Food and Agriculture Center for Science Education

Keeping Lakes Open

Middle School, Life Sciences

Task Overview

In this task, students will analyze data (including graphs, charts, and images) to determine how harmful algal blooms in New York waterways can affect biodiversity and human access to recreational waterways.

Students will then consider changes in the ecosystem that contribute to harmful algal blooms. They'll consider four existing beef cattle production/industry practices for conservation management (managing the beef life cycle, filter strips/forested buffers, managing grazing, and fenced waterways). Students will select a combination of two practices and use empirical evidence and scientific reasoning to support or refute an argument about how combining conservation practices could contribute to protecting water quality and biodiversity in water ecosystems.

Next Generation Science Standards

Three-Dimensional Claim 1 (Prompts 1 – 4)

Update an existing model to represent how changes to physical or biological components of an ecosystem affect populations.

Three-Dimensional Claim 1 (Prompts 5 and 6)

Students will construct an argument to support a proposed design solution, with empirical evidence and scientific reasoning from data, to reduce harmful impacts on recreational waterways.

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This task is intended to elicit student learning of the following **NGSS elements** for each of the three dimensions:

Disciplinary Core Ideas

LS2.C-M1: Ecosystem Dynamics, Functioning and Resilience (MS)

- Ecosystems are dynamic in nature, their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.

LS4.D-M1: Biodiversity and Humans (MS)

- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on – for example, water purification and recycling (secondary to MS-LS2-5).

Science and Engineering Practices

ARG-M3 and ARG-M4: Engaging in Argument from Evidence (MS)

- Construct, use, and/or present an oral & written argument supported by empirical evidence & scientific reasoning to support or refine an explanation or a model for a phenomenon or solution to a problem.
- Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system, based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.

MOD-M2: Using Models (MS)

- Develop or modify a model, based on evidence, to match what happens if a variable or component of a system is changed.

Crosscutting Concepts

SC-M2: Stability and Change (MS)

- Small changes in one part of a system might cause large changes in another part.

PAT-M4: Patterns (MS)

- Graphs, charts, and images can be used to identify patterns in data.

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New York State P-12 Standards

- *MS-LS2-2*: Construct an explanation that predicts patterns of interactions among organisms in a variety of ecosystems
- *MS-LS2-5*: Evaluate competing design solutions for maintaining biodiversity and protecting ecosystem stability

Helpful Prior Knowledge

Excess nutrients in water ecosystems can contribute to an overgrowth of algae, harming other species in the ecosystem. One source of excess nutrients is agriculture through nutrient runoff into nearby streams that feed into larger waterways. If not well-managed, livestock, such as cattle, can contribute to increased nutrient runoff by increasing erosion or directly by adding nutrients via waste into the streams. There are a variety of solutions being implemented by cattle producers. Scientific evidence shows that best practices include the following solutions to mitigate excess nutrient runoff due to production. Each has a unique impact on the biodiversity of a water ecosystem. Using cover crops helps soil hold onto nutrients so they are not released into the ecosystem. Managing the life cycle of beef cattle and grazing practices by using a feedlot for a portion of the cattle's life cycle and reducing overgrazing helps maintain the local ecosystem. Buffers or filter strips can help trap nutrients that otherwise end up in the local water ecosystem. Fencing is a physical barrier that keeps water sources clean by blocking livestock access.

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Collaborations

American Farm Bureau Foundation For Agriculture

New York Agriculture in the Classroom

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