat food

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

A. Indicates photosynthesis occurred near the earliest ancestor
B. Demonstrated three domains of life regarding genetic diversity
C. Points towards a single ancestor for the origin of life
D. Indicates prokaryotes had a thermophilic origin
E. Shows that each domain is nearly as distantly related as any other

10. Consider the **reinforcement** model that happens during the completion of speciation. Which of the following type of selection is *best* associated with this model?

A. Directional Selection
B. Sexual Selection
C. Stabilizing Selection
D. Disruptive Selection
E. Natural Selection

PART II. Short answer questions – (Number of points in parentheses, 100 points total).

11. (10 points) Briefly, what does **prezygotic** reproductive isolation by **assortative mating** mean?

12. (10 points) Compare and contrast the concepts of **allopatric** and **sympatric** speciation.

13. (10 points) What are the factors that lead up to **extinction vortex** and how might one offer a solution to an escape from this scenario?

14. (10 points) Describe the concept of **impact frustration** and how this may have affected the initial development of the life on Earth as opposed to more recent evolutionary developments. How might **hydrothermal vents** have factored into this scenario?

15. (10 points) A recent study of the bone strength of ***Tyrannosaurus rex*** revealed that if a fast running *T. rex* ever tripped, it would probably not survive due to broken bones. Given these high costs, why did large body size ever evolve? Can you think of some costs associated with small body size?

16. (10 points) One of the most heated aspects of human racial politics is the contention that human races are genetically distinct. How does the African replacement (Out of Africa) model vs. multiregional model of human evolution address this issue? That is, which model predicts that human races are more genetically similar and/or different AND why?

17. (20 points) Based on reciprocal transplant experiments, the relative fitness for big sagebrush is greater for hybrids only in the intermediate elevations or transitional habitats. (A) This is an example of what specific type of speciation model? (B) What would you predict as the eventual outcome based on what you know about secondary contact and the narrow range of the hybridization zone and why?

18. (20 points) Examine the graph provided which shows F_{st}, a measure of genetic variability between populations as a function of geographic distance. These data are from human populations in Europe. F_{st} has been calculated from autosomes (both parents), mtDNA (only from the mother), and Y chromosome (only from the father) loci. Consider these data and develop a hypothesis using an evolutionary force/mechanism to explain why these alleles are more homogenized across populations of autosomal and mtDNA loci rather than for Y-chromosome loci.

PART III. Short Essay – (Number of points in parentheses, 50 points total).

19. (25 points) Consider the mutation that causes **sickle-cell anemia** and then how the environment impacts **genotype frequency** for people living near the equator vs. temperate regions. Based on the examples we have covered in class, compare and contrast the expected genotype frequencies and describe how each is maintained through natural selection. Now, how might this pattern have changed if **quinine**, a drug that cures malaria, was found in relatively high concentrations (medicinal as well as nonlethal) in a food item located only in the tropics?

20. (25 points) In some species of deep-sea anglerfish, the male lives as a symbiont permanently attached to the female. The male is tiny compared to the female and many of his organs including the eyes are reduced. The jaws and teeth are specifically modified for attachment to the female. The circulatory systems become fused and the male gets all his nutrition from the female this way. **(A)** What mechanism do you think drives this relationship? **(B)** What is/are the limiting factor(s) and forcing function involved? **(C)** Do you think the male's symbiotic strategy evolved due to natural selection or sexual selection?

21. Extra Credit, Short answer (10 points): Describe at least two planetary conditions that are required to support multicellular life, which may be very rare.

Figure for **Question #18**: F_{st} values.

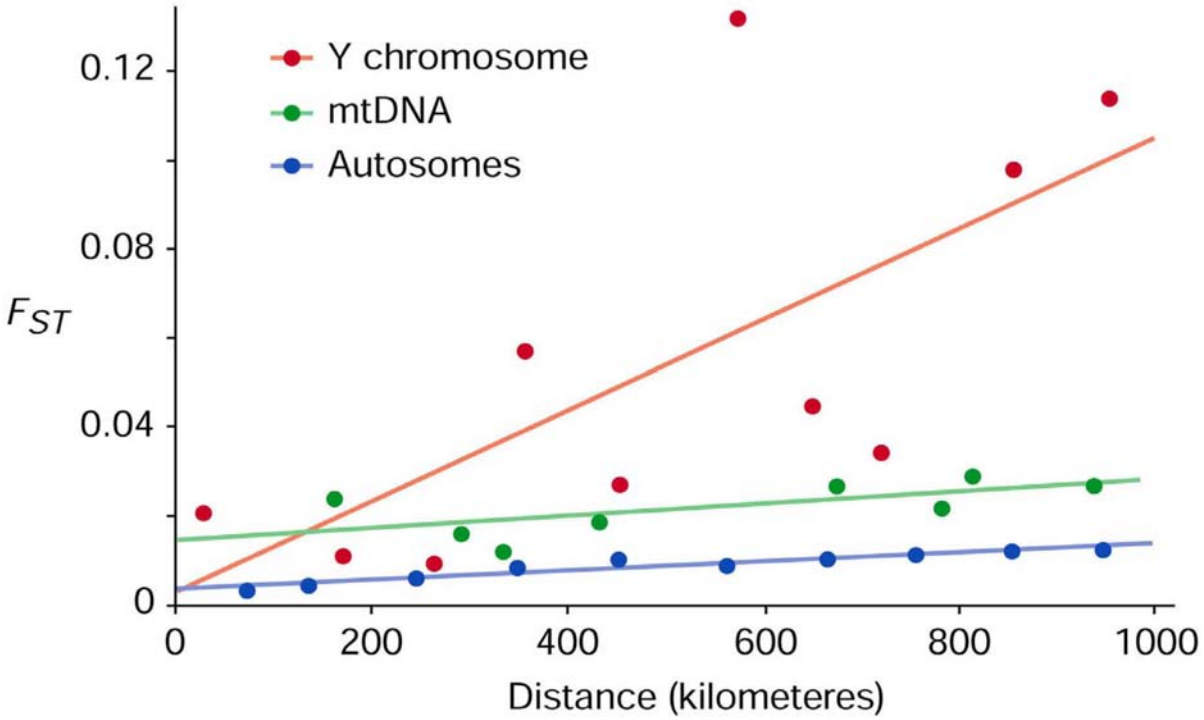

Figure for **Question #19**: Genotypic values (Hb^S = sickle cell; Hb^A = wild type).