Aquarium Simulator Activity: Microbial Mediation of the Nitrogen Cycle

Middle School (NGSS Aligned) 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 how nitrogen cycles through an aquatic ecosystem
- Students will explain the role of bacteria in transforming nitrogen compounds
- Students will predict the effects of different interventions on water chemistry

Standards Alignment

- **MS-LS2-3:** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem
- **MS-PS1-5:** Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved

Prerequisites

- Basic understanding of chemical changes
- Knowledge that living things produce waste
- Familiarity with bacteria as decomposers

Time Estimate

45-50 minutes

Materials Needed

- Computer/tablet with internet access
- Student Activity Sheet (digital or printed)
- Colored pencils (optional for drawing)

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!
