PEEBEDU Reproductive Isolation Simulator

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

> Open **peebedu.com** and navigate to the **Reproductive Isolation Simulator**. Click the **Introduction** button and read through the popup, which describes how populations evolve different traits through natural selection, how predation and mating preferences drive adaptation, and how splitting populations into separate environments models geographic isolation and speciation.

Part 1 — Model Evaluation (MAPP Framework)

Scientific models are simplified representations of natural phenomena. Use the MAPP framework below to evaluate the Reproductive Isolation Simulator as a scientific model.

M — Mode

What type of model is the Reproductive Isolation Simulator? Describe how this computational simulation represents speciation and reproductive isolation. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about how new species can arise.

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A — Accuracy

(a) Identify two things this simulation represents **accurately** about speciation and reproductive isolation. For each, name the specific simulation feature and explain what biological process it demonstrates.

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(b) Identify two things this simulation **oversimplifies or leaves out** about speciation and reproductive isolation. Consider what mechanisms or factors you cannot observe in the simulation that would be important for a complete understanding of how new species form.

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P — Purpose

What is the learning goal of this simulation? Explain how the Reproductive Isolation Simulator is designed to help you understand how populations become reproductively isolated and diverge into separate species. In your answer, connect at least one specific simulation feature to a real-world biological scenario in which reproductive isolation leads to speciation.

P — Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries might change or improve a simulation like the Reproductive Isolation Simulator. Explain why scientific models, including computational simulations, are revised as new evidence becomes available.

Small-Group Discussion

With your group, discuss the following:

- What are the strengths of this simulation as a model for speciation and reproductive isolation?
- What are its limitations?
- If you could add one feature to improve this simulation, what would it be and why?
- How does the simulation help you connect the concept of reproductive isolation to the formation of new species?

Part 2 — Free Response Questions

Conceptual Analysis

Question 1 — Allopatric Speciation and Prezygotic Barriers

Simulation Task: Set the Initial Population to 100, Initial Mean Trait (Color) to 128, and Initial Trait Variation (SD) to 20. Set Mating Preference to "None (Random mating)" and Max Color Diff for Mating to 30. Click "Run 10 Generations" to establish your baseline population. Then click "Split Population" to separate the organisms into two environments. Enable the predator in Population 1 with Predator Target Trait set to 200 and Predator Accuracy set to 60. Enable the predator in Population 2 with Predator Target Trait set to 50 and Predator Accuracy set to 60. Click "Run 100 Generations" and observe how the two populations diverge.

(A) (1 pt) **Describe** the concept of allopatric speciation and the conditions that must be met for two populations to become reproductively isolated from each other.

(B) (1 pt) **Explain** why the two populations in the simulation diverged in their color trait distributions after being split into separate environments with different predation pressures.

(C) (1 pt) **Predict** what would happen to the two populations if the geographic barrier were removed and the populations were reunited after 100 generations of divergent selection.

(D) (1 pt) **Justify** your prediction by explaining how prezygotic isolation mechanisms, such as differences in mating traits, can prevent gene flow between reunited populations and maintain them as separate species even in the absence of a geographic barrier.

EK 7.10.A.1, 7.10.C.1

Analyze Model / Visual Representation

Question 2 — Behavioral Isolation and Sympatric Speciation

Simulation Task: Click "Reset Simulation." Set the Initial Population to 150, Initial Shape (% Circle) to 50%, and Max Color Diff for Mating to 50. Change Mating Preference to "Like Shapes Prefer." Do NOT split the population. Click "Run 100 Generations" and observe the shape frequency graphs and population counts. Note whether circles and squares maintain distinct groups or merge over time.

(A) (1 pt) **Describe** the biological species concept and how it defines what constitutes a species among sexually reproducing organisms.

(B) (1 pt) **Explain** how the "Like Shapes Prefer" mating preference in the simulation models behavioral (sexual) isolation as a prezygotic barrier.
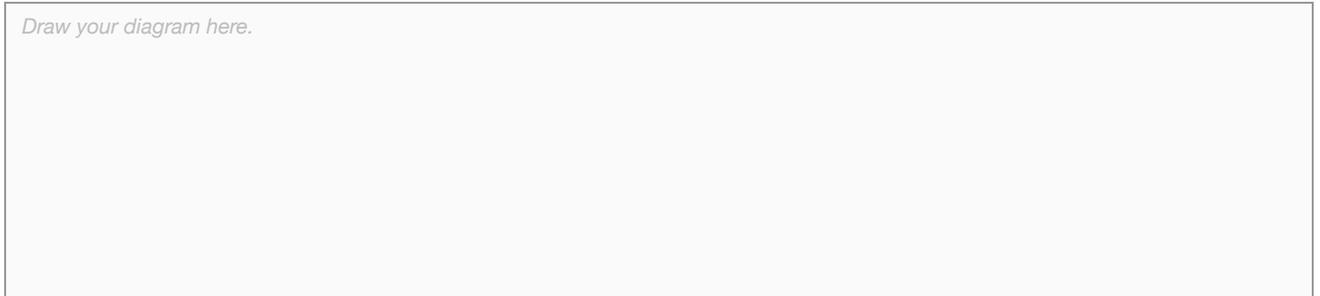
(C) (1 pt) **Represent** the process of speciation through reproductive isolation.

Draw your diagram here.

(D) (1 pt) **Explain** how the formation of new species through reproductive isolation can affect community structure and biodiversity within an ecosystem.

EK 7.10.A.2, 7.10.C.2