

Biological Science, 4e (Freeman)

Chapter 1 Biology and the Tree of Life

1) Which of the following statements about cells is true? A cell is _____.

- A) only found in multiples of two, because single cells cannot exist independently
- B) always between 200 and 500 micrometers in diameter
- C) characteristic of eukaryotic but not prokaryotic organisms
- D) characteristic of both prokaryotic and eukaryotic organisms

Answer: D

Reference: Section 1.4

Bloom's Taxonomy: Level 1 Knowledge

2) How does a scientific theory differ from a scientific hypothesis?

- A) Theories are proposed to test scientific hypotheses.
- B) A theory is an explanation for a very general phenomenon or observation; hypotheses treat more specific observations.
- C) A hypothesis is an explanation for a very general phenomenon; theories treat more specific issues.
- D) Theories define scientific laws; hypotheses are used to set up experiments.

Answer: B

Reference: Section 1.5

Bloom's Taxonomy: Level 2 Comprehension

3) Algae in the genus *Caulerpa* typically grow to a length of over half a meter and have structures similar to stems, leaves, and roots. Reproduction occurs when adults produce sperm and eggs that fuse to form offspring. Each adult *Caulerpa* consists of just a single cell, however. Which of the following statements is true?

- A) *Caulerpa* violate the pattern component of the cell theory—that all organisms consist of cells.
- B) *Caulerpa* violate the process component of the cell theory—that all cells come from preexisting cells.
- C) *Caulerpa* violate both the pattern and process components of the cell theory.
- D) The existence of *Caulerpa* is consistent with the cell theory.

Answer: D

Reference: Section 1.5

Bloom's Taxonomy: Level 3 Application

4) Which statement about spontaneous generation is false?

- A) Pasteur demonstrated that it does not occur under normal laboratory conditions.
- B) It apparently occurred at least once—when life on Earth began.
- C) It occurs every time a new species evolves from a preexisting species.
- D) It addresses the formation of living cells from previously nonliving material.

Answer: C

Reference: Section 1.5

Bloom's Taxonomy: Level 2 Comprehension

5) Recall Pasteur's experiment on spontaneous generation. If he had just warmed the nutrient-rich broth, rather than boiled it, what would have been the likely outcome of his experiment?

- A) Cells would not have appeared in either flask.
- B) Cells would have appeared in both flasks.
- C) Cells would have appeared in the swan-neck, but not the straight-neck flask.
- D) Cells would have appeared in the straight-neck, but not the swan-neck flask.

Answer: B

Reference: Section 1.2

Bloom's Taxonomy: Level 4 Analysis

6) Lance Armstrong just finished third (by about 5 minutes) in the 2009 Tour de France cycling race. This was an incredible feat for the 37-year-old father of 4. First and second-place winners, Alberto Contador (age 27) and Andy Schleck (age 24), respectively, have no children. Which of these three men shows the greatest evolutionary fitness?

- A) Alberto Contador, because he won the race.
- B) Lance Armstrong, because he came in third at the advanced age of 37!
- C) Andy Schleck, because he beat the highly experienced Lance Armstrong.
- D) Lance Armstrong, because he has reproduced.

Answer: D

Reference: Section 1.3

Bloom's Taxonomy: Level 3 Application

7) The cow *Bos primigenius* (which is bred for meat and milk) has a smaller brain and larger eyes than closely related wild species of ungulates. These traits most likely arose by ____.

- A) natural selection, because these traits arose in the population over time
- B) natural selection, because these were not the traits consciously selected by humans
- C) artificial selection, because these changes in traits co-occurred with human selection for high milk output and high muscle content
- D) artificial selection because these animals differ from their close relatives and common ancestor

Answer: C

Reference: Section 1.3

Bloom's Taxonomy: Level 3 Application

8) Over the past several decades, natural selection has caused populations of *Staphylococcus aureus* (an infectious wound bacterium) to evolve resistance to most antibiotics. If antibiotic use were stopped, what would you predict would happen to these *S. aureus* populations?

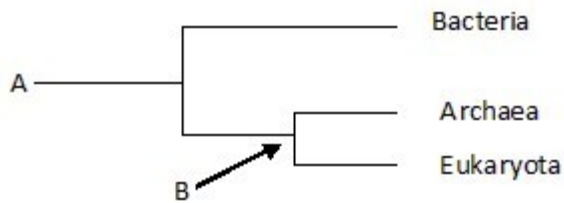
- A) They will go extinct without the antibiotic.
- B) The populations will begin colonizing new environments.
- C) The frequency of nonresistant forms will increase in these populations.
- D) The frequency of resistant forms will definitely increase in these populations.

Answer: C

Reference: Section 1.5

Bloom's Taxonomy: Level 3 Application

9) The phylogenetic tree below _____.



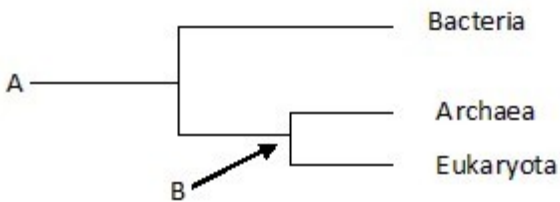
- A) depicts the three major domains of life
- B) includes unicellular but not multicellular life
- C) includes unicellular and some forms of multicellular life, but not complex animals and plants
- D) includes noncellular life-forms

Answer: A

Reference: Section 1.4

Bloom's Taxonomy: Level 1 Knowledge

10) In the diagram below, "A" is _____; "B" is _____.



- A) the most recent species identified on Earth; an ancestor of group "A"
- B) the common ancestor of all life; the common ancestor of Bacteria and Archaea
- C) the most recent species identified on Earth; the common ancestor of Archaea and Eukaryota
- D) the common ancestor of life; the common ancestor of Archaea and Eukaryota

Answer: D

Reference: Section 1.4

Bloom's Taxonomy: Level 1 Knowledge

11) Current understanding of the evolutionary relationships among organisms _____.

- A) are always based only on molecular data
- B) may change, as more species are discovered and studied
- C) represent a complete and unchanging data set
- D) tell us nothing about the history of life on Earth

Answer: B

Reference: Section 1.4

Bloom's Taxonomy: Level 2 Comprehension

12) Starting from the wild mustard *Brassica oleracea*, breeders have created the strains known as Brussels sprouts, broccoli, kale, and cabbage. Which of the following statements is supported by this observation?

- A) In this species, there is enough heritable variation to create a variety of features.
- B) Heritable variation is low—otherwise the wild strain would have different characteristics.
- C) Natural selection has not occurred very frequently in the wild populations.
- D) In this species, most of the variation present is due to differences in soil, nutrition, amount of sunlight, or other aspects of the environment.

Answer: A

Reference: Section 1.3

Bloom's Taxonomy: Level 4 Analysis

13) In comparison to eukaryotes, prokaryotes _____.

- A) are more structurally complex
- B) are larger
- C) are smaller
- D) lack any cell membranes

Answer: C

Reference: Section 1.4

Bloom's Taxonomy: Level 1 Knowledge

14) One aspect of Darwin's theory of natural selection is that adaptations not useful to fitness are lost faster if they have a greater cost. With this in mind, which of the following explanation is most likely true?

- A) The human little toe is not going away in the near future.
- B) The human appendix must currently serve an essential function or it would not be in our bodies.
- C) It is a mystery why we do not have tails.
- D) Humans are relatively hairless because we look better without hair.

Answer: A

Reference: Section 1.3

Bloom's Taxonomy: Level 4 Analysis

15) Both tuna (fish) and dolphins (mammals) have a streamlined body shape and large tail fins that they use to move through the water. Many other anatomical and molecular data indicate, however, that tuna and dolphins are not closely related from an evolutionary perspective. The latter data suggest that _____.

- A) Anatomical data is useless for classifying evolutionary relationships
- B) Organisms that live in the same environment (for example, water) will always look the same
- C) Tuna and dolphins faced similar selective pressures on body shape for reproductive success
- D) These organisms are, actually, closely related evolutionarily

Answer: C

Reference: Section 1.4

Bloom's Taxonomy: Level 2 Comprehension

16) Which of the following would not be a good reason for studying rRNA to understand the major branches in the evolutionary history of life?

- A) This molecule is found in every species.
- B) It is passed on through evolutionary history with only minor modifications.
- C) It is a necessary part of the cellular machinery for reproduction and other purposes.
- D) It mutates very frequently.

Answer: D

Reference: Section 1.3

Bloom's Taxonomy: Level 5 Synthesis

17) If you find a mouse in your basement, it is likely *Mus musculus*. *Peromyscus leucopus* is also common. Or, you may get lucky and find a relatively rare *Peromyscus maniculatus* instead. Out of these three species, which two are the most closely related (from an evolutionary standpoint)?

- A) the two most common: *M. musculus* and *P. leucopus*
- B) the two species in the *Peromyscus* genus
- C) the two with the species name that starts with "m" because species that start with the same first letter are closely related
- D) There is no way to tell with the information provided in this question.

Answer: B

Reference: Section 1.4

Bloom's Taxonomy: Level 3 Application

18) Why did the five-kingdom system of classification fall out of favor?

- A) It was too complex□the original two-kingdom system of Linnaeus was more useful.
- B) It was too difficult to distinguish plants from fungi and animals from protists.
- C) There were too few monerans to justify their classification at the kingdom level.
- D) It did not reflect the actual evolutionary relationships among organisms very well.

Answer: D

Reference: Section 1.4

Bloom's Taxonomy: Level 1 Knowledge

19) What do nodes on a phylogenetic tree represent?

- A) environmental events that caused speciation
- B) new kingdoms or domains
- C) ancestral groups that split into two or more descendant groups
- D) groups that got new names

Answer: C

Reference: Section 1.4

Bloom's Taxonomy: Level 1 Knowledge

20) On an evolutionary tree, any group that includes a common ancestor and all of its descendants is called monophyletic ("one-tribe"). Recall the current evolutionary tree for Bacteria, Archaea, and Eukarya. Are prokaryotes monophyletic?

A) yes

B) no

Answer: B

Reference: Section 1.4

Bloom's Taxonomy: Level 4 Analysis

21) On an evolutionary tree, any group that includes a common ancestor and all of its descendants is called monophyletic ("one-tribe"). Recall the current evolutionary tree for Bacteria, Archaea, and Eukarya. According to this tree, are all organisms alive today monophyletic?

A) yes

B) no

Answer: A

Reference: Section 1.4

Bloom's Taxonomy: Level 4 Analysis

22) You find yourself standing next to a beautiful rosebush. Based on the current evolutionary data, which of the following do you and the rose have in common?

A) You both are multicellular.

B) You both lack a membrane-bound nucleus.

C) You are both prokaryotic.

D) You and the rose have nothing in common.

Answer: A

Reference: Entire Chapter 1

Bloom's Taxonomy: Level 3 Application

23) Current evolutionary data groups land plants with green algae and red algae. Brown algae, which you often find in the same habitat as red and green algae, is part of a distantly related group that includes the diatoms. This suggests that _____.

A) green algae and land plants are not closely related

B) green algae are very closely related to the brown algae

C) green, red, and brown algae form a single taxon unto themselves

D) the term "algae" does not indicate a single taxon

Answer: D

Reference: Section 1.4

Bloom's Taxonomy: Level 4 Analysis

24) Louis Pasteur's experiment had a good design because _____.

- A) simple equipment was used
- B) a major question, spontaneous generation, was tested
- C) the possible outcomes led to distinct, unambiguous conclusions
- D) the experiment was a success

Answer: C

Reference: Section 1.2

Bloom's Taxonomy: Level 3 Application

25) Which of the following observations led to the conclusion that the food competition hypothesis for giraffe neck length might not be correct?

- A) In the populations studied to date, giraffes never feed high in trees.
- B) In certain populations at certain times of year, only male giraffes feed high in trees.
- C) Male and female giraffes spend most of their time feeding low in trees.
- D) Giraffes rarely die of starvation, so food availability is unimportant.

Answer: C

Reference: Section 1.5

Bloom's Taxonomy: Level 1 Knowledge

26) Recall the giraffe experiment that suggested longer necks gave a reproductive advantage to males. Which of the following could counteract or negate this advantage?

- A) the presence of only short plants in the environment
- B) the presence of only tall plants in the environment
- C) a drought that reduced the amount of food available in the environment
- D) female preference for short-necked males

Answer: D

Reference: Section 1.5

Bloom's Taxonomy: Level 3 Application

27) Recall the experiment on ant navigation. What parameters would have to be held constant for the test group of 75 ants in order to run a controlled experiment?

- A) stride number
- B) leg length
- C) all variables except leg length (and therefore stride length)
- D) Stride number, leg length, and environmental temperature would all have to be held constant.

Answer: C

Reference: Section 1.5

Bloom's Taxonomy: Level 2 Comprehension

28) Your colleague proposes to test the mechanism of ant navigation by placing a food source 7 m from the nest. She will then pick up the ants from the nest and move them 4 meters from the nest (3 m from the food source). Based on the previous data, when do you expect the ants to start searching for their nest on their return trip?

- A) after they have traveled 3 meters from the food source
- B) after they have traveled 4 meters from the food source
- C) after they have traveled 7 meters from the food source
- D) All of A, B, and C are incorrect.

Answer: A

Reference: Section 1.5

Bloom's Taxonomy: Level 4 Analysis

29) For many years, no one bothered to test the food-competition hypothesis for why giraffes have long necks. Why?

- A) Technically it was much too difficult until recently.
- B) The hypothesis was so plausible that no one thought to question it.
- C) They tried, but the results were inconclusive.
- D) The hypothesis doesn't make any clear predictions that can be tested.

Answer: B

Reference: Section 1.5

Bloom's Taxonomy: Level 1 Knowledge

30) A friend of yours calls to say that his car would not start this morning. He asks for your help. You say that you think the battery must be dead, and that if so, then jump-starting the car from a good battery will solve the problem. In doing so, you are _____.

- A) only stating a hypothesis for why the car won't start
- B) searching for observations that might inspire a hypothesis for why the car won't start
- C) stating both a specific hypothesis about why the car won't start and a prediction of the hypothesis
- D) performing an experimental test of a hypothesis for why the car won't start

Answer: C

Reference: Section 1.5

Bloom's Taxonomy: Level 4 Analysis

The following experiment is used for the corresponding question(s).

A researcher discovered a species of moth that lays its eggs on oak trees. Eggs are laid at two distinct times of the year: early in spring when the oak trees are flowering and in midsummer when flowering is past. Caterpillars from eggs that hatch in spring feed on oak flowers and look like oak flowers. But caterpillars that hatch in summer feed on oak leaves and look like oak twigs.

How does the same population of moths produce such different-looking caterpillars on the same trees? To answer this question, the biologist caught many female moths from the same population and collected their eggs. He put at least one egg from each female into eight identical cups. The eggs hatched, and at least two larvae from each female were maintained in one of the four temperature and light conditions listed below.

Temperature	Day Length
Springlike	Springlike
Springlike	Summerlike
Summerlike	Springlike
Summerlike	Summerlike

Figure 1.1

In each of the four environments, one of the caterpillars was fed oak flowers, the other oak leaves. Thus, there were a total of eight treatment groups (4 environments $\times$ 2 diets).

31) In Figure 1.1, which of the following is not a plausible hypothesis to explain the difference in caterpillar appearance observed in this population?

- A) The longer day lengths of summer trigger the development of twig-like caterpillars.
- B) The cooler temperatures of spring trigger the development of flowerlike caterpillars.
- C) Differences in air pressure, due to differences in elevation, trigger the development of different types of caterpillars.
- D) Differences in diet trigger the development of different types of caterpillars.

Answer: C

Reference: Section 1.5

Bloom's Taxonomy: Level 4 Analysis

32) Refer to Figure 1.1. In every case, caterpillars that feed on oak flowers look like oak flowers. In every case, caterpillars that were raised on oak leaves looked like twigs. These results support which of the following hypotheses?

- A) The longer day lengths of summer trigger the development of twig-like caterpillars.
- B) Differences in air pressure, due to elevation, trigger the development of different types of caterpillars.
- C) Differences in diet trigger the development of different types of caterpillars.
- D) The differences are genetic—a female will produce all flowerlike caterpillars or all twig-like caterpillars.

Answer: C

Reference: Section 1.5

Bloom's Taxonomy: Level 4 Analysis

33) Refer to Figure 1.1. Recall that eggs from the same female were exposed to each of the eight treatments used. This aspect of the experimental design tested which of the following hypotheses?

- A) The longer day lengths of summer trigger the development of twig-like caterpillars.
- B) Differences in air pressure, due to elevation, trigger the development of different types of caterpillars.
- C) Differences in diet trigger the development of different types of caterpillars.
- D) The differences are genetic—a female will produce all flowerlike caterpillars or all twig-like caterpillars.

Answer: D

Reference: Section 1.5

Bloom's Taxonomy: Level 4 Analysis

34) Recall the caterpillar experiment, where caterpillars born in the spring looked like flowers, and caterpillars born in the summer looked like twigs. What is the most likely selective advantage for this difference in body shape?

- A) Looking like their food sources allows the caterpillars to move through their environment more efficiently.
- B) Development into the adult moth form is faster for caterpillars shaped like twigs than like flowers.
- C) Looking like their food source lets the caterpillars blend into their surroundings, and thus avoids predation and increases survival rates.
- D) Looking like their food source will increase the caterpillars' feeding efficiency; this would increase their growth rate and survival rate.

Answer: C

Reference: Section 1.5

Bloom's Taxonomy: Level 4 Analysis

35) *Agrobacterium* is a type of bacteria that infects plants and causes them to form tumors. You are asked to determine how long a plant must be exposed to the bacteria to become infected. Which of the following experiments will provide the best data for that question?

- A) determining the survival rate of *Agrobacterium* to different concentrations of an antibiotic
- B) determining the number of tumors formed on a plant depending on the concentration of *Agrobacterium* applied
- C) determining the concentration of *Agrobacterium* in different soil environments
- D) determining the number of tumors formed on a plant depending on how long it is exposed to *Agrobacterium*

Answer: D

Reference: Section 1.5

Bloom's Taxonomy: Level 4 Analysis

36) *Agrobacterium* is a type of bacteria that infects plants and causes them to form tumors. You determine that tumor formation requires a huge amount of the plant's energy for tissue formation. How might this change the number of offspring a plant produces, and what is the most likely explanation for this change?

- A) The number of offspring should increase because, in general, illness increases the reproductive output of organisms.
- B) The number of offspring should increase because the bacteria will provide lots of energy for the plant.
- C) The number of offspring should decrease because the plant will be spending lots of energy producing the tumors.
- D) There should be no effect of infection on offspring production because reproductive success is probably independent of infection.

Answer: C

Reference: Section 1.5

Bloom's Taxonomy: Level 4 Analysis

Use the following information when answering the corresponding question(s).

In 1668 Francesco Redi did a series of experiments on spontaneous generation. He began by putting similar pieces of meat into eight identical jars. Four jars were left open to the air, and four were sealed. He then did the same experiment with one variation: Instead of sealing four of the jars completely, he covered them with gauze (the gauze will exclude the flies while allowing the meat to be exposed to air). In both experiments, he monitored the jars and recorded whether or not maggots (young flies) appeared in the meat.

37) Refer to the paragraph on Redi's experiments. What hypothesis was being tested in the initial experiment with open versus sealed jars?

- A) Spontaneous generation is more likely during the long days of summer.
- B) The type of meat used affects the likelihood of spontaneous generation.
- C) Maggots do not arise spontaneously, but from eggs laid by adult flies.
- D) Spontaneous generation can occur only if meat is surrounded by air.

Answer: C

Reference: Entire Chapter 1

Bloom's Taxonomy: Level 4 Analysis

- 38) Refer to the paragraph on Redi's experiments. In both experiments, flies appeared in all of the open jars and only in the open jars. Which one of the following statements is correct?
- A) The experiment was inconclusive because Redi used only one kind of meat.
 - B) The experiment was inconclusive because it did not run long enough.
 - C) The experiment supports the hypothesis that spontaneous generation occurs in rotting meat.
 - D) The experiment supports the hypothesis that maggots arise only from eggs laid by adult flies.

Answer: D

Reference: Entire Chapter 1

Bloom's Taxonomy: Level 4 Analysis

- 39) The best experimental design _____.
A) includes a large number of replicates for each condition
B) includes a control
C) alters only one condition between the controls and the experimental condition
D) includes a large number of replicates, a control, and alters only one condition between the controls and the experimental condition

Answer: D

Reference: Section 1.5

Bloom's Taxonomy: Level 1 Knowledge

- 40) What is the difference between experimental replicates and experimental controls?
- A) Replicates are "repeat" samples under a given condition.
 - B) Replicates decrease sample size.
 - C) All replicates in an experiment are found under the control conditions.
 - D) All replicates differ from other replicates by a single factor.

Answer: A

Reference: Section 1.5

Bloom's Taxonomy: Level 2 Comprehension