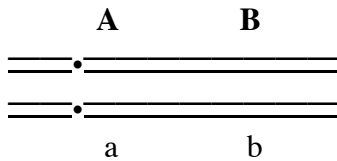
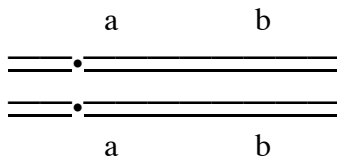


RECOMMENDED PROBLEMS: Mapping, Population, and Quantitative Genetics

1. A plant of genotype:



is test crossed to:



If a single crossover occurs between a and b in 20% of meioses, what proportion of progeny will be AaBb? How far apart are a and b, in map units?

2. Assume that a chiasma forms between genes C and D in 8% of the meioses of an individual having genotype CD//cd. The // represent two homologous chromosomes that contain the A and B genes: one homolog contains the C and D alleles and the other contains the c and d alleles. You testcross this individual (by crossing to an cd//cd individual) and examine progeny resulting from this testcross.

- a) What proportion of the testcross progeny will be CD//cd ?
- b) What proportion of the testcross progeny will be Cd//ab ?

3. In rabbits, black (B) is dominant to brown (b) and full-color (C) is dominant to chinchilla (c^{ch}). Individuals heterozygous for both traits were crossed to brown, chinchilla rabbits ($bb\ c^{ch}c^{ch}$). The following offspring resulted:

- 31 brown, chinchilla
- 34 black, full-color
- 16 brown, full-color
- 19 black, chinchilla

- a) Are the B and C genes linked (on the same chromosome)?
- b) If they are linked, what is the map distance between them?

4. Maize plants homozygous for the recessive gene "*variable sterile*" (*va*) exhibit irregular distribution of chromosomes during meiosis. Yellowish-green seedlings are the result of another recessive gene called "*virescent*" (*v*). A third recessive called "*glossy*" (*gl*) produces shiny leaves. All 3 of these genes are linked. Two homozygous plants were crossed and produced all normal F1. When the F1 was testcrossed, progeny phenotypes appeared as follows:

- 60 virescent
- 48 virescent, glossy
- 7 glossy
- 270 variable sterile, virescent, glossy
- 4 variable sterile, virescent
- 40 variable sterile
- 62 variable sterile, glossy
- 235 wild type

- a) What were the genotypes and the phenotypes of the original parents?
- b) Diagram the linkage relationships in the F1.
- c) Determine the gene order.
- d) Calculate the amount of recombination observed.
- e) How much interference is there?

5. From the phenotype data given below for two three-point testcrosses involving (1) a, b, and c and (2) b, c and d, determine the sequence of the four genes a, b, c, and d and the three map distances between them. Recessive phenotypes are symbolized by lowercase letters and dominant phenotypes by pluses (+).

Cross 1		Cross 2	
+++	680	bcd	8
ab+	139	b++	441
+++	3	b+d	90
++c	121	+cd	376
+bc	2	+++	14
a+c	2280	++d	129
abc	685	+c+	64
+b+	2215	bc+	130

- 6 a) List 5 processes that cause deviations from Hardy-Weinberg predictions.
- b) Which of these processes cause adaptive evolution and which cause non-adaptive evolution?

7. Below are the genotypes of 10 individuals for six different genes. Gene 1 has three different alleles (A, B, C); all the other genes have one or two alleles each. Each row represents the genotypes of one individual for all six loci.

Gene1	Gene2	Gene3	Gene4	Gene5	Gene6
AC	BB	AA	BB	BB	BB
AC	BB	AA	AB	AA	BB
AA	BB	AA	AB	BB	BB
CC	BB	AA	AB	AB	BB
BB	BB	AA	AA	BB	BB
BB	BB	AA	BB	AB	AB
AC	BB	AA	AB	AA	BB
BB	BB	AA	BB	AB	BB
BB	BB	AA	AB	BB	BB
AC	BB	AA	BB	AB	BB

- a) What is the allele frequency of allele B of gene 2?
- b) What is the allele frequency of allele B of gene 3?
- c) What is the genotype frequency of the BB genotype at Gene 4?
- d) Test the hypothesis that Gene 5 is in Hardy-Weinberg equilibrium.
8. List two kinds of natural selection that can actively maintain genetic variation within populations.
8. Fill in the blank in the following statements
- a) _____ causes random allele frequency change from generation to generation but does not usually lead to significant deviations from Hardy-Weinberg proportions within generations.
- b) _____ does not change allele frequencies, but leads to an excess of homozygotes within populations.

9 a) Phenylketonuria (PKU) is the inability to metabolize the amino acid phenylalanine, and is a recessive autosomal condition. If 1/10,000 infants are born with PKU, what is the frequency of the PKU allele in the population?

b) In another population with the same frequency of the PKU allele, the average inbreeding coefficient is 0.1. What is the expected frequency of infants born with the disease in the inbred population?

10. *Thalassemia major* is a recessive disorder that is lethal without medical attention. If the mutation rate to the thalassemia allele is 1×10^{-6} , what is the expected equilibrium allele frequency in a randomly-mating population.

11. Genetic and non-genetic variances in traits related to running speed were determined for a herd of thoroughbred race horses.

	<u>Hind leg length</u>	<u>Body Mass Index</u>
Environmental variance	25	20
Dominance variance	5	5
Additive variance	10	5

a) Which trait would respond fastest to directional selection, given the same selection differential (show your calculations)?

b) The herd has an average leg length of 150 cm. Horses are chosen for breeding that have an average leg length of 154 cm. What is the expected leg length in the offspring of the selected parents?