The Effect of Algal Blooms on Marine Ecosystems

by Mark Weese

The goal of this module is for students to learn about the importance of population balance in marine ecosystems and how human activities (specifically fertilizer run-off from nearby farmlands into the Mississippi River) can impact energy webs by changing predator/prey relationships.

A lab activity is included in this module during the Reading/Data Collection Process, enabling students to supplement the data collected from reading with their own lab results.

Students are required to use scientific articles to research the cause and effect of algal blooms off the coast of the U.S. and write a letter to the Environmental Protection Agency to inform them of the problem as well as suggest possible solutions.

I highly recommend having students complete the Dead in The Water lab to provide evidence in the classroom of the effects fertilizer has on pond ecosystems. Students should use their observations when constructing a strong letter to the EPA. This lab is provided in my resources.

After sending in letters to the EPA, we did receive a letter in response from the agency. This letter can be found under my resources.

This module was created by Mark Weese, a Life Science teacher from Effingham County.

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This module can be adapted to emphasize any of the Life Science Georgia Performance Standards, and I was able to include concepts taken from each of the five Life Science standards.

You can use the articles that I used in my module or find articles that work better for your discipline and regional concerns. I have uploaded additional articles (see digital articles) that include lexile levels for each resource.

Articles used in this module:


"The Gulf of Mexico Dead Zone and Red Tides" by Elizabeth Carlisle.
http://www.tulane.edu/~bfleury/envirobio/enviroweb/DeadZone.htm

**Grades:** 7

**Discipline:** Science

**Teaching Task:** Task Template 25 (Informational or Explanatory and Cause/Effect)

**Course:** Life Science

**Author Information:**
Mark Weese (Effingham County)
Section 1: What Task?

TEACHING TASK

Task Template 25 — [1 Level]  Informational & Cause/Effect

L1: What effect do algal blooms have on marine environments off the coast of the United States? After reading scientific texts on fertilizer run-off and algal blooms, write a letter to the Environmental Protection Agency that examines the causes of algal blooms and explains the effect(s) fertilizer run-off has on the population of algae in marine ecosystems. What conclusions or implications can you draw? Support your discussion with evidence from the text(s).

STUDENT BACKGROUND

The Environmental Protection Agency is composed of ecologist that engage in decision making at various levels of government. They work with federal agencies to create environmental laws that ensure preserving, utilizing, and sustaining the American ecosystems. This organization works to communicate with the public, the importance of maintaining balanced ecosystems. Write a letter that addresses how the agricultural industries are contributing to the occurrence of algal blooms off the coast of the United States and the effect it has had on marine life. In your discussion, include several ideas that may resolve efforts for a ecological balance. In efforts to have a larger voice, informing this organization of the problem will help in efforts to address the situation as well as expedite a solution.

EXTENSION

Dead in the Water Lab: This lab simulates the creation of a dead zone similar to the one in the Gulf of Mexico due to huge expanses of algal growth.
## Rubric

<table>
<thead>
<tr>
<th>Scoring Elements</th>
<th>Not Yet</th>
<th>Approaches Expectations</th>
<th>Meets Expectations</th>
<th>Advanced</th>
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<td>1</td>
<td>1.5</td>
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<tr>
<td>Focus</td>
<td>Attempts to address prompt, but lacks focus or is off-task.</td>
<td>Addresses prompt appropriately, but with a weak or uneven focus.</td>
<td>Addresses prompt appropriately and maintains a clear, steady focus.</td>
<td>Addresses all aspects of prompt appropriately and maintains a strongly developed focus.</td>
</tr>
<tr>
<td>Controlling Idea</td>
<td>Attempts to establish a controlling idea, but lacks a clear purpose.</td>
<td>Establishes a controlling idea with a general purpose.</td>
<td>Establishes a controlling idea with a clear purpose maintained throughout the response.</td>
<td>Establishes a strong controlling idea with a clear purpose maintained throughout the response.</td>
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<tr>
<td>Reading/Research</td>
<td>Attempts to present information in response to the prompt, but lacks connections or relevance to the purpose of the prompt. (L2) Does not address the credibility of sources as prompted.</td>
<td>Presents information from reading materials relevant to the purpose of the prompt with minor lapses in accuracy or completeness. (L2) Begins to address the credibility of sources when prompted.</td>
<td>Presents information from reading materials relevant to the prompt with accuracy and sufficient detail. (L2) Addresses the credibility of sources when prompted.</td>
<td>Accurately presents information relevant to all parts of the prompt with effective selection of sources and details from reading materials. (L2) Addresses the credibility of sources and identifies salient sources when prompted.</td>
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<tr>
<td>Development</td>
<td>Attempts to provide details in response to the prompt, including retelling, but lacks sufficient development or relevancy. (L2) Implication is missing, irrelevant, or illogical. (L3) Gap/unanswered question is missing or irrelevant.</td>
<td>Presents appropriate details to support the focus and controlling idea. (L2) Briefly notes a relevant implication or (L3) a relevant gap/unanswered question.</td>
<td>Presents appropriate and sufficient details to support the focus and controlling idea. (L2) Explains relevant and plausible implications, and (L3) a relevant gap/unanswered question.</td>
<td>Presents thorough and detailed information to strongly support the focus and controlling idea. (L2) Thoroughly discusses relevant and salient implications or consequences, and (L3) one or more significant gaps/unanswered questions.</td>
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<tr>
<td>Organization</td>
<td>Attempts to organize ideas, but lacks control of structure.</td>
<td>Uses an appropriate organizational structure to address the specific requirements of the prompt, with some lapses in coherence or awkward use of the organizational structure.</td>
<td>Maintains an appropriate organizational structure to address the specific requirements of the prompt.</td>
<td>Maintains an organizational structure that intentionally and effectively enhances the presentation of information as required by the specific prompt.</td>
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<td>Conventions</td>
<td>Content Understanding</td>
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<tr>
<td>Attempts to demonstrate standard English conventions, but lacks cohesion and control of grammar, usage, and mechanics. Sources are used without citation.</td>
<td>Attempts to include disciplinary content in explanations, but understanding of content is weak; content is irrelevant, inappropriate, or inaccurate.</td>
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<td>Demonstrates an uneven command of standard English conventions and cohesion. Uses language and tone with some inaccurate, inappropriate, or uneven features. Inconsistently cites sources.</td>
<td>Briefly notes disciplinary content relevant to the prompt; shows basic or uneven understanding of content; minor errors in explanation.</td>
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<td>Demonstrates a command of standard English conventions and cohesion, with few errors. Response includes language and tone appropriate to the audience, purpose, and specific requirements of the prompt. Consistently cites sources using an appropriate format.</td>
<td>Accurately presents disciplinary content relevant to the prompt with sufficient explanations that demonstrate understanding.</td>
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<tr>
<td>Demonstrates and maintains a well-developed command of standard English conventions and cohesion, with few errors. Response includes language and tone consistently appropriate to the audience, purpose, and specific requirements of the prompt. Consistently cites sources using appropriate format.</td>
<td>Integrates relevant and accurate disciplinary content with thorough explanations that demonstrate in-depth understanding.</td>
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<td>Standards</td>
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<td><strong>Georgis — Life Science</strong></td>
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<td><strong>S7L1:</strong> Students will investigate the diversity of living organisms and how they can be compared scientifically.</td>
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<td><strong>S7L2:</strong> Students will describe the structure and function of cells, tissues, organs, and organ systems.</td>
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<td><strong>S7L3:</strong> Students will recognize how biological traits are passed on to successive generations.</td>
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<td><strong>S7L4:</strong> Students will examine the dependence of organisms on one another and their environments.</td>
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<td><strong>S7L5:</strong> Students will examine the evolution of living organisms through inherited characteristics that promote survival of organisms and the survival of successive generations of their offspring.</td>
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<tr>
<th>Anchor Standards — Reading</th>
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<tr>
<td><strong>R.CCR.1:</strong> Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.</td>
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<tr>
<td><strong>R.CCR.2:</strong> Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.</td>
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<tr>
<td><strong>R.CCR.4:</strong> Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.</td>
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<td><strong>R.CCR.6:</strong> Assess how point of view or purpose shapes the content and style of a text.</td>
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<td><strong>R.CCR.10:</strong> Read and comprehend complex literary and informational texts independently and proficiently.</td>
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<tr>
<th>Anchor Standards — Writing</th>
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<tr>
<td><strong>W.CCR.2:</strong> Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.</td>
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</tbody>
</table>
**W.CCR.4:** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

**W.CCR.5:** Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.

**W.CCR.9:** Draw evidence from literary or informational texts to support analysis, reflection, and research.

**W.CCR.10:** Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

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**Anchor Standards — Language**

**L.CCR.1:** Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

**L.CCR.2:** Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

**L.CCR.3:** Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.

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**Anchor Standards — Speaking and Listening**

**SL.CCR.4:** Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

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**Custom Standards**
### Section 2: What Skills?

#### Selected Skills

**Preparing for the Task**

**TASK ENGAGEMENT:** Ability to connect the task and new content to existing knowledge, skills, experiences, interests, and concerns

**TASK ANALYSIS:** Ability to understand and explain the task’s prompt and rubric.

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**Reading/Data Collection Process**

**NOTE-TAKING:** Ability to read purposefully and select relevant information; to summarize and/or paraphrase.

**ESSENTIAL VOCABULARY:** Ability to apply strategies for developing an understanding of text(s) by locating words and phrases that identify key concepts and facts, or information.

**MAKING INFERENCES:** Ability to make observations and relate these observations to key concepts and essential vocabulary learned.

**ACTIVE READING:** Ability to identify the central point and main supporting elements of a text.

**SCIENTIFIC INQUIRY:** Ability to use scientific concepts and apply them to develop or simulate experimental designs.

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**Transition to Writing**

**BRIDGING:** Ability to begin linking reading results to writing task.

**ACADEMIC INTEGRITY:** Ability to use and credit sources appropriately.

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**Writing Process**

**CONTROLLING IDEA:** Ability to establish a controlling idea and consolidate information relevant to task.

**PLANNING:** Ability to develop a line of thought and text structure appropriate to an information/explanation task.
| **DEVELOPMENT:** | Ability to construct an initial draft with an emerging line of thought and structure. |
| **REVISION:**   | Ability to refine text, including line of thought, language usage, and tone as appropriate to audience and purpose. |
| **EDITING:**    | Ability to proofread and format a piece to make it more effective. |
| **COMPLETION:** | Ability to submit final piece that meets expectations. |
Section 3: What Instruction?

MiniTasks

Preparing for the Task

**TASK ENGAGEMENT:** Ability to connect the task and new content to existing knowledge, skills, experiences, interests, and concerns

**SHORT CONSTRUED RESPONSE**
In a quick write, write your first reaction to the task prompt. Add some notes of things you know about balanced ecosystems as well as how this consideration of the topic might require more information than what you already have.

**Pacing:** 15 minutes

**Scoring Guide: work meets expectations if:**
None

**Teaching Strategies:**
• Link this task to earlier class content.
• Discuss student responses.
• Clarify timetable and support plans for the task.

**TASK ANALYSIS:** Ability to understand and explain the task’s prompt and rubric.

**SHORT CONSTRUED RESPONSE**
In your own words, what are the important features of a good response to this prompt?

**Pacing:** 20 minutes

**Scoring Guide: work meets expectations if:**
None

**Teaching Strategies:**
Discuss why this task is important to us and how it relates to people in our region (local and national).
Share examples of types of text students will produce (use student samples or samples from professional writers).
Discuss the importance of writing letters to public figures and ways to get information out to the general public.
Reading/Data Collection Process

**NOTE-TAKING:** Ability to read purposefully and select relevant information; to summarize and/or paraphrase.

**NOTES**
During the presentation, list key essential concepts that define the Protist Kingdom and differentiates this kingdom from other kingdoms of organisms.

**Pacing:** 35 minutes

**Scoring Guide:** work meets expectations if:
- Participates in discussion and provides credible responses to verbal questioning.

**Teaching Strategies:**
- Present characteristics of the Protist Kingdom and how they are classified scientifically (see PowerPoint in resources below).
- Compare and contrast these characteristics to the Prokaryotic Kingdoms.
- Share the important roles of algae and relate their usefulness and place in our lives.

**ESSENTIAL VOCABULARY:** Ability to apply strategies for developing an understanding of text(s) by locating words and phrases that identify key concepts and facts, or information.

**LIST**
In your notebook, list words and phrases essential to the texts. Add definitions, and (if appropriate) notes on connotation in this context.

**Pacing:** 20 minutes

**Scoring Guide:** work meets expectations if:
- Lists appropriate phrases.
- Provides accurate definitions.

**Teaching Strategies:**
- Discuss essential vocabulary such as photosynthesis, chloroplast, algae, and algal blooms

**OUTLINE**
Concept Map:
Represent the relationship between photosynthesis and cellular respiration by designing a diagram of the chloroplast and the mitochondria; include products and reactants of each cellular process.

Pacing: 30 minutes

Scoring Guide: work meets expectations if:
• Designs an appropriate model that represents how the two processes work together to present a cycle within the eukaryotic plant cell.

Teaching Strategies:
• Present the concepts of photosynthesis and cellular respiration and how these two organelles work together to provide energy for producers such as algae.
• Discuss reactants, products of each process, and how each depends on one another.
• Relate these processes to what is occurring in pond water algae.

MAKING INFERENCES: Ability to make observations and relate these observations to key concepts and essential vocabulary learned.

SHORT CONSTRUCTED RESPONSE
How are protists classified?
What characteristics define this kingdom of organisms?
Draw and describe several of the organisms that you found in the pond water. Using the dichotomous key, try to identify the organisms you observed.

Pacing: 60 minutes

Scoring Guide: work meets expectations if:
Records appropriate observations using appropriate descriptive terms that relate to key concepts.

Teaching Strategies:
Pass out and explain “Life in a Drop of Water” pond water lab: Using microscopes, students observe life in pond water.
Students identify key characteristics learned in previous lessons and record observations.
Using identification key or dichotomous key, students identify protists found in the water.
ACTIVE READING: Ability to identify the central point and main supporting elements of a text.

SHORT CONSTRUCTED RESPONSE
Research Questions to guide reading:
How does fertilizer get into the Mississippi River?
What is the active ingredient in the fertilizer?
How does fertilizer run-off promote a “dead zone” in the Gulf of Mexico”?
How have algal blooms impacted marine life in the Gulf of Mexico?
How do scientists hope to decrease the size of the “dead zone”?  
Pacing: 35 minutes

Scoring Guide: work meets expectations if:
• Appropriately explains how algal blooms have formed in the Gulf of Mexico and affected marine life.
• Answers questions with credible response.

Teaching Strategies:
• Provide Kirsten Weir’s, “Dead in the Water” article and discuss the value of the content as it relates to the everyday life of citizens in the United States.
• Discuss the causes and effects of algal blooms and how they affect marine ecosystems.
• Ask students to describe the process of algal bloom formations and the role bacteria play in the production of “hypoxic waters”; using student descriptions, draw a representation of the process on the board.

SHORT CONSTRUCTED RESPONSE
Guided Reading:
Nitrogen and phosphorous create favorable conditions for which organisms?
What are the toxins produced by these algae?
What specific health problems occur from these toxins?
Explain how these toxins affect organisms found higher in the food chain?

Pacing: 35 minutes

Scoring Guide: work meets expectations if:
• Answers questions with credible response.

Teaching Strategies:
• Provide students with the excerpt from Elizabeth Carlisle's The Gulf of Mexico
Dead Zone and Red Tides.
• Discuss the cause of red tides and how this relates to typical algal blooms.
• Discuss the effects red tides have on marine life, human health, tourism, fishing industries, and economical decline.

SHORT CONSTRUCTED RESPONSE
Research Questions to guide reading:
• What is being carried in dust clouds across the Atlantic Ocean from Africa, causing an increase in bacteria in surface water?
• What is the name of the bacteria causing algal blooms?
• Explain how these bacteria increase the amount of algae in the water.
• What is the impact of red tides on the region’s economy? Cite evidence.
• How can red tides be predicted?

Pacing: 40 minutes

Scoring Guide: work meets expectations if:
• Answers questions with credible responses and evidence from text.

Teaching Strategies:
• Provide Students with Kimbra Cutlip’s “Red Tide’s Weather Trail.”
• Discuss favorable conditions for the formation of Red Tides.
• Discuss the effects of red tides on marine life, human health, tourism, fishing industries, and local economies.

SCIENTIFIC INQUIRY: Ability to use scientific concepts and apply them to develop or simulate experimental designs.

SHORT CONSTRUCTED RESPONSE
Scientific Method:
Design a controlled experiment that answers the problem, “How does fertilizer run-off impact pond water ecosystems?”
Come up with a hypothesis that answers this scientific problem (See Dead in the Water Lab in resources below).

Pacing: 2 days

Scoring Guide: work meets expectations if:
• Lab sheets, data analysis, observations, and data recording reflect the experimental procedure was accurately carried out and recorded.
**Teaching Strategies:**

- Provide students with the Dead in the Water Lab sheets and discuss procedures and pre-lab research questions.
- Set up classroom simulation of the dead zone occurring in the Gulf of Mexico by setting up a controlled experiment including three containers of pond water with different amounts of fertilizer added. (See Dead in the Water Lab in resources below).
- Additional fertilizer will be added weekly to two groups as noted in lab instructions. (See Dead in the Water Lab in resources)
- Make initial readings of turbidity, dissolved oxygen, and PH levels. Continue measuring and recording data on these features weekly to observe changes.

**Notes:**
This is a description of the experiment my students designed in response to the prompt. Any feasible and practical experiment students recommend could be used for this part of the module.

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**Transition to Writing**

**BRIDGING:** Ability to begin linking reading results to writing task.

**OUTLINE**

Cause and Effect Concept Map
To organize the information from your experiment and from your reading, design a cause and effect map using the following main ideas:
- Farm Lands and fertilizer use
- Mississippi River traveling into the Gulf of Mexico
- Formation of Algal Blooms
- Red Tides
- Disruptive Ecosystem
- Economic Decline

**Pacing:** 45 minutes

**Scoring Guide: work meets expectations if:**
- Check concept maps and provide appropriate feedback.

**Teaching Strategies:**
- Using the article read in class, students should be prompted to organize their ideas on the causes and effects associated with algal blooms and red tides. (See Cause
Pacing: 25 minutes

\begin{itemize}
\item Discuss that designing concept maps is an essential step in the pre-writing process.
\end{itemize}

\begin{center}
ACADEMIC INTEGRITY: Ability to use and credit sources appropriately.
\end{center}

\begin{center}
LIST
Citations:
Practice ways to include citations in a paper to support ideas and properly provide credit to authors.
\end{center}

\begin{center}
Pacing: 20 minutes
\end{center}

\begin{center}
Scoring Guide: work meets expectations if:
Work meets expectations if citations are appropriately included on the concept map.
\end{center}

\begin{center}
Teaching Strategies:
\begin{itemize}
\item After students complete the Cause and Effect concept map, have students list quotes from the readings that support the ideas they listed.
\item Have students practice various ways to properly incorporate these quotes and evidence into their paper using correct methods of crediting the author.
\end{itemize}
\end{center}

\begin{center}
Writing Process
\end{center}

\begin{center}
CONTROLLING IDEA: Ability to establish a controlling idea and consolidate information relevant to task.
\end{center}

\begin{center}
SHORT CONSTRUCTED RESPONSE
Write an opening paragraph that includes a controlling idea and sequences the key points you plan to make in your composition.
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\begin{center}
Pacing: 25 minutes
\end{center}

\begin{center}
Scoring Guide: work meets expectations if:
\begin{itemize}
\item Writes a concise summary statement or draft opening.
\item Provides direct answer to main prompt requirements.
\item Establishes a controlling idea.
\item Identifies key points that support development of argument.
\end{itemize}
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\begin{center}
Teaching Strategies:
\end{center}
• Students can be prompted to write the opening paragraph of their letter with the following questions:
  - “Whom are they addressing in their letter?”
  - “Why is this an important issue?”
  - “What makes the information they will discuss credible?”

**PLANNING:** Ability to develop a line of thought and text structure appropriate to an information/explanation task.

**OUTLINE**
Create an outline based on your notes and reading in which you state your claim, sequence your points, and note your supporting evidence.

**Pacing:** 50 minutes

**Scoring Guide: work meets expectations if:**
• Creates an outline or organizer.
• Supports controlling idea. Uses evidence from texts read and experiment conducted.

**Teaching Strategies:**
• Have students come up with their own outline for their letter using a sequencing map that includes major concepts they plan to discuss in each paragraph such as:
  - Define algae and explain their important ecological niche.
  - How algal blooms develop
  - How fertilizer enhances growth of algae
  - The ecological effects of algal blooms
  - The economical effects of algal blooms
  - Evidence from their experiments that supports the effects algal blooms have on marine life. (Students will have completed all data collection from "Dead in the Water Lab" and formed a conclusion from evidence.)
  - Brainstorm and discuss possible solutions to decrease the effects of algal blooms.
  - Struggling students may need a sequencing map such as the one above that is already completed for them.
  - Students should refer to the cause-and-effect concept map for quotations and details to incorporate into the outline.

**DEVELOPMENT:** Ability to construct an initial draft with an emerging line of thought and structure.
LONG CONSTRUCTED RESPONSE
Using your sequencing outline, write an initial draft complete with opening (already written), development, and closing; insert and cite textual evidence from your cause and effect map.

Pacing: 60 minutes

Scoring Guide: work meets expectations if:
• Provides complete draft with all parts.
• Supports the opening in the later sections with evidence and citations.

Teaching Strategies:
• Encourage students to refer back to their opening paragraph as they work on developing their letter to make sure they are supporting the main ideas of the letter.
• Have students use their sequencing maps as well as the cause and effect maps to organize and develop their letters.
• Encourage students to use appropriate transition words to link ideas.

REVISION: Ability to refine text, including line of thought, language usage, and tone as appropriate to audience and purpose.

LONG CONSTRUCTED RESPONSE
Refine composition’s analysis, logic, and organization of ideas/points. Use textual evidence carefully, with accurate citations. Decide what to include and what not to include.

Pacing: 60 minutes

Scoring Guide: work meets expectations if:
• Provides complete draft with all parts.
• Supports the opening in the later sections with evidence and citations.
• Improves earlier edition.

Teaching Strategies:
• Provide useful feedback that balances support for strengths and clarity about weaknesses.
• Provide students with a checklist of components (claim, evidence, warrant) that will strengthen their paper, and have the students highlight these features in their paper in order to prove they have incorporated them in their writing.
**EDITING**: Ability to proofread and format a piece to make it more effective.

**LONG CONSTRUCTED RESPONSE**
Revise draft to have sound spelling, capitalization, punctuation and grammar. Adjust formatting as needed to provide clear, appealing text.

**Pacing**: 50 minutes

**Scoring Guide: work meets expectations if:**
- Provides draft free from distracting surface errors.
- Uses format that supports purpose.

**Teaching Strategies:**
- Teach a short list of proofreading marks.
- Assign students to proofread each other’s letters and add feedback.

**COMPLETION**: Ability to submit final piece that meets expectations.

**LONG CONSTRUCTED RESPONSE**
Turn in your complete set of drafts, plus the final version of your piece

**Scoring Guide: work meets expectations if:**
- Fits the “Meets Expectations” category in the rubric for the teaching task.

**Teaching Strategies:**
- Teacher and peers provide meaningful feedback.
Selected Articles

Dead Zones Spreading in World Oceans.
BioScience (Jul 2005)—Dybas, Cheryl Lyn
This article deals with the spread of dead zones in the ocean. As of 2005, there are some 146 coastal dead zones. Since the 1960s, according to a report by the United Nations Environment Programme (UNEP), Global Environment Outlook Year Book 2003, the number of dead zones has doubled which each passing decade. Most are seasonal, but some persist year-round. The complex chain of events that led to dead zones begins not in the sea, but on land. Farmers often overfertilize their fields. The excess fertilizer, laden with nutrients like nitrogen, washes into creeks and rivers, where it is eventually carried into coastal bays and the open sea. Dead zones range in size, from small areas of coastal bays and estuaries to huge areas of the open sea, where they can reach tens of thousands of square kilometers. Most are found in temperate waters, off the eastern coast of the U.S. and in the seas of Europe. Some are brewing in the waters off China, Japan, Brazil, Australia, and New Zealand. The world’s largest dead zone is in the Baltic Sea, where nutrient-enriched runoff from farms has combined with nitrogen deposition from the burning of fossil fuels and human waste discharged directly into the sea’s waters. In the summers of 2002 and 2004, a new dead zone joined the worldwide ranks: waters off Newport, Oregon, suddenly had oxygen levels well below the minimum needed to support most marine life. At last count, 43 of the world’s known coastal dead zones occur in the US. waters. Dead zones are also found in the Great Lakes. A dead zone in Lake Erie now happens every year. Factors contributing to the problem are low water levels and fertilizer runoff from large farms. Scientists fear that it is affecting the dynamics of the lake’s food web.

The dead zones.
New Scientist (12/9/2006)—Schrope, Mark
The article focuses on issues related to the occurrence of dead zones in oceans. Oxygen levels in the water can fall to dangerously low levels under certain conditions, creating what is commonly known as a dead zone. Fast-swimming creatures like fish can flee, but most bottom dwellers, such as shellfish, are likely to die. Dead zones are both human induced, through pollution, and natural. Natural dead zones can be caused by high concentrations of algae in surface waters. INSETS: Adapting to the lows; Red tide.

Dead Waters.
Science News (6/5/2004)—Raloff, Janet
The article presents the first in a two part series on dead zones in coastal waters. Summer tourists cruising the waters off Louisiana or Texas in the Gulf of Mexico take in gorgeous vistas as they pull in red snappers and blue marlins. Few realize that the lower half of the water column below them may lack fish, despite the piscine bounty near the surface. For many years now, an annual dead zone has developed in the Gulf. Fish that can evacuate as oxygen drops do so—although abandoning their home habitat may render them vulnerable to predators. There is no mystery as to what triggers this annual hypoxic zone, as the oxygen-starved region is formally termed. Growing in unnatural abundance, bacteria use up most of the oxygen from the bottom water. A growing dead zone each summer is creating a habitat that favors jellyfish over the commercially valuable finfish, crabs, and oysters. Marine ecologists have documented both large and small dead zones in U.S. coastal waters throughout the past decade.

Reviving Dead Zones.
Scientific American (Nov2006)—Mee, Laurence
The article looks at the ways in which coastal seas ravaged by extreme amounts of plant and algae growth caused by human activities can be restored. Mentioned are the roles of eutrophication, fertilizing chemicals, nutrients, and oxygen in the overgrowth of microscopic plants. According to the author, significant reductions in agricultural and sewage runoff, as well as controls on overfishing, can restore marine ecosystems. INSETS: Overview; The Black Sea Comes Back.

Oceans of Trouble.
Current Health Teens (Oct2010)—Kowalski, Kathiann M.
The article focuses on ocean pollution which puts sea creatures at risk as well as the people who eat them. It also mentions the Deepwater Horizon explosion which killed 11 people and triggered oil spill into the Gulf of Mexico. It says that due to polychlorinated biphenyl (PCB) pollution, the U.S. Environmental Protection Agency (EPA) cautions people against eating too much fish such as shark, tilefish, king mackerel and swordfish.

Agreement to Shrink Dead Zone.
Science Now (10/12/2000)—Ferber, Dan
Reports the agreement between federal and state officials on the revival of the dead zone in the Gulf of Mexico in the United States. Effect of nutrients from sewage and fertilizer on the coastal waters; Plans on funding efforts in tracking nitrogen flow; Opposition of farmers against farm runoff reduction; Impact of nitrogen on oxygen supply.
DEAD IN THE WATER.

Current Science (3/4/2005)—Weir, Kirsten
This article reports that every minute of every day, the Mississippi River dumps 1 billion liters (260 million gallons) of water into the Gulf of Mexico. Mississippi River water carries huge amounts of fertilizer that have been washed into it from surrounding farms. It is opined that fertilizer sustains life. But in the Gulf of Mexico, it has the opposite effect. It promotes the development of a region devoid of sea life. Scientists call the region a dead zone. The Gulf of Mexico dead zone emerges at the seafloor and extends as high as 10 meters (33 feet) up the water column, says Nancy Rabalais, a marine scientist at the Louisiana Universities Marine Consortium. INSET: ZONED OUT.

Red Tide’s Weather Trail.

Weatherwise (Nov/Dec2001)—Cutlip, Kimbra
Reports that dust from the Sahara Desert is responsible for the red tide in the Gulf of Mexico, according to a study by researchers at the University of Florida. What was used to track large dust clouds leaving Africa on June 17, 1999; Dangers brought by toxic algal blooms, sometimes called red tides.

Uploaded Files

- **E:Life ScienceCell Structure and ProtistsThe Protist Kingdom.ppt**
  This PowerPoint was used to introduce the protist kingdom and provide essential vocabulary used to complete task.

- **E:Life ScienceCell Structure and ProtistsProtists Notes Fill In.doc**
  These are guided notes that go along with the Protist Kingdom PowerPoint to be provided to the students.

- **E:LDCDead in The Water TaskDead in the Water Prelab.doc**
  Life in a Drop of Water Lab: In this lab, students observe pond water under the microscope and identify the different microorganisms using an identification key.
Cause and Effect Concept Map: Prewrite process

This prompt provides the students with an idea of what is expected of them in their letters along with the provided rubric.

This is a guided reading that can be used to guide lower level students in reading Kirsten Weir’s “Dead in the Water” article. Students will be able to outline the important concepts needed and used to complete their task.

The full article may be found at this website: http://www.tulane.edu/~bfleury/envirobio/enviroweb/DeadZone.htm Article written by Elizabeth Carlisle on Red Tides and the impact it has on marine life as well as human health. The above file is an exert from The Gulf of Mexico Dead Zone and Red Tides by Elizabeth Carlisle along with guided questions that allows students to pull out the important information from the article.

Dead in the Water Lab: This is an ongoing lab report that simulates the effect fertilizer has on pond water. Students record data weekly on dissolved oxygen levels, pH levels, and other observations.
This is a concept map that the students create to illustrate the process of photosynthesis and cellular respiration. Because algae is the biggest producer of the Earth’s oxygen, it is a great opportunity to introduce cellular processes and cell organelles.

Letter from the EPA.pdf

This is a letter one student received back from the EPA in response to her letter

F:LDCDead in The Water TaskMap out Your Letter.doc

This sequencing concept map helps students organize their ideas during the prewriting process. The back side of this activity has students reflect on the cause and effects of several major concepts that should be included in their letter.

Keywords

- Algal Bloom
- Protist
- Food Web
- Food Chain
- Hypoxic
- Ecology
- Predator
- Prey
- Photosynthesis
- Red Tide
- Nitrates

Links*
Great article to use to provide evidence of the effect algal growth in the Gulf of Mexico and the devastation it has had on Marine life as well as the threats it has on human health.

* These Lexile measures were computed automatically and did not undergo human review. They are not certified measures and should not be published or recorded in any way.

**Other Resources**

Dead in The Water

The Gulf of Mexico Dead Zone and Red Tides
An exert from The Gulf of Mexico Dead Zone and Red Tides by Elizabeth Carlisle. http://www.tulane.edu/~bfleury/envirobio/enviroweb/DeadZone.htm This article explains the harmful toxins produced by cyanobacteria and how this affects other marine life.

Red Tide's Weather Trail
Red Tide's Weather Trail. By: Cutlip, Kimbra. Weatherwise, Nov/Dec2001, Vol. 54 Issue 6, p10, 2p. This text explains the cause and effects of algal blooms and the implications they have on commercial businesses that rely on marine ecosystems.
## Section 4: What Results?

### Classroom Assessment Rubric

<table>
<thead>
<tr>
<th></th>
<th>Not Yet</th>
<th>Meets Expectations</th>
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<tbody>
<tr>
<td><strong>Focus</strong></td>
<td>Attempts to address prompt but lacks focus or is off-task.</td>
<td>Addresses prompt with a focused response.</td>
</tr>
<tr>
<td><strong>Reading/Research</strong></td>
<td>Attempts to present information relevant to prompt.</td>
<td>Presents and applies relevant information with general accuracy.</td>
</tr>
<tr>
<td><strong>Controlling Idea</strong></td>
<td>Controlling idea is weak and does not establish a purpose and/or address a research question.</td>
<td>Establishes a controlling idea that states the main purpose and/or question for the tasks. L2 Addresses the credibility of sources.</td>
</tr>
<tr>
<td><strong>Development</strong></td>
<td>Tends to retell rather than present information in order to answer questions, solve problems; lacks details to develop topic. *L2 Implications are weak or not relevant to topic. L3 Does not identifies a relevant gap or unanswered question.</td>
<td>Presents sufficient information in order to examine or convey topics or issues, answer questions, solve problems; identifies salient themes or features; explains key information with sufficient detail. *L2 Discusses relevant implications to topic. L3 Identifies a gap or unanswered question.</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td>Applies an ineffective structure; composition does not address requirements of the prompt.</td>
<td>Applies a generally effective structure to address specific requirements of the prompt.</td>
</tr>
<tr>
<td><strong>Conventions</strong></td>
<td>Demonstrates a weak command of standard English conventions; lacks cohesion; language and tone are inappropriate to audience and purpose.</td>
<td>Demonstrates a command of standard English conventions and cohesion; employs language and tone appropriate to audience and purpose.</td>
</tr>
</tbody>
</table>

### Classroom Assessment Task

No Classroom Assessment Task for this module

### Exemplar Work

**Uploaded Files**

**E:LDCDead in The Water TaskStudent Work_ Final Product.pdf** (Advanced)  

This is a letter to the Environmental Protection Agency submitted by a 7th grade student

**E:LDCDead in The Water TaskStudent Work_entire module.pdf** (Advanced)  

This file provides all work submitted throughout the module and includes concept maps, editing process, and lab report. This work does not provide teacher feedback or corrected
responses to reflections from lab experiment.

**E:LDCDead in The Water TaskStudent Work3.pdf** (Approaches Expectations)
(http://literacybytechnology.s3.amazonaws.com/worksampleuploads/3573/1641136145_May_31_2012_091057716.pdf)

This is a letter to the EPA written by a 7th grade student

**E:LDCDead in The Water TaskStudent Work 4.pdf** (Approaches Expectations)

This is a letter to the EPA written by a 7th grade student
### Comments

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<th>Other Comments</th>
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