PEEBEDU

Bed Bug Treatment Lab

Unit 7: Natural Selection and Evolution

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

> Open **peebedu.com** and navigate to **Bed Bug Treatment Lab**. Click the **How to Play** button to read the introduction. This simulation models a bed bug population in a home where you can apply different pest control treatments and observe how the population changes over time. Pay attention to the population stats panel (Total, Normal, Resistant, Eggs, q Freq), the two graphs (Population Over Time and Allele Frequency), and the five treatment options (DDT Spray, Steam, Vacuum, Wash Sheets, Call Professionals).

Part 1 — Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Bed Bug Treatment Lab as a scientific model.

M — Mode

What type of model is the Bed Bug Treatment Lab? Describe how this computational simulation represents the evolution of pesticide resistance in an insect population. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about natural selection and allele frequency change.

A — Accuracy

(a) Identify two things this simulation represents **accurately** about the evolution of pesticide resistance. For each, name the specific simulation feature and explain what biological concept it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about how resistance evolves in real insect populations. Consider what you cannot observe in the simulation that would be important for a complete understanding of resistance evolution.

P — Purpose

What is the learning goal of this simulation? Explain how the Bed Bug Treatment Lab is designed to help you understand how natural selection drives the evolution of pesticide resistance in populations. In your answer, connect at least one specific simulation feature to a real-world consequence of pesticide resistance.

P — Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries about insect resistance mechanisms might change or improve a simulation like the Bed Bug Treatment Lab. 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 resistance evolution?
- 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 population-level observations to molecular-level explanations of natural selection?

Part 2 — Free Response Questions

Conceptual Analysis

Question 1 — Pesticide Resistance and Natural Selection

> *Simulation Task: Reset the simulation so you begin on Day 1 with 100 total bugs (99 Normal, 1 Resistant) and a q frequency of 0.010. Use only DDT Spray to treat the infestation. Press Play and apply DDT every time the population begins to recover. Continue until you have applied DDT at least five times and observe what happens to the population stats and both graphs.*

(A) (1 pt) **Describe** how the application of a pesticide such as DDT acts as a selective pressure on a population of insects that contains both susceptible and resistant individuals.

(B) (1 pt) **Explain** why the frequency of the resistance allele (q) increases in the bed bug population after repeated applications of DDT.

(C) (1 pt) **Predict** what would happen to the allele frequency (q) over time if you stopped using DDT entirely and instead used only steam treatment and vacuuming.

(D) (1 pt) **Justify** why the evolution of pesticide resistance in insects is considered evidence that evolution is an ongoing process in living organisms, rather than an event that occurred only in the past.

EK 7.8.A.1(iii)

Analyze Model / Visual Representation

Question 2 — Integrated Pest Management and Allele Frequency

> *Simulation Task: Reset the simulation. Run two separate trials. In Trial 1, treat the bugs using only DDT Spray for 30 days and record the final q frequency. In Trial 2, reset and treat using a combination of DDT Spray, Steam, and Vacuum over 30 days and record the final q frequency. Compare the two outcomes.*

(A) (1 pt) **Describe** the difference between a selective treatment (such as DDT) and a non-selective treatment (such as steam or vacuuming) in terms of their effect on allele frequencies in a population.

(B) (1 pt) **Explain** why an integrated pest management approach that combines chemical and physical treatments is less likely to drive the evolution of resistance than relying on a single pesticide.

(C) (1 pt) **Represent** the predicted change in the resistance allele frequency (q) over 30 days for each of your two trials.

Draw your graph here.

(D) (1 pt) **Explain** how the persistence of a resistant bed bug population could affect the host-parasite interaction and community structure in a shared living environment such as an apartment building.

EK 7.8.A.1(iii); cross-unit: 8.5.B.4