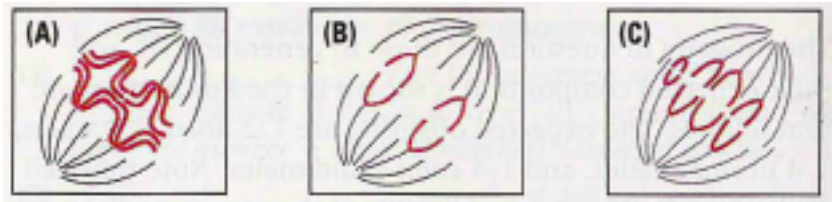


WEEK 3 PROBLEMS

Problems From Chapter 3

3.1 Emmer wheat (*Triticum dicoccum*) has a somatic chromosome number of 28, and rye (*Secale cereale*) has a somatic chromosome number of 14. Hybrids produced by crossing these cereal grasses are highly sterile and have many characteristics intermediate between the parental species. How many chromosomes do the hybrids possess?

3.2 The diagrams shown here depict anaphase in cell division in a cell of a hypothetical organism with two pairs of chromosomes. Identify the panels as being anaphase of mitosis, anaphase I of meiosis, or anaphase II of meiosis, stating on what basis you reached your conclusions.



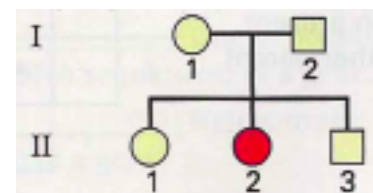
Problems From Chapter 2

2.1 The recurrence risk of a genetic disorder is the probability that the next child born into a sibship will be affected, given that one or more previous children is affected. What is the recurrence risk for:

- (a) A dominant trait in which one parent is affected?
- (b) A recessive trait in which neither parent is affected?
- (c) A recessive trait in which one parent is affected?

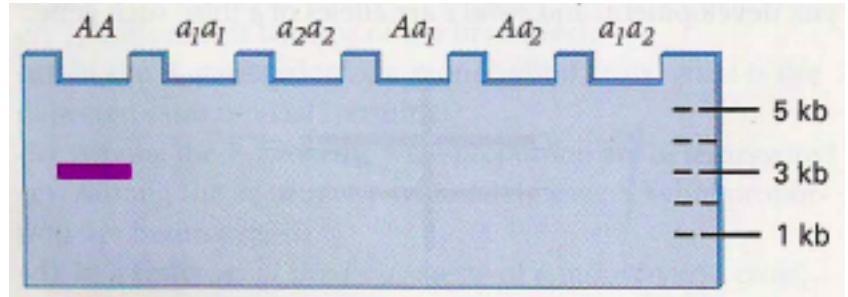
2.2 With independent assortment, how many different types of gametes are possible from the genotype $Aa Bb Cc Dd$, and in what proportions are they expected?

2.3 The pedigree illustrated here shows individual II-2 affected with a recessive trait. Let A and a represent the dominant and recessive alleles.



- (a) What is the genotype of II-2 ?
- (b) What are the genotypes of I-1 and I-2?
- (c) What are the possible genotypes of II-1 and II-3?
- (d) What is the probability that II-3 is a heterozygous "carrier" of the a allele?
- (e) What is the probability that both II-1 and II-3 are carriers?
- (f) What is the probability that neither II-1 or II-3 is a carrier?
- (f) What is the probability that at least one of these two individuals (II-1 and II-3) is a carrier?

2.4 The accompanying *diagram* shows an electrophoresis gel in which DNA samples are placed ("loaded") in the depressions ("wells") at the top of the gel and electrophoresis is in the downward direction. The dashed lines on the right denote the positions to which DNA fragments of various sizes would migrate. The fragment sizes are given in kilobase pairs (kb); 1 kb refers to a duplex DNA molecule 1000 base pairs in length. Also shown is the position of a DNA fragment corresponding to part of the coding region of a gene in DNA extracted from a homozygous wildtype (*AA*) organism. Assuming that *a1* is a mutant allele that has a 2-kb insertion of DNA into the wildtype fragment, and that *a2* is a mutant allele that has a 1-kb deletion within the wildtype fragment, show the positions at which DNA bands would be expected in each of the other genotypes shown.



2.5 Complementation tests of the recessive *a* mutant genes *a* through *f* produced the data in the accompanying matrix. The circles represent missing data. Assuming that all of the missing mutant combinations would yield data consistent with the entries that are known, complete the table by filling each circle with a + or - as need.

	<i>a</i>	<i>b</i>	<i>c</i>	<i>a</i>	<i>e</i>	<i>f</i>
<i>a</i>	○	+	-	○	+	○
<i>b</i>	○	○	○	○	○	-
<i>c</i>	○	○	○	-	○	○
<i>d</i>	○	○	○	○	○	○
<i>e</i>	○	○	○	○	○	+
<i>f</i>	○	○	○	○	○	○

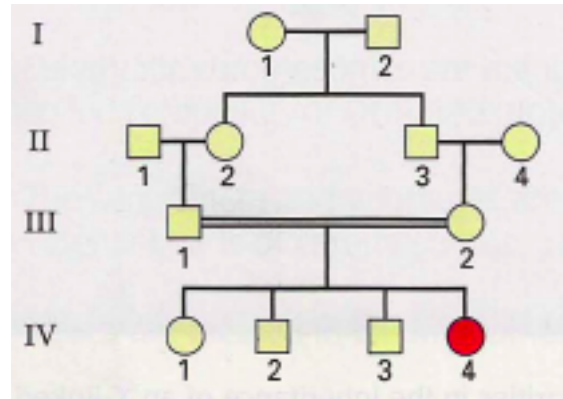
2.6 A trihybrid cross $A/A; B/B; r/r \times a/a; b/b; R/R$ is made in a plant species in which *A* and *B* are dominant to their respective alleles but there is incomplete dominance between *R* and *r*. Assume independent assortment, and consider the F₂ progeny from this cross.

- (a) How many phenotypic classes are expected?
- (b) What is the probability of the parental *ala; bib; R/R* genotype?
- (c) What proportion of the progeny would be expected to be homozygous for all three genes?

2.7 A man and a woman each have a 50 percent chance of being a carrier (heterozygous) for a recessive allele associated with a genetic disease. If they have one child, what is the chance that the child will be homozygous recessive?

2.8 Assume that the trait in the accompanying pedigree is due to simple Mendelian inheritance.

- Is it likely to be due to a dominant allele or a recessive allele? Explain.
- What is the meaning of the double horizontal line connecting III-1 with III-2?
- What is the biological relationship between III-1 and III-2?
- If the allele responsible for the condition is rare, what are the most likely genotypes of all of the persons in the pedigree in generations I, II, and III? (Use A and a for the dominant and recessive alleles, respectively.)



2.9 *Meiotic drive* is a phenomenon observed occasionally in which a heterozygous genotype does not produce a 1:1 proportion of functional gametes, usually because one of the gametic types is not formed or fails to function. Suppose that an allele D shows meiotic drive such that heterozygous Dd genotypes form $3/4$ D -bearing and $1/4$ d -bearing functional gametes. What is the expected ratio of genotypes in the F_2 generation of a monohybrid cross under the assumptions stipulated below? (*Hint*: Use Punnett squares.)

- The meiotic drive occurs equally in both sexes.
- The meiotic drive occurs only in females.