BIOL*2400 EVOLUTION
W19
Midterm I

February 6th, 12:30 – 1:20pm

Instructor: Dr. Moira Ferguson

Last																	
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Instructions (pink)

1. Fill in SECTION 55 on your test scoring answer sheet (scantron) with a pencil. Also, fill in your name, student number, Courselink ID (under Email).

2. This first midterm exam is worth either 15% or 25% of your final grade depending on how you do on the second midterm. It consists of 16 multiple choice questions all weighted equally (1 mark each) and 3 short answer questions. You must answer 2 out of the 3 short answer questions (3 marks each). If you answer all three short answer questions, the first two will be marked. Total value of exam is 22 marks.

3. Use a #2 HB pencil to completely fill in the circle of your choice for the Multiple Choice Questions. Choose only one answer per question. If more than one answer is chosen, the question will not be marked.

4. Write your full name and student ID on the top of Section 2. Use full sentences in your answers to the short answer questions.

5. This exam should have 9 pages including the cover page.

6. You are permitted to use dedicated calculators and NOT your phone.

7. Please bring your exam to the front of the room when you are finished so that we can check that your scantron has been completed.

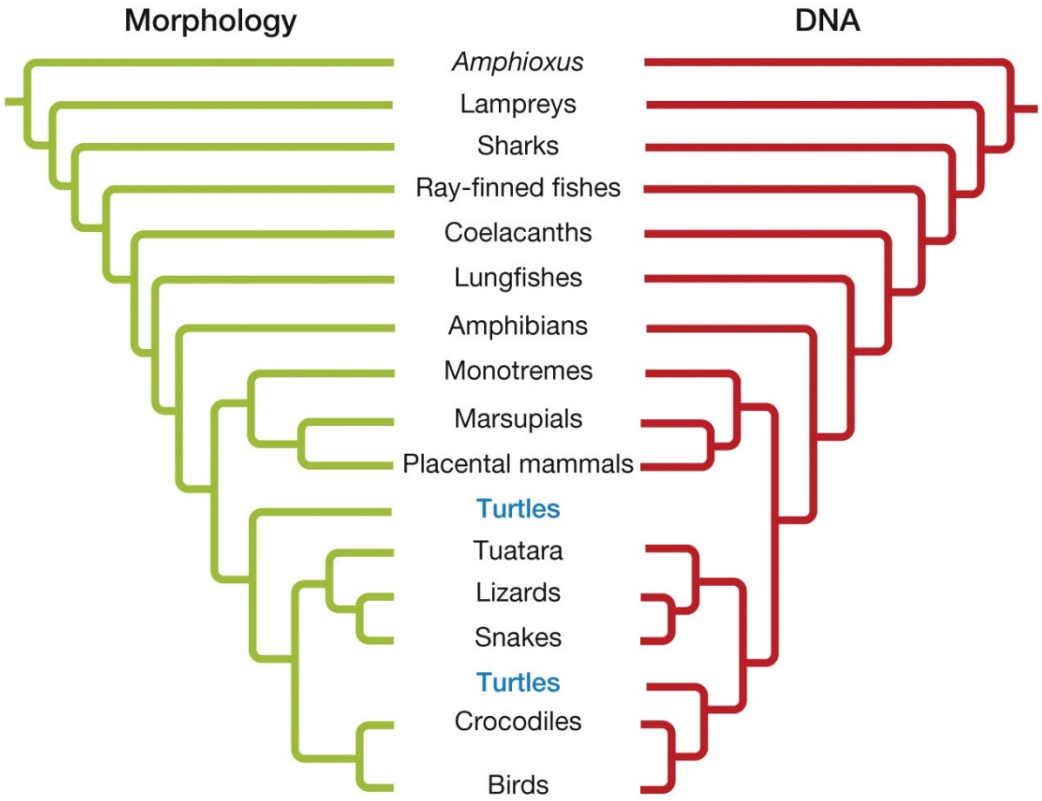
8. All remaining exams will be collected at 1:20 pm. You will not be given extra time to fill in your multiple-choice answers on the scantron form.

Part 1 Multiple Choice [16 questions – 1 mark each]

1. Fill in the blanks in the following sentence using the pairs of words below: Evolution by natural selection occurs in _____, not _____".

   a) species, individuals.
   b) individuals, species.
   c) populations, individuals.
   d) individuals, populations.
   e) species, populations.

2. The figure below shows relationships among major groups of vertebrates.

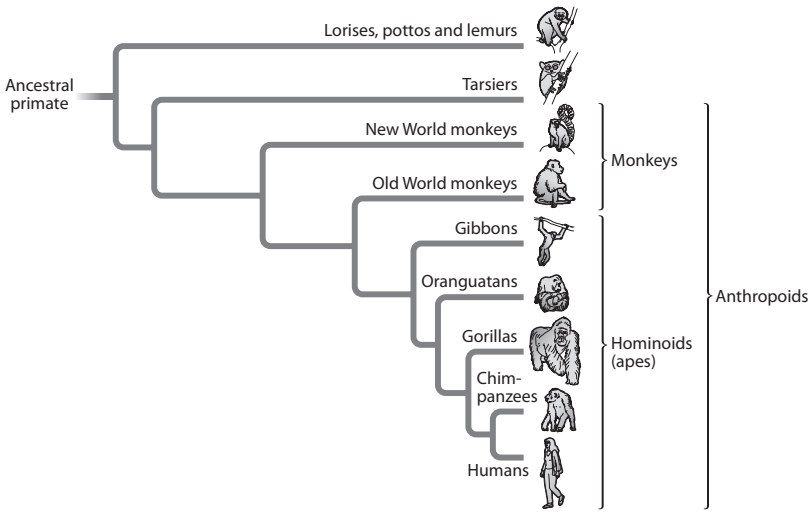


According to the data in the figure:

   a) Lampreys are the ancestors of the ray-finned fishes.
   b) mammals (monotremes, marsupials and placental mammals) are monophyletic in both phylogenies.
   c) amphibians are more closely related to mammals (monotremes, marsupials, and placental mammals) than they are to reptiles (tuatara, lizards, snakes, turtles, crocodiles, and birds).
   d) Coelacanths and lungfishes occupy their own clade in the phylogeny.
   e) birds are an outgroup for both phylogenies.

3. Which of the individuals listed below developed the first detailed theory of evolution?

a) **Jean-Baptiste Lamarck.**
b) George Buffon.
c) Charles Darwin.
d) Nicolaus Steno.
e) Aristotle.



4. Considering the rules/logic of using phylogenies inform the naming of taxonomical groups (Linnaean classification) as discussed in class, which of the following statements is/are true based on the tree above?

a) The term "Anthropoids" is a valid taxonomical group.
b) "Monkeys" are not a valid taxonomical group.
c) "Monkeys" would be a valid taxonomical group if it also included tarsiers.
d) a and b are correct.
e) a and c are correct.

5. Which of the following observation was used as part of Darwin's logic that evolution occurred by natural selection?

a) Fossils and living species from one area show many similarities and are different from those in other areas.
b) More organisms are produced than can survive.
c) Mendel's laws explain the resemblance of parents and offspring.
d) Similarities among organisms are due to common ancestry.
e) The earth is young.

6. You are constructing a phylogeny of a hypothetical group of insects. Several of the species have a pattern of four veins on the forewing while another group of species has a pattern of six veins. The outgroup in your analysis has a pattern of six veins. From this you can conclude:

   a) the trait of having six veins is a shared derived character state (synapomorphy).
   b) the group of species with six veins are more closely related to each other than they are to the any of the species with four veins.
   c) the trait of having four veins is a synapomorphy.
   d) a and b are correct.
   e) b and c are correct.

7. A scientist determines the numbers of individuals with the following genotypes: $A_1A_1 = 22$; $A_1A_2 = 16$: $A_2A_2 = 62$. The frequency of the A_2 allele in the population is:

   a) 0.30
   b) 0.62
   c) 0.22
   d) 0.79
   e**) 0.70**

8. If p (A_1) = 0.8 and q (A_2) = 0.2 what would be the expected frequency of the A_2A_2 genotype at Hardy-Weinberg Equilibrium?

   a) 0.64
   b) 0.04
   c) 0.03
   d) 0.06
   e) 0.16

9. If the expected frequency of the A_1A_1 genotype at Hardy-Weinberg equilibrium was 0.4 in a population of 1000 animals, how many individuals would you expect to have the A_1A_1 genotype at Hardy-Weinberg equilibrium?

   a) 400
   b) 800
   c) 40
   d) 80
   e) 20

10. If the heritability of a trait in a population is low:

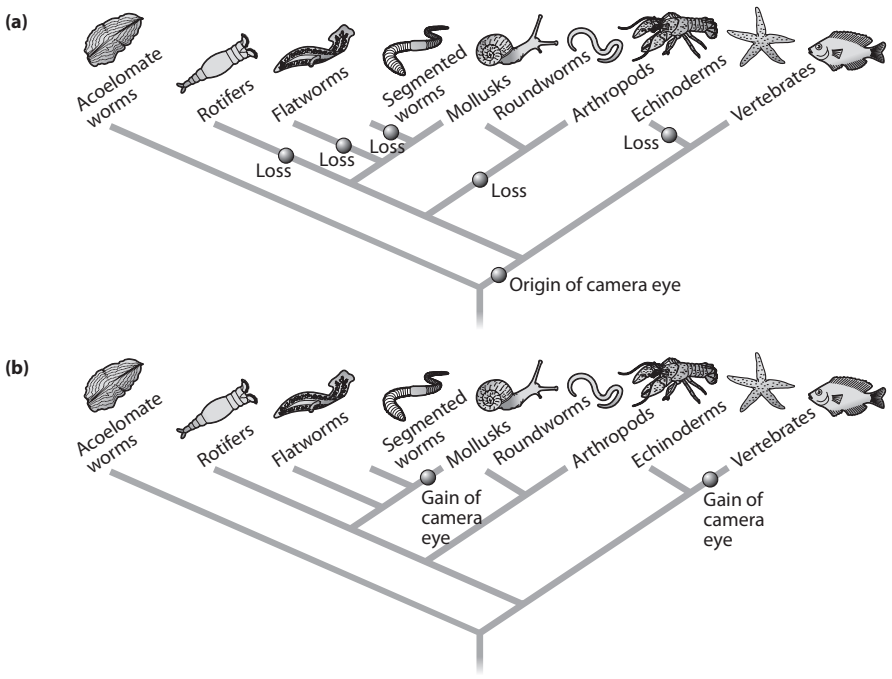
    a) few individuals have the trait.
    b) most of the phenotypic variation for the trait in the population is due to environmental differences experienced by individuals.
    c) most of the phenotypic variation for the trait in the population is due to genetic differences among individuals.
    d) there are no genes that code for the trait.

11. A species is subdivided into subpopulations of the same size. If genetic drift and gene flow are operating at a locus with two alleles, what is a likely outcome over an infinite number of generations if there is no mutation or natural selection?

    a) the allele frequencies will not change.
    b) the subpopulations will fix for one of the two alleles.
    c) the subpopulations will behave as a single large random mating population with a F_{ST} of 0.
    d) F_{ST} will be greater than 0 and less than 1.

12. The colors of individuals in a snail population are determined by a single locus. A_1A_1 homozygotes are red, A_1A_2 heterozygotes are pink, and A_2A_2 homozygotes are white. If only natural selection is operating and genotypic fitnesses are as follows: $w_{A_1A_1} = 0.5$; $w_{A_1A_2} = 0.75$; $w_{A_2A_2} = 1.0$, which of the following will happen after an infinite number of generations?

    a) the population will almost fix for A_2 and a small number of A_1 alleles will persist in the heterozygous state.
    b) both alleles will persist in the population and allele A_1 will be more common than allele A_2.
    c) the population will fix for allele A_2.
    d) the population will contain only A_1A_2 heterozygotes.

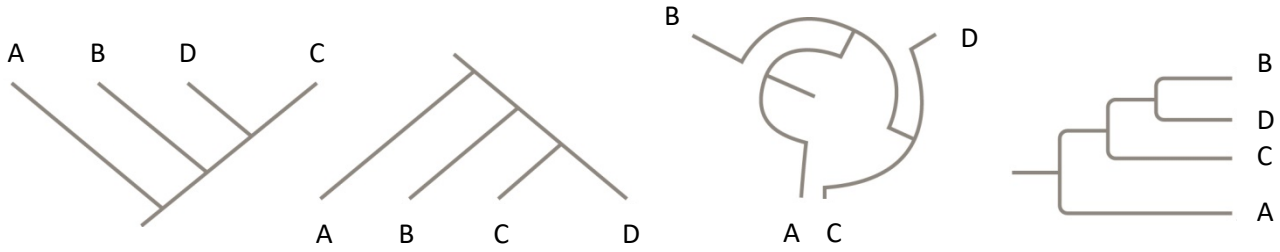


13. Referring to the phylogenetic trees above, which statement(s) is/are correct?

    a) Tree A proposes that the camera eye of mollusks and vertebrates evolved once; Tree B proposes that the camera eye of mollusks and vertebrates evolved through convergent evolution.
    b) Tree B proposes that the camera eye of mollusks and vertebrates evolved once; Tree A proposes that the camera eye of mollusks and vertebrates evolved through convergent evolution.
    c) Tree B is more parsimonious.
    d) a and c are correct.
    e) b and c are correct.

14. A researcher is studying the genetics and evolution of sugar content in apples, which is influenced by many genes and the environment. They determine that V_D is 1.2, V_G is 7.6, V_A is 6.4, V_E is 15.4 and $V_P = 25.0$. A pest preferentially kills apples with high sugar content before they produce seeds. Which of the following is a correct statement?

    a) h^2 is 0.30 and will decrease in the next generation.
    b) h^2 is 0.30 and will increase in the next generation.
    c) h^2 is 0.26 and will decrease in the next generation.
    d) h^2 is 0.26 and will increase in the next generation.



Tree A Tree B Tree C Tree D

15. Which one of the four trees above does NOT depict the same relationships among the four taxa as the other three?

    a) Tree A
    b) Tree B
    c) Tree C
    d) Tree D

16. Which statement is true about quantitative/continuous traits?

    a) A quantitative trait is mostly caused by the effects of alleles where one allele is dominant over the other with respect to the phenotype.
    b) Loci that affect quantitative traits such as disease risk in humans and coat colour in mice have been located in the genome.
    c) Understanding the environmental basis of quantitative traits allows us to predict future evolutionary responses to selection.
    d) High heritability of quantitative traits means that environmental improvements won't affect the trait.

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Part 2 Short Answer [Complete 2 of the 3 questions = 3 marks each]. Use full sentences and write your answer in the spaces below.

1. Genetic bottlenecks and founder effects greatly influence the amount of genetic variation in a population. Describe/define these concepts and explain how they influence the amount of genetic variation in a population. Be sure to make reference to the major evolutionary force involved. (3 marks)

A genetic bottleneck is when a population suddenly decreases in size. (0.5)
A founder effect is when a small number of individuals leave a much larger population and found a new smaller population. (0.5)
Both bottlenecks and founder effects lead to less genetic variation because only a finite number of alleles can be present after a bottleneck and founder event (fewer individuals). (1 mark) Also the smaller populations will also experience increase drift, which will result in allele frequency fluctuations and loss of alleles. (1 mark)

2. Define and contrast the terms "Homologous trait" and "Homoplasious trait." Which one is preferred for building phylogenies? Why? (3 marks)

A homologous trait is one that is identical by descent – two species have it because they inherited from a common ancestor.(0.5)
A homoplasious trait is one that is not identical by descent (not inherited from a common ancestor). (0.5) These can arise from reversals (0.5) (actually had a different state but reversal led to similar state) and/or convergent evolution (0.5)(two species have it because in similar environment) Homologous characters are preferred for phylogenies (0.5) as one is trying to understand ancestral/descendant relationships. (0.5).

3. A new beneficial mutation arises in a population in the heterozygous state. Describe three attributes of the beneficial allele and/or the population in which it occurs that would increase the probability that the allele would persist and increase in frequency. (3 marks)
   1. New allele is dominant in expression – will quickly increase in frequency faster than additive or recessive expression.
   2. New allele arises in large population – greater chance of persisting because drift will be smaller (won't be lost)
   3. New allele has strong beneficial effect compared to a weaker effect. Fitness of homozygotes is much higher than heterozygotes or alternate homozygotes.

Question	Mark
1	/3
2	/3
3	/3
Total	/6