

Lesson Planner Template (Launch, Explore, Summarize)

Topic: Water Quality

Lesson: Biotic

Lesson Length: 70 minutes

Part One: Goals and Objectives

What are the big ideas of the investigation?

Shellfish are filter-feeders and shellfish growers need to find a location/system which provides this for their crop
How do growers either provide and/or quantify how much food the shellfish are getting?
Harmful algae blooms result from multiple inputs into the water system and affect both animal and human health
Harmful algae blooms are also a natural phenomenon related to the seasons
Larval transport in ocean currents - leads to seeding the farm and also bio-fouling

What will students know or be able to do when this investigation is completed?

Students will follow Standard Operating Procedures to collect and analyze a sample, identifying and quantifying what is present in the sample
Students will be able to name and identify the top 3 Harmful Algae Bloom species (HABs) - Alexandrium, Dinophysis, Pseudonichea)
Students will be able to calculate cells per liter
Students will be able to explain how abiotic water quality affects biotic water quality, and how human action affects both.

Part Two: Teaching Model

Launch (5-10 minutes)

How will I launch this problem?

Pose the question, "When is it safe to eat shellfish?" "When isn't it safe to consume shellfish?" Have students discuss in pairs, and then share with the group.

What prior knowledge do my students need?

What are biotoxins and how do they affect organisms - great to know what a neurotoxin does
How do shellfish eat? This activity could be a good followup to a dissection of a scallop/oyster
What does bioaccumulation mean, and how does it relate to biomagnification
What chlorophyll does and how producers/autotrophs use it
Abiotic water quality factors and how human activity affects them

Explore (15 - 45 minutes)

How will I organize the students to explore this problem?

*(Individuals/Groups/**Pairs**)*

What materials will students need to encourage diverse thinking and problem solving?

Bucket of known volume, or with a known volume level clearly measured and marked (10 liters)
20 micron pour-through filter
Small vial of known volume to concentrate sample into (100mL)
Pipettes - disposable
Sedwick Rafter microscope slide
Compound microscope with 4X, 10X lenses
Phyto- and zoo- plankton identification sheets

What are different strategies I anticipate them using?

Students could suggest other locations, other times of day, multiple depths, different tides, etc.
While we'll use the Sedwick cell counter, students might suggest other methods for quantifying the plankton, or ways to use the cell counter slide.
Other different ways to identify plankton? By color? By shape?

What kinds of questions can I ask?

Prompt students to consider if this community/population of plankton would be static? If not, how might they change? What would drive those changes?
Why is it important to follow an SOP for this work? What could happen if people didn't follow it?
How many samples should be taken to get an accurate picture of the plankton community?
How often should those samples be taken?

Summarize (15-25 minutes)

How can I orchestrate the discussion so the students summarize the thinking in the problem?

Share satellite imagery of chlorophyll levels throughout the year in the Gulf of Maine, then ask:

- Are chlorophyll levels static?
- What could cause changes?
- What does the chlorophyll represent?
- What can we measure with it that we can't measure with satellite imagery?

What connections are there between the chlorophyll levels throughout the year and human activity?

When do students think we are most likely to see increases in HAB populations?

When would students expect to see the highest/fastest growth rate in filter-feeding shellfish?

Ask students to explain their rationale for choosing the sites they did for collecting the water samples. What did they expect they would find? Were there any surprises?

What scientific knowledge and processes need to be drawn out and emphasized?

The SOP for identification and reporting of HABs
How seasonality affects plankton populations and communities - nutrient loading, runoff, sunlight, temperatures, migrating predators

Next Steps - additional problems, homework, independent projects

Which investigations are appropriate for my students to do after the investigation?

Biosecurity - what protocols does the state have in place to preserve biosecurity
Biofouling - how does this impact the aquaculture industry? What strategies exist to cope with this challenge? Can students suggest a new technology or strategy for minimizing biofouling?