Learning Objectives

Chapter 14

1. Define the following terms: true breeding, hybridization, monohybrid cross, P generation, F_1 generation, F_2 generation
2. Distinguish between the following pairs of terms: dominant and recessive; heterozygous and homozygous; genotype and phenotype
3. Use a Punnett square to predict the results of a cross and to state the phenotypic and genotypic ratios of the F_2 generation
4. Explain how phenotypic expression in the heterozygote differs with complete dominance, incomplete dominance, and codominance
5. Define and give examples of pleiotropy and epistasis
6. Explain why lethal dominant genes are much rarer than lethal recessive genes
7. Explain how carrier recognition, fetal testing, and newborn screening can be used in genetic screening and counseling

Chapter 15

1. Explain the chromosomal theory of inheritance and its discovery
2. Explain why sex-linked diseases are more common in human males than females
3. Distinguish between sex-linked genes and linked genes
4. Explain how meiosis accounts for recombinant phenotypes
5. Explain how linkage maps are constructed
6. Explain how nondisjunction can lead to aneuploidy
7. Define trisomy, triploidy, and polyploidy
8. Distinguish among deletions, duplications, inversions, and translocations
9. Explain genomic imprinting

10. Explain why extranuclear genes (i.e. from mitochondria) are not inherited in a Mendelian fashion

Ask Yourself

Chapter 14

1. Imagine crossing a pea heterozygous at the loci for flower color (purple vs. white ; P vs. p) and seed color (yellow vs. green; Y vs. y) with a second pea homozygous for flower color (white) and seed color (yellow).

    a) What types of gametes will the peas produce?

    b) What would be the genetic ratio of offspring with purple flowers and yellow pea color?

    c) What other genetic variations could occur and what are their ratios?

    d) What are the phenotypic ratio outcomes of this cross?

2. Imagine a genetic counselor working with a couple who have just had a child who is suffering from Tay-Sachs disease. Neither parent has Tay-Sachs, nor does anyone in their families. What could their genetic counselor suggest as the genetic reason they may have born a child with Tay-Sachs.

3. Albinism in humans occurs when both alleles at a locus produce defective enzymes in the biochemical pathway leading to melanin. Given that heterozygotes are normally pigmented, what mode of inheritance is this most likely to be indicative of?

4. In humans, alleles for dark hair are genetically dominant while alleles for light hair are recessive. Which hair color occurs most frequently? Can you predict this by simple genetics or do other types of analysis need to be applied? (Hint: Hardy-Weinberg law shows that simple genetic dominance might not predict frequency of traits.)

5. Imagine a locus with four different alleles for fur color in an animal. The alleles are named Da, Db, Dc, and Dd. If you crossed two heterozygotes, DaDb and DcDd, what genotype proportions would you expect in the offspring?

6. Envision a family in which the grandfather, age 47, has just been diagnosed with Huntington's disease. His daughter, age 25, now has a 2-year-old baby boy. No one

else in the family has the disease. What is the probability that the daughter will contract the disease?

7. Review the family described in the previous question. What is the probability that the baby will contract the disease?

Chapter 15

1. In some Drosophila species there are genes on the Y chromosome that do not occur on the X chromosome. Imagine that a mutation of one gene on the Y chromosome reduces the size by half of individuals with the mutation. Which off spring would carry the mutation? Which offspring would be reduced in size by half? Why is this the case?
2. Imagine that a deleterious recessive allele occurs on the X chromosome of mice (2N = 46). Where would it be most likely to appear first in a genetics experiment, i.e. in male or female mice? What is the probability that the allele would it occur in female mice? Male mice? What is the phenotypic probability that disease would result from inheritance of the gene in women? In men?
3. What would change if the gene described above were a dominant gene?
4. Imagine a species with three loci thought to be on the same chromosome. The recombination rate between locus A and locus B is 35% and the recombination rate between locus B and locus C is 33%. Predict the recombination rate between A and C.
5. Individuals with three sex chromosomes are often sterile. Why do you think this might be? What diseases are related to aberrant chromosomal number?
6. Chromosomal rearrangements can occur after chromosomes break. How this might assist in the process of evolution? How might this assist in disease processes?
7. The lawyer for a defendant in a paternity suit asked for DNA testing of a baby girl. What results would demonstrate that the purported father was not actually the genetic father of the child?

Key Terms (as an exercise fill these in yourself or make flash-cards)

aneuploidy
Barr body
chromosome theory of inheritance
crossing over
cytogenetic map
dendrite
Down syndrome
Duchenne muscular dystrophy
duplication
genetic map
genetic recombination
genomic imprinting
hemophilia
inversion
linkage map
linked genes
map unit
monosomic
nondisjunction
parental type
polyploidy
sex-linked gene
translocation
trisomic
wild type

Word Roots

The word roots listed below are for your reference in learning the vocabulary necessary to understand these chapters. You will be tested on concepts which use the words from the chapter.

-centesis = a puncture (*amniocentesis:* a technique for determining genetic abnormalities in a fetus by the presence of certain chemicals or defective fetal cells in the amniotic fluid, obtained by aspiration from a needle inserted into the uterus)

co- = together (*codominance:* phenotype in which both dominant alleles are expressed in the heterozygote)

di- = two (*dihybrid cross:* a breeding experiment in which offspring of a cross of parental varieties differing in two traits are mated)

epi- = beside; **-stasis** = standing (*epistasis:* a phenomenon in which one gene alters the expression of another gene that is independently inherited)

geno- = offspring (*genotype:* the genetic makeup of an organism)

hetero- = different (*heterozygous:* having two different alleles for a trait)

homo- = alike (*homozygous:* having two identical alleles for a trait)

mono- = one (*monohybrid cross:* a breeding experiment that crosses offspring of a cross of parental varieties differing in a single character)

pedi- = a child (*pedigree:* a family tree describing the occurrence of heritable characters in parents and offspring across as many generations as possible)

pheno- = appear (*phenotype:* the physical and physiological traits of an organism)

pleio- = more (*pleiotropy:* when a single gene impacts more than one characteristic)

poly- = many; **gene-** = produce (*polygenic:* an additive effect of two or more gene loci on a single phenotypic character); many (*polyploidy:* a chromosomal alteration in which the organism possesses more than two complete chromosome sets)

aneu- = without (*aneuploidy:* a chromosomal aberration in which certain chromosomes are present in extra copies or are deficient in number)

cyto- = cell (*cytogenetic maps:* charts of chromosomes that locate genes with respect to chromosomal features)

hemo- = blood (*hemophilia:* a human genetic disease caused by a sex-linked recessive allele, characterized by excessive bleeding following injury)

mono- = one (*monosomic:* a chromosomal condition in which a particular cell has only one copy of a chromosome, instead of the normal two; the cell is said to be monosomic for that chromosome)

non- = not; **dis-** = separate (*nondisjunction:* an accident of meiosis or mitosis in which both members of a pair of homologous chromosomes or both sister chromatids fail to move apart properly)

re- = again; **com-** = together; **bin-** = two at a time (*recombinant:* an offspring whose phenotype differs from that of the parents)

trans- = across (*translocation:* attachment of a chromosomal fragment to a nonhomologous chromosome)

tri- = three; **soma-** = body (*trisomic:* a chromosomal condition in which a particular cell has an extra copy of one chromosome, instead of the normal two; the cell is said to be trisomic for that chromosome)

**Some of the information in this study guide was supplied by Pearson from the Textbook Biology, 8th edition Campbell and Reece. The instructor has modified materials and added materials as she saw fit to enhance student learning.