Red Tide Effects on Marine Populations

Companion Lesson to X-STEM All Access Episode "Combining STEM Superpowers"

Grade/ Grade Band: High School	Topic: Environmental Science/Life Science			
Brief Lesson Description:				
Explore the phenomenon of Harmful Algal Blooms (Red Tide) and determine how patterns in data help scientists predict the biodiversity and				
populations in the Gulf of Mexico Ecosystem.				
Performance Expectation(s):				
HS LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and				
populations in ecosystems of different scales.				
Specific Learning Outcomes:				
-Students can explain what Red Tide is and how it is caused by Algal Blooms				
-Students can use the identify-interpret-Summarize strategy to analyze data in a graph				
Narrative / Background Information				
Prior Student Knowledge:				
-Students should be familiar with how energy	and matter cycle through a food web using the i	idea of primary, secondary, and tertiary		
consumers				
-Students should have the familiarity of readin	g graphs and interpreting their meaning			
Science & Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concepts:		
Using Mathematics and Computational	LS2.A: Interdependent Relationships in	Scale, Proportions, and Quantity		
Thinking	Ecosystems	Using the concepts of orders of		
Mathematical and computational thinking in	 Ecosystems have carrying capacities, which are limits to the 	magnitude allows one to		
9-12 builds on K-8 experiences and	numbers of organisms and	understand how a model at one		
progresses to using algebraic thinking and	populations they can support.	scale relates to a model at another		
functions including trigonometric functions	These limits result from such	Scale		
exponentials and logarithms, and	factors as the availability of living			
computational tools for statistical analysis to	and nonliving resources and from			
analyze represent and model data. Simple	such challenges such as predation,			
computational simulations are created and	competition, and disease.			
used based on mathematical models of	Organisms would have the			
basic assumptions.	capacity to produce populations			
Use mathematical representations	of great size were it not for the			
of phenomena or design solutions	fact that environments and			
to support and revise	resources are finite. This			
explanations.	fundamental tension affects the			
	individuals) of species in any given			
Connections to Nature of Science	ecosystem			
Scientific Knowledge is Open to Revision in	ccosystem.			
Light of New Evidence Most scientific knowledge is guite	LS2.C: Ecosystem Dynamics,			
durable but is in principle subject	Functioning, and Resilience			
to change based on new evidence	A complex set of interactions			
and/or reinterpretation of existing	within an ecosystem can keep its			
evidence.	numbers and types of organisms			
	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 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.		
Possible Preconceptions/Misconceptions:			
-Students may have an oversimplified view of i	nteractions in an ecosystem and how various m	nembers are affected by environmental	
changes. They may believe that varying the po	pulation size of a species may not affect an eco	system because some organisms are not	
important.			
-Students may believe that Ecosystems change	little over time.		
LESSON PLAN – 5-E Model			
ENGAGE: Opening Activity – Access Prior Lea	rning / Stimulate Interest / Generate Question	S:	
Start the lesson by displaying this image of Red Tide. Do not tell students what the images are about. Instead, tell students that			
Environmental Scientists on the coast of the Gulf of Mexico are observing a phenomenon. Ask students to take a couple of minutes to look			
at the image and then , ask students to discuss the following questions about the image:			
 What is going on in this picture? 			
 What do you see that makes you say 	that?		
• What more can you find?			
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Have groups of students share what they think is going on in this picture. Explain to students that to learn about this phenomenon, you are going to watch the X-STEM Video "<u>Combining STEM Super Powers with Dr. Tracy Fanara.</u>" *Note: This video segment starts with the link and ends at 21:30.

Following the video, discuss as a class what phenomenon Dr. Tracy Fanara presented about these pictures. (Red Tide). Explain that today the rest of the lesson will focus on answering the question "How does the Red Tide impact the populations of other species in the Gulf of Mexico?"

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:

Students will start by looking at the <u>food web diagram from the US National Office for Harmful Algal Blooms</u>. In small groups, have students discuss the following questions:

- What organisms are primary consumers of the Toxic HAB? Secondary consumers? Tertiary consumers?
- If the amount of toxin from the algae increases in this food web, what do you predict will happen to the populations of the other organisms in the ecosystem?

Next, tell students that they are going to participate in a simulation to check their prediction. Use the <u>Activity: Algal Bloom (Pages 6-7)</u> from Project Oceanography to collect data about how the fish population in this ecosystem will be affected. After the simulation, have the students *compare their results to the predictions that they originally made in this activity.* Then, have them discuss how they would answer the focus question *"How does the Red Tide impact the populations of other species in the Gulf of Mexico?"*

EXPLAIN: Concepts Explained and Vocabulary Defined:

Now that they have a basic understanding of how the Red Tide has affected fish in the food web, explain that they will now start to delve more deeply into data about Red Tide. As Dr. Fanara discussed in the X-STEM video, scientists are collaborating to determine what causes the Red Tide and how to predict its impacts in the future. Students will be analyzing data that has been generated using a computerized ecosystem model to determine how different lethal amounts of Red Tide would impact different classification of Marine animals. (Extension opportunity: have students read the <u>abstract of this paper here</u>.)

To analyze this data, students will be using the Identify, Interpret, and Summarize strategy. To explain this strategy to the students, show the following <u>YouTube Video</u>-OR- have students read and summarize the <u>following article</u>. Now students will practice this strategy to answer the question "How has the severity of Red Tide changed over time?" Then provide students with <u>Graph 1: NOAA Bloom Severity Index for Each Calendar Year</u>. With a partner, have them practice using the Identify-Interpret-Summarize Strategy. As a class, discuss each step of the process. *What patterns are identified? What is their interpretation of each pattern? What summary can they write to explain this graph*.

ELABORATE: Applications and Extensions:

Students will next use the Identify-Interpret-Summarize strategy to analyze <u>Graph 2: Predicted Time Series of Community Indicator</u> to answer the focus question *"How does the Red Tide impact the populations of other species in the Gulf of Mexico?"* Pair students to analyze the graph. Then provide students with <u>Graph 2: Predicted Time Series of Community Indicator</u>. With a partner, have them practice using the Identify-Interpret-Summarize Strategy. Each group of students should answer the following questions for the graph on a large white board or a piece of chart paper.

1. What patterns are identified? 2. What is their interpretation of each pattern? 3. What summary can they write to explain this graph?

After students have completed their analysis, they will complete a <u>Gallery Walk</u> to see how their classmates analyzed the graph. At each group that they visit, students should provide the following feedback using post-it notes: I like...I wonder...Next I would....

When students return to their own work, they should read the feedback provided by their classmates. They can then make any needed improvements to their poster.

EVALUATE:

Formative Assessment:

Prompts throughout the lesson in **bold and italics** and posters of graph two analysis can be used to check student understanding throughout the lesson.

Summative Assessment:

Students should write a scientific explanation using the Claim-Evidence Reasoning format to answer the question "How does the Red Tide impact the populations of other species in the Gulf of Mexico?" This can be graded using this <u>Rubric</u> or other locally available tools.

Elaborate Further / Reflect: Enrichment:

Possible activities include:

- Students can grow algae and observe its properties using the Activity: Growing Algae from Project Oceanography.
- Students can develop and debate hypotheses about real world Harmful Algal Bloom situations using this lesson from National Geographic
- Students can learn more about Dr. Fanara and Environmental Engineering by exploring her Inspector Planet website

SOCIAL EMOTIONAL LEARNING ACTIVITY

CASEL Competency Addressed: Self Management

In the X-STEM video, Dr. Fanara talked about the importance of connecting with nature. Today we are going to delve into why nature benefits your mental health and then spend some time in nature.

Start by showing the video, <u>"Stanford Researchers find Mental Health Prescription: Nature"</u>. After the video, have students summarize the findings of the Stanford study.

Next, have students generate a list of areas locally where they can go explore nature. If they cannot identify any areas, you can use google maps and search "Nature Areas Near Me" to point out areas. Next, have students brainstorm a list of possible times that they feel anxious or depressed that visiting nature could help.

If your campus is located near a nature area, have students go out and walk in the area for five (or more) minutes. If your campus is not located near a nature area, you can have students watch a nature video on YouTube for five (or more minutes).

After their exposure to nature, have students reflect with a partner on their mood. How did interacting with nature impact them?

INTERDISCIPLINARY CONNECTIONS/IDEAS

Geography: Have students explore the <u>data maps from FWC Fish and Wildlife Research Institute</u>. Have them use the Identify-Interpret-Summarize strategy from the Explain segment of this lesson to determine what this data set means about the annual timing of the Red Tide. Have them reflect on how geography and climate may result in these patterns.

Economics/Mathematics: Have students read the Article "<u>Quantifying the Economic Costs of Red Tides.</u>" Have students analyze the article to determine what metrics and statistics are helpful in quantifying the costs and what factors may not be considered.

Language Arts: Have students read <u>"Seekers of Science: Volume 1"</u> Have students complete a character analysis on each of the scientists (including Dr. Fanara). How does the graphic novel develop their super powers using literary techniques?

Materials Required for This Lesson/Activity		
Quantity	Description	
Class Set	Poker Chips (or two different colored paper scraps)	
Four	Cones or Boundary Markers	
Class Set	Gym Vests or other object to identify roles in a game	
1 per group	Chart Paper -or-Large Whiteboard	



Lesson Created by Jess Noffsinger For questions please contact info@usasciencefestival.org