LESSON PLAN:

A Walk Across the Bottom of Seneca Lake

OVERVIEW:
Students will examine research from the Seneca Lake Archaeological & Bathymetric Survey to understand the Erie Canal artifacts and the invasive quagga mussels found in the lake.

Grade Level: 6-8

Class Periods: Three to five 45-minute lessons with an optional project

ESSENTIAL QUESTIONS:
• What are invasive species?
• What are quagga mussels?
• What impact do quagga mussels have on shipwrecks discovered in Seneca Lake?

OBJECTIVES:
• Students will be introduced to the research done by the Seneca Lake Survey Project team.
• Students will understand invasive quagga mussels.
• Students will understand the impact invasive quagga mussels have on the deep-water artifacts in Seneca Lake.

MATERIALS NEEDED:
• Computer with internet
• Student worksheets
• If you choose to have your students do the optional project, they will need a slide presentation application (Google Slides, Microsoft PowerPoint, etc.)

LESSON PLAN ACTIVITIES:
• Activity 1: Picture Walk
• Activity 2: Investigate
• Activity 3: Packet Boats
• Activity 4: Quagga Mussels

NEW YORK STATE EDUCATION STANDARDS:

SCIENCE STANDARDS
• MS. Matter and Energy in Organisms and Ecosystems
  – MS-LS2-1—Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
  – MS-LS2-4—Construct an argument supported by empirical evidence that changes to physical and biological components of an ecosystem affect populations.
Teacher Procedure & Answer Keys

**ACTIVITY 1: Picture Walk**

**INFORMATION AND INSTRUCTIONS**
Using images of artifacts on the bottom of Seneca Lake, take students on a “picture walk” to see what they find and record their discoveries.

1. Divide students into small groups.
2. Provide Worksheet 1: Picture Walk to students and have students discuss the images in a free form discussion.
3. Have students discuss and answer questions on the worksheet.

**KEY > WORKSHEET 1: Picture Walk**

**KEY FOR IMAGES**

A. ROV image of Target 7  
B. Target 7, Pantry, Stern Cabin, Port Side  
C. Target 7, Looking AFT from Rear Cabin  
D. Target 7, Passenger Cabin Interior  
E. Target 7, Stern and Rudder  
F. Target 7, Woodstove Heavily Encrusted with Mussels

*All Images Courtesy: Tim Caza & Dennis Gerber and the Seneca Lake Survey Project.*

1. **What do you think these are pictures of?**
   - **Shipwrecks**

2. **Where do you think these pictures were taken?**
   - **Seneca Lake**

3. **How do you think these pictures were taken?**
   - **Remote operated vehicles used during underwater archeological survey**

4. **Who do you think took these pictures?**
   - **Underwater archeologists**

5. **What are your questions when you look at these pictures? What are you left wondering? What do you want to know?**
   - **How old are the shipwrecks?**
   - **What types of boats were found?**
   - **How did the boats sink?**

6. **Do you think there is anything in these pictures that might present a problem or concern? If so, explain.**
   - **Something is covering the boats which might damage them**
ACTIVITY 2: Investigate

INFORMATION AND INSTRUCTIONS

Students will create a hypothesis about artifacts found in Seneca Lake and conduct independent research about the Erie Canal.

1. Provide students with this clue about the pictures:
   
   The pictures were taken on the bottom of Seneca Lake in New York State.

2. Have students write a hypothesis about what they see covering the shipwrecks in the pictures on Worksheet 2: Investigate, Part 1 Hypothesis.

3. Instruct students to conduct online research to determine what the pictures are and try to figure out why the artifacts are covered in clusters of objects. Tell them to think like detectives and investigate. Along with queries using words from the previous clue, direct students to research invasive species in Seneca Lake.


KEY > WORKSHEET 2: Investigate

HYPOTHESIS:

What do you think is covering the objects seen in the images from the Picture Walk?

- They are covered by quagga mussels which are an invasive species

Was your hypothesis correct?

- yes or no based on individual student responses

What new information did you discover?

- What the Erie Canal is
- What packet boats were
- What invasive species and quagga mussels are
- Quagga mussels are damaging to shipwrecks
VOCABULARY:

Artifact—objects that are made, used, or modified by humans and give us information about life in the past.

Erie Canal—an artificial, or human-made, waterway in New York connecting the Hudson River to Lake Erie.

Invasive Species—an organism that causes ecological or economic harm in a new environment where it is not native.

Packet Boat—passenger boats which traveled on the Erie Canal and could accommodate 40 to 60 people.

Quagga Mussels—filter-feeding, freshwater, bivalve mollusks.

RESEARCH:

1. Where is the Erie Canal?
   • Upstate New York. The original canal ran from the Hudson River at Albany to Lake Erie at Buffalo

2. What year did the New York State Legislature authorize construction of the Erie Canal?
   • 1817

3. What year did the Erie Canal fully open to traffic?
   • 1825

4. What was the name of the New York Governor who promoted the construction of the Erie Canal?
   • DeWitt Clinton
ACTIVITY 3: Packet Boats

INFORMATION AND INSTRUCTIONS
Using information from the Seneca Lake Survey project, students will learn about Erie Canal packet boats and the significant findings made by the Survey team.

1. Introduce and explain the following:
   The Seneca Lake Archaeological & Bathymetric Survey Project is a geological study of the landscape at the bottom of Seneca Lake, as well as an investigation of any discovered artifacts that lie beneath the water. In 2018 the project was organized, and as of the date of this writing, the investigation continues. The team has discovered many shipwrecks dating back to the 1800s that were used for travel and commerce on the New York State Canal System. One of the most significant finds is of an Erie Canal packet boat, which is believed to be the first archaeological example of this type of boat to be discovered.

2. As a class, read the excerpt “Packet Boats” from page 76 of the Seneca Lake Archaeological & Bathymetric Survey, 2019 Final Report on Worksheet 3: Packet Boats. Students may also want to read about the Buffalo Maritime Center’s Packet Boat Project https://buffalomaritimecenter.org/packetboat/.

3. After reading the excerpt, have students answer the corresponding questions on Worksheet 3: Packet Boats. Discuss answers as a class.

KEY > WORKSHEET 3: Packet Boats

1. What were packet boats?
   • *Passenger boats which carried travelers on the Erie Canal*

2. What was the name of the packet boat used in October 1825 to celebrate the opening of the Erie Canal?
   • *Seneca Chief*

3. How many passengers could a packet boat typically carry?
   • *40-60*

4. How fast did packet boats travel on the Erie Canal?
   • *4 mph*

5. Why do you think the discovery of a packet boat by the Seneca Lake Survey team is important?
   • *Only one known to have been discovered*
   • *Tells us about how people traveled on the Erie Canal in the 1800s*
**ACTIVITY 4: Quagga Mussels**

**INFORMATION AND INSTRUCTIONS**

Students will learn about invasive quagga mussels in Seneca Lake and the impacts they have on historic shipwrecks.

1. Introduce and explain the following:
   Quagga mussels are an invasive species which were first observed in Seneca Lake in the 1990s. They are considered invasive because of their potential to cause economic and ecological damage to Seneca Lake.


3. Introduce and explain the following:
   Quagga mussels have been observed on all shipwrecks discovered by the Seneca Lake Survey team. Previous studies of shipwrecks in other lakes show that quagga mussels damage the iron fastenings which hold the wooden boats together.

4. Have students analyze the images and answer corresponding questions on **Worksheet 4: Quagga Mussels, Part 2 Quagga Mussels and Shipwrecks**.

5. At the conclusion of the lesson, have students return to their hypothesis on **Worksheet 2: Investigate** and answer the final questions.

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**KEY > WORKSHEET 4: Quagga Mussels**

**PART 1—FACT SHEET**

1. **What are quagga mussels?**
   - *filter-feeding, freshwater, bivalve mollusks*

2. **What type of habitat do quagga mussels prefer?**
   - *freshwater habitats up to depths of 90 ft., attaching to most surfaces including sand, silt and hard substrates*

3. **How are quagga mussels commonly spread?**
   - *through fishing and boating equipment*

4. **What steps can be taken to help prevent quagga mussels from spreading?**
   - *cleaning, draining, and drying boats and other aquatic equipment before moving to another water body*
PART 2—QUAGGA MUSSELS AND SHIPWRECKS

These images were taken of the same shipwreck which sunk in Lake Ontario. The first image was photographed in 1982, before quagga mussels were observed in the lake. The second image was photographed in 2008.

How did the condition of the shipwreck change from 1982 to 2008?

• Quagga mussels on the shipwreck increased significantly

This image was taken in 2019 by the Seneca Lake Survey team of an Erie Canal packet boat. Considering your observations from the previous images, how might the condition of the packet boat shipwreck be different if it were photographed again in 20 years?

• There would be more quagga mussels present
EXTENSION ACTIVITY

DIRECTIONS:
Ask students to prepare a slide presentation about the content discussed and what they discovered. Students will present to the class once completed.

Presentation Outline Guidelines:
Students may find it helpful to follow the general guideline below while constructing their slide presentation.

Slide #1—
*Title Slide*—Title, student name, date, class name, picture of topic content.

Slide #2
*Introduction Slide*—Introduce the Seneca Lake Survey Project. What do you find most interesting about the work being done?

Slide #3
*The Erie Canal and Packet Boats*—What new information have you learned?

Slide #4
*Seneca Lake Survey Project shipwreck discoveries*—Why are these discoveries significant? What additional questions do you have about them?

Slide #5
*Quagga Mussels*—What information have you learned about quagga mussels and invasive species, in general? What are their impacts on the environment and shipwrecks? What are the best methods of preventing and managing the spread of invasive species?

Slide #6
*Preserving Shipwrecks*—Why is it important to study shipwrecks? What information have you learned by studying the findings from the Seneca Lake Survey? What additional information would you like to know?

Slide #7
*Sources Slide*—List all the sources used to make this slide presentation.
SOURCES

PUBLICATIONS:


WEBSITES:

https://buffalomaritimecenter.org/packetboat/
https://hws.app.box.com/s/5k4z49wv21ntq6es5nliop8v0ewhh7pz
https://nyis.info/invasive_species/zebra-and-quagga-mussel/
https://www.wnyprism.org/invasive_species/quagga-mussel/
Student Worksheets
WORKSHEET 1: Picture Walk

All Images Courtesy: Tim Caza & Dennis Gerber and the Seneca Lake Survey Project.
WORKSHEET 1: PICTURE WALK

1. What do you think these are pictures of?

_________________________________________________________________________________________
_________________________________________________________________________________________

2. Where do you think these pictures were taken?

_________________________________________________________________________________________
_________________________________________________________________________________________

3. How do you think these pictures were taken?

_________________________________________________________________________________________
_________________________________________________________________________________________

4. Who do you think took these pictures?

_________________________________________________________________________________________
_________________________________________________________________________________________

5. What are your questions when you look at these pictures? What are you left wondering? What do you want to know?

_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________

6. Do you think there is anything in these pictures that might present a problem or concern? If so, explain.

_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________
WORKSHEET 2: Investigate

PART 1—

DIRECTIONS: Read the definition of “hypothesis”. Write your answer to the prompt below. Discuss your thoughts with your group before writing your hypothesis. At the end of the lesson, you will return to the hypothesis that you have written on this page to determine if your hypothesis was correct.

HYPOTHESIS— a proposed explanation made based on limited evidence as a starting point for further investigation.

1. Why do you think the artifacts in the pictures are covered with clusters of items?

___________________________________________________________________________________

___________________________________________________________________________________

(To be completed at the end of the lesson)

2. Was your hypothesis correct?

___________________________________________________________________________________

3. What new information did you discover?

___________________________________________________________________________________

___________________________________________________________________________________
WORKSHEET 2: INVESTIGATE

PART 2—VOCABULARY

DIRECTIONS: Research the following terms and provide definition for each.

1. Artifact
   ____________________________
   ____________________________

2. Erie Canal
   ____________________________
   ____________________________

3. Invasive Species
   ____________________________
   ____________________________

4. Packet Boat
   ____________________________
   ____________________________

5. Quagga Mussels
   ____________________________
   ____________________________
WORKSHEET 2: INVESTIGATE

PART 2—RESEARCH

DIRECTIONS: Conduct research to answer the following questions.

1. Where is the Erie Canal?

2. What year did the New York State Legislature authorize construction of the Erie Canal?

3. What year did the Erie Canal fully open to traffic?

4. What was the name of the New York State Governor who promoted the construction of the Erie Canal?
WORKSHEET 3: Packet Boats

DIRECTIONS:
Read the following excerpt about packet boats from the Seneca Lake Archaeology & Bathymetric Survey 2019 Final Report.

1. What were packet boats?

2. What was the name of the packet boat used in October 1825 to celebrate the opening of the Erie Canal?

3. How many passengers could a packet boat typically carry?

4. How fast did packet boats travel on the Erie Canal?

5. Why do you think the discovery of a packet boat by the Seneca Lake Survey team is important?
WORKSHEET 4: Quagga Mussels

DIRECTIONS:
Read the fact sheet http://fingerlakesinvasives.org/invasive_species/quagga-mussel/ about quagga mussels to answer the questions.

PART 1—FACT SHEET

1. What are quagga mussels?
   ____________________________________________
   ____________________________________________

2. What type of habitat do quagga mussels prefer?
   ____________________________________________
   ____________________________________________

3. How are quagga mussels commonly spread?
   ____________________________________________
   ____________________________________________

4. What steps can be taken to help prevent quagga mussels from spreading?
   ____________________________________________
   ____________________________________________
WORKSHEET 4: QUAGGA MUSSELS

PART 2—QUAGGA MUSSELS AND SHIPWRECKS

These images were taken of the same shipwreck which sunk in Lake Ontario. The first image was photographed in 1982, before quagga mussels were observed in the lake. The second image was photographed in 2008.

An anchor from the Hamilton photographed in 1982. Courtesy: City of Hamilton, Ontario

An anchor from the Hamilton photographed in 2008. Courtesy: City of Hamilton, Ontario

How did the condition of the shipwreck change from 1982 to 2008?

______________________________________________________________________________________
______________________________________________________________________________________

This image was taken in 2019 by the Seneca Lake Survey team. It is a compartment inside the sunken packet boat that the team discovered.

Image of an Erie Canal packet boat photographed in 2019.
Courtesy: Tim Caza & Dennis Gerber and the Seneca Lake Survey Project

Considering your observations from the previous images, how might the condition of the packet boat shipwreck be different if it were photographed again in 20 years?
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