

### **Calculating Mapping Units**

1. Define map unit in eukaryotes.
2. What is the relationship of the order of genes calculated from genetic crosses to that of the true physical order in the chromosome?
3. In corn (*Zea mays*), colored aleurone (*R*) is dominant to colorless (*r*) and yellow plant color (*y*) is recessive to green (*Y*). A cross of a heterozygous colored green plant (*RY/r*) by a homozygous recessive, colorless yellow plant (*ry/ry*) gave the following progeny:

Phenotype	Number
colored green	88
colorless yellow	92
colored yellow	12
colorless green	8

Give the genotypes of the progeny and determine the distance between the aleurone color and plant color alleles.

4. In *Neurospora* a cross was made between the mutant strain ragged and the mutant strain albino.

ragged ( <i>rg al</i> <sup>+</sup> )	60	<i>al</i> is for albino, white hyphae and conidia
albino ( <i>rg</i> <sup>+</sup> <i>al</i> )	63	
wild type ( <i>rg</i> <sup>+</sup> <i>al</i> <sup>+</sup> )	42	
ragged albino ( <i>rg al</i> )	<u>35</u>	

Total 200

What are the genotypes of the parental strains and what is the genetic distance between the genes?

5. In *Drosophila*, males are XY and are therefore hemizygous for the genes in the X chromosome. Therefore, the recombination frequency between genes on the X chromosome can be easily found using males only. (*Why?*)

Two X-linked genes, *scute* (*sc* = certain bristles are missing) and *echinus* (*ec* = rough eye) were used in the following cross.

Parents: Heterozygous female (+ *ec/sc* +) crossed to recessive male (*sc ec/Y*).

Phenotypes	Genotype of Male	Number
echinus	+ <i>ec</i>	4,789
scute	<i>sc</i> +	4,903
wild type	++	358
scute echinus	<i>sc ec</i>	<u>343</u>

		10,393
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What is the recombination frequency between *ec* and *sc*?

6. The following *Neurospora* cross was made, resulting in the data shown below. Draw a map of this region. (Note: The genes are not necessarily **given** in the correct order.)

Cross:  $st^+ col^+ ad-4 \times st col ad-4^+$

Progeny	Number	
$st^+ col^+ ad-4$	300	<i>st</i> = stubby pyphae
$st^+ col ad-4^+$	50	<i>col</i> = colonial growth
$st col ad-4$	3	<i>ad-4</i> = requires adenine
$st col^+ ad-4^+$	145	
$st^+ col ad-4$	146	
$st col ad-4^+$	309	
$st col^+ ad-4$	41	
$st^+ col^+ ad-4^+$	<u>6</u>	
	1,000	

7. A cross was made between two strains of the hypothetical plant Blue Lagmaratus, a man eating species. Oblivious to the hazards involved in working with this plant, a dedicated and nimble researcher made the following cross: a heterozygous wild type plant was crossed to a homozygous recessive, quick tentacled (*q*), accelerated appetite (*a*), attractively scented (*s*) plant. The following progeny were obtained.

435 quick tentacles, accelerated appetite, obnoxious scent  
 22 quick, normal, obnoxious  
 28 slow, normal, obnoxious  
 450 slow, normal, attractive  
 7 quick, normal, attractive  
 23 quick, accelerated, attractive  
 27 slow, accelerated, attractive  
8 slow, accelerated, obnoxious  
 1000

Determine the gene order and map distances.

8. Assume that map units between four genes on the X chromosome of man are as given below.
- 5 G-6PD deficiency (*G*) – deutan colorblind (*D*)
  - 29 XG blood group (*XG*) – G-6 PD deficiency (*G*)
  - 34 deutan colorblind (*D*) – XG blood group (*XG*)
  - 12 deutan colorblind (*D*) – hemophilia A(*A*)

- 46 hemophilia A(*A*) – XG blood group (*XG*)  
17 hemophilia A(*A*) – G-6-PD (*G*) deficiency

What is the correct order of the genes on the chromosome?

9. An individual has the genotype  $Xwz/xWZ$ , with the genes in the order given. Which gametes are double crossovers?
10. What is the basis for the statement: “The further apart two genetic loci are on the chromosome the greater the amount of recombination between them.”?
11. Why is it easier to map human genes located on the X chromosome than those on the autosomes?
12. What is the length of a chromosome, in map units, if it has an average of three crossovers in meiosis?