LABORATORY INVESTIGATION

MAPPING CHROMOSOMES

PROBLEM

How can rates of crossing-over be used to map chromosomes?

MATERIALS *(per group)*

wooden stick from a frozen-dessert bar
metric ruler
pen
sheet of unlined paper

PROCEDURE

1. Using a pen and a ruler, draw a vertical line 15 cm long in the center of a clean sheet of unlined paper. Make a small horizontal mark at the bottom of the line. Measuring from the bottom of the line, add horizontal marks at 1 cm, 3 cm, 6 cm, 10 cm, and 15 cm.
2. Label each horizontal mark alphabetically (A through F), starting from the bottom.
3. The vertical line on the paper represents a chromosome that has six genes on it—A, B, C, D, E, and F. This chromosome's homologous chromosome is represented by the colored edge of the wooden stick.
4. Adjust the sheet of paper so that its bottom edge is about 15 cm from the edge of your lab table or desk. Move your chair back so that the front edge of your seat is about 30 cm from the edge of your lab table or desk.
5. Toss the wooden stick, underhand, toward the vertical line until the stick lands across the line. The landing of the stick across the line represents crossing-over.
6. When crossing-over occurs, look at the colored edge of the stick to determine which genes have been separated. Make a tally mark in the appropriate place in the data table for each gene that has become separated from gene A. For example, if the colored edge of the stick lands between D and E, make tally marks for genes E and F because they have been separated from gene A as a result of crossing-over.
7. Toss the stick and tally the results until crossing-over has occurred 100 times.
8. Count up the number of tally marks for each of the five genes. In the appropriate place in your data table, record the number of times each gene was separated from gene A.
9. Calculate the frequency of crossing-over by dividing the number of times each gene was separated from gene A by 100. Record the results of your calculations.
10. Calculate the location of each gene by multiplying the frequency of its crossing-over by 15 and rounding off to the nearest integer. Record the calculated gene locations.

OBSERVATIONS

Genes Separated from Gene A	Times Separated from Gene A		Frequency of Crossing-over	Gene Locations	
	Tally	Number		Calculated	Actual
B					1
C					3
D					6
E					10
F					15

1. Did every toss result in crossing-over?
2. Which genes became separated from gene A most frequently? Most infrequently?

ANALYSIS AND CONCLUSIONS

1. What is the relationship between the frequency of gene separation due to crossing-over and the distance between genes?
2. Are your calculated gene locations exactly the same as the actual gene locations? If so, discuss why the experiment went as expected. If not, discuss possible sources of error.
3. How can the frequencies of crossing-over be used to map chromosomes?