CHAPTER 2: Evolution: Constructing a Fundamental Scientific Theory

MULTIPLE CHOICE

1. Which of the following is true?
   a. Organisms classified in two different biological orders can still belong to the same genus.
   b. Organisms classified as two different species can still belong to the same genus.
   c. Organisms classified in two different families can still belong to the same genus.
   d. Organisms classified in two different kingdoms can still belong to the same genus.

   ANS: B DIF: Easy REF: Page 26 TOP: Context for Darwin
   MSC: Factual

2. James Hutton's research in the mid-18th century demonstrated that the earth was
   a. 4.6 billion years old.
   b. millions of years old.
   c. a few thousand years old.
   d. 100 billion years old.

   ANS: B DIF: Easy REF: Page 24 TOP: Context for Darwin
   MSC: Factual

3. Like most of his contemporaries, Charles Darwin believed
   a. that physical traits were passed from the father to the offspring.
   b. that physical traits were acquired in an individual's lifetime.
   c. that physical traits were passed down from each parent and then blended together in the offspring.
   d. that physical traits were passed from the mother to the offspring.

   ANS: C DIF: Easy REF: Page 33 TOP: Mechanisms of Inheritance
   MSC: Factual

4. _____ is most powerful as an evolutionary cause when operating on small populations.
   a. Genetic flow
   b. Mutation
   c. Genetic drift
   d. Natural selection

   ANS: C DIF: Easy REF: Page 36
   TOP: Evolutionary Forces and Synthesis MSC: Factual

5. Darwin's theory of evolution by means of natural selection was supported by which leading scientist of the time?
   a. Gregor Mendel
   b. Thomas Malthus
   c. Thomas Henry Huxley
   d. Charles Lyell

   ANS: C DIF: Easy REF: Page 34
   TOP: What Happened Since Darwin? MSC: Factual

6. What is the only source of new genetic material?
   a. genetic drift
   b. gene flow
   c. evolution
   d. mutation

   ANS: D DIF: Easy REF: Page 36
   TOP: Evolutionary Forces and Synthesis MSC: Factual

7. Mendel's discrete units responsible for the characteristics in his pea plants are now known as
   a. chromosomes.
   b. DNA.
   c. genes.
   d. RNA.

   ANS: C DIF: Easy REF: Page 33
   TOP: Mendel's discovery of principles of inheritance MSC: Factual

8. What decreases the number of genetic differences between populations?
   a. genetic drift
   b. mutation
   c. DNA
   d. gene flow

   ANS: D DIF: Easy REF: Page 36
   TOP: Evolutionary Forces and Synthesis MSC: Factual

9. Whose efforts helped explain how chromosomes are replicated?
   a. Rosalind Franklin
   b. James Watson
   c. Francis Crick
   d. all of the above

   ANS: D DIF: Easy REF: Page 38
   TOP: Discovery of DNA as Blueprint MSC: Factual

10. Natural selection
    a. works on preexisting variation in a population.
    b. works on traits acquired through an organism's lifetime.
    c. works only on deleterious traits.
    d. works only on advantageous traits.

    ANS: A DIF: Medium REF: Page 36
    TOP: Evolutionary Forces and Synthesis MSC: Factual

11. Among the first scientists to conceive of evolutionary change was
    a. Charles Darwin.
    b. Georges Cuvier.
    c. Erasmus Darwin.
    d. Alfred Wallace.

    ANS: C DIF: Easy REF: Page 31 TOP: Context for Darwin
    MSC: Factual

12. 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. none of the above.

    ANS: B DIF: Medium REF: Page 23 | Page 31
    TOP: What Was Darwin's Contribution to the Theory of Evolution?
    MSC: Conceptual

13. Darwin's theory of evolution drew from all of the following scientific disciplines *except*

a. demography.
b. geology.
c. genetics.
d. systematics.

ANS: C DIF: Easy REF: Page 23 TOP: Context for Darwin
MSC: Factual

14. Why is the work of Alfred Russel 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.
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.
d. Wallace was well-known and gathered even more evidence to support evolution than Darwin.

ANS: A DIF: Easy REF: Page 32
TOP: Darwin's contemporaries and competition: Wallace MSC: Conceptual

15. The evolutionary synthesis
a. occurred in 1900 immediately after Mendel's work was rediscovered.
b. emphasized the important role of mutation and macromutation in evolutionary change.
c. emphasized theoretical differences between diverse scientific fields.
d. accepted Darwin's theory of evolution and Mendel's theory of heredity as explaining most evolutionary change.

ANS: D DIF: Medium REF: Pages 35–36
TOP: Evolutionary Forces and Synthesis MSC: Factual

16. Deoxyribonucleic acid (DNA)
a. was studied during Darwin's lifetime.
b. is the "recipe" for all biological characteristics and functions.
c. was discovered by Mendel.
d. is stored in the cells as ribosomes.

ANS: B DIF: Easy REF: Pages 37–38
TOP: Discovery of DNA as Blueprint MSC: Factual

17. While at the gorilla exhibit at the zoo you notice that the sign reads *Gorilla gorilla gorilla.* You recall that this is a scientific name and is part of a naming system known as
a. binomial nomenclature, which was developed by Carolus Linnaeus as a classification system for plants and animals.
b. natural selection, because you know that Carolus Linnaeus was a proponent of evolutionary change.
c. independent assortment, developed by Gregor Mendel.
d. none of the above.

ANS: A DIF: Easy REF: Page 26 TOP: Context for Darwin
MSC: Applied

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

ANS: C DIF: Easy REF: Page 24 TOP: Context for Darwin
MSC: Factual

19. How is the concept of catastrophism different from the concept of uniformitarianism?
    a. Catastrophism is the idea that the shape of the earth's surface gradually shifts over time.
    b. Catastrophism is only the result of human-induced changes.
    c. Catastrophism is the idea that geologic changes are the result of single cataclysmic events.
    d. None of the above.

    ANS: C DIF: Medium REF: Pages 24–25 TOP: Context for Darwin
    MSC: Factual

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

    ANS: A DIF: Easy REF: Page 22
    TOP: Darwin's natural selection theory as primary mechanism of evolution
    MSC: Conceptual

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

    ANS: C DIF: Easy REF: Page 29 TOP: Context for Darwin
    MSC: Factual

22. How was Darwin influenced by Thomas Malthus's work on population growth?
    a. Darwin was interested in Malthus's examinations 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: Medium REF: Page 29 TOP: Context for Darwin
    MSC: Applied

23. 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 REF: Pages 29–30
    TOP: Problems explaining heredity: Lamarckian inheritance MSC: Applied

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

    ANS: C DIF: Easy REF: Page 32
    TOP: Darwin's contemporaries and competition: Wallace MSC: Factual

25. Cuvier's work on fossil elephants in France supported the then controversial notion of
    a. extinction.
    b. evolution.
    c. natural selection.
    d. genetics.

    ANS: A DIF: Easy REF: Pages 25–26 TOP: Context for Darwin
    MSC: Applied

26. The physical expression of an organism's genetic constitution is called its
    a. karyotype.
    b. phenotype.
    c. stereotype.
    d. genotype.

    ANS: B DIF: Easy REF: Page 34
    TOP: Mendel's discovery of principles of inheritance MSC: Factual

27. Different versions, or subunits, of the same gene are
    a. chromosomes.
    b. gemmules.
    c. alleles.
    d. blenders.

    ANS: C DIF: Easy REF: Page 33
    TOP: Mendel's discovery of principles of inheritance MSC: Factual

28. The only possible source of new genetic material is
    a. natural selection.
    b. mutation.
    c. gene flow.
    d. gene drift.

    ANS: B DIF: Easy REF: Page 36
    TOP: Evolutionary Forces and Synthesis MSC: Factual

29. Recessive alleles will be expressed if they are inherited
    a. from either parent.
    b. from neither parent.
    c. from both parents.
    d. along with a dominant allele.

    ANS: C DIF: Easy REF: Page 33
    TOP: Mendel's discovery of principles of inheritance MSC: Applied

30. Which of the following is *false* regarding populations of living organisms?
    a. Parents often produce many offspring.
    b. Population size is limited by the food supply.
    c. Individuals in populations actively compete for scarce resources.
    d. Individuals in populations show little or no variation.

    ANS: D DIF: Easy REF: Page 31
    TOP: Darwin's natural selection theory as primary mechanism of evolution
    MSC: Applied

31. Mendel's plant hybridization experiments demonstrated that
    a. inherited traits 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 REF: Page 33

TOP: Mendel's discovery of principles of inheritance MSC: Applied

32. 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 REF: Page 34 TOP: Discovery of Chromosomes
    MSC: Factual

33. 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 REF: Page 26 TOP: Context for Darwin
    MSC: Factual

34. 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 REF: Page 36
    TOP: Evolutionary Forces and Synthesis MSC: Factual

35. You're watching a show on TV about the history of scientific thought in Europe prior to 1800. The narrator correctly states that at that time
    a. all species were believed to have evolved from a common ancestor.
    b. all forms were thought to have been created by God and to remain constant over time.
    c. most species were thought to go extinct over time.
    d. evolution was attributed to natural selection acting upon genetic variation.

    ANS: B DIF: Medium REF: Page 23 TOP: Context for Darwin
    MSC: Applied

36. All of the following are formal taxonomic categories *except*
    a. kingdom.
    b. population.
    c. order.
    d. family.

    ANS: B DIF: Easy REF: Page 28 TOP: Context for Darwin
    MSC: Factual

37. The Human Genome Project (a massive collaboration to decode and study the human genome) is most likely to contribute to an understanding of which disease?
    a. cancer
    b. influenza
    c. tuberculosis
    d. smallpox

    ANS: A DIF: Medium REF: Page 38
    TOP: Modern Understanding of Evolution MSC: Factual

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

ANS: B DIF: Easy REF: Page 33
TOP: Mendel's discovery of principles of inheritance MSC: Factual

39. 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 REF: Page 34 TOP: Discovery of Chromosomes
    MSC: Factual

40. 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: Medium REF: Page 22 TOP: Natural selection
    MSC: Factual

41. By the mid-twentieth century, the causes of evolution were seen as all of the following *except*
    a. natural selection.
    b. macromutation.
    c. gene flow.
    d. genetic drift.

    ANS: B DIF: Medium REF: Page 36
    TOP: Evolutionary Forces and Synthesis MSC: Factual

42. In your textbook, the lesser 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: Medium REF: Page 36
    TOP: Evolutionary Forces and Synthesis MSC: Factual

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

    ANS: C DIF: Medium REF: Page 22 TOP: Natural selection
    MSC: Conceptual

44. 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 REF: Page 26 TOP: Context for Darwin
    MSC: Conceptual

45. How do Darwin's finches demonstrate the concept of adaptive radiation?
    a. They are closely related species that have branched from one species.
    b. They are no different than ancient species of lemurs.
    c. They have radiated from ancient species of monkeys.
    d. They show great cultural flexibility.

    ANS: A DIF: Medium REF: Page 22
    TOP: Darwin's natural selection theory as primary mechanism of evolution
    MSC: Applied

46. 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: Medium REF: Page 47
    TOP: Evolutionary Forces and Synthesis MSC: Applied

47. Darwin was a crew member on _____ , a ship whose voyage informed his later theory of natural selection.
    a. the HMS *Labrador*
    b. the HMS *Beagle*
    c. the HMS *Papillon*
    d. the HMS *Elizabeth*

    ANS: B DIF: Easy REF: Page 21 TOP: Observations
    MSC: Factual

ESSAY

1. Detail Darwin's major contribution to the theory of evolution.

   ANS:

   Darwin's key contribution was deducing that natural selection is the primary driver of evolution. Variation exists among members of a population. Individuals having variations that lend advantages for both survival and reproduction increase in relative frequency over time.

   DIF: Hard REF: Pages 31–33 TOP: Natural selection
   MSC: Factual

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, i.e., 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: Hard REF: Pages 33–34 TOP: What Happened Since Darwin?
   MSC: Factual

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; fossils represent remains of once-living, sometimes extinct, organisms and provide a record of the history of life; life evolves over time; groups of related species provide insight into evolutionary history; the number of adults in a population tends to remain the same over time.

   DIF: Hard REF: Pages 23–31 TOP: Context for Darwin
   MSC: Conceptual

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: Hard REF: Pages 21–22 | Page 31
   TOP: What Was Darwin's Contribution to the Theory of Evolution?
   MSC: Conceptual

5. Why is Linnaeus's taxonomic system called a "nested hierarchy"? Considering that Linnaeus was *not* an evolutionist, why is his system still used today by evolutionary biologists?

   ANS:

   Linnaeus organized species into ever more inclusive higher-order taxonomic groups based on overall similarity. So although each species was unique, several of them could be combined into a single genus as a result of their shared traits. Similarly, different genera could be collected into a single, more inclusive family, families combined into orders, etc. Linnaeus's system is still useful because in many cases he identified similarities among species that reflect common ancestry (homologous traits). For example, while Linnaeus placed humans, monkeys, and lemurs into a single order (the primates) based on a simple acknowledgement of similarity, a modern biologist would see those species' shared traits as evidence of common evolutionary history.

   DIF: Hard REF: Pages 26–28 TOP: Context for Darwin
   MSC: Conceptual