

Chromosome Mapping Practice

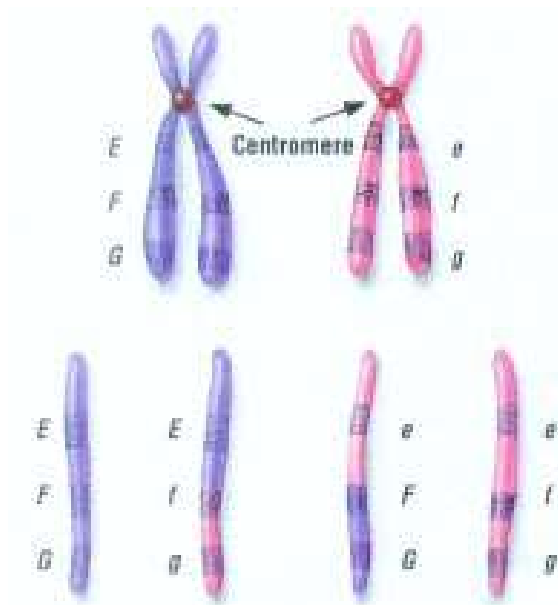
Background Information

A.H. Sturtevant, a student who worked with Thomas Morgan, made the following hypotheses: Genes are located in a linear series along a chromosome, much like beads on a string. Genes that are closer together will be separated less frequently than those that are farther apart. Crossover frequencies can be used to construct gene maps.

Sturtevant's work with *Drosophila* helped establish techniques for mapping chromosomes.

Procedure

1. Examine the diagram of the chromosome shown. Crossing over takes place when breaks occur in the chromatids of homologous chromosomes during meiosis. The chromatids break and join with the chromatids of their homologous chromosomes. This causes an exchange of alleles between chromosomes.



a) Indicate the areas of the chromatids that show crossing over.

b) According to the diagram, which genes appear farthest apart?

c) Which alleles have been exchanged?

2. In 1913, Sturtevant used crossover frequencies of *Drosophila* to construct chromosome maps. To determine map distances, he arbitrarily assigned one recombination for every 100 fertilized eggs (*i.e.*, 1%). For example, genes that had a crossover frequency of 15% were said to be 15 units apart. Genes that had 5% recombinations were much closer: 5 units apart.

d) Using the following data, determine the distance between genes E and F.

Cross	EF x ef	
Offspring	EF + ef (from parent)	94%
	Ef + eF (recombinant)	6%

3. Using the following data, determine the distance between genes E and F.

Cross	Offspring	Frequency
EF x ef	EF+ ef (from parent)	94%
	Ef + eF (recombination)	6%
EG x eg	EG + eg (from parent)	90%
	Eg + eG (recombination)	10%
FG x fg	FG + fg (from parent)	96%
	Fg + fG (recombination)	4%

e) What is the distance between genes E and G?

f) What is the distance between genes F and G?

g) What mathematical evidence indicates that gene F must be found between genes E and G?

h) Draw the gene map to scale. (1 cm = 1 unit)

i) For each of the following unrelated breeding experiments, linkage group composed of genes were found to show the gene combinations given. All recombinations are expressed per 100 fertilized eggs. For both examples, construct a gene map showing the relative positions of each of the genes along the chromosome and indicate distances in gene units.

i) Genes

	W	X	Y	Z
W	-	5	7	8
X	5	-	2	3
Y	7	2	-	1
Z	8	3	1	-

j) Genes

	A	B	C	D
A	-	12	15	4
B	12	-	3	8
C	15	3	-	11
D	4	8	11	-