



# GREAT LAKES LEARNING

LESSONS & ACTIVITIES BASED ON THE  
MONTHLY GREAT LAKES NOW PROGRAM

EPISODE 2206 | INVASIVE SEA LAMPREY

## THE GREAT LAKES "VAMPIRE"



*Image Credit: Great Lakes Now*

### OVERVIEW

This lesson will explore the phenomenon of invasive species in the Great Lakes, specifically the sea lamprey, to help students learn how predator-prey relationships affect populations in an ecosystem, why invasive species like the sea lamprey pose a threat to the Great Lakes, and which efforts can most successfully control them.

### LESSON OBJECTIVES

- **Know** why sea lamprey pose a threat to the Great Lakes ecosystem
- **Understand** what measures have been taken to try and control the sea lamprey population
- **Be able to** research and defend the best possible solutions to the sea lamprey threat in the Great Lakes

### WHAT YOU'LL NEED

- Computer or mobile device with Internet access to view video and online resources
- Notebooks and pencils
- Chart paper
- Sticky notes
- Markers
- Lab supplies (see individual activities for a full list)
- Copies of the Student Handouts

## INTRODUCTION

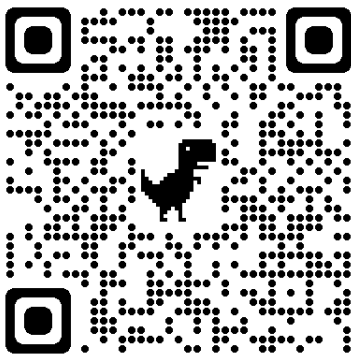
What happens when a non-native species is introduced into a new ecosystem? Will it get along well with other species, compete with the native species for resources and food, or prey upon the native species? It all depends on the nature of the invasive species. But regardless of what happens, one thing is for sure: the ecosystem will never be the same again.

This lesson will explore the phenomenon of the invasive species sea lamprey in the Great Lakes to help students learn about how the lamprey got into the Great Lakes, how it has threatened the ecosystem, and what can be done about it. They will learn about several efforts that have been taken to try and control the lamprey population and research which solution is most viable to defend in a debate.

This lesson includes multiple activities, including lab activities, that can span the course of several sessions or be adapted to fit the needs of your group's meeting format.

Some prior knowledge\* with which students should be familiar includes:

- Food chains and food webs
- Predator-prey relationships
- Population dynamics
- Mitosis and meiosis
- DNA replication
- Transcription and translation



Follow this QR Code or hyperlink to the [Episode Landing Page!](#)

*\*Check out our full collection of lessons for more activities related to topics like these.*

*\*\*The sequence of these activities is flexible, and can be rearranged to fit your teaching needs.*

## NGSS CONNECTIONS

### Phenomenon: Invasive Species

- |            |              |
|------------|--------------|
| • MS-LS2.C | • ETS1.B     |
| • MS-LS2-7 | • MS-LS2.A   |
| • HS-LS4.D | • SEP-6      |
| • MS-LS2-4 | • SEP-7      |
| • MS-LS2-2 | • 5-ESS3-1   |
| • SEP-1    | • MS-LS3.A.1 |

During the course of the lesson, students will progress through the following sequence\*\* of activities:

- Class discussion to elicit or activate prior knowledge
- Learning how sea lamprey populations have been controlled by different approaches
- Close reading [a photo](#)
- Teacher notes on sea lamprey and how they have impacted the Great Lakes
- Taking an [invasive species "personality quiz"](#) to learn about several invasive species
- Watch segments from *Great Lakes Now*
- Class discussion to debrief the video
- Extract DNA from strawberries
- Research potential solutions, both existing and novel, to control the sea lamprey population
- Present and debate solutions to compare potential solutions with others

The lesson progresses through three major sections: **launch, activities, and closure**. After the launch of the lesson, you are ready to begin the lesson activities. Once finished with the activities, students will synthesize their learning in the closure.

*If you use this lesson or any of its activities with your learners, we'd love to hear about it!*

Contact us with any feedback or questions at: [GreatLakesNow@DPTV.org](mailto:GreatLakesNow@DPTV.org)

## TEACHER BACKGROUND INFORMATION

by Great Lakes Now Contributor, Gary G. Abud, Jr.

*\*This information can be presented by the teacher as notes to students at the teacher's discretion.*

When you first look at a sea lamprey, your first thought may not be Nemo or Dory, but it turns out, according to the National Oceanic and Atmospheric Administration (NOAA) that the sea lamprey is, in fact, a fish—an ancient Atlantic fish, no less.

Based on its history of negatively affecting the Great Lakes ecosystem, it may hold the title of the nation's first invasive species to cause destruction to native species in continental U.S. waters.

That is because the sea lamprey is a parasite, a fish that feeds off of the body fluids and blood of other species in the Great Lakes, like fish, instead of simply eating them. They look more like an eel than a traditional fish, but that is because of their ancient heritage. They are a primitive species of vertebrate originally from the Atlantic Ocean. At some point about a century ago, the sea lamprey made its way through the St. Lawrence seaway and into lake Ontario and from there proceeded through the Great Lakes waterways to infiltrate the entire Great Lakes ecosystem.

Although sea lampreys are a fish, they have some distinct features from most other fish, most notably they lack some of the traits that fish are traditionally known for having, such as fins and scales. Their gills are located near their face and not on the sides of their bodies like many other fish.

The feature that most clearly makes sea lamprey stand out upon first glance would be their circular mouths with their spiraling rows of sharp teeth and rough bristly tongue. When the sea lamprey latches onto the body of an unsuspecting fish, it chews away a circular hole in the side of the body of the host fish and then sucks its fluids and blood right out of its body—just like Dracula!

The affected fish don't stand much of a chance to survive because of the loss of blood and body fluid, but also because of the exposed hole in the side of their bodies that makes them prone to infection or more blood and body fluid loss.

As the sea lamprey reproduced and established their new home in the Great Lakes, they killed more and more native fish species, which affected both commercial and recreational fishing among other harm to the ecosystem.

According to the Great Lakes Fishery Commission, the sea lamprey is an incredibly destructive invasive species. And so, as the invasive species population increases, the native species populations decrease. That is reason for alarm, and it has caused a lot of attention to be put on solving the problem.

The Great Lakes Fishery Commission is in charge of controlling the sea lamprey population in the Great Lakes through a variety of means, each of which is conducted by the U.S. Fish and Wildlife Service and Fisheries and Oceans Canada across the five Great Lakes and their connecting waterways. Effective population control methods require careful study of the sea lamprey life cycle, behavioral patterns, such as travel pathways, and habitat.

Measures that have been taken have included special chemicals, called lampricides, that kill the lamprey larvae but do not affect most other wildlife in the waters. Other population control strategies have focused on physical barriers, traps, pheromones and other odors, and genetic engineering.

But which methods are most effective in safely controlling sea lamprey populations without doing any harm to the rest of the ecosystem? That is a question that will require some research!

## LESSON LAUNCH

### A. Warm Up

The warm up is intended to be structured as teacher-facilitated, whole-group student discussion activities. It helps students to begin thinking about the topic at the center of the lesson.

1. Ask students to list out on their paper the five words that come to mind when thinking of the term **invasive species**.
2. Have students pair up with a partner to share their five words each. If any words appeared on both lists, have students circle those words.
3. Then, engage students in a whole-group discussion to ask them to share any words that were circled.
4. Generate a list of the circled words.
5. Ask for volunteers to share any words that were not circled that they think are really important to associate with this topic.
6. Generate a separate list of those words.
7. At the end of making the two lists, have students copy down one single list of all the circled words and important words in their notebooks.
8. Ask students individually to rank the words in the list from most to least relevant.
9. Ask students to stand up from their seats and to move with their lists to a certain spot in the room to be near other students who chose the same word as most relevant (though this might seem chaotic, they will figure out a way to sort themselves, but if necessary you can come up with an organized way to sort them in the room.)
10. Have them discuss why that word was most relevant.
11. Ask for some students to share which term should be most relevant and why they think that is. Engage the whole group in discussion to arrive at consensus about the most relevant term.

### B. Bridge to Learning

After the warm-up activity has concluded, help students prepare for the learning that is about to come:

1. Ask students to individually take the online quiz entitled, [What Great Lakes Invasive Species Are You?](#) available from *Great Lakes Now*.
2. Have students read about the invasive species they got from their quiz results.
3. Pair students up with someone who had a different result from the quiz and give partners some time to teach each other a little about the invasive species they got and how their two species compare and connect with each other.
4. Invite a few volunteers to share what they discussed with their partner.
5. Explain that today we will be learning about invasive species, including specific efforts to control the sea lamprey population in the Great Lakes.

### C. Close Reading a Photo

Start by explaining that there are over two dozen invasive fish species in the Great Lakes, yet some are more harmful than others. Then, display [this photo of a fisher with a sea lamprey](#) and ask students to talk with a partner about what they notice and wonder about the photo. Next, invite a few students to share their responses. Last, have students make connection to the most relevant term the class decided upon from the warm up activity in Part A.

### D. Background Information Notes

Explain that we are going to build on these ideas and learn more about sea lamprey in this lesson. Then give the notes from the **Teacher Background Information**.

## ACTIVITY 1: WATCH A GREAT LAKES NOW SEGMENT

This activity is a video discussion of a *Great Lakes Now* episode segment.

First, inform students that they will be watching a *Great Lakes Now* segment discussing the invasive sea lamprey species in the Great Lakes and what is being done to control it. During the video they need to jot down four things they took away from the video using the **4 Notes Summary Protocol**.

Then, if students are not already familiar, introduce them to the 4 Notes Summary Protocol, which they will use after they finish watching the video, where they write down one of each of the following notes:

- **Oooh!** (something that was interesting)
- **Aaah!** (something that was an ah-ha moment)
- **Hmmm...** (something that left them wanting to know more)
- **Huh?** (a question they have afterward)

Next, have students watch the **1st segment** from episode 2206 of *Great Lakes Now* called [Vampires of the Great Lakes](#).

Last, have students complete their individual 4 Notes Summary and then discuss those in groups of 3-4 students.

### Post-Video Discussion

After the groups have had time to go over their 4 Notes Summaries, invite a handful of students to share out some of their notes, eliciting at least 1-2 of each of the 4 Notes and listing those somewhere for the whole group to see.

Ask students to turn back and talk with their groups to make connections between the *Great Lakes Now* video and what they remember from the warm-up activities.

### **How is what we saw in the video the related to what we discussed earlier in this lesson?**

After giving the groups some time to talk, bring the whole group back together for a shareout and discussion of ideas.

In this culminating discussion, the goal is to help students make connections between the video and what they discussed during the warm up activities earlier in the lesson about what they anticipated about invasive species in the Great Lakes.

Once the discussion finishes, have each student write a "**Sum It Up**" statement in their notebooks. This is a single sentence that captures the big idea of what was just learned.

Have 2-3 students share out their **Sum It Up** statements before concluding this activity.

***Teaching Tip:** Use the Student Handouts to help students organize their thinking in writing around each of the lesson protocols.*

## ACTIVITY 2: READ ABOUT GENETIC ENGINEERING

The challenge of eliminating an invasive species from an ecosystem is complex, but could be achievable using genetic engineering. This activity introduces students to the way that genetic alteration technology is being used to control—and possibly eliminate—the sea lamprey population in the Great Lakes.

In this activity, students will use a **Think Pair Square Protocol** for discussing the what they will read.

First, have students partner up and distribute the article [Genetic Engineering: Researchers Take First Steps Toward Controlling Sea Lamprey](#) by Andrew Blok from *Great Lakes Now*. Allow time for students to individually read the article, and have them jot down three things they learned in the article.

Then, give students time after reading to discuss the article that they read with their partner. Have students share which three points they noted from the article and how those points connect to each other. The pair should come up with a statement to summarize all of their article takeaways.

Next, have two student pairs join up, standing near each other to form the four corners of a square, to discuss the article and what they talked about in their pairs. Encourage them to come to a consensus about which point they found most important or interesting in the article.



*Image Credit: Great Lakes Now*

Last, have each group come up with a summary statement of the most important point from their discussion and ask for a volunteer in each group to share that most important point with the whole group.

As student groups share out their most important point, record their ideas on the board and have students copy the list of student ideas down into their notebooks.

After the shareout is complete, ask students to return to their groups and discuss one last question\* based on the article:

**Based on the article, do you think it is actually possible to completely eliminate all the sea lamprey from the Great Lakes?**

After giving the groups some time to discuss this question, invite conversation from the entire class to see what consensus can be reached.

*\*Alternatively, or additionally, they can consider this question: should scientists use genetic engineering to eliminate sea lamprey from the Great Lakes?*

**Teaching Tip:** Depending on the background knowledge of your students, it might be worth doing a high-level review of the central dogma of biology (DNA → RNA → Protein) before reading this article. You should also strategically connect this activity with Activity 3.

## ACTIVITY 3: DNA EXTRACTION FROM STRAWBERRIES



*Image Credit: Science U*

### Background:

So much is known about DNA that we can alter the genetic makeup of organisms, such as the sea lamprey. As Activity 2 discusses, genetic engineering is being used as a possible solution to controlling the sea lamprey population and reducing the threat they pose to the Great Lakes ecosystem by altering lamprey genes.

This takes advantage of what's known as the **central dogma of molecular biology**: DNA, a molecule that contains the code of all the proteins necessary to make an organism, gets transcribed into RNA—a similar molecule that contains the same code in a different language, so to speak—and the RNA gets translated into proteins that do everything an organism needs to do at the molecular level.

In order to learn about DNA and develop technologies with it, scientists first need to be able to get DNA out of an organism in the first place to study it and work with it. So, how does that happen? Using a lab technique called DNA extraction.

### Pre-Lab:

First, ask students to raise their hand if they have ever eaten DNA before. Some students may look around and hesitate, but after you allow for some awkward time, inform them that every hand should be raised, because any living organism (plant or animal) contains DNA.

Next, brief students about the notes from the background section above in this activity and let them know that today they will be extracting DNA from an organism—strawberries—using a variation of the technique scientists use to do this.

Then, show this Science U **video from PBS LearningMedia** about extracting DNA from strawberries to give them an overview of what they will be doing. Check for understanding with a few comprehension questions about the video.

Last, provide the materials needed and give students a copy of the DNA Extraction Student Handout to allow them time to conduct the investigation.

Have all groups list their calculated average mass of DNA in one strawberry on the board. Part of the analysis will be for groups to calculate a class average for the amount of DNA in one strawberry and determine a percent difference from their group compared to the class average.

Discuss with the class why the class average number might be different than an individual group's calculated value for the mass of DNA in one strawberry and what it means if a group calculated a negative versus positive value for the percent difference.

***Teaching Tip: If you have students who are allergic to strawberries, consider using another fruit like bananas or raspberries instead.***

## ACTIVITY 4: RESEARCH & DESIGN LAMPREY SOLUTIONS

This activity invites students to research existing solutions, or generate novel ideas for potential solutions, for sea lamprey population control. As part of their research project, they will design a proposal for what they think is the best solution possible and defend their proposal in a town hall presentation to a group of stakeholders.

Other students can be selected to be the stakeholders, or you can also find adults to volunteer to play this role and take part in the debate on proposal presentation day. You can even consider reaching out to *Great Lakes Now* via email to get connected to some of our experts who can be stakeholders virtually to hear student presentations and ask follow-up questions about their proposals: [gln@dptv.org](mailto:gln@dptv.org).

First, inform students that they will be working with a small group to research solutions to control the sea lamprey population and pitch their idea to a panel of people from different roles in the community. Ask for some volunteers to recall what population control methods they remembered learning about from the *Great Lakes Now* video segment. List those ideas out for all to see. Add additional solutions to the list if students do not mention them, such as: odors, traps, barriers, lampricides, genetic engineering, and natural lamprey predators.

Then, give each group time to research one of the solutions\* on their own. Encourage them to jot down notes and sketch a model of how their solution would work.

Next, have students prepare a presentation that would explain their solution and give them time to prepare for presenting to the stakeholders in the town hall.



Image Credit: Great Lakes Now

Select a panel of 4 people (students or adults) and assign each of them a different community role to "play" in the town hall, e.g., scientist, fisher, resident, business owner. Instruct the panel to be prepared to ask follow up questions.

Last, give groups 5 minutes to present their solution to the town hall panel and field questions from the stakeholder panelists. At the end of the presentation time, the panelists should each give the solution a score on a (least) 1-4 (most) scale of how likely they would be to support this solution in the Great Lakes. Add up all the scores for each presentation from all the panelists. Once all the groups have presented, tally up the scores to reveal which solution(s) had the best scores.

Once everyone knows which solution(s) had the top scores, ask students to discuss with a partner what considerations there might be for carrying out that solution on a large scale in the Great Lakes. Invite a few students to share their ideas and engage the class in dialogue about limitations of solutions when they are done at different scales.

Conclude the activity by having students complete the **Rose Thorn Bud Protocol** individually to reflect on their research proposal and presentation experience. Distribute the handout, give students 5 minutes to complete it, and then allow them time to share the ideas they generated with a partner before a whole-group shareout of roses, thorns, and buds.

**\*Teaching Tip:** You can assign a different solution to each group to research or let them choose a solution of their own to investigate.



## LESSON CLOSURE

After the conclusion of all the activities, help students to make connections\* between everything they did in the lesson and what they learned overall.

### **A. Free Recall**

Group students in pairs or triads (e.g., in groups of 2-3 partners) and distribute the **Free Recall Protocol handout**. Alternatively, you can have students do this in their notebooks. Set a 3-min timer and have students generate a list of everything they can remember learning about in this lesson related to the central topic of the lesson. This doesn't have to be in depth, just whatever each group can call to mind. Have them draw lines between any terms that relate to one another. After the timer finishes, give groups a chance to volunteer to share aloud 2-3 things from their free recall lists and any of the connections that they made with those. Jot down any ideas that come up multiple times during the shareout for the whole group to see.

### **B. Lesson Synthesis**

Give students individual thinking and writing time in their notebooks to synthesize their learning, by jotting down their own reflections using the **Word, Phrase, Sentence Protocol**.

In the Word-Phrase-Sentence Protocol, students write:

- A **word** that they thought was most important from the lesson
- A **phrase** that they would like to remember
- A **sentence** that sums up what they learned in the lesson



### **C. Cool Down**

After the individual synthesis is complete, students should share their synthesis with a partner.

After sharing their syntheses, have students complete a **3, 2, 1 Review** for the lesson with their partner, recording in their notebooks or, optionally, on exit ticket slips to submit, each of the following:

- **3 things** that they liked or learned
- **2 ideas** that make more sense now
- **1 question** that they were left with

Invite several students to share aloud what they wrote in either the synthesis or 3, 2, 1 Review.

Lastly, ask one student volunteer to summarize what has been heard from the students as a final summary of student learning.

*\*Optionally here, the teacher can revisit the learning objectives and make connections more explicit for students.*

***Teaching Tip: Use the Student Handouts to help students organize their thinking in writing around each of the lesson protocols.***

NAME: \_\_\_\_\_

## A Word, Phrase, Sentence Protocol

What is a **word** that you thought was most important from this lesson?

What is a **phrase** that you would like to remember from this lesson?

What is a **sentence** that sums up what you learned in this lesson?

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## 3, 2, 1 Review Protocol

What are **3 things that you liked or learned** from this lesson's activities?

- 
- 
- 

What are **2 ideas that make more sense** now to you?

- 
- 

What is **1 question that you were left with** after this lesson?

-

NAME: \_\_\_\_\_

## Free Recall Protocol

*With a 1-2 partners, generate a list of everything you can remember learning about in this lesson related to the central topic of the lesson. Draw lines between any terms that relate to one another.*

---

NAME: \_\_\_\_\_

4 Notes Summary Protocol

**OOOH!**

*Something that was interesting to you*

**AAAH!**

*Something that became clearer; an "ah-ha" moment*

**HMMM...**

*Something that left you wanting to learn more*

**HUH?**

*Something you questioned or wondered*

Sum It Up Statement:

*Summarize your group discussion about your 4 Notes Summaries below:*

NAME: \_\_\_\_\_

Think Pair Square Protocol

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**THINK**

*Write down your own individual ideas*

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**PAIR**

*Summarize what you and your partner discussed*

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**SQUARE**

*Summarize what your group discussed*

NAME: \_\_\_\_\_

Rose, Thorn, Bud Protocol

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# ROSE

Something that "blossomed" for you in your learning

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# THORN

Something that challenged your thinking or was difficult to understand

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# BUD

Something that's new and growing in your mind — a "budding" idea

NAME: \_\_\_\_\_

DATE: \_\_\_\_\_

## DNA Extraction With Strawberries

*Adapted from Science-U by WPSU via PBS LearningMedia*

### Preparation:

Before you begin this experiment, take turns with your group members having each person take turns reading one step of the procedure at a time aloud while others follow along on their paper.

Take time after each step is read, to check your group's understanding by having someone who didn't read the step explain what the step means in their own words.

Gather all of the materials needed and decide which group member will do which jobs in the procedure before getting started with the experiment.

### Make a prediction of how much DNA (in grams) you think will be in one strawberry:

### Materials:

- 70% isopropyl rubbing alcohol
- 3 large strawberries
- 80mL water
- 6g salt
- 1 tablespoon liquid dish soap
- Beaker (or measuring cup)
- Measuring spoons
- Mixing bowl
- Cheesecloth
- Funnel
- Large beaker (or tall drinking glass)
- Small beaker (or small drinking glass)
- Resealable plastic food storage bag
- Tweezers
- Plastic weighboat (or lightweight plastic tray)
- Electronic Mass Balance

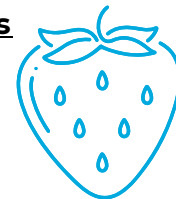


### Procedure:

1. Chill the bottle of rubbing alcohol in the freezer or put it on ice for some time.
2. Cut the stems and cores out of the 3 large strawberries.
3. Completely line the funnel with the cheesecloth, and place the tube of the funnel down into the tall glass.
4. In the mixing bowl, mix together the water, salt, and liquid dish soap. This is your extraction liquid.
5. Place the strawberries in the resealable plastic bag.
6. Add 3 tablespoons of the extraction liquid to the bag. Lay the bag flat on its side and press out all of the extra air. Seal the top of the bag tightly.
7. Use your hands to squish and squeeze the strawberry mixture for 2 minutes.
8. Pour the strawberry mush from the bag into the funnel. Let it drip into the glass until there is very little liquid left in the funnel.
9. Pour the filtered strawberry mixture from the tall beaker into the small beaker so it is about one-quarter full.
10. Take the rubbing alcohol out of the freezer. Using the measuring cup, measure 120mL (about ½ cup) of cold rubbing alcohol.
11. Tilt the small drinking glass with the filtered strawberry mixture and SLOWLY pour the rubbing alcohol down **the side** of the glass. Pour until the alcohol has formed about a 1-inch deep layer on top of the strawberry mixture.
12. Use your tweezers to collect the cloudy clumps that form between the alcohol and strawberry layers. This is the strawberry DNA!
13. Transfer the DNA into the weighboat and put it on the balance to get its mass.
14. Transport the DNA sample back to your station to complete the analysis steps.

**Analysis: Observe the DNA clump and discuss how it looks, feels, and smells**

What do you notice about how the DNA looks compared to the strawberry itself?



What do you wonder about the strawberry DNA?

Explain how you think the extracted DNA of other fruits or vegetables would look when compared to the DNA of a strawberry?

**Calculations: Use your calculators and the space below to complete your analysis**

Calculate the average mass of DNA in one strawberry and submit your value to your teacher to display with the class data. (hint: you found the mass of the DNA for all your strawberries when you put it on the balance)

Based on the data collected and reported from each group, calculate the class average for the mass of the DNA of one strawberry.

Using the Percent Difference Formula to the right,  $\frac{\text{Group Average Mass} - \text{Class Average Mass}}{\text{Class Average Mass}} \times 100\%$  calculate the percent difference of your group's data for the average mass of the DNA of one strawberry when compared to the class average.

What might explain why there would be a difference between an individual group's calculated value for the mass of DNA in one strawberry and the class average? What would a positive or negative value for the percent difference mean about your group's average mass?