CHAPTER 02: Evolution: Constructing a Fundamental Scientific Theory

MULTIPLE CHOICE

1. Adaptive radiation occurs when:
   a. one species gives rise to multiple closely related species.
   b. several species adapt to one environment.
   c. species adapt to environments with high radiation levels.
   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 it:
   a. coined the concept of evolution.
   b. synthesized information from diverse scientific fields in order to document evolutionary change.
   c. was immediately and widely accepted by the scientific community as the mechanism for evolutionary change.
   d. 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.
   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 the most prominent scientist of the time who opposed Darwin's work on evolution.

   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 it:
   a. supports the theory of catastrophism.
   b. proves that changes to the earth were caused by cataclysmic events like earthquakes and floods.
   c. allowed the understanding of evidence of change in the geological past by understanding what we see in the present day.
   d. 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 the:
   a. binomial taxonomic system of naming species.
   b. theory that the earth’s old age is based on geologic evidence resulting from cataclysmic events.
   c. observation that an abundance of food would allow a population to increase geometrically and indefinitely, but there simply is not enough food, so populations are limited by food supply.
   d. theory that environmental resources increase 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 adaptations.

   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 primarily 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: The theory of evolution: the context for Darwin MSC: Remembering

9. Darwin drew on information from the following 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 proposed the first serious model of how traits are passed on from parent to offspring through inheritance of acquired characteristics, though that idea turned out to be incorrect.
d. He 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 co-discovered 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, their ideas 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 evolutionary change.

    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 through natural selection.
    b. a unified theory of evolution that combines genetics with natural selection.
    c. a combination of the inheritance of acquired characteristics and natural selection.
    d. the combination of 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. Which of the following is NOT a cause of evolution in a population?
    a. inheritance of acquired traits
    b. mutation
    c. gene flow
    d. genetic drift

    ANS: A DIF: Easy
    OBJ: Define each of the four forces of evolution and provide examples for 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 for 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 than it was.
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 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 are passed on from parent to offspring as discrete units.

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: The theory of evolution: the 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. phenotype.
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 were the three key observations made by Darwin that allowed him to deduce that natural selection is a primary driver of evolution?
    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, variation exists among members of populations, and advantageous variations increase in relative frequency over time.
    d. The number of adults tends to remain the same over time, individuals vary very little over time, 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. 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

28. 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. proposed the theory of inheritance of acquired characteristics.

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

29. 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

30. In your textbook, the lower frequency of sickle-cell anemia among present-day Americans of West African ancestry as compared to people living in West Africa 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 for them
TOP: The evolutionary synthesis, the study of populations, and the causes of evolution
MSC: Remembering

31. 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

32. Linnaeus's taxonomic system is referred to as a "hierarchy" because:
    a. each species has a "higher level" genus and "lower level" species, and are placed within additional higher level categories.
    b. species are placed in a ranked list called the "Great Chain of Being."
    c. humans are considered the most evolved species.
    d. naming species officially requires approval of an appointed board of high-level experts.

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

33. Gene flow differs from genetic drift because it is the:
    a. random change in the frequency of alleles.
    b. random change in a gene or chromosome.
    c. guiding force of evolution.
    d. 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 for them
    TOP: The evolutionary synthesis, the study of populations, and the causes of evolution
    MSC: Understanding

34. 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

35. 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 for them
TOP: Evolution: constructing a fundamental scientific theory MSC: Analyzing