PEEBEDU Reproductive Isolation Simulator (NGSS)

Unit 7: Natural Selection and Evolution

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.

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.

(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.

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 — NGSS Questions

1.

> *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.*

Explain how a geographic barrier, such as the one modeled by the "Split Population" button, can prevent members of the same species from mating with each other. Describe what happens to the flow of genetic information between the two groups once they are separated.

HS-LS4-5

2.

> *Simulation Task: With the populations still split, 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 the color histograms for each population.*

Describe how the two populations changed in their color traits after 100 generations under different predation pressures. Explain why natural selection caused the two separated groups to develop different traits over time.

HS-LS4-5

3.

> *Simulation Task: Look at the color histograms for Population 1 and Population 2 after the 100-generation run. Compare the mean color values shown for each population and consider whether the Max Color Diff for Mating setting (30) would allow organisms from the two populations to successfully mate.*

Based on the color distributions you observe, explain whether organisms from Population 1 would still be able to mate with organisms from Population 2. Describe how differences in traits that build up over many generations can eventually prevent two groups from reproducing with each other, leading to the formation of new species.

HS-LS4-5

4.

> *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.*

Explain how mating preferences based on body shape can act as a barrier to reproduction even when organisms live in the same area. Describe what happened to the circle and square groups over the 100 generations and why choosing mates with similar traits can lead to the emergence of separate species without any geographic separation.

HS-LS4-5

5.

> *Simulation Task: Click "Reset Simulation." Set the Initial Population to 100, Initial Mean Trait (Color) to 128, Initial Trait Variation (SD) to 40, and Max Color Diff for Mating to 15. Set Mating Preference to "None (Random mating)." Click "Run 100 Generations" and watch the population counts and color histogram closely.*

Describe what happens to the population when the trait variation is high but the mating threshold is very narrow. Explain how strict requirements for mate similarity can split a single population into separate breeding groups and how this relates to the process of new species forming.

HS-LS4-5

6.

> *Simulation Task: Review the results from your runs in Questions 1–3 (geographic separation with different predators) and Question 4 (mating preference without separation). Compare the two different pathways that led to reproductive isolation.*

In the box below, draw a diagram showing two different pathways by which a single population can split into two separate species. On the left side, show how geographic isolation and different environmental pressures lead to new species. On the right side, show how behavioral differences in mate choice lead to new species without geographic separation. Label the starting population, the type of barrier, the role of natural selection, and the resulting species in each pathway.

Draw your diagrams here.

HS-LS4-5

7.

> *Simulation Task: Run any configuration of the simulator for at least 100 generations where two populations become reproductively isolated. Observe how each group develops its own distinct set of traits over time.*

The simulation shows how one ancestral group can split into two distinct species over many generations. Explain how the repeated formation of new species through reproductive isolation over millions of years can produce the patterns of shared traits and branching lineages that scientists observe when comparing living and fossil organisms. Describe how this process contributes to the diversity of life on Earth.

HS-LS4-1