

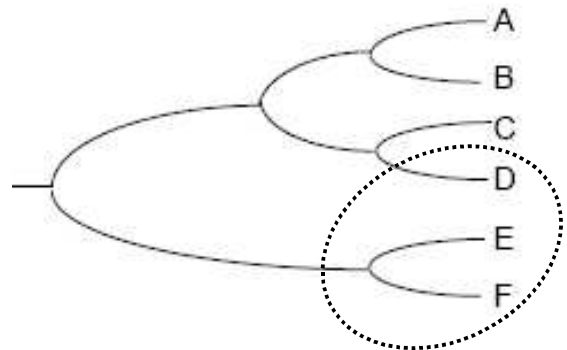
ECOL182R INTRODUCTORY BIOLOGY
SCHAFFER, BONINE, FERRIERE
MIDTERM ONE
19 FEBRUARY 2009

Here are the correct answers to the first exam. Typos in the questions are corrected in **blue**. Please note: As written out on the exam, Question 53 was unintelligible. So we gave credit for all answers. We will post comments on most frequently missed questions in the next day or so. – WS.

1. Which of the following is the correct order of taxa as proposed by Linnaeus?
 - a. Family → Class → Order
 - b. **Class → Order → Family**
 - c. Class → Family → Order
 - d. Order → Family → Class
 - e. Order → Class → Family

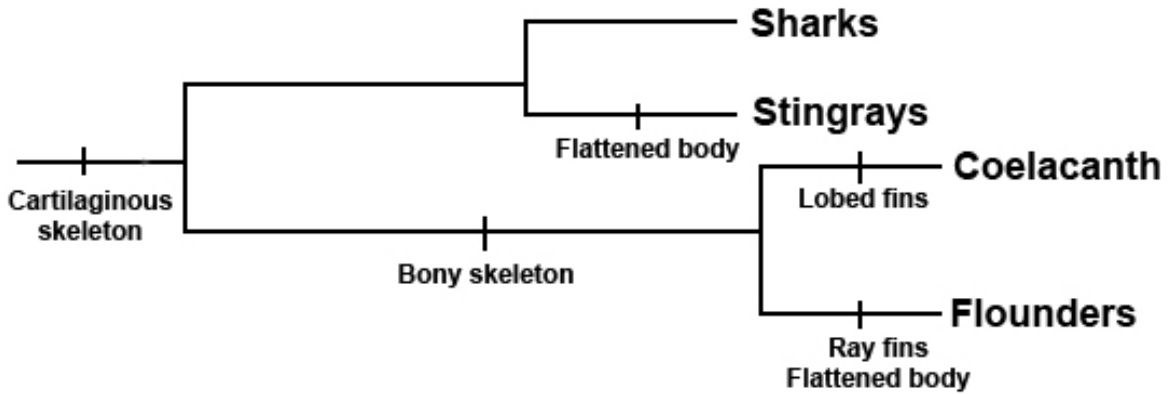
2. Which of the following statements is FALSE?
 - a. **The extinction of a species means that all the evolutionary history leading up to that species is lost from global biodiversity**
 - b. Adaptive radiation is a term used to describe the diversification of one species into many in situations where there is little (or no) other competition
 - c. Ancestral traits found in related species are those traits that their most recent common ancestor also had
 - d. A derived trait differs from the form of the trait found in an ancestor
 - e. Convergent evolution can make it difficult to determine if a trait is ancestral or not

3. What is the best way to describe the group containing species D, E, and F as circled?
 - a. Monophyletic
 - b. Paraphyletic
 - c. Parsiphyletic
 - d. **Polyphyletic**
 - e. Synapomorphic

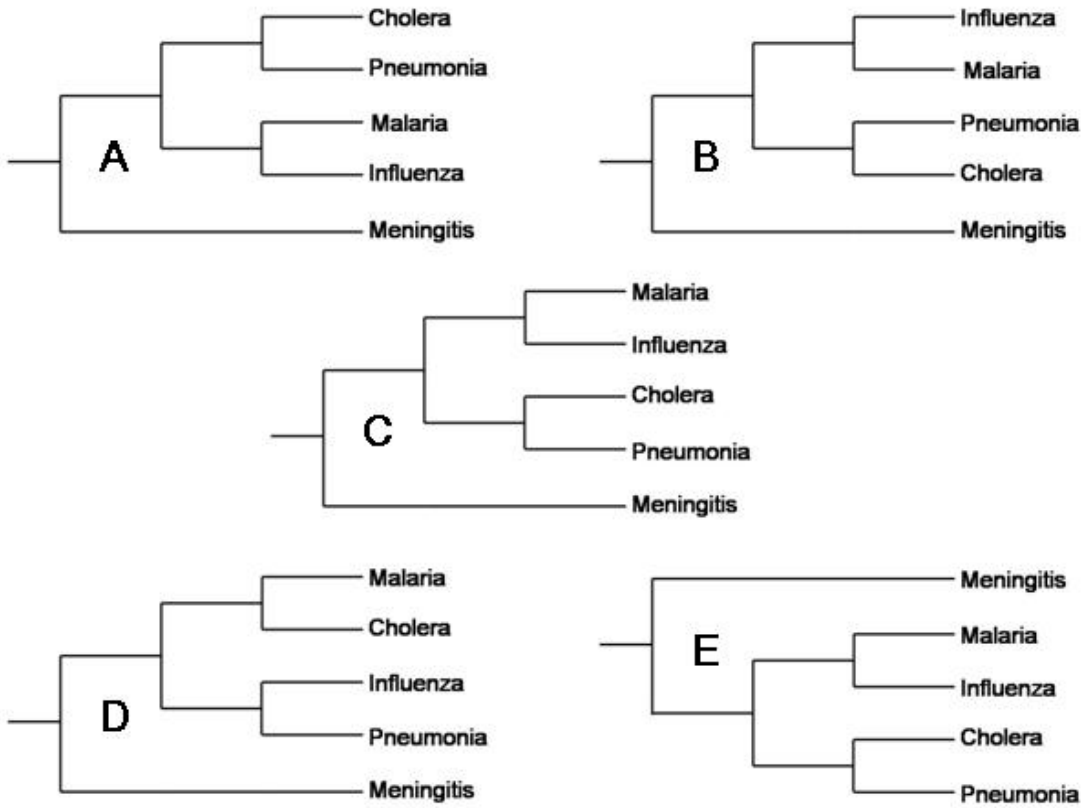


4. In the context of the biogeological history of earth, which of these events occurred first?
 - a. Dinosaurs went extinct at end of the Cretaceous
 - b. **Cambrian Explosion**
 - c. Insects evolved ability to fly
 - d. Mammals appeared
 - e. Adaptive radiation of mammals

5. Based on the phylogenetic tree below, the flat body of stingrays and flounders is
- a. a homologous trait
 - b. the result of stabilizing selection in the common ancestor of these two taxa
 - c. clear evidence that stingrays and flounders share a common ancestor
 - d. the result of disruptive selection in the common ancestor of these two taxa
 - e. a homoplastic trait



6. Which of the following phylogenetic trees is NOT the same as the others? **D.**



7. The emergence of macroscopic structure or behavior from interactions on smaller length scales is said to be a(n) _____ .
- adaptive trait
 - developmental constraint
 - emergent property
 - evolutionary novelty
 - increased entropy
8. The atoms of DNA and crystalline salts are distributed in a non-random fashion. The difference is that in salts, the pattern _____; in DNA, the pattern _____.
- does not repeat; does not repeat
 - does not repeat; repeats
 - repeats; does not repeat
 - repeats; repeats
9. Terrestrial organisms convert ammonia to urea
- as a way of producing energy.
 - because ammonia is more highly neurotoxic in terrestrial than in aquatic environments.
 - to prevent excessive water loss that would result from producing a dilute urine.
 - a. and b.
 - a., b. and c.
10. The Second Law of thermodynamics requires that
- biological order can only arise at certain times in the history of the universe.
 - biological order can only be maintained by the expenditure of energy.
 - local reductions in entropy must be compensated for by global increases that exceed the local reduction.
 - a. and b.
 - b. and c.
11. The property by which organisms buffer their internal environments against fluctuating external conditions is called
- abiosis.
 - homeostasis.
 - hyperammonemia
 - parthenogenesis.
 - symbiosis.
12. True or False. All biological cascades promote proper physiologic functioning.
- True.
 - False.
13. At the molecular level, cell differentiation during development is mediated by
- differential gene expression.
 - gene cascades.
 - somatic mutation.
 - a. and b.
 - a. and c.

14. True or False. Equilibrium necessitates stability.

- a. true.
- b. false.

15. Lord Kelvin (William Thomson)

- a. argued against transmutation of species in Volume 2 of his the *Principles of Geology*.
- b. believed that the major groups of organisms could be arranged ladder-like in order of increasing complexity and that this reflected life's inherent tendency to progress.
- c. calculated the age of the earth to be substantially less than the hundreds of millions of years believed by Darwin and his fellow evolutionists to have been necessary for evolution to produce contemporary biological diversity.
- d. invented the theory of pangenesis to justify his belief in the inheritance of acquired characters.
- e. observed that the laws of inheritance as they were then understood lead to the rapid elimination of heritable variation.

16. Charles Darwin

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- b. believed that the major groups of organisms could be arranged ladder-like in order of increasing complexity and that this reflected life's inherent tendency to progress.
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17. Fleeming Jenkin

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18. Which of the following are essential ingredients of the theory of natural selection?

- a. Adaptive mutations are induced by environmental stress.
- b. All species possess excess biotic potential.
- c. Characteristics acquired by individuals during the course of their lives are passed to their descendants.
- d. There exists heritable variation among individuals that affects rates of reproduction and survival.
- e. b. and d.

19. Stripped of the complications of diploid genetics, evolution by natural selection is essentially a theory of

- a. competition.
- b. cooperation.
- c. predation.
- d. synergism.
- e. none of the above.

20. Consider a single gene, with two alleles, A and a . Let p be the frequency of gene A . Let the fitnesses of these alleles be w_{AA} , w_{Aa} and w_{aa} . If $w_{AA} > w_{Aa} < w_{aa}$. The equilibrium value(s), p^* , of p is (are)

- a. $p^* = 0$.
- b. $0 < p^* < 1$.
- c. $p^* = 1$.
- d. $p^* = 0$ or 1 depending on the initial value of p .

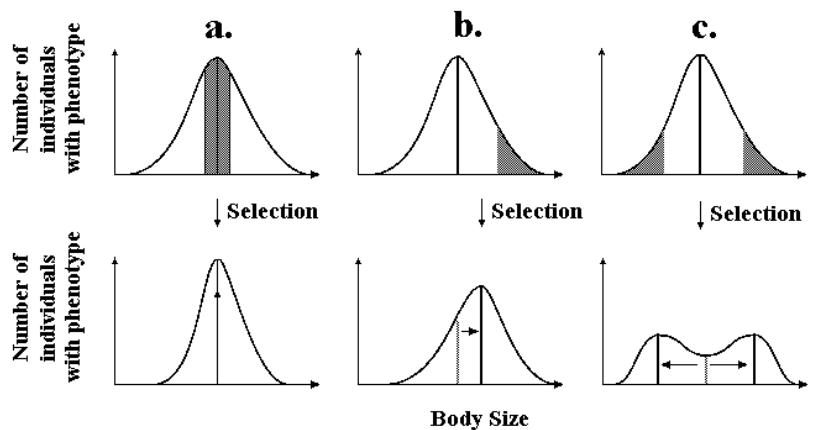
21. Consider a single gene, with two alleles, A and a . Let p be the frequency of gene A . Let the fitnesses of these alleles be w_{AA} , w_{Aa} and w_{aa} . If $w_{AA} > w_{Aa} > w_{aa}$. The equilibrium value(s), p^* , of p is (are)

- a. $p^* = 0$
- b. $0 < p^* < 1$
- c. $p^* = 1$.
- d. $p^* = 0$ or 1 depending on the initial value of p .

22. A well known example of heterozygote advantage in humans involves normal and abnormal variants of hemoglobin in the presence of

- a. African sleeping sickness.
- b. diphtheria.
- c. malaria.
- d. meningitis.
- e. trichinosis.

23. The accompanying diagram shows distributions of body sizes in birds before (top) and after (bottom) selection. The three cases ("a," "b" and "c") respectively correspond to



- a. stabilizing, disruptive and directional selection
- b. stabilizing, directional and disruptive selection.
- c. directional, stabilizing and disruptive selection
- d. directional, disruptive and stabilizing selection.
- e. disruptive, stabilizing and directional selection.

- 24. Which of the following studies support the idea that variation exists prior to selection.**
- August Weissmann's tail-cutting experiments with mice.
 - "Fluctuation" experiments of Luria and Delbruck.
 - Francis Galton's blood transfusion experiments.
 - Replica plating experiments of Joshua and Esther Lederberg.
 - b. and d.**
- 25. Consider a single gene, with two alleles, A and a . Let p be the frequency of gene A . If $p = 0.1$, the Hardy-Weinberg frequencies for the AA , Aa and aa genotypes are**
- 0.1, 0.18, 0.81
 - .01, 0.60, 0.40
 - .01, 0.18, 0.81**
 - 0.1, 0.00, 0.90
- 26. When residual DDT spraying (dusting the interiors of houses several times a year) was discontinued in the 1960's, the prevalence of malaria in South America, southeast Asia and Africa**
- decreased.
 - remained about the same.
 - increased.**
- 27. The fundamental units of evolution are**
- species.**
 - genera
 - families.
 - orders
 - phyla
- 28. Species are held together by _____ and pulled apart by _____.**
- reproduction; divergent selective pressures in different parts of their ranges.
 - reproduction; neutral mutation.
 - gene flow; neutral mutation.
 - gene flow; divergent selective pressures in different parts of their ranges.
 - c. and d.**
- 29. In allopatric speciation, the two types of isolating mechanisms are**
- sexual and asexual.
 - pre- and post-reproductive.
 - pre-zygotic and post-zygotic.**
 - physiological and genetic.
 - profound and illusory.
- 30. The formation of new species by polyploidy**
- is an example of allopatric speciation.
 - is an example of "instant" speciation.
 - is an example of sympatric speciation.
 - a. and b.
 - b. and c.**

- 31. How does the Galapagos “woodpecker finch” forage?**
- a. Drills with its bill – like all good woodpeckers.
 - b. Probes for insects with a cactus thorn that it holds in its beak.
 - c. Scratches for insects with its feet.
 - d. a. and b.
 - e. a. and c.
- 32. The theory of “punctuated equilibrium”**
- a. asserts that most evolution takes place in large, panmictic populations.
 - b. holds that evolution is a “start-stop” process.
 - c. is an alternative to phyletic gradualism.
 - d. a. and b.
 - e. b. and c.
- 33. The earliest organisms were probably**
- a. anoxic autotrophs.
 - b. oxygenic autotrophs.
 - c. aerobic heterotrophs;
 - d. anaerobic heterotrophs.
 - e. saprophytes.
- 34. Stromatolites**
- a. are now extinct
 - b. are / were reef-like structures with photosynthetic bacteria in the upper layers.
 - c. are / were vulnerable to grazing animals such as snails and worms.
 - d. a. and b.
 - e. b. and c.
- 35. One interpretation of Ediacaran “animals” is that**
- a. they were giant, plasmodial protozoans.
 - b. they constituted a “failed experiment” and left no descendants.
 - c. they were, in fact, the soft-bodied ancestors (no teeth, skeletons) of modern organisms
 - d. a. and b.
 - e. a., b. and c.
- 36. The more _____ a planetary atmosphere, the _____ it is to imagine the spontaneous production of biological molecules.**
- a. oxidizing; more difficult
 - b. oxidizing; easier
 - c. reducing; more difficult
 - d. reducing; easier
 - e. a. and d.
- 37. Among the characters used to distinguish the major groups of metazoa are**
- a. Number of cell layers.
 - b. Number of tissue types.
 - c. Kind (e.g., sexual vs. asexual) of reproduction.
 - d. Anaerobic vs. aerobic respiration.
 - e. Anoxic vs. oxygenic photosynthesis.

38. Cephalization refers to

- a. the modification of the molluscan foot into tentacles in squids and octopi.
- b. the secondary elaboration of a filter-feeding gill basket in certain jawless fishes.
- c. the concentration of sense organs at the front of an animal.
- d. None of the above.

39. The Portuguese Man of War is a(n)

- a. hydrozoan.
- b. scyphozoan.
- c. anthozoan.
- d. gonozoan.
- e. dactylzoan.

40. Which of the following characters distinguish cnidarians from ctenophores?

- a. Two cell layers vs. three.
- b. Incomplete vs. complete gut.
- c. nematocysts vs. tentacles.
- d. a. and b.
- e. b. and c.

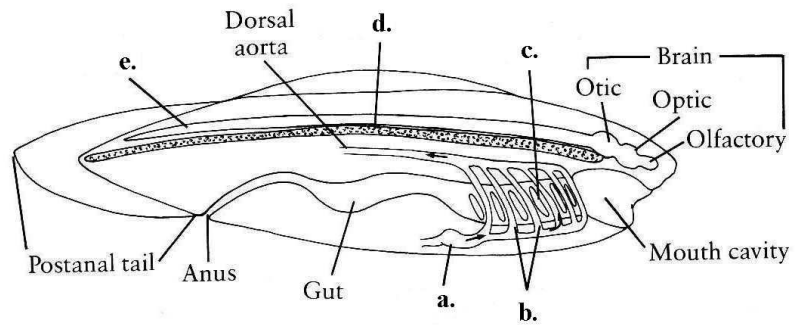
41. Which of the following lophotrochozoans have a lophophore?

- a. flatworms.
- b. rotifers.
- c. bryozoans
- d. spiralian
- e. mollusks.

42. Which of the following lophotrochozoan groups contain species that are “jet propelled?”

- a. flatworms.
- b. rotifers.
- c. bryozoans.
- d. spiralian.
- e. mollusks.

43-47. The accompanying sagittal section of a hypothetical vertebrate ancestor has five of the labels replaced with the letters a. – e. Answer the following questions by choosing the letter that corresponds to the organ named. For example, if you think the structures labeled “a” in the figure are aortic arches, answer question 43 as “a.”



43. Aortic arches **b.**

44. Dorsal nerve cord **e.**

45. Heart **a.**

46. Notochord **d.**

47. Gill slits **c.**

48. If vertebrates evolved from tunicate-like ancestors, the transition involved

- a. parthenogenesis.
- b. neoteny.**
- c. a saltatory (large, discontinuous) evolutionary jump.
- d. a. and b.
- e. b. and c.

49. Which of the following characters are shared by clams and tunicates?

- a. Mobile larval stage.
- b. Sessile adult stage.
- c. Filter feeding life style.
- d. **a. and b.**
- e. a., b. and c.**

50. Two of the three mammalian middle ear bones are descended from

- a. reptilian ear bones.
- b. reptilian jaw bones.**
- c. reptilian neck bones.
- d. reptilian snout bones.

Bonus Questions.

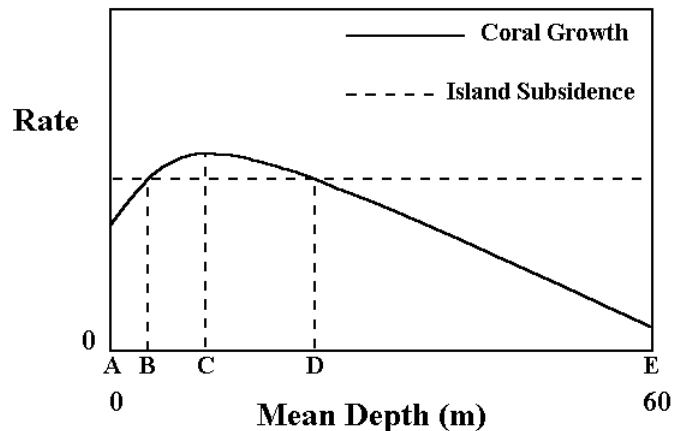
51. Which of the following statements about molecular clocks is TRUE?

- a. The measurable mutation rate is the same across all genes in a given population
- b. A synonymous mutation is considered silent because the genetic code is redundant and the mutation does not change the amino acid added to a growing protein
- c. The measurable mutation rate is the same across all base pairs in the genome
- d. A non-synonymous mutation is more often selected for than it is selected against
- e. The neutral theory states that mutations in the amino acid composition of proteins are usually selectively neutral

52-55. The picture at the right is a graphical representation of Darwin's theory of oceanic reef formation in which island / sea floor subsidence is balanced by coral growth rate. That is the depth, D , of the uppermost corals, is given by the equation,

$$\frac{dD}{dt} = S - G$$

where S is the rate of subsidence, and G is the upward coral growth rate.



In the figure, mean depth of the uppermost corals is plotted on the x-axis. Upward coral growth rate is plotted on the y-axis. Also plotted on the y-axis is the rate of island / sea floor subsidence, which is assumed constant. Answer the following questions. Note that a mean depth of zero requires that the corals spend roughly half of their time above the water's surface.

52. Coral growth rates generally decline with depth. However, at shallow depths, i.e., to the left of the depth marked "C," the growth rate increases with depth. This is because

- a. Corals near and above the surface are subject to erosion by winds and waves.
- b. Corals above the surface cannot feed.
- c. Corals above the surface can desiccate (dry out).
- d. The symbiotic photosynthetic algae within the corals cannot photosynthesize efficiently when the corals are near the surface due to lack of light.
- e. a., b. and c.

53. The decline in coral growth rates with increasing growth-rate depth to the right of C reflects the fact that

- a. Corals below the surface are subject to erosion by winds and waves.
- b. Corals below the surface cannot feed.
- c. The symbiotic photosynthetic algae within the corals cannot photosynthesize efficiently when the corals are far below the surface due to lack of light.
- d. a. and b.

54. Which of the following are stable equilibria?

- a. A and C.
- b. B and D.
- c. A., C. and E.
- d. Only B.
- e. Only D.

55. What happens if coral depth falls below level D – for example, if there is a violent earthquake that suddenly drops the sea floor?

- a. The corals slowly grow back to depth A.
- b. The corals slowly grow back to depth B.
- c. The corals slowly grow back to depth C.
- d. The corals maintain a constant depth.
- e. Coral depth continues to increase, and the corals die.