BACK BAY SCIENCE CENTER

Harmful Algal Blooms

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SCIENCE
CENTER

Newport Beach ~ California

ACTIVITY : ALGAE ATTACK!: A lesson on Harmful Algal Blooms
GRADE LEVEL: 8th-12th

Activity at a Glance: Through scenario situations they will discover how harmful blooms of algae can affect the ocean food web and human health.

NEXT GENERATION SCIENCE STANDARDS

PERFORMANCE EXPECTATIONS

MS-LS2-2 Ecosystems: Interactions, Energy, and Dynamics
Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
MS-LS2-4 Ecosystems: Interactions, Energy, and Dynamics
Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
MS-ESS3-2 Earth and Human Activity
Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
HS-LS2-6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
HS-LS4-5. Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions • Apply scientific principles to design an object, tool, process, or system (MS-ESS3-3) **Engaging in Argument from Evidence** • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments (HS-LS2-6) Connections to Nature of Science ------------------------- **Scientific Knowledge is Open to Revision in Light of New Evidence** • Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation (HS-LS2-6)	**ETS1.B: Developing Possible Solutions** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it (MS-ETS1-4) • Models of all kinds are important for testing solutions (MS-ETS1-4) **ETS1.C: Optimizing the Design Solution** • The iterative process of testing the most promising solutions and modifying what is posposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution (MS-ETS1-4) **ESS3.C: Human Impacts on Earth Systems** • Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things (MS-ESS3-3) • Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth, unless the activities and technologies involved are engineered otherwise. (MS-ESS3-3) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** • A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e. the ecosystem is	**Cause and Effect** • Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation (MS-ESS3-3) **Stability and Change** • Much of science deals with constructing explanations of how things change and how they remain stable (HS-LS2-6)

	resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability (HS-LS2-6)	

Ocean Literacy Principle 5: The ocean supports a great diversity of life and ecosystems
A- Ocean life ranges in size from the smallest living things, microbes, to the largest animal on Earth, blue whales.
B- Most of the organisms and biomass in the ocean are microbes, which are the basis of all ocean food webs. Microbes are the most important primary producers in the ocean. They have extremely fast growth rates and life cycles, and produce a huge amount of the carbon and oxygen on Earth.

Ocean Literacy Principle 6: The ocean and humans are inextricably interconnected.
C- Humans effect the ocean in a variety of ways. Laws, regulations, and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (point source, non-point source, and noise pollution), changes to ocean chemistry (changes to the beaches, shores, and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

TEACHING GUIDE – HARMFUL ALGAL BLOOMS

ACTIVITY: Algae Attack!

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OBJECTIVES:
Students will be able to:
> Explain how the presence and abundance of plankton can affect entire ecosystems and sources of pollution.

MATERIALS: (Print materials)
HABs analysis questions (optional)
Patient scenarios A,B,C,D
Shellfish poisoning symptoms dichotomous key
Plankton identification card
Marine bioaccumulation and biomagnification worksheet

KEY TERMS:

Algal Bloom   Anoxic   Biomagnification   Bioaccumulation   Cellular Respiration
Chloroplast Flagella   Holoplankton   Meroplankton   Morphology   Organism
Phytoplankton   Photosynthetic   Plankton   Primary Producer Thermocline
Trophic Level   Water Column   Zooplankton   Productivity   Harmful algal blooms
Diarrhetic Shellfish Poisoning   Amnesic Shellfish Poisoning
Nuertoxic Shellfish Poisoning   Paralytic Shellfish Poisoning

TEACHING METHOD:

Engage your student :
"*What are the two main types of plankton?*" "*Which type is a producer and which is a consumer?*" A: phytoplankton are producers. Like plants, they make their own food through photosynthesis. Zooplankton are animals and consume other zooplankton or phytoplankton.
"*How does pollution affect phytoplankton?*" Like plants, phytoplankton need: sunlight, carbon dioxide, water, and nutrients to grow. Nutrients are typically the limiting factor for phytoplankton. If humans introduce excess nutrients through pollution, we sometimes see population explosions, or "blooms" of phytoplankton.
"*What are some sources of pollution?*" A: runoff of pollution from land, industrial waste, cleaning chemicals, fertilizers.

 NOTE: *the students might not know the answers to these engagement questions, which is ok! By the end of the lesson they should have a better understanding of the overriding concepts.

Let your student explore:
Students will read the background section. Then help them with the Marine Bioaccumulation and Biomagnification Worksheet. They will then use the dichotomous key to diagnose a hypothetical Patient's illness (scenarios A,B,C,and D). This will help them to discover the species of plankton that caused their "patient's" illness. They can then read the plankton ID card to find out what type of toxin is produced by the species of plankton that they had discovered. Use the Marine Bioaccumulation and Biomagnification worksheet to emphasize the concepts of bioaccumulation and biomagnification.

Explain & Expand:
After completing the activity, your student should be able to explain to you the importance of plankton in the ocean food web, as well as what happens when some species of phytoplankton form blooms.

Evaluate their understanding: What species of phytoplankton cause each type of poisoning? **Amnesic shellfish poisoning** : Psuedo-nitzschia.
Neurotoxic shellfish poisoning: Karenia brevis
Diarrhetic Shellfish Poisoning: Dinophysis
Paralytic shellfish poisoning: Alexandrium
What is the name of the toxin that causes that poisoning?
Amnesic shellfish poisoning : domoic acid
Neurotoxic shellfish poisoning: brevetoxins
Diarrhetic Shellfish Poisoning: okadaic acid
Paralytic shellfish poisoning: saxitoxins
Are there ways that humans could potentially help mitigate HABs or reduce the number of events? A: Answers will vary.