Gene Mapping Interactive

Name: _____ **Period:** _____ **Date:** _____

> Open **peebedu.com** and navigate to **Gene Mapping Interactive**. Begin on the **Introduction** tab, which covers crossing over during meiosis, how gene distance controls recombination frequency, and how linked genes deviate from Mendel's Law of Independent Assortment. Use the crossing over animation and distance slider to explore these concepts before moving to the **Tutorial** and **Problems** tabs.

Part 1 — Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Gene Mapping Interactive as a scientific model.

M — Mode

What type of model is the Gene Mapping Interactive? Describe how this computational simulation represents the relationship between crossing over, gene distance, and recombination frequency.

A — Accuracy

(a) Identify two things this simulation represents accurately about how crossing over produces recombinant chromosomes and how recombination frequency relates to gene distance.

(b) Identify two things this simulation oversimplifies or leaves out about the real process of meiotic recombination and gene mapping.

P — Purpose

What is the learning goal of this simulation? Explain how the Gene Mapping Interactive is designed to help you understand why linked genes do not follow Mendel's Law of Independent Assortment.

P — Permanency

Could this model change with new scientific evidence? Describe one way that advances in genome sequencing or chromosome mapping technology might change or improve a simulation like this one.

Small-Group Discussion

With your group, discuss the following:

- What are the strengths of this simulation as a model for understanding genetic linkage?
- What are its limitations?
- If you could add one feature to improve this simulation, what would it be and why?
- How does adjusting the distance slider help you understand the difference between tightly linked and loosely linked genes?

Part 2 — Free Response Questions

Conceptual Analysis

Question 1 — Genetic Linkage and Recombination

> *Simulation Task: On the **Introduction** tab, use the crossing over animation to step through all four phases. Then adjust the **gene distance slider** from 5 map units to 48 map units and observe how the recombination frequency and linkage status change. Note the testcross ratio table showing how linkage changes offspring ratios compared to independent assortment.*

(A) (1 pt) **Describe** the process by which crossing over during meiosis I produces recombinant chromosomes.

(B) (1 pt) **Explain** why genes located close together on the same chromosome do not follow Mendel's Law of Independent Assortment.

(C) (1 pt) **Predict** how the proportion of recombinant offspring in a testcross would change if the distance between two linked genes increased from 5 map units to 40 map units.

(D) (1 pt) **Justify** your prediction.

EK 5.3.A.1, 5.4.A.1 (i)

Analyze Model / Visual Representation

Question 2 — Calculating Recombination Frequency and Map Distance

> *Simulation Task: Navigate to the **Problems** tab and select **Problem 1**. Read the testcross data and work through each step: identify parental and recombinant phenotype classes, calculate the recombination frequency, and convert it to map units. After completing Problem 1, select **Problem 2** and compare the recombination frequencies between the two gene pairs.*

(A) (1 pt) **Describe** the process by which recombination frequency from testcross data is used to calculate the map distance between two linked genes.

(B) (1 pt) **Explain** the relationship between the physical distance separating two genes on a chromosome and the ratio of parental to recombinant offspring in a testcross.

(C) (1 pt) **Represent** a pair of homologous chromosomes during prophase I of meiosis, showing two linked genes and the location of a crossover event between them. Label the parental and recombinant chromatids that would result.

Draw your diagram here.

(D) (1 pt) **Explain** how crossing over during meiosis increases genetic variation in sexually reproducing populations.

EK 5.4.A.1 (i), 5.3.A.1, 7.2.A.1