

**Test Bank for Genetics A Conceptual Approach 5th Edition by Pierce ISBN
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Chapter 1: Introduction to Genetics

Multiple Choice Questions

1. Which one 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

Answer: e

Section: 1.1

Comprehension Question

2. Which one of the following topic 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

Answer: a

Section: 1.1

Comprehension Question

3. The complete genetic makeup of an organism is referred to as its

- a. chromosome.
- b. alleles.
- c. locus.
- d. genome.
- e. phenotype.

Answer: d

Section: 1.1

Comprehension Question

4. Identify a true statement from the descriptions concerning genetics below.
- a. The theory of pangenesis states that all living organisms are composed of cells.
 - b. Bacteria and viruses 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.

Answer: d

Section: 1.1

Comprehension Question

5. Identify a false statement from the descriptions of genetics below.
- a. Humans first applied genetics to the domestication of plants and animals between approximately 10,000 and 12,000 years ago.
 - b. Some viruses use RNA to carry their genetic information.
 - 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 single gene.
 - e. The process by which genetic information is copied and decoded is similar for all forms of life.

Answer: d

Section: 1.1

Comprehension Question

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, *Hylachrysoyelis*
- e. The chimpanzee, *Pan troglodytes*

Answer: c

Section: 1.1

Comprehension Question

7. Which of the following would serve the *least* well as a model for understanding basic mechanisms of inheritance?
- a. Fruit flies
 - b. Humans
 - c. Yeast
 - d. Mice
 - e. Zebrafish

Answer: b

Section: 1.1

Comprehension Question

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 othersubdisciplines.
 - b. All phenotypes or traits are always determined by multiple genes.
 - c. Albinism rises from the overexpression of the gene that controls the synthesis and storage of melanin.
 - d. Humans make excellent model organisms, as a variety of traits are well-defined.
 - e. None of the statements above are true.

Answer: e

Section: 1.1

Application Question

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.

Answer: b

Section: 1.1

Application Question

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.

Answer: a

Section: 1.2

Comprehension Question

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 gene in different environments
- c. Transcription
- d. Chemical alternation of chromosomes
- e. Mechanism of DNA repairs and maintenance

Answer: b

Section: 1.2

Comprehension Question

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.

Answer: e

Section: 1.2

Comprehension Question

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 which enlarges in the course of development
- d. The genetic material itself blends, which cannot be separated out in figure generations.
- e. Traits acquired in a person's lifetime become incorporated into the person's hereditary information, which will be passed onto their offspring.

Answer: b

Section: 1.2

Comprehension Question

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. Gilbert and Sanger—DNA sequencing methods
- d. Morgan—polymerase chain reaction
- e. Sutton—genes on chromosomes as units of inheritance

Answer: d

Section: 1.2

Comprehension Question

15. Choose the correct match between the scientist and the field of genetics that they made the contribution to.

- a. Haldane and Wright—transmission genetics
- b. Mendel—molecular genetics
- c. Gilbert and Sanger—population genetics
- d. Darwin—molecular genetics
- e. Morgan—transmission genetics

Answer: e

Section: 1.2

Comprehension Question

16. The first complete DNA sequence of a non-viral, 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.

Answer: c

Section: 1.2

Comprehension Question

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

Answer: e

Section: 1.2

Comprehension Question

18. Which of the following scientists contributed significantly to the foundations of population genetics?

- a. James Watson
- b. Thomas Hunt Morgan
- c. Ronald Fisher
- d. Charles Darwin

Answer: c

Section: 1.2

Comprehension Question

19. Which of the following scientists contributed significantly to the foundations of molecular genetics?

- a. James Watson
- b. Thomas Hunt Morgan
- c. John B. S. Haldane
- d. Charles Darwin

Answer: a

Section: 1.2

Comprehension Question

20. Which of the following scientists contributed significantly to the foundations of transmission genetics?

- a. James Watson
- b. Thomas Hunt Morgan
- c. John B. S. Haldane
- d. Charles Darwin

Answer: b

Section: 1.2

Comprehension Question

21. 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.

Answer: b

Section: 1.2

Comprehension Question

22. _____ combines molecular biology and computer science.

- a. Single-nucleotide polymorphism
- b. MicroRNAs
- c. Polymerase chain reaction
- d. Bioinformatics
- e. Eukaryotics

Answer: d

Section: 1.2

Comprehension Question

23. 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.

Answer: a

Section: 1.2

Comprehension Question

24. The complete genetic makeup of any organism is referred to as

- a. phylogeny.
- b. phenotype.
- c. genome.
- d. genotype.
- e. single-nucleotide polymorphism.

Answer: c

Section: 1.2

Comprehension Question

25. A change in allele frequency within a population over time leads to

- a. agenome.
- b. aphenotype.
- c. agenotype.
- d. mutations.
- e. evolution.

Answer: e

Section: 1.3

Comprehension Question

26. 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

Answer: d

Section: 1.3

Comprehension Question

27. 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

Answer: c

Section: 1.3

Comprehension Question

28. The contribution of Gilbert and Sanger to modern genetics was to

- a. develop the PCR technique.
- b. discover DNA in the nucleus of cells.
- c. describe the structure of DNA.
- d. show that genes were made of DNA.
- e. develop a method for sequencing DNA.

Answer: e

Section: 1.3

Comprehension Question

29. Which of the following is not a part of a single nucleotide?

- a. Nitrogenous base
- b. Sugar
- c. Hydrogen bond
- d. Phosphate

Answer: c

Section: 1.3

Comprehension Question

30. 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.

Answer: b

Section: 1.3

Comprehension Question

31. _____ is a change in allele frequency of a population over time.

- a. Blending inheritance
- b. Preformation
- c. Genome
- d. Evolution
- e. Phenotype

Answer: d

Section: 1.3

Comprehension Question

32. Permanent, heritable changes in genetic information (DNA) are called

- a. evolution.
- b. defects.
- c. SNP.
- d. alleles.
- e. mutations.

Answer: e

Section: 1.3
Comprehension Question

33. Within cells, genes are located on structures called
- genomes.
 - chromosomes.
 - phenotypes.
 - genotypes.
 - alleles.

Answer: b
Section: 1.3
Comprehension Question

Short Answer Questions

34. 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.

Answer: In most populations, there is fairly strong selection against albinism because albinos don't produce melanin, causing their skin cells not to be protected from the damaging effects of sunlight. Also, the lack of melanin in their eyes causes them to have poor eyesight. Finally, in most cultures albinos are seen as abnormal, and they are not normally sought out for marriage and mating. 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.

Introduction
Application Question

35. 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.

Answer: 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.

Introduction

Application Question

36. 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 beneficial (adaptive) or harmful (maladaptive).

Answer: 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.

Introduction

Application Question

37. List some traits of a species that make it ideal as a genetic model organism.

Answer:

- (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

Section 1.1

Application Question

38. 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?

Answer: 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.

Section 1.1

Application Question

39. 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?

Answer:

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.

Section 1.1

Application Question

40. What common features of heredity suggest that all life on Earth evolved from a common ancestor?

Answer: 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.

Section 1.1

Application Question

41. Why might bacteria and viruses be good model organisms for studying the basics of inheritance? Describe two advantages over studying genetics in mice, dogs, or humans.

Answer: Bacteria and viruses 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 and viruses are simpler when compared to higher eukaryotic organisms such as mice, dogs, or humans: they have fewer genes, fewer chromosomes, and less DNA.

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

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

Section 1.1

Application Question

42. 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.

Answer: Answers will vary but might include pangenesis, inheritance of acquired characteristics, preformationism, or blending inheritance, which are all described in Section 1.1. 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.

Section 1.1

Application Question

43. 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 this 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.

Answer: 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.

Section 1.1

Application Question

44. Many good ideas in science ultimately turn out to be incorrect. The author mentions several such ideas in the history of genetics. Summarize the evidence that ultimately caused the idea to be rejected by modern geneticists.

Answer: 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.

Section 1.1

Application Question

45. List and describe two significant events in the history of genetics that occurred during the twentieth century.

Answer:

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: Fisher, Haldane, and Wright outlined the founding principles of population genetics.

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: The Gilbert and Sanger methods for DNA sequencing were published.

1986: Mullis developed PCR.

1990: The first use of gene therapy was used in humans.

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.

Section 1.2

Comprehension Question

46. Write a paragraph explaining why genetics is considered a young science, even though people have been applying genetic principles for thousands of years.

Answer: 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 of Mendel's work in 1900. 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.

Section 1.2

Application Question

47. What common-sense observation makes the theory of preformationism unlikely?

Answer: 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.

Section 1.2

Application Question

48. What common-sense observation makes the theory of acquired characteristics unlikely?

Answer: 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.

Section 1.2

Application Question

49. Which features distinguish a prokaryotic cell from a eukaryotic cell?

Answer: 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.

Section 1.3

Application Question

50. What common-sense observation makes the theory of blending inheritance unlikely?

Answer: This theory states that genetic information is mixed in an offspring and never separated. Some traits, however, disappear from one generation to the next, only to reappear in a subsequent generation.

Section 1.3

Application Question

51. Describe one way in which discoveries in genetics currently impact your daily life apart from this course.

Answer: Answers will vary, but the best answers will include one or more specific discoveries in genetics and describe how they affect the student personally. Examples could

come from those listed in section 1.1 or from the students' background knowledge. This question and Questions 52 and 53 will work best if students are asked to consider ahead of time how these discoveries might impact their lives. 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 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.

Sections 1.1–1.3

Application Question

52. Describe one way in which discoveries in genetics will likely impact your life in the future.

Answer: 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.

Sections 1.1–1.3

Application Question

53. 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.

Answer: Again, answers will vary, but an 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.

Sections 1.1–1.3

Application Question