

**GENERAL GENETICS BIOL3024 HOMEWORK PROBLEM SET #3 SPRING 2006**

1. A series of two-point crosses were carried out among seven loci (a, b, c, d, e, f, and g), producing the following recombination frequencies. Using these recombination frequencies, map the seven loci, showing their correct gene order and distance between adjacent pairs of genes.

Loci	Recombination Frequency	Loci	Recombination Frequency
a,b	0.10	c,d	0.50
a,c	0.50	c,e	0.08
a,d	0.14	c,f	0.50
a,e	0.50	c,g	0.12
a,f	0.50	d,e	0.50
a,g	0.50	d,f	0.50
b,c	0.50	d,g	0.50
b,d	0.04	e,f	0.50
b,e	0.50	e,g	0.18
b,f	0.50	f,g	0.50
b,g	0.50		

2. A cross between individuals with genotypes  $a^+ a b^+ b$  X  $aa bb$  produces the following progeny:

$a^+ a b^+ b$	83
$a^+ a bb$	21
$aa b^+ b$	19
$aa bb$	77

- Does the evidence indicate that the a and b loci are linked?
  - If the loci are linked, what is the map distance between these loci?
  - If the loci are linked, is the double heterozygous parent in the cis or trans-configuration? How do you know?
3. In silk moths (*Bombyx mori*) red eyes (re) and white-banded wing (wh) are encoded by two mutant alleles that are recessive to those that produce wild-type traits ( $re^+$  and  $wh^+$ ); the two genes are on the same chromosome. A moth homozygous for red eyes and white-banded wings is crossed with a moth homozygous for the wild-type traits. The F1 have normal eyes and normal wings. The F1 are crossed with moths that have red eyes and white-banded wings. The progeny of this testcross are:
- |                              |     |
|------------------------------|-----|
| wild-type                    | 418 |
| red-eyes                     | 19  |
| white-banded wings           | 16  |
| red-eyes, white banded wings | 426 |
- what phenotypic proportions would you expect if the genes for red eyes and white-banded wings were located on different chromosomes?
  - What is the genetic distance between the genes for red-eyes and white-banded wings?

4. In tomatoes, dwarf ( $d$ ) is recessive to tall ( $d^+$ ) and opaque (light green) leaves ( $op$ ) are recessive to green leaves ( $op^+$ ). The loci that determine the height and leaf color are linked and separated by a distance of 7 m.u. For each of the following crosses, determine the phenotypes and proportions of progeny produced.
- $d^+ op^+//d op \times d op//d op$
  - $d^+ op^+//d op \times d^+ op//d op^+$
5. In *Drosophila melaongaster*, ebony body ( $e$ ) and rough eyes ( $ro$ ) are encoded by autosomal recessive genes found on chromosome 3 and they are separated by 20 map units. The gene that encodes forked bristles ( $f$ ) is X-linked recessive and assorts independently from  $e$  and  $ro$ . Give the phenotypes of progeny and expected proportions when each of the following genotypes is test-crossed:
- $e^+ ro^+//e ro \quad f^+//f$
  - $e^+ ro//e ro^+ \quad f^+//f$
6. Consider a female *Drosophila* with the following X-chromosome genotype:  $w dor^+//w^+ dor$ . The recessive alleles  $w$  and  $dor$  cause mutant eye color (white and deep orange, respectively). However,  $w$  is epistatic over  $dor$ ; that is, the genotypes  $w dor/Y$  and  $w dor//w^+ dor$  have white eyes. If there is 40 percent recombination between  $w$  and  $dor$ , what is the phenotypic ratio for sons produced from this heterozygous female.
7. Female *Drosophila* heterozygous for three recessive mutations  $e$  (ebony body),  $st$  (scarlet eyes), and  $ss$  (spineless bristles) were testcrossed, and the following progeny were obtained:

Phenotype	Number
Wild-type	67
Ebony	8
Ebony, Scarlet	68
Ebony, Spineless	347
Ebony, Scarlet, Spineless	78
Scarlet	368
Scarlet, Spineless	10
Spineless	54

- Construct a chromosomal map indicating correct gene order and distance between each pair of genes.
- What is the coefficient of coincidence?

8. Assume that in *Drosophila* there are three genes x, y, and z, with each mutant allele recessive to the wild-type allele. A cross between females heterozygous for all three loci and wild-type males yielded the following progeny:

	Phenotypes	Number
Females	+++	1010
Males	+++	39
	++z	430
	+yz	32
	x++	27
	xy+	441
	xyz	31
	total	2010

Using these data, construct a chromosomal map indicating correct gene order and distance between each pair of genes.

9. *Drosophila* females heterozygous for three recessive mutations, a, b, and c, were crossed to males homozygous for all three mutations. The cross yielded the following results:

Phenotype	Number
+++	75
++c	348
+bc	96
a++	110
ab+	306
abc	65

Construct a chromosomal map indicating the correct gene order and distance between each pair of genes.

10. In *Drosophila melanogaster*, black body (b) is recessive to gray body ( $b^+$ ), purple wings (pr) are recessive to wild-type wings ( $pr^+$ ), and vestigial wings (vg) are recessive to normal wings ( $vg^+$ ). The genes for these three traits are linked in the order b—pr—vg. Based on two-point crossing experiments, the distance between b and vg is 19 m.u. where as the distance between pr and vg is 13 m.u. Based on this information, determine the gametes that a female heterozygous for all three loci in the cis-configuration could produce and the frequency of each gamete.

**ANSWER SHEET:** Only turn in your answer sheet. You should keep the questions to help when we cover the questions in class. Answers are due before the beginning of class on Thursday 2 February 2006. Alternatively, answers may be put in my mailbox in 430 LSW prior to 2 February. Answers turned in after the beginning of class on 2 February will not be given credit.

1.

2a.

2b.

2c.

3a.

3b.

4a.

4b.

5a.

5b.

6.

7a.

7b.

8.

9.

10.