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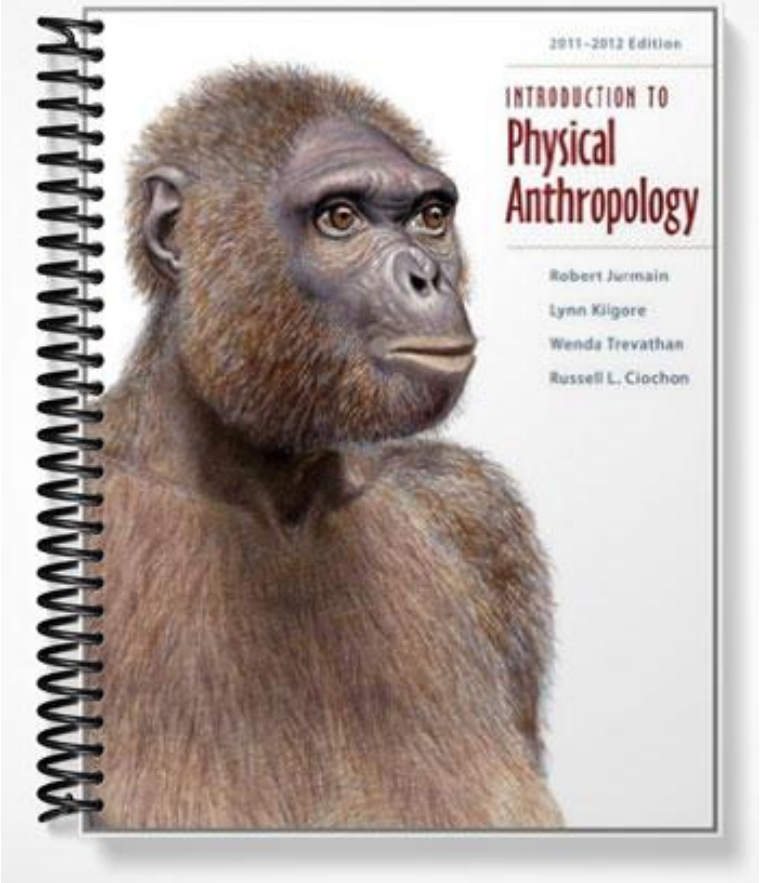
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INTRODUCTION TO
Physical
Anthropology
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CHAPTER 2: THE DEVELOPMENT OF EVOLUTIONARY THEORY

Chapter Outline

I. Introduction

a) There are many myths and misunderstanding about evolution
   i) We did not evolve from monkeys
   ii) New species take millions of years but we can see microevolutionary changes
b) Evolution is often denigrated as being "only" a theory.
   i) Evolution is, in fact, a scientific theory that has a wealth of support, and is the unifying theory of the biological sciences.
c) Evolution is of central importance to physical anthropology, and evolutionary thought has had a long history of development.

II. A Brief History of Evolutionary Thought

a) Charles Darwin is credited with formulating the theory of natural selection, although Alfred Russel Wallace independently duplicated Darwin's ideas.
b) The predominant European worldview throughout the Middle Ages was one of stasis and the fixity of the species.
   i) The religious system was extremely powerful and the Christian teachings that God created all life were taken literally, as the only "truth."
   ii) The universe was perceived as being part of the Grand Design.
      (1) Archbishop James Ussher calculated that the world had been created in 4004 B.C.
   iii) The belief that the earth was very young, coupled with the notion of fixity of the species was a significant obstacle to the development of evolutionary thought.
c) The Scientific Revolution
   i) The scientific revolution developed as fundamental ideas of the earth and the biological world were overturned.
      (1) In 1514, Copernicus challenged Aristotle's idea that the earth was the center of the universe by arguing that the solar system was heliocentric.
      (2) In the 1600s an Italian mathematician named Galileo Galilei wrote in support of Copernicus theories and was penalized by the Catholic clergy and condemned to house arrest.
      (3) Europeans began to investigate nature as though it was mechanistic, and sought to discover its fundamental laws without reference to supernatural intervention.
d) Precursors to the Theory of Evolution
   i) John Ray (1627-1705), an ordained minister at Cambridge University, was first to recognize that groups of plants and animals could be distinguished from other groups by their ability to mate with one another and produce offspring.
      (1) These reproductively isolated organisms were termed species.
      (2) Ray also coined the term genus, recognizing that similar species could be grouped together.
   ii) Carolus Linnaeus (1707-1778), a Swedish naturalist and believer in the fixity of species, developed the binomial system of classification plants in his publication, *Systema Naturae* (1735).
      (1) He added the taxonomic levels class and order and classified humans as *Homo sapiens*.
   iii) Georges-Louis Leclerc de Buffon (1707-1788) a French naturalist (a.k.a. Comte de Buffon) stressed the importance of change in the universe and the dynamics between nature and living forms in *Natural History* (1749).

iv) Erasmus Darwin (1731-1802), Charles Darwin's grandfather, was a freethinking physician who wrote about evolutionary ideas composed in verse but the degree to which he influenced his grandson's ideas is unclear.
v) Jean-Baptiste Lamarck (1744-1829) was the first to propose an explanation of the evolutionary process.
    (1) He proposed a theory of the inheritance of acquired characteristics in which an animal's body parts are altered through use or disuse and these altered characteristics are transmitted to their offspring.
        (a) Although this is biologically impossible, he nevertheless is credited with being the first to recognize the importance of the interaction between organisms and their environment in the evolutionary process.
        (b) Lamarck is credited for the term biology.
vi) Georges Cuvier (1769-1832), a French vertebrate paleontologist, was an opponent of Lamarck's evolutionary ideas.
    (1) Cuvier introduced the concept of extinction to explain the existence of hitherto unknown fossil forms.
    (2) Cuvier was a proponent of catastrophism, the idea that the earth's geological features are a result of catastrophic events, and the most recent being the biblical flood.
        (a) These events destroyed old life forms, and the newer forms were the result of creation events.
vii) Thomas Malthus (1766-1834), an English clergyman and economist wrote *An Essay on the Principles of Population* (1798).
    (1) He noted that population sizes increase exponentially but food supplies remain stable.
        (a) This concept inspired both Charles Darwin and Alfred Wallace.
viii) Charles Lyell (1797-1875), author of *Principles of Geology* (1830-1833), is considered the founder of modern geology, he was also Darwin's friend and mentor.
    (1) He demonstrated that uniform processes (uniformitarianism) could account for present geological features.
        (a) His ideas provided the time depth necessary for biological evolution to have occurred.
ix) Mary Anning (1799-1847), an amateur geologist and famous "fossilist", unknowingly contributed significantly to the field of paleontology by discovering hundreds of fossils including the first complete fossil of an *Ichthyosaurus*.

III. The Discovery of Natural Selection

a) Charles Darwin (1809-1882) proposed the first credible mechanism for evolutionary change, natural selection, in *On the Origin of the Species* (1859).
    i) After graduating from Cambridge University, where he studied theology, but also cultivated his interests in natural science and geology, he was recommended to join the five-year expedition of the HMS *Beagle*.
        (1) Darwin began the voyage as a believer in the fixity of species, but his observations of, among other things, fossils of giant ancient versions of living animals and varieties of Galápagos finches eventually convinced him to the contrary.
        (2) After his return to England in October 1836, he began to formulate his theory of natural selection.
            (a) He wrote summaries of his ideas in 1842 and 1844, but felt he needed more evidence before he published.
            (b) Initial reaction to *On the Origin of Species* was mostly negative, but scientific opinion gradually shifted to Darwin's favor.
        (3) In Darwin's Shadow: Alfred Russel Wallace (1823-1913) developed his own theory of natural selection after collecting bird and insect specimens in Southeast Asia.

(a) He first published some of his ideas in 1855, and then in 1858 Wallace wrote "On the Tendency of Varieties to Depart Indefinitely from the Original Type".

(b) Darwin was sent both of Wallace's papers, and Darwin was spurred to put all of his ideas in writing.

IV. Natural Selection

a) Darwin envisioned it as a process in which individuals with favorable variations survive and reproduce at a higher rate than those with unfavorable variations. The key elements in Darwin's formulation include:
   i) The potential for reproductive rates that outpace the rate of increase of food supplies.
   ii) The presence of biological variation within all species.
   iii) Constant competition among individuals for survival.
   iv) Individuals with favorable traits are more likely to survive and reproduce.
   v) The environment "determines" which traits are favorable.
   vi) Favorable traits are passed on to offspring at a higher rate than non-favorable traits, thus increasing in frequency through time and eventually producing new species.
   vii) Geographical isolation may lead to the formation of new species.
   viii) Populations may become geographically isolated and over time, populations may respond to selective pressure and may become different species.

V. Natural Selection in Action

a) Natural selection is an empirically studied phenomenon.
   i) Industrial melanism is a documented case of evolutionary shifts in frequencies of pigmentation patterns in peppered moth populations near Manchester, England.
      (1) Evolutionary shifts in response to the environment are called adaptations.
   ii) Deer mice living in the San Hills of Nebraska provide another example of natural selection in the coloration as response to environmental change. Populations living in the light solid of San Hills serve as camouflage.
   iii) Natural selection has been demonstrated on the (Galápagos) island of Daphne Major.
      (1) Measurements of beak thickness changes through time among the medium ground finch indicate that thicker-beaked individuals had greater reproductive success during droughts.
   iv) Natural selection, through the use of antibiotics, is responsible for the increased number of antibiotic-resistant strains of microorganisms.
b) These examples of natural selection in action indicate that certain common principles apply:
   i) A trait must be inherited to have importance in natural selection.
   ii) Natural selection cannot occur without variation in inherited characteristics.
   iii) Fitness is a relative measure that will change as the environment changes
   iv) Natural selection can act only on traits that affect reproduction.
c) Natural selection can act through not only differential death rates, but also through differential fertility rates.

VI. Constraints on Nineteenth Century Evolutionary Theory

a) Darwin argued that natural selection acts on variation within species, yet no one could explain the source of this variation.
b) Darwin also didn't know how favorable traits were passed from generation to generation.
   i) The laws of heredity were unknown, and most believed that parental traits were blended in the offspring.
   ii) Gregor Mendel had worked out the modern principles of heredity, but his work was not recognized until the beginning of the 20th century.

VII. Opposition to Evolution Today

a) Darwin's formulation of evolution was offensive to Christians because it was in conflict with biblical versions of the creation.
b) The mechanisms of evolution are complex, and many people do not understand them.
    i) Many are not comfortable with the principles of biology and genetics and have little scientific background.
    ii) Most Americans are raised in belief systems that do not emphasize the biological continuity between life forms.
c) Yet, evolutionary theories are accepted, in part, by the Catholic Church and most mainstream Protestants.
d) A Brief History of Religious-Based Opposition to Evolution in the United States reveals why most fundamentalists reject all scientific explanations of evolution.
    (1) Historically, religious fundamentalists opposed the teaching of evolution in public schools at the pre-baccalaureate level, and some states prohibited any mention of evolution until 1968.
        (a) Proponents of *creation science* now prefer to use the term *intelligent design*.
        (b) Many attempts to legislate the teaching of evolution have been overturned, such as the attempted takeover of the Dover Area School Board that was thwarted when none of the eight members of the School Board were reelected in 2004.
    (2) The state and federal courts have consistently ruled that laws that require the teaching of ID violate the First Amendment of the Constitution.

Learning Objectives

After reading Chapter 2, the student should be able to:

1. Trace the development of theories of biological evolution in light of advances in the natural sciences, resulting in part from the age of discovery and exploration.
2. Explain Western European world views, particularly the notions of fixity of species and a general sense of stasis, and how these concepts inhibited the development of theories of biological evolution.
3. Analyze the contributions of 18th and 19th century scientists to evolutionary theory.
4. Describe the contributions of Charles Darwin and Alfred Russel Wallace to the theory of evolution by means of natural selection.
5. Explain and give examples of natural selection.
6. Describe and trace the history of the opposition to evolution in the United States starting in the 1920s through to the present.

Key Terms and Concepts

Binomial nomenclature	p. 31	Natural selection	p. 28
Biological continuity	p. 46	Reproductive success	p. 42
Catastrophism	p. 32	Reproductively isolated	p. 31
Christian fundamentalists	p. 47	Selective pressures	p. 42
Fertility	p. 44	Taxonomy	p. 31
Fitness	p. 41	Uniformitariasm	p. 34
Fixity of species	p. 29		
Genome	p. 45		

Lecture Suggestions

1. Often, beginning students have little knowledge of the history of science, and are therefore unaware that creationist/evolutionist debates have been ongoing for over 150 years. It is enlightening to demonstrate that many current "creationist" arguments are merely recycled, previously rejected old ideas.

2. Discuss the history of the debate between creationism and evolution by showing the film *Judgement Day* available at http://topdocumentaryfilms.com/judgment-day-intelligent-design-on-trial/.

3. Most students have heard of Darwin, but few really understand the full impact of his ideas not only on scientific thought, but also on his personal life. This author has found that, rather than lecturing, showing a video on Darwin's life brings home these points. The video *Charles Darwin: Evolution's Voice* from A & E's *Biography* series is particularly relevant. Be sure to point out that Darwin waited over 20 years to publish his ideas after returning from the voyage of the HMS *Beagle*, mostly because he was aware that his theories ran contrary to widely accepted biblical doctrines.

4. Visit the PBS website for topics on evolution and creationism at http://www.pbs.org/search/evolution%20vs.%20creationism/.

Student Media Exercises

1. Visit the National Center for Science Education's website, http://www.ncseweb.org/, and read about creationist attempts to teach "creation science" in public schools. First click on "Links" and then the "Critiques of Creationism" link and write a paragraph summarizing one of the critiques.

2. One historical figure that vehemently opposed Darwin's ideas was Louis Agassiz (1807-1873). Go to the University of California - Berkeley's Museum of Paleontology website for information on Agassiz http://www.ucmp.berkeley.edu/history/agassiz.html and write a brief paragraph on his life and ideas.

3. Visit the PBS website for topics on evolution and creationism and explore some of the videos, activities, and articles about this debate. Available at http://www.pbs.org/search/evolution%20vs.%20creationism/.

InfoTrac Exercises

1. In InfoTrac, do a Keyword search on "Darwin" (limited by refereed publications) and find the article by Janice Swab that was published in the American biology Teacher in May 2010. While promoted as a tool for instructors, it is an interesting read of the travels of Darwin.

2. In InfoTrac, do a Keyword search on "uniformitarianism" (do not limit your search by refereed publications) and read the article by Richard Monastersy that shows how this two-century-old concept still resonates in today's geology. Does this article support Cuvier's "catastrophism"?

3. Follow-up with a Keyword search on “catastrophism” to see how this concept is interpreted today.

Multiple Choice Questions

1. The last common human ancestor lived
   A. 10-12 million years ago.
   B. 3 to 4 million years ago.
   C. 6 to 8 million years ago.
   D. 150 to 200 thousand years ago.
   E. None of the above

   ANS: c REF: page 27 LO: 1 MSC: New

2. Which is true about evolutionary theory?
   A. It is the most fundamental unifying force in biological science.
   B. It has been tested and subjected to verification and has not been disproved.
   C. It is controversial in the U.S. among some religious groups.
   D. There is opposition to teaching evolution in public schools.
   E. All of the above.

   ANS: e REF: page 28 LO: 1 MSC: New

3. In Europe during the Middle Ages, it was believed that
   A. all species had evolved from a common ancestor.
   B. evolution was the result of natural selection acting upon genetic variation.
   C. all forms were created by God and did not change over time.
   D. most species had become extinct over time.
   E. life was created slowly, over millions of years.

   ANS: c REF: page 28 LO: 2

4. Among the widely held beliefs in 19th century Europe that prevented the acceptance of biological evolution were the
   A. notion that species did not change.
   B. belief in the recent origin of life on earth.
   C. concept that species were continuously changing.
   D. all of these
   E. notion that species did not change, and belief in the recent origin of life on earth.

   ANS: e REF: page 28-29 LO: 2

5. The belief that species do not change but are the same as when first created is known as
   A. fixity of species.
   B. the Great Chain of Being.
   C. heliocentrism.
   D. uniformitarianism.
   E. natural selection.

   ANS: a REF: page 29 LO: 2

6. The plan of the entire universe was viewed as
   A. the binomial system.
   B. natural selection.
   C. uniformitarianism.
   D. God's design.
   E. Lamarckism.

   ANS: d REF: page 29 LO: 2

7. Several events had combined to alter Western Europeans' ideas about the earth by the 18th century. These included
   A. the circumnavigation of the globe.
   B. the discovery of the New World.
   C. the discovery of the heliocentric universe.
   D. all of these
   E. the circumnavigation of the globe and the discovery of the New World.

   ANS: d REF: pages 29-30 LO: 3

8. The fact that anatomical structures appear to be uniquely engineered to meet the purpose for which they were required was the basis for the
   A. theory of uniformitarianism.
   B. theory of natural selection.
   C. theory of the inheritance of acquired characteristics.
   D. theory of catastrophism.
   E. argument from design.

   ANS: e REF: page 29 LO: 2

9. By the 17th century, some scientists were beginning to break with long-held traditions and sought to discover
   A. the physical laws of physics, motion, and gravity.
   B. the supernatural forces that created life.
   C. the structure of the DNA molecule.
   D. how genetic mutations occurred.
   E. none of these

   ANS: a REF: pages 29-30 LO: 3

10. Which is true about Galileo Galilei?
   A. He was a French mathematician.
   B. He restated Copernicus' views of the earth being a place in motion.
   C. He was tried by the Catholic Church and condemned to house arrest.
   D. All of the above.
   E. He restated Copernicus' views of the earth being a place in motion, and he was tried by the Catholic Church and condemned to house arrest b and c only.

   ANS: e REF: pages 30-31 LO: 3 MSC: New

11. Who first recognized that species were groups of organisms that were distinguished from other such groups by their ability to reproduce?
    A. John Ray
    B. Charles Darwin
    C. Carolus Linnaeus
    D. Alfred Russel Wallace
    E. Jean-Baptiste Lamarck

    ANS: a REF: page 31 LO: 3

12. Who developed the binomial system of classifying biological organisms?
    A. Jean-Baptiste Lamarck
    B. Georges Cuvier
    C. Carolus Linnaeus
    D. Charles Lyell
    E. Erasmus Darwin

    ANS: c REF: page 31 LO: 3

13. Carolus Linnaeus
    A. developed a binomial system of classification for plants and animals.
    B. was a proponent of evolutionary change.
    C. opposed all notions of fixity of species.
    D. was a supporter of Charles Darwin.
    E. developed theories of natural selection.

    ANS: a REF: page 31 LO: 3

14. _____ was an 18^{th} century thinker who believed that living forms changed in response to the environment. Although he did not think nature was perfect or had a grand purpose, he still rejected the idea that one species could give rise to another.
    A. Alfred Russel Wallace
    B. Georges-Louis Leclerc de Buffon
    C. Erasmus Darwin
    D. John Ray
    E. Georges Cuvier

    ANS: b REF: pages 31-32 LO: 3

15. Charles Darwin was not the first to conceive of evolutionary change. Those who preceded him included
    A. Jean Baptiste Lamarck.
    B. Erasmus Darwin.
    C. Georges-Louis Leclerc de Buffon.
    D. all of these
    E. none of these

    ANS: d REF: pages 31-33 LO: 3

16. Who was the first to offer a scientific explanation for how species changed?
    A. Carolus Linnaeus
    B. Jean-Baptiste Lamarck
    C. Charles Lyell
    D. Charles Darwin
    E. Erasmus Darwin

    ANS: b REF: pages 32-33 LO: 3

17. The theory that the frequent use of an organ caused it to be enhanced was developed by
    A. Charles Darwin.
    B. Carolus Linnaeus.
    C. Georges Cuvier.
    D. Charles Lyell.
    E. Jean-Baptiste Lamarck.

    ANS: e REF: pages 32-33 LO: 3

18. The role of the environment as a significant factor in evolutionary change was first recognized and stated by
    A. Jean-Baptiste Lamarck.
    B. Georges Cuvier.
    C. Thomas Malthus.
    D. Charles Darwin.
    E. Charles Lyell.

    ANS: a REF: pages 32-33 LO: 3

19. The term "biology" was coined by
    A. Jean-Baptiste Lamarck.
    B. Georges Cuvier.
    C. Thomas Malthus.
    D. Charles Darwin.
    E. Charles Lyell.

    ANS: a REF: page 32 LO: 3

20. The theory that characteristics acquired during the lifetime of an individual could be passed on to that individual's offspring is termed
    A. natural selection.
    B. catastrophism.
    C. the inheritance of acquired characteristics.
    D. uniformitarianism.
    E. fixity of species.

    ANS: c REF: pages32-33 LO: 3

21. The view that the extinction and the subsequent appearance of more modern forms could be explained by a series of disasters and creations is known as
    A. natural selection.
    B. catastrophism.
    C. use-disuse theory.
    D. uniformitarianism.
    E. descent with modification.

    ANS: b REF: pages 33-34 LO: 3

22. The opponent of Jean-Baptiste Lamarck who proposed the theory of catastrophism was
    A. Charles Lyell.
    B. Alfred Russel Wallace.
    C. Thomas Malthus.
    D. Erasmus Darwin.
    E. Georges Cuvier.

    ANS: e REF: pages 33-34 LO: 3

23. Thomas Malthus
    A. proposed that population size is kept in check by the limited availability of resources.
    B. wrote *An Essay on the Principle of Population*.
    C. influenced the development of Charles Darwin's and Alfred Russel Wallace's theories of natural selection.
    D. all of these
    E. proposed that population size is kept in check by the limited availability of resources, and wrote *An Essay on the Principle of Population*.

    ANS: d REF: page 34 LO: 3

24. Who proposed that population size increases at a faster rate than food supplies?
    A. Erasmus Darwin
    B. Alfred Russel Wallace
    C. Thomas Malthus
    D. Charles Lyell
    E. Jean-Baptiste Lamarck

    ANS: c REF: page 34 LO: 3

25. Who wrote *Principles of Geology* and emphasized the principle of uniformitarianism?
    A. Charles Darwin
    B. Charles Lyell
    C. Alfred Russel Wallace
    D. Jean-Baptiste Lamarck
    E. Thomas Malthus

    ANS: b REF: page 34 LO: 3

26. The principle of uniformitarianism
    A. stated that the geological processes that operated in the past are still occurring in the present.
    B. was a problem for the development of evolutionary theories.
    C. proposed that the earth was only a few thousand years old.
    D. was the same as the theory of catastrophism.
    E. was first proposed by Georges Cuvier.

    ANS: a REF: page 34 LO: 3

27. Which concept, proposed by Charles Lyell, was to have a profound effect on 19th century scientific thought?
    A. recent origins for earth
    B. the role of catastrophic events in producing geological phenomena
    C. natural selection
    D. the immense age of the earth and uniform processes
    E. the inheritance of acquired characteristics

    ANS: d REF: page 34 LO: 3

28. Mary Anning is credited with
    A. the principle of uniformitarianism.
    B. being the co discoverer of natural selection.
    C. finding numerous important fossils during the 19th century.
    D. being married to Charles Darwin.
    E. none of these

    ANS: c REF: page 35 LO: 3

29. Charles Darwin
    A. grew up in modest circumstances.
    B. began to doubt the fixity of species during a voyage around the world in the 1830s.
    C. received no formal education.
    D. spent two years in Africa where he developed the theory of natural selection.
    E. was a physician who studied natural history as a hobby.

    ANS: b REF: page 37 LO: 4

30. In formulating his theory of natural selection, Charles Darwin
    A. recognized the importance of biological variation within a population.
    B. applied his knowledge of domesticated species to undomesticated ones.
    C. appreciated the fact that population size is limited by availability of food.
    D. all of these
    E. none of these

    ANS: d REF: pages 37-39 LO: 4

31. Charles Darwin
    A. was reluctant to publish his theories.
    B. wrote his theory of natural selection while still on board the *Beagle*.
    C. published his theories as soon as he returned from his voyage on the *Beagle*.
    D. was not concerned with public opinion and did not mind if his theories were criticized.
    E. knew his friends and colleagues would not be affected by the publication of his theory.

    ANS: a REF: pages 39-40 LO: 4

32. Which contemporary of Charles Darwin also developed a theory of evolution by means of natural selection?
    A. Charles Lyell
    B. Jean-Baptiste Lamarck
    C. Erasmus Darwin
    D. Alfred Russel Wallace
    E. Georges Cuvier

    ANS: d REF: page 40 LO: 4

33. The fact that individuals who possess favorable traits are more likely to survive and reproduce than those who possess less favorable traits is the basis for the theory of
    A. uniformitarianism.
    B. natural selection.
    C. the inheritance of acquired characteristics.
    D. catastrophism.
    E. the fixity of species.

    ANS: b REF: pages 41-42 LO: 5

34. Which of the following concepts DID NOT influence Darwin in developing his theory of evolution?
    A. Population size increases more rapidly than food supplies.
    B. There is competition among individuals for resources.
    C. Species are unchanging types, and individual variation within a species is not important.
    D. There is biological variation in all members of a species.
    E. Favorable variations are passed on and accumulate in populations over time.

    ANS: c REF: pages 36-39 LO: 4

35. Darwin based his evolutionary ideas on
    A. the religious views of the time of a very young earth.
    B. the reality of the concept of fixity of species.
    C. an understanding of modern genetic principles.
    D. all of these
    E. none of these

    ANS: e REF: pages 36-39 LO: 4

36. Selective pressures
    A. remain constant, regardless of the environment.
    B. are unimportant in the evolutionary process.
    C. can change if environmental conditions change.
    D. are directionless and random.
    E. are not related to adaptation.

    ANS: c REF: page 42 LO: 5

37. "Fitness", in an evolutionary sense, refers to an individual's
    A. strength.
    B. reproductive success.
    C. aggressiveness.
    D. size.
    E. age at death.

    ANS: b REF: page 41 LO: 5

38. According to natural selection theory
    A. traits that confer a reproductive advantage will be selected for.
    B. mutations in somatic cells can be passed on to offspring.
    C. natural selection only acts on hereditary traits.
    D. all of these
    E. a and c only

    ANS: e REF: pages 41-42 LO: 5

39. Which examples are used to illustrate natural selection?
    A. Deer mice in Nebraska
    B. Finches in Galapagos
    C. Resistant strains of micro organisms and antibiotics
    D. All of these
    E. Finches in Galapagos and resistant strains of micro organisms and antibiotics.

    ANS: d REF: page 43 LO: 5 MISC: New

40. Opposition to evolution today
    A. is mainly found among bible literalists.
    B. results from a lack of understanding of genetics and biology.
    C. emerges because of lack of scientific evidence for evolution.
    D. All of the above
    E. found among bible literalists and results from lack of understanding of genetics and biology.

    ANS: e REF: page 46 LO: 6 MSC: New

True/False Questions

1. Evolution is a theory that has little scientific support.

   ANS: F REF: page 28 LO: 3

2. The "argument from design" was first proposed by Charles Darwin.

   ANS: F REF: page 29 LO: 4

3. Natural Selection is the notion that species, once created, can never change.

   ANS: F REF: page 29 LO: 4 MSC: New

4. Erasmus Darwin is credited with heavily influencing Charles Darwin's evolutionary thinking.

   ANS: F REF: page 32 LO: 3

5. Use-disuse theory has recently displaced natural selection as mainstream science's most accepted theory of evolutionary change.

   ANS: F REF: page 32 LO: 3

6. Georges Cuvier, author of *Principles of Geology*, is considered the founder of modern geology.

   ANS: F REF: page 33 LO: 3

7. Charles Darwin collected thirteen varieties of finches while visiting the Galápagos Islands and observing its finches.

   ANS: T REF: page 38 LO: 4

8. Charles Darwin acknowledged the importance of sexual reproduction when formulating his theory of natural selection.

   ANS: T REF: pages 38-39 LO: 4

9. Charles Darwin refrained from immediately publishing his theory of natural selection because he was aware of its controversial nature.

   ANS: T REF: pages 39-40 LO: 4

10. There are no well-documented examples of natural selection operating in natural populations.

    ANS: F REF: pages 42-44 LO: 5

11. Both Darwin and Mendel believed in the blending theory of inheritance.

    ANS: F REF: page 45 LO: 6 MSC: New

12. The opposition to evolution is mainly found in the U.S. and increasingly in several Muslim countries.

ANS: T REF: page 46 LO: 6 MSC: New

13. Proponents of "creation science" hold that their ideas are absolute and infallible.

ANS: T REF: page 46 LO: 6

Short Answer Questions

1. Explain how traditionally held views prevented wide acceptance of evolutionary theories in 19th century Europe and America. Give a specific example.

ANS: Not Given REF: pages 28-29 & 45-46 LO: 2

2. Outline Lamarck's theory of inheritance of acquired characteristics. According to this theory, what was the environment's role in biological change?

ANS: Not Given REF: pages 32-33 LO: 3

3. Discuss the ideas of two individuals who significantly affected Darwin's formulation of the theory of natural selection.

ANS: Not Given REF: pages 31-35 LO: 3

4. How is natural selection related to environmental factors? How can selective pressures change? Give an example.

ANS: Not Given REF: pages 41-45 LO: 5

5. Discuss the definition of fitness as it pertains to natural selection.

ANS: Not Given REF: pages 41-42 LO: 5

Essay Questions

1. Many people argue that evolution is "only a theory". Define *theory* and then describe how evolution does or does not fit the definition.

ANS: Not Given

2. Discuss the role of differential fertility in natural selection.

ANS: Not Given

3. Many people in the United States believe in the biblical creation. What factors may account for the fact that many people do not accept evolution as an explanation for the origins and diversity of life?

ANS: Not Given

4. Explain why Charles Lyell's principle of uniformitarianism was important to Charles Darwin and Alfred Russel Wallace as they developed their theories of biological evolution.

ANS: Not Given