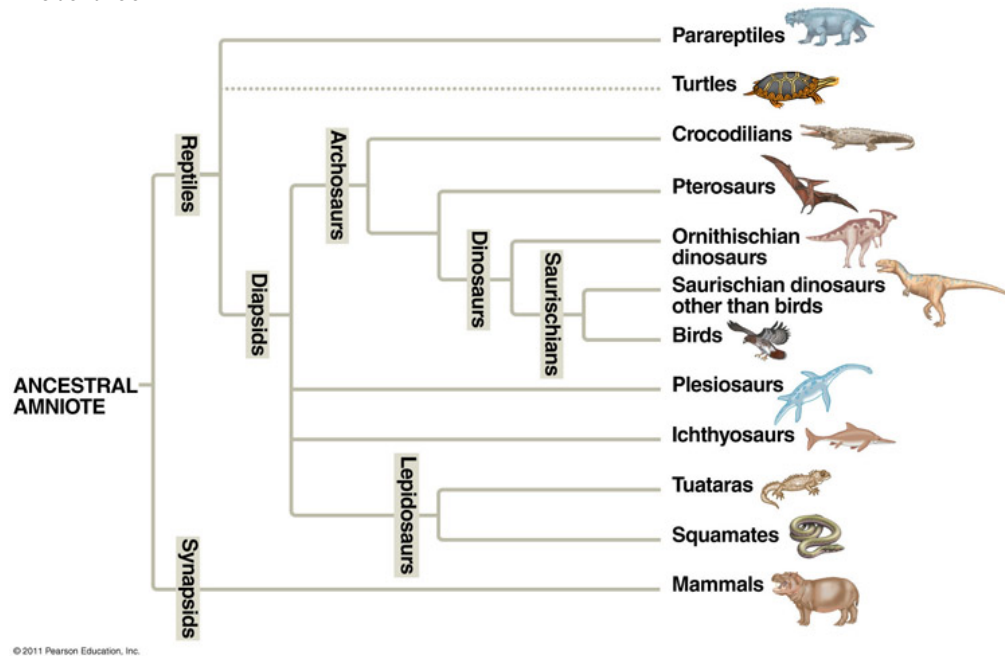


1. A species of frog was separated into two populations in the Andean mountains several thousand years ago by a cold spell that prevented them from living on hills separating two valleys. Offspring from the two populations are now observed to survive, grow and reproduce well on the hills and in the valleys. These two populations are most likely undergoing

- A. Fusion
- B. Divergence through reinforcement
- C. Speciation through hybridization
- D. Competitive exclusion
- E. Allopolyploidy

Amniote tree



2. According to the model shown in Amniote tree, the sister taxon of the crocodilians is:

- A. The pterosaurs
- B. The pterosaurs plus the ornithischian dinosaurs
- C. The pterosaurs plus the dinosaurs (not including the birds)
- D. The pterosaurs plus the dinosaurs (including the birds)

3. Which of the following labelled groups on the Amniote tree is *not* a clade according to the model shown in the tree?

- A. Plesiosaurs
- B. Lepidosauria
- C. Diapsids
- D. Saurischians
- E. None; these are all clades

4. Scientists should use phenetic analysis:

- A. Always
- B. Never
- C. Whenever there is enough information to do so
- D. When there is enough information to do so, but not enough to do a cladistic analysis

5. Pine trees and oak trees share similar vascular adaptations for getting water to high leaves. Grasses lack these adaptations. Scientists now have strong evidence that oak and grass are closely related to each other, and that pine is a more distant relative. The vascular adaptations are probably examples of _____ if the common ancestor of pines, oaks and grasses had them, and of _____ if the common ancestor did not have them.

- A. homology; homology
- B. homoplasy; homology
- C. homology; homoplasy
- D. homoplasy; homoplasy

6. Why is a phylogenetic tree an imperfect model of the true history of life?

- A. Because of natural selection
- B. Because of genetic drift
- C. Because of sex and gene transfer
- D. It doesn't have to be; if we knew enough to construct the best tree there would be no problem

7. Which of the following is the best example of co-evolution?

- A. Apes radiated into many habitats, and were later replaced by monkeys
- B. The radiation of flowering plants provided habitats that encouraged the radiation of primates
- C. Insect-eating birds evolve to catch different kinds of insects; different kinds of insects evolve to avoid insect-eating birds
- D. Lizards arriving on several different islands evolve to fill similar niches in similar ways

8. Taxonomic bias refers to the fact that
- A. Fossils are more likely to form at certain times
 - B. Fossils are more likely to form in certain places
 - C. Fossils are more likely to be *found* in certain places
 - D. Abundant taxa are more likely to form fossils
 - E. Taxa with hard parts are more likely to form fossils
9. A polyploid population living in sympatry with its ancestor population may be less likely to lead to a divergence event because of
- A. gene flow
 - B. competition
 - C. both of these apply
 - D. neither of these apply
10. We discussed the fact that gene duplication is usually bad for _____ but can sometimes be good for _____.
- A. efficiency; efficiency
 - B. efficiency; innovation
 - C. innovation; efficiency
 - D. innovation; innovation
11. A population of crows living in a city has a great deal of variation in reproductive success based on the ability of individuals to use flexible strategies for finding and processing food. This population will experience adaptive selection for individuals to improve this ability _____.
- A. no matter what
 - B. only if the population is growing
 - C. only if this ability is heritable in the population
 - D. only if the type of food available continues to change
12. Scientists believe that some hawks learn to specialize on the common color of squirrels in their area: if grey-colored squirrels are more common, the hawks search, find and eat grey-colored squirrels, and if black-colored squirrels are more common, the hawks search, find and eat black-colored squirrels. If true, this would be a mechanism for:
- A. Stabilizing selection
 - B. Directional selection
 - C. Frequency-dependent selection
 - D. Heterozygote advantage

13. Which of the following is *not* an example of observer bias?

- A. People used to think that chimps were more closely related to gorillas than to people
- B. People used to think that differences between human population were bigger than those between chimpanzee populations
- C. We understand more about clades that we see than those that we don't
- D. Human biology is difficult to understand because of complex culture and large, complicated brains

14. Which of the following is *not* a reason why clades with a history of radiation may be more successful, even if they have later contracted?

- A. They have progressed further towards the "goal state" of a highly efficient organism
- B. They have explored more kinds of environments
- C. They may still be present in more varied places
- D. They have had more chances to adapt

15. Modern humans arose 200K years ago according to the fossil record, but only spread widely throughout the world in the last 50K years. Which of the following is *not* a likely reason why it took 150K years for them to start spreading?

- A. Conditions were good and there was no evolutionary pressure to spread
- B. There was a cultural change that helped them survive and reproduce better
- C. There was a gradual evolutionary change that helped them survive and reproduce better
- D. There was a sudden evolutionary change that helped them survive and reproduce better

16. Grevy's zebras live in large, well-mixed social groups. Male plains zebras fight to become stallions, who then control "harems" of reproductive females. Compared to plains zebras, we would expect male Grevy's zebras to invest _____ in fighting strength and _____ in genitals (as a proportion of available resources).

- A. more; more
- B. more; less
- C. less; more
- D. less; less

17. The fact that humans have unusually complicated brains likely reflects:

- A. A changing physical environment that our ancestors needed to adapt to
- B. Loops involving bigger brains and complex culture and language
- C. Competition from other primates
- D. Competition from non-primates

18. Genetic information allows scientists to make more reliable phylogenetic trees mostly because:

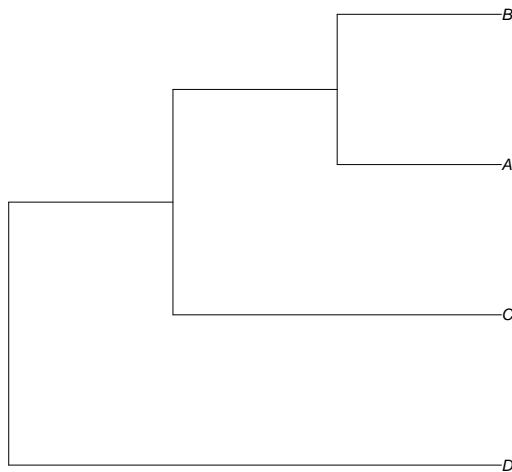
- A. Genetic information allows us to measure a greater number of traits
- B. Genetic traits can be measured more reliably than morphological traits
- C. It is easier to tell whether genetic traits are homologous
- D. Genetic traits are necessary for making cladistic trees, which are in turn a better model of evolution

Short-answer questions

Answer questions *in pen*. *Briefly* show necessary work and equations. Points may be *deducted* for wrong information, even when the correct information is also there.

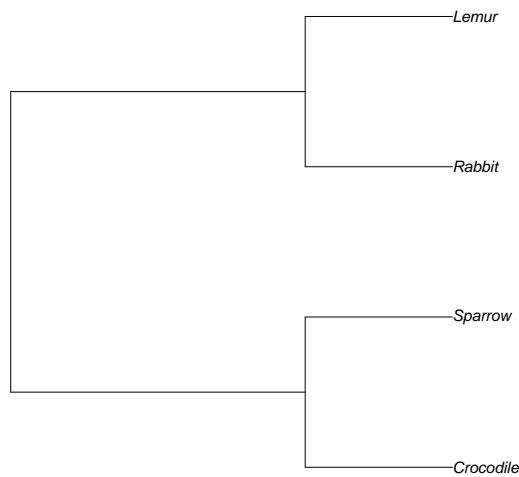
19. Assume the following are all derived characters in the relevant context. Crocodiles have amniotic eggs, eggshells, and claws; Lemurs have amniotic eggs and hair; Rabbits have amniotic eggs, hair, and claws; Sparrows have amniotic eggs, eggshells and claws.

a) (1 point) Based on this information alone, which two species are most likely to be sisters at the species level?



b) (2 points) A scientist draws the tree above, based on the information above. Which species should correspond to which labels?

c) (2 points) According to the tree above, is C more closely related to A or to B? To B or to D?



d) (2 points) Another scientist draws the tree above, based on the same information. Which character listed above does *not* support this tree? If this tree is correct, how would you explain the evolution of the character that does not fit?