

1. Which of the following pairings between the subdiscipline of genetics and the phenomenon is INCORRECT?
 - A) Evolution—Population genetics
 - B) Gene regulation—Molecular genetics
 - C) Allelic frequency alteration—Population genetics
 - D) Arrangement of genes on chromosome—Transmission genetics
 - E) Chemical nature of the gene—Transmission genetics

2. Which of the following topics of research belongs to the discipline of transmission genetics?
 - A) Inheritance pattern of gene alleles
 - B) Mechanism of DNA replication
 - C) Gene expression patterns
 - D) Evolution
 - E) Chemical modification of nucleic acids

3. The complete genetic makeup of an organism is referred to as its:
 - A) chromosome.
 - B) alleles.
 - C) locus.
 - D) genome.
 - E) phenotype.

4. Identify a TRUE statement from the descriptions concerning genetics.
 - A) The theory of pangenesis states that all living organisms are composed of cells.
 - B) Bacteria are not useful in studying genes and inheritance because they are structurally and metabolically different from eukaryotic cells.
 - C) Charles Darwin accurately described the laws of inheritance in his landmark book, *On the Origin of Species*.
 - D) Many human traits, such as skin and hair color, are determined by more than a single gene.
 - E) Evolution can occur without genetic changes in the population.

5. Identify a FALSE statement from the descriptions of genetics.
- A) Humans first applied genetics to the domestication of plants and animals between approximately 10,000 and 12,000 years ago.
 - B) Many of the model organisms used in genetic research are useful because they have short generation times.
 - C) Albinism results from a mutation in the genes that control the synthesis and storage of melanin.
 - D) All human traits that display blending inheritance are affected by a single gene.
 - E) The process by which genetic information is copied and decoded is similar for all forms of life.
6. Which of the following species is considered a model genetic organism?
- A) The plant, *Linaria vulgaris*
 - B) The deer mouse, *Peromyscus maniculatus*
 - C) The worm, *Caenorhabditis elegans*
 - D) The frog, *Hyla chrysoscelis*
 - E) The chimpanzee, *Pan troglodytes*
7. Which of the following would be LEAST useful as a model for analyzing the mechanisms of inheritance?
- A) Fruit flies
 - B) Humans
 - C) Yeast
 - D) Mice
 - E) Zebrafish
8. Which of the following statements is TRUE?
- A) Each subdiscipline of genetics is very specific as to what is explored and does not overlap with the other subdisciplines.
 - B) All phenotypes or traits are always determined by multiple genes.
 - C) Albinism arises from the overexpression of the gene that controls the synthesis and storage of melanin.
 - D) Humans make excellent model organisms because they have long life spans.
 - E) None of the statements above are true.

9. Which of the following statements is CORRECT?
- A) All genomes are encoded in DNA only.
 - B) All genomes are encoded in nucleic acids.
 - C) All genomes are encoded in proteins only.
 - D) The genetic instructions are decoded completely differently in each organism.
 - E) The molecular mechanism suggests life evolved from multiple primordial ancestors.
10. Which of the following theories of inheritance is currently considered TRUE?
- A) Germ-plasm theory
 - B) Pangenesis
 - C) Blending inheritance
 - D) Inheritance of acquired characteristics
 - E) None of the above is considered true based on new evidence.
11. Which one of the following topics belongs to a different subdiscipline of genetics when compared to the rest?
- A) Mechanism of gene regulation
 - B) Allele frequencies of certain genes differ in different environments
 - C) Transcription
 - D) Replication of chromosomes
 - E) Translation
12. Which of the following theories of inheritance is no longer accepted as TRUE?
- A) Pangenesis
 - B) Blending inheritance
 - C) Inheritance of acquired characteristics
 - D) Preformationism
 - E) None of the above is currently considered true.
13. Which of the following CORRECTLY describes the cell theory?
- A) Genetic information from different parts of the body travels to the reproductive organs.
 - B) The cell is the compositional and functional unit of all life.
 - C) Inside the germ cells, there exists a fully formed miniature adult that enlarges in the course of development.
 - D) The genetic material itself blends, which cannot be separated out in future generations.
 - E) Traits acquired in a person's lifetime become incorporated into the person's hereditary information, which will be passed onto the person's offspring.

14. Which of the following examples of scientist and their contribution is matched INCORRECTLY?
- A) Watson and Crick—Chemical structure of DNA
 - B) Mendel—Principles of heredity using pea plants
 - C) Flemming—An accurate description of mitosis
 - D) Morgan—Polymerase chain reaction
 - E) Sutton—Genes on chromosomes as units of inheritance
15. Choose the CORRECT match between the scientist and the field of genetics that they made a contribution to.
- A) Watson and Crick—Transmission genetics
 - B) Mendel—Molecular genetics
 - C) Flemming—Population genetics
 - D) Darwin—Molecular genetics
 - E) Morgan—Transmission genetics
16. The first complete DNA sequence of a nonviral, free-living organism was obtained for:
- A) a bacterium in 1900.
 - B) a bacterium in 1945.
 - C) a bacterium in 1995.
 - D) humans in 1990.
 - E) humans in 2000.
17. The three-dimensional structure of DNA was first deciphered based on the work of:
- A) James Watson.
 - B) Francis Crick.
 - C) Maurice Wilkins.
 - D) Rosalind Franklin.
 - E) All of the above answers are correct.
18. Which of the following scientists contributed significantly to the foundations of molecular genetics?
- A) James Watson
 - B) Thomas Hunt Morgan
 - C) Walther Flemming
 - D) Charles Darwin
 - E) Walter Sutton

19. Which of the following scientists contributed significantly to the foundations of transmission genetics?
- A) James Watson
 - B) Thomas Hunt Morgan
 - C) Francis Crick
 - D) Charles Darwin
 - E) Kary Mullis
20. The contribution Charles Darwin made to biology was to:
- A) demonstrate the connection between Mendel's principles of inheritance and evolution.
 - B) propose that evolution occurs by natural selection.
 - C) develop the theory of evolution, based on earlier theories of population genetics.
 - D) connect the fields of evolution and molecular genetics.
 - E) demonstrate that genes were located on chromosomes.
21. _____ combines molecular biology and computer science.
- A) Single-nucleotide polymorphism
 - B) MicroRNAs
 - C) Polymerase chain reaction
 - D) Bioinformatics
 - E) Eukaryotics
22. A measurable or observable trait or characteristic is called a:
- A) phenotype.
 - B) genotype.
 - C) single-nucleotide polymorphism.
 - D) small interfering RNA.
 - E) gene bank.
23. A change in the frequencies of genetic variants within a population over time leads to:
- A) a genome.
 - B) a phenotype.
 - C) a genotype.
 - D) mutations.
 - E) evolution.

24. Genetic information can be carried in which of the following biomolecules?
- A) Proteins
 - B) DNA and not RNA
 - C) RNA and not DNA
 - D) Either DNA or RNA
 - E) Proteins and not RNA
25. Which CORRECTLY shows the flow of genetic information during gene expression?
- A) RNA → DNA → protein
 - B) Protein → DNA → RNA
 - C) DNA → RNA → protein
 - D) DNA → protein → DNA
 - E) None of the above answers is correct.
26. Which of the following is NOT a part of a single nucleotide?
- A) Nitrogenous base
 - B) Sugar
 - C) Hydrogen bond
 - D) Phosphate
 - E) Nitrogenous base and sugar are both correct.
27. A form of a gene that has a slightly different sequence than other forms of the same gene but encodes the same type of an RNA or protein, is called a(n):
- A) locus.
 - B) allele.
 - C) homologous chromosome.
 - D) heterozygote.
 - E) homozygote.
28. _____ is a change in genetic variant frequencies of a population over time.
- A) Blending inheritance
 - B) Preformation
 - C) Genome
 - D) Evolution
 - E) Phenotype

29. Permanent, heritable changes in genetic information (DNA) are called:
- A) evolution.
 - B) defects.
 - C) phenotypes.
 - D) alleles.
 - E) mutations.
30. Within cells, genes are located on structures called:
- A) genomes.
 - B) chromosomes.
 - C) phenotypes.
 - D) genotypes.
 - E) alleles.
31. Which of the following nitrogenous bases is found in RNA but not in DNA?
- A) Guanine
 - B) Cytosine
 - C) Uracil
 - D) Adenine
 - E) Thymine
32. Which of the following model organisms was initially used to discover a human gene *SLC24A5* that helps to determine level of skin pigmentation?
- A) Nematode (*Caenorhabditis elegans*)
 - B) Zebrafish (*Danio rerio*)
 - C) Fruit fly (*Drosophila melanogaster*)
 - D) Clawed frog (*Xenopus laevis*)
 - E) Corn (*Zea mays*)
33. Who developed polymerase chain reaction (PCR), a technique that quickly amplifies samples of DNA?
- A) Kary Mullis
 - B) James Watson
 - C) Walter Sutton
 - D) Thomas Hunt Morgan
 - E) Maurice Wilkins

34. Which of the following model organisms is a prokaryote?
- A) *Drosophila melanogaster*
 - B) *Mus musculus*
 - C) *Saccharomyces cerevisiae*
 - D) *Escherichia coli*
 - E) *Arabidopsis thaliana*
35. A giraffe reaches for food from the high branches of trees. Over a period of generations of this type of activity, the necks of giraffes increase in length. Which incorrect notion of inheritance would this example BEST represent?
- A) Blending inheritance
 - B) Pangenesis
 - C) Inheritance of acquired characteristics
 - D) Preformationism
 - E) Cell theory
36. Albinism in humans is sometimes caused by a mutation in the *OCA2* gene. Albinism is a _____ while the mutant DNA sequence in the *OCA2* gene that causes albinism is a _____.
- A) genome; allele
 - B) allele; chromosome mutation
 - C) allele; genome
 - D) mutation; trait
 - E) phenotype; genotype
37. Albinism is rare in most human populations, occurring at a frequency of about 1 in 20,000 people. However, the trait occurs at a frequency of 1 in 200 in certain Hopi villages of Black Mesa in Arizona. Explain in terms of natural selection why albinism is so rare in most human populations.
38. Albinism is rare in most human populations, occurring at a frequency of about 1 in 20,000 people. However, the trait occurs at a frequency of 1 in 200 in certain Hopi villages of Black Mesa in Arizona. Explain in terms of natural selection why the trait is so much more common among the Hopis of Black Mesa.
39. Albinism is rare in most human populations, occurring at a frequency of about 1 in 20,000 people. However, the trait occurs at a frequency of 1 in 200 in certain Hopi villages of Black Mesa in Arizona. In light of this example and others that you might be aware of, critique the idea that a particular allele is either always beneficial (adaptive) or always harmful (maladaptive).

40. List some traits of a species that make it ideal as a genetic model organism.
41. The fruit fly *Drosophila melanogaster* is an important model system for studying inheritance in animals and genetic control of animal development, including humans. If researchers ultimately want to understand a biological process in humans, why might they want to study the process in fruit flies first?
42. The fruit fly *Drosophila melanogaster* is an important model system for studying inheritance in animals and genetic control of animal development, including humans. Evaluate fruit flies as a model system for human biology. What are their strengths and weaknesses as a model system?
43. What common features of heredity suggest that all life on Earth evolved from a common ancestor?
44. Why might bacteria be good model organisms for studying the basics of inheritance? Describe two advantages over studying genetics in mice, dogs, or humans.
45. Many good ideas in science ultimately turn out to be incorrect. The author mentions several such ideas in the history of genetics. In your own words, state one idea in the history of genetics that turned out to be incorrect.
46. Many good ideas in science ultimately turn out to be incorrect. The author mentions several such ideas in the history of genetics. Why do you think a particular idea was widely accepted by scholars of that time? Include in your answer some evidence in favor of the idea, observations that seemed to support the idea, or other rationale for accepting the idea.
47. Many good ideas in science ultimately turn out to be incorrect. Two of these are the inheritance of acquired characteristics and blending inheritance. Summarize the evidence that ultimately caused the idea to be rejected by modern geneticists.
48. List and describe two significant events in the history of genetics that occurred during the twentieth century.

49. Write a paragraph explaining why genetics is considered a young science, even though people have been applying genetic principles for thousands of years.
50. What common-sense observation makes the theory of preformationism unlikely?
51. What common-sense observation makes the theory of acquired characteristics unlikely?
52. Which features distinguish a prokaryotic cell from a eukaryotic cell?
53. Describe one way in which discoveries in genetics currently impact your daily life apart from this course.
54. Describe one way in which discoveries in genetics will likely impact your life in the future.
55. Describe a discovery in genetics or an area of current research that you are concerned about that might have a negative impact on your life in the future. Explain why you think it might have a negative impact on you personally.
56. How do gene mutations differ from chromosome mutations? What characteristic do they both have in common?
57. Why was it particularly surprising when albinism was found to be in a very high frequency among the Hopi Native Americans?
- A) This condition is not found at all among other human populations.
 - B) The Hopi considered albinos to be “bad luck” and exiled them to other Native American groups to live.
 - C) The desert environment of the Hopi would normally not be considered favorable to the health of albinos.
 - D) Albinism is a genetic condition found only among individuals in societies with modern medical practices available since it is lethal before birth without medical intervention and would not appear among living individuals in societies without good medical care.
 - E) The Hopi, like many Native American populations, do not normally suffer from genetic disorders.

58. The “Green Revolution” involved which of the following?
- A) An increase in food production by the genetic manipulation of crop plants
 - B) The development of new drugs through the biotech industry
 - C) Irrigation of formerly desert lands so that new farming locations could be developed
 - D) The use of genetics to develop alternative fuel sources so that oil and coal will no longer be needed
 - E) The completion of the human genome project that allows more diseases to be studied at a molecular level
59. In addition to eukaryotic, what is the other main type of cell?
- A) Animal
 - B) Plant
 - C) Viral
 - D) Prokaryotic
 - E) Yeast
60. Evolution can be viewed as which of the following?
- A) The transition from somatic cells to sex cells by mitosis is followed by mutations created in the DNA.
 - B) A change in the environment of a group of plants is followed by the replacement of plants with DNA genomes by plants with RNA genomes.
 - C) A competition for food resources occurs between two species occupying the same location
 - D) There are several alleles for a single gene so that multiple phenotypes for a plant or animal is possible.
 - E) Genetic variation arises, and some genetic variants increase in frequency while others decrease in frequency.
61. What is the BEST way to describe most of the variation in height in human populations?
- A) It is the result of mainly epigenetic changes in a few dozen genes and some variation in the amount of medical care that individuals receive.
 - B) It is the result of variation in human diets and variation in genes that exist on one of our chromosomes.
 - C) Unlike variation in weight, variation in height is mainly the result of structural differences among the chromosomes.
 - D) Variation in height is due to variation in hundreds of genes and environmental factors.
 - E) Most of the variation in height is due to variation among blood groups.

62. Which scientist is MOST closely associated with the Green Revolution?
- A) Norman Borlaug
 - B) James Watson
 - C) Gregor Mendel
 - D) Walter Sutton
 - E) Kary Mullis
63. In animals, meiosis is the process that leads to:
- A) new alleles.
 - B) gametes.
 - C) somatic cells.
 - D) a doubling of chromosomes.
 - E) loss of detrimental mutant alleles.
64. Changes to genes or to chromosome structure that can affect gene expression but do not change the nucleotide sequence of the gene are called:
- A) gene mutations.
 - B) chromosome mutations.
 - C) epigenetic changes.
 - D) single nucleotide polymorphisms (SNPs).
 - E) blending.
65. What is the complete set of genetic instructions for an organism called?
- A) Chromosome
 - B) Genome
 - C) Phenotype
 - D) RNA complement
 - E) Acquired characteristics
66. Which of the following model organisms is a green plant?
- A) *Escherichia coli*
 - B) *Saccharomyces cerevisiae*
 - C) *Mus musculus*
 - D) *Caenorhabditis elegans*
 - E) *Arabidopsis thaliana*

67. Recently, geneticists have associated particular single nucleotide polymorphisms (SNPs) in humans with an increased risk for a heart attack. How do you think this study and similar studies, which have found other SNPs associated with other diseases, will impact medical practice in the future? What is a current limitation in using this type of information clinically?
68. Charles Darwin put forth the theory of evolution without knowing:
- A) that organisms vary over time.
 - B) the correct understanding of inheritance.
 - C) that heredity was fundamental to evolution.
 - D) that plants and animals both evolve.
 - E) that evolution involves selection.
69. What is a technique for rapidly amplifying a small piece of DNA?
- A) Pangenesis
 - B) Microchipping of chromosome segments
 - C) Polymerase chain reaction
 - D) DNA sequencing
 - E) RNA-dependent DNA synthesis
70. Currently, many new areas of genetic research are being explored. Briefly mention some of these.
71. What is the field of study called that involves the storage, retrieval, and analysis of large amounts of gene information using sophisticated computer programs?
- A) Polymerase chain reaction
 - B) Proteomics
 - C) Population genetics
 - D) Bioinformatics
 - E) Transmission genetics
72. _____ are alternative forms of a gene, and they arise through the process of _____.
- A) Genomes; evolution
 - B) Chromosomes; mitosis
 - C) Alleles; mutation
 - D) Genomes; meiosis
 - E) Genotypes; evolution

73. A defect in the production of _____ causes albinism in humans.

- A) Melanin
- B) DNA
- C) RNA
- D) A antigen
- E) B antigen

74. Briefly describe the difference between genotype and phenotype.

75. Briefly distinguish between mitosis and meiosis.

Answer Key

1. E
2. A
3. D
4. D
5. D
6. C
7. B
8. E
9. B
10. A
11. B
12. E
13. B
14. D
15. E
16. C
17. E
18. A
19. B
20. B
21. D
22. A
23. E
24. D
25. C
26. C
27. B
28. D
29. E
30. B
31. C
32. B
33. A
34. D
35. C
36. E
37. In most populations, there is fairly strong selection against albinism because albinos don't produce melanin, causing their skin cells to be unprotected from the damaging effects of sunlight. Also, the lack of melanin in their eyes causes them to have poor eyesight. Therefore, in most populations the alleles that cause albinism are selected against, and they decrease in frequency or are kept at a low level, causing the recessive trait to be rare.
38. Albinos occupy a privileged position among the Hopis of Black Mesa. In this culture, albinos are viewed as especially pretty, clean, and intelligent, and they often occupy

positions of leadership. Albinos are celebrated in the villages as a sign of purity of Hopi blood in the community. Furthermore, albinos are often excused from normal male field labor because of their sensitivity to sunlight, causing them to be left behind in the village with the women during the daytime. This allows them extra mating opportunities compared to the other men of the village. Therefore, the alleles that cause albinism are either selected for in this culture or at least not selected against as strongly as in other cultures, allowing the trait to occur at a much higher frequency.

39. This example and others show that the effect of a particular allele cannot be evaluated outside of the context of the environment of the population in which the allele exists. A particular allele might be harmful in one environment but beneficial in another environment. Although we know of some alleles that seem to be harmful in all current environments, they might have been beneficial in the past or might be in the future.
40. (1) Short generation time
(2) Sufficient numbers of progeny for study
(3) Adaptability to a laboratory environment
(4) Ability to be inexpensively housed and propagated
(5) Small size
41. Researchers might want to study the process in fruit flies first because it would likely be easier to study it in fruit flies, and what is discovered in fruit flies might apply to humans. Fruit flies have been used for over 100 years as a model system to study animal genetics and development.
42. Strengths—Fruit flies have proven to be an excellent model system for studying aspects of biology that they share with humans. Fruit flies are simpler in structure and physiology than humans and have a much simpler genome. They are small and easy to raise, they have a short generation time, and they produce a large number of offspring. Their chromosomes have been mapped and their genomes analyzed extensively. It is relatively easy to isolate and study mutants that are defective in specific processes of interest. These characteristics make them ideal for genetic studies of biological processes.

Weaknesses—Some aspects of fruit fly genetics and development are not shared with humans. Therefore, some features discovered in fruit flies will not apply directly to humans. Also, humans have many features that fruit flies lack. Fruit flies will not serve well as a model system for studying these features of human biology.

43. Despite the remarkable diversity of life on Earth, all genomes are encoded in nucleic acids. With few exceptions, the genetic code is common to all forms of life. Finally, the process by which genetic information is copied and decoded is remarkably similar for all forms of life.
44. Bacteria have their genetic material (DNA) organized into genes, just like other organisms, so the basics of inheritance are the same in bacteria and viruses, as in other organisms.

The genetic systems of bacteria are simpler when compared to higher eukaryotic organisms such as mice, dogs, or humans: they have fewer genes, fewer chromosomes, and less DNA.

Bacteria reproduce more quickly than higher eukaryotic organisms: the generation time is shorter than for mice, dogs, or humans.

Bacteria are easy and less expensive to grow (take up less space, have less complicated nutritional needs) than vertebrates.

45. Answers will vary but might include pangenesis, inheritance of acquired characteristics, preformationism, or blending inheritance, which are all described in Section 1.2.

Pangenesis—The idea that information needed to encode each body structure is stored in that structure and transported to the reproductive organs and passed to the embryo at conception. Inheritance of acquired characteristics—The idea that traits acquired through use during one's lifetime can be passed to one's offspring.

Preformationism—The idea that the sperm or egg carries a tiny preformed person whose development simply involves enlargement. Blending inheritance—The idea that the genetic material is a fluid that gets blended during sexual reproduction between a male and female, resulting in the production of traits in the offspring that are blended intermediates of those of the parents.

46. Answers will vary but should include specific evidence or observations that support the idea. Examples: Pangenesis—It is reasonable to assume that the information needed to build a structure must reside in that structure. It is less obvious that the information might also reside in other structures. Therefore, it is reasonable to envision the information being stored in each structure and transported to the reproductive structures before being passed to the next generation. Inheritance of acquired characteristics—Observations to support this view would have been commonplace. For example, a man with a muscular physique would often have sons with muscular physiques. A talented musician often produced children with musical talent. Preformationism—It would have been hard for people before the late 1800s to imagine how a complex organism could build itself from a single undifferentiated cell. Indeed, the problem has occupied developmental biologists for over 100 years.

Preformationism is easier to understand. Add to that the poor optics of microscopes at that time, and it is easy to understand how early biologists might have thought they could see a preformed person in a sperm or an egg, such as in Figure 1.11. Blending inheritance—For example, a mating between a tall person and a short person producing a person of medium stature might have suggested blending inheritance.

47. Answers will vary but should include specific evidence or observations that do not support the idea. Pangenesis—Observations of animals with body parts lost to injury producing normal offspring would not support pangenesis. Inheritance of acquired characteristics—Experiments were conducted in which body parts were removed and normal offspring were produced, showing that the acquired characteristic was not inherited. Also, experiments in which offspring are raised in an environment different from that of their parents and do not develop their parents' traits would suggest that the environment influences development of these traits. Preformationism—Eventually, better microscopes were produced that proved that gametes do not contain preformed people. Also, we eventually came to understand that both sperm and eggs contribute genetic information during sexual reproduction. Blending inheritance—Mendel showed that genes behave as particles that are not blended or changed during inheritance.

48. 1900: Mendel's previously published work on pea plants, which stated basic principles of inheritance, was rediscovered.
1902: Sutton proposed that genes are located on chromosomes.
1910: Thomas Hunt Morgan began studies of transmission genetics, using fruit fly mutants.
1930s: The founding principles of population genetics are outlined.
1940s: Organization of chromosomes and genes were studied using bacteria and viruses.
1940s–1950s: Evidence was accumulated for DNA as the genetic material; Watson and Crick described the DNA structure.
1966: The relationship between chemical structure of DNA and amino acid sequence of proteins was determined.
1973: The first recombinant DNA experiments were conducted.
1977: Methods for DNA sequencing were published.
1986: Mullis developed PCR.
1990s: The Human Genome Project was started.
1995: The first genome of a free-living organism was sequenced (*Haemophilus influenzae*).
1996: The first genome of a eukaryote was sequenced (yeast).
2000–present: The human genome sequence was released.
49. Techniques for the observation of cells have been available only since the late 1500s, when the first microscopes were produced. The observation of chromosomes has been possible for only a century and a half. The widespread systematic study of genes and inheritance has been conducted only in the twentieth century, since the rediscovery in 1900 of Mendel's work. The structure of DNA was determined only in the mid-twentieth century. Many molecular genetic techniques, like PCR, have been developed only in the last few decades. However, without understanding the nature of chromosomes and genes, plant and animal breeders have been applying the principles of inheritance for thousands of years, to obtain desired characteristics in domesticated organisms.
50. Preformationism states that the egg or sperm carries a miniature adult, which would mean that all characteristics come from either the mother or father. Simple observation shows that offspring have traits from both parents.
51. This theory states that characteristics acquired during one's lifetime are passed to offspring. However, anatomical changes, like the loss of a limb, or the removal of a mouse's tail, are not seen in offspring.
52. Prokaryotic cells lack a nuclear membrane and possess no true membrane-bounded cell organelles, whereas eukaryotic cells possess a nucleus and membrane-bounded organelles such as chloroplasts and mitochondria.
53. Answers will vary, but the best answers will include one or more specific discoveries in genetics and describe how they affect the student personally. For example, students might discuss the role of genetics and genetic technology in the Green Revolution of the 1950s and 1960s, which greatly expanded food production throughout the world, making food production more efficient, more affordable, and more available to world populations. A much smaller part of the world's population work in agriculture, freeing up more people for work in other industries. They might also discuss the use of genetically modified crops in agriculture, including a significant proportion of corn and soybeans in the United States and other countries.

54. An example would be the use of genetic tests in medical practice. Genetic tests are already fairly commonplace and will become more common in the near future. In the future, most people will be offered one or more genetic tests as part of their ordinary medical care. They will need to understand the basis of the tests and their limitations, as well as how to interpret results and how to use the information provided.

Other examples could include genetically modified plants and animals that may improve human nutrition or advances in biotechnology that will result in new drugs and other useful products.

55. Again, answers will vary, but one example is the possible abuse of genetic information about individuals that is becoming more available. Many people worry that results from genetic tests, for example, could be used to discriminate against individuals in the workplace and in the insurance marketplace. The Genetic Information Nondiscrimination Act offers limited protection against genetic discrimination, but the possibility of negative consequences from such tests remains.
56. Gene mutations affect only the genetic information of a single gene while chromosome mutations alter the number or the structure of whole chromosomes. Both types of mutation might be passed from cell to cell or from parent to offspring.
57. C
58. A
59. D
60. E
61. D
62. A
63. B
64. C
65. B
66. E
67. The main goal is to be able to identify individuals who are at risk for future health problems such as heart disease before the problem occurs and then take preventive action such as a drug regimen and/or changes in lifestyle. Currently, the problem is that these are simply statistical associations of genetic variants with a disease or disorder and may not apply to each individual who carries the variant. There are surely other variants that have yet to be discovered that either increase or decrease the risk to the disease and we do not know which of these an individual carries or how all the variants interact with each other. In addition, epigenetic variation and lifestyle choices further impact the possibility of having or not having the disease. All this prevents a precise risk assessment to a particular individual impossible at the present time, although the situation is expected to improve in the future as more knowledge is gained.
68. B
69. C
70. There will be varied answers for this question. Based on the chapter, some of them may include the following: epigenetics is the study of modifications to DNA and chromosome structure that don't change the DNA nucleotide sequence but can affect gene expression, and these changes have been implicated in human health. Multiple types of RNA molecules have been found, and many appear to regulate gene expression.

The finding that many SNPs and other genetic variants are associated with some human disorders has led to the hope that such disorders will be better understood and some can be prevented or treated successfully.

- 71. D
- 72. C
- 73. A
- 74. A phenotype is the expression of a gene(s) in a trait. It is the appearance or manifestation of a characteristic and can be influenced by environmental factors as well as genes. A genotype is the allele combinations that an individual possesses that, along with environmental factors, can cause a trait or disorder.
- 75. Mitosis is the separation of replicated chromosomes in the cellular division of somatic or nonsex cells. Meiosis is the pairing and separation of replicated chromosomes in the division of sex cells to produce gametes or reproductive cells.