MCDB 1150-3:Biofundamentals 2014 Midterm I Name: _____

There are 15 questions, each worth a maximum of 5 points. For the multiple choice questions, your choice (if correct) is worth 3 points, your explanation of the logic of your answer is worth 2 points.

You always have a choice to pick "no idea" and get +1 point. No written answer is required if you pick "no idea".

1. What distinguishes a scientific theory from a law?

❑ A. laws are obviously true
❑ B. theories are speculative and based on ideas rather than observations
✓ C. a theory explains why a law exists
❑ D. a law is broken only under extraordinary circumstances
❑ NO IDEA

Explain the logic of your answer:

It is the ability to explain what happens, and to accurately predict what will happen and why, that is the key feature of a theory.

2.Which is not a core and universal feature of organisms …

✓ A. The ability to move actively from place to place
❑ B. the presence of a barrier between the organism and the external world
❑ C. The ability to maintain a non-equilibrium state
❑ D. The ability to reproduce copies of itself
❑ NO IDEA

Explain the logic of your answer:

There are many organisms that do not move from place to place (trees for example).

3. Evolutionary theory explains an organism's place in the Linnaean classification system based on …

❑ A. independent creation events
✓ B. its ancestry
❑ C. stochastic, non-adaptive processes
❑ D. selective, adaptive pressures
❑ NO IDEA

Explain the logic of your answer:

Relatives resemble each other is important ways (traits), and those traits are the basis for clustering organisms.

4. In evolutionary theory, the structural similarities between the wings of birds, the arms of humans, the front legs of horses, and the flippers of whales are evidence of:

- ❑ A. convergent evolution
- ❑ B. selection of a common phenotype
- ❑ C. the influence of non-adaptive processes
- ✓ D. a shared ancestor with a forelimb
- ❑ NO IDEA

Explain the logic of your answer:

Because all of these structures share what appear to be modified versions of the same bones, presumably because they inherited them from a common ancestor.

5. Insects and vertebrates both have limbs but they are quite distinct. it would be most reasonable to assume that the common ancestor of these two groups …

- ❑ A. had vertebrate-like limbs
- ❑ B. had insect-like limbs
- ✓ C. had no limbs or limbs of a completely different type
- ❑ D. This observation indicates that insects & vertebrates do not share is a common ancestor.
- ❑ NO IDEA

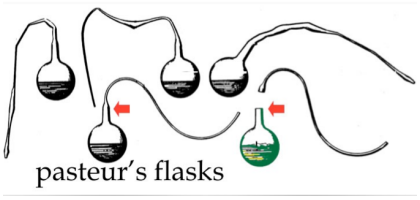
Explain the logic of your answer:

The differences in the limb structures suggest that they arose independently, so the simplest of assumptions is that they evolved independent from a limbless ancestor.

Of course it is possible that the ancestor had limbs that were lost in one or the other lineage, and replace later on with a new structure.

6. Assume that in Pasteur's experiment there was no growth in the broth after the flasks were broken open, that would ….

- ❑ A. prove that spontaneous generation was impossible.
- ✓ B. leave open the possibility that heat sterilization destroyed a component necessary for spontaneous generation.
- ❑ C. prove that there were no bacteria present in the air (in Paris, France in the 19th century).
- ❑ D. have no effect on the interpretation of the experimental result.
- ❑ NO IDEA



Explain the logic of your answer:

Since the broth normally would support microbial growth, absence to grow would suggest some change that actively inhibited growth, and probably would (if it were possible) inhibit spontaneous generation. We are therefore unable to draw any conclusion.

7. Draw a graph of the probability of spontaneous generation of life on Earth as a function of time after the origin of the Earth.

Explain (below) how the origin and evolution of life influences the probability of spontaneous generation.

Probability is highest after the surface of the Earth has stabilized (since various chemical can accumulate), and decreases with appearance of organisms that can consume the molecules that would be needed to generate new organisms.

8. Given the results of the Miller-Urey experiment and Wohler's in vitro synthesis of urea, we might reasonably conclude…

- ❑ A. life is common in the universe
- ✓ B. spontaneous generation is a plausible explanation for the origin of life
- ❑ C. there have been multiple independent origins of life on Earth
- ❑ D. organic (and inorganic) chemicals cannot spontaneously form organisms.
- ❑ no idea.

Explain the logic of your answer:

These experiments suggest that the kinds of molecules that we think would be needed for spontaneous generation are rather easy to generate. If they could not be synthesized abiologically, spontaneous generation would be more difficult to imagine.

9. The major observation that the theory of evolution explains is ….

- ❑ A. the structure of cells
- ❑ B. the use of DNA as genetic material
- ✓ C. the diversity of organisms
- ❑ D. the ability of organisms to reproduce
- ❑ NO IDEA.

Explain the logic of your answer:

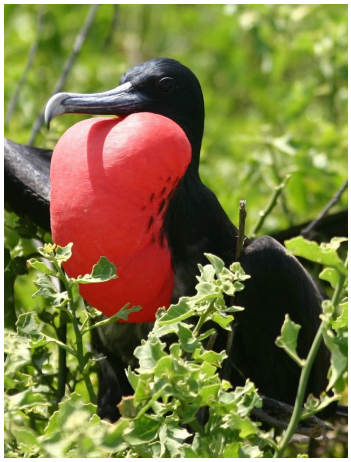
Diversification into available niches would give organisms a reproductive advantage, so it would be selected for. This leads to evolutionary .

10. Evolutionary theory is based on directly observable features of organisms. Which is not one of the empirical observations upon which evolutionary theory is based?

- ❑ A. the ability of organisms to produce multiple copies of themselves.
- ❑ B. the phenotypic variation between organisms
- ✓ C. the presence of sexual dimorphism
- ❑ D. the inheritable nature of traits
- ❑ NO IDEA

Explain the logic of your answer:

Sexual dimorphism a specific, evolved trait and not a basic feature of all biological populations.



11. Sexual selection was originally proposed to explain ….

- ✓ A. the presence of seemingly disadvantageous traits
- ❑ B. monogamous mating systems
- ❑ C. the organization of social systems
- ❑ D. sexual dimorphism
- ❑ no idea.

Explain the logic of your answer:

Traits like the bright colors of birds or apparently excessive traits not directly like to simple reproductive success (such as giant antler, facial colors in primates) that enhance reproductive success through mate choice (access to mates).

12. A population of bacteria cooperate through quorum sensing to generated a digestive environment … Generate a model (a diagram) of the various components that would be required for this behavior and explain the logic of your answer.

gene encodes → secreted signal
+ → generates response (expensive behavior)
↘
gene encodes receptor → signal binds receptor benefits to group
(and individuals within the group).
greater than could be achieved as individual

13. In some systems, quorum sensing can be used to drive the stochastic death of cells. Such a behavior is most likely to arise through ….

- ✓ A. kin selection / inclusive fitness
- ❑ B. innate cooperative behavior
- ❑ C. genetic drift
- ❑ D. sexual selection
- ❑ NO IDEA

Explain the logic of your answer:

Because death of a cell releases nutrients that can increase the reproductive success of the neighboring cells, which are likely to be closely related to the cell that has "sacrificed" itself.

14. A small population invades a new environment and is cut off from its larger parental population. After time N, this population begins to increase dramatically in size. On the graph, indicate the strength of genetic drift as a function of time.

Explain the assumptions behind your answer: Genetic drift is (relatively) high while the population size is small, and decreases as the population increases in size.

15. Consider a species in which only those females that successfully establish and defend a territory are able to form a stable pair-bond with one of many available males; this male then helps the female with rearing the young.

- ❑ A. natural selection affects all organisms, sexual selection also affects females
- ✓ B. natural selection affects all organisms, sexual selection also affects males
- ❑ C. only natural selection is acting in this scenario
- ❑ D. sexual selection, not natural selection, is acting in this scenario
- ❑ E. no types of selection are active, pair bonding is a stochastic process.
- ❑ NO IDEA

Explain the logic of your answer:

Because there are multiple males are available, and only a single male pairs with a female. the females select from males (and males are selected for traits that influence female choices).

Optional extra credit (3 points): Discuss whether you agree or disagree with this statement and why: “Isotopes are to atoms as alleles are to genes.”

Yes, isotopes are versions of a atoms, as alleles are versions of genes.