

Study Guide Chapter 13-15

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Refer to the drawings in Figure 13.2 of a single pair of homologous chromosomes as they might appear during various stages of either mitosis or meiosis, and answer the following questions.

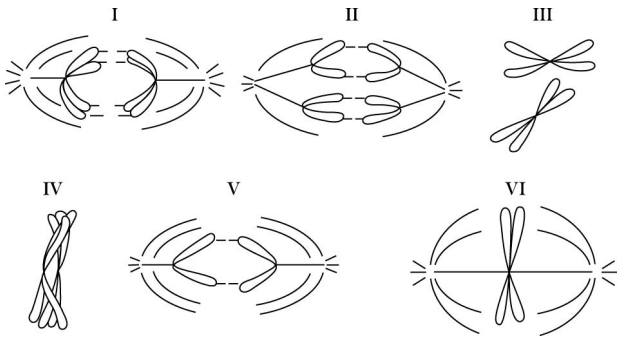


Figure 13.2

- 1) Which diagram(s) represent anaphase II of meiosis? 1) _____
 - A) II only
 - B) III only
 - C) IV only
 - D) V only
 - E) either II or V

- 2) After telophase I of meiosis, the chromosomal makeup of each daughter cell is 2) _____
 - A) tetraploid, and the chromosomes are each composed of two chromatids.
 - B) haploid, and the chromosomes are each composed of two chromatids.
 - C) diploid, and the chromosomes are each composed of two chromatids.
 - D) haploid, and the chromosomes are each composed of a single chromatid.
 - E) diploid, and the chromosomes are each composed of a single chromatid.

- 3) If an organism is diploid and a certain gene found in the organism has 18 known alleles (variants), then any given organism of that species can/must have which of the following? 3) _____
 - A) up to 18 chromosomes with that gene
 - B) up to 18 genes for that trait
 - C) at most, 2 alleles for that gene
 - D) a haploid number of 9 chromosomes
 - E) up to, but not more than, 18 different traits

- 4) Which of the following occurs in meiosis but not in mitosis? 4) _____
 - A) condensation of chromatin
 - B) synapsis of chromosomes
 - C) production of daughter cells
 - D) alignment of chromosomes at the equator
 - E) chromosome replication

- 5) If the DNA content of a diploid cell in the G₁ phase of the cell cycle is x, then the DNA content of the same cell at metaphase of meiosis I would be 5) _____
 - A) x.
 - B) 4x.
 - C) 0.5x.
 - D) 0.25x.
 - E) 2x.

- 6) Meiosis II is similar to mitosis in that 6) _____
A) homologous chromosomes synapse.
B) the chromosome number is reduced.
C) sister chromatids separate during anaphase.
D) DNA replicates before the division.
E) the daughter cells are diploid.
- 7) Homologous chromosomes move toward opposite poles of a dividing cell during 7) _____
A) mitosis.
B) fertilization.
C) meiosis II.
D) binary fission.
E) meiosis I.
- 8) A karyotype results from which of the following? 8) _____
A) a natural cellular arrangement of chromosomes in the nucleus
B) the cutting and pasting of parts of chromosomes to form the standard array
C) the ordering of human chromosome images
D) an inherited ability of chromosomes to arrange themselves
E) the separation of homologous chromosomes at metaphase I of meiosis
- 9) A tetrad includes which of the following sets of DNA strands? 9) _____
A) two single-stranded chromosomes that have synapsed
B) four sets of sister chromatids
C) eight sets of sister chromatids
D) two sets of sister chromatids that have synapsed
E) four sets of unique chromosomes
- 10) Independent assortment of chromosomes occurs. 10) _____
A) The statement is true for mitosis and meiosis I.
B) The statement is true for mitosis only.
C) The statement is true for mitosis and meiosis II.
D) The statement is true for meiosis I only.
E) The statement is true for meiosis II only.
- 11) Which of the following is *true* of a species that has a chromosome number of $2n = 16$? 11) _____
A) The species is diploid with 32 chromosomes per cell.
B) A gamete from this species has four chromosomes.
C) During the S phase of the cell cycle there will be 32 separate chromosomes.
D) The species has 16 sets of chromosomes per cell.
E) Each cell has eight homologous pairs.
- 12) Which of the following is a true statement about sexual vs. asexual reproduction? 12) _____
A) In sexual reproduction, individuals transmit 50% of their genes to each of their offspring.
B) In asexual reproduction, offspring are produced by fertilization without meiosis.
C) Sexual reproduction requires that parents be diploid.
D) Asexual reproduction, but not sexual reproduction, is characteristic of plants and fungi.
E) Asexual reproduction produces only haploid offspring.

Use the following information to answer the next questions.

There is a group of invertebrate animals called rotifers, among which a particular group of species reproduces, as far as is known, only asexually. These rotifers, however, have survived a long evolutionary history without evidence of having been overcome by excessive mutations.

- 13) Since the rotifers develop from eggs, but asexually, what can you predict? 13) _____
- A) No males can be found.
 - B) While asexual, both males and females are found in nature.
 - C) The animals are all hermaphrodites.
 - D) All males can produce eggs.
 - E) The eggs and the zygotes are all haploid.
- 14) How does the sexual life cycle increase the genetic variation in a species? 14) _____
- A) by increasing gene stability
 - B) by decreasing mutation frequency
 - C) by allowing fertilization
 - D) by allowing crossing over
 - E) by conserving chromosomal gene order
- 15) If a cell has completed the first meiotic division and is just beginning meiosis II, which of the following is an appropriate description of its contents? 15) _____
- A) It has one-fourth the DNA and one-half the chromosomes as the originating cell.
 - B) It is identical in content to another cell from the same meiosis.
 - C) It has half the amount of DNA as the cell that began meiosis.
 - D) It has half the chromosomes but twice the DNA of the originating cell.
 - E) It has the same number of chromosomes but each of them has different alleles than another cell from the same meiosis.
- 16) Referring to a plant's sexual life cycle, which of the following terms describes the process that leads directly to the formation of gametes? 16) _____
- A) sporophyte meiosis
 - B) gametophyte mitosis
 - C) sporophyte mitosis
 - D) alternation of generations
 - E) gametophyte meiosis
- 17) Independent assortment of chromosomes is a result of 17) _____
- A) the random and independent way in which each pair of homologous chromosomes lines up at the metaphase plate during meiosis I.
 - B) the random and independent way in which each pair of homologous chromosomes lines up at the metaphase plate during meiosis I, the random nature of the fertilization of ova by sperm, the random distribution of the sister chromatids to the two daughter cells during anaphase II, and the relatively small degree of homology shared by the X and Y chromosomes.
 - C) the relatively small degree of homology shared by the X and Y chromosomes.
 - D) the random nature of the fertilization of ova by sperm.
 - E) the random distribution of the sister chromatids to the two daughter cells during anaphase II.

- 18) The frequency of heterozygosity for the sickle-cell anemia allele is unusually high, presumably because this reduces the frequency of malaria. Such a relationship is related to which of the following? 18) _____
- A) Darwin's observations of competition
 - B) Mendel's law of segregation
 - C) the malarial parasite changing the allele
 - D) Mendel's law of independent assortment
 - E) Darwin's explanation of natural selection

- 19) In certain plants, tall is dominant to short. If a heterozygous plant is crossed with a homozygous tall plant, what is the probability that the offspring will be short? 19) _____
- A) 1/4
 - B) 0
 - C) 1/2
 - D) 1
 - E) 1/6

The following questions refer to the pedigree chart in Figure 14.2 for a family, some of whose members exhibit the dominant trait, *W*. Affected individuals are indicated by a dark square or circle.

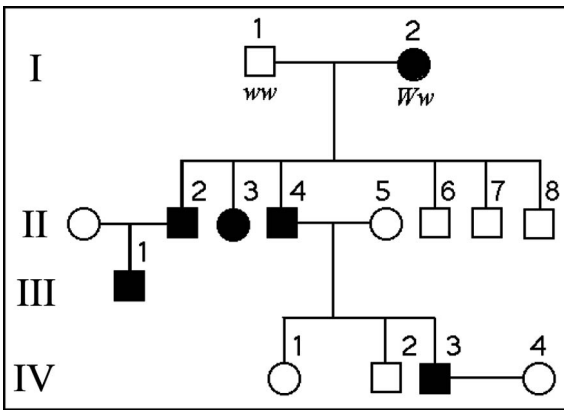


Figure 14.2

- 20) What is the genotype of individual II-5? 20) _____
- A) *Ww*
 - B) *WW* or *ww*
 - C) *ww* or *Ww*
 - D) *WW*
 - E) *ww*
- 21) In the cross $AaBbCc \times AaBbCc$, what is the probability of producing the genotype *AABBCC*? 21) _____
- A) 1/8
 - B) 1/4
 - C) 1/16
 - D) 1/32
 - E) 1/64
- 22) Which of the following describes the ability of a single gene to have multiple phenotypic effects? 22) _____
- A) multiple alleles
 - B) incomplete dominance
 - C) epistasis
 - D) pleiotropy
- 23) The individual with genotype $AaBbCCDdEE$ can make many kinds of gametes. Which of the following is the major reason? 23) _____
- A) crossing over during prophase I
 - B) different possible alignments of chromosomes
 - C) the tendency for dominant alleles to segregate together
 - D) segregation of maternal and paternal alleles
 - E) recurrent mutations forming new alleles

Use the following information to answer the questions below.

Radish flowers may be red, purple, or white. A cross between a red-flowered plant and a white-flowered plant yields all-purple offspring. The part of the radish we eat may be oval or long, with long being the dominant characteristic.

- 24) In the F₂ generation of the above cross, which of the following phenotypic ratios would be expected? 24) _____
A) 6:3:3:2:1:1 B) 9:3:3:1 C) 1:1:1:1 D) 1:1:1:1:1:1 E) 9:4:3
- 25) Which of the following differentiates between independent assortment and segregation? 25) _____
A) The law of segregation is accounted for by anaphase of mitosis.
B) The law of independent assortment requires describing two or more genes relative to one another.
C) The law of independent assortment is accounted for by observations of prophase I.
D) The law of segregation requires having two or more generations to describe.
E) The law of segregation requires describing two or more genes relative to one another.
- 26) Hutchinson-Gilford progeria is an exceedingly rare human genetic disorder in which there is very early senility and death, usually from coronary artery disease, at an average age of approximately 13. Patients, who look very old even as children, do not live to reproduce. Which of the following represents the most likely assumption? 26) _____
A) The disorder may be due to mutation in a single protein-coding gene.
B) Successive generations of a family will continue to have more and more cases over time.
C) All cases must occur in relatives; therefore, there must be only one mutant allele.
D) The disease is autosomal dominant.
E) Each patient will have had at least one affected family member in a previous generation.
- 27) The fact that all seven of the pea plant traits studied by Mendel obeyed the principle of independent assortment most probably indicates which of the following? 27) _____
A) All of the genes controlling the traits behaved as if they were on different chromosomes.
B) None of the traits obeyed the law of segregation.
C) The diploid number of chromosomes in the pea plants was 7.
D) All of the genes controlling the traits were located on the same chromosome.
E) The formation of gametes in plants occurs by mitosis only.

Use the following information to answer the questions below.

Tallness (*T*) in snapdragons is dominant to dwarfness (*t*), while red (*R*) flower color is dominant to white (*r*). The heterozygous condition results in pink (*Rr*) flower color.

- 28) A dwarf, red snapdragon is crossed with a plant homozygous for tallness and white flowers. What are the genotype and phenotype of the F₁ individuals? 28) _____
A) *TTRR*—tall and red
B) *ttRr*—dwarf and pink
C) *TtRr*—tall and red
D) *ttrr*—dwarf and white
E) *TtRr*—tall and pink

Use the following pedigree (Figure 14.3) for a family in which dark-shaded symbols represent individuals with one of the two major types of colon cancer. Numbers under the symbols are the individual's age at the time of diagnosis.

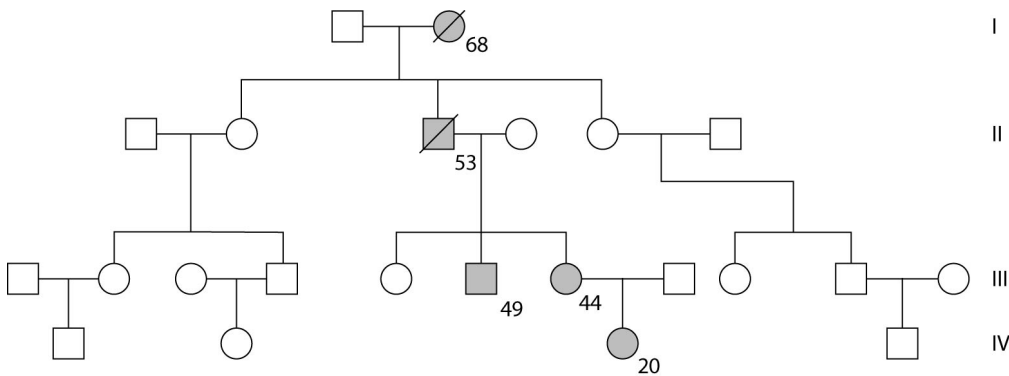


Figure 14.3

- 29) The affected woman in generation IV is thinking about her future and asks her oncologist (cancer specialist) whether she can know whether any or all of her children will have a high risk of the same cancer. The doctor would be expected to advise which of the following? 29) _____
- I. genetic counseling
 - II. prenatal diagnosis when/if she becomes pregnant
 - III. testing to see whether she has the allele
 - IV. testing to see whether her future spouse or partner has the allele
- A) II only
 - B) III and IV only
 - C) I and II only
 - D) I, II, and III only
 - E) I only
- 30) Two plants are crossed, resulting in offspring with a 3:1 ratio for a particular trait. What does this suggest? 30) _____
- A) that the parents were true-breeding for contrasting traits
 - B) that each offspring has the same alleles for each of two traits
 - C) that the trait shows incomplete dominance
 - D) that a blending of traits has occurred
 - E) that the parents were both heterozygous for a single trait
- 31) Most genes have many more than two alleles. However, which of the following is also true? 31) _____
- A) There may still be only two phenotypes for the trait.
 - B) Most of the alleles will never be found in a live-born organism.
 - C) At least one allele for a gene always produces a dominant phenotype.
 - D) More than two alleles in a genotype is considered lethal.
 - E) All of the alleles but one will produce harmful effects if homozygous.

Use the following information to answer the questions below.

A woman who has blood type A positive has a daughter who is type O positive and a son who is type B negative. Rh positive is a trait that shows simple dominance over Rh negative and is designated by the alleles R and r , respectively. A third gene for the MN blood group has codominant alleles M and N .

- 32) Which of the following is a possible phenotype for the father? 32) _____
- A) B positive
 - B) AB negative
 - C) O negative
 - D) A negative
 - E) impossible to determine

Use the following information to answer the questions below.

Radish flowers may be red, purple, or white. A cross between a red-flowered plant and a white-flowered plant yields all-purple offspring. The part of the radish we eat may be oval or long, with long being the dominant characteristic.

- 33) The flower color trait in radishes is an example of which of the following? 33) _____
- A) incomplete dominance
 - B) a multiple allelic system
 - C) codominance
 - D) epistasis
 - E) sex linkage
- 34) If true-breeding red long radishes are crossed with true-breeding white oval radishes, the F_1 will be expected to be which of the following? 34) _____
- A) red and oval
 - B) purple and oval
 - C) purple and long
 - D) red and long
 - E) white and long
- 35) How many unique gametes could be produced through independent assortment by an individual with the genotype $AaBbCCDdEE$? 35) _____
- A) 64 B) 4 C) 8 D) 32 E) 16
- 36) Black fur in mice (B) is dominant to brown fur (b). Short tails (T) are dominant to long tails (t). What fraction of the progeny of crosses $BbTt \times BBtt$ will be expected to have black fur and long tails? 36) _____
- A) 1/2 B) 3/16 C) 9/16 D) 1/16 E) 3/8
- 37) Males are more often affected by sex-linked traits than females because 37) _____
- A) female hormones such as estrogen often compensate for the effects of mutations on the X chromosome.
 - B) mutations on the Y chromosome often worsen the effects of X-linked mutations.
 - C) X chromosomes in males generally have more mutations than X chromosomes in females.
 - D) male hormones such as testosterone often alter the effects of mutations on the X chromosome.
 - E) males are hemizygous for the X chromosome.

- 38) Map units on a linkage map cannot be relied upon to calculate physical distances on a chromosome for which of the following reasons? 38) _____
- A) Physical distances between genes change during the course of the cell cycle.
 - B) The gene order on the chromosomes is slightly different in every individual.
 - C) The relationship between recombination frequency and map units is different in every individual.
 - D) Linkage map distances are identical between males and females.
 - E) The frequency of crossing over varies along the length of the chromosome.

- 39) A nonreciprocal crossover causes which of the following products? 39) _____
- A) duplication and nondisjunction
 - B) duplication only
 - C) deletion only
 - D) nondisjunction
 - E) deletion and duplication

The following is a map of four genes on a chromosome.

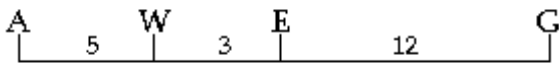


Figure 15.1

- 40) Between which two genes would you expect the highest frequency of recombination? 40) _____
- A) *W* and *E*
 - B) *A* and *W*
 - C) *E* and *G*
 - D) *A* and *G*
 - E) *A* and *E*
- 41) Which of the following is known as a Philadelphia chromosome? 41) _____
- A) a human chromosome 9 that is found only in one type of cancer
 - B) a human chromosome 22 that has had a specific translocation
 - C) an animal chromosome found primarily in the mid-Atlantic area of the United States
 - D) a chromosome found not in the nucleus but in mitochondria
 - E) an imprinted chromosome that always comes from the mother
- 42) What is the source of the extra chromosome 21 in an individual with Down syndrome? 42) _____
- A) nondisjunction in the father only
 - B) duplication of the chromosome
 - C) nondisjunction or translocation in either parent
 - D) nondisjunction in the mother only
 - E) It is impossible to detect with current technology.
- 43) Recombination between linked genes comes about for what reason? 43) _____
- A) Crossovers between these genes result in chromosomal exchange.
 - B) Mutation on one homolog is different from that on the other homolog.
 - C) When genes are linked they always "travel" together at anaphase.
 - D) Independent assortment sometimes fails because Mendel had not calculated appropriately.
 - E) Nonrecombinant chromosomes break and then re-join with one another.

- 44) How would one explain a testcross involving F₁ dihybrid flies in which more parental-type offspring than recombinant-type offspring are produced? 44) _____
- A) The two genes are linked but on different chromosomes.
 - B) Recombination did not occur in the cell during meiosis.
 - C) Both of the characters are controlled by more than one gene.
 - D) The testcross was improperly performed.
 - E) The two genes are closely linked on the same chromosome.

- 45) Cinnabar eyes is a sex-linked recessive characteristic in fruit flies. If a female having cinnabar eyes is crossed with a wild-type male, what percentage of the F₁ males will have cinnabar eyes? 45) _____
- A) 100% B) 0% C) 50% D) 75% E) 25%

Refer to the following information to answer the questions below.

A man who is an achondroplastic dwarf with normal vision marries a color-blind woman of normal height. The man's father was 6 feet tall, and both the woman's parents were of average height. Achondroplastic dwarfism is autosomal dominant, and red-green color blindness is X-linked recessive.

- 46) How many of their daughters might be expected to be color-blind dwarfs? 46) _____
- A) three out of four
 - B) half
 - C) one out of four
 - D) none
 - E) all

- 47) At which phase(s) is it preferable to obtain chromosomes to prepare a karyotype? 47) _____
- A) anaphase
 - B) late telophase
 - C) late prophase or metaphase
 - D) late anaphase or early telophase
 - E) early prophase

- 48) Sex determination in mammals is due to the SRY region of the Y chromosome. An abnormality of this region could allow which of the following to have a male phenotype? 48) _____
- A) Down syndrome, 46, XX
 - B) translocation of SRY to an autosome of a 46, XX individual
 - C) a person with one normal and one shortened (deleted) X
 - D) Turner syndrome, 45, X
 - E) a person with an extra X chromosome

- 49) Mitochondrial DNA is primarily involved in coding for proteins needed for electron transport. Therefore, in which body systems would you expect most mitochondrial gene mutations to be exhibited? 49) _____
- A) the circulation system
 - B) the immune system and the blood
 - C) the skin and senses
 - D) the nervous and muscular systems
 - E) the excretory and respiratory systems

- 50) Sturtevant provided genetic evidence for the existence of four pairs of chromosomes in *Drosophila* in which of these ways? 50) _____
- A) *Drosophila* genes have, on average, four different alleles.
 - B) *Drosophila* genes cluster into four distinct groups of linked genes.
 - C) The entire *Drosophila* genome has approximately 400 map units.
 - D) The overall number of genes in *Drosophila* is a multiple of four.
 - E) There are four major functional classes of genes in *Drosophila*.
- 51) Suppose that a gene on human chromosome 18 can be imprinted in a given pattern in a female parent but not in a male parent. A couple in whom each maternal meiosis is followed by imprinting of this gene have children. What can we expect as a likely outcome? 51) _____
- A) All daughters but no sons will bear their mother's imprinting pattern.
 - B) Each of the children will imprint a different chromosome.
 - C) All sons but no daughters will bear their mother's imprinting pattern.
 - D) All the children will bear their mother's imprinting pattern but only daughters will then pass it down.
 - E) All sons and daughters will have a 50% chance of receiving the mother's imprinting pattern.
- 52) Which of the following produces a Mendelian pattern of inheritance? 52) _____
- A) a mitochondrial gene mutation
 - B) a chloroplast gene mutation
 - C) genomic imprinting
 - D) a trait acted upon by many genes
 - E) viral genomes that inhabit egg cytoplasm
- 53) Calico cats are female because 53) _____
- A) multiple crossovers on the Y chromosome prevent orange pigment production.
 - B) a male inherits only one of the two X-linked genes controlling hair color.
 - C) the males die during embryonic development.
 - D) the Y chromosome has a gene blocking orange coloration.
 - E) only females can have Barr bodies.
- 54) One possible result of chromosomal breakage is for a fragment to join a nonhomologous chromosome. What is this alteration called? 54) _____
- A) translocation
 - B) transversion
 - C) deletion
 - D) inversion
 - E) duplication