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| **True / False** |

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| 1. Normal white blood cells (called B cells) and cancerous B cells that cause leukemia both carry a unique surface protein called CD-19.​   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | True | |

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| 2. Genetic modification of immune cells has not been shown to be an effective leukemia treatment.​   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | False | |

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| 3. The human genome carries approximately 20,000 genes.​   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | True | |

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| 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.​   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | False | |

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| 5. In some societies, the birth of a deformed child is regarded as a sign of impending war or famine.​   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | True | |

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| 6. Genes are precisely copied during the process of DNA replication and never undergo any change.​   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | False | |

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| 7. The U.S. has stayed ahead of the issues surrounding genetic technology by implementing ground-breaking public policy and laws.​   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | False | |

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| 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.​   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | True | |

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| 9. Genetic discoveries made in one organism cannot necessarily be applied to other species.​   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | False | |

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| 10. The Immigration Restriction Act of 1924 was supported by research that demonstrated that Western Europeans were genetically superior to Eastern Europeans.​   |  |  |  | | --- | --- | --- | |  | a. | True | |  | b. | False |  |  |  | | --- | --- | | *ANSWER:* | False | |

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| **Multiple Choice** |

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| 11. What is the greatest risk factor for cancer?​   |  |  |  | | --- | --- | --- | |  | a. | ​family history | |  | b. | ​age | |  | c. | ​environmental toxins | |  | d. | ​diet | |  | e. | ​physical inactivity |  |  |  | | --- | --- | | *ANSWER:* | b | |

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| 12. ​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 |  |  |  | | --- | --- | | *ANSWER:* | a | |

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| 13. 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 |  |  |  | | --- | --- | | *ANSWER:* | e | |

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| 14. ​Genetics is defined as the scientific study of \_\_\_\_.   |  |  |  | | --- | --- | --- | |  | a. | ​diseases | |  | b. | ​DNA | |  | c. | ​heredity | |  | d. | ​chromosome structure | |  | e. | ​cell structure |  |  |  | | --- | --- | | *ANSWER:* | c | |

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| 15. ​The DNA components adenine, thymine, guanine, and cytosine are examples of \_\_\_\_.   |  |  |  | | --- | --- | --- | |  | a. | ​phosphates | |  | b. | ​sugars | |  | c. | ​bases | |  | d. | ​genes | |  | e. | ​ribosomes |  |  |  | | --- | --- | | *ANSWER:* | c | |

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| 16. 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 |  |  |  | | --- | --- | | *ANSWER:* | b | |

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| 17. What Mendel called “factors,” we now call \_\_\_\_.​   |  |  |  | | --- | --- | --- | |  | a. | ​nucleotides | |  | b. | ​DNA | |  | c. | ​chromosomes | |  | d. | ​genes | |  | e. | ​bases |  |  |  | | --- | --- | | *ANSWER:* | d | |

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| 18. 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 |  |  |  | | --- | --- | | *ANSWER:* | c | |

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| 19. 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 |  |  |  | | --- | --- | | *ANSWER:* | e | |

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| 20. 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 |  |  |  | | --- | --- | | *ANSWER:* | b | |

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| 21. 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 |  |  |  | | --- | --- | | *ANSWER:* | c | |

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| 22. 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 |  |  |  | | --- | --- | | *ANSWER:* | d | |

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| 23. 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 |  |  |  | | --- | --- | | *ANSWER:* | e | |

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| 24. 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 |  |  |  | | --- | --- | | *ANSWER:* | a | |

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| 25. ​Gene therapy can best be described as the \_\_\_\_.   |  |  |  | | --- | --- | --- | |  | a. | ​repair 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 |  |  |  | | --- | --- | | *ANSWER:* | b | |

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| 26. The methods of \_\_\_\_ have had the greatest impact on human genetics in recent decades.​   |  |  |  | | --- | --- | --- | |  | a. | ​cytogenetics | |  | b. | molecular genetics | |  | c. | ​transmission genetics | |  | d. | ​translational medicine | |  | e. | ​genomics |  |  |  | | --- | --- | | *ANSWER:* | b | |

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| 27. 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 |  |  |  | | --- | --- | | *ANSWER:* | d | |

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| 28. 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 |  |  |  | | --- | --- | | *ANSWER:* | c | |

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| 29. 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 |  |  |  | | --- | --- | | *ANSWER:* | a | |

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| 30. ​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 |  |  |  | | --- | --- | | *ANSWER:* | a | |

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| **Completion** |

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| 31. The union of research and medicine that seeks to quickly translate research findings into methods for the diagnosis and treatment of diseases is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.​   |  |  | | --- | --- | | *ANSWER:* | translational medicine​ | |

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| 32. ​The simplest type of variation in a genome sequence is a single nucleotide change called a(n)   |  |  | | --- | --- | | *ANSWER:* | single nucleotide polymorphism (SNP)​ | |

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| 33. A set of genetic markers located close together on a single \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is called a haplotype.​   |  |  | | --- | --- | | *ANSWER:* | chromosome  chromosome region​ | |

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| 34. 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.​   |  |  | | --- | --- | | *ANSWER:* | DNA microarrays  DNA chips  microarrays  chips  ​ | |

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| 35. In the mid-twentieth century, researchers discovered that genes are made of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and that this molecule is part of cellular structures known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.​   |  |  | | --- | --- | | *ANSWER:* | DNA, chromosomes​ | |

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| 36. The process in which genes move from one chromosome to another is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.​   |  |  | | --- | --- | | *ANSWER:* | recombination  recombining  ​ | |

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| 37. Each nucleotide in a strand of DNA is composed of a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.​   |  |  | | --- | --- | | *ANSWER:* | sugar, base, phosphate group  base, sugar, phosphate group  sugar, phosphate group, base  phosphate group, sugar, base  base, phosphate group, sugar  phosphate group, base, sugar  ​ | |

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| 38. ​Chemical subunits called amino acids combine to make \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.   |  |  | | --- | --- | | *ANSWER:* | proteins​ | |

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| 39. Transmission genetics studies the pattern of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as traits are passed from generation to generation.​   |  |  | | --- | --- | | *ANSWER:* | ​inheritance | |

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| 40. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the branch of genetics that is used to map genes and study chromosome structure and abnormalities in chromosome number and organization.​   |  |  | | --- | --- | | *ANSWER:* | ​Cytogenetics | |

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| 41. DNA is a helical molecule consisting of two strands of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that is the primary carrier of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ information.​   |  |  | | --- | --- | | *ANSWER:* | nucleotides, genetic​ | |

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| 42. ​In 1927, the U.S. Supreme Court upheld the right of states to use \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as a means of preventing reproduction by those deemed “unfit.”   |  |  | | --- | --- | | *ANSWER:* | sterilization  eugenic sterilization | |

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| 43. Recombinant DNA technology has been used for over 30 years to produce \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in bacteria for the treatment of diabetes.​   |  |  | | --- | --- | | *ANSWER:* | insulin  human insulin  ​ | |

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| 44. Results from the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the development of new technologies have revolutionized the detection, diagnosis, and treatment of cancer.​   |  |  | | --- | --- | | *ANSWER:* | Human Genome Project  HGP  ​ | |

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| 45. Eugenics is the attempt to improve the human species by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.​   |  |  | | --- | --- | | *ANSWER:* | selective breeding​ | |

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| 46. Mendel’s experiments on pea plants showed that genes are passed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from generation to generation and that traits are not \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.​   |  |  | | --- | --- | | *ANSWER:* | intact, blended​ | |

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| 47. Clones are genetically identical molecules, cells, or organisms, all derived from a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.   |  |  | | --- | --- | | *ANSWER:* | single ancestor  single individual | |

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| 48. Population geneticists are interested in the forces that change the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of genes in a population.​   |  |  | | --- | --- | | *ANSWER:* | frequency​ | |

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| 49. A trait is a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  property of an organism.​   |  |  | | --- | --- | | *ANSWER:* | observable​ | |

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| 50. The fundamental unit of heredity is called a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.​   |  |  | | --- | --- | | *ANSWER:* | gene​ | |

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| **Essay** |

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| 51. 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.   |  |  | | --- | --- | | *ANSWER:* | 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.​ | |

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| 52. ​Discuss how and why the investigative method of molecular genetics has had the greatest impact on human genetics over the last several decades.   |  |  | | --- | --- | | *ANSWER:* | 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.​ | |

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| 53. Differentiate between basic and applied research and discuss how the two are linked in terms of genetics.   |  |  | | --- | --- | | *ANSWER:* | 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. | |

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| 54. Define eugenics and discuss Francis Galton’s influence in the development of the fundamentally flawed ‘science.’   |  |  | | --- | --- | | *ANSWER:* | ​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? | |

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| 55. What was the benefit envisioned from the Human Genome Project? Was this project an appropriate use of taxpayers' money? Why or why not?​   |  |  | | --- | --- | | *ANSWER:* | 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. | |

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| 56. Discuss some negative implications of recombinant DNA technology.​   |  |  | | --- | --- | | *ANSWER:* | 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.​ | |

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| 57. In what sense is genetics the key to all of biology?​   |  |  | | --- | --- | | *ANSWER:* | 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*.​ | |

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| 58. Define stem cells and briefly discuss stem cell research and its potential for use in treating disease.​   |  |  | | --- | --- | | *ANSWER:* | 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​ | |

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| 59. 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?   |  |  | | --- | --- | | *ANSWER:* | 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.​ | |

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| 60. 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.​   |  |  | | --- | --- | | *ANSWER:* | 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.  ​ | |