

Chapter 2 – Biology, Genetics, and Evolution

MULTIPLE CHOICE

1. How do scientific accounts and creation stories differ from each other?
 - a. Evolution is true, and creation stories are not
 - b. Evolution, unlike creation stories, explains how life forms became diverse
 - c. Scientific accounts focus on testable ideas, and creation stories do not
 - d. Creation stories are based on religion, and scientific accounts are based on ideology
 - e. These two accounts do not differ from each other; they are simply two different stories

ANS: C

DIF: Conceptual

REF: The Classification of Living Things

OBJ: 1

MSC: New

2. All of the following are characteristics of scientific thought regarding the theory of evolution except:
 - a. it is developed on a molecular basis.
 - b. it applies to groups of individuals.
 - c. it uses testable ideas.
 - d. it does not come out of a vacuum, but, instead, is part of a unified way of understanding life.
 - e. it does not account for the diversity of life.

ANS: E

DIF: Conceptual

REF: The Classification of Living Things

OBJ: 1

MSC: New

3. The smallest working units in biological classificatory systems that are reproductively isolated populations or groups of populations capable of interbreeding to produce fertile offspring are called
 - a. genus.
 - b. genes.
 - c. species.
 - d. genome.
 - e. genetic code.

ANS: C

DIF: Factual

REF: The Classification of Living Things

OBJ: 2

MSC: Pickup

4. Modern taxonomy, or the science of classification, is based on
 - a. body structure and growth.
 - b. body structure and function.
 - c. body structure, growth, and function.
 - d. body structure, function, and sequence of bodily growth.
 - e. body structure, growth, function, protein structure, and genetic material.

ANS: D

DIF: Factual

REF: The Classification of Living Things

OBJ: 2

MSC: Pickup

5. The hand of a human and the wing of a bat are _____ structures, while the wings of birds and butterflies are _____ structures.
- analogous; homologous
 - homologous; analogous
 - kingdom; phylum
 - suborder; subfamily
 - higher order; lower order

ANS: B

DIF: Applied

REF: The Classification of Living Things

OBJ: 2

MSC: Pickup

6. Which scientist proposed that an organism's behavior could bring about changes in its anatomy? This was called the inheritance of acquired characteristics.
- Charles Darwin
 - Gregor Mendel
 - Carolus Linnaeus
 - Jean-Baptiste Lamarck
 - Sir Charles Lyell

ANS: D

DIF: Factual

REF: The Discovery of Evolution

OBJ: 3

MSC: New

7. The theory of uniformitarianism argued that
- changes on Earth are caused by gradual processes over time.
 - all life forms came from a single-celled organism.
 - change has occurred quickly and catastrophically to all life forms and physical substances.
 - both physical Earth and all its lifeforms were created by God and exist exactly as they were formed.
 - mutation occurred at regular intervals and could account for the diversity that exists today.

ANS: A

DIF: Factual

REF: The Discovery of Evolution

OBJ: 3

MSC: New

8. All of the following are part of the theory of natural selection except:
- all species display a range of variation, and some variations are more favorable than others.
 - organisms face a "struggle for existence" within their environments.
 - all species can expand and exceed their means of subsistence.
 - nature selects the most advantageous variations.
 - individuals with better adaptation will more selectively reproduce, favoring less offspring that are better cared for.

ANS: E

DIF: Conceptual

REF: Heredity

OBJ: 3

MSC: New

9. Gregor Mendel's law of independent assortment argues that
- pairs of genes separate during reproduction and are passed on to the next generations without being altered (they remain distinct).
 - different genetic traits are inherited as separate qualities (they are not dependent on each other).
 - inheritance is particulate and not blended (they come in pairs and are passed intact).
 - heredity occurs only during meiosis (mitosis is not associated with heredity).
 - genes are exchanged between parents at the moment of conception.

ANS: B DIF: Conceptual REF: Heredity OBJ: 3
MSC: New

10. The molecular basis of a gene was not known until
- observed in a microscope by the Austrian monk, Gregor Mendel.
 - deduced rather than observed by the naturalist, Charles Darwin.
 - discovered during the 20th century when the electron microscope was invented.
 - observed in the sex cells of eels by Sigmund Freud.
 - deduced rather than observed by Gregor Mendel as a result of his experiments with garden peas.

ANS: E DIF: Applied REF: Heredity OBJ: 3
MSC: Pickup

11. Genes are portions of molecules of long strands of which form chromosomes, or
- codons.
 - DNA.
 - RNA.
 - ribosomes.
 - transcriptions.

ANS: B DIF: Factual REF: Heredity OBJ: 3
MSC: Pickup

12. The three base sequence of a gene that specifies production of an amino acid is the
- condom.
 - DNA.
 - codon.
 - alleles.
 - ribosome.

ANS: C DIF: Factual REF: Heredity OBJ: 3
MSC: Pickup

13. A particular kind of protein within a DNA molecule that initiates and directs a chemical reaction is known as a(n)
- virus.
 - enzyme.
 - bacteria.
 - platelet.
 - antioxidant.

ANS: B DIF: Factual REF: Heredity OBJ: 3
MSC: Pickup

14. What is a karyotype?
- It is an array of chromosomes from inside the nucleus of one cell
 - It is similar to DNA, but it transmits messages from one cell to another
 - It is an alternate form of a gene
 - It is a protein that initiates and directs chemical reactions in the cell
 - It is the complete structure sequence of DNA for the entire species

ANS: A DIF: Factual REF: Heredity OBJ: 3
MSC: New

15. Which of the following statements about protein in the body is not correct?
- Proteins generate energy.
 - Proteins fight disease.
 - Proteins digest food.
 - Proteins form hair.
 - Proteins do not carry oxygen.

ANS: E DIF: Applied REF: Heredity OBJ: 3
MSC: New

16. Which statement best expresses the major difference between mitosis and meiosis?
- Mitosis is cell division in animals; meiosis is cell division in humans.
 - Mitosis is the process by which a single cell with X number of chromosomes divides into two cells, each with the same number of chromosomes; meiosis is the process by which a single cell with X number of chromosomes goes through two stages of division, producing four new cells each with X/2 (half the original number) of chromosomes.
 - Mitosis is the process by which chromosomes are divided; meiosis is the process by which DNA is divided.
 - Mitosis is the process by which cells divide into four different sets of genetic information (called codons); meiosis is the process by which cells are joined together and multiplied to create growth and development.
 - Mitosis and meiosis are both types of cell division in which a single cell with X number of chromosomes divides into two cells, each with one half of the original chromosomes; mitosis is associated with the creation of sex cells that determine the sex of the offspring, and meiosis is associated with cell growth and development.

ANS: B DIF: Conceptual REF: Heredity OBJ: 3
MSC: Pickup

17. If you have a chromosome pair on which the alleles for a single gene are identical (for example, if you have the genotype AA for blood type in the ABO system), this pair is described as
- hetrazygous.
 - anthropomorphic.
 - heterozygous.
 - homozygous.
 - genotypic.

ANS: D DIF: Applied REF: Heredity OBJ: 3
MSC: Pickup

18. To say that the allele for type A blood is dominant to that of type O means an individual whose blood type genes are heterozygous, with one A and one O allele, will have what type of blood?
- O
 - A
 - AO
 - AB
 - OO

ANS: B DIF: Applied REF: Heredity OBJ: 3
MSC: Pickup

19. Which of the following has figured most prominently in human evolutionary studies?
- RNA
 - Mitochondrial DNA
 - Regular DNA
 - Chromatids
 - Karyotins

ANS: B DIF: Conceptual REF: Heredity OBJ: 3
MSC: New

20. Why did the U.S. government begin genetic testing among Africans seeking asylum in the country in 2008?
- They tested those individuals seeking asylum on the basis of family reunification in order to guarantee they were genetically related.
 - They tested those seeking asylum for illnesses and genetic traits that might be harmful if introduced into the U.S. population.
 - Because their status as political prisoners was being used to gain entrance, the U.S. government sought to clear them from any felonies in their home countries before granting admission.
 - They performed genetic tests and collected DNA so that these individuals could be documented in case of future fraud committed while citizens of the U.S.
 - They began this testing in order to contribute to a worldwide data bank on human evolution.

ANS: A DIF: Applied REF: Heredity OBJ: 3
MSC: New

21. The U.S. government found that Africans seeking asylum on the basis of family reunification had committed fraud in 80% of the tested cases. What is the best possible explanation for this high degree of dissonance between what the individual said and what the genetic test showed?
- Africans seeking political asylum rarely tell the truth.
 - Genetic tests in 2008 were not as advanced as they are today.
 - The definition of family is different from one culture to another.
 - Those officials doing the genetic tests were not fully qualified.
 - Family and relationship never show up in genetic tests.

ANS: C DIF: Conceptual REF: Heredity OBJ: 3
MSC: New

22. Physical traits such as height, skin color, or liability to disease are controlled by multiple genes. This is called
- dominant genes.
 - recessive genes.
 - polygenetic inheritance.
 - hemoglobin.
 - dominant recession.

ANS: C DIF: Factual REF: Heredity OBJ: 3
MSC: Pickup

23. What technique do anthropologists use to analyze genetic differences between humans and apes?
- Comparative anatomy
 - Mutational projection analysis
 - DNA sequencing
 - Evolutionary comparisons
 - Linear evolution analysis

ANS: C DIF: Factual REF: Evolution, Individuals, and Populations
OBJ: 3 MSC: Pickup

24. The “paradox of the 98% genetic similarity with chimpanzees” is based on all of the following except:
- genetic evolution involves much more than simply sequencing the four bases of DNA.
 - all multicellular life on Earth is related to each other.
 - because of the limited number of possible sequences that exists, any random species will match at least 25% of the time.
 - genetic comparison ignores qualitative differences.
 - in statistical DNA comparison there is a larger margin of error between closer species.

ANS: E DIF: Applied REF: Evolution, Individuals, and Populations
OBJ: 3 MSC: New

25. The physical characteristics of a person are known as the
- genotype.
 - phenotype.
 - polygenetic type.
 - genome.
 - chromatid.

ANS: B

DIF: Factual

REF: Heredity

OBJ: 5

MSC: New

26. Generation after generation, the bullfrogs in a farm pond look much alike, have the same cells, and exhibit the same behavior when breeding. This appearance of stability is linked primarily to
- the Hardy-Weinberg principle.
 - the gene pool.
 - a dominant allele.
 - a recessive allele.
 - a genotype.

ANS: B

DIF: Conceptual

REF: Evolution, Individuals, and Populations

OBJ: 3

MSC: Pickup

27. The ultimate source of evolutionary change is
- polygenetic inheritance.
 - genetic drift.
 - founder effect.
 - a recessive gene.
 - mutation.

ANS: E

DIF: Applied

REF: Evolutionary Forces

OBJ: 4

MSC: Pickup

28. Chance fluctuations of allele frequencies in the gene pool of a population
- come about due to random events at the population level.
 - illustrate the operation of polygenes.
 - illustrate the phenomenon of incomplete dominance of the allele for normal hemoglobin.
 - come about due to random events at the individual level.
 - indicate that the species is endangered.

ANS: D

DIF: Applied

REF: Evolutionary Forces

OBJ: 5

MSC: Pickup

29. The study of inheritance in individuals tells us about how genes can be combined and recombined through sexual reproduction, but to see how species change over time as natural selection favors some combinations over others, we need to look at
- two individuals.
 - populations.
 - gene flow.
 - genetic drift.
 - directional selection.

ANS: B DIF: Conceptual REF: Evolution, Individuals, and Populations
OBJ: 5 MSC: Pickup

30. The Hardy-Weinberg principle is correct as long as certain conditions are met. Which of the following is not one of those conditions?
- All individuals are equally successful in reproducing
 - No new variants are introduced into the gene pool
 - The population is large enough statistically
 - Mating is entirely random
 - There are no recessive alleles in the gene pool

ANS: E DIF: Applied REF: Evolutionary Forces
OBJ: 3 MSC: New

31. A chance creation of a new allele is called
- mutation.
 - meiosis.
 - genotype.
 - genetic drift.
 - directional selection.

ANS: A DIF: Factual REF: Evolutionary Forces
OBJ: 4 MSC: Pickup

32. There are four evolutionary forces. Which of the following is not one of these?
- Gene flow
 - Genetic drift
 - Mutation
 - Translation
 - Natural selection

ANS: D DIF: Factual REF: Evolutionary Forces
OBJ: 4 MSC: New

33. Which of the following statements about mutation is correct?
- a. The rate at which mutations occur in populations is constant.
 - b. Mutation does not contribute to the variability of a gene pool.
 - c. All mutations are harmful.
 - d. All mutations are caused by environmental factors external to the body, such as chemicals in food or X rays.
 - e. The only mutations of evolutionary significance are those which occur in sex cells.

ANS: E DIF: Conceptual REF: Evolutionary Forces
OBJ: 4 MSC: Pickup

34. Adaptation is best described as all of the following except:
- a. a series of beneficial adjustments to the environment.
 - b. not an active process but rather the outcome of natural selection.
 - c. the way humans make beneficial adjustments to their environment through culture as well as biology.
 - d. a result of gene flow and genetic drift.
 - e. occurring through natural selection at the genetic level.

ANS: D DIF: Applied REF: Evolutionary Forces
OBJ: 6 MSC: New

35. Ultimately, all natural selection is measured in terms of
- a. homozygous communities.
 - b. the heterozygous communities.
 - c. the gene pool.
 - d. mutations.
 - e. reproductive success.

ANS: E DIF: Conceptual REF: Evolutionary Forces
OBJ: 7 MSC: Pickup

36. All of the following statements about sickle-cell anemia are correct except:
- a. it came to the attention of geneticists when it was observed that most North Americans who suffer from it are of African ancestry.
 - b. it was traced to abnormalities in populations that live in a clearly defined belt across tropical Central Africa.
 - c. it is notable in areas where high rates of deadly form of malaria is common.
 - d. because it is a disease of adaptation, it can never be brought under control or eradicated.
 - e. heterozygous individual suffer few negative consequences except under stress or low oxygen.

ANS: D DIF: Applied REF: The Case of Sickle-Cell Anemia
OBJ: 5 MSC: Pickup

37. Which of the following situations is likely to result in genetic drift?
- a. A volcanic eruption on a small island that wipes out half the population of 100 iguanas
 - b. A tidal wave that destroys 50 homes in a seaside community of 3 million people
 - c. A political order that results in the purposeful, selective killing of all people with red hair
 - d. A disease kills large numbers of a stable population
 - e. Two or more groups are reunited after generations of separation

ANS: A DIF: Applied REF: Evolutionary Forces
OBJ: 7 MSC: Pickup

38. Despite the usefulness of a large brain in a cultural environment, the size of the human brain has not increased significantly for the last 200,000 years. This is an example of
- a. directional selection.
 - b. stabilizing selection.
 - c. convergent evolution.
 - d. divergent evolution.
 - e. isolating mechanism.

ANS: B DIF: Applied REF: Evolutionary Forces
OBJ: 6 MSC: Pickup

39. What is the evolutionary value of studying clines?
- a. It allows scientists to witness the development of a new species
 - b. It helps scientists understand the phenomenon of adaptation
 - c. It helps scientists understand mutation rates over time
 - d. It allows scientists to study gradual change over time
 - e. It is the only mechanisms for understanding how species become extinct

ANS: B DIF: Conceptual REF: Adaptation and Physical Variation
OBJ: 6 MSC: New

40. When two species accumulate differences over time, gradually becoming ever more distinct, this is an example of
- a. cladogenesis.
 - b. anagenesis.
 - c. clinogenesis.
 - d. parvogenesis.
 - e. gene flow

ANS: A DIF: Factual REF: Macroevolution and the Process of Speciation
OBJ: 7 MSC: New

TRUE/FALSE

1. Both creation stories and evolution strive to account for the diversity of life on Earth.

ANS: T REF: The Classification of Living Things
OBJ: 1 MSC: New

2. Evolution explains the diversity of life by using hypotheses.

ANS: T REF: The Classification of Living Things
OBJ: 1 MSC: New

3. Monkeys are anthropoids, but humans are not.

ANS: F REF: The Classification of Living Things
OBJ: 2 MSC: New

4. Carolus Linnaeus based his classificatory system on body structure and function.

ANS: T REF: The Classification of Living Things
OBJ: 2 MSC: New

5. Analogous structures arise in similar fashion and pass through similar stages before differentiating.

ANS: F REF: The Discovery of Evolution OBJ: 2
MSC: New

6. Darwin could not explain the mechanism of heredity from one generation to another.

ANS: T REF: Heredity OBJ: 3 MSC: New

7. Chromosomes are long strands of DNA combined with protein that can be seen under the microscope in the cell nucleus.

ANS: T REF: Heredity OBJ: 3 MSC: Pickup

8. French scientist Rosalind Franklin pioneered work in DNA sequencing in 1955.

ANS: F REF: Heredity OBJ: 3 MSC: Pickup

9. Barring errors in replication, cells divide meiotically to form identical daughter cells.

ANS: F REF: Heredity OBJ: 3 MSC: New

10. You can always tell a person's genotype from their phenotype.

ANS: F REF: Heredity OBJ: 3 MSC: Pickup

11. Certain traits have three or more allelic forms. One example of this is hemoglobin.

ANS: T REF: Heredity OBJ: 3 MSC: New

12. Even two unrelated genetic sequences will be 25 percent identical.

ANS: T REF: Evolution, Individuals, and Populations
OBJ: 5 MSC: Pickup

13. Microevolution is changes in allelic frequencies in populations.

ANS: T REF: Evolutionary Forces OBJ: 5
MSC: New

14. Gene flow always occurs between populations of related organisms.

ANS: F REF: Evolutionary Forces OBJ: 5
MSC: Pickup

15. If five campers from Albany are killed in a chance avalanche, this event will have less impact on the gene pool than if five food foragers from a band of 30 are killed in a chance mudslide.

ANS: T REF: Evolutionary Forces OBJ: 5
MSC: Pickup

16. Natural selection is often thought of as “survival of the fittest,” a phrase coined and used by Darwin.

ANS: F REF: Evolutionary Forces OBJ: 3
MSC: Pickup

17. Over generations, the relative proportions of alleles in a population changes according to the varying reproductive success of individuals with that population. So, by definition, it can be said that individuals with more reproductive success are better adapted to their environment.

ANS: T REF: Evolutionary Forces OBJ: 6
MSC: Pickup

18. Natural selection promotes change, and it is a stabilizing factor.

ANS: T REF: Evolutionary Forces OBJ: 6
MSC: Pickup

19. Clinal analysis allows anthropologists to study how populations have adapted regionally.

ANS: T REF: Adaptation and Physical Variation OBJ: 6
MSC: New

20. Punctuated equilibrium is a sustained directional shift in a population’s average characteristics.

ANS: F REF: Macroevolution and the Process of Speciation
OBJ: 7 MSC: New

SHORT ANSWER

1. Describe how humans are classified taxonomically.

ANS: Will vary REF: The Classification of Living Things MSC: New

2. Distinguish between analogous and homologous structures.

ANS: Will vary REF: The Discovery of Evolution MSC: New

3. How did Lamarck's and Lyell's theories contribute to the development of Darwin's theory of evolution?

ANS: Will vary REF: The Discovery of Evolution MSC: New

4. When was the molecular basis of the gene known, and how has our conception of genes changed over time?

ANS: Will vary REF: Heredity MSC: Pickup

5. Why is natural selection often thought of as "survival of the fittest"?

ANS: Will vary REF: Heredity MSC: Pickup

6. What is DNA?

ANS: Will vary REF: Heredity MSC: New

7. Describe the role of DNA and RNA in the process of translation.

ANS: Will vary REF: Heredity MSC: New

8. What do mitosis and meiosis have to do with growing and maintaining good health?

ANS: Will vary REF: Heredity MSC: Pickup

9. What does the Hardy-Weinberg principle demonstrate, and what is its relevance for the study of evolution?

ANS: Will vary REF: Evolution, Individuals, and Populations MSC: Pickup

10. Why is mutation considered to be the ultimate source of evolutionary change?

ANS: Will vary REF: Evolutionary Forces MSC: Pickup

11. What is gene flow, and what is its role in evolution?

ANS: Will vary REF: Evolutionary Forces MSC: Pickup

12. What is the relationship between random mutations and evolution?

ANS: Will vary REF: Evolutionary Forces MSC: Pickup

13. Provide an example of Mendel's "law of segregation."

ANS: Will vary REF: Heredity MSC: Pickup

14. Why do characteristics controlled by multiple genes show a continuous range of variation in their phenotype expression?
- ANS: Will vary REF: Heredity MSC: Pickup
15. Why is an understanding of the mechanics of heredity important to an understanding of how evolution works?
- ANS: Will vary REF: Heredity MSC: Pickup
16. What is the importance of knowing that humans, chimpanzees, and the banana share a remote common ancestry?
- ANS: Will vary REF: Heredity MSC: Pickup
17. Describe how sickle-cell anemia is an environmental adaptation.
- ANS: Will vary REF: The Case of Sickle-Cell Anemia MSC: New
18. What is stabilizing selection? Give an example of this.
- ANS: Will vary REF: Evolutionary Forces MSC: New
19. Distinguish among cladogenesis, anagenesis, and punctuated equilibrium.
- ANS: Will vary REF: Macroevolution and the Process of Speciation MSC: New
20. How do each of the four evolutionary forces contribute to diversity of life on Earth?
- ANS: Will vary REF: Evolutionary Forces MSC: New

ESSAY

1. Both creation stories and the theory of evolution account for the diversity of life, yet they differ in so many other ways. Discuss the major differences between these two approaches and why you think creation stories retain so much significance today in spite of science.
- ANS: Will vary MSC: New
2. Describe the discovery of evolution as an historic account. What pre-conditions were in place when Darwin's theory emerged?
- ANS: Will vary MSC: New
3. What is the significance of sickle cell for our understanding of evolution and the role of culture in adaptation?
- ANS: Will vary MSC: Pickup

4. Describe stabilizing selection and critique the traditional assumption that the evolution of life forms is characterized by steady progress.

ANS: Will vary MSC: Pickup

5. Explain the difference between analogies and homologies, and give specific examples of each.

ANS: Will vary MSC: Pickup

6. Explain the statement that evolution must be understood at the level of the population rather than at the level of the individual.

ANS: Will vary MSC: Pickup

7. What are the elements of evolution illustrated in the unusually large size of a kiwi egg? Using this as an example, explain the process of evolution.

ANS: Will vary MSC: Pickup

8. Understanding how evolution works requires an understanding of the mechanics of heredity, because heritable variation constitutes the raw material for evolution. Describe the molecular level of the mechanics of heredity.

ANS: Will vary MSC: Pickup

9. What evolutionary forces account for change in the genetic composition of populations? How have the changes affected populations over time?

ANS: Will vary MSC: Pickup

10. What are some ethical, legal, and social implications of genetic research and new genetic technology?

ANS: Will vary MSC: Pickup

11. Explain the relationship between the origin of the discipline of biology, the theory of evolution, and the cultural changes in Europe during the early 19th century.

ANS: Will vary MSC: Pickup

12. Define the Hardy-Weinberg principle, and explain why it is significant in explaining evolution.

ANS: Will vary MSC: Pickup

13. Why does evolution matter?

ANS: Will vary MSC: New

14. What is the relationship between natural selection and adaptation?

ANS: Will vary MSC: New

15. Compare and contrast microevolution and macroevolution. How do these work together?

ANS: Will vary MSC: New

16. How are new species formed? Discuss macroevolution as a result of evolutionary forces.

ANS: Will vary MSC: New

17. Discuss the significance of DNA comparisons and what it means to be genetically alike and different across species.

ANS: Will vary MSC: New