Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Crossing Over**

**What is crossing over?**

**Procedure:**

1. Using a pencil and ruler, draw a vertical line 15cm long in the center of a clean sheet of unlined paper.
2. Make a small horizontal mark at the bottom of the line.
3. Measuring from the bottom of the line, add horizontal marks at 1cm, 3cm, 6cm, 10cm and 15cm.
4. Label each horizontal mark from A to F, starting from the bottom.
5. The vertical line on the paper represents the chromosome that has six genes on it (A,B,C,D,E and F). Color one edge of the popsicle stick to represent this chromosome’s homologous chromosome.
6. Place the paper flat on a desk and have one group member stand 1 meter away from it.
7. 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.
8. When crossing over occurs, look at the colored edge of the stick to determine which genes have been separated.
9. Make a tally mark in the table each time the gene has become separated from gene A.
10. Toss the stick and tally the results until crossing over has occurred 100 times.
11. Count up the number of tally marks for each of the five genes.
12. In the appropriate place in the data table, record the number of times each gene was separated from gene A.
13. Calculate the frequency of crossing over by dividing the number of times each gene from separated from gene A by 100. Record the results.
14. Calculate the location of each gene by multiplying the frequency of its crossing over by 15 and round to the nearest full integer. Record the calculated gene locations.

**Which genes do you think will be crossed over most frequently?**

**Data:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Genes Separated from Gene A | Times Separated from Gene A | | Frequency of Crossing Over | Gene Locations | |
|  | Tallies | Number |  | Calculated | Measured |
| B |  |  |  |  |  |
| C |  |  |  |  |  |
| D |  |  |  |  |  |
| E |  |  |  |  |  |
| F |  |  |  |  |  |

**Analysis:**

1. Which genes became separated from gene A most frequently?
2. Which genes became separated from gene A least frequently?
3. What is the relationship between the frequency of gene separation due to crossover and the distance between genes?
4. 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 the possible sources of error.
5. How can the frequencies of crossing over be used to map chromosomes?
6. Why do most individuals with blonde hair also have blue eyes?
7. How do exceptions come about?
8. When and how does crossing over and recombination occur?