Exam

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Sexual reproduction uses _____ to generate _____ gametes, which join at fertilization. 1) _____
A) mitosis; diploid
B) meiosis; haploid
C) mitosis; identical
D) meiosis; diploid
E) mitosis; haploid

Answer: B

2) When a diploid cell divides by mitosis, the result is _____. 2) _____
A) identical diploid cells
B) identical haploid cells
C) unique haploid cells
D) a zygote
E) unique diploid cells

Answer: A

3) Modern genetics consists of three major branches. Which of these branches, also known as "transmission genetics," involves the study of the transmission of traits and characteristics in successive generations? 3) _____
A) molecular
B) evolutionary
C) reproductive
D) Mendelian
E) population

Answer: D

4) You identify a new unicellular organism with multiple chromosomes organized by proteins within the cell's nucleus. Into which of the three domains of life might this organism fit? 4) _____
A) Eukarya
B) Archaea
C) Bacteria
D) Archaea or Bacteria
E) Archaea or Eukarya

Answer: A

5) Watson and Crick used evidence from several studies to determine the structure of DNA. What conclusion were they able to draw from Rosalind Franklin's X-ray diffraction data, specifically? 5) _____
A) DNA nucleotides form complementary base pairs.
B) The DNA strands are antiparallel, and the strands are held together by hydrogen bonds.
C) DNA consists of four types of nucleotide bases: A, T, C, and G.
D) DNA is a duplex, with two strands forming a double helix.
E) Adenine pairs with thymine and cytosine pairs with guanine when they are on opposite DNA strands.

Answer: D

6) What kind of bond is formed between the 5′ phosphate group of one nucleotide and the 3′ hydroxyl (OH) group of the adjacent nucleotide? 6) _____

A) hydrogen bond
B) disulfide bond
C) hydroxyl bond
D) ionic bond
E) phosphodiester bond

Answer: E

7) What kind of bond is formed between complementary base pairs to join the two DNA strands into a double helix? 7) _____

A) hydrogen bond
B) peptide bond
C) ionic bond
D) disulfide bond
E) phosphodiester bond

Answer: A

8) Identify which of the following includes three possible components of a RNA nucleotide? 8) _____

A) deoxyribose, uracil, phosphate group
B) deoxyribose, cytosine, phosphate group
C) deoxyribose, guanine, phosphate group
D) ribose, thymine, phosphate group
E) ribose, adenine, phosphate group

Answer: E

9) What chemical group appears on the 5' carbon of a DNA nucleotide? 9) _____

A) carboxyl group
B) phosphate group
C) nitrogenous base
D) hydroxyl group
E) amino group

Answer: B

10) If a eukaryotic chromosome was composed of 20% adenine, how much cytosine should theoretically be present in that same chromosome? 10) _____

A) 40% B) 30% C) 60% D) 10% E) 20%

Answer: B

11) Use the data in the following table to determine which nucleic acid sample can be ALL of the following 4 types: double-stranded DNA, single-stranded DNA, double-stranded RNA, or single-stranded RNA. 11) _____

Nucleic Acid Sample	Data
Sample 1	25% of the bases are thymine
Sample 2	35% of the bases are adenine
Sample 3	25% of the bases are uracil
Sample 4	55% of the bases are cytosine
Sample 5	50% of the five-carbon sugars are deoxyribose

A) Sample 1 B) Sample 2 C) Sample 3 D) Sample 4 E) Sample 5

Answer: B

12) What is the sequence and polarity of the DNA strand complementary to the strand 5' AAATGTCCATGC 3'? 12) _____

A) 5' UUUACAGGUACG 3'
B) 3' UUUACAGGUACG 5'
C) 3' AAATGTCCATGC 5'
D) 5' TTTACAGGTACG 3'
E) 3' TTTACAGGTACG 5'

Answer: E

13) Messenger RNA (mRNA) is _____. 13) _____

A) the molecule that carries the genetic information from DNA and is used as a template for protein synthesis
B) the major structural material making up ribosomes
C) the monomer of polypeptides
D) a molecule that incorporates a specific amino acid into the growing protein when it recognizes a specific group of three bases
E) the major structural component of chromosomes

Answer: A

14) What are the DNA regulatory sequences recognized by RNA polymerase called? 14) _____

A) anticodons
B) termination sequences
C) promoters
D) introns
E) proteomes

Answer: C

15) What is the process of synthesizing proteins from mRNA sequences? 15) _____

A) transcription
B) replication
C) transformation
D) transduction
E) translation

Answer: E

16) What is the process of synthesizing single-stranded RNA from template DNA? 16) _____
A) transduction
B) replication
C) transformation
D) translation
E) transcription

Answer: E

17) What kind of bond is formed between successive amino acids during translation? 17) _____
A) ionic bond
B) phosphodiester bond
C) peptide bond
D) hydrogen bond
E) disulfide bond

Answer: C

18) Retroviruses carry their genetic information in the form of RNA, which is subsequently coded into DNA after the virus enters its host cell. What enzyme does the retrovirus use to produce this initial DNA? 18) _____
A) RNA polymerase
B) ribosomes
C) reverse transcriptase
D) DNA polymerase
E) reverse translationase

Answer: C

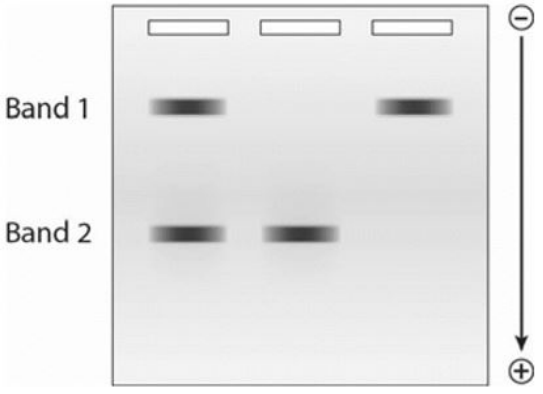
19) Only sixty-one of the sixty-four codons specify an amino acid. In what process do the other three codons function? 19) _____
A) termination of transcription
B) initiation of replication
C) termination of translation
D) initiation of transcription
E) initiation of translation

Answer: C

20) The movement of DNA or RNA in gel electrophoresis is often a matter of molecular weight alone. Which of the following molecular parameters usually influence the movement of protein? 20) _____
A) only shape
B) only charge
C) weight, charge, or shape
D) only weight
E) only weight and shape

Answer: C

21) Which of the following statements is NOT consistent with the DNA fragments shown in the gel? 21) _____



A) Band 1 is closer to the origin of migration than Band 2
B) Band 1 must have been stained or hybridized by a molecular probe
C) Band 1 has a lower molecular mass than Band 2
D) Band 1 has a lower electrophoretic mobility than Band 2
E) Band 1 must have a negative charge

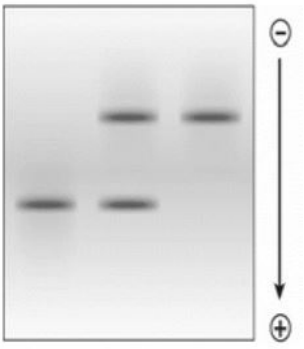
Answer: C

22) Hereditary anemia known as sickle cell disease (SCD) results from inheritance of a variant form of β-globin protein (βS), rather than the wild-type β-globin protein (βA). Which of the following did Linus Pauling find following gel electrophoresis of hemoglobin protein from individuals with the following three genotypes: βAβA, βAβS, or βSβS? 22) _____

A) all three lanes had just one protein band with the same electrophoretic mobility
B) the lane containing the hemoglobin from the heterozygote (βAβS) individual had two protein bands with differing electrophoretic mobility
C) the lane containing the hemoglobin from the homozygous (βAβA) individual had two protein bands with differing electrophoretic mobility
D) the lane containing the hemoglobin from the homozygous (βSβS) individual with SCD had two protein bands
E) all three lanes had the same two protein bands with the same electrophoretic mobility

Answer: B

23) Hereditary anemia known as sickle cell disease (SCD) results from inheritance of a variant form of β-globin protein (βS), rather than the wild-type β-globin protein (βA). The βS protein does not migrate as far as the βA protein. Which of following does NOT explain why the gel electrophoresis lane containing the hemoglobin protein from the heterozygous (βAβS) individual has two protein bands? 23) _____



A) The protein bands migrated different distances based solely on differences in molecular weight.
B) The different electrophoretic mobility of the two proteins was a result of differences in their molecular weight, charge, and/ or shape.
C) The band closer to the origin of migration contained βS protein and the band farther from the origin of migration contained βA protein.
D) The βS protein has a lower electrophoretic mobility.
E) The βA protein has a higher electrophoretic mobility.

Answer: A

24) You have digested a molecule of DNA and want to identify a specific fragment of interest. The DNA is subjected to gel electrophoresis, but you get two bands that are very close in size. What could you use to determine which band is the correct one? 24) _____

A) southern blot
B) western blot
C) northern blot
D) eastern blot
E) stain with ethidium bromide

Answer: A

25) Which of the follow refers to all the RNA produced by transcription of DNA? 25) _____

A) population genetics
B) proteome
C) transcriptome
D) translatome
E) genome

Answer: C

26) Which evolutionary process describes the movement of members of a species from one population to another? 26) _____

A) natural selection
B) migration
C) mutation
D) random genetic drift
E) population genetics

Answer: B

27) Which evolutionary process is most pronounced in small populations where statistical fluctuations in allele frequencies can be significant from one generation to the next? 27) _____

A) natural selection
B) migration
C) mutation
D) random genetic drift
E) population genetics

Answer: D

28) Which evolutionary process involves the slow addition of allelic variation that increases the hereditary diversity of populations, ultimately leading to evolutionary change? 28) _____

A) natural selection
B) migration
C) mutation
D) random genetic drift
E) population genetics

Answer: C

29) Which evolutionary process relies on the premise that individuals with the best adaptations are most successful at reproducing and leave more offspring than those with less adaptive forms? 29) _____

A) natural selection
B) migration
C) mutation
D) random genetic drift
E) population genetics

Answer: A

30) Which term describes a set of organisms that descended from a single common ancestor and are more closely related to other members of the group than to organisms outside the group? 30) _____

A) species
B) paraphyletic group
C) monophyletic group
D) parsimony
E) phylogeny

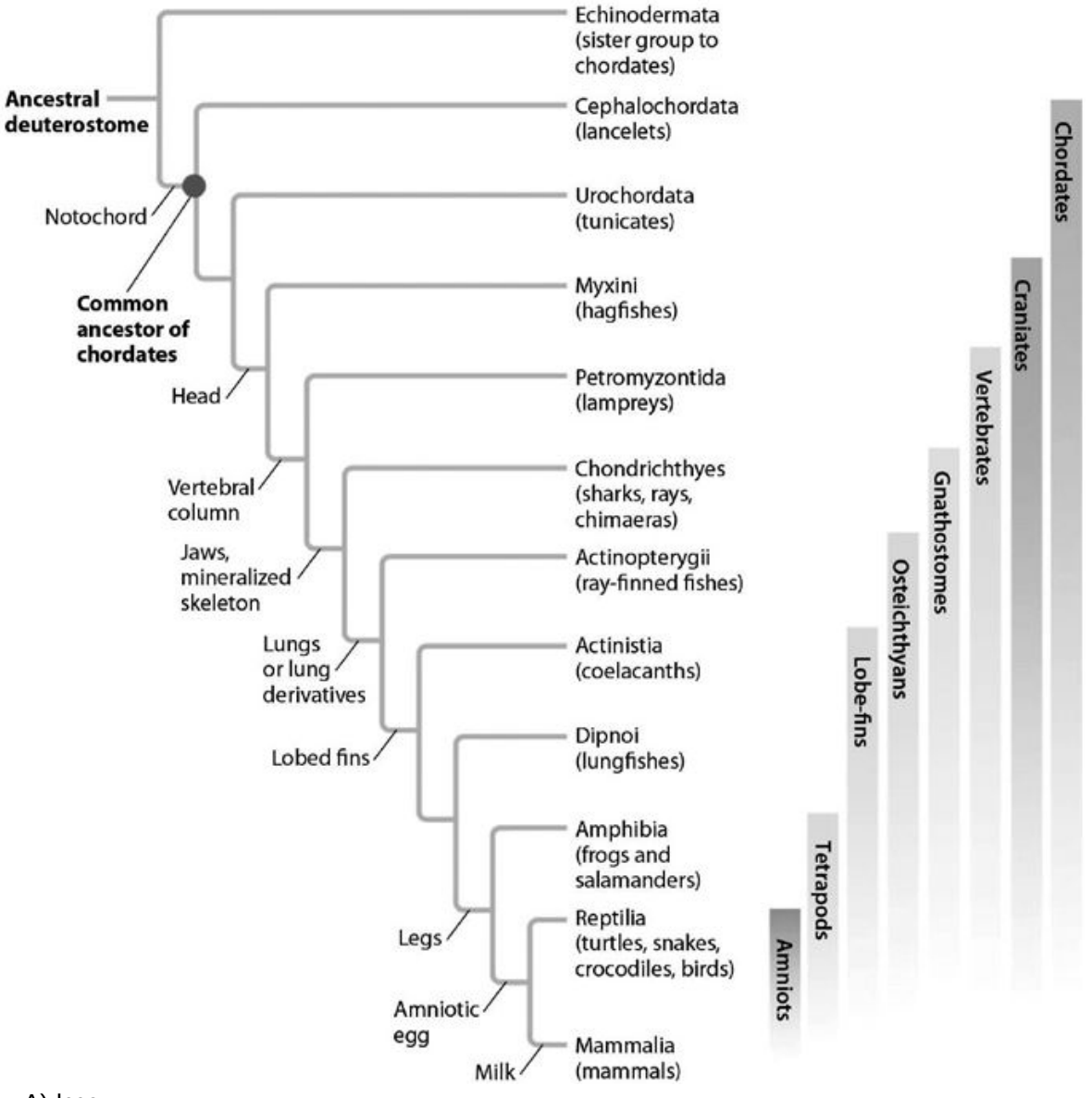
Answer: C

31) Morphological or molecular characters shared by members of a clade are called _____. 31) _____

A) common ancestors
B) paraphyletic groups
C) monophyletic groups
D) synaptomorphies
E) homoplasmies

Answer: D

32) In the phylogenetic tree below, which feature distinguishes snakes and mammals from frogs and salamanders? 32) _____



A) legs
B) head
C) milk
D) notochord
E) amniotic egg

Answer: E

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

33) What are the three domains of life? 33) _____

Answer: Bacteria, Archaea, and Eukarya

34) With the assistance of William Bateson, Archibald Garrod produced the first documented example of a human hereditary disorder that shaped the study of biochemical pathways. Which disorder were they describing? 34) _____

Answer: alkaptonuria

35) The physical units of heredity composed of defined DNA sequences that collectively control gene transcription and contain the information to produce RNA molecules or proteins are better known as what? 35) _____

Answer: genes

36) A complete set of chromosomes is transmitted to produce identical daughter cells in which cell division process? 36) _____

Answer: mitosis

37) The genotypes of humans are more than 99% similar. What is the term that describes the alternative forms of genes that contribute to human genetic variation? 37) _____

Answer: alleles

38) In eukaryotes, most of the cells' DNA is found in the form of chromosomes in the nucleus. Which organelles contain their own genomes (descended from ancient endosymbiotic bacteria)? 38) _____

Answer: mitochondria and chloroplasts

39) During DNA replication, nascent DNA strands are synthesized in only one direction. Nucleotides are added only to which end of the nascent strand? 39) _____

Answer: the 3′ hydroxyl end

40) Messenger RNA codons pair with tRNA anticodons at which cell structure? 40) _____

Answer: the ribosome

41) Peptidyl transferase and other proteins power the continuous progression of the ribosome along mRNA and catalyze what type of bond formation in the growing polypeptide chain? 41) _____

Answer: peptide bonds

42) Before transferring DNA from a gel to the membrane in Southern blotting, the DNA must be denatured (usually by soaking the gel in NaOH). Why is this step necessary? 42) _____

Answer: to make the DNA single stranded so that the molecular probe can bind via complementary base pairing to its target DNA

43) What process proposed by Wallace and Darwin describes the higher rates of survival and reproduction of certain forms of a species over alternative forms? 43) _____

Answer: natural selection

44) As natural selection increases the frequency of one morphological form over another in the population, what changes at the *genotypic* level? 44) _____

Answer: allele frequency

45) What type of diagram would you use to depict morphological or molecular similarities and differences that identify evolutionary relationships? 45) _____

Answer: phylogenetic tree

46) Both sugar gliders and flying squirrels have evolved characteristics that allow them to glide, despite being geographically separated. Similar traits that have independent origins arise as a result of what phenomenon? 46) _____

Answer: convergent evolution

47) Phylogenetic trees are constructed based on morphological characteristics, but molecular phylogenetic trees are constructed based on which feature? 47) _____

Answer: nucleic or amino acid sequence

48) The work of Walter Sutton and Theodor Boveri suggested that the hereditary units, or *genes*, described by Mendel are located on _____. 48) _____

Answer: chromosomes

49) Genetic experiments have revealed the relationship between the observable traits of an organism, or _____, and the genetic constitution of an organism, or _____. 49) _____

Answer: phenotype; genotype

50) DNA replication is called _____ because the newly replicated DNA consists of a parental strand (from the original DNA) and a newly synthesized daughter strand. 50) _____

Answer: semiconservative

51) The _____, first proposed by Francis Crick, summarizes the relationships between DNA, RNA, and protein. 51) _____

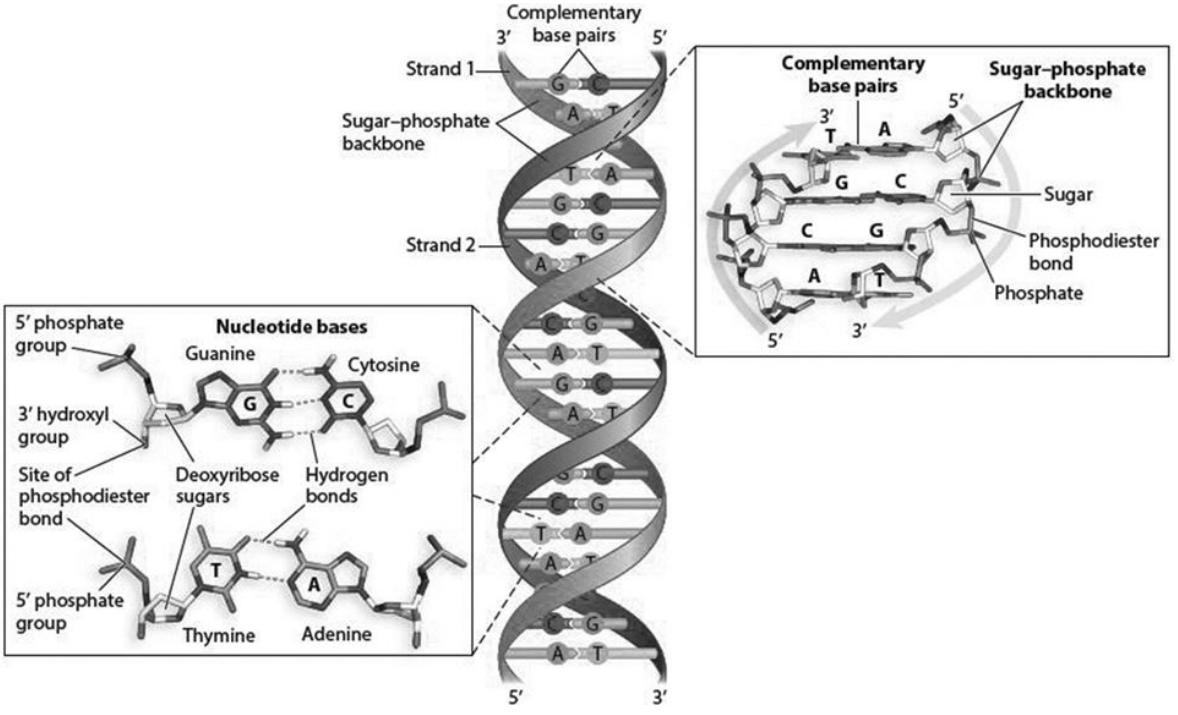
Answer: central dogma of biology

52) A general labeling compound called _____ attaches to all DNA or RNA in a gel by binding to the sugar-phosphate backbone, thus allowing researchers to visualize the nucleic acids when the gel is exposed to UV light. 52) _____

Answer: ethidium bromide (EtBr)

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

53) DNA strands can be pulled apart by adding heat and "melting" the double-stranded DNA. The temperature required that melts a region of DNA changes based on the base-pair composition. Based on the structure of the A-T and C-G bonds in the accompanying figure, which type of bond would require more energy (heat) to break? How might this help you predict which regions of the DNA helix may be the most stable and harder to break apart?



Answer: C-G bonds contain three hydrogen bonds, whereas A-T bonds have only two hydrogen bonds. The more hydrogen bonds in a particular region of DNA, the more energy required to break those bonds apart. Thus, regions of DNA with large numbers of C and G residues will be more heat resistant (and probably transcribed less often) than A-T rich regions.

54) The DNA sequence below encodes the first five amino acids of a large protein.
5' ATGTTAGGATATCAG 3'
3' TACAATCCTATAGTC 5'
a. Identify the coding and template strands.
b. Write the sequence and polarity of the mRNA transcript produced by this sequence. Which process in the cei dogma of biology did you perform? Where does this process occur in eukaryotes?
c. Write the amino acid sequence of the amino acids produced using the three-letter code for amino acids. (See genetic code table in text.) Which process in the central dogma of biology did you perform? Where does this process occur in eukaryotes?

Answer: a. The top strand is the coding strand. The bottom strand is the template.
b. 5' AUGUUAGGAUAUCAG 3'. Transcription occurs in the nucleus in eukaryotes.
c. Met-Leu-Gly-Tyr-Gln. Translation occurs on ribosomes.

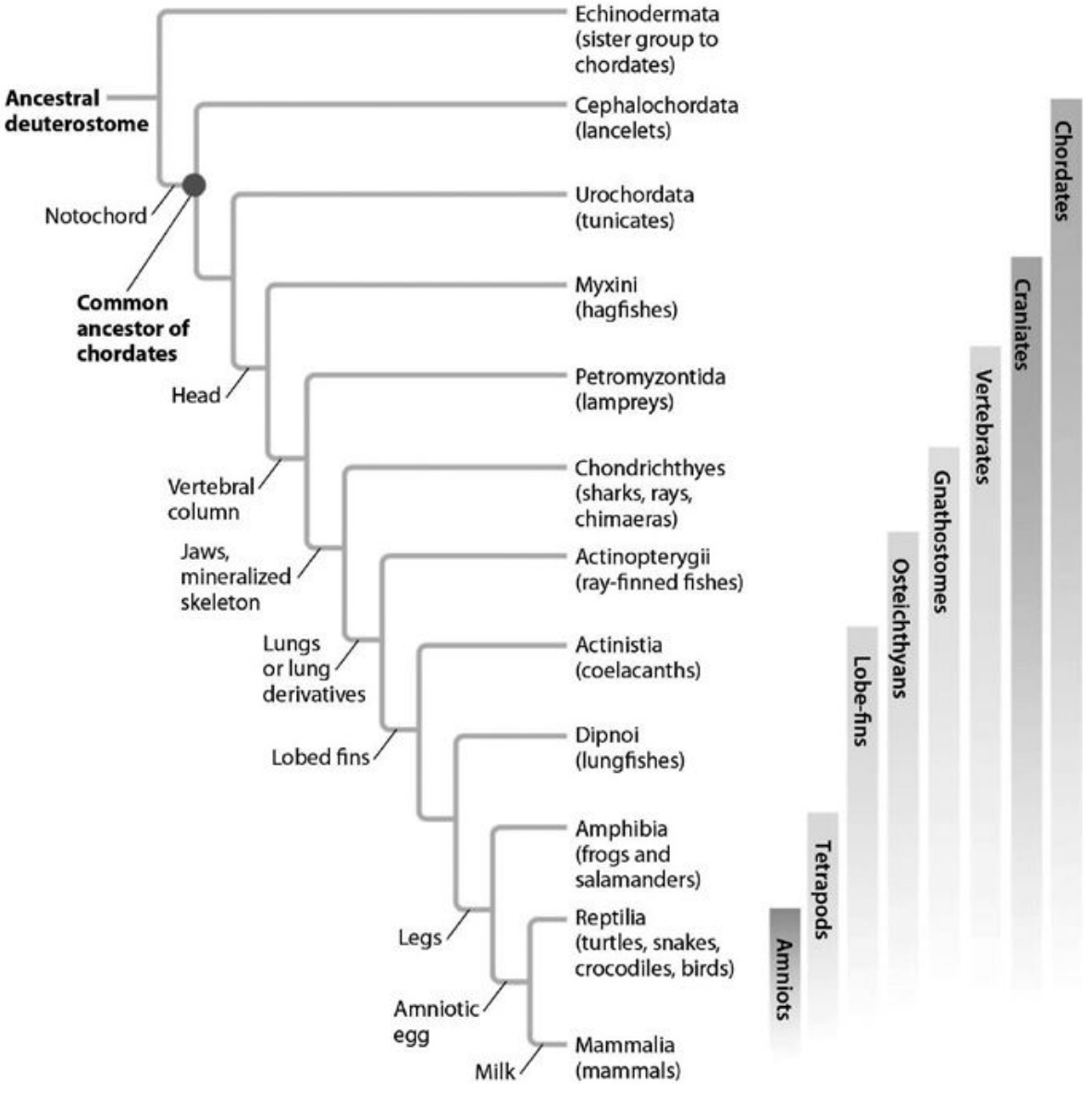
55) What are the three major types of RNA and their functions? What would happen to translation if each type of RNA were degraded?

Answer: 1. Messenger RNA (or mRNA) is transcribed from the DNA template and translated into proteins.
2. Ribosomal RNA (or rRNA) forms part of the ribosomes, the plentiful cellular structures where protein assembly takes place.
3. Transfer RNA (or tRNA) carries amino acids, the building blocks of proteins, to ribosomes.
If any of these types of RNA were degraded, then translation would not occur. Degrading mRNA would prevent translation of that particular gene. Degrading rRNA or tRNA would prevent translation of any mRNAs because the ribosome would not form properly, and the transfer RNA would not bring the correct amino acid to the growing polypeptide chain.

56) Describe what is meant by adaptive and nonadaptive evolution. Which type of evolution might be represented by the differences in the shape of finch beaks on different islands with different food sources, and which type by the presence of both attached and detached earlobes in a given population?

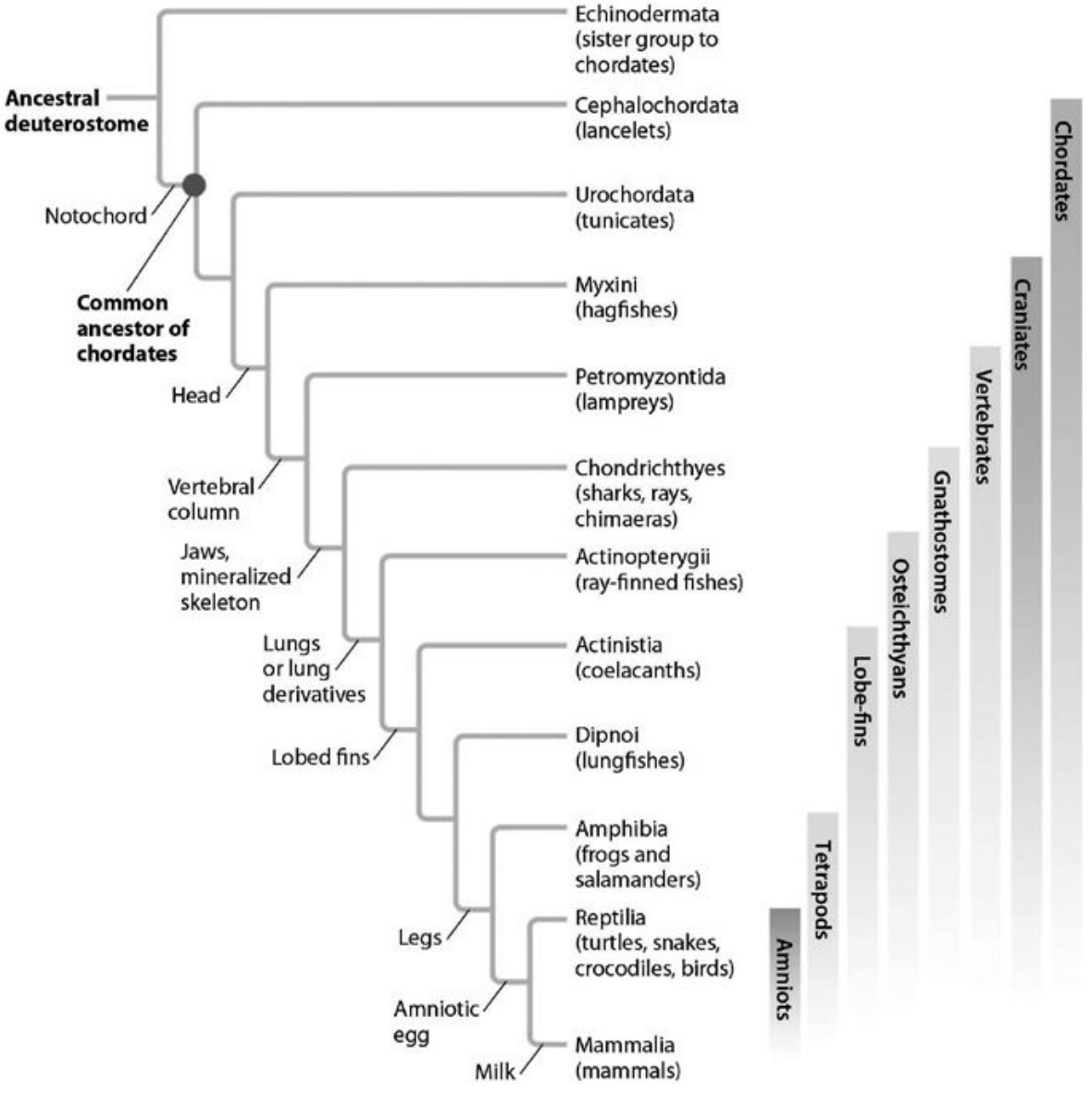
Answer: Adaptive evolution implies that one form reproduces in greater numbers than others in a population because of being better adapted to the conditions driving natural selection. Finch beak shape is an example of adaptive evolution. Nonadaptive evolution describes the evolution of characteristics that are reproductively equivalent to other forms in the population. Nonadaptive traits are neutral with respect to natural selection, conferring neither a selective advantage nor a selective disadvantage to their bearer (e.g., attached versus detached earlobes).

57) Describe the evolutionary relationship of lancelets to tunicates and to hagfishes. Are lancelets more closely related to tunicates or to hagfishes, or are they equally related?



Answer: Lancelets are equally related to tunicates and to hagfishes. The most recent common ancestor of lancelets and tunicates is the common ancestor of chordates. The most recent common ancestor of lancelets and hagfishes is the same (the common ancestor of chordates).

58) Based on molecular evidence, the ancestor of snakes had legs. How might you explain the loss of legs in modern snakes?



Answer: In a given environment, it was an advantage for the ancestors of modern snakes to be limbless. Due to natural selection, the legs became minimized over many generations to the point where they were eventually lost. So, just as traits can be gained by evolution, they can be lost if there is an evolutionary advantage to that change.

59) You obtain the following sequence data from a group of related populations:

Base #:	1 2 3 4 5 6 7 8 9
Ancestral sequence:	AAT TCA GGA
Descendant population #1:	AAT TCA GGA
Descendant population #2:	AAT CCA GAA
Descendant population #3:	AAT CAA GGA
Descendant population #4:	AAT CAA GGG

Construct a phylogenetic tree that fits the data and requires the least amount of genetic change, in other words, tl most parsimonious outcome. Indicate which genetic changes occurred, if any, that were passed down to descendant populations.

Answer: