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Aquarium Simulator Activity: Microbial Mediation of the Nitrogen Cycle

AP Biology/College Level Teacher Guide

Overview

This guide supports implementation of the Aquarium Simulator Activity: Microbial Mediation of the Nitrogen Cycle using the 5E instructional model.

Learning Objectives

- Students will analyze the biogeochemical cycling of nitrogen through biotic and abiotic reservoirs
- Students will investigate how microorganisms facilitate nitrogen cycling in ecosystems
- Students will observe nitrogen transformations over time

Standards Alignment

Topic 8.2: Energy Flow Through Ecosystems

- **LO 8.2.B:** Explain how energy flows and matter cycles through trophic levels

Essential Knowledge:

- **EK 8.2.B.6:** The nitrogen cycle involves several steps, including nitrogen fixation, assimilation, ammonification, nitrification, and denitrification. These steps are performed by microorganisms in the soil

Topic 8.7: Disruptions in Ecosystems

- **LO 8.7.C:** Describe human activities that lead to changes in ecosystem structure and dynamics

- **EK 8.7.C.1:** Human impact accelerates changes at local and global levels. These activities can drive changes in ecosystems, such as the following, that cause extinctions to occur: i. Biomagnification ii. Eutrophication

Prerequisites

- Understanding of biogeochemical cycles
- Matter cycling through ecosystems

Time Estimate

50 minutes

Materials Needed

- Computer with internet access
- Scientific calculator or spreadsheet software
- Student Investigation Sheet
- Primary literature excerpt (provided)

Teaching Tips by Phase

Phase 1: ENGAGE (5-10 minutes)

- Start with the phenomenon or problem presented
- Elicit student predictions and prior knowledge
- Create cognitive dissonance if possible
- Build excitement for investigation

Phase 2: EXPLORE (15-20 minutes)

- Allow students to investigate with minimal guidance
- Circulate and ask probing questions
- Encourage systematic data collection
- Note common discoveries and difficulties

Phase 3: EXPLAIN (10-15 minutes)

- Have students share their findings first
- Build on their observations to introduce concepts
- Address misconceptions directly
- Connect to broader biological principles

Phase 4: ELABORATE (10 minutes)

- Apply knowledge to new scenarios
- Make real-world connections
- Encourage deeper investigation
- Support transfer of learning

Phase 5: EVALUATE (5-10 minutes)

- Use varied assessment strategies
- Focus on conceptual understanding
- Provide immediate feedback
- Plan follow-up based on results

> **Remember:**
>
> The goal is student discovery through guided inquiry. Resist the urge to explain concepts before students have explored them!
