

## Chapter 26 Phylogeny and the Tree of Life

### Multiple-Choice Questions

- 1) 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.

Answer: C

Topic: Concept 26.1

Skill: Knowledge/Comprehension

- 2) The scientific *discipline* concerned with naming organisms is called
- A) taxonomy.
  - B) cladistics.
  - C) binomial nomenclature.
  - D) systematics.
  - E) phylocode

Answer: A

Topic: Concept 26.1

Skill: Knowledge/Comprehension

- 3) The various taxonomic levels (*viz*, 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) the body sizes of the organisms assigned to each.
  - C) their inclusiveness.
  - D) the relative genome sizes of the organisms assigned to each.
  - E) morphological characters that are applicable to all organisms.

Answer: C

Topic: Concept 26.1

Skill: Knowledge/Comprehension

- 4) Which of these illustrates the correct representation of the binomial scientific name for the African lion?
- A) *Panthera leo*
  - B) panthera leo
  - C) *Panthera leo*
  - D) Panthera Leo
  - E) *Panthera leo*

Answer: E

Topic: Concept 26.1

Skill: Knowledge/Comprehension

- 5) A phylogenetic tree that is "rooted" is one
- A) that extends back to the origin of life on Earth.
  - B) at whose base is located the common ancestor of all taxa depicted on that tree.
  - C) that illustrates the rampant gene swapping that occurred early in life's history.
  - D) that indicates our uncertainty about the evolutionary relationships of the taxa depicted on the tree.
  - E) with very few branch points.

Answer: B

Topic: Concept 26.1

Skill: Knowledge/Comprehension

- 6) The correct sequence, from the most to the least comprehensive, of the taxonomic levels listed here is
- A) family, phylum, class, kingdom, order, species, and genus.
  - B) kingdom, phylum, class, order, family, genus, and species.
  - C) kingdom, phylum, order, class, family, genus, and species.
  - D) phylum, kingdom, order, class, species, family, and genus.
  - E) phylum, family, class, order, kingdom, genus, and species.

Answer: B

Topic: Concept 26.1

Skill: Knowledge/Comprehension

- 7) The common housefly belongs to all of the following taxa. Assuming you had access to textbooks or other scientific literature, knowing which of the following should provide you with the most specific information about the common housefly?
- A) order Diptera
  - B) family Muscidae
  - C) genus *Musca*
  - D) class Hexapoda
  - E) phylum Arthropoda

Answer: C

Topic: Concept 26.1

Skill: Application/Analysis

- 8) 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

Answer: E

Topic: Concept 26.1

Skill: Application/Analysis

- 9) Darwin analogized the effects of evolution as the above-ground portion of a many-branched tree, with extant species being the tips of the twigs. The common ancestor of two species is most analogous to which anatomical tree part?
- A) a single twig that gets longer with time
  - B) a node where two twigs diverge
  - C) a twig that branches with time
  - D) the trunk
  - E) neighboring twigs attached to the same stem

Answer: B

Topic: Concept 26.1

Skill: Knowledge/Comprehension

- 10) Dozens of potato varieties exist, differing from each other in potato-tuber size, skin color, flesh color, and shape. One might construct a classification of potatoes based on these morphological traits. Which of these criticisms of such a classification scheme is most likely to come from an adherent of the phylocode method of classification?
- A) Flesh color, rather than skin color, is a valid trait to use for classification because it is less susceptible to change with the age of the tuber.
  - B) Flower color is a better classification criterion, because below-ground tubers can be influenced by minerals in the soil as much as by their genes.
  - C) A more useful classification would codify potatoes based on the texture and flavor of their flesh, because this is what humans are concerned with.
  - D) The most accurate phylogenetic code is that of Linnaeus. Classify potatoes based on Linnaean principles; not according to their color.
  - E) The only biologically valid classification of potato varieties is one that accurately reflects their genetic and evolutionary relatedness.

Answer: E

Topic: Concept 26.1

Skill: Synthesis/Evaluation

- 11) The term "homoplasy" is most applicable to which of these features?
- A) the legless condition found in various types of extant lizards
  - B) the 5-digit condition of human hands and bat wings
  - C) the beta-hemoglobin genes of mice and of humans
  - D) the fur that covers Australian moles and North American moles
  - E) the basic skeletal features of dog forelimbs and cat forelimbs

Answer: A

Topic: Concept 26.2

Skill: Knowledge/Comprehension

- 12) If, someday, an archaean cell is discovered whose SSU-rRNA sequence is more similar to that of humans than the sequence of mouse SSU-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) co-evolution of humans and that archaean.

Answer: B

Topic: Concept 26.2

Skill: Application/Analysis

- 13) 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) corroborates the classification scheme in use at the time of Charles Darwin.
  - E) reflects the basic separation of prokaryotes from eukaryotes.

Answer: C

Topic: Concept 26.2

Skill: Knowledge/Comprehension

14) Which of the following pairs are the best examples of homologous structures?

- A) bat wing and human hand
- B) owl wing and hornet wing
- C) porcupine quill and cactus spine
- D) bat forelimb and bird wing
- E) Australian mole and North American mole

Answer: A

Topic: Concept 26.2

Skill: Knowledge/Comprehension

15) Some molecular data place the giant panda in the bear family (Ursidae) but place the lesser panda in the raccoon family (Procyonidae). Consequently, the morphological similarities of these two species are probably due to

- A) inheritance of acquired characteristics.
- B) sexual selection.
- C) inheritance of shared derived characters.
- D) possession of analogous structures.
- E) possession of shared primitive characters.

Answer: D

Topic: Concept 26.2

Skill: Knowledge/Comprehension

16) In angiosperm plants, flower morphology can be very intricate. If a tree, such as a New Mexico locust, has flowers that share many morphological intricacies with flowers of the sweet pea vine, then the most likely explanation for these floral similarities is the same general explanation for the similarities between the

- A) dorsal fins of sharks and of dolphins.
- B) reduced eyes of Australian moles and North American moles.
- C) scales on moth wings and the scales of fish skin.
- D) cranial bones of humans and those of chimpanzees.
- E) adaptations for flight in birds and adaptations for flight in bats.

Answer: D

Topic: Concept 26.2

Skill: Synthesis/Evaluation

17) 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.

Answer: E

Topic: Concept 26.2

Skill: Knowledge/Comprehension

18) Which mutation should *least* require realignment of homologous regions of a gene that is common to several related species?

- A) 3-base insertion
- B) 1-base substitution
- C) 4-base insertion
- D) 1-base deletion
- E) 3-base deletion

Answer: B

Topic: Concept 26.2

Skill: Application/Analysis

19) The common ancestors of birds and mammals were very early (stem) reptiles, which almost certainly possessed 3-chambered hearts (2 atria, 1 ventricle). Birds and mammals, however, are alike in having 4-chambered hearts (2 atria, 2 ventricles). The 4-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.

Answer: C

Topic: Concept 26.2

Skill: Application/Analysis

20) Generally, within a lineage, the largest number of shared derived characters should be found among two organisms that are members of the same

- A) kingdom.
- B) class.
- C) domain.
- D) family.
- E) order.

Answer: D

Topic: Concept 26.3

Skill: Knowledge/Comprehension

Use Figure 26.1 to answer the following questions.

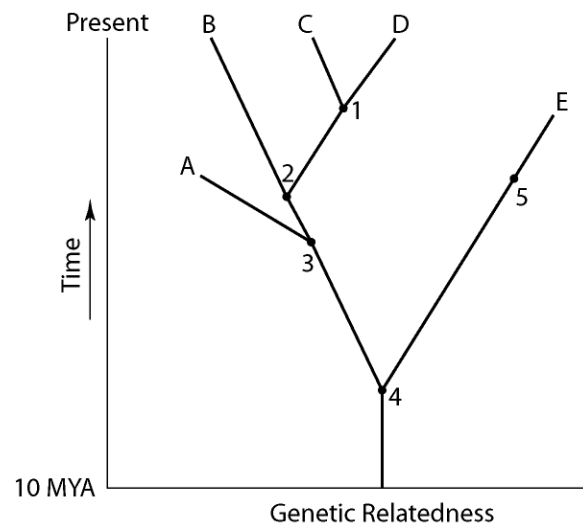


Figure 26.1

21) A common ancestor for both species C and E could be at position number

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

Answer: D

Topic: Concept 26.3

Skill: Application/Analysis

22) The two extant species that are most closely related to each other are

- A) A and B.
- B) B and C.
- C) C and D.
- D) D and E.
- E) E and A.

Answer: C

Topic: Concept 26.3

Skill: Application/Analysis

23) Which species are extinct?

- A) A and E
- B) A and B
- C) C and D
- D) D and E
- E) cannot be determined from the information provided

Answer: A

Topic: Concept 26.3

Skill: Application/Analysis

24) Which extinct species should be the best candidate to serve as the outgroup for the clade whose common ancestor occurs at position 2?

- A) A
- B) B
- C) C
- D) D
- E) E

Answer: A

Topic: Concept 26.3

Skill: Application/Analysis

25) If this evolutionary tree 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) 2 and 5
- B) 1 and 3
- C) 3 and 4
- D) 2, 3, and 4
- E) 1, 2, and 3

Answer: E

Topic: Concept 26.3

Skill: Application/Analysis

The following questions refer to the hypothetical patterns of taxonomic hierarchy shown in Figure 26.2.

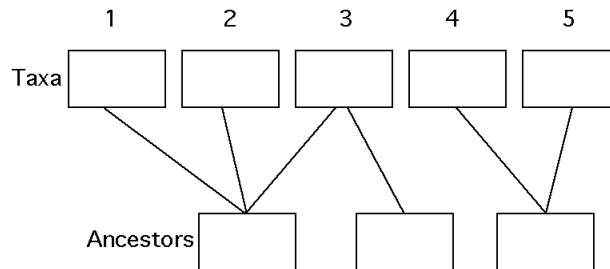


Figure 26.2

26) Which of the following numbers represents a polyphyletic taxon?

- A) 2
- B) 3
- C) 4
- D) 5
- E) more than one of these

Answer: B

Topic: Concept 26.3

Skill: Application/Analysis

- 27) If this figure is an accurate depiction of relatedness, then which taxon is unacceptable, based on cladistics?
- A) 1
  - B) 2
  - C) 3
  - D) 4
  - E) 5

Answer: C

Topic: Concept 26.3

Skill: Application/Analysis

- 28) Which of the following is *not* true of all horizontally oriented phylogenetic trees, where time advances to the right?
- A) Each branch point represents a point in absolute time.
  - B) Organisms represented at the base of such trees are ancestral to those represented at higher levels.
  - C) The more branch points that occur between two taxa, the more divergent their DNA sequences should be.
  - D) The common ancestor represented by the rightmost branch point existed more recently in time than the common ancestors represented at branch points located to the left.
  - E) The more branch points there are, the more taxa are likely to be represented.

Answer: A

Topic: Concept 26.3

Skill: Knowledge/Comprehension

- 29) Ultimately, which of these serves as the basis for both the principle of maximum parsimony and the principle that shared complexity indicates homology rather than analogy?
- A) the laws of thermodynamics
  - B) Boyle's law
  - C) the laws of probability
  - D) chaos theory
  - E) Hutchinson's law

Answer: C

Topic: Concept 26.3

Skill: Knowledge/Comprehension

- 30) Shared derived characters are most likely to be found in taxa that are
- A) paraphyletic.
  - B) polyphyletic.
  - C) monophyletic.

Answer: C

Topic: Concept 26.3

Skill: Knowledge/Comprehension

- 31) A taxon, all of whose members have the same common ancestor, is
- A) paraphyletic.
  - B) polyphyletic.
  - C) monophyletic.

Answer: C

Topic: Concept 26.3

Skill: Knowledge/Comprehension



32) The term that is most appropriately associated with *clade* is

- A) paraphyletic.
- B) polyphyletic.
- C) monophyletic.

Answer: C

Topic: Concept 26.3

Skill: Knowledge/Comprehension

33) If birds are excluded from the class Reptilia, the term that consequently describes the class Reptilia is

- A) paraphyletic.
- B) polyphyletic.
- C) monophyletic.

Answer: A

Topic: Concept 26.3

Skill: Application/Analysis

34) If the eukaryotic condition arose, independently, several different times during evolutionary history, and if ancestors of these different lineages are extant and are classified in the domain Eukarya, then the domain Eukarya would be

- A) paraphyletic.
- B) polyphyletic.
- C) monophyletic.

Answer: B

Topic: Concept 26.3

Skill: Application/Analysis

35) 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

Answer: C

Topic: Concept 26.3

Skill: Knowledge/Comprehension

36) The four-chambered hearts of birds and the four-chambered hearts of mammals evolved independently of each other. If one were unaware of this independence, then one might logically conclude that

- A) the birds were the first to evolve a 4-chambered heart.
- B) birds and mammals are more distantly related than is actually the case.
- C) early mammals possessed feathers.
- D) the common ancestor of birds and mammals had a four-chambered heart.
- E) birds and mammals should be placed in the same family.

Answer: D

Topic: Concept 26.3

Skill: Application/Analysis

- 37) Phylogenetic hypotheses (such as those represented by phylogenetic trees) are strongest when
- A) they are based on amino acid sequences from homologous proteins, as long as the genes that code for such proteins contain no introns.
  - B) each clade is defined by a single derived character.
  - C) they are supported by more than one kind of evidence, such as when fossil evidence corroborates molecular evidence.
  - D) they are accepted by the foremost authorities in the field, especially if they have won Nobel Prizes.
  - E) they are based on a single DNA sequence that seems to be a shared derived sequence.

Answer: C

Topic: Concept 26.3

Skill: Knowledge/Comprehension

- 38) 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.

Answer: E

Topic: Concept 26.3

Skill: Knowledge/Comprehension

*The following questions refer to the information below.*

A researcher compared the nucleotide sequences of a homologous gene from five different species of mammals with the homologous human gene. The sequence homology between each species' version of the gene and the human gene is presented as a percentage of similarity.

Species	Percentage
Chimpanzee	99.7
Orangutan	98.6
Baboon	97.2
Rhesus Monkey	96.9
Rabbit	93.7

**Figure 26.3**

- 39) What probably explains the inclusion of rabbits in this research?
- A) Their short generation time provides a ready source of DNA.
  - B) They possess all of the shared derived characters as do the other species listed.
  - C) They are the closest known relatives of rhesus monkeys.
  - D) They are the outgroup.
  - E) They are the most recent common ancestor of the primates.

Answer: D

Topic: Concept 26.3

Skill: Application/Analysis

- 40) What conclusion can be drawn validly from these data?
- A) Humans and other primates evolved from rabbits within the past 10 million years.
  - B) Most of the genes of other organisms are paralogous to human genes, or with chimpanzee genes.
  - C) Among the organisms listed, humans shared a common ancestor most recently with chimpanzees.
  - D) Humans evolved from chimpanzees somewhere in Africa within the last 6 million years.

Answer: C

Topic: Concepts 26.3, 26.4

Skill: Application/Analysis

- 41) When sufficient heat is applied, double -stranded DNA denatures into two single -stranded molecules as the heat breaks all of the hydrogen bonds. In an experiment, molecules of single -stranded DNA from species X are separately hybridized with putatively homologous single -stranded DNA molecules from five species (A -E). The hybridized DNAs are then heated, and the temperature at which complete denaturation occurs is recorded. Based on the data below, which species is probably most closely related to species X?

Species	Temperature at Which Hybridized DNA Denatures
A	30°C
B	85°C
C	74°C
D	60°C
E	61°C

Answer: B

Topic: Concepts 26.3, 26.4

Skill: Application/Analysis

- 42) A researcher wants to determine the genetic relatedness of several breeds of dog (*Canis familiaris*). The researcher should compare homologous sequences of \_\_\_\_\_ that are known to be \_\_\_\_\_.
- A) carbohydrates; poorly conserved
  - B) fatty acids; highly conserved
  - C) lipids; poorly conserved
  - D) proteins or nucleic acids; poorly conserved
  - E) amino acids; highly conserved

Answer: D

Topic: Concepts 26.4

Skill: Knowledge/Comprehension

- 43) Concerning growth in genome size over evolutionary time, which of these does *not* belong with the others?
- A) orthologous genes
  - B) gene duplications
  - C) paralogous genes
  - D) gene families

Answer: A

Topic: Concept 26.4

Skill: Knowledge/Comprehension

- 44) 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.

Answer: C

Topic: Concept 26.4

Skill: Knowledge/Comprehension

- 45) 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) chloroplast genomes.
  - C) mitochondrial genomes.
  - D) homologous genes that are poorly conserved.
  - E) homologous genes that are highly conserved.

Answer: E

Topic: Concept 26.4

Skill: Knowledge/Comprehension

- 46) Typically, mutations that modify the active site of an enzyme are more likely to be harmful than mutations that affect other parts of the enzyme. A hypothetical enzyme consists of four domains (A—D), and the amino acid sequences of these four domains have been determined in five related species. Given the proportion of amino acid homologies among the five species at each of the four domains, which domain probably contains the active site?

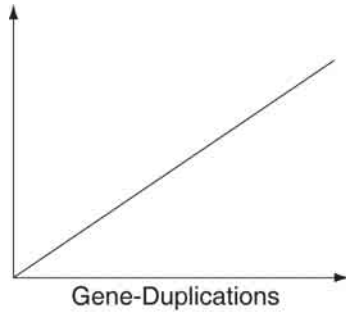
Percentage of Homologous	
Domain	Amino Acids
A	32%
B	8%
C	78%
D	45%

Answer: C

Topic: Concept 26.4

Skill: Application/Analysis

47) Which of these 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 graph below?



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

Answer: E

Topic: Concept 26.4

Skill: Application/Analysis

48) Which kind of DNA should provide the best molecular clock for gauging 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 non-critical part of a polypeptide

Answer: A

Topic: Concept 26.4

Skill: Application/Analysis

49) 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) Hawaiian silverswords.
- D) sharks and dolphins
- E) mosses and ferns.

Answer: C

Topic: Concept 26.4

Skill: Application/Analysis

- 50) 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

Answer: B

Topic: Concept 26.4

Skill: Application/Analysis

- 51) Which statement represents the best explanation for the observation that the nuclear DNA of wolves and domestic dogs has a very high degree of 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.
  - E) Convergent evolution has occurred.

Answer: D

Topic: Concept 26.4

Skill: Knowledge/Comprehension

- 52) 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.

Answer: D

Topic: Concept 26.4

Skill: Knowledge/Comprehension

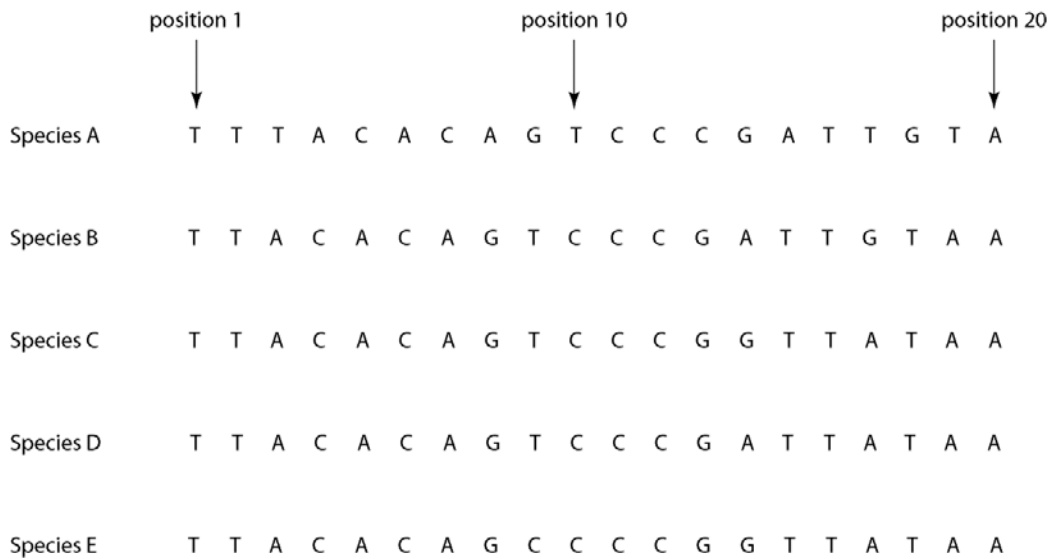
- 53) If the genes of yeast are 50% orthologous to those of humans, and if the genes of mice are 99% orthologous to those of humans, then what percentage of the genes of fish might one validly predict to be orthologous to the genes of humans?
- A) 10%
  - B) 30%
  - C) 40%
  - D) 50%
  - E) 80%

Answer: E

Topic: Concept 26.4

Skill: Application/Analysis

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 one studies the nucleotides present at each position.



**Figure 26.4**

- 54) If the sequence of Species A 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, not nucleotide sequence, but rather the amino acid sequence of the actual protein product, 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.

Answer: B

Topic: Concept 26.4

Skill: Application/Analysis

- 55) What is true of gene duplication (NOTE: gene duplication is a process that is distinct from DNA replication)?
- A) It is a type of point mutation.
  - B) Its occurrence is limited to diploid species.
  - C) Its occurrence is limited to organisms without functional DNA -repair enzymes.
  - D) It is most similar in its effects to a deletion mutation.
  - E) It can increase the size of a genome over evolutionary time.

Answer: E

Topic: Concept 26.4

Skill: Knowledge/Comprehension

- 56) Paralogous genes that have lost the function of coding for a functional gene product are known as "pseudogenes." Which of these is a valid prediction regarding the fate of pseudogenes over evolutionary time?
- A) They will be preserved by natural selection.
  - B) They will be highly conserved.
  - C) They will ultimately regain their original function.
  - D) They will be transformed into orthologous genes.
  - E) They will have relatively high mutation rates.

Answer: E

Topic: Concepts 26.4, 26.5

Skill: Application/Analysis

- 57) Theoretically, molecular clocks are to molecular phylogenies as radiometric dating is to phylogenies that are based on the
- A) fossil record.
  - B) geographic distribution of extant species.
  - C) morphological similarities among extant species.
  - D) amino acid sequences of homologous polypeptides.

Answer: A

Topic: Concept 26.5

Skill: Knowledge/Comprehension

- 58) The most important feature that permits a gene to act as a molecular clock is
- A) having a large number of base pairs.
  - B) having a larger proportion of exonic DNA than of intronic DNA.
  - C) having a reliable average rate of mutation.
  - D) its recent origin by a gene-duplication event.
  - E) its being acted upon by natural selection.

Answer: C

Topic: Concept 26.5

Skill: Knowledge/Comprehension

- 59) 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 is not acted upon by natural selection.

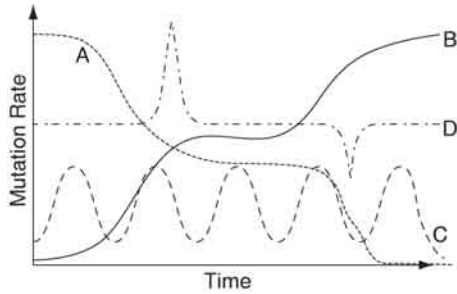
Answer: E

Topic: Concept 26.5

Skill: Knowledge/Comprehension



- 60) Which curve in the graph below best depicts the way that mutation rate varies over time in a gene that can serve as a reliable molecular clock?



Answer: C

Topic: Concept 26.5

Skill: Knowledge/Comprehension

- 61) When it acts upon a gene, which of these processes consequently makes that gene an accurate molecular clock?

- A) transcription
- B) directional natural selection
- C) mutation
- D) proofreading
- E) reverse transcription

Answer: B

Topic: Concept 26.5

Skill: Knowledge/Comprehension

- 62) Which of these would, if it had acted upon a gene, prevent this gene from acting as a reliable molecular clock?

- A) neutral mutations
- B) genetic drift
- C) mutations within introns
- D) natural selection
- E) most substitution mutations involving an exonic codon's 3rd position

Answer: D

Topic: Concept 26.5

Skill: Knowledge/Comprehension

- 63) The HIV genome's reliably *high* rate of change permits it to serve as a molecular clock. Which of these features is most responsible for this genome's high rate of change?

- A) the relatively low number of nucleotides in the genome
- B) the relatively small number of genes in the genome
- C) the genome's ability to insert itself into the genome of the host
- D) the lack of proofreading by the enzyme that converts HIV's RNA genome into a DNA genome

Answer: D

Topic: Concept 26.5

Skill: Application/Analysis

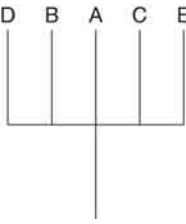
The following questions refer to the table below, which compares the % sequence homology of four different parts (2 introns and 2 exons) of a gene that is found in five different eukaryotic species. Each part is numbered to indicate its distance from the promoter (e.g., Intron I is that closest to the 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%

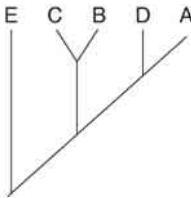
C	98%	99%	89%	96%
D	99%	99%	92%	97%
E	98%	99%	80%	94%

64) 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?

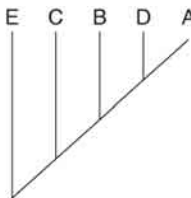
A)



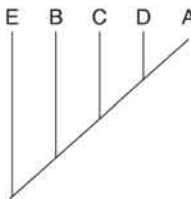
B)



C)



D)



Answer: D

Topic: Concepts 26.2, 26.3

Skill: Synthesis/Evaluation

65) Which of these 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, is more stable.

Answer: C

Topic: Concepts 26.2, 26.4

Skill: Synthesis/Evaluation

- 66) 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.

Answer: D

Topic: Concept 26.3

Skill: Synthesis/Evaluation

- 67) Which of these is the best explanation for the relatively low level of sequence homology observed in Intron VI?
- A) Mutations that occur here are neutral; thus, are neither selected for nor against, and thereby accumulate over time.
  - B) Its higher mutation rate has resulted in its highly conserved nature.
  - C) The occurrence of molecular homoplasy explains it.
  - D) This intron is not actually homologous, having resulted from separate bacteriophage -induced transduction events in these five species.

Answer: A

Topic: Concepts 26.2, 26.4, 26.5

Skill: Synthesis/Evaluation

- 68) Which of these is the best explanation for Intron I's relatively high sequence homology among these five species?
- A) It is the most-upstream of this gene's introns.
  - B) It was once an exon, but became intronic in the common ancestor of these five species.
  - C) Due to alternative gene splicing, it is often treated as an exon in these five species; as an exon, it codes for an important part of a polypeptide.
  - D) It has a relatively high *average* rate of mutation.

Answer: C

Topic: Concepts 26.2, 26.4, 26.5

Skill: Synthesis/Evaluation

- 69) Which of these four gene parts should allow the construction of the most accurate phylogenetic tree, assuming that this is the only part of the gene that has acted as a reliable molecular clock?
- A) Intron I
  - B) Exon I
  - C) Intron VI
  - D) Exon V

Answer: C

Topic: Concept 26.5

Skill: Synthesis/Evaluation

- 70) Which process hinders clarification of the deepest branchings in a phylogenetic tree that depicts the origins of the three domains?
- A) binary fission
  - B) mitosis
  - C) meiosis
  - D) horizontal gene transfer
  - E) gene duplication

Answer: D

Topic: Concept 26.6

Skill: Knowledge/Comprehension

71) 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

Answer: A

Topic: Concept 26.6

Skill: Knowledge/Comprehension

72) 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

Answer: C

Topic: Concept 26.6

Skill: Knowledge/Comprehension

73) Which is an obsolete kingdom that includes prokaryotic organisms?

- A) Plantae
- B) Fungi
- C) Animalia
- D) Protista
- E) Monera

Answer: E

Topic: Concept 26.6

Skill: Knowledge/Comprehension

74) Members of which kingdom have cell walls and are all heterotrophic?

- A) Plantae
- B) Fungi
- C) Animalia
- D) Protista
- E) Monera

Answer: B

Topic: Concept 26.6

Skill: Knowledge/Comprehension

75) Which kingdom has been replaced with two domains?

- A) Plantae
- B) Fungi
- C) Animalia
- D) Protista
- E) Monera

Answer: E

Topic: Concept 26.6

Skill: Knowledge/Comprehension

76) Which eukaryotic kingdom is polyphyletic and therefore not acceptable, based on cladistics?

- A) Plantae
- B) Fungi
- C) Animalia
- D) Protista
- E) Monera

Answer: D

Topic: Concept 26.6

Skill: Knowledge/Comprehension

77) 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

Answer: A

Topic: Concept 26.6

Skill: Knowledge/Comprehension

78) The human nuclear genome includes hundreds of genes that are orthologs of bacterial genes, and hundreds of other genes that are orthologs of archaean genes. This finding can be explained by proposing that

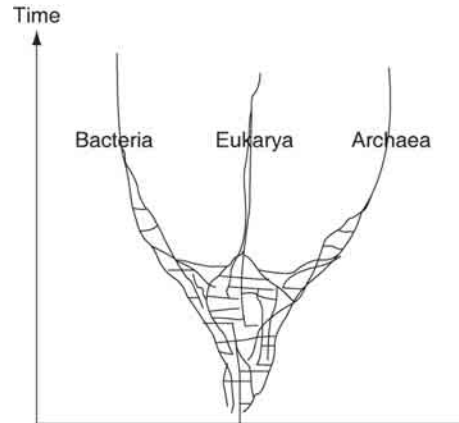
- A) neither archaea nor bacteria contain paralogous genes.
- B) the eukaryotic lineage leading to humans involved at least one fusion of an ancient bacterium with an ancient archaean.
- C) the infection of humans by bacteriophage introduced prokaryotic genes into the human genome.
- D) horizontal gene transfer did not occur to any significant extent among the prokaryotic ancestors of humans.

Answer: B

Topic: Concept 26.6

Skill: Application/Analysis

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.



- 79) If the early history of life on Earth is accurately depicted by this phylogenetic tree, 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.

Answer: D

Topic: Concepts 26.2, 26.6

Skill: Synthesis/Evaluation

- 80) Which process is observed in prokaryotes and is responsible for the *vertical* components of the various bacterial and archaeal lineages?
- A) mitosis
  - B) meiosis
  - C) sexual reproduction
  - D) binary fission

Answer: D

Topic: Concept 26.6

Skill: Knowledge/Comprehension

- 81) Which of these processes can be included among those responsible for the *horizontal* components of this phylogeny?
- A) endosymbiosis
  - B) mitosis
  - C) binary fission
  - D) point mutations
  - E) S phase of the cell cycle

Answer: A

Topic: Concept 26.6

Skill: Application/Analysis

82) Which portion of this tree may ultimately be better depicted as a "ring"?

- A) the bacterial lineage
- B) the archaean lineage
- C) the eukaryotic lineage
- D) the weblike part near the base of the tree
- E) the part corresponding to the first living cell on Earth

Answer: D

Topic: Concept 26.6

Skill: Application/Analysis

83) A large proportion of archaeans are "extremophiles," so called because they inhabit extreme environments with high acidity and/or high temperature. Such environments are thought to have been much more common on the primitive Earth. Thus, modern extremophiles survive only in places that their ancestors became adapted to long ago. Which of these is, consequently, a valid statement about modern extremophiles, assuming that their habitats have remained relatively unchanged?

- A) Among themselves, they should share relatively few ancestral traits, especially those that enabled ancestral forms to adapt to extreme conditions.
- B) On a phylogenetic tree whose branch lengths are proportional to amount of genetic change, the branches of the extremophiles should be shorter, relative to branches of the non-extremophilic archaeans.
- C) They should contain genes that originated in eukaryotes that are the hosts for numerous species of bacteria.
- D) They should currently be undergoing a high level of horizontal gene transfer with non-extremophilic archaeans.

Answer: B

Topic: Concepts 26.3, 26.6

Skill: Synthesis/Evaluation

### Self-Quiz Questions

1) In Figure 26.4 from your textbook, which similarly inclusive taxon descended from the same common ancestor as Canidae?

- A) Felidae
- B) Mustelidae
- C) Carnivora
- D) *Canis*
- E) *Lutra*

Answer: B

Topic:

Skill:

2) Three living species X, Y, and Z share a common ancestor T, as do extinct species U and V. A grouping that includes species T, X, Y, and Z makes up

- A) a valid taxon.
- B) a monophyletic clade.
- C) an ingroup, with species U as the outgroup.
- D) a paraphyletic grouping.
- E) a polyphyletic grouping.

Answer: D

Topic:

Skill:

- 3) In a comparison of birds with mammals, having four appendages is
- A) a shared ancestral character.
  - B) a shared derived character.
  - C) a character useful for distinguishing birds from mammals.
  - D) an example of analogy rather than homology.
  - E) a character useful for sorting bird species.

Answer: A  
 Topic:  
 Skill:

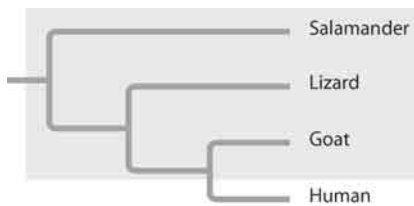
- 4) If you were using cladistics to build a phylogenetic tree of cats, which of the following would be the best outgroup?
- A) lion
  - B) domestic cat
  - C) wolf
  - D) leopard
  - E) tiger

Answer: C  
 Topic:  
 Skill:

- 5) The relative lengths of the amphibian and mouse branches in the phylogeny in Figure 26.12 in your textbook indicate that
- A) amphibians evolved before mice.
  - B) mice evolved before amphibians.
  - C) the genes of amphibians and mice have only coincidental homoplasies.
  - D) the homologous gene has evolved more slowly in mice.
  - E) the homologous gene has evolved more rapidly in mice.

Answer: D  
 Topic:  
 Skill:

- 6) Based on this tree, which of the following statements is *not* correct?



- A) The lineage leading to salamanders was the first to diverge from the other lineages.
- B) Salamanders are a sister group to the group containing lizards, goats, and humans.
- C) Salamanders are as closely related to goats as they are to humans.
- D) Lizards are more closely related to salamanders than lizards are to humans.
- E) The group highlighted by shading is paraphyletic.

Answer: D  
 Topic:  
 Skill:



- 7) 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.

Answer: D

Topic:

Skill: