PEEBEDU

Aquarium Simulator

Unit 8: Ecology

Name: ______________________ **Period:** ________ **Date:** ______________

> Open **peebedu.com** and navigate to **Aquarium Simulator**. Read the introduction popup, which describes the nitrogen cycle in an aquarium ecosystem: ammonia production by fish, conversion to nitrite and then nitrate by beneficial bacteria, and absorption of nitrate by aquatic plants. Click through the introduction, then explore the simulator controls.

Part 1 — Model Evaluation (MAPP Framework)

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

M — Mode

What type of model is the Aquarium Simulator? Describe how this computational simulation represents an aquatic ecosystem. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about ecological interactions in an aquarium.

A — Accuracy

(a) Identify two things this simulation represents **accurately** about aquatic ecosystem dynamics. For each, name the specific simulation feature and explain what ecological concept it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about real aquatic ecosystems. Consider what you cannot observe in the simulation that would be important for a complete understanding of community ecology.

P — Purpose

What is the learning goal of this simulation? Explain how the Aquarium Simulator is designed to help you understand how populations of different species interact within a community and how those interactions affect the flow of matter through an ecosystem. In your answer, connect at least one specific simulation feature to a biological concept about population or community ecology.

P — Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries about aquatic ecology or nitrogen cycling might change or improve a simulation like the Aquarium 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 aquatic community ecology?
- 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 organism-level processes to community-level outcomes?

Part 2 — NGSS Questions

1.

> *Simulation Task: Start with an empty tank. Add two guppies and one goldfish. Click "Feed Fish" three times and observe the Nitrogen Cycle Monitor. Record the ammonia level displayed.*

Describe how adding more fish to the aquarium changes the ammonia level. Explain why a larger fish population produces more waste and how this limits the number of organisms the tank can support.

HS-LS2-1

2.

> *Simulation Task: Without clearing the tank, add four more goldfish. Feed the fish three more times and watch the ammonia and nitrite levels on the Nitrogen Cycle Monitor. Note the status message displayed.*

Explain what happens to the nitrogen compound levels when you overstock the tank with fish. Describe how rising toxic waste levels act as a factor that limits population growth and define the maximum population the tank can sustain as its carrying capacity.

HS-LS2-1

3.

> *Simulation Task: Clear the aquarium. Build a balanced community: add two guppies, one goldfish, two Hornwort plants, and one Anubias plant. Add nitrifying bacteria. Feed the fish twice and observe the Nitrogen Cycle Monitor as it stabilizes.*

Explain how each type of organism in the tank (fish, plants, and bacteria) depends on the others for the cycling of nitrogen. Describe how matter moves through the aquarium community and why a balanced mix of species keeps nitrogen levels stable.

HS-LS2-2

4.

> *Simulation Task: Starting from the balanced tank in Question 3, remove all plants. Feed the fish twice more and observe how the ammonia and nitrate levels change on the Nitrogen Cycle Monitor.*

Describe the changes in nitrogen levels after removing the plants. Explain why having a variety of different species (biodiversity) is important for keeping an ecosystem stable and what happens to nutrient cycling when a key group of organisms is removed.

HS-LS2-6

5.

> *Simulation Task: Clear the aquarium. Add one guppy and one Anubias plant, but do not add any bacteria. Feed the fish twice and observe the Nitrogen Cycle Monitor. Then add nitrifying bacteria and observe how the levels change.*

Explain the role bacteria play in converting ammonia into less harmful compounds. Describe what happened to the nitrogen levels before and after adding bacteria, and explain why ecosystems depend on organisms that may not be visible to maintain healthy conditions for all species.

HS-LS2-2

6.

> *Simulation Task: Reset the aquarium. Add two guppies, one goldfish, two Hornwort plants, one Anubias plant, and all three bacteria types (nitrifying, ammonifying, and denitrifying). Feed the fish twice and observe the stable nitrogen levels on the monitor.*

In the box below, draw a diagram showing how nitrogen flows through the aquarium ecosystem. Include fish, plants, and all three bacteria types. Use labeled arrows to show the direction nitrogen moves and the form it takes (ammonia, nitrite, nitrate) at each step. Include the role of water changes as a way to remove excess nitrogen.

Draw your nitrogen-flow diagram here.

HS-LS2-6

7.

> *Simulation Task: Clear the aquarium one more time. Add five goldfish and no plants or bacteria. Feed the fish repeatedly and observe the rising ammonia and nitrite levels. Then perform a 50% Water Change and observe its effect.*

In the simulation, the water change acts as a human intervention to reduce harmful waste. Describe a real-world example of how human activity has disrupted nutrient cycling in a natural ecosystem (such as fertilizer runoff causing algal blooms). Propose one action humans could take to reduce their impact on that ecosystem and explain how the action would help restore balance.

HS-LS2-7
