MULTIPLE CHOICE

1. What is the greatest risk factor for cancer?
   A. family history
   B. age
   C. environmental toxins
   D. diet
   E. physical inactivity
   ANS: B  DIF: Bloom's: Remember
   REF: 1-1 Genetics and Translational Medicine
   OBJ: HUHE.CUMM.16.1-1-1 Explain the connection between genetic research and clinical medicine as it relates to cancer treatment.

2. The immune system ____.
   A. works by attacking anything recognized as foreign
   B. plays no role in fighting cancer
   C. often accelerates development of malignant cancers
   D. works by turning off specific genes in an individual’s DNA
   E. is highly resistant to genetic modification
   ANS: A  DIF: Bloom's: Understand
   REF: 1-1 Genetics and Translational Medicine
   OBJ: HUHE.CUMM.16.1-1-1 Explain the connection between genetic research and clinical medicine as it relates to cancer treatment.

3. What is an example of basic research?
   A. Developing a new diagnostic test
   B. Synthesizing proteins for treating disease
   C. Manufacturing a vaccine
   D. Developing a new drug to treat diabetes
   E. Learning how plants turn carbon dioxide into sugar
   ANS: E  DIF: Bloom's: Understand
   REF: 1-5 How Do Scientists Study Genes?
   OBJ: HUHE.CUMM.16.1-5-2 Differentiate between basic and applied research and illustrate how each approach is used in the study of genetics.

4. Genetics is defined as the scientific study of ____.
   A. diseases
   B. DNA
   C. heredity
   D. chromosome structure
   E. cell structure
   ANS: C  DIF: Bloom's: Remember
   REF: 1-2 Genetics Is the Key to Biology
   OBJ: HUHE.CUMM.16.1-2-1 Define the term genetics and summarize its role in our understanding of all of biology.

5. The DNA components adenine, thymine, guanine, and cytosine are examples of ____.
   A. phosphates
6. Gregor Mendel ____.
   A. discovered the structure of DNA
   B. claimed that each individual carries a pair of "factors" for a given trait
   C. demonstrated that traits carried by parents are “blended” in their offspring
   D. cross-bred thirty different species of pea plants over a span of fifty years
   E. reasoned that each parent carries one gene for a specific trait

ANS: B  DIF: Bloom's: Understand
REF: 1-4 How Are Genes Transmitted from Parents to Offspring?
OBJ: HUHE.CUMM.16.1-4-1 Discuss Gregor Mendel and his role in the early science of genetics.

7. What Mendel called “factors,” we now call ____.
   A. nucleotides
   B. DNA
   C. chromosomes
   D. genes
   E. bases

ANS: D  DIF: Bloom's: Remember
REF: 1-4 How Are Genes Transmitted from Parents to Offspring?
OBJ: HUHE.CUMM.16.1-4-2 Explain how Mendel’s research with pea plants has increased our understanding of how specific traits are passed from parent to offspring by genes.

8. Before Mendel, most people would have predicted that a cross of a red rose with a yellow rose would produce ____.
   A. all red roses
   B. all yellow roses
   C. all orange roses
   D. about half yellow roses and half red roses
   E. about three-fourths red roses and one-fourth yellow roses

ANS: C  DIF: Bloom's: Understand
REF: 1-4 How Are Genes Transmitted from Parents to Offspring?
OBJ: HUHE.CUMM.16.1-4-2 Explain how Mendel’s research with pea plants has increased our understanding of how specific traits are passed from parent to offspring by genes.

9. The main purpose of preparing karyotypes is to ____.
   A. prepare for gene extractions
   B. determine gender
   C. determine which genes are on which chromosomes
   D. separate DNA into its component parts
   E. diagnose or rule out certain genetic disorders

ANS: E  DIF: Bloom's: Understand
REF: 1-5 How Do Scientists Study Genes?
10. Transmission genetics ____.
   A. studies the pattern of inheritance as traits are passed from generation to generation
   B. reconstructs the pattern of inheritance associated with a trait as it passes through several generations
   C. maps genes to study chromosome structure and abnormalities in chromosome numbers and organization
   D. uses recombinant DNA technology to identify, isolate, and produce millions of copies of genes that can be studied in the laboratory
   E. sequences the complete human genome
   ANS: A
   DIF: Bloom's: Understand
   REF: 1-5 How Do Scientists Study Genes?

11. Eugenics ____.
   A. has been scientifically tested and shown to be a valid theory
   B. is a dubious method for improving the human species through selective breeding
   C. assumes that human traits are much more influenced by environment than by genes
   D. had major social ramifications in Germany but is largely dismissed in the United States
   E. was based on faulty karyotyping and DNA analysis
   ANS: B
   DIF: Bloom's: Understand
   REF: 1-6 Has Genetics Affected Social Policy and Law?

12. Carrie Buck is significant in the history of genetics because she ____.
   A. was a well-known advocate for eugenics
   B. became the first woman geneticist
   C. was sterilized after the U.S. Supreme Court determined she was feebleminded
   D. discovered how to genetically modify corn to be resistant to herbicides
   E. is the author of the first biography of Gregor Mendel
   ANS: C
   DIF: Bloom's: Remember
   REF: 1-6 Has Genetics Affected Social Policy and Law?

13. Hereditarianism is the idea that all human traits are ____.
   A. partly influenced by environment
   B. traceable to our earliest ancestors
   C. influenced equally by genes and environment
   D. determined only by genes
   E. immutable from generation to generation
   ANS: D
   DIF: Bloom's: Understand
   REF: 1-6 Has Genetics Affected Social Policy and Law?

14. The decline of the eugenics movement in the U.S. in the early 20th century resulted from ____.
   A. breakthroughs in genetic technology
   B. violent protests by the medical community
C. the ability to manipulate gene expression
D. social outrage at the number of deaths caused by botched sterilizations
E. its misuse for social and political purposes by the Nazis

ANS: E  DIF: Bloom’s: Understand
REF: 1-6 Has Genetics Affected Social Policy and Law?
OBJ: HUHE.CUMM.16.1-6-3 Summarize the flaws in eugenics theory and critique its influence in the U.S. during the early 20th century.

15. Induced pluripotent stem cells are ____
A. produced from normal body cells
B. not used for human genetic research
C. a major cause of cancer
D. grown in the lab to produce clones
E. isolated from embryos

ANS: A  DIF: Bloom’s: Understand
REF: 1-7 What Impact Is Genomics Having?
OBJ: HUHE.CUMM.16.1-7-1 Describe genome sequencing and illustrate various methods of use in the treatment of disease, genetic testing, and plant and animal modification.

16. Gene therapy can best be described as the ____.
A. elimination of a defect (mutation) in a gene
B. insertion of normal genes to act in place of mutant genes
C. insertion of human genes into other organisms
D. cloning of genes to produce and purify therapeutically useful proteins
E. mapping of all human genetic information

ANS: B  DIF: Bloom’s: Understand
REF: 1-5 How Do Scientists Study Genes?
OBJ: HUHE.CUMM.16.1-5-1 Compare and contrast the different methods scientists use to study genetics.

17. The “recombining” property of genes refers to their ability to ____.
A. be transmitted from parents to children
B. move from one chromosome to another
C. be turned on and off
D. mutate
E. break apart and then reassemble

ANS: B  DIF: Bloom’s: Understand
REF: 1-3 What Are Genes and How Do They Work?
OBJ: HUHE.CUMM.16.1-3-1 Identify basic gene components and diagram the structure of a DNA molecule.

18. A human pedigree ____.
A. is a family tree chart showing birth and death dates
B. certifies that an individual has a particular genome
C. certifies good genetic health
D. represents the inheritance of a trait through several generations of a family
E. summarizes the health history of an individual and his/her parents

ANS: D  DIF: Bloom’s: Remember
REF: 1-5 How Do Scientists Study Genes
OBJ: HUHE.CUMM.16.1-5-1 Compare and contrast the different methods scientists use to study
genetics.

19. The development and use of ____ ushered in the era of genomics when geneticists began planning ways to sequence the 3.2 billion nucleotides in the human genome.
   A. transmission genetics
   B. the electron microscope
   C. recombinant DNA technology
   D. cytogenetics
   E. karyotypes

   ANS: C   DIF: Bloom's: Understand
   REF: 1-7 What Impact Is Genomics Having?
   OBJ: HUHE.CUMM.16.1-7-1 Describe genome sequencing and illustrate various methods of use in the treatment of disease, genetic testing, and plant and animal modification.

20. The nucleotide sequence encoded in a gene defines the ____ that make up proteins.
    A. phosphate groups
    B. polypeptides
    C. ribosomes
    D. haplotypes
    E. amino acids

    ANS: E   DIF: Bloom's: Understand
    REF: 1-3 What Are Genes and How Do They Work?
    OBJ: HUHE.CUMM.16.1-3-2 Describe the role of genes in the production of proteins.

TRUE/FALSE

1. Normal white blood cells (called B cells) and cancerous B cells that cause leukemia both carry a unique surface protein called CD-19.

   ANS: T   DIF: Bloom's: Remember
   REF: 1-1 Genetics and Translational Medicine
   OBJ: HUHE.CUMM.16.1-1-1 Explain the connection between genetic research and clinical medicine as it relates to cancer treatment.

2. Genetic modification of immune cells has not been shown to be an effective leukemia treatment.

   ANS: F   DIF: Bloom's: Remember
   REF: 1-1 Genetics and Translational Medicine
   OBJ: HUHE.CUMM.16.1-1-1 Explain the connection between genetic research and clinical medicine as it relates to cancer treatment.

3. The human genome carries approximately 20,000 genes.

   ANS: T   DIF: Bloom's: Remember
   REF: 1-7 What Impact Is Genomics Having?
   OBJ: HUHE.CUMM.16.1-7-1 Describe genome sequencing and illustrate various methods of use in the treatment of disease, genetic testing, and plant and animal modification.

4. In the years after the completion of the human genome project, genome sequencing revealed surprisingly little amount of variation in the sequence and arrangement of nucleotides in humans.
5. In some societies, the birth of a deformed child is regarded as a sign of impending war or famine.

6. Genes are precisely copied during the process of DNA replication and never undergo any change.

7. The U.S. has stayed ahead of the issues surrounding genetic technology by implementing ground-breaking public policy and laws.

8. The separation of genes during the formation of the sperm and egg and the reunion of genes at fertilization is explained by the behavior of chromosomes in a form of cell division called meiosis.

9. Genetic discoveries made in one organism cannot necessarily be applied to other species.

10. The Immigration Restriction Act of 1924 was supported by research that demonstrated that Western Europeans were genetically superior to Eastern Europeans.

**COMPLETION**

1. The union of research and medicine that seeks to quickly translate research findings into methods for the diagnosis and treatment of diseases is called ____________________.
2. The simplest type of variation in a genome sequence is a single nucleotide change called a(n) ________________.

ANS: single nucleotide polymorphism (SNP)

3. A set of genetic markers located close together on a single ____________________ is called a haplotype.

ANS: chromosome, chromosome region

4. New technology has made it possible to screen an individual’s entire genome, instead of testing for one genetic disorder at a time. This technology uses ____________________ that carry DNA from the entire human genome.

ANS: DNA microarrays, DNA chips, microarrays, chips

5. In the mid-twentieth century, researchers discovered that genes are made of ____________________ and that this molecule is part of cellular structures known as ____________________.

ANS: DNA, chromosomes

6. The process in which genes move from one chromosome to another is called ________________.

ANS: recombination
recombining

DIF: Bloom's: Remember  
OBJ: HUHE.CUMM.16.1-3-2 Describe the role of genes in the production of proteins.

7. Each nucleotide in a strand of DNA is composed of a(n) ________________, a(n) ________________, and a(n) ________________.

ANS: sugar, base, phosphate group

DIF: Bloom's: Remember  
OBJ: HUHE.CUMM.16.1-3-1 Identify basic gene components and diagram the structure of a DNA molecule.

8. Chemical subunits called amino acids combine to make ________________.

ANS: proteins

DIF: Bloom's: Understand  
OBJ: HUHE.CUMM.16.1-3-2 Describe the role of genes in the production of proteins.

9. Transmission genetics studies the pattern of ________________ as traits are passed from generation to generation.

ANS: inheritance

DIF: Bloom's: Understand  
OBJ: HUHE.CUMM.16.1-5-1 Compare and contrast the different methods scientists use to study genetics.

10. ________________ is the branch of genetics that is used to map genes and study chromosome structure and abnormalities in chromosome number and organization.

ANS: Cytogenetics

DIF: Bloom's: Remember  
OBJ: HUHE.CUMM.16.1-5-1 Compare and contrast the different methods scientists use to study genetics.

11. DNA is a helical molecule consisting of two strands of ________________ that is the primary carrier of ________________ information.

ANS: nucleotides, genetic

DIF: Bloom's: Understand  
OBJ: HUHE.CUMM.16.1-3-1 Identify basic gene components and diagram the structure of a DNA molecule.
12. In 1927, the U.S. Supreme Court upheld the right of states to use ________________ as a means of preventing reproduction by those deemed “unfit.”

ANS: sterilization
eugenic sterilization

DIF: Bloom's: Remember REF: 1-6 Has Genetics Affected Social Policy and Law?
OBJ: HUHE.CUMM.16.1-6-2 Assess the social and political ramifications of eugenics policies.

13. Recombinant DNA technology has been used for over 30 years to produce ________________ in bacteria for the treatment of diabetes.

ANS: insulin
human insulin

DIF: Bloom's: Remember REF: 1-7 What Impact Is Genomics Having?
OBJ: HUHE.CUMM.16.1-7-1 Describe genome sequencing and illustrate various methods of use in the treatment of disease, genetics testing, and plant and animal modification.

14. Results from the ________________ and the development of new technologies have revolutionized the detection, diagnosis, and treatment of cancer.

ANS: Human Genome Project
HGP

DIF: Bloom's: Understand REF: 1-1 Genetics and Translational Medicine
OBJ: HUHE.CUMM.16.1-1-1 Explain the connection between genetic research and clinical medicine as it relates to cancer treatment.

15. Eugenics is the attempt to improve the human species by ________________.

ANS: selective breeding

DIF: Bloom's: Remember REF: 1-6 Has Genetics Affected Social Policy and Law?
OBJ: HUHE.CUMM.16.1-6-1 Explain the field of eugenics as proposed by Francis Galton.

16. Mendel’s experiments on pea plants showed that genes are passed ________________ from generation to generation and that traits are not ________________.

ANS: intact, blended

DIF: Bloom's: Understand
REF: 1-4 How Are Genes Transmitted from Parents to Offspring?
OBJ: HUHE.CUMM.16.1-4-2 Explain how Mendel’s research with pea plants has increased our understanding of how specific traits are passed from parent to offspring by genes.

17. Clones are genetically identical molecules, cells, or organisms, all derived from a(n) ________________.

ANS: single ancestor

DIF: Bloom's: Understand
REF: 1-6 Has Genetics Affected Social Policy and Law?
Population geneticists are interested in the forces that change the ____________________ of genes in a population.

ANS: frequency

A trait is a(n) ________________ property of an organism.

ANS: observable

The fundamental unit of heredity is called a(n) ________________.

ANS: gene

ESSAY

1. Consider this statement: Information about citizens' genomes should be held in a centralized database by a single private company or by the government. Do you agree or disagree? Explain your reasoning.

ANS: Answers will vary. Students might discuss privacy and security issues with regard to their personal data, as well as the potential misuse of these data by corporations or the government to restrict the rights of groups based on real or imagined traits.

Discuss how and why the investigative method of molecular genetics has had the greatest impact on human genetics over the last several decades.

ANS:
Molecular genetics uses recombinant DNA technology to identify, isolate, and produce millions of copies of genes (clones) that can be studied in the laboratory. These methods have greatly advanced our knowledge of how genes are organized and how they work at the molecular level.

DIF: Bloom's: Understand  REF: 1-5 How Do Scientists Study Genes?
OBJ: HUHE.CUMM.16.1-5-1 Compare and contrast the different methods scientists use to study genetics.

3. Differentiate between basic and applied research and discuss how the two are linked in terms of genetics.

ANS:
Scientists do basic research in laboratory and field settings to understand how something works or why it works the way it does. In basic research, there is no immediate goal of solving a practical problem or making a commercial product; knowledge itself is the goal. In turn, the results of basic research generate new ideas and more basic research. In this way, we gain detailed information about the structure and function of cells, why animals behave in certain ways, and how plants turn carbon dioxide into sugar. Among other things, basic research in genetics has provided us with details about genes, how they work, and, more importantly, what happens when they don’t work properly.

Applied research is usually done to solve a practical problem or turn a discovery into a commercial service or product. Applied research uses basic methods such as transmission genetics to study the way in which a trait is inherited, and it also uses biotechnology to make products such as transgenic organisms, medicines, and nutritionally enhanced foods. In agriculture, applied genetic research has increased crop yields, lowered the fat content of pork, and created new forms of corn and soybeans that are resistant to herbicides and pests. In medicine, new diagnostic tests, the synthesis of customized proteins for treating disease, and the production of vaccines are just a few examples of applied genetic research.

DIF: Bloom's: Analyze  REF: 1-5 How Do Scientists Study Genes?
OBJ: HUHE.CUMM.16.1-5-2 Differentiate between basic and applied research and illustrate how each approach is used in the study of genetics.

4. Define eugenics and discuss Francis Galton’s influence in the development of the fundamentally flawed ‘science.’

ANS:
Francis Galton proposed that selection should be used to improve the human species. Galton started a new field, which he called eugenics. He claimed that by applying the principle of natural selection, we could improve the intellectual, economic, and social level of humankind through selective breeding. Bypassing legal and ethical considerations, Galton’s proposals were simple: People with desirable traits such as leadership and musical ability should be encouraged to have large families, whereas those with undesirable traits such as intellectual disability and physical deformities should be discouraged from reproducing. Galton’s reasoning was flawed for several reasons, including his belief that human traits are handed down without any environmental influence. His proposals failed to address another important consideration: Who defines what is a desirable or an undesirable trait?

DIF: Bloom's: Understand  REF: 1-6 Has Genetics Affected Social Policy and Law?
OBJ: HUHE.CUMM.16.1-6-1 Explain the field of eugenics as proposed by Francis Galton.

5. What was the benefit envisioned from the Human Genome Project? Was this project an appropriate use of taxpayers' money? Why or why not?
ANS:
The benefit envisioned from the Human Genome Project was the ability to identify, map, and assign functions to all genes carried in our cells and then turn those results into new methods of diagnosis and treatment of disease.

Answers will vary.

DIF: Bloom's: Evaluate REF: 1-7 What Impact Is Genomics Having?
OBJ: HUHE.CUMM.16.1-7-1 Describe genome sequencing and illustrate various methods of use in the treatment of disease, genetic testing, and plant and animal modification.

6. Discuss some negative implications of recombinant DNA technology.

ANS:
The use of herbicide-resistant corn and soybeans may speed the development of herbicide-resistant weeds and increase our use of and dependence on chemical herbicides. There is also the possibility that genetically engineered traits may be transferred to other organisms, leading to irreversible and deleterious changes in ecosystems.

OBJ: HUHE.CUMM.16.1-7-1 Describe genome sequencing and illustrate various methods of use in the treatment of disease, genetic testing, and plant and animal modification.

7. In what sense is genetics the key to all of biology?

ANS:
Genes control what cells look like and what they do as well as how babies develop and how we reproduce. An understanding of what genes are, how they are passed from generation to generation, and how they work is essential to our understanding of all life on Earth, including our species, Homo sapiens.

DIF: Bloom's: Understand REF: 1-2 Genetics Is the Key to Biology
OBJ: HUHE.CUMM.16.1-2-1 Define the term genetics and summarize its role in our understanding of all of biology.

8. Define stem cells and briefly discuss stem cell research and its potential for use in treating disease.

ANS:
In the embryo, stem cells divide to form about 200 different cell types that become parts of the tissues and organs of the body. In adults, stem cells are a reservoir that provides replacements for cells lost through injury, disease, or wear and tear. The ability to isolate stem cells from embryos and to produce stem cells from normal body cells in the laboratory offers the possibility of using stem cells to treat disorders such as heart disease, diabetes, and other degenerative conditions.

OBJ: HUHE.CUMM.16.1-7-1 Describe genome sequencing and illustrate various methods of use in the treatment of disease, genetic testing, and plant and animal modification.
9. Describe the experimental design Mendel used while researching pea plant traits and explain the general result that lead him to form his hypothesis about the transmission of “factors” from parents to offspring?

ANS:
Mendel chose pea parental plants that each had a different distinguishing characteristic, called a trait. For example, Mendel bred tall pea plants with short pea plants. Plant height is the trait in this case and has two variations: tall and short. He also bred plants carrying green seeds with plants having yellow seeds. In this work, seed color is the trait; green and yellow are the variations of the trait he studied. In these breeding experiments, he wanted to see how traits such as height and seed color were passed from generation to generation. Mendel kept careful records of the number and type of traits present in each generation. He also recorded the number of individual plants that carried each trait. He discovered patterns in the way traits were passed from parent to offspring through several generations. Based on those patterns, Mendel concluded that traits such as plant height and seed color are passed from generation to generation by “factors” that are transmitted from parent to offspring.

DIF: Bloom's: Understand
REF: 1-4 How Are Genes Transmitted from Parents to Offspring?
OBJ: HUHE.CUMM.16.1-4-1 Discuss Gregor Mendel and his role in the early science of genetics.

10. Should we buy and eat food that comes from genetically modified plants and animals? Defend your answer based on previous knowledge and on what you learned from this chapter.

ANS:
Answers will vary. Students should address one or more controversial uses of biotechnology. Here are two examples:

Critics have raised concerns that the use of herbicide-resistant corn and soybeans will speed the development of herbicide-resistant weeds and increase our use of and dependence on chemical herbicides. Others point to the possibility that genetically engineered traits may be transferred to other organisms, leading to irreversible and deleterious changes in ecosystems.

Genetically modified sheep, rabbits, and cows are being used to produce medically important human proteins in their milk. These proteins are, or soon will be, used in clinical trials to treat human diseases such as emphysema and Pompe disease.

DIF: Bloom's: Evaluate
REF: 1-8 What Choices Do We Make in the Era of Genomics and Biotechnology?
OBJ: HUHE.CUMM.16.1-8-1 Debate the ethical and social issues that the use of genomics and biotechnology introduces to society.