Name: _____ **Date:** _____

Section: _____

Aquarium Simulator Activity

The Nitrogen Cycle: Chemical Transformations in Aquatic Systems

Phase 1: ENGAGE (5 minutes)

Getting Started: Open peebedu.com and navigate to Aquarium Simulator

Read the introduction popup to understand the nitrogen cycle basics.

Phenomenon: In natural water bodies, ammonia from fish waste doesn't accumulate to toxic levels, even without human intervention. Somehow, nature has a built-in chemical processing system.

Initial Model Development: Draw a diagram showing what you think happens to ammonia (NH_3) in natural water:

[Space for drawing]

Peer Discussion: Compare your model with a partner. Identify:

- One chemical transformation you both included: _____

Phase 2: EXPLORE (20 minutes)

Investigation: Observing the Nitrogen Cycle

Part A: Systematic Investigation

Start with an empty aquarium. Use each control systematically:

Step 1: Add Fish

- Prediction: What will happen to nitrogen levels? _____

Step 2: Add Bacteria

- Prediction: How will bacteria affect each compound? _____

Step 3: Add Plants

- Prediction: What role will plants play? _____

Part B: Pattern Analysis

Identify patterns in your data:

- Pattern 1: _____
- Pattern 3: _____

Cause-and-effect relationships:

- When I added _____, then _____ happened

Collaborative Checkpoint: Form groups of 4. Each person explores ONE intervention:

- Student 1: Add bacteria and observe changes
- Student 2: Add plants and observe changes
- Student 3: Add more fish and observe changes
- Student 4: Remove organisms and observe changes

Share your observations about how each intervention affects nitrogen compounds.

Phase 3: EXPLAIN (15 minutes)

Constructing Scientific Arguments

Pattern Analysis:

- Graph the nitrogen compound concentrations over time
- Circle the key turning points where patterns change
- Label cause-and-effect relationships on your graph

Systems Model: Create a diagram showing:

- How each organism affects nitrogen compounds
- Which changes trigger other changes
- Any feedback loops you discovered

Developing Your Argument:

- ‘`How does the nitrogen cycle demonstrate interconnected systems?`‘*

Claim: The nitrogen cycle requires _____

Evidence: (List 3 specific patterns with data)

- Pattern 1: _____

- Pattern 3: _____

Reasoning: These patterns show that _____

Peer Review: Exchange with another group. Ask:

- Did they identify the same patterns? _____

Phase 4: ELABORATE (12 minutes)

Application: Understanding Aquarium Management

Context: You're helping a friend set up a new aquarium.

Your Task: Work in teams to design a healthy aquarium ecosystem.

Design Challenge:

- Your friend has added fish to a brand new aquarium
- You need to explain what will happen and how to manage it

Test Your Ideas: Use the simulator to explore:

- What happens in a new aquarium with fish? _____

- What role do plants play? _____

Create a Guide:

- Draw the nitrogen cycle in an aquarium
- Explain each transformation
- List recommendations for maintaining balance

Present Your Solution: Share your guide and explain:

- The sequence of changes in a new aquarium
- Why patience is important
- How different organisms contribute to balance

Phase 5: EVALUATE (8 minutes)

Assessment & Model Critique

Pattern Recognition Test:

- Describe 3 patterns you discovered: _____

Prediction Challenge:

Your friend's aquarium has high ammonia but no nitrite or nitrate.

- What's missing from the system? _____
- Draw the sequence of changes you expect: _____

Systems Thinking: Explain how removing each component would affect the system:

- No fish: _____
- No plants: _____

Model Evaluation: Patterns Well-Represented:

- _____

Real-World Complexity Missing:

- _____