TEST BANK

Introduction to Genetic Analysis

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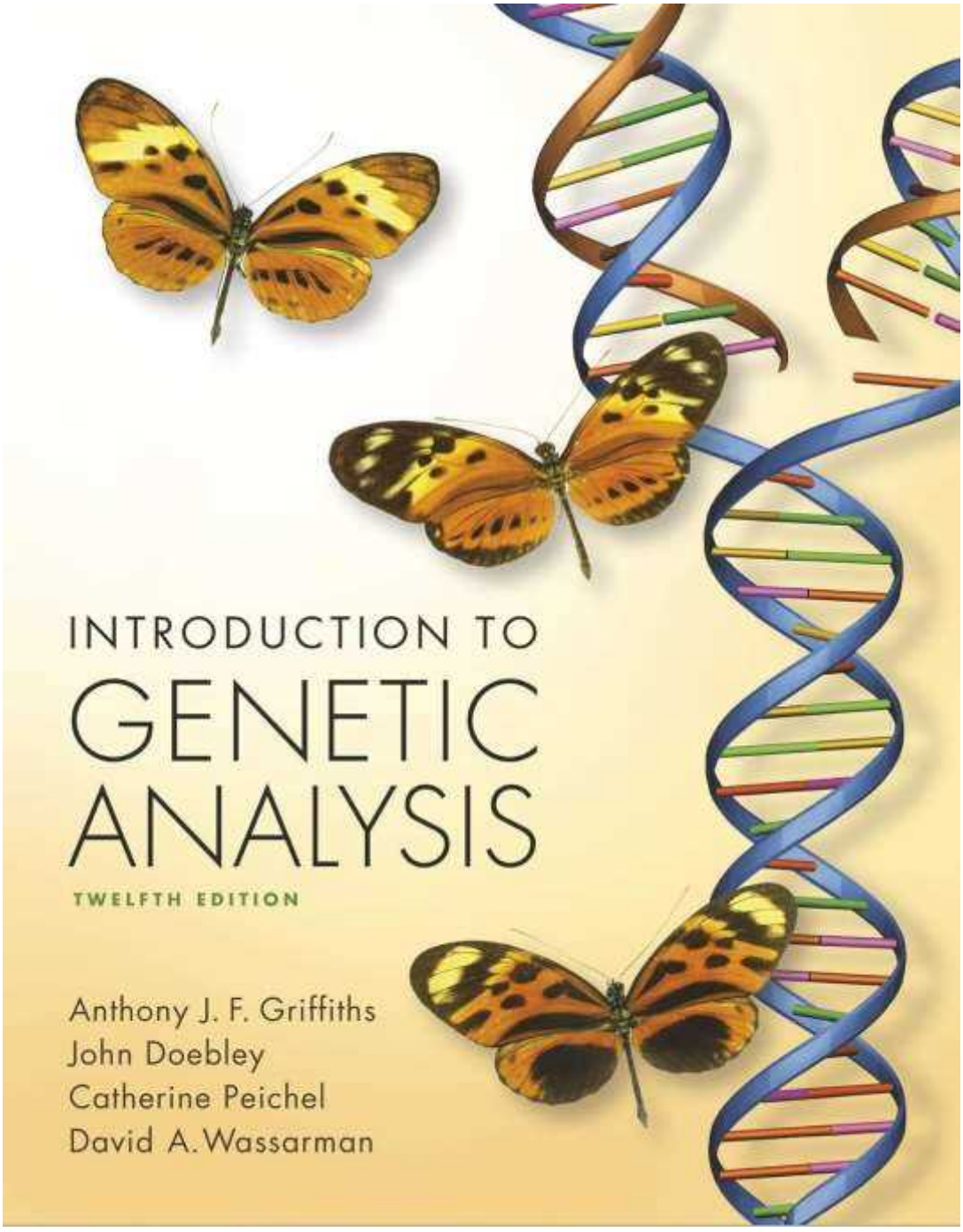
12th Edition



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Chapter 01: The Genetics Revolution

1. The early 1900s was an important period for genetics due to which of the following major events?
   a. the rediscovery of Gregor Mendel's scientific findings
   b. Watson and Crick solving the structure of DNA
   c. Walter Sutton and Theodore Boveri hypothesizing that chromosomes are the hereditary elements
   d. the rediscovery of Gregor Mendel's scientific findings *and* Walter Sutton and Theodore Boveri hypothesizing that chromosomes are the hereditary elements
   e. All of the answer options are correct.

ANSWER: e

2. A sample of normal double-stranded DNA was found to have a guanine content of 18%. What is the expected proportion of adenine?
   a. 9%
   b. 32%
   c. 36%
   d. 68%
   e. 82%

ANSWER: b

3. In one strand of DNA, the nucleotide sequence is 5′-ATGC-3′. The complementary sequence in the other strand must be
   a. 3′-ATGC-5′.
   b. 3′-TACG-5′.
   c. 5′-ATCG-3′.
   d. 5′-CGTA-3′.
   e. 5′-TACG-3′.

ANSWER: b

4. How many different DNA molecules that are eight-nucleotide-pairs long are theoretically possible?
   a. 24
   b. 32
   c. 64
   d. 256
   e. 65,536

ANSWER: e

5. Which of the following is/are TRUE about genes?
   a. Genes are located on chromosomes.
   b. Genes come in variants known as alleles.
   c. Genes usually encode protein products.
   d. All of the answer options are correct.
   e. None of the answer options is correct.

ANSWER: d

6. Wild cats (*Felis silvestris*) and common mice (*Mus musculus*) are diploid. In wild cats, $2n = 38$, while in common mice, $2n = 40$. Based on this information, we can conclude that wild-cat cells have
   a. less DNA than common-mouse cells.
   b. smaller genomes than common-mouse cells.
   c. fewer DNA molecules than common-mouse cells.
   d. fewer genes than common-mouse cells.
   e. fewer sets of chromosomes than common-mouse cells.

ANSWER: c

7. Which of the following is a component of DNA?
   a. alanine
   b. arginine
   c. cysteine
   d. guanine
   e. tyrosine

ANSWER: d

8. Which of the following is/are TRUE of the DNA structure solved by Watson and Crick?
   a. It is a double-helical structure.
   b. Sugar–phosphate backbone is always toward the outside of the DNA.
   c. There are two hydrogen bonds between A and T and three hydrogen bonds between C and G.
   d. There are four types of nitrogenous bases.
   e. All of the answer options are correct.

ANSWER: e

9. Which of the following is a CORRECT representation of the central dogma?
   a. RNA → DNA → protein
   b. protein → DNA → RNA
   c. DNA → RNA → protein
   d. DNA → protein → DNA
   e. None of the answer options is correct.

ANSWER: c

10. You have come across a dog (named Cindy) that does not have a tail. Interestingly, all the puppies produced by this dog don't have a tail. If the lack of tail is caused by a genetic mutation, where has this mutation most likely taken place?
   a. in Cindy's gametes
   b. in the cells that should normally have given rise to Cindy's tail
   c. in the cells that should normally have given rise to Cindy's and her puppies' tails
   d. in all of Cindy's cells (including her gametes)
   e. in a gamete of one of Cindy's parents

ANSWER: a

11. Which of the following features makes a species suitable as a model organism?

a. small organism
b. short generation time
c. small genome
d. produce large number of offspring
e. All of the answer options are correct.

ANSWER: e

12. Using molecular techniques, researchers have knocked out both copies of gene *G* in a series of genetically identical mouse embryos. These mice develop normally, except for their forelimbs, which are missing several small bones. What can be concluded from the results of this experiment?
a. Gene *G* encodes a protein that is a crucial component of the forelimbs' small bones in mice.
b. Gene *G* encodes a protein that is normally only present in the forelimb cells of developing mice.
c. Gene *G* is necessary for proper development of the forelimbs' small bones in mice.
d. Gene *G* is normally only present in the forelimb cells of developing mice.
e. Gene *G* is normally only transcribed in the forelimb cells of developing mice.

ANSWER: c

13. Who originated the one-gene–one-enzyme hypothesis?
a. Tatum and Beadle
b. Gregor Mendel
c. Watson and Crick
d. Franklin and Wilkins
e. Hershey and Chase

ANSWER: a

14. What are alleles?
a. gene variants
b. enzymes
c. regulatory elements
d. *de novo* mutations
e. quantitative trait loci

ANSWER: a

15. Which enzyme cuts DNA at a specific location?
a. polymerase
b. ligase
c. nuclease
d. allele
e. ribosome

ANSWER: c

16. Which type of mutation is a unique DNA variant that exists in a child but in neither of its parents?
a. point mutation
b. *de novo* mutation

c. quantitative trait locus
d. single nucleotide polymorphism
e. dominant allele

ANSWER: b

17. Which enzyme is responsible for DNA replication?
a. polymerase
b. ligase
c. nuclease
d. allele
e. ribosome

ANSWER: a

18. Which scientists offered the first compelling experimental evidence that genes are made of deoxyribonucleic acid (DNA)?
a. Oswald Avery, Colin MacLeod, and Maclyn McCarty
b. John Gurdon and Shinya Yamanaka
c. François Jacob and Jacques Monod
d. James Watson and Francis Crick
e. Barbara McClintock and Erwin Chargoff

ANSWER: a

19. The Central Dogma describes
a. the hypothesis of how DNA is packaged into small molecules.
b. the process by which RNA is processed within a cell.
c. the flow of genetic information within cells from DNA to RNA to protein.
d. how model organisms are used in experiments.
e. the method of gene transfer between organisms.

ANSWER: c

20. The process of inserting foreign DNA molecules into the genomes of a recipient organism is called
a. replication.
b. transformation.
c. transcription.
d. translation.
e. ligation.

ANSWER: b

21. Adenine and thymine are held together by two hydrogen bonds, while guanine and cytosine are held together by three hydrogen bonds. If you were to slowly heat a piece of DNA rich in GC base pairs—in order to denature it—would you expect the melting temperature to be higher or lower than a piece of DNA rich in AT base pairs?

ANSWER: The melting temperature would be higher for DNA rich in GC, owing to the three hydrogen bonds that must be broken in order for it to denature.

22. *Arabidopsis thaliana* is a diploid plant model organism with $2n = 10$.
a) How many copies of each gene does each *Arabidopsis thaliana* cell have?
b) How many sets of chromosomes does the nucleus of an *Arabidopsis thaliana* leaf cell contain?
c) How many pairs of homologous chromosomes does the nucleus of an *Arabidopsis thaliana* leaf cell contain?
ANSWER: a) two b) two c) five

23. Explain what it means to say that the genetic code is redundant. How does this redundancy help protect against mutations?
ANSWER: The genetic code is redundant because some of the amino acids are encoded by more than one triplet (codon). This protects against the effects of mutation since a change in the nucleotide base may not cause a different amino acid to be inserted.

24. Mutations are often viewed as negative events, and they are nearly always bad for an organism. Paradoxically, without mutations there would be no evolution, and so they are essential. Explain how this is so.
ANSWER: Variation is introduced. So even though mutations are often viewed as negative events, all variation that we see around us originally came from mutations.

25. Describe the purpose and function of DNA polymerase, nuclease, and ligase.
ANSWER: DNA polymerase, nuclease, and ligase are tools for characterizing and manipulating DNA, RNA, and proteins. They each have a different function. DNA polymerase copies DNA, nucleases cut DNA molecules in specific locations or degrade an entire DNA molecule into single nucleotides, and ligases join two DNA molecules.

26. Why does the age of the father matter, while that of the mother seems to have no effect on the frequency of new point mutations?
ANSWER: Eggs are made prior to a woman's birth, while sperm production occurs throughout a man's life. From the point of conception until formation of egg cells, there are about 23 rounds of cell division and DNA replication. Because egg formation occurs prior to birth, as a woman ages there is no chance for additional point mutations. By comparison, the cell divisions that produce sperm continue throughout a man's life and with each cell division there is greater risk of introducing new point mutations.

Chapter 02: Single Gene Inheritance

1. If a plant of genotype *A/a* is selfed, and numerous offspring are scored, what proportion of the progeny is expected to have homozygous genotypes?

a. 0
b. 25%
c. 50%
d. 75%
e. 100%

ANSWER: c

2. What is the maximum number of heterozygous genotypes that could be produced by monohybrid self?

a. 1
b. 2
c. 3
d. 4
e. 6

ANSWER: a

3. A plant is heterozygous at three loci. How many different gamete genotypes can it theoretically produce with respect to these three loci?

a. 2
b. 3
c. 4
d. 8
e. 16

ANSWER: d

4. In mountain rabbits, the *EL-1* gene is located on chromosome 3. Four alleles of this gene have been identified in the population. With respect to *EL-1*, what is the maximum number of genotypes in the progeny of a SINGLE CROSS between two mountain rabbits?

a. 1
b. 2
c. 3
d. 4
e. 6

ANSWER: d

5. A wild-type strain of haploid yeast is crossed to a mutant strain with phenotype *d*. What phenotypic ratios will be observed in the progeny?

a. All wild type
b. 75% wild type and 25% mutant (*d*)
c. 50% wild type and 50% mutant (*d*)
d. 25% wild type and 75% mutant (*d*)

e. All mutant (*d*)

ANSWER: c

6. Mice (*Mus musculus*) have 40 chromosomes per diploid cell (2*n* = 40). How many double- stranded DNA molecules and how many chromosomes are there in a mouse cell that is in the G2 stage of the cell cycle?

a. 40 DNA molecules and 20 chromosomes
b. 40 DNA molecules and 40 chromosomes
c. 40 DNA molecules and 80 chromosomes
d. 80 DNA molecules and 40 chromosomes
e. 80 DNA molecules and 80 chromosomes

ANSWER: d

7. A mutation occurs in a germ cell of a pure-breeding, wild-type male mouse prior to DNA replication. The mutation is not corrected, and the cell undergoes DNA replication and a normal meiosis producing four gametes. How many of these gametes will carry the mutation?

a. 1
b. 2
c. 3
d. 4
e. It is impossible to predict.

ANSWER: b

8. What is the mechanism that ensures Mendel's first law of segregation?

a. formation of chiasmata
b. formation of the kinetochore
c. pairing of homologous chromosomes
d. segregation of homologous chromosomes during meiosis I
e. segregation of sister chromatids during meiosis II

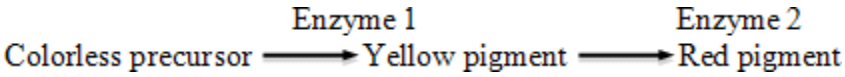
ANSWER: d

9. A laboratory mouse homozygous for an RFLP marker is mated to a wild mouse that is heterozygous for that marker. One of the heterozygous individuals resulting from this cross is mated back to the wild parent. What proportion of the offspring will have the same RFLP pattern as the original laboratory mouse?

a. None of the offspring
b. 1/4
c. 1/2
d. 3/4
e. All of the offspring

ANSWER: c

10. The diagram below shows a part of the biochemical pathway responsible for fruit color in peppers (*Caspicum annuum*). Enzyme 1 is responsible for catalyzing the reaction that turns the colorless precursor into yellow pigment, whereas Enzyme 2 catalyzes the step that turns the yellow pigment into red pigment. A breeder crosses a pure-breeding plant that makes yellow peppers to a pure-breeding plant that makes red peppers. What proportion of the offspring will make red peppers?



a. All of the offspring
b. 3/4
c. 1/2
d. 1/4
e. None of the offspring

ANSWER: a

11. The wild-type eye color in the fruit fly *Drosophila melanogaster* is dark red, as a result of a mixture of bright red and brown pigments. Enzyme A is encoded by the *a* gene and is required to synthesize the bright red pigment. A lack of red pigment results in a somewhat brown eye color. You cross two fruit flies who are heterozygous for a recessive mutation that completely inactivates the *a* gene. What proportion of their offspring will have a recessive eye color phenotype?

a. All of the offspring
b. 3/4
c. 1/2
d. 1/4
e. None of the offspring

ANSWER: d

12. In pet rabbits, brown coat color is recessive to black coat color. A black female rabbit gives birth to four black-coated and three brown-coated baby rabbits. What can be deduced about the genotype of the baby rabbits' father?

a. He could be heterozygous black/brown or homozygous brown.
b. He could be heterozygous black/brown or homozygous black.
c. He must be heterozygous black/brown.
d. He must be homozygous black.
e. He must be homozygous brown.

ANSWER: a

13. "Dumpy" is a commonly used mutant phenotype in the nematode worm *C. elegans*. Two dumpy individuals are crossed to each other, and this cross produces 210 dumpy and 68 wild-type individuals. If one of the dumpy individuals used in this cross was mated with a wild type, what dumpy:wild-type ratio would we observe in the offspring?

a. 0:1
b. 1:0
c. 1:1
d. 1:3
e. 3:1

ANSWER: c

14. A female rabbit of phenotype c' is crossed to a male rabbit with c^{ch}. The F_1 is comprised of five rabbits with

a c' phenotype, two with c^{ch} phenotype, and three with c phenotype. Of the phenotypically c rabbits, two are females and are backcrossed to their father. This cross produces only rabbits with c^{ch} phenotype. These results suggest that

a. c could be dominant or recessive to c'.
b. c is dominant to c' but recessive to c^{ch}.
c. c is dominant to c^{ch} but recessive to c'.
d. c is dominant to both c' and c^{ch}.
e. c is recessive to both c' and c^{ch}.

ANSWER: e

15. A plant with small red flowers is crossed to a plant with large white flowers. The resulting F_1 is comprised of 75 plants with small red flowers and 72 plants with small white flowers.
If flower color and flower size are controlled by a single gene each, what can be concluded from these results?

a. Flower color is controlled by a sex-linked gene.
b. Red color and small size are dominant to white color and large size, respectively.
c. Small size is dominant to large size, but we cannot determine which color is dominant.
d. We cannot determine which color and which size are dominant.
e. White color and small size are dominant to red color and large size.

ANSWER: c

16. A dominant gene b^+ is responsible for the wild-type body color of *Drosophila*; its recessive allele b produces black body color. A testcross of a heterozygous b^+/b female by a black b/b male gave 52 black and 58 wild-type progeny. If a black female from these progeny were crossed with a wild-type brother, what phenotypic ratios would be expected in their offspring?

a. All males will be wild type, and all females will be black.
b. All progeny will be black.
c. All progeny will be wild type.
d. 75% will be wild type; 25% will be black.
e. 50% will be wild type; 50% will be black.

ANSWER: e

17. A very common type of red–green color blindness in humans is caused by a mutation in a gene located on the X chromosome. Knowing that the mutant allele is recessive to the wild type, what is the probability that the son of a woman whose father is color-blind is going to also be color-blind?

a. 0%
b. 25%
c. 50%
d. 75%
e. 100%

ANSWER: c

18. A phenotypically normal woman is heterozygous for the recessive Mendelian allele causing phenylketonuria, a disease caused by the inability to process phenylalanine in food. She is also heterozygous for

a recessive X-linked allele causing red–green color blindness. What percentage of her eggs will carry the dominant allele that allows normal processing of phenylalanine and the X-linked recessive allele that causes color blindness?

a. 0%
b. 25%
c. 50%
d. 75%
e. 100%

ANSWER: b

19. A rare, curly winged mutant of *Drosophila* was found in nature. A mating of this fly with a true-breeding, normal laboratory stock produced progeny in the ratio 1 curly winged to 1 normal (both sexes had the same ratio). All curly winged progeny of this cross, mated with normal progeny of the same cross, again yielded 1 curly winged to 1 normal fly. When mated with one another, the curly winged progeny of the first cross yielded a progeny of 623 curly:323 normal. This ratio strongly suggests which of the following?

a. Curly and normal are in the 3:1 ratio expected from intercrossing monohybrid genotypes for a recessive mutant allele (curly).
b. Curly and normal are in the 3:1 ratio expected from intercrossing monohybrid genotypes for a dominant mutant allele (curly).
c. The curly winged parent of the curly × curly cross is homozygous.
d. Flies homozygous for the curly allele are lethal and never survive.
e. The gene for curly is sex-linked.

ANSWER: d

20. A female *Drosophila* with the mutant phenotype *a* is crossed to a male who has the mutant phenotype *b*. In the resulting F_1 generation all females are wild type and all males have the *a* mutant phenotype. Based on these results, we can conclude that the mode of inheritance of the phenotypes of interest is

a. autosomal for *a* and X-linked for *b*.
b. dominant for *a* and recessive for *b*.
c. recessive for *a* and dominant for *b*.
d. recessive for both *a* and *b*.
e. X-linked for *a* and autosomal for *b*.

ANSWER: d

21. A recessive X-linked gene mutation is known to generate premature baldness in males but is without effect in women. If a heterozygous female marries an affected male, what proportion of all their children is expected to be prematurely bald?

a. 1/4
b. 1/8
c. 1/16
d. 1/32
e. 1/216

ANSWER: a

22. You have three jars of gumballs. The first jar has 100 white gumballs and 25 green, the second jar has 50