CHAPTER 2: Evolution: Constructing a Fundamental Scientific Theory

MULTIPLE CHOICE

1. Adaptive radiation occurs when:
   a. one species produces multiple closely related species.
   b. several species adapt to one environment.
   c. species radiate to different environments and adapt to the varying environments.
   d. an individual adapts to varying environments.

   ANS: A DIF: Easy
   OBJ: Explain Darwin's main contribution(s) to the theory of evolution
   TOP: Evolution: Constructing a fundamental scientific theory MSC: Remembering

2. Charles Darwin's book *On the Origin of Species* (1859) was considered an important contribution to modern science because:
   a. it coined the concept of evolution.
   b. it synthesized information from diverse scientific fields in order to document evolutionary change.
   c. it was immediately and widely accepted by the scientific community as the mechanism for evolutionary change.
   d. it proposed the use of the scientific method for the first time.

   ANS: B DIF: Moderate
   OBJ: Explain Darwin's main contribution(s) to the theory of evolution
   TOP: What was Darwin's contribution to the theory of evolution?
   MSC: Remembering

3. Uniformitarianism is the theory that:
   a. the earth is very old, based on geologic evidence from stratigraphic layers in Scotland.
   b. the natural processes operating today are the same as the natural processes that operated in the past.
   c. the uniformity of species is derived from the common ancestor of all species.
   d. processes such as earthquakes are evidence supporting catastrophism as proposed by Lamarck.

   ANS: B DIF: Moderate
   OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
   TOP: Geology: reconstructing earth's dynamic history MSC: Remembering

4. Why is the work of Alfred Russell Wallace considered when discussing the theory of evolution?
   a. He was an English naturalist who had arrived at many of the same conclusions as Darwin through his own research in the Amazon.
   b. His work is not considered, as he was mistakenly credited with the theory of natural selection.
   c. He was a British dog breeder who worked on artificial selection experiments in the same way Mendel worked on sweet peas to determine inheritance.
   d. He was well known and gathered even more evidence to support evolution than Darwin, though from the Amazon rather than the Galapagos.

   ANS: A DIF: Easy

OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
TOP: Darwin's Contemporaries and Competition: Wallace MSC: Understanding

5. The relevance of the theory of uniformitarianism is that:
   a. it supports the theory of catastrophism.
   b. it proves that changes to the Earth were caused by cataclysmic events like earthquakes and floods.
   c. it proves that the Earth has a long history and supports the theory of natural selection.
   d. it demonstrates that the Earth is 4.4 billion years old, based on geologic evidence from stratigraphic layers.

   ANS: C DIF: Moderate
   OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
   TOP: Geology: reconstructing earth's dynamic history MSC: Understanding

6. Thomas Malthus's contribution to natural selection is:
   a. the binomial taxonomic system of naming species.
   b. the theory that the Earth's old age is based on geologic evidence resulting from cataclysmic events.
   c. the theory that events like warfare, disease, and famine are necessary to control population size and thereby reduce the risk of depleting resources.
   d. the theory that environmental resources are subject to population pressures.

   ANS: C DIF: Moderate
   OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
   TOP: Demography: influences on population size and competition for limited resources
   MSC: Remembering

7. Darwinian evolution proposes that:
   a. species adapt and change over time based on the environment.
   b. an individual can change within its own lifetime.
   c. species adapt based on individual goals.
   d. individuals determine their own biological adaptation.

   ANS: A DIF: Moderate
   OBJ: Explain Darwin's main contribution(s) to the theory of evolution
   TOP: Evolution: Constructing a fundamental scientific theory MSC: Understanding

8. James Hutton is associated with:
   a. adaptation.
   b. catastrophism.
   c. uniformitarianism.
   d. principles of heredity.

   ANS: C DIF: Easy
   OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
   TOP: Context for Darwin MSC: Remembering

9. Darwin drew on information from five scientific disciplines:
   a. geology, physical anthropology, taxonomy and systematics, demography, and

evolutionary biology.
b. geology, paleontology, taxonomy and systematics, geography, and evolutionary biology.
c. geology, paleontology, taxonomy and systematics, demography, and biology.
d. geology, paleontology, taxonomy and systematics, demography, and evolutionary biology.

ANS: D DIF: Moderate
OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
TOP: The theory of evolution: the context for Darwin MSC: Remembering

10. According to Darwin, natural selection operates at the level of:
a. individuals.
b. genes.
c. populations.
d. species.

ANS: A DIF: Easy
OBJ: Explain Darwin's main contribution(s) to the theory of evolution
TOP: Darwin's Natural Selection Theory as Primary Mechanism of Evolution
MSC: Understanding

11. The English demographer whose work on population growth greatly influenced Darwin's thinking on population adaptation was:
a. Jean-Baptiste de Lamarck.
b. Georges Cuvier.
c. Thomas Malthus.
d. Charles Lyell.

ANS: C DIF: Easy
OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
TOP: Demography: influences on population size and competition for limited resources
MSC: Remembering

12. How was Darwin influenced by Thomas Malthus's work on population growth?
a. Darwin was interested in Malthus's examination of population changes in pea plants.
b. Darwin was influenced by Malthus's work on demography and population responses to food availability.
c. Darwin liked the concept of Latin taxonomic classification as it pertained to human groups.
d. Darwin was greatly influenced by research on acquired characteristics.

ANS: B DIF: Moderate
OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
TOP: Demography: influences on population size and competition for limited resources
MSC: Understanding

13. How did Lamarck contribute to the theory of evolution?
a. He discovered genetic mutation through experiments with pea plants.
b. He proposed the concept of natural selection after his voyage to the Galapagos Islands and his study of finches.
c. He did not but instead proposed an erroneous evolutionary mechanism known today as inheritance of acquired characteristics.
d. He did not but instead proposed a concept known today as gene flow.

ANS: C DIF: Easy

OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
TOP: Evolutionary biology: explaining the transformation of earlier life-forms into later life-forms
MSC: Understanding

14. The English scientist who independently codiscovered the theory of natural selection was:
    a. Charles Lyell.
    b. Jean-Baptiste de Lamarck.
    c. Alfred Russell Wallace.
    d. Carolus Linnaeus.

    ANS: C DIF: Easy
    OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
    TOP: The theory of evolution: Darwin's contribution MSC: Remembering

15. Cuvier, Lamarck, and Erasmus Darwin all shared an idea of evolution; however, they all lacked:
    a. the longevity necessary for evolution to take place.
    b. a basic understanding of inheritance.
    c. an understanding of variation.
    d. a mechanism for evolution.

    ANS: D DIF: Moderate
    OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
    TOP: Evolutionary biology: explaining the transformation of earlier life-forms into later life-forms
    MSC: Understanding

16. The advantageous "attributes" to which Darwin refers are now known as:
    a. traits.
    b. genes.
    c. alleles.
    d. chromosomes.

    ANS: A DIF: Moderate
    OBJ: Explain the role of Mendelian inheritance in the evolutionary synthesis
    TOP: The theory of evolution: Darwin's contribution MSC: Remembering

17. Evolutionary synthesis is:
    a. the concept of evolution and natural selection.
    b. the melding of natural selection and Mendelian inheritance.
    c. a combination of the inheritance of acquired characteristics and natural selection.
    d. the theory of evolution and Linnaean taxonomy.

    ANS: B DIF: Moderate
    OBJ: Explain the role of Mendelian inheritance in the evolutionary synthesis
    TOP: The evolutionary synthesis, the study of populations, and the causes of evolution
    MSC: Remembering

18. A source of new genetic material to a population is:
    a. natural selection.
    b. mutation.
    c. gene flow.
    d. gene drift.

    ANS: B DIF: Easy
    OBJ: Define each of the four forces of evolution and provide examples of them
    TOP: Evolutionary Forces and Synthesis MSC: Remembering

19. The forces of evolution include:
    a. gene flow, mutations, chromosomes, and genes.
    b. mutations, genes, and genetic drift.
    c. natural selection, gene flow, genetic drift, and mutations.
    d. natural selection, genes, alleles, and chromosomes.

    ANS: C DIF: Moderate
    OBJ: Define each of the four forces of evolution and provide examples of them
    TOP: The evolutionary synthesis, the study of populations, and the causes of evolution
    MSC: Understanding

20. Without the work of x-ray crystallographer _____, DNA might not have been discovered for some time longer.
    a. James Watson
    b. Francis Crick
    c. Thomas Malthus
    d. Rosalind Franklin

    ANS: D DIF: Moderate
    OBJ: Explain how the discovery of DNA revolutionized the understanding of evolution
    TOP: The evolutionary synthesis, the study of populations, and the causes of evolution
    MSC: Remembering

21. Mendel's plant hybridization experiments demonstrated that:
    a. traits inherited from each parent blended together in the offspring.
    b. DNA was the molecule carrying the genetic code.
    c. peas were a poor choice for understanding basic hereditary principles.
    d. traits inherited from each parent remained distinct in the offspring.

    ANS: D DIF: Easy OBJ: Define the concept of Mendelian inheritance
    TOP: Mendel's Discovery of Principles of Inheritance MSC: Understanding

22. The geneticist who studied the workings of fruit flies' chromosomes was:
    a. Charles Darwin.
    b. Gregor Mendel.
    c. Thomas Hunt Morgan.
    d. Thomas Huxley.

    ANS: C DIF: Easy
    OBJ: Explain how the discovery of DNA revolutionized the understanding of evolution
    TOP: Discovery of Chromosomes MSC: Remembering

23. The scientist who coined the name *Homo sapiens* for human beings and placed them in a higher taxonomic group (primates) was:
    a. Charles Darwin.
    b. Georges Cuvier.
    c. Carolus Linnaeus.
    d. Robert Hooke.

    ANS: C DIF: Easy OBJ: Isolate humans' place in Linnaean taxonomy
    TOP: Context for Darwin MSC: Remembering

24. The individual genotypes in a breeding population, taken as a whole, are the:
    a. gene pool.
    b. DNA.
    c. genome.
    d. polygene.

    ANS: A DIF: Easy
    OBJ: Explain how the discovery of DNA revolutionized the understanding of evolution
    TOP: Evolutionary Forces and Synthesis MSC: Remembering

25. Fossils represent the remains of once-living:
    a. extant species that tell the story of human origins.
    b. extinct organisms that provide a record of the history of life on the planet.
    c. plants that provide proof of catastrophism.
    d. organisms that demonstrate the age of the Earth through the process of uniformitarianism.

    ANS: B DIF: Easy
    OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
    TOP: Answering the big questions: How did the theory of evolution come to be?
    MSC: Remembering

26. What are the three observations of natural selection?
    a. Species change and adapt based on environmental pressure, individuals change within their lifetime, and offspring inherit the changes.
    b. Genetic drift, gene flow, and mutations provide the change necessary in populations that affect future generations.
    c. Organisms produce more offspring than survive, populations vary, and traits are inherited.
    d. The number of adults tends to remain the same over time, inheritance provides all of the genetic variation needed for future generations, and natural selection works on only the best of those adults in each generation.

    ANS: C DIF: Difficult
    OBJ: Explain Darwin's main contribution(s) to the theory of evolution
    TOP: What was Darwin's contribution to the theory of evolution?
    MSC: Understanding

27. Gregor Mendel's discovery of the principles of inheritance contributed to the field of:
    a. psychology.
    b. paleontology.
    c. zoology.
    d. biology.

    ANS: D DIF: Moderate
    OBJ: Explain the role of Mendelian inheritance in the evolutionary synthesis
    TOP: Answering the big questions: What has happened since Darwin in the development of our understanding of evolution? MSC: Remembering

28. The scientist whose work provided the foundation for later understandings of genetics was:
    a. John Ray.
    b. Gregor Mendel.
    c. Charles Darwin.
    d. Robert Hooke.

    ANS: B DIF: Easy
    OBJ: Explain the role of Mendelian inheritance in the evolutionary synthesis
    TOP: Mechanisms of inheritance MSC: Remembering

29. Thomas Hunt Morgan:
    a. demonstrated that chromosomes carry genetic material in the form of genes.
    b. studied mutations in *Homo sapiens*.
    c. thought change was gradual and occurred over long time periods.
    d. none of the above

    ANS: A DIF: Easy
    OBJ: Explain the role of Mendelian inheritance in the evolutionary synthesis

TOP: Mechanisms of inheritance MSC: Remembering

30. Darwin observed that adaptations:
    a. resulted from supernatural forces.
    b. did not vary among Galápagos finches living in different habitats.
    c. were physical traits that enhanced survival and reproduction.
    d. were peripheral to evolutionary change.

    ANS: C DIF: Moderate
    OBJ: Explain Darwin's main contribution(s) to the theory of evolution
    TOP: Evolution: Constructing a fundamental scientific theory MSC: Remembering

31. The presence of iridium in geologic deposits around the world supported the theory that:
    a. the impact of a giant meteor that struck the Earth produced mass extinctions of dinosaur species across the planet.
    b. alien material was a factor in the origins of species on this planet.
    c. catastrophes occurred in the past and produced major changes in species, causing dinosaurs to adapt and eventually become mammals.
    d. Cuvier's proposal of catastrophism as the theory explaining human origins is correct.

    ANS: A DIF: Moderate
    OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
    TOP: How do we know? Catastrophes in the past MSC: Understanding

32. In your textbook, the lower frequency of sickle-cell anemia among present day American blacks as compared to West African blacks is attributed to:
    a. genetic drift.
    b. gene flow.
    c. new mutations.
    d. none of the above

    ANS: B DIF: Moderate
    OBJ: Define each of the four forces of evolution and provide examples of them
    TOP: Evolutionary synthesis, the study of populations and the causes of evolution
    MSC: Remembering

33. Why are Darwin's finches considered good examples of natural selection?
    a. They are found on every continent.
    b. They originated in North America, according to fossil evidence.
    c. They embody the idea of descent with modification.
    d. They did not differ between populations.

    ANS: C DIF: Moderate
    OBJ: Explain Darwin's main contribution(s) to the theory of evolution
    TOP: Evolution: Constructing a fundamental scientific theory MSC: Understanding

34. Linnaeus's taxonomic system is referred to as a "hierarchy" because:
    a. each species has a "higher level" genus and "lower level" species.
    b. species are placed in a ranked list called the "Great Chain of Being."
    c. humans are considered the most evolved species.
    d. none of the above

    ANS: A DIF: Easy OBJ: Define the concept of Linnaean taxonomy
    TOP: Taxonomy and systematics MSC: Remembering

35. How do modern-day lemurs of Madagascar demonstrate the concept of adaptive radiation?
    a. They are closely related species that have branched from one species.
    b. They are no different from ancient species of lemurs.
    c. They have radiated from ancient species of monkeys.
    d. They show great cultural flexibility.

    ANS: A DIF: Difficult
    OBJ: Explain Darwin's main contribution(s) to the theory of evolution
    TOP: Evolution: Constructing a fundamental scientific theory MSC: Analyzing

36. Gene flow differs from genetic drift because:
    a. it is the random change in the frequency of alleles.
    b. it is the random change in a gene or chromosome.
    c. it is the guiding force of evolution.
    d. it is the spread of new genetic material from one gene pool to another.

    ANS: D DIF: Moderate
    OBJ: Define each of the four forces of evolution and provide examples of them
    TOP: Evolutionary synthesis, the study of populations and the causes of evolution
    MSC: Understanding

37. Zoonosis is:
    a. the transfer of pathogens from other animals to humans.
    b. the transfer of genes from other animals to humans.
    c. a gene pool of nonhuman genes only.
    d. the phenomenon of genetic change in nonhuman species.

    ANS: A DIF: Moderate
    OBJ: Explain how the discovery of DNA revolutionized the understanding of evolution
    TOP: Anthropology Matters! H1N1, The Evolution of the Swine Flu Pandemic
    MSC: Remembering

38. What are the classification levels of humans from order to species?
    a. Chordata, Mammalia, Haplorhini, Hominoidea, *Homo*, and *sapiens*
    b. Primates, Haplorhini, Anthropoidea, Catarrhini, Hominoidea, Hominidea, Homininae, Hominine, *Homo*, and *sapiens*
    c. Primates, Strepsirhini, Catarrhini, Hominoidea, Hominidea, *Homo*, and *sapiens*
    d. Mammalia, Platyrrhini, Hominioidea, Hominidae, *Homo*, and *sapiens*

    ANS: B DIF: Moderate OBJ: Isolate humans' place in Linnaean taxonomy
    TOP: Figure 2.10, The place of humans in Linnaeus's taxonomy
    MSC: Applying

39. The Human Genome Project has identified the location of genes that influence diseases such as:
    a. the common cold, flu, whooping cough, and meningitis.
    b. high blood pressure, diabetes, sinus inflammation, and sickle-cell anemia.
    c. sickle-cell anemia, breast cancer, Tay-Sachs, and cystic fibrosis.
    d. thyroid disease, menopause, meningitis, and breast cancer.

    ANS: C DIF: Moderate
    OBJ: Explain how the discovery of DNA revolutionized the understanding of evolution
    TOP: Figure 2.24, DNA chromosomes in medical research MSC: Remembering

40. James Hutton:
    a. extensively studied fossils.
    b. revealed that fossils would provide the history of past life.
    c. created the first scientific classification of plants and animals.
    d. provided geologic evidence necessary for calculating the time span of evolution.

    ANS: D DIF: Easy
    OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
    TOP: Concept check MSC: Remembering

ESSAY

1. Discuss four key individuals who helped Darwin formulate the theory of natural selection.

   ANS:

   Hutton, Lyell, Malthus, Linnaeus, Lamarck, Ray, Erasmus Darwin, and Cuvier could all be included for the discussion to be correct. Their contributions should also be correctly identified to receive full credit.

   DIF: Difficult
   OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of evolution and explain the principles in each that contributed to his ideas
   TOP: Concept check MSC: Analyzing

2. Why was Darwin's 1859 published theory of natural selection not widely accepted by his peers? What later scientific advance was critical to the subsequent broad acceptance of natural selection as a major force in evolutionary change?

   ANS:

   Darwin's theory lacked a mechanism for the inheritance of desirable characteristics. Gregor Mendel discovered the principles of inheritance—that is, the basis for understanding how traits are transmitted from parent to offspring. Mendel's discovery that traits are passed as discrete units (genes) laid the foundation for our understanding of chromosomes and of population genetics.

   DIF: Difficult OBJ: Explain the role of Mendelian inheritance in the evolutionary synthesis
   TOP: Mechanisms of inheritance MSC: Analyzing

3. What are some of the important scientific discoveries that laid the groundwork for Darwin's theory of evolution?

   ANS:

   Scientists working in geology, paleontology, taxonomy and systematics, demography, and what is now evolutionary biology had shown that the earth is old and has changed over its history; that fossils represent remains of once-living, sometimes extinct organisms and provide a record of the history of life; that life evolves over time; that groups of related species provide insight into evolutionary history; and that the number of adults in a population tends to remain the same over time.

   DIF: Difficult
   OBJ: Define the five major scientific disciplines from which Darwin drew to create his theory of

evolution and explain the principles in each that contributed to his ideas
TOP: The theory of evolution: the context for Darwin MSC: Remembering

4. What is the significance for evolutionary theory of Darwin's analysis of the Galápagos finches? Provide at least one example in your answer.

   ANS:

   The diversity of the various finch populations lent support to the idea that over time natural selection could transform a single common ancestral form into a variety of descendant species. This phenomenon is referred to as adaptive radiation. Each descendant species had adapted to its particular habitat; for example, the ground finch had evolved a more robust beak to accommodate a diet including hard objects such as seeds.

   DIF: Difficult
   OBJ: Understand the importance of Darwin's voyage around the world to the development of the theory of evolution TOP: What was Darwin's contribution to the theory of evolution?
   MSC: Analyzing

5. Discuss the forces of evolution and their role in evolution.

   ANS:

   Natural selection, gene flow, genetic drift, and mutations are all acceptable answers.

   DIF: Moderate
   OBJ: Define each of the four forces of evolution and provide examples of them
   TOP: Evolution: Constructing a fundamental scientific theory MSC: Analyzing