

AP Biology - Evolution Unit Practice Exam

Multiple Choice

Identify the choice that best completes the statement or answers the question.

- _____ 1) Catastrophism, meaning the regular occurrence of geological or meteorological disturbances (catastrophes), was Cuvier's attempt to explain the existence of
- A) evolution.
 - B) the fossil record.
 - C) uniformitarianism.
 - D) the origin of new species.
 - E) natural selection.
- _____ 2) What was the prevailing belief prior to the time of Lyell and Darwin?
- A) Earth is a few thousand years old, and populations are unchanging.
 - B) Earth is a few thousand years old, and populations gradually change.
 - C) Earth is millions of years old, and populations rapidly change.
 - D) Earth is millions of years old, and populations are unchanging.
 - E) Earth is millions of years old, and populations gradually change.
- _____ 3) During a study session about evolution, one of your fellow students remarks, "The giraffe stretched its neck while reaching for higher leaves; its offspring inherited longer necks as a result." Which statement is most likely to be helpful in correcting this student's misconception?
- A) Characteristics acquired during an organism's life are generally not passed on through genes.
 - B) Spontaneous mutations can result in the appearance of new traits.
 - C) Only favorable adaptations have survival value.
 - D) Disuse of an organ may lead to its eventual disappearance.
 - E) If the giraffes did not have to compete with each other, longer necks would not have been passed on to the next generation.
- _____ 4) Which of the following is the most accurate summary of Cuvier's consideration of fossils found in the vicinity of Paris?
- A) extinction of species yes; evolution of new species yes
 - B) extinction of species no; evolution of new species yes
 - C) extinction of species yes; evolution of new species no
 - D) extinction of species no; evolution of new species yes
- _____ 5) In the mid-1900s, the Soviet geneticist Lysenko believed that his winter wheat plants, exposed to ever-colder temperatures, would eventually give rise to ever more cold-tolerant winter wheat. Lysenko's attempts in this regard were most in agreement with the ideas of
- A) Cuvier.
 - B) Hutton.
 - C) Lamarck.
 - D) Darwin.
 - E) Lyell.

- _____ 6) Which of these conditions should completely prevent the occurrence of natural selection in a population over time?
- A) All variation between individuals is due only to environmental factors.
 - B) The environment is changing at a relatively slow rate.
 - C) The population size is large.
 - D) The population lives in a habitat where there are no competing species present.
- _____ 7) Natural selection is based on all of the following *except*
- A) genetic variation exists within populations.
 - B) the best-adapted individuals tend to leave the most offspring.
 - C) individuals who survive longer tend to leave more offspring than those who die young.
 - D) populations tend to produce more individuals than the environment can support.
 - E) individuals adapt to their environments and, thereby, evolve.
- _____ 8) Which of the following represents an idea that Darwin learned from the writings of Thomas Malthus?
- A) Technological innovation in agricultural practices will permit exponential growth of the human population into the foreseeable future.
 - B) Populations tend to increase at a faster rate than their food supply normally allows.
 - C) Earth changed over the years through a series of catastrophic upheavals.
 - D) The environment is responsible for natural selection.
 - E) Earth is more than 10,000 years old.
- _____ 9) A biologist studied a population of squirrels for 15 years. During that time, the population was never fewer than 30 squirrels and never more than 45. Her data showed that over half of the squirrels born did not survive to reproduce, because of both competition for food and predation. In a single generation, 90% of the squirrels that were born lived to reproduce, and the population increased to 80. Which inference(s) about this population might be true?
- A) The amount of available food may have increased.
 - B) The parental generation of squirrels developed better eyesight due to improved diet; the subsequent squirrel generation inherited better eyesight.
 - C) The squirrels of subsequent generations should show greater levels of genetic variation than previous generations, because squirrels that would not have survived in the past will now survive.
 - D) Three of the statements above are correct.
 - E) Two of the statements above are correct.
- _____ 10) Which of the following must exist in a population before natural selection can act upon that population?
- A) genetic variation among individuals
 - B) variation among individuals caused by environmental factors
 - C) sexual reproduction
 - D) Three of the responses are correct.
 - E) Two of the responses are correct.
- _____ 11) Which of Darwin's ideas had the strongest connection to Darwin having read Malthus's essay on human population growth?

- A) descent with modification
- B) variation among individuals in a population
- C) struggle for existence
- D) the ability of related species to be conceptualized in "tree thinking"
- E) that the ancestors of the Galápagos finches had come from the South American mainland

- _____ 12) If Darwin had been aware of genes, and of their typical mode of transmission to subsequent generations, with which statement would he most likely have been in agreement?
- A) If natural selection can change one gene's frequency in a population over the course of generations then, given enough time and enough genes, natural selection can cause sufficient genetic change to produce new species from old ones.
 - B) If an individual's somatic cell genes change during its lifetime, making it more fit, then it will be able to pass these genes on to its offspring.
 - C) If an individual acquires new genes by engulfing, or being infected by, another organism, then a new genetic species will be the result.
 - D) A single mutation in a single gene in a single gamete will, if perpetuated, produce a new species within just two generations.
- _____ 13) The role that humans play in artificial selection is to
- A) determine who lives and who dies.
 - B) create the genetic variants, which nature then selects.
 - C) choose which organisms breed, and which do not.
 - D) train organisms to breed more successfully.
 - E) perform artificial insemination.
- _____ 14) Currently, two extant elephant species (X and Y) are placed in the genus *Loxodonta*, and a third species (Z) is placed in the genus *Elephas*. Thus, which statement should be true?
- A) Species X and Y are not related to species Z.
 - B) Species X and Y share a greater number of homologies with each other than either does with species Z.
 - C) Species X and Y share a common ancestor that is still extant (in other words, not yet extinct).
 - D) Species X and Y are the result of artificial selection from an ancestral species Z.
 - E) Species X, Y, and Z share a common ancestor, but nothing more can be claimed than this.
- _____ 15) The rise of methicillin-resistant *Staphylococcus aureus* (MRSA) can be considered to be an example of artificial selection because
- A) humans purposefully raise MRSA in large fermenters in an attempt to make the bacteria ever-more resistant.
 - B) *S. aureus* is cultivated by humans to replenish the soil with nutrients.
 - C) humans synthesize methicillin and create environments in which bacteria frequently come into contact with methicillin.
 - D) Humans are becoming resistant to bacteria by taking methicillin.

- _____ 16) DDT was once considered a "silver bullet" that would permanently eradicate insect pests. Today, instead, DDT is largely useless against many insects. Which of these would have been required for this pest eradication effort to be successful in the long run?
- A) Larger doses of DDT should have been applied.
 - B) All habitats should have received applications of DDT at about the same time.
 - C) The frequency of DDT application should have been higher.
 - D) None of the individual insects should have possessed genomes that made them resistant to DDT.
 - E) DDT application should have been continual.
- _____ 17) If the bacterium *Staphylococcus aureus* experiences a cost for maintaining one or more antibiotic-resistance genes, then what should happen in environments from which antibiotics are missing?
- A) These genes should continue to be maintained in case the antibiotics ever appear.
 - B) These bacteria should be outcompeted and replaced by bacteria that have lost these genes.
 - C) The bacteria should try to make the cost worthwhile by locating, and migrating to, microenvironments where traces of antibiotics are present.
 - D) The bacteria should start making and secreting their own antibiotics.
- _____ 18) If two modern organisms are distantly related in an evolutionary sense, then one should expect that
- A) they live in very different habitats.
 - B) they should share fewer homologous structures than two more closely related organisms.
 - C) their chromosomes should be very similar.
 - D) they shared a common ancestor relatively recently.
 - E) they should be members of the same genus.
- _____ 19) Structures as different as human arms, bat wings, and dolphin flippers contain many of the same bones, these bones having developed from very similar embryonic tissues. How do biologists interpret these similarities?
- A) by identifying the bones as being homologous structures
 - B) by the principle of convergent evolution
 - C) by proposing that humans, bats, and dolphins share a common ancestor
 - D) Three of the statements above are correct.
 - E) Two of the statements above are correct.
- _____ 20) Over evolutionary time, many cave-dwelling organisms have lost their eyes. Tapeworms have lost their digestive systems. Whales have lost their hind limbs. How can natural selection account for these losses?
- A) Natural selection cannot account for losses, only for innovations.
 - B) Natural selection accounts for these losses by the principle of use and disuse.
 - C) Under particular circumstances that persisted for long periods, each of these structures presented greater costs than benefits.
 - D) The ancestors of these organisms experienced harmful mutations that forced them to find new habitats that these species had not previously used.

- _____ 21) Logically, which of these should cast the most doubt on the relationships depicted by an evolutionary tree?
- A) None of the organisms depicted by the tree ate the same foods.
 - B) Some of the organisms depicted by the tree had lived in different habitats.
 - C) The skeletal remains of the organisms depicted by the tree were incomplete (in other words, some bones were missing).
 - D) Transitional fossils had not been found.
 - E) Relationships between DNA sequences among the species did not match relationships between skeletal patterns.
- _____ 22) Which of the following statements most detracts from the claim that the human appendix is a *completely* vestigial organ?
- A) The appendix can be surgically removed with no immediate ill effects.
 - B) The appendix might have been larger in fossil hominids.
 - C) The appendix has a substantial amount of defensive lymphatic tissue.
 - D) Individuals with a larger-than-average appendix leave fewer offspring than those with a below-average-sized appendix.
 - E) In a million years, the human species might completely lack an appendix.
- _____ 23) Ichthyosaurs were aquatic dinosaurs. Fossils show us that they had dorsal fins and tails, as do fish, even though their closest relatives were terrestrial reptiles that had neither dorsal fins nor aquatic tails. The dorsal fins and tails of ichthyosaurs and fish are
- A) homologous.
 - B) examples of convergent evolution.
 - C) adaptations to a common environment.
 - D) Three of the responses above are correct.
 - E) Two of the responses above are correct.
- _____ 24) Both ancestral birds and ancestral mammals shared a common ancestor that was terrestrial. Today, penguins (which are birds) and seals (which are mammals) have forelimbs adapted for swimming. What term best describes the relationship of the bones in the forelimbs of penguins and seals, and what term best describes the flippers of penguins and seals?
- A) homologous; homologous
 - B) analogous; homologous
 - C) homologous; analogous
 - D) analogous; analogous
- _____ 25) What must be true of any organ that is described as *vestigial*?
- A) It must be analogous to some feature in an ancestor.
 - B) It must be homologous to some feature in an ancestor.
 - C) It must be both homologous and analogous to some feature in an ancestor.
 - D) It need be neither homologous nor analogous to some feature in an ancestor.
- _____ 26) What is true of pseudogenes?
- A) They are composed of RNA, rather than DNA.
 - B) They are the same things as introns.
 - C) They are unrelated genes that code for the same gene product.
 - D) They are vestigial genes.

- _____ 27) It has been observed that organisms on islands are different from, but closely related to, similar forms found on the nearest continent. This is taken as evidence that
- A) island forms and mainland forms descended from common ancestors.
 - B) common environments are inhabited by the same organisms.
 - C) the islands were originally part of the continent.
 - D) the island forms and mainland forms are converging.
 - E) island forms and mainland forms have identical gene pools.
- _____ 28) A high degree of endemism is most likely in environments that are
- A) easily reached and heterogeneous.
 - B) isolated and heterogeneous.
 - C) isolated and homogeneous.
 - D) isolated and extremely cold.
 - E) easily reached and homogeneous.

The following questions refer to Figure 22.1, which shows an outcrop of sedimentary rock whose strata are labeled A–D.

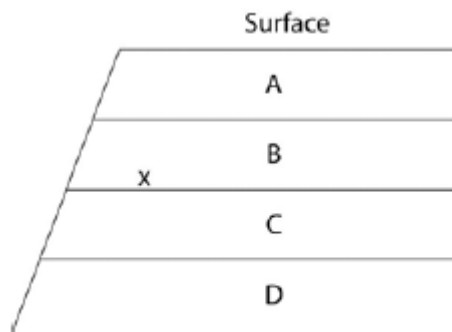
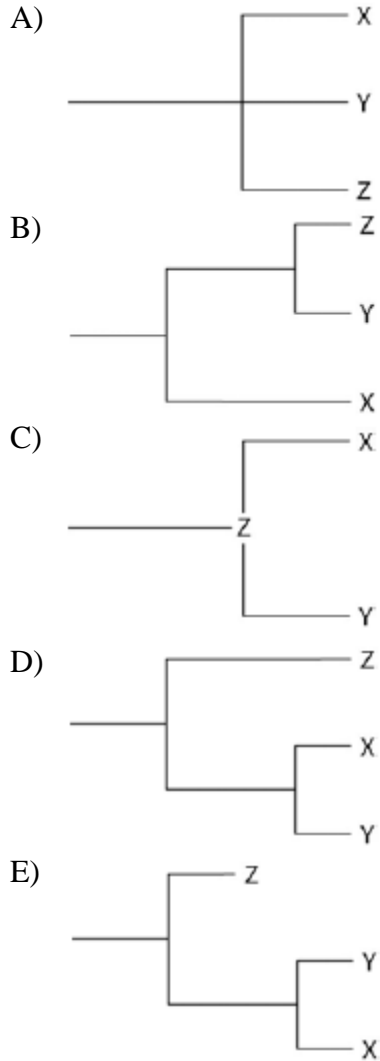


Figure 22.1

- _____ 29) If x indicates the location of fossils of two closely related species, then fossils of their most-recent common ancestor are most likely to occur in which stratum?
- A) A
 - B) B
 - C) C
 - D) D
- _____ 30) If x indicates the fossils of two closely related species, neither of which is extinct, then their remains may be found in how many of these strata?
- A) one stratum
 - B) two strata
 - C) three strata
 - D) four strata

31) Currently, two extant elephant species (X and Y) are placed in the genus *Loxodonta* and a third species (Z) is placed in the genus *Elephas*. Assuming this classification reflects evolutionary relatedness, which of the following is the most accurate phylogenetic tree?



The following questions refer to the evolutionary tree in Figure 22.2.

The horizontal axis of the cladogram depicted below is a timeline that extends from 100,000 years ago to the present; the vertical axis represents nothing in particular. The labeled branch points on the tree (V–Z) represent various common ancestors. Let’s say that only since 50,000 years ago has there been enough variation between the lineages depicted here to separate them into distinct species, and only the tips of the lineages on this tree represent distinct species.

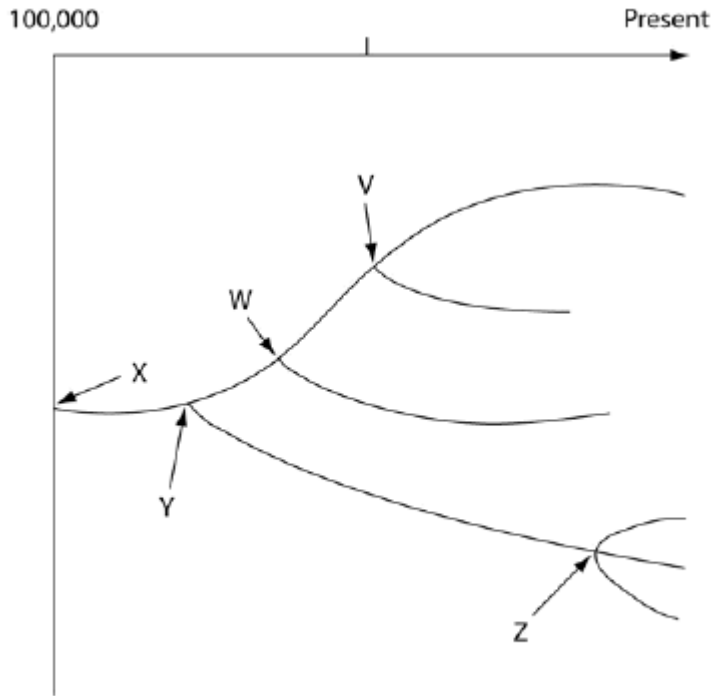


Figure 22.2

- ___ 32) How many separate species, both extant and extinct, are depicted in this tree?
- A) two
 - B) three
 - C) four
 - D) five
 - E) six
- ___ 33) According to this tree, what percent of the species seem to be extant (in other words, not extinct)?
- A) 25%
 - B) 33%
 - C) 50%
 - D) 66%
 - E) 75%
- ___ 34) Which of the five common ancestors, labeled V–Z, has given rise to the greatest number of species, both extant and extinct?
- A) V
 - B) W
 - C) Z
 - D) Both W and Z can be considered to have given rise to the greatest number of extant and extinct species.
 - E) Both X and Y can be considered to have given rise to the greatest number of extant and extinct species.

- _____ 35) Which of the five common ancestors, labeled V–Z, has been least successful in terms of the percent of its derived species that are extant?
- A) V
 - B) W
 - C) X
 - D) Y
 - E) Z
- _____ 36) Which of the five common ancestors, labeled V–Z, has been most successful in terms of the percent of its derived species that are extant?
- A) V
 - B) W
 - C) X
 - D) Y
 - E) Z
- _____ 37) Which pair would probably have agreed with the process that is depicted by this tree?
- A) Cuvier and Lamarck
 - B) Lamarck and Wallace
 - C) Aristotle and Lyell
 - D) Wallace and Linnaeus
 - E) Linnaeus and Lamarck
- _____ 38) Evolutionary trees such as this are properly understood by scientists to be
- A) theories.
 - B) hypotheses.
 - C) guesses.
 - D) dogmas.
 - E) facts.

About 13 different species of finches inhabit the Galápagos Islands today, all descendants of a common ancestor from the South American mainland that arrived a few million years ago. Genetically, there are four distinct lineages, but the 13 species are currently classified among three genera. The first lineage to diverge from the ancestral lineage was the warbler finch (genus *Certhidea*). Next to diverge was the vegetarian finch (genus *Camarhynchus*), followed by five tree finch species (also in genus *Camarhynchus*) and six ground finch species (genus *Geospiza*).

- _____ 39) If the six ground finch species have evolved most recently, then which of these is the most logical prediction?
- A) They should be limited to the six islands that most recently emerged from the sea.
 - B) Their genomes should be more similar to each other than are the genomes of the five tree finch species.
 - C) They should share fewer anatomical homologies with each other than they share with the tree finches.
 - D) The chances of hybridization between two ground finch species should be less than the chances of hybridization between two tree finch species.

- _____ 40) According to a 1999 study, the vegetarian finch is genetically no more similar to the tree finches than it is to the ground finches, despite the fact that it is placed in the same genus as the tree finches. Based on this finding, it is reasonable to conclude that the vegetarian finch
- A) is no more closely related to the tree finches than it is to the ground finches, despite its classification.
 - B) should be re-classified as a warbler finch.
 - C) is not truly a descendent of the original ancestral finch.
 - D) is a hybrid species, resulting from a cross between a ground finch and a tree finch.
- _____ 41) A 14th species that descended from the original ancestral finch, the Cocos Island finch, is endemic to its namesake island, located 550 km off Costa Rica. The Cocos Island finch is genetically much more similar to the tree finches than is the vegetarian finch, yet it is classified in its own genus *Pinarolaxias*. Moreover, the Cocos Island finch and the vegetarian finch are the two finch species that are most genetically different from the ancestral Galápagos finch. Thus, if classification is to reflect evolutionary relationships, the vegetarian finch should
- A) remain in the genus *Camarhynchus*.
 - B) be switched from *Camarhynchus* to *Certhidea*.
 - C) be switched from *Camarhynchus* to *Pinarolaxias*.
 - D) be switched from *Camarhynchus* to *Geospiza*.
 - E) be placed in its own genus.
- _____ 42) Which of the following is *not* an observation or inference on which natural selection is based?
- A) There is heritable variation among individuals.
 - B) Poorly adapted individuals never produce offspring.
 - C) Species produce more offspring than the environment can support.
 - D) Individuals whose characteristics are best suited to the environment generally leave more offspring than those whose characteristics are less well suited.
 - E) Only a fraction of an individual's offspring may survive.
- _____ 43) Which of the following observations helped Darwin shape his concept of descent with modification?
- A) Species diversity declines farther from the equator.
 - B) Fewer species live on islands than on the nearest continents.
 - C) Birds can be found on islands located farther from the mainland than the birds' maximum nonstop flight distance.
 - D) South American temperate plants are more similar to the tropical plants of South America than to the temperate plants of Europe.
 - E) Earthquakes reshape life by causing mass extinctions.
- _____ 44) The upper forelimbs of humans and bats have fairly similar skeletal structures, whereas the corresponding bones in whales have very different shapes and proportions. However, genetic data suggest that all three kinds of organisms diverged from a common ancestor at about the same time. Which of the following is the most likely explanation for these data?
- A) Humans and bats evolved by natural selection, and whales evolved by Lamarckian mechanisms.
 - B) Forelimb evolution was adaptive in people and bats, but not in whales.
 - C) Natural selection in an aquatic environment resulted in significant changes to whale forelimb anatomy.

- D) Genes mutate faster in whales than in humans or bats.
E) Whales are not properly classified as mammals.
- ___ 45) If, on average, 46% of the loci in a species' gene pool are heterozygous, then the average homozygosity of the species should be
A) 23%.
B) 46%.
C) 54%.
D) There is not enough information to say.
- ___ 46) Which of these variables is likely to undergo the largest change in value as the result of a mutation that introduces a brand-new allele into a population's gene pool at a locus that had formerly been fixed?
A) average heterozygosity
B) nucleotide variability
C) geographic variability
D) average number of loci
- ___ 47) Although each of the following has a better chance of influencing gene frequencies in small populations than in large populations, which one most consistently requires a small population as a precondition for its occurrence?
A) mutation
B) nonrandom mating
C) genetic drift
D) natural selection
E) gene flow
- ___ 48) A trend toward the decrease in the size of plants on the slopes of mountains as altitudes increase is an example of
A) a cline.
B) a bottleneck.
C) relative fitness.
D) genetic drift.
E) geographic variation.
- ___ 49) The higher the proportion of loci that are "fixed" in a population, the lower is that population's
A) nucleotide variability only.
B) genetic polyploidy only.
C) average heterozygosity only.
D) nucleotide variability, average heterozygosity, and genetic polyploidy.
E) nucleotide variability and average heterozygosity only.
- ___ 50) Which statement about variation is true?
A) All phenotypic variation is the result of genotypic variation.
B) All genetic variation produces phenotypic variation.
C) All nucleotide variability results in neutral variation.
D) All new alleles are the result of nucleotide variability.
E) All geographic variation results from the existence of clines.

- _____ 51) Rank the following one –base point mutations (from most likely to least likely) with respect to their likelihood of affecting the structure of the corresponding polypeptide:
1. insertion mutation deep within an intron
 2. substitution mutation at the third position of an exonic codon
 3. substitution mutation at the second position of an exonic codon
 4. deletion mutation within the first exon of the gene
- A) 1, 2, 3, 4
B) 4, 3, 2, 1
C) 2, 1, 4, 3
D) 3, 1, 4, 2
E) 2, 3, 1, 4
- _____ 52) Most invertebrates have a cluster of ten similar *Hox* genes, all located on the same chromosome. Most vertebrates have four such clusters of *Hox* genes, located on four nonhomologous chromosomes. The process that could have potentially contributed to the cluster's presence on more than one chromosome was _____.
- A) binary fission
B) translation
C) gene duplication
D) nondisjunction
E) transcription
- _____ 53) Which of the following is a true statement concerning genetic variation?
- A) It is created by the direct action of natural selection.
B) It arises in response to changes in the environment.
C) It must be present in a population before natural selection can act upon the population.
D) It tends to be reduced by the processes involved when diploid organisms produce gametes.
E) A population that has a higher average heterozygosity has less genetic variation than one with a lower average heterozygosity.
- _____ 54) How many of these statements regarding populations are true?
1. Mature males and females of a population can interbreed with each other.
 2. Populations are sometimes geographically isolated from other populations.
 3. Biological species are made up of populations.
 4. Members of a population tend to be genetically more similar to each other than to members of other populations.
 5. Populations have genomes, but not gene pools.
- A) Only one of these statements is true.
B) Two of these statements are true.
C) Three of these statements are true.
D) Four of these statements are true.
E) All five of these statements are true.
- _____ 55) In the formula for determining a population's genotype frequencies, the 2 in the term $2pq$ is necessary because
- A) the population is diploid.

- B) heterozygotes can come about in two ways.
- C) the population is doubling in number.
- D) heterozygotes have two alleles.

- _____ 56) In the formula for determining a population's genotype frequencies, the pq in the term $2pq$ is necessary because
- A) the population is diploid.
 - B) heterozygotes can come about in two ways.
 - C) the population is doubling in number.
 - D) heterozygotes have two alleles.
- _____ 57) In a Hardy–Weinberg population with two alleles, A and a , that are in equilibrium, the frequency of the allele a is 0.3. What is the percentage of the population that is homozygous for this allele?
- A) 0.09
 - B) 0.49
 - C) 0.9
 - D) 9.0
 - E) 49.0
- _____ 58) In a Hardy–Weinberg population with two alleles, A and a , that are in equilibrium, the frequency of allele a is 0.2. What is the percentage of the population that is heterozygous for this allele?
- A) 0.2
 - B) 2.0
 - C) 4.0
 - D) 16.0
 - E) 32.0
- _____ 59) You sample a population of butterflies and find that 56% are heterozygous at a particular locus. What should be the frequency of the recessive allele in this population?
- A) 0.07
 - B) 0.08
 - C) 0.09
 - D) 0.70
 - E) Allele frequency cannot be determined from this information.
- _____ 60) In peas, a gene controls flower color such that R = purple and r = white. In an isolated pea patch, there are 36 purple-flowering plants and 64 white-flowering plants. Assuming Hardy–Weinberg equilibrium, what is the value of q for this population?
- A) 0.36
 - B) 0.64
 - C) 0.75
 - D) 0.80
- _____ 61) Over time, the movement of people on Earth has steadily increased. This has altered the course of human evolution by increasing
- A) nonrandom mating.
 - B) geographic isolation.
 - C) genetic drift.

D) gene flow.

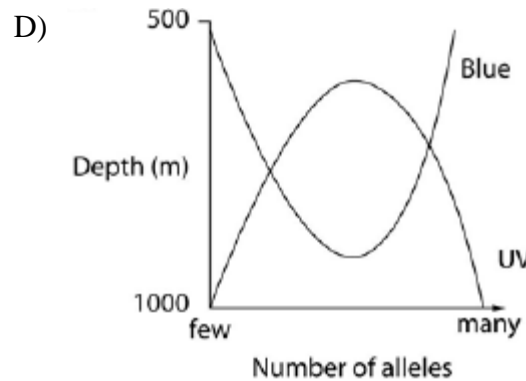
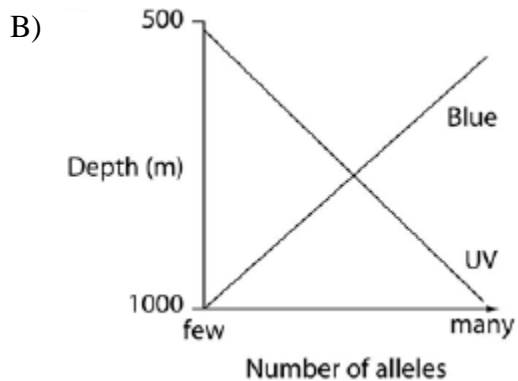
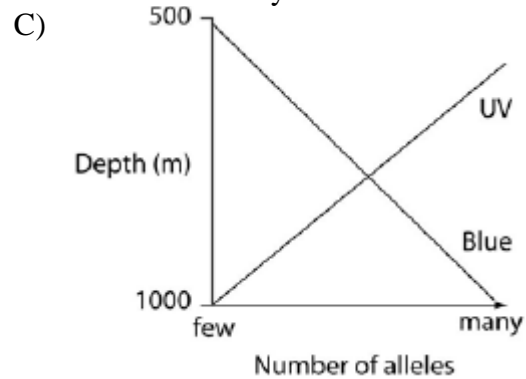
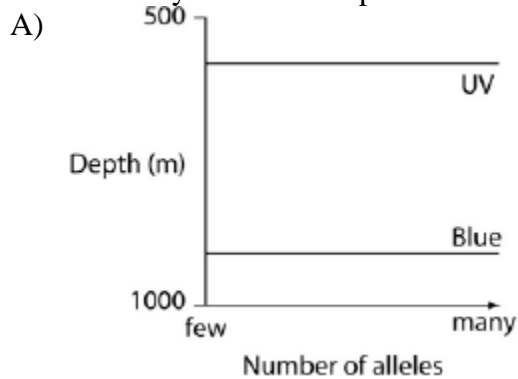
- _____ 62) If the original finches that had been blown over to the Galápagos from South America had already been genetically different from the parental population of South American finches, even before adapting to the Galápagos, this would have been an example of
- A) genetic drift.
 - B) bottleneck effect.
 - C) founder effect.
 - D) all three of these.
 - E) both the first and third of these.
- _____ 63) The restriction enzymes of bacteria protect the bacteria from successful attack by bacteriophages, whose genomes can be degraded by the restriction enzymes. The bacterial genomes are not vulnerable to these restriction enzymes because bacterial DNA is methylated. This situation selects for bacteriophages whose genomes are also methylated. As new strains of resistant bacteriophages become more prevalent, this in turn selects for bacteria whose genomes are not methylated and whose restriction enzymes instead degrade methylated DNA. The outcome of the conflict between bacteria and bacteriophage at any point in time results from
- A) frequency-dependent selection.
 - B) evolutionary imbalance.
 - C) heterozygote advantage.
 - D) neutral variation.
 - E) genetic variation being preserved by diploidy.
- _____ 64) Arrange the following from most general (i.e., most inclusive) to most specific (i.e., least inclusive):
- 1. natural selection
 - 2. microevolution
 - 3. intrasexual selection
 - 4. evolution
 - 5. sexual selection
- A) 4, 1, 2, 3, 5
 - B) 4, 2, 1, 3, 5
 - C) 4, 2, 1, 5, 3
 - D) 1, 4, 2, 5, 3
 - E) 1, 2, 4, 5, 3
- _____ 65) Most Swiss starlings produce four to five eggs in each clutch. Starlings producing fewer, or more, than this have reduced fitness. Which of the following terms best describes this situation?
- A) artificial selection
 - B) directional selection
 - C) stabilizing selection
 - D) disruptive selection
 - E) sexual selection
- _____ 66) The recessive allele that causes phenylketonuria (PKU) is harmful, except when an infant's diet lacks the amino acid phenylalanine. What maintains the presence of this harmful allele in a population's gene pool?

- A) heterozygote advantage
- B) stabilizing selection
- C) diploidy
- D) balancing selection

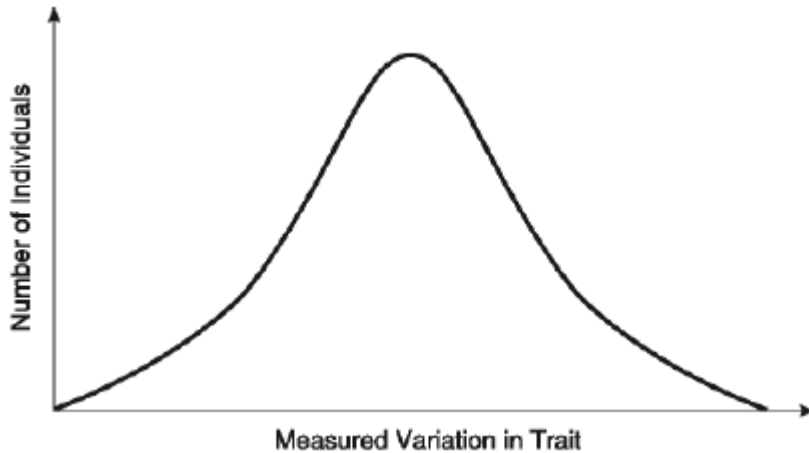
- _____ 67) Heterozygote advantage should be most closely linked to which of the following?
- A) sexual selection
 - B) stabilizing selection
 - C) random selection
 - D) directional selection
 - E) disruptive selection
- _____ 68) In seedcracker finches from Cameroon, small- and large-billed birds specialize in cracking soft and hard seeds, respectively. If long-term climatic change resulted in all seeds becoming hard, what type of selection would then operate on the finch population?
- A) disruptive selection
 - B) directional selection
 - C) stabilizing selection
 - D) No selection would operate because the population is in Hardy-Weinberg equilibrium.
- _____ 69) The same gene that causes various coat patterns in wild and domesticated cats also causes the cross-eyed condition in these cats, the cross-eyed condition being slightly maladaptive. In a hypothetical environment, the coat pattern that is associated with crossed eyes is highly adaptive, with the result that both the coat pattern and the cross-eyed condition increase in a feline population over time. Which statement is supported by these observations?
- A) Evolution is progressive and tends toward a more perfect population.
 - B) Phenotype is often the result of compromise.
 - C) Natural selection reduces the frequency of maladaptive genes in populations over the course of time.
 - D) Polygenic inheritance is generally maladaptive, and should become less common in future generations.
 - E) In all environments, coat pattern is a more important survival factor than is eye-muscle tone.
- _____ 70) A proficient engineer can easily design skeletal structures that are more functional than those currently found in the forelimbs of such diverse mammals as horses, whales, and bats. The actual forelimbs of these mammals do not seem to be optimally arranged because
- A) natural selection has not had sufficient time to create the optimal design in each case, but will do so given enough time.
 - B) in many cases, phenotype is not merely determined by genotype, but by the environment as well.
 - C) though we may not consider the fit between the current skeletal arrangements and their functions excellent, we should not doubt that natural selection ultimately produces the best design.
 - D) natural selection is generally limited to modifying structures that were present in previous generations and in previous species.

- 71) There are those who claim that the theory of evolution cannot be true because the apes, which are supposed to be closely related to humans, do not likewise share the same large brains, capacity for complicated speech, and tool-making capability. They reason that if these features are generally beneficial, then the apes should have evolved them as well. Which of these provides the best argument against this misconception?
- A) Advantageous alleles do not arise on demand.
 - B) A population's evolution is limited by historical constraints.
 - C) Adaptations are often compromises.
 - D) Evolution can be influenced by environmental change.

- 72) Blue light is that portion of the visible spectrum that penetrates the deepest into bodies of water. Ultraviolet (UV) light, though, can penetrate even deeper. A gene within a population of marine fish that inhabits depths from 500 m to 1,000 m has an allele for a photopigment that is sensitive to UV light, and another allele for a photopigment that is sensitive to blue light. Which of the following graphs best depicts the predicted distribution of these alleles within a population if the fish that carry these alleles prefer to locate themselves where they can see best?



In a very large population, a quantitative trait has the following distribution pattern:



- ___ 73) What is true of the trait whose frequency distribution in a large population appears in the previous figure? It has probably undergone
- directional selection.
 - stabilizing selection.
 - disruptive selection.
 - normal selection.
- ___ 74) If the curve in the previous figure shifts to the left or to the right, there is no gene flow, and the population size consequently increases over successive generations. Which of the following is (are) probably occurring?
- immigration or emigration
 - directional selection
 - adaptation
 - genetic drift
 - disruptive selection
- 1 only
 - 4 only
 - 2 and 3
 - 4 and 5
 - 1, 2, and 3

The following questions refer to the following paragraph.

HIV's genome of RNA includes the code for reverse transcriptase (RT), an enzyme that acts early in infection to synthesize a DNA genome off of an RNA template. The HIV genome also codes for protease (PR), an enzyme that acts later in infection by cutting long viral polyproteins into smaller, functional proteins. Both RT and PR represent potential targets for antiretroviral drugs. Drugs called nucleoside analogs (NA) act against RT, whereas drugs called protease inhibitors (PI) act against PR.

- ___ 75) Within the body of an HIV-infected individual who is being treated with a single NA, and whose HIV particles are currently vulnerable to this NA, which of these situations can increase the virus' relative fitness?

1. mutations resulting in RTs with decreased rates of nucleotide mismatch
2. mutations resulting in RTs with increased rates of nucleotide mismatch
3. mutations resulting in RTs that have proofreading capability

- A) 1 only
- B) 2 only
- C) 3 only
- D) 1 and 3
- E) 2 and 3

- _____ 76) HIV has nine genes in its RNA genome. Every HIV particle contains two RNA molecules, and each molecule contains all nine genes. If, for some reason, the two RNA molecules within a single HIV particle do not have identical sequences, then which of these terms can be applied due to the existence of the nonidentical regions?
- A) homozygous
 - B) gene variability
 - C) nucleotide variability
 - D) average heterozygosity
 - E) All but one of the responses are correct.
- _____ 77) Every HIV particle contains two RNA molecules. If two genes from one RNA molecule become detached and then, as a unit, get attached to one end of the other RNA molecule within a single HIV particle, which of these is true?
- A) There are now fewer genes within the viral particle.
 - B) There are now more genes within the viral particle.
 - C) A point substitution mutation has occurred in the retroviral genome.
 - D) The retroviral equivalent of crossing over has occurred, no doubt resulting in a heightened positive effect.
 - E) One of the RNA molecules has experienced gene duplication as the result of translocation.
- _____ 78) In a hypothetical population's gene pool, an autosomal gene, which had previously been fixed, undergoes a mutation that introduces a new allele, one inherited according to incomplete dominance. Natural selection then causes stabilizing selection at this locus. Consequently, what should happen over the course of many generations?
- A) The proportions of both types of homozygote should decrease.
 - B) The proportion of the population that is heterozygous at this locus should remain constant.
 - C) The population's average heterozygosity should decrease.
 - D) The two homozygotes should decrease at different rates.

Use this information to answer the following questions.

A large population of laboratory animals has been allowed to breed randomly for a number of generations. After several generations, 25% of the animals display a recessive trait (*aa*), the same percentage as at the beginning of the breeding program. The rest of the animals show the dominant phenotype, with heterozygotes indistinguishable from the homozygous dominants.

- _____ 79) What is the most reasonable conclusion that can be drawn from the fact that the frequency of the recessive trait (aa) has not changed over time?
- A) The population is undergoing genetic drift.
 - B) The two phenotypes are about equally adaptive under laboratory conditions.
 - C) The genotype AA is lethal.
 - D) There has been a high rate of mutation of allele A to allele a .
 - E) There has been sexual selection favoring allele a .
- _____ 80) What is the estimated frequency of allele A in the gene pool?
- A) 0.25
 - B) 0.50
 - C) 0.75
- _____ 81) What proportion of the population is probably heterozygous (Aa) for this trait?
- A) 0.05
 - B) 0.25
 - C) 0.50
 - D) 0.75

Use this information to answer the following questions.

You are studying three populations of birds. Population A has ten birds, of which one is brown (a recessive trait) and nine are red. Population B has 100 birds, of which ten are brown. Population C has 30 birds, and three of them are brown.

- _____ 82) Which population is most likely to be subject to the bottleneck effect?
- A) population A
 - B) population B
 - C) population C
 - D) They are all equally likely.
 - E) It is impossible to tell from the information given.

Use the following information to answer the following questions.

In those parts of equatorial Africa where the malaria parasite is most common, the sickle-cell allele constitutes 20% of the β hemoglobin alleles in the human gene pool.

- _____ 83) If the sickle-cell allele is recessive, what proportion of the population should be susceptible to sickle-cell anemia under typical conditions?
- A) 0.04
 - B) 0.16
 - C) 0.20
 - D) 0.32
 - E) 0.80

- _____ 84) In the United States, the parasite that causes malaria is not present, but African–Americans whose ancestors were from equatorial Africa are present. What should be happening to the sickle–cell allele in the United States, and what should be happening to it in equatorial Africa?
- A) stabilizing selection; disruptive selection
 - B) disruptive selection; stabilizing selection
 - C) disruptive selection; directional selection
 - D) directional selection; disruptive selection
 - E) directional selection; stabilizing selection
- _____ 85) Considering the overall human population of the U.S. mainland at the time when the slave trade brought large numbers of people from equatorial Africa, what was primarily acting to change the frequency of the sickle–cell allele in the overall U.S. population?
- A) natural selection
 - B) gene flow
 - C) genetic drift
 - D) founder effect
 - E) Two of the responses are correct.

In the year 2500, five male space colonists and five female space colonists (all unrelated to each other) settle on an uninhabited Earthlike planet in the Andromeda galaxy. The colonists and their offspring randomly mate for generations. All ten of the original colonists had free earlobes, and two were heterozygous for that trait. The allele for free earlobes is dominant to the allele for attached earlobes.

- _____ 86) If four of the original colonists died before they produced offspring, the ratios of genotypes could be quite different in the subsequent generations. This would be an example of
- A) diploidy.
 - B) gene flow.
 - C) genetic drift.
 - D) disruptive selection.
 - E) stabilizing selection.
- _____ 87) You are maintaining a small population of fruit flies in the laboratory by transferring the flies to a new culture bottle after each generation. After several generations, you notice that the viability of the flies has decreased greatly. Recognizing that small population size is likely to be linked to decreased viability, the best way to reverse this trend is to
- A) cross your flies with flies from another lab.
 - B) reduce the number of flies that you transfer at each generation.
 - C) transfer only the largest flies.
 - D) change the temperature at which you rear the flies.
 - E) shock the flies with a brief treatment of heat or cold to make them more hardy.
- _____ 88) The volcano is currently dormant, but in a hypothetical future scenario, satellite cones at the base of Mt. Kilimanjaro spew sulfurous gases and lava, destroying all life located between the base and 6,000 feet above sea level. As a result of this catastrophe, how should the frequency of the sickle–cell allele change in the remnant human population that survives above 6,000 feet, and which phenomenon accounts for this change in allele frequency?

- A) decreases; disruptive selection
- B) increases; genetic drift
- C) decreases; gene flow
- D) increases; nonrandom mating
- E) decreases; bottleneck effect

- _____ 89) No two people are genetically identical, except for identical twins. The main source of genetic variation among human individuals is
- A) new mutations that occurred in the preceding generation.
 - B) genetic drift due to the small size of the population.
 - C) the reshuffling of alleles in sexual reproduction.
 - D) geographic variation within the population.
 - E) environmental effects.
- _____ 90) Sparrows with average-sized wings survive severe storms better than those with longer or shorter wings, illustrating
- A) the bottleneck effect.
 - B) disruptive selection.
 - C) frequency-dependent selection.
 - D) neutral variation.
 - E) stabilizing selection.
- _____ 91) There are 40 individuals in population 1, all with genotype A_1A_1 , and there are 25 individuals in population 2, all with genotype A_2A_2 . Assume that these populations are located far from each other and that their environmental conditions are very similar. Based on the information given here, the observed genetic variation is most likely an example of
- A) genetic drift.
 - B) gene flow.
 - C) disruptive selection.
 - D) discrete variation.
 - E) directional selection.
- _____ 92) A fruit fly population has a gene with two alleles, A_1 and A_2 . Tests show that 70% of the gametes produced in the population contain the A_1 allele. If the population is in Hardy-Weinberg equilibrium, what proportion of the flies carry both A_1 and A_2 ?
- A) 0.7
 - B) 0.49
 - C) 0.21
 - D) 0.42
 - E) 0.09
- _____ 93) What is true of macroevolution?
- A) It is the same as microevolution, but includes the origin of new species.
 - B) It is evolution above the species level.
 - C) It is defined as the evolution of microscopic organisms into organisms that can be seen with the naked eye.
 - D) It is defined as a change in allele or gene frequency over the course of many generations.

E) It is the conceptual link between irritability and adaptation.

- _____ 94) Which of the following statements about species, as defined by the biological species concept, is (are) correct?
- I. Biological species are defined by reproductive isolation.
 - II. Biological species are the model used for grouping extinct forms of life.
 - III. The biological species is the largest unit of population in which successful interbreeding is possible.
- A) I and II
 - B) I and III
 - C) II and III
 - D) I, II, and III
- _____ 95) Which of the various species concepts distinguishes two species based on the degree of genetic exchange between their gene pools?
- A) phylogenetic
 - B) ecological
 - C) biological
 - D) morphological
- _____ 96) There is still some controversy among biologists about whether Neanderthals should be placed within the same species as modern humans or into a separate species of their own. Most DNA sequence data analyzed so far indicate that there was probably little or no gene flow between Neanderthals and *Homo sapiens*. Which species concept is most applicable in this example?
- A) phylogenetic
 - B) ecological
 - C) morphological
 - D) biological
- _____ 97) You are confronted with a box of preserved grasshoppers of various species that are new to science and have not been described. Your assignment is to separate them into species. There is no accompanying information as to where or when they were collected. Which species concept will you have to use?
- A) biological
 - B) phylogenetic
 - C) ecological
 - D) morphological
- _____ 98) Dog breeders maintain the purity of breeds by keeping dogs of different breeds apart when they are fertile. This kind of isolation is most similar to which of the following reproductive isolating mechanisms?
- A) reduced hybrid fertility
 - B) hybrid breakdown
 - C) mechanical isolation
 - D) habitat isolation
 - E) gametic isolation

- _____ 99) Two species of frogs belonging to the same genus occasionally mate, but the offspring fail to develop and hatch. What is the mechanism for keeping the two frog species separate?
- A) the postzygotic barrier called hybrid inviability
 - B) the postzygotic barrier called hybrid breakdown
 - C) the prezygotic barrier called hybrid sterility
 - D) gametic isolation
- _____ 100) When male horses (stallions) and female donkeys (jennets) mate, they produce a sterile hybrid called a hinny. Hinnies occur much less frequently than do mules, but are just as healthy and robust as mules. Logically, which of the following best accounts for the relative rarity of hinnies, and what kind of prezygotic isolating mechanism is at work here?
- A) Most hinnies die during fetal development; reduced hybrid viability.
 - B) Most hinnies die soon after being born; hybrid breakdown.
 - C) Most hinnies are reproductively sterile; reduced hybrid fertility.
 - D) Stallions and jennets are choosier about their mating partners than are mares and jacks; behavioral isolation.
 - E) Stallions and jennets are choosier about their mating partners than are mares and jacks; gametic isolation.
- _____ 101) Dogs (*Canis lupus familiaris*) and gray wolves (*Canis lupus*) can interbreed to produce viable, fertile offspring. These species shared a common ancestor recently (in geologic time) and have a high degree of genetic similarity, although their anatomies vary widely. Judging from this evidence, which *two* species concepts are most likely to place dogs and wolves together into a single species?
- A) ecological and morphological
 - B) ecological and phylogenetic
 - C) morphological and phylogenetic
 - D) biological and morphological
 - E) biological and phylogenetic
- _____ 102) Rocky Mountain juniper (*Juniperus scopulorum*) and one-seeded juniper (*J. monosperma*) have overlapping ranges. If pollen grains (which contain sperm cells) from one species are unable to germinate and make pollen tubes on female ovules (which contain egg cells) of the other species, then which of these terms are applicable?
- 1. sympatric species
 - 2. prezygotic isolation
 - 3. postzygotic isolation
 - 4. allopatric species
 - 5. habitat isolation
 - 6. reduced hybrid fertility
- A) 1 and 2
 - B) 2 and 4
 - C) 1, 3, and 6
 - D) 2, 4, and 5
 - E) 1, 2, 5, and 6

- _____ 103) Rocky Mountain juniper (*Juniperus scopulorum*) and one-seeded juniper (*J. monosperma*) have overlapping ranges. If pollen grains (which contain sperm cells) from one species are unable to germinate and make pollen tubes on female ovules (which contain egg cells) of the other species, then which of these terms is applicable?
- behavioral isolation
 - mechanical isolation
 - hybrid breakdown
 - reduced hybrid viability
- _____ 104) In a hypothetical situation, a certain species of flea feeds only on pronghorn antelopes. In rangelands of the western United States, pronghorns and cattle often associate with one another. If some of these fleas develop a strong preference for cattle blood and mate only with other fleas that prefer cattle blood, then over time which of these should occur, if the host mammal can be considered as the fleas' habitat?
- reproductive isolation
 - sympatric speciation
 - habitat isolation
 - prezygotic barriers
- 1 only
 - 2 and 3
 - 1, 2, and 3
 - 2, 3, and 4
 - 1 through 4
- _____ 105) Two closely related populations of mice have been separated for many generations by a river. Climatic change causes the river to dry up, thereby bringing the mice populations back into contact in a zone of overlap. Which of the following is not a possible outcome when they meet?
- They interbreed freely and produce fertile hybrid offspring.
 - They no longer attempt to interbreed.
 - They interbreed in the region of overlap, producing an inferior hybrid. Subsequent interbreeding between inferior hybrids produces progressively superior hybrids over several generations.
 - They remain separate in the extremes of their ranges but develop a persistent hybrid zone in the area of overlap.
 - They interbreed in the region of overlap, but produce sterile offspring.
- _____ 106) The difference between geographic isolation and habitat differentiation is the
- relative locations of two populations as speciation occurs.
 - speed (tempo) at which two populations undergo speciation.
 - amount of genetic variation that occurs among two gene pools as speciation occurs.
 - identity of the phylogenetic kingdom or domain in which these phenomena occur.
 - the ploidy of the two populations as speciation occurs.
- _____ 107) Among known plant species, which of these have been the *two* most commonly occurring phenomena that have led to the origin of new species?
- allopatric speciation
 - sympatric speciation

3. sexual selection

4. polyploidy

A) 1 and 3

B) 1 and 4

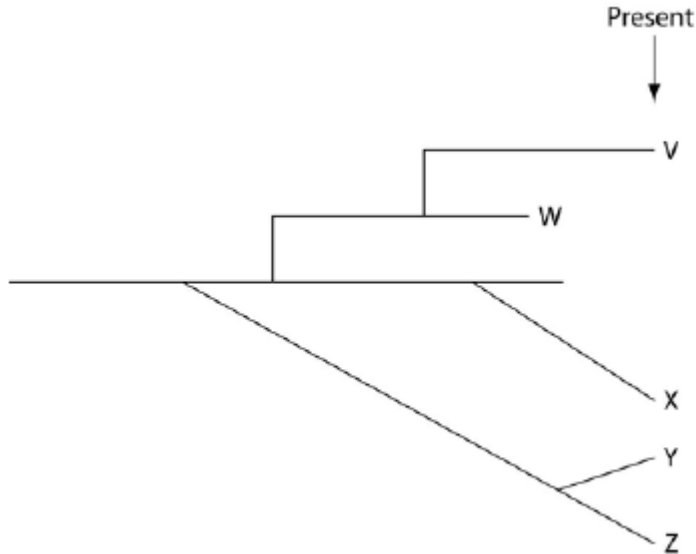
C) 2 and 3

D) 2 and 4

- ___ 108) Beetle pollinators of a particular plant are attracted to its flowers' bright orange color. The beetles not only pollinate the flowers, but they mate while inside of the flowers. A mutant version of the plant with red flowers becomes more common with the passage of time. A particular variant of the beetle prefers the red flowers to the orange flowers. Over time, these two beetle variants diverge from each other to such an extent that interbreeding is no longer possible. What kind of speciation has occurred in this example, and what has driven it?
- A) allopatric speciation; ecological isolation
B) sympatric speciation; habitat differentiation
C) allopatric speciation; behavioral isolation
D) sympatric speciation; sexual selection
E) sympatric speciation; allopolyploidy
- ___ 109) The origin of a new plant species by hybridization, coupled with accidents during nuclear division, is an example of
- A) allopatric speciation.
B) sympatric speciation.
C) autopolyploidy.
D) habitat selection.
- ___ 110) Which of these should decline in hybrid zones where reinforcement is occurring?
- A) gene flow between distinct gene pools
B) speciation
C) the genetic distinctness of two gene pools
D) mutation rate
E) hybrid sterility
- ___ 111) The most likely explanation for the high rate of sympatric speciation that apparently existed among the cichlids of Lake Victoria in the past is
- A) sexual selection.
B) habitat differentiation.
C) polyploidy.
D) pollution.
E) introduction of a new predator.
- ___ 112) The most likely explanation for the recent decline in cichlid species diversity in Lake Victoria is
- A) reinforcement.
B) fusion.
C) stability.
D) geographic isolation.
E) polyploidy.

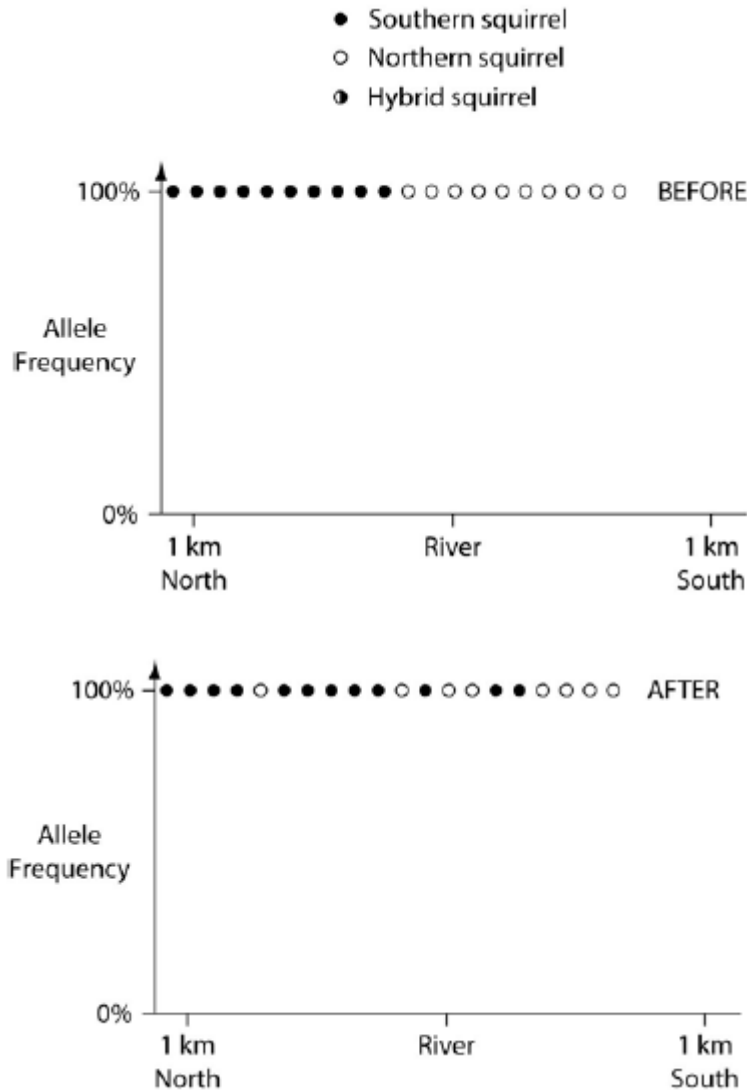
- _____ 113) A narrow hybrid zone separates the toad species *Bombina bombina* and *Bombina variegata*. What is true of those alleles that are unique to the parental species?
- A) Such alleles should be absent.
 - B) Their allele frequency should be nearly the same as the allele frequencies in toad populations distant from the hybrid zone.
 - C) The alleles' heterozygosity should be higher among the hybrid toads there.
 - D) Their allele frequency on one edge of the hybrid zone should roughly equal their frequency on the opposite edge of the hybrid zone.
- _____ 114) According to the concept of punctuated equilibrium, the "sudden" appearance of a new species in the fossil record means that
- A) the species is now extinct.
 - B) speciation occurred instantaneously.
 - C) speciation occurred in one generation.
 - D) speciation occurred rapidly in geologic time.
 - E) the species will consequently have a relatively short existence, compared with other species.
- _____ 115) According to the concept of punctuated equilibrium,
- A) natural selection is unimportant as a mechanism of evolution.
 - B) given enough time, most existing species will branch gradually into new species.
 - C) a new species accumulates most of its unique features as it comes into existence.
 - D) evolution of new species features long periods during which changes are occurring, interspersed with short periods of equilibrium, or stasis.
 - E) transitional fossils, intermediate between newer species and their parent species, should be abundant.
- _____ 116) Speciation
- A) occurs at such a slow pace that no one has ever observed the emergence of new species.
 - B) occurs only by the accumulation of genetic change over vast expanses of time.
 - C) must begin with the geographic isolation of a small, frontier population.
 - D) and microevolution are synonymous.
 - E) can involve changes to a single gene.
- _____ 117) In order for speciation to occur, what must be true?
- A) The number of chromosomes in the gene pool must change.
 - B) Changes to centromere location or chromosome size must occur within the gene pool.
 - C) Large numbers of genes that affect a single phenotypic trait must change.
 - D) Large numbers of genes that affect numerous phenotypic traits must change.
 - E) At least one gene, affecting at least one phenotypic trait, must change.

The next few questions refer to the following evolutionary tree, whose horizontal axis represents time (present time is on the far right) and whose vertical axis represents morphological change.



- ___ 118) Which species is most closely related to species W?
- V is most closely related to species W.
 - X is most closely related to species W.
 - Y and Z are equally closely related to W.
 - It is not possible to say from this tree.
- ___ 119) Which species is *least* expected to have a good record of transitional fossils; in other words, which species' fossils, if present at all, are expected only in relatively superficial (i.e., shallow) strata?
- V
 - W
 - X
 - Y
 - Z
- ___ 120) Which conclusion can be drawn from this evolutionary tree?
- Gradualistic speciation and speciation involving punctuated equilibrium are mutually exclusive concepts; only one of them can occur.
 - Eldredge and Gould would deny that the lineages labeled X, Y, and Z could represent true species.
 - Assuming that the tip of each line represents a species, there are five extant (i.e., not extinct) species resulting from the earliest common ancestor.
 - A single clade (i.e., a group of species that share a common ancestor) can exhibit both gradualism and punctuated equilibrium.
 - V and W shared a common ancestor more recently than any of the other species.

121) In a hypothetical situation, the National Park Service, which administers Grand Canyon National Park in Arizona, builds a footbridge over the Colorado River at the bottom of the canyon. The footbridge permits interspersal of two closely related antelope squirrels. Previously, one type of squirrel had been restricted to the terrain south of the river, and the other type had been restricted to terrain on the north side of the river. Immediately before and ten years after the bridge's completion, researchers collected ten antelope squirrels from both sides of the river, took blood samples, and collected frequencies of alleles unique to the two types of antelope squirrels (see the following graphs).



The data in the previous graphs indicate that

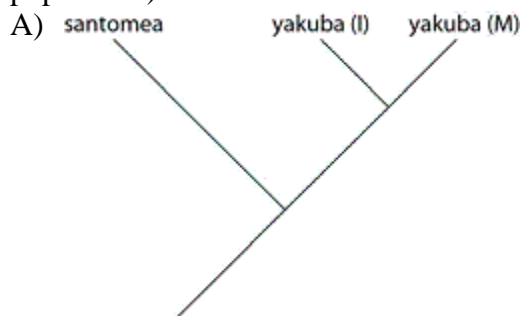
- A) a hybrid zone was established after the completion of the bridge.
- B) no interspersal of the two types of squirrel occurred after the completion of the bridge.
- C) gene flow occurred from one type of squirrel into the gene pool of the other type of squirrel.

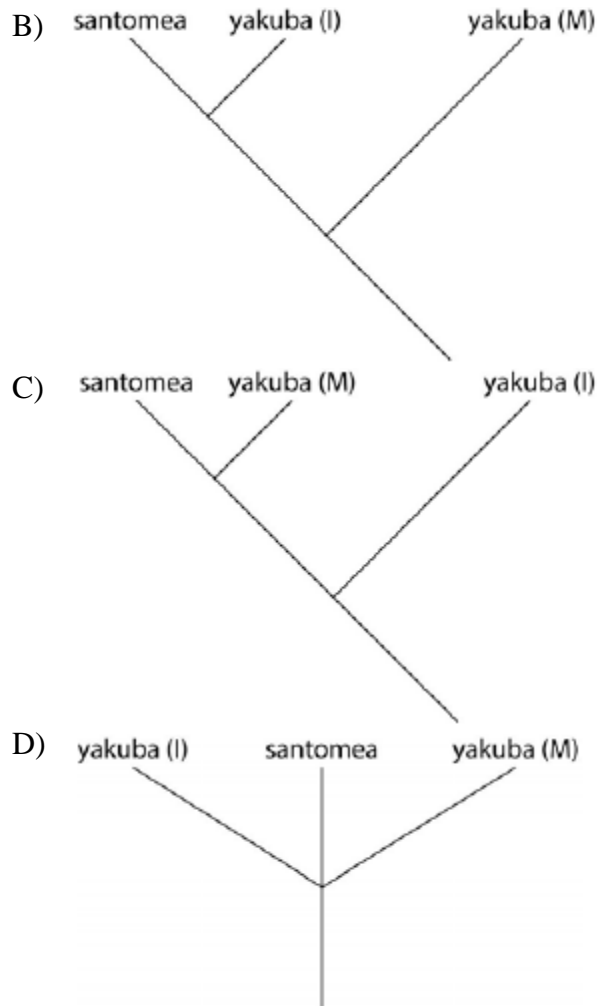
- D) two-way migration of squirrels occurred across the bridge, but without hybridization.
- E) some northern squirrels migrated south, but no southern squirrels migrated north across the bridge.

The next few questions refer to the following description.

On the volcanic, equatorial West African island of Sao Tomé, two species of fruit fly exist. *Drosophila yakuba* inhabits the island's lowlands, and is also found on the African mainland, located about 200 miles away. At higher elevations, and only on Sao Tomé, is found the very closely related *Drosophila santomea*. The two species can hybridize, though male hybrids are sterile. A hybrid zone exists at middle elevations, though hybrids there are greatly outnumbered by *D. santomea*. Studies of the two species' nuclear genomes reveal that *D. yakuba* on the island is more closely related to mainland *D. yakuba* than to *D. santomea* ($2n = 4$ in both species). Sao Tomé rose from the Atlantic Ocean about 14 million years ago.

- ___ 122) Which of the following reduces gene flow between the gene pools of the two species on Sao Tomé, despite the existence of hybrids?
 - A) hybrid breakdown
 - B) hybrid inviability
 - C) hybrid sterility
 - D) temporal isolation
 - E) a geographic barrier
- ___ 123) Using only the information provided in the paragraph, which of the following is the best initial hypothesis for how *D. santomea* descended from *D. yakuba*?
 - A) geographic isolation
 - B) autopolyploidy
 - C) habitat differentiation
 - D) sexual selection
 - E) allopolyploidy
- ___ 124) Which of these evolutionary trees represents the situation described in the previous paragraph (Note: *Yakuba (I)* represents the island population, and *yakuba (M)* represents the mainland population)?





- ___ 125) If the low number of hybrid flies in the hybrid zone, relative to the number of *D. santomea* flies there, is due to the fact that hybrids are poorly adapted to conditions in the hybrid zone, and if fewer hybrid flies are produced with the passage of time, these conditions will most likely lead to
- A) fusion.
 - B) reinforcement.
 - C) stability.
 - D) further speciation events.

The next few questions refer to the following description.

On the Bahamian island of Andros, mosquitofish populations live in various, now-isolated, freshwater ponds that were once united. Currently, some predator-rich ponds have mosquitofish that can swim in short, fast bursts; other predator-poor ponds have mosquitofish that can swim continuously for a long time. When placed together in the same body of water, the two kinds of female mosquitofish exhibit exclusive breeding preferences.

- ___ 126) Which type of reproductive isolation operates to keep the mosquitofish isolated, even when fish from different ponds are reunited in the same body of water?

- A) behavioral isolation
- B) habitat isolation
- C) temporal isolation
- D) mechanical isolation
- E) gametic isolation

- _____ 127) What is the best way to promote fusion between two related populations of mosquitofish, one of which lives in a predator-rich pond, and the other of which lives in a predator-poor pond?
- A) Build a canal linking the two ponds that permits free movement of mosquitofish, but not of predators.
 - B) Transfer only female mosquitofish from a predator-rich pond to a predator-poor pond.
 - C) Perform a reciprocal transfer of females between predator-rich and predator-poor ponds.
 - D) Remove predators from a predator-rich pond and transfer them to a predator-poor pond.
- _____ 128) If one builds a canal linking a predator-rich pond to a predator-poor pond, then what type(s) of selection should subsequently be most expected among the mosquitofish in the original predator-rich pond, and what type(s) should be most expected among the mosquitofish in the formerly predator-poor pond?
- A) stabilizing selection; directional selection
 - B) stabilizing selection; stabilizing selection
 - C) less-intense directional selection; more-intense directional selection
 - D) less-intense disruptive selection; more-intense disruptive selection
- _____ 129) The predatory fish rely on visual cues and speed to capture mosquitofish. Mosquitofish rely on speed and visual cues to avoid the predatory fish. Which adaptation(s) might help the predators survive in ponds that are home to faster mosquitofish?
1. directional selection for increased speed
 2. stabilizing selection for speed that matches that of the mosquitofish
 3. change in hunting behavior that replaces reliance on visual cues with reliance on tactile cues, which can be used to hunt at night
 4. change in hunting behavior that eliminates speed in favor of better camouflage, which permits an ambush strategy
- A) 1 only
 - B) 2 only
 - C) either 1 or 3
 - D) either 2 or 3
 - E) 1, 3, or 4

The following question refer to the description below.

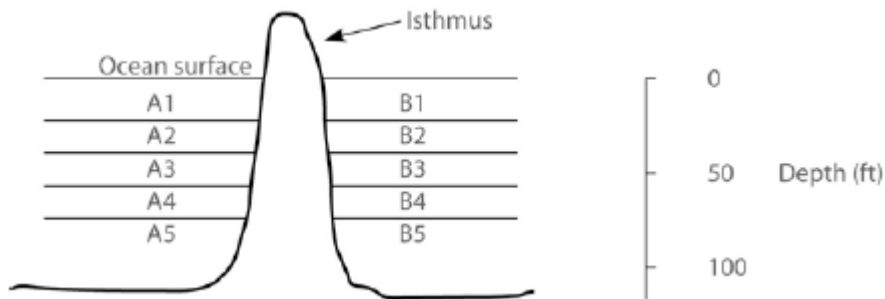
In the ocean, on either side of the Isthmus of Panama, are 30 species of snapping shrimp; some are shallow-water species, others are adapted to deep water. There are 15 species on the Pacific side and 15 different species on the Atlantic side. The Isthmus of Panama started rising about 10 million years ago. The oceans were completely separated by the isthmus about 3 million years ago.

- ___ 130) Why should deepwater shrimp on different sides of the isthmus have diverged from each other earlier than shallow-water shrimp?
- A) They have been geographically isolated from each other for a longer time.
 - B) Cold temperatures, associated with deep water, have accelerated the mutation rate, resulting in faster divergence in deepwater shrimp.
 - C) The rise of the land bridge was accompanied by much volcanic activity. Volcanic ash contains heavy metals, which are known mutagens. Ash fall caused high levels of heavy metals in the ocean sediments underlying the deep water, resulting in accelerated mutation rates and faster divergence in deepwater shrimp.
 - D) Fresh water entering the ocean from the canal is both less dense and cloudier than seawater. The cloudy fresh water interferes with the ability of shallow-water shrimp to locate mating partners, which reduces the frequency of mating, thereby slowing the introduction of genetic variation.

The next few questions refer to the following description.

In the ocean, on either side of the Isthmus of Panama, are 30 species of snapping shrimp; some are shallow-water species, others are adapted to deep water. There are 15 species on the Pacific side and 15 different species on the Atlantic side. The Isthmus of Panama started rising about 10 million years ago.

In the following figure, the isthmus separates the Pacific Ocean on the left (side A) from the Atlantic Ocean on the right (side B). The seawater on either side of the isthmus is separated into five depth habitats (1–5), with 1 being the shallowest.



- ___ 131) In which habitat should one find snapping shrimp most closely related to shrimp that live in habitat A4?
- A) A3
 - B) A5
 - C) B4
 - D) either A3 or A5
 - E) any species from any one of the side A habitats
- ___ 132) Which of these habitats is likely to harbor the youngest species?
- A) A5
 - B) B4

- C) A3
- D) B2
- E) A1

- ___ 133) Which habitats should harbor snapping shrimp species with the greatest degree of genetic divergence from each other?
- A) A1 and A5
 - B) A1 and B5
 - C) B5 and B1
 - D) A5 and B5
 - E) Both A1/A5 and B1/B5 should have the greatest, but equal amounts of, genetic divergence.
- ___ 134) Which factor is most important for explaining why there are equal numbers of snapping shrimp species on either side of the isthmus?
- A) the relative shortness of time they have been separated
 - B) the depth of the ocean
 - C) the number of actual depth habitats between the surface and the sea floor
 - D) the elevation of the isthmus above sea level
 - E) the depth of the canal
- ___ 135) The Panama Canal was completed in 1914, and its depth is about 50 feet. After 1914, snapping shrimp species from which habitats should be most likely to form hybrids as the result of the canal?
- A) A5 and B5
 - B) A3 and B3
 - C) A1 and B1
 - D) either A1 and A2, or B1 and B2
 - E) A1–A3 and B1–B3 have equal likelihoods of harboring snapping shrimp species that can hybridize.
- ___ 136) There are currently two large, permanent bridges that span the Panama Canal. The bridges are about 8 miles apart. If snapping shrimp avoid swimming at night and avoid swimming under shadows, then what do these bridges represent for the snapping shrimp?
- A) sources of refuge
 - B) geographic barriers
 - C) sources of a hybrid zone between the two bridges
 - D) sources for increased gene flow
- ___ 137) The *largest* unit within which gene flow can readily occur is a
- A) population.
 - B) species.
 - C) genus.
 - D) hybrid.
 - E) phylum.

- _____ 138) Males of different species of the fruit fly *Drosophila* that live in the same parts of the Hawaiian Islands have different elaborate courtship rituals. These rituals involve fighting other males and making stylized movements that attract females. What type of reproductive isolation does this represent?
- A) habitat isolation
 - B) temporal isolation
 - C) behavioral isolation
 - D) gametic isolation
 - E) postzygotic barriers
- _____ 139) According to the punctuated equilibria model,
- A) natural selection is unimportant as a mechanism of evolution.
 - B) given enough time, most existing species will branch gradually into new species.
 - C) most new species accumulate their unique features relatively rapidly as they come into existence, then change little for the rest of their duration as a species.
 - D) most evolution occurs in sympatric populations.
 - E) speciation is usually due to a single mutation.
- _____ 140) Bird guides once listed the myrtle warbler and Audubon's warbler as distinct species. Recently, these birds have been classified as eastern and western forms of a single species, the yellow-rumped warbler. Which of the following pieces of evidence, if true, would be cause for this reclassification?
- A) The two forms interbreed often in nature, and their offspring have good survival and reproduction.
 - B) The two forms live in similar habitats.
 - C) The two forms have many genes in common.
 - D) The two forms have similar food requirements.
 - E) The two forms are very similar in coloration.
- _____ 141) Plant species A has a diploid number of 12. Plant species B has a diploid number of 16. A new species, C, arises as an allopolyploid from A and B. The diploid number for species C would probably be
- A) 12.
 - B) 14.
 - C) 16.
 - D) 28.
 - E) 56.
- _____ 142) Which of the following factors weaken(s) the hypothesis of abiotic synthesis of organic monomers in early Earth's atmosphere?
1. the relatively short time between intense meteor bombardment and the appearance of the first life-forms
 2. the lack of experimental evidence that organic monomers can form by abiotic synthesis
 3. uncertainty about which gases comprised early Earth's atmosphere
- A) 1 only
 - B) 2 only
 - C) 1 and 2
 - D) 1 and 3

E) 2 and 3

- _____ 143) How were conditions on the early Earth of more than 3 billion years ago different from those on today's Earth?
- A) Only early Earth was intensely bombarded by large space debris.
 - B) Only early Earth had an oxidizing atmosphere.
 - C) Less ultraviolet radiation penetrated early Earth's atmosphere.
 - D) Early Earth's atmosphere had significant quantities of ozone.
- _____ 144) What is true of the amino acids that might have been delivered to Earth within carbonaceous chondrites?
- A) They had the same proportion of L and D isomers as Earth does today.
 - B) Their abundance would have been dramatically reduced upon passage through early Earth's oxidizing atmosphere.
 - C) There were more kinds of amino acids on the chondrites than are found in living organisms today.
 - D) They were delivered in the form of polypeptides.
- _____ 145) Which of the following is the correct sequence of events in the origin of life?
- I. formation of protobionts
 - II. synthesis of organic monomers
 - III. synthesis of organic polymers
 - IV. formation of DNA-based genetic systems
- A) I, II, III, IV
 - B) I, III, II, IV
 - C) II, III, I, IV
 - D) II, III, IV, I
- _____ 146) The first genes on Earth were probably
- A) DNA produced by reverse transcriptase from abiotically produced RNA.
 - B) DNA molecules whose information was transcribed to RNA and later translated in polypeptides.
 - C) auto-catalytic RNA molecules.
 - D) oligopeptides located within protobionts.
- _____ 147) The synthesis of new DNA requires the prior existence of oligonucleotides to serve as primers. On Earth, these primers are small RNA molecules. This latter observation is evidence in support of the hypothesized existence of
- A) a snowball Earth.
 - B) earlier genetic systems than those based on DNA.
 - C) the abiotic synthesis of organic monomers.
 - D) the delivery of organic matter to Earth by meteors and comets.
 - E) the endosymbiotic origin of mitochondria and chloroplasts.
- _____ 148) Several scientific laboratories across the globe are involved in research concerning the origin of life on Earth. Which of these questions is currently the most problematic and would have the greatest impact on our understanding if we were able to answer it?
- A) How can amino acids, simple sugars, and nucleotides be synthesized abiotically?

- B) How can RNA molecules catalyze reactions?
- C) How did RNA sequences come to carry the code for amino acid sequences?
- D) How could polymers involving lipids and/or proteins form membranes in aqueous environments?
- E) How can RNA molecules act as templates for the synthesis of complementary RNA molecules?

- _____ 149) If natural selection in a particular environment favored genetic systems that permitted the production of daughter "cells" that were genetically dissimilar from the mother "cells," then one should expect selection for which of the following?
- I. polynucleotide polymerase with low mismatch error rates
 - II. polynucleotide polymerases without proofreading capability
 - III. batteries of efficient polynucleotide repair enzymes
 - IV. polynucleotide polymerases with proofreading capability
 - V. polynucleotide polymerases with high mismatch error rates
- A) I only
 - B) I and IV
 - C) I, III, and IV
 - D) II and V
 - E) II, III and V
- _____ 150) If the half-life of carbon-14 is about 5,730 years, then a fossil that has one-sixteenth the normal proportion of carbon-14 to carbon-12 should be about how many years old?
- A) 1,400
 - B) 2,800
 - C) 11,200
 - D) 16,800
 - E) 22,900
- _____ 151) Which measurement(s) would help determine absolute dates by radiometric means?
- A) the accumulation of the daughter isotope
 - B) the loss of parent isotopes
 - C) the loss of daughter isotopes
 - D) Three of the responses above are correct.
 - E) Two of the responses above are correct.
- _____ 152) Approximately how far back in time does the fossil record extend?
- A) 3.5 million years
 - B) 5.0 million years
 - C) 3.5 billion years
 - D) 5.0 billion years
- _____ 153) What is true of the fossil record of mammalian origins?
- A) It is a good example of punctuated equilibrium.
 - B) It shows that mammals and birds evolved from the same kind of dinosaur.
 - C) It includes transitional forms with progressively specialized teeth.
 - D) It indicates that mammals and dinosaurs did not overlap in geologic time.
 - E) It includes a series that shows the gradual change of scales into fur.

- _____ 154) If a fossil is encased in a stratum of sedimentary rock without any strata of igneous rock (for example, lava, volcanic ash) nearby, then it should be
- A) easy to determine the absolute age of the fossil, because the radioisotopes in the sediments will not have been "reset" by the heat of the igneous rocks.
 - B) easy to determine the absolute age of the fossil, because the igneous rocks will not have physically obstructed the deposition of sediment of a single age next to the fossil.
 - C) easy to determine, as long as there is enough metamorphic rock nearby.
 - D) difficult to determine the absolute age of the fossil, because the "marker fossils" common to igneous rock will be absent.
 - E) difficult to determine the absolute age of the fossil, because radiometric dating of sedimentary rock is less accurate than that of igneous rock.
- _____ 155) An early consequence of the release of oxygen gas by plant and bacterial photosynthesis was to
- A) generate intense lightning storms.
 - B) change the atmosphere from oxidizing to reducing.
 - C) make it easier to maintain reduced molecules.
 - D) cause iron in ocean water and terrestrial rocks to rust (oxidize).
 - E) prevent the formation of an ozone layer.
- _____ 156) Which of the following statements provides the strongest evidence that prokaryotes evolved before eukaryotes?
- A) Prokaryotic cells lack nuclei.
 - B) The meteorites that have struck Earth contain fossils only of prokaryotes.
 - C) Laboratory experiments have produced liposomes abiotically.
 - D) Liposomes closely resemble prokaryotic cells.
 - E) The oldest fossilized cells resemble prokaryotes.
- _____ 157) What is true of the Cambrian explosion?
- A) There are no fossils in geological strata that are older than the Cambrian explosion.
 - B) Only the fossils of microorganisms are found in geological strata older than the Cambrian explosion.
 - C) The Cambrian explosion is evidence for the instantaneous creation of life on Earth.
 - D) The Cambrian explosion marks the appearance of filter-feeding animals in the fossil record.
 - E) Recent evidence supports the contention that the Cambrian explosion may not have been as "explosive" as was once thought.
- _____ 158) What is thought to be the correct sequence of these events, from earliest to most recent, in the evolution of life on Earth?
- 1. origin of mitochondria
 - 2. origin of multicellular eukaryotes
 - 3. origin of chloroplasts
 - 4. origin of cyanobacteria
 - 5. origin of fungal-plant symbioses
- A) 4, 3, 2, 1, 5
 - B) 4, 1, 2, 3, 5

- C) 4, 1, 3, 2, 5
- D) 4, 3, 1, 5, 2
- E) 4, 3, 1, 2, 5

- ___ 159) Recent evidence indicates that the first major diversification of multicellular eukaryotes may have coincided in time with the
- A) origin of prokaryotes.
 - B) switch to an oxidizing atmosphere.
 - C) melting that ended the "snowball Earth" period.
 - D) origin of multicellular organisms.
 - E) massive eruptions of deep-sea vents.
- ___ 160) Which of these observations gives the most support to the endosymbiotic theory for the origin of eukaryotic cells?
- A) the existence of structural and molecular differences between the plasma membranes of prokaryotes and the internal membranes of mitochondria and chloroplasts
 - B) the similarity in size between the cytosolic ribosomes of prokaryotes and the ribosomes within mitochondria and chloroplasts
 - C) the size disparity between most prokaryotic cells and most eukaryotic cells
 - D) the observation that some eukaryotic cells lack mitochondria
- ___ 161) Which event is nearest in time to the end of the period known as snowball Earth?
- A) oxygenation of Earth's seas and atmosphere
 - B) evolution of mitochondria
 - C) Cambrian explosion
 - D) evolution of true multicellularity
 - E) Permian extinction
- ___ 162) The snowball Earth hypothesis provides a possible explanation for the
- A) diversification of animals during the late Proterozoic era.
 - B) oxygenation of Earth's seas and atmosphere.
 - C) colonization of land by plants and fungi.
 - D) origin of oxygen-releasing photosynthesis.
 - E) existence of prokaryotes around hydrothermal vents on the ocean floor.
- ___ 163) Which of the following characteristics should have been possessed by the first animals to colonize land?
1. were probably herbivores (ate photosynthesizers)
 2. had four appendages
 3. had the ability to resist dehydration
 4. had lobe-finned fishes as ancestors
 5. were invertebrates
- A) 3 only
 - B) 3 and 5
 - C) 1, 3, and 5
 - D) 2, 3, and 4
 - E) 1, 2, 3, and 4

- ___ 164) The first terrestrial organisms probably were considered which of the following?
1. burrowers
 2. photosynthetic
 3. multicellular
 4. prokaryotes
 5. eukaryotes
 6. plants and their associated fungi
- A) 2 and 4
B) 3 and 5
C) 1, 3, and 5
D) 2, 3, and 6
E) 2, 3, 5, and 6
- ___ 165) On the basis of their morphologies, how might Linnaeus have classified the Hawaiian silverswords?
- A) He would have placed them all in the same species.
B) He would have classified them the same way that modern botanists do.
C) He would have placed them in more species than modern botanists do.
D) He would have used evolutionary relatedness as the primary criterion for their classification.
- ___ 166) An organism has a relatively large number of *Hox* genes in its genome. Which of the following is true of this organism?
- A) These genes are fundamental, and are expressed in all cells of the organism.
B) The organism must have multiple paired appendages along the length of its body.
C) The organism has the genetic potential to have a relatively complex anatomy.
D) Most of its *Hox* genes owe their existence to gene fusion events.
E) Its *Hox* genes cooperate to bring about sexual maturity at the proper stage of development.
- ___ 167) The loss of ventral spines by modern freshwater sticklebacks is due to natural selection operating on the phenotypic effects of *Pitx1* gene
- A) duplication (gain in number).
B) elimination (loss).
C) mutation (change).
D) silencing (loss of expression).
- ___ 168) The existence of the phenomenon of exaptation is most closely associated with which of the following observations that natural selection cannot fashion perfect organisms?
- A) Natural selection and sexual selection can work at cross-purposes to each other.
B) Evolution is limited by historical constraints.
C) Adaptations are often compromises.
D) Chance events affect the evolutionary history of populations in environments that can change unpredictably.

- _____ 169) In the 5–7 million years that the hominid lineage has been diverging from its common ancestor with the great apes, dozens of hominid species have arisen, often with several species coexisting in time and space. As recently as 30,000 years ago, *Homo sapiens* coexisted with *Homo neanderthalensis*. Both species had large brains and advanced intellects. The fact that these traits were common to both species is most easily explained by which of the following?
- A) species selection
 - B) uniformitarianism
 - C) sexual selection
 - D) convergent evolution
- _____ 170) The existence of evolutionary trends, such as increasing body sizes among horse species, is evidence that
- A) a larger volume–to–surface area ratio is beneficial to all mammals.
 - B) an unseen guiding force is at work.
 - C) evolution always tends toward increased complexity or increased size.
 - D) in particular environments, similar adaptations can be beneficial in more than one species.
 - E) evolution generally progresses toward some predetermined goal.
- _____ 171) Fossil evidence indicates that several kinds of flightless dinosaurs possessed feathers. If some of these feather–bearing dinosaurs incubated clutches of eggs in carefully constructed nests, this might be evidence supporting the claim that
- A) dinosaurs were as fully endothermal (warm–blooded) as modern birds and mammals.
 - B) their feathers originally served as insulation, and only later became flight surfaces.
 - C) the earliest reptiles could fly, and the feathers of flightless dinosaurs were vestigial flight surfaces.
 - D) the feathers were plucked from the bodies of other adults to provide nest–building materials.
 - E) all fossils with feathers are actually some kind of bird.

The following questions refer to the description and figure below.

The figure represents a cross section of the sea floor through a mid-ocean rift valley, with alternating patches of black and white indicating sea floor with reversed magnetic polarities. At the arrow labeled “I” (the rift valley), the igneous rock of the sea floor is so young that it can be accurately dated using carbon-14 dating. At the arrow labeled “III,” however, the igneous rock is about 1 million years old, and potassium-40 dating is typically used to date such rocks. *Note:* The horizontal arrows indicate the direction of sea-floor spreading, away from the rift valley.

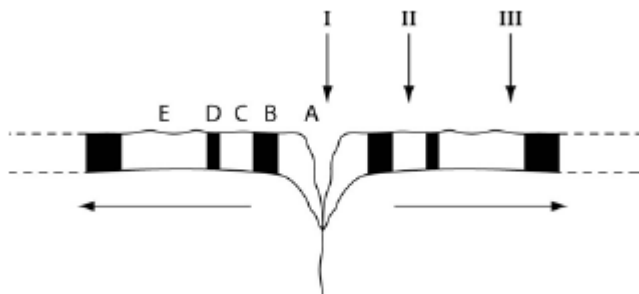


Figure 25.1

- _____ 172) If a particular marine organism is fossilized in the sediments immediately overlying the igneous rock at the arrow labeled "II," at which other location, labeled A–E, would a search be most likely to find more fossils of this organism?
- A) B only
 B) C only
 C) D only
 D) B and C
 E) C and D
- _____ 173) How many other bands of sea-floor crust in Figure 25.1 have the same magnetic polarity as the crust that directly straddles the rift valley?
- A) two bands
 B) four bands
 C) six bands
 D) eight bands
 E) ten bands
- _____ 174) Assuming that the rate of sea-floor spreading was constant during the 1-million-year period depicted above, what should be the approximate age of marine fossils found in undisturbed sedimentary rock immediately overlying the igneous rock at the arrow labeled "II"?
- A) 10,000 years
 B) 250,000 years
 C) 400,000 years
 D) 1,000,000 years

The following questions refer to the paragraph below.

A sediment core is removed from the floor of an inland sea. The sea has been in existence, off and on, throughout the entire time that terrestrial life has existed. Researchers wish to locate and study the terrestrial organisms fossilized in this core. The core is illustrated as a vertical column, with the top of the column representing the most recent strata and the bottom representing the time when land was first colonized by life.

Key:
 # = carnivorous tetrapods
 ~ = herbivorous invertebrates
 * = plants and fungi
 ^ = terrestrial cyanobacteria

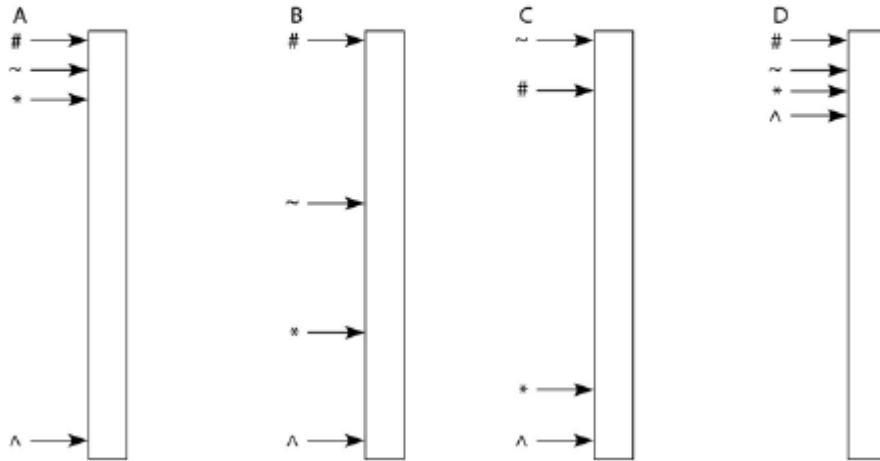


Figure 25.2

- ___ 175) If arrows indicate locations in the column where fossils of a particular type (see key above) first appear, then which core in Figure 25.2 has the most accurate arrangement of fossils?
- A) core A
 B) core B
 C) core C
 D) core D
- ___ 176) In order to properly interpret sediment cores, it is necessary to apply the principle of
- A) catastrophism.
 B) superposition.
 C) punctuated equilibrium.
 D) uniformitarianism.
 E) gradualism.
- ___ 177) Assuming the existence of fossilized markers for each of the following chemicals, what is the sequence in which they should be found in this sediment core, working from ancient sediments to recent sediments?
1. chitin coupled with protein
 2. chlorophyll
 3. bone
 4. cellulose
- A) 2, 4, 3, 1
 B) 2, 4, 1, 3
 C) 4, 2, 1, 3
 D) 4, 2, 3, 1
- ___ 178) In order to assign absolute dates to fossils in this sediment core, it would be most helpful if
- A) we knew the order in which the fossils occurred in the core.

- B) the sediments had not been affected by underwater currents during their deposition.
- C) volcanic ash layers were regularly interspersed between the sedimentary strata.
- D) metamorphic rock strata alternated with sedimentary rock strata.
- E) fossils throughout the column had equal ratios of a parental radioisotope to its daughter isotope.

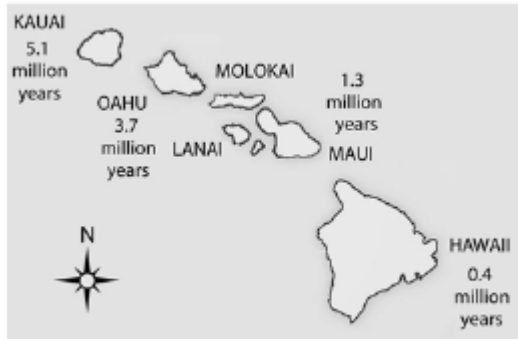


Figure 25.3

- 179) According to the theory of sea–floor spreading, oceanic islands, such as the Hawaiian Islands depicted in Figure 25.3, form as oceanic crustal plates move over a stationary "hot spot" in the mantle. Currently, the big island of Hawaii is thought to be over a hot spot, which is why it is the only one of the seven islands that has active volcanoes. What should be true of the island of Hawaii?
1. Scientists in search of ongoing speciation events are more likely to find them here than on the other six islands.
 2. Its species should be more closely related to those of nearer islands than to those of farther islands.
 3. It should have a rich fossil record of terrestrial organisms.
 4. There is a good chance of finding endemic species on this island.
 5. On average, it should have fewer species per unit surface area than the other six islands.
- A) 1, 2, and 3
 - B) 1, 2, and 5
 - C) 1, 2, 3, and 4
 - D) 1, 2, 4, and 5
 - E) 2, 3, 4, and 5
- 180) Hawaii is the most southeastern of the seven islands and is also closest to the sea–floor spreading center from which the Pacific plate originates, which lies about 5,600 km further to the southeast. Assuming equal sedimentation rates, what should be the location of the thickest sediment layer and, thus, the area with the greatest diversity of fossils above the oceanic crust?
- A) between the island of Hawaii and the sea–floor spreading center
 - B) around the base of the island of Hawaii
 - C) around the base of Kauai, the oldest of the Hawaiian islands
 - D) where the islands are most concentrated (highest number of islands per unit surface area)

- _____ 181) Soon after the island of Hawaii rose above the sea surface (somewhat less than 1 million years ago), the evolution of life on this new island should have been most strongly influenced by
- A) genetic bottleneck.
 - B) sexual selection.
 - C) habitat differentiation.
 - D) founder effect.

Refer to the following information to answer the questions below.

Fossils of *Lystrosaurus*, a dicynodont therapsid, are most common in parts of modern-day South America, South Africa, Madagascar, India, South Australia, and Antarctica. It apparently lived in arid regions, and was mostly herbivorous. It originated during the mid-Permian period, survived the Permian extinction, and dwindled by the late Triassic, though there is evidence of a relict population in Australia during the Cretaceous period. The dicynodonts had two large tusks, extending down from their upper jaws. The tusks were not used for food gathering, and in some species were limited to males. Food was gathered using an otherwise toothless beak. Judging from the fossil record in sedimentary rocks, these pig-sized organisms were the most common mammal-like reptiles of the Permian.

- _____ 182) Anatomically, what was true of *Lystrosaurus*?
- A) Its jaw would have been hinged the same way as the jaws of the early reptiles were hinged.
 - B) It was a tetrapod.
 - C) It had skin without scales, typical of modern amphibians.
 - D) It would have had no temporal fenestra in its skull.
- _____ 183) How many of *Lystrosaurus*' features below can help explain why these organisms fossilized so abundantly?
- I. the presence of hard parts, such as tusks
 - II. its arid environment
 - III. its persistence across at least two geological eras
 - IV. its widespread geographic distribution
 - V. its mixture of reptilian and mammalian features
- A) only one of these statements
 - B) two of these statements
 - C) three of these statements
 - D) four of these statements
 - E) all five of these statements
- _____ 184) If an increase in dicynodont species diversity (in other words, number of species) occurred soon after the Permian extinction, and if it occurred for the same general reason usually given for the increase in mammalian diversity following the Cretaceous extinction, then it should be attributed to
- A) an innovation among the dicynodonts that allowed them to fill brand-new niches.
 - B) the availability of previously occupied niches.
 - C) the extinction of the dinosaurs (except the birds).
 - D) their outcompetition of many other terrestrial organisms.

The following questions are based on the observation that several dozen different proteins comprise the prokaryotic flagellum and its attachment to the prokaryotic cell, producing a highly complex structure.

- _____ 185) Certain proteins of the complex motor that drives bacterial flagella are modified versions of proteins that had previously belonged to plasma membrane pumps. This evidence supports the claim that
- A) some structures are so complex that natural selection cannot, and will not, explain their origins.
 - B) the power of natural selection allows it to act in an almost predictive fashion, producing organs that will be needed in future environments.
 - C) the motors of bacterial flagella were originally synthesized abiotically.
 - D) natural selection can produce new structures by coupling together parts of other structures.
 - E) bacteria that possess flagella must have lost the ability to pump certain chemicals across their plasma membranes.

The following questions refer to this hypothetical situation.

A female fly, full of fertilized eggs, is swept by high winds to an island far out to sea. She is the first fly to arrive on this island, and the only fly to arrive in this way. Thousands of years later, her numerous offspring occupy the island, but none of them resembles her. There are, instead, several species, each of which eats only a certain type of food. None of the species can fly, for their flight wings are absent, and their balancing organs (in other words, halteres) are now used in courtship displays. The male members of each species bear modified halteres that are unique in appearance to their species. Females bear vestigial halteres. The ranges of all of the daughter species overlap.

- _____ 186) If these fly species lost the ability to fly independently of each other as a result of separate mutation events in each lineage, then the flightless condition in these species could be an example of
- A) adaptive radiation.
 - B) species selection.
 - C) sexual selection.
 - D) allometric growth.
 - E) habitat differentiation.
- _____ 187) Which of these fly organs, as they exist in current fly populations, best fits the description of an exaptation?
- A) wings
 - B) balancing organs
 - C) mouthparts
 - D) thoraxes
 - E) walking appendages

The following questions refer to the description below.

All animals with eyes or eyespots that have been studied so far share a gene in common. When mutated, the gene *Pax-6* causes lack of eyes in fruit flies, tiny eyes in mice, and missing irises (and other eye parts) in humans. The sequence of *Pax-6* in humans and mice is identical. There are so few sequence differences with fruit fly *Pax-6* that the human/mouse version can cause eye formation in eyeless fruit flies, even though vertebrates and invertebrates last shared a common ancestor more than 500 million years ago.

- _____ 188) The appearance of *Pax-6* in all animals with eyes can be explained in multiple ways. Based on the information above, which explanation is most likely?
- A) *Pax-6* in all of these animals is not homologous; it arose independently in many different animal phyla due to intense selective pressure favoring vision.
 - B) The *Pax-6* gene is really not "one" gene. It is many different genes that, over evolutionary time and due to convergence, have come to have a similar nucleotide sequence and function.
 - C) The *Pax-6* gene was an innovation of an ancestral animal of the early Cambrian period. Animals with eyes or eyespots are descendants of this ancestor.
 - D) The perfectly designed *Pax-6* gene appeared instantaneously in all animals created to have eyes or eyespots.
- _____ 189) Fruit fly eyes are of the compound type, which is structurally very different from the camera-type eyes of mammals. Even the camera-type eyes of molluscs, such as octopi, are structurally quite different from those of mammals. Yet, fruit flies, octopi, and mammals possess very similar versions of *Pax-6*. The fact that the same gene helps produce very different types of eyes is most likely due to
- A) the few differences in nucleotide sequence among the *Pax-6* genes of these organisms.
 - B) variations in the number of *Pax-6* genes among these organisms.
 - C) the independent evolution of this gene at many different times during animal evolution.
 - D) differences in the control of *Pax-6* expression among these organisms.
- _____ 190) *Pax-6* usually causes the production of a type of light-receptor pigment. In vertebrate eyes, though, a different gene (the *rh* gene family) is responsible for the light-receptor pigments of the retina. The *rh* gene, like *Pax-6*, is ancient. In the marine ragworm, for example, the *rh* gene causes production of c-opsin, which helps regulate the worm's biological clock. Which of these most likely accounts for vertebrate vision?
- A) The *Pax-6* gene mutated to become the *rh* gene among early mammals.
 - B) During vertebrate evolution, the *rh* gene for biological clock opsin was co-opted as a gene for visual receptor pigments.
 - C) In animals more ancient than ragworms, the *rh* gene(s) coded for visual receptor pigments; in lineages more recent than ragworms, *rh* has flip-flopped several times between producing biological clock opsins and visual receptor pigments.
 - D) *Pax-6* was lost from the mammalian genome, and replaced by the *rh* gene much later.
- _____ 191) The oxygen revolution changed Earth's environment dramatically. Which of the following took advantage of the presence of free oxygen in the oceans and atmosphere?

- A) the evolution of cellular respiration, which used oxygen to help harvest energy from organic molecules
- B) the persistence of some animal groups in anaerobic habitats
- C) the evolution of photosynthetic pigments that protected early algae from the corrosive effects of oxygen
- D) the evolution of chloroplasts after early protists incorporated photosynthetic cyanobacteria
- E) the evolution of multicellular eukaryotic colonies from communities of prokaryotes

- _____ 192) Which factor most likely caused animals and plants in India to differ greatly from species in nearby southeast Asia?
- A) The species have become separated by convergent evolution.
 - B) The climates of the two regions are similar.
 - C) India is in the process of separating from the rest of Asia.
 - D) Life in India was wiped out by ancient volcanic eruptions.
 - E) India was a separate continent until 45 million years ago.
- _____ 193) Adaptive radiations can be a direct consequence of four of the following five factors. Select the exception.
- A) vacant ecological niches
 - B) genetic drift
 - C) colonization of an isolated region that contains suitable habitat and few competitor species
 - D) evolutionary innovation
 - E) an adaptive radiation in a group of organisms (such as plants) that another group uses as food
- _____ 194) Which of the following steps has *not* yet been accomplished by scientists studying the origin of life?
- A) synthesis of small RNA polymers by ribozymes
 - B) abiotic synthesis of polypeptides
 - C) formation of molecular aggregates with selectively permeable membranes
 - D) formation of protocells that use DNA to direct the polymerization of amino acids
 - E) abiotic synthesis of organic molecules
- _____ 195) A genetic change that caused a certain *Hox* gene to be expressed along the tip of a vertebrate limb bud instead of farther back helped make possible the evolution of the tetrapod limb. This type of change is illustrative of
- A) the influence of environment on development.
 - B) paedomorphosis.
 - C) a change in a developmental gene or its regulation that altered the spatial organization of body parts.
 - D) heterochrony.
 - E) gene duplication.
- _____ 196) A swim bladder is a gas-filled sac that helps fish maintain buoyancy. The evolution of the swim bladder from lungs of an ancestral fish is an example of

- A) an evolutionary trend.
- B) exaptation.
- C) changes in *Hox* gene expression.
- D) pedomorphosis.
- E) adaptive radiation.

- ___ 197) The legless condition that is observed in several groups of extant reptiles is the result of
- A) their common ancestor having been legless.
 - B) a shared adaptation to an arboreal (living in trees) lifestyle.
 - C) several instances of the legless condition arising independently of each other.
 - D) individual lizards adapting to a fossorial (living in burrows) lifestyle during their lifetimes.
- ___ 198) The various taxonomic levels (namely, genera, classes, etc.) of the hierarchical classification system differ from each other on the basis of
- A) how widely the organisms assigned to each are distributed throughout the environment.
 - B) their inclusiveness.
 - C) the relative genome sizes of the organisms assigned to each.
 - D) morphological characters that are applicable to all organisms.
- ___ 199) If organisms A, B, and C belong to the same class but to different orders and if organisms D, E, and F belong to the same order but to different families, which of the following pairs of organisms would be expected to show the greatest degree of structural homology?
- A) A and B
 - B) A and C
 - C) B and D
 - D) C and F
 - E) D and F
- ___ 200) Which of the following is (are) problematic when the goal is to construct phylogenies that accurately reflect evolutionary history?
- A) polyphyletic taxa
 - B) paraphyletic taxa
 - C) monophyletic taxa
 - D) Two of the responses are correct.
- ___ 201) Which individual would make the *worst* systematist? One who is uncomfortable with the
- A) Linnaean system of classification.
 - B) notion of hypothetical phylogenies.
 - C) PhyloCode method of classification.
 - D) notion of permanent polytomies.
- ___ 202) If, someday, an archaean cell is discovered whose rRNA sequence is more similar to that of humans than the sequence of mouse rRNA is to that of humans, the best explanation for this apparent discrepancy would be
- A) homology.
 - B) homoplasy.

- C) common ancestry.
- D) retro-evolution by humans.
- E) coevolution of humans and that archaean.

- ___ 203) The best classification system is that which most closely
- A) unites organisms that possess similar morphologies.
 - B) conforms to traditional, Linnaean taxonomic practices.
 - C) reflects evolutionary history.
 - D) reflects the basic separation of prokaryotes from eukaryotes.
- ___ 204) Which of the following pairs are the best examples of homologous structures?
- A) bones in the bat wing and bones in the human forelimb
 - B) owl wing and hornet wing
 - C) bat wing and bird wing
 - D) eyelessness in the Australian mole and eyelessness in the North American mole
- ___ 205) The importance of computers and of computer software to modern cladistics is most closely linked to advances in
- A) light microscopy.
 - B) radiometric dating.
 - C) fossil discovery techniques.
 - D) Linnaean classification.
 - E) molecular genetics.
- ___ 206) Which mutation should *least* require realignment of homologous regions of a gene that is common to several related species?
- A) three-base insertion
 - B) one-base substitution
 - C) four-base insertion
 - D) one-base deletion
 - E) three-base deletion
- ___ 207) The common ancestors of birds and mammals were very early (stem) reptiles, which almost certainly possessed three-chambered hearts (two atria, one ventricle). Birds and mammals, however, are alike in having four-chambered hearts (two atria, two ventricles). The four-chambered hearts of birds and mammals are best described as
- A) structural homologies.
 - B) vestiges.
 - C) homoplasies.
 - D) the result of shared ancestry.
 - E) molecular homologies.
- ___ 208) When using a cladistic approach to systematics, which of the following is considered most important for classification?
- A) shared primitive characters
 - B) analogous primitive characters
 - C) shared derived characters
 - D) the number of homoplasies

- E) overall phenotypic similarity
- _____ 209) Cladograms (a type of phylogenetic tree) constructed from evidence from molecular systematics are based on similarities in
- A) morphology.
 - B) the pattern of embryological development.
 - C) biochemical pathways.
 - D) habitat and lifestyle choices.
 - E) mutations to homologous genes.
- _____ 210) There is some evidence that reptiles called cynodonts may have had whisker-like hairs around their mouths. If true, then what can be properly said of hair?
- A) It is a shared derived character of mammals, even if cynodonts continue to be classified as reptiles.
 - B) It is a shared derived character of the amniote clade, and not of the mammal clade.
 - C) It is a shared ancestral character of the amniote clade, but only if cynodonts are reclassified as mammals.
 - D) It is a shared derived character of the mammals, but only if cynodonts are reclassified as mammals.
- _____ 211) A researcher wants to determine the genetic relatedness of several breeds of dog (*Canis lupus familiaris*). The researcher should compare homologous sequences of this type of biochemical—_____—which can be described as _____.
- A) fatty acids; highly conserved
 - B) lipids; poorly conserved
 - C) proteins; highly conserved
 - D) amino acids; highly conserved
 - E) nucleic acids, poorly conserved
- _____ 212) Nucleic acid sequences that undergo few changes over the course of evolutionary time are said to be conserved. Conserved sequences of nucleic acids
- A) are found in the most crucial portions of proteins.
 - B) include all mitochondrial DNA.
 - C) are abundant in ribosomes.
 - D) are proportionately more common in eukaryotic introns than in eukaryotic exons.
 - E) comprise a larger proportion of pre-mRNA (immature mRNA) than of mature mRNA.
- _____ 213) Species that are not closely related and that do not share many anatomical similarities can still be placed together on the same phylogenetic tree by comparing their
- A) plasmids.
 - B) mitochondrial genomes.
 - C) homologous genes that are poorly conserved.
 - D) homologous genes that are highly conserved.
- _____ 214) Which kind of DNA should provide the best molecular clock for determining the evolutionary relatedness of several species whose common ancestor became extinct billions of years ago?
- A) that coding for ribosomal RNA

- B) intronic DNA belonging to a gene whose product performs a crucial function
- C) paralogous DNA that has lost its function (i.e., no longer codes for functional gene product)
- D) mitochondrial DNA
- E) exonic DNA that codes for a noncrucial part of a polypeptide

- _____ 215) A phylogenetic tree constructed using sequence differences in mitochondrial DNA would be most valid for discerning the evolutionary relatedness of
- A) archaeans and bacteria.
 - B) fungi and animals.
 - C) chimpanzees and humans.
 - D) sharks and dolphins.
 - E) mosses and ferns.
- _____ 216) The lakes of northern Minnesota are home to many similar species of damselflies of the genus *Enallagma* that have apparently undergone speciation from ancestral stock since the last glacial retreat about 10,000 years ago. Sequencing which of the following would probably be most useful in sorting out evolutionary relationships among these closely related species?
- A) nuclear DNA
 - B) mitochondrial DNA
 - C) small nuclear RNA
 - D) ribosomal RNA
 - E) amino acids in proteins
- _____ 217) Which statement represents the best explanation for the observation that the nuclear DNA of wolves and domestic dogs has a very high degree of sequence homology?
- A) Dogs and wolves have very similar morphologies.
 - B) Dogs and wolves belong to the same order.
 - C) Dogs and wolves are both members of the order Carnivora.
 - D) Dogs and wolves shared a common ancestor very recently.
- _____ 218) The reason that paralogous genes can diverge from each other within the same gene pool, whereas orthologous genes diverge only after gene pools are isolated from each other, is that
- A) having multiple copies of genes is essential for the occurrence of sympatric speciation in the wild.
 - B) paralogous genes can occur only in diploid species; thus, they are absent from most prokaryotes.
 - C) polyploidy is a necessary precondition for the occurrence of sympatric speciation in the wild.
 - D) having an extra copy of a gene permits modifications to the copy without loss of the original gene product.
- _____ 219) Neutral theory proposes that
- A) molecular clocks are more reliable when the surrounding pH is close to 7.0.
 - B) most mutations of highly conserved DNA sequences should have no functional effect.
 - C) DNA is less susceptible to mutation when it codes for amino acid sequences whose side groups (or R groups) have a neutral pH.

- D) DNA is less susceptible to mutation when it codes for amino acid sequences whose side groups (or R groups) have a neutral electrical charge.
 - E) a significant proportion of mutations are not acted upon by natural selection.
- _____ 220) When it acts upon a gene, which of the following processes consequently makes that gene an accurate molecular clock?
- A) transcription
 - B) directional natural selection
 - C) mutation
 - D) proofreading
 - E) reverse transcription
- _____ 221) What kind of evidence has recently made it necessary to assign the prokaryotes to either of two different domains, rather than assigning all prokaryotes to the same kingdom?
- A) molecular
 - B) behavioral
 - C) nutritional
 - D) anatomical
 - E) ecological
- _____ 222) What important criterion was used in the late 1960s to distinguish between the three multicellular eukaryotic kingdoms of the five-kingdom classification system?
- A) the number of cells present in individual organisms
 - B) the geological stratum in which fossils first appear
 - C) the nutritional modes they employ
 - D) the biogeographic province where each first appears
 - E) the features of their embryos
- _____ 223) Which kingdom has been replaced with two domains?
- A) Plantae
 - B) Fungi
 - C) Animalia
 - D) Protista
 - E) Monera
- _____ 224) Which eukaryotic kingdom is polyphyletic, and therefore unacceptable, based on cladistics?
- A) Plantae
 - B) Fungi
 - C) Animalia
 - D) Protista
 - E) Monera
- _____ 225) Which eukaryotic kingdom includes members that are the result of endosymbioses that included an ancient proteobacterium and an ancient cyanobacterium?
- A) Plantae
 - B) Fungi
 - C) Animalia
 - D) Protista

E) Monera

Use Figure 26.1 to answer the following questions.

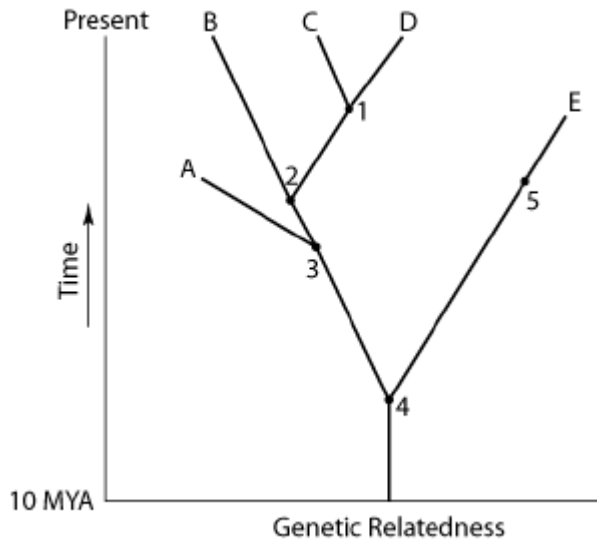


Figure 26.1

- ___ 226) Which extinct species should be the best candidate to serve as the outgroup for the clade whose common ancestor occurs at position 2 in Figure 26.1?
- A) A
 - B) B
 - C) C
 - D) D
 - E) E
- ___ 227) If Figure 26.1 is an accurate depiction of relatedness, then which of the following should be correct?
- 1. The entire tree is based on maximum parsimony.
 - 2. If all species depicted here make up a taxon, this taxon is monophyletic.
 - 3. The last common ancestor of species B and C occurred more recently than the last common ancestor of species D and E.
 - 4. Species A is the direct ancestor of both species B and species C.
 - 5. The species present at position 3 is ancestral to C, D, and E.
- A) 1 and 3
 - B) 3 and 4
 - C) 2, 3, and 4
 - D) 1, 2, and 3

Traditionally, whales and hippopotamuses have been classified in different orders, the Cetacea and the Artiodactyla, respectively. Recent molecular evidence, however, indicates that the whales' closest living relatives are the hippos. This has caused some zoologists to lump the two orders together into a single clade, the Cetartiodactyla. There is no consensus on whether the Cetartiodactyla should be accorded order status or superorder status. This is because it remains unclear whether the whale lineage diverged from the lineage leading to the hippos before or after the other members of the order Artiodactyla (pigs, camels, etc.) diverged (see Figure 26.2).

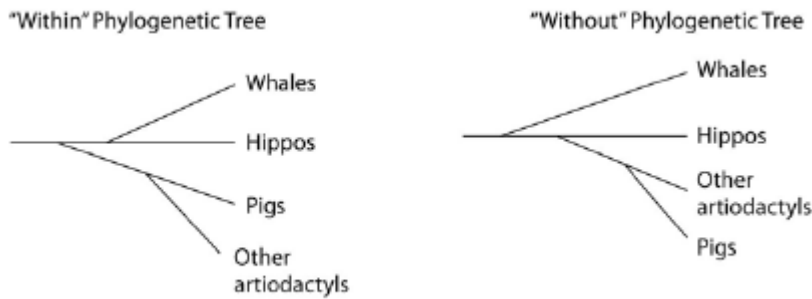


Figure 26.2

Figure 26.2 contrasts the "Within the artiodactyls" origin of the whale lineage with the "Without the artiodactyls" origin of the whale lineage.

- _____ 228) Placing whales and hippos in the same clade means
- that these organisms are phenotypically more similar to each other than to any others shown on the trees in Figure 26.2.
 - that their morphological similarities are probably homoplasies.
 - that they had a common ancestor.
 - that all three of the responses are correct.
 - that two of the responses are correct.
- _____ 229) If it turns out that the whale lineage diverged from the lineage leading to hippos *after* the divergence of the lineage leading to the pigs and other artiodactyls, and *if* the whales continue to be classified in the order Cetacea, then what becomes true of the order Artiodactyla?
- It becomes monophyletic.
 - It becomes paraphyletic.
 - It becomes polyphyletic.
 - It is incorporated into the order Cetacea.
- _____ 230) If it turns out that the whale lineage diverged from the lineage leading to hippos *after* the divergence of the lineage leading to the pigs and other artiodactyls, and *if* the whales continue to be classified in the order Cetacea, then what becomes true of the taxon Cetartiodactyla?
- It should be considered as one monophyletic order.
 - It should be considered a superorder that consists of two monophyletic orders.
 - It should be established as a paraphyletic order.
 - It should be thrown out or modified by taxonomists if classification is to reflect evolutionary history.

- _____ 231) One morphological feature of modern cetaceans is a vestigial pelvic girdle. If it is determined that cetacean lineage diverged from the artiodactyls' lineage *after* the divergence of pigs and other artiodactyla, then what should be true of the vestigial pelvic girdle of cetaceans?
- It should be considered a shared ancestral character of the cetartiodactyls.
 - It should be considered a shared derived character of the cetartiodactyls.
 - It should be considered a shared ancestral character of the cetaceans.
 - It should be considered a shared derived character of the cetaceans.
- _____ 232) If cetaceans are determined to have diverged from the lineage leading to the artiodactyls *before* the divergence of lineages leading to the modern artiodactyls (including hippos), then the cetaceans can be considered
- a sister order to the order Artiodactyla.
 - an ingroup of the order Artiodactyla.
 - the common ancestor of the order Artiodactyla.
- 1 only
 - 3 only
 - 1 and 2
 - 1 and 3
 - 2 and 3
- _____ 233) What can be properly inferred from Figure 26.2?
- In the "Without" tree, pigs are more distantly related to hippos than is depicted in the "Within" tree.
 - In the "Without" tree, pigs are more closely related to hippos than are whales.
 - In the "Within" tree, pigs are more closely related to whales than they are to hippos.
 - The "Without" tree is more consistent with molecular evidence than is the "Within" tree.
 - In the "Within" tree, all artiodactyls, including hippos, are more closely related to each other than any are to the whales.

_____ 234)

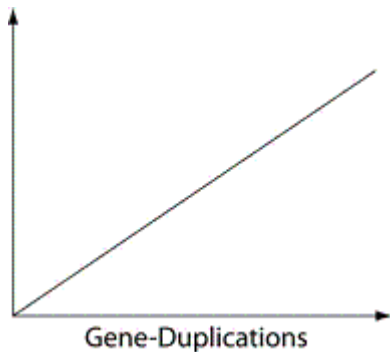
	position 1		position 10		position 20															
	↓		↓		↓															
Species A	T	T	T	A	C	A	C	A	G	T	C	C	C	G	A	T	T	G	T	A
Species B	T	T	A	C	A	C	A	G	T	C	C	C	G	A	T	T	G	T	A	A
Species C	T	T	A	C	A	C	A	G	T	C	C	C	G	G	T	T	A	T	A	A
Species D	T	T	A	C	A	C	A	G	T	C	C	C	G	A	T	T	A	T	A	A
Species E	T	T	A	C	A	C	A	G	C	C	C	C	G	G	T	T	A	T	A	A

Figure 26.3. Morphologically, species A is very similar to four other species, B–E. Yet the nucleotide sequence deep within an intron in a gene shared by all five of these eukaryotic species is quite different in species A compared to that of the other four species when we study the nucleotides present at each position.

If the sequence of species A in Figure 26.3 differs from that of the other four species due to simple misalignment, then what should the computer software find when it compares the sequence of species A to those of the other four species?

- A) The nucleotide at position 1 should be different in species A, but the same in species B–E.
- B) The nucleotide sequence of species A should have long sequences that are nearly identical to those of the other species, but offset in terms of position number.
- C) The sequences of species B–E, though different from that of species A, should be identical to each other, without exception.
- D) If the software compares the amino acid sequence of the actual protein product rather than the nucleotide sequence, then the amino acid sequences of species B–E should be similar to each other, but very different from that of species A.
- E) Computer software is useless in determining sequences of introns; it can only be used with exons.

- _____ 235) Which of the following items does not necessarily exist in a simple linear relationship with the number of gene–duplication events when placed as the label on the vertical axis of the following graph?



- A) number of genes
- B) number of DNA base pairs
- C) genome size
- D) mass (in picograms) of DNA
- E) phenotypic complexity

The following questions refer to this phylogenetic tree, depicting the origins of life and of the three domains. Horizontal lines indicate instances of gene or genome transfer.

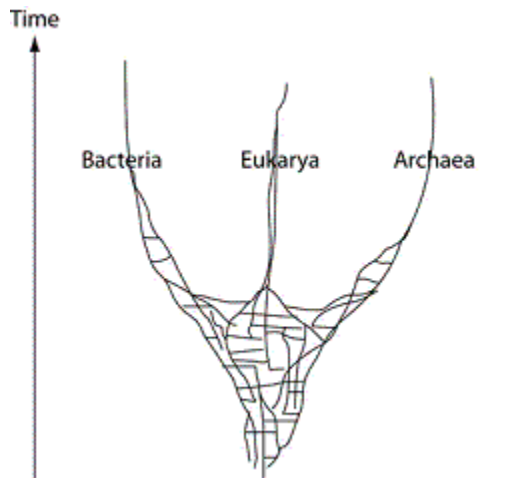


Figure 26.4. A possible phylogenetic tree for the three domains of life.

- ___ 236) If the early history of life on Earth is accurately depicted by Figure 26.4, then which statement is *least* in agreement with the hypothesis proposed by this tree?
- A) The last universal common ancestor of all extant species is better described as a community of organisms, rather than an individual species.
 - B) The origin of the three domains appears as a polytomy.
 - C) Archaeal genomes should contain genes that originated in bacteria, and vice versa.
 - D) Eukaryotes are more closely related to archaeans than to bacteria.
- ___ 237) Which of these processes can be included among those responsible for the horizontal components of Figure 26.4?
- A) endosymbiosis
 - B) mitosis
 - C) binary fission
 - D) point mutations
 - E) S phase of the cell cycle

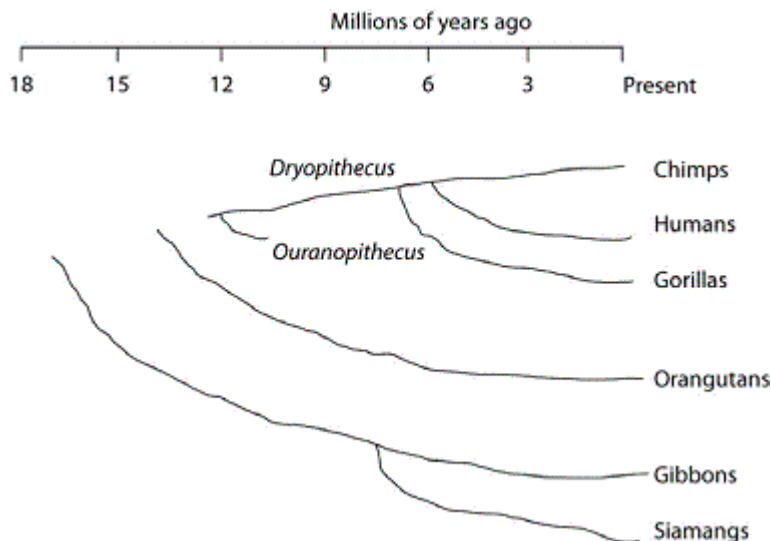


Figure 26.5. Humans, chimpanzees, gorillas, and orangutans are members of a clade called the great apes, which shared a common ancestor about 18 million years ago (Figure 26.4). Gibbons and siamangs comprise a clade called the lesser apes. Tree-branch lengths indicate elapsed time.

- ___ 238) Together, the lesser apes and great apes shared a common ancestor most recently with other members of their
- order.
 - class.
 - subclass.
 - subfamily.
 - family.
- ___ 239) From Figure 26.5, to which of the extant apes are orangutans most closely related?
- gibbons and siamangs
 - Dryopithecus* and *Ouranopithecus*
 - gorillas
 - chimps
 - chimps, gorillas, and humans
- ___ 240) Assuming chimps and gorillas are humans' closest relatives, removing humans from the great ape clade and placing them in a different clade has the effect of making the phylogenetic tree of the great apes
- polyphyletic.
 - paraphyletic.
 - monophyletic.
 - conform with Linnaeus' view of great ape phylogeny.
- ___ 241) What is true of the phylogeny in Figure 26.5?
- It is rooted.
 - The gibbons and siamangs represent an outgroup of the great apes.
 - Chimps and humans are the closest extant sister taxa depicted here.
 - It is absolute, meaning *free of error*.
 - The last common ancestor of the great apes lived about 14 million years ago.
- 1, 2, and 3
 - 1, 2, and 5
 - 1, 2, 3, and 4
 - 1, 2, 3, and 5
 - 2, 3, 4, and 5
- ___ 242) From Figure 26.5, what is true of *Dryopithecus* and *Ouranopithecus*?
- They were great apes.
 - They shared a common ancestor more recently with the orangutans than with the other great apes.
 - They appear to be part of a polytomy.
 - Their closest common ancestor with all of the extant great apes is the one they share with the orangutans.

5. They were about as different from each other genetically as humans are different from chimps.

- A) 1, 2, and 4
- B) 1, 3, and 4
- C) 2, 4, and 5
- D) 1, 2, 3, and 4
- E) 2, 3, 4, and 5

- _____ 243) From Figure 26.5, which other event occurred closest in time to the divergence of gorillas from the lineage that led to humans and chimps?
- A) the divergence of chimps and humans
 - B) the divergence of *Dryopithecus* and *Ouranopithecus*
 - C) the divergence of gibbons and siamangs
 - D) could be either the divergence of chimps and humans OR of *Dryopithecus* and *Ouranopithecus*
 - E) could be either the divergence of chimps and humans OR of gibbons and siamangs
- _____ 244) Which of these can be properly inferred from the phylogeny in Figure 26.5?
- A) Chimps and humans evolved from gorillas.
 - B) The lesser apes are genetically more distinct from each other than the members of the great apes are from each other.
 - C) Orangutans have existed for about 14 million years.
 - D) Chimps and humans should share more homoplasies than should chimps and gorillas.
 - E) Together, the lesser apes and great apes form a clade.

Traditionally, zoologists have placed birds in their own class, Aves. More recently, molecular evidence has shown that birds are more closely related to reptiles than their anatomy reveals. Genetically, birds are more closely related to crocodiles than crocodiles are to turtles. Thus, bird anatomy has become highly modified as they have adapted to flight, without their genes having undergone nearly as much change.

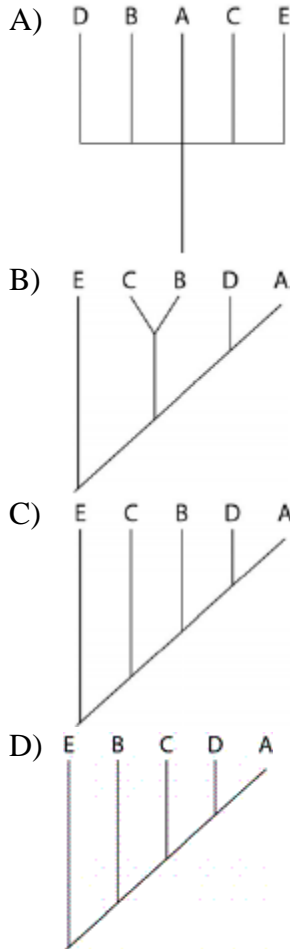
- _____ 245) For a proponent of PhyloCode classification, what is true of the reptile clade if birds are not included in it?
- A) It becomes paraphyletic and, thus, an invalid reflection of evolutionary history.
 - B) It becomes a subclass, instead of a class.
 - C) It becomes a superclass, whereas the birds remain a class.
 - D) PhyloCode does not concern itself with what is, or is not, a clade.

The next questions refer to the following table, which compares the % sequence homology of four different parts (two introns and two exons) of a gene that is found in five different eukaryotic species. Each part is numbered to indicate its distance from the promoter (e.g., Intron I is the one closest to the promoter). The data reported for species A were obtained by comparing DNA from one member of species A to another member of species A.

Species	% Sequence Homology			
	Intron I	Exon I	Intron VI	Exon V

A	100%	100%	100%	100%
B	98%	99%	82%	96%
C	98%	99%	89%	96%
D	99%	99%	92%	97%
E	98%	99%	80%	94%

___ 246) Based on the tabular data, and assuming that time advances vertically, which cladogram (a type of phylogenetic tree) is the most likely depiction of the evolutionary relationships among these five species?



___ 247) Which of the following is the best explanation for the high degree of sequence homology observed in Exon I among these five species?

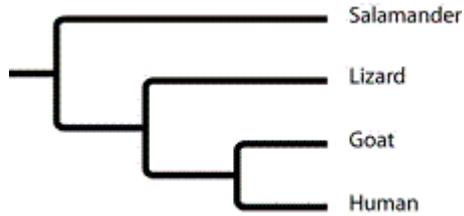
- A) It is the most-upstream exon of this gene.
- B) Due to alternative gene splicing, this exon is often treated as an intron.
- C) It codes for a polypeptide domain that has a crucial function.
- D) These five species must actually constitute a single species.
- E) This exon is rich in G-C base pairs; thus, it is more stable.

___ 248) Regarding these sequence homology data, the principle of maximum parsimony would be applicable in

- A) distinguishing introns from exons.
- B) determining degree of sequence homology.
- C) selecting appropriate genes for comparison among species.
- D) inferring evolutionary relatedness from the number of sequence differences.

- _____ 249) To apply parsimony to constructing a phylogenetic tree,
- A) choose the tree that assumes all evolutionary changes are equally probable.
 - B) choose the tree in which the branch points are based on as many shared derived characters as possible.
 - C) base phylogenetic trees only on the fossil record, as this provides the simplest explanation for evolution.
 - D) choose the tree that represents the fewest evolutionary changes, either in DNA sequences or morphology.
 - E) choose the tree with the fewest branch points.

- _____ 250) Based on this tree, which statement is *not* correct?



- A) The salamander lineage is a basal taxon.
- B) Salamanders are a sister group to the group containing lizards, goats, and humans.
- C) Salamanders are as closely related to goats as to humans.
- D) Lizards are more closely related to salamanders than to humans.

**AP Biology - Evolution Unit Practice Exam
Answer Section**

MULTIPLE CHOICE

- 1) ANS: B
- 2) ANS: A
- 3) ANS: A
- 4) ANS: C
- 5) ANS: C
- 6) ANS: A
- 7) ANS: E
- 8) ANS: B
- 9) ANS: E
- 10) ANS: A
- 11) ANS: C
- 12) ANS: A
- 13) ANS: C
- 14) ANS: B
- 15) ANS: C
- 16) ANS: D
- 17) ANS: B
- 18) ANS: B
- 19) ANS: E
- 20) ANS: C
- 21) ANS: E
- 22) ANS: C
- 23) ANS: E
- 24) ANS: C
- 25) ANS: B
- 26) ANS: D
- 27) ANS: A
- 28) ANS: B
- 29) ANS: A
- 30) ANS: B
- 31) ANS: D
- 32) ANS: E
- 33) ANS: D
- 34) ANS: E
- 35) ANS: B
- 36) ANS: E
- 37) ANS: B
- 38) ANS: B

- 39) ANS: B
- 40) ANS: A
- 41) ANS: E
- 42) ANS: B
- 43) ANS: D
- 44) ANS: C
- 45) ANS: C
- 46) ANS: A
- 47) ANS: C
- 48) ANS: A
- 49) ANS: E
- 50) ANS: D
- 51) ANS: B
- 52) ANS: D
- 53) ANS: C
- 54) ANS: D
- 55) ANS: B
- 56) ANS: D
- 57) ANS: D
- 58) ANS: E
- 59) ANS: E
- 60) ANS: D
- 61) ANS: D
- 62) ANS: E
- 63) ANS: A
- 64) ANS: C
- 65) ANS: C
- 66) ANS: C
- 67) ANS: B
- 68) ANS: B
- 69) ANS: B
- 70) ANS: D
- 71) ANS: A
- 72) ANS: B
- 73) ANS: B
- 74) ANS: C
- 75) ANS: B
- 76) ANS: E
- 77) ANS: E
- 78) ANS: A
- 79) ANS: B
- 80) ANS: B
- 81) ANS: C

- 82) ANS: A
- 83) ANS: A
- 84) ANS: E
- 85) ANS: B
- 86) ANS: C
- 87) ANS: A
- 88) ANS: E
- 89) ANS: C
- 90) ANS: E
- 91) ANS: A
- 92) ANS: D
- 93) ANS: B
- 94) ANS: B
- 95) ANS: C
- 96) ANS: D
- 97) ANS: D
- 98) ANS: D
- 99) ANS: A
- 100) ANS: D
- 101) ANS: E
- 102) ANS: A
- 103) ANS: B
- 104) ANS: E
- 105) ANS: C
- 106) ANS: A
- 107) ANS: D
- 108) ANS: B
- 109) ANS: B
- 110) ANS: A
- 111) ANS: A
- 112) ANS: B
- 113) ANS: C
- 114) ANS: D
- 115) ANS: C
- 116) ANS: E
- 117) ANS: E
- 118) ANS: A
- 119) ANS: A
- 120) ANS: D
- 121) ANS: D
- 122) ANS: C
- 123) ANS: C
- 124) ANS: A

- 125) ANS: B
- 126) ANS: A
- 127) ANS: A
- 128) ANS: C
- 129) ANS: E
- 130) ANS: A
- 131) ANS: C
- 132) ANS: E
- 133) ANS: D
- 134) ANS: A
- 135) ANS: C
- 136) ANS: B
- 137) ANS: B
- 138) ANS: C
- 139) ANS: C
- 140) ANS: A
- 141) ANS: D
- 142) ANS: D
- 143) ANS: A
- 144) ANS: C
- 145) ANS: C
- 146) ANS: C
- 147) ANS: B
- 148) ANS: C
- 149) ANS: D
- 150) ANS: E
- 151) ANS: E
- 152) ANS: C
- 153) ANS: C
- 154) ANS: E
- 155) ANS: D
- 156) ANS: E
- 157) ANS: E
- 158) ANS: C
- 159) ANS: C
- 160) ANS: B
- 161) ANS: C
- 162) ANS: A
- 163) ANS: C
- 164) ANS: A
- 165) ANS: C
- 166) ANS: C
- 167) ANS: D

- 168) ANS: B
- 169) ANS: A
- 170) ANS: D
- 171) ANS: B
- 172) ANS: B
- 173) ANS: B
- 174) ANS: C
- 175) ANS: A
- 176) ANS: B
- 177) ANS: B
- 178) ANS: C
- 179) ANS: D
- 180) ANS: C
- 181) ANS: D
- 182) ANS: B
- 183) ANS: C
- 184) ANS: B
- 185) ANS: D
- 186) ANS: B
- 187) ANS: B
- 188) ANS: C
- 189) ANS: D
- 190) ANS: B
- 191) ANS: A
- 192) ANS: E
- 193) ANS: B
- 194) ANS: D
- 195) ANS: C
- 196) ANS: B
- 197) ANS: C
- 198) ANS: B
- 199) ANS: E
- 200) ANS: D
- 201) ANS: B
- 202) ANS: B
- 203) ANS: C
- 204) ANS: A
- 205) ANS: E
- 206) ANS: B
- 207) ANS: C
- 208) ANS: C
- 209) ANS: E
- 210) ANS: D

- 211) ANS: E
- 212) ANS: C
- 213) ANS: D
- 214) ANS: A
- 215) ANS: C
- 216) ANS: B
- 217) ANS: D
- 218) ANS: D
- 219) ANS: E
- 220) ANS: C
- 221) ANS: A
- 222) ANS: C
- 223) ANS: E
- 224) ANS: D
- 225) ANS: A
- 226) ANS: A
- 227) ANS: D
- 228) ANS: C
- 229) ANS: B
- 230) ANS: A
- 231) ANS: D
- 232) ANS: A
- 233) ANS: B
- 234) ANS: B
- 235) ANS: E
- 236) ANS: D
- 237) ANS: A
- 238) ANS: A
- 239) ANS: E
- 240) ANS: B
- 241) ANS: D
- 242) ANS: B
- 243) ANS: E
- 244) ANS: E
- 245) ANS: A
- 246) ANS: D
- 247) ANS: C
- 248) ANS: D
- 249) ANS: D
- 250) ANS: D