How clean is the water?

Focus questions	How clean is the water? How can we monitor water quality and the conditions that allow for different animals and plants to survive in an aquatic ecosystem?
Vocabulary	Biodiversity, ecosystem
Learning target	Students describe several factors that can affect water quality.

MS-LS1: From Molecules to Organisms: Structures and Processes

Performance expectation MS-LS1-5	Classroom connection: This activity is an introduction for the students to begin visualizing the differences that can occur in aquatic ecosystems and water health.

Science and engineering practices

Constructing Explanations and Designing Solutions	Classroom connection: Students begin to construct an explanation by observing data to support their explantation of water health in the provided slide deck. Classroom connection: Students begin to design solutions to potential poor water health issues by observing external factors that might contribute to said health and determine methods to improve the aquatic ecosystem.

Disciplinary core ideas

LS1.B: Growth and Development of Organisms	Classroom connection: The slidedeck photos provide several images of aquatic ecosystems that indicate both good and poor water health. Students determine possible human interactions that could be contributing to the health of each ecosystem.

Cross-cutting concepts

Cause and Effect	Classroom connection: Human impacts have made a significant impact on aquatic ecosystems. Students will observe possible factors that have led to ecosystem decline and design possible solutions to correct this decline.

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This lesson focuses on Constructing Explanations and Designing Solutions as a means to identify some potential factors that affect the health and **biodiversity** of aquatic **ecosystems** and the corresponding conditions that allow aquatic organisms to survive. Students will make observations about photos of aquatic ecosystems and predict if the water is clean or not. Then they will brainstorm ideas for additional factors that may affect water health and the overall biodiversity of the aquatic ecosystem and possible ways to test for these factors. Finally, students will begin to design possible remediation strategies to maintain or improve water health.

Background

Natural and human activities have altered the landscape and quality of many ecosystems around the world, including aquatic ecosystems. There is no single measure that constitutes good water quality. Water health is defined in terms of the chemical, physical, and biological content of the water. The health of aquatic ecosystems changes with the seasons and geographic areas, even when there is no pollution present. Precipitation dissolves or entraps dust and gases in the air to reach the earth's surface and flow over and through the soil and rocks, dissolving and picking up other substances. Human activities such as mining, forestry, urbanization, and agriculture have altered the landscape and quality of aquatic ecosystems. For example, industrial activities can increase concentrations of metals and toxic chemicals, increase temperature, and lower dissolved oxygen in the water. Agriculture can increase the concentration of nutrients, pesticides, and suspended sediments. Urban living has increased the runoff of debris and increased the concentrations of nutrients, pathogens, oil products, and road salts. A healthy aquatic ecosystem is one in which the water quality supports a rich and diverse community of organisms. The interrelationships between climate change, human activities, changing watershed conditions, and water quality can quickly make the balance shift, causing a change in the composition of the ecosystem.

Materials

- Slide deck with aquatic ecosystem slides
- Water samples
- Student handout
- Access to a computer or other device with wifi for possible research

Prior knowledge and possible observations or questions about water quality from your students:
- The color and smell of the water system
- The diversity of plant or animal life in the water system
- The movement and turbidity of the water system
- The shade cover and temperature of the water system
- Is the water polluted? What pollutants would cause harm?
- What do aquatic organisms need to survive in this body of water?
- How can we test for water quality?

How clean is the water?

Focus questions	What is clean water? How can we monitor water quality and the conditions that allow for different animals and plants to survive?
Vocabulary	Ecosystem, biodiversity, aboiotic, bioti, turbidity

Background

Human activities have altered the landscape and quality of many **ecosystems** around the world, including aquatic ecosystems. Many aquatic ecosystems have been impacted by climate change, pollution, population, and habitat changes. A healthy aquatic ecosystem is one in which the water quality supports a high **biodiversity** of organisms. For this to happen, the biotic and abiotic components of the ecosystem must be in balance with one another. The interrelationships between human activities, changing watershed conditions, and water quality can quickly make the balance shift, causing a change in the composition of the ecosystem. What are some ways that abiotic and biotic factors can change an aquatic ecosystem?

Procedure

1. What are some visible indicators of a healthy water ecosystem?

Possible answers: high biodiversity, clear water, no smell, low aquatic plant growth, no visible pollutants, etc.

2. What are some ways in which aquatic ecosystems have been impacted due to human activity?

Possible answers: waterway diversion, wetland fill, dam construction, overfishing, invasive species, canopy removal, pollution, sediment overload, pollution, etc.

3. How can we assess the health of an aquatic ecosystem? What can we test for?

Possible answers: Turbidity, temperature, pH, nutrients (N, P), smell, coliform bacteria, dissolved oxygen (DO), biological oxygen demand (BOD)

4. What are some ways that humans can improve the health of an aquatic ecosystem?

Possible answers: Repair riparian zones, increase biodiversity along aquatic ecosystems, decrease runoff from suburban and rural zones, etc.

Teacher preparation

1. Make copies of the student handout.
2. Load the *"How clean is your water?"* slide deck to show your students and promote conversation about what clean water means. Add these questions:
   - **Slide 1:** Does this water seem clean? What factors about this image help you to decide it is clean or not clean?
   - **Slide 2:** Is this water clean? How does this water compare to the first picture? What factors about this image help you to make your decision?
   - **Slide 3:** Is this water clean? How does this water compare to the first two pictures? What factors about this image help you to make your decision?
   - **Slide 4:** Is this water clean? How does this water compare to the first three pictures? What factors about this image help you to make your decision?
   - **Slide 4:** Is this water clean? How does this water compare to the first four pictures? What factors about this image help you to make your decision?
3. Discuss as a class or in pairs to brainstorm ideas about water quality.

Differentiation

Other ways to connect with students with various needs:
- **Local Community:** Students may investigate local aquatic ecosystems to predict the health of the system and observe possible causes for that health assessment.
- **Students with special needs (language/reading/auditory/visual):** Students may investigate real aquatic ecosystems instead of the photos from the provided slidedeck to discuss possible water health. Teachers can also create copies of the slides to pass out to the students so that they can write on the slides as they identify the potential harm and possible remediation to that harm on that slide.
- **Extra support:** Volunteer Stream Monitoring, A Methods Manual: **epa.gov/sites/ production/files/2015-06/documents/stream.pdf**, Nebraska Department for Environmental Quality, Stream Monitoring: **deq.ne.gov/NDEQProg.nsf/OnWeb/SBMP**
- **Extensions:** Students can observe real time data in Nebraska through USGS: **nrtwq.usgs. gov/ne/**. Students can help to solve real water problems within their community. Take part in organizations such as Give Water a Hand: https://erc.cals.wisc.edu/gwah/

Assessments

Rubric for assessment

Skill	Beginning	Satisfactory	Exemplar
Constructing Explanations	Student can give an example of a human impact that can disrupt the health of an aquatic ecosystem.	Student can give an example of a human impact that can cause disruption to the health of an aquatic ecosystem and explain how this impact can lead to future harm.	Student can give an example of a human impact to an aquatic ecosystem, explain how this impact can lead to additional harm, and create a possible solution to alter the course of future harm.

Rubric for self-assessment

Skill: Constructing Explanations	Yes	No	Unsure
I can explain what a healthy aquatic ecosystem is.			
I can describe both biotic and abiotic components that can lead to aquatic ecosystem imbalances.			
I can describe possible ways that the health of a disrupted aquatic ecosystem can be improved.			