TEACHER LESSON PLAN

On The Trail of a Snail

Grade	Length	Subjects/strands	Topics
9th–12th grade	90 minutes	Biology, ecology, science inquiry, characteristics of the phylummolluska	Watersheds, structure and function, interactions of organisms

INTRODUCTION

This lesson involves an investigative exercise regarding the biology and impacts of a mysterious aquatic snail (New Zealand mudsnail). In Part A, students will identify a mysterious snail. In Part B, students will learn about the snail's biology, ecology, possible origins, and behavior. In Part C, students will predict the potential ecological impacts of the snail's invasion and design an experiment that allows them to measure the impact. If feasible, you have the option of collecting aquatic organisms in a nearby stream for students to study and predict how the NZ mudsnail may interact with that organism and impact your nearby aquatic ecosystem.

LEARNING OBJECTIVES

Students will

- Learn or review characteristics of the phylum Mollusca, domain Eukaria; and learn to identify a snail from a verbal description
- Create a simple dichotomous key for identifying New Zealand mudsnails
- Learn about the biology, ecology, and possible origins of the snail
- Predict how the snail will interact with or affect other organisms in the ecosystem
- Have the opportunity to make predictions and design an experiment to test the predictions

BACKGROUND

The New Zealand mudsnail is a highly invasive species of freshwater mollusk of the family Hydrobiidae. They tolerate a wide variety of habitats, can clone themselves, and have high reproductive rates. They are extremely small and can survive out of water for a number of days, allowing them to easily hitchhike on boats or gear that is not properly cleaned and dried. All of these factors have allowed the New Zealand mudsnail to rapidly spread throughout the western United States. First discovered in the United States in 1987 in the Snake River, now they are locally abundant in many western rivers. The New Zealand mudsnail has been observed at densities as high as 800,000 per m2. It is predicted that the NZ mudsnail will negatively impact the native species and food webs in streams. It can exclude native invertebrates and makes poor fish food. Fish fed exclusively a diet of NZ mudsnails will lose weight!

MATERIALS NEEDED

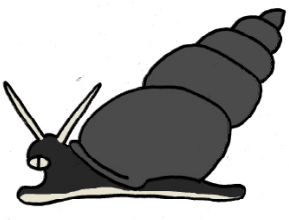
- Student handout*
- Interactive Quiz PowerPoint*
- Video about NZ mudsnails*
- NZ mudsnail species guide*
- Equipment to show a PowerPoint presentation.
- Dissecting microscope, probes, forceps, and petri dishes (optional).
- Aquatic organisms collected from a nearby stream (optional).

VOCABULARY

Aquatic invasive species, ecosystem, foot, gastropod, genetic variability, mantle, mollusk, operculum, parthenogenesis, protostome development, torsion, whorl, visceral mass, eukaria, dichotomous key

PREPARATION

For more information about New Zealand mudsnails, we suggest you review the species guide and the online video before presenting the lesson. You may also want to research whether or not the NZ mudnail is located in your area. There are links to additional



*included on www.menacetothewest.org

resources and to a database with a map of NZ mudsnail distribution on MenaceToTheWest.org. If you are interested in collecting and observing aquatic organisms, then we recommend utilizing stream research resources on the StreamWebs.org website.

PROCEDURE

Part A

Identify the snail and create a dichotomous key

1. Using the information provided on the student pages, help students identify the snail.
2. Emphasize the importance of recognizing key characteristics when identifying an organism.
3. Have students use the characteristics of the snails to create a dichotomous key. Students can cut out photos of the snails and use the descriptions to create a dichotomous key. Write the key on a sheet of paper and glue the photos in their appropriate place. Instructions for creating a dichotomous key are included in the student handout.

Dichotomous Key Solution

1. **Is the max size no more than 4 mm?**
   Yes — go to 2.
   No — go to 3.
2. **Does it have a creamy yellow color?**
   Yes — Taylorconcha
   No — Colligyrus
3. **Does it have more than 4 whorls?**
   Yes — Potamopyrgus
   No — go to 4.
4. **Is the bottom whorl almost twice the size of the second-to-the-bottom whorl?**
   Yes — Amnicola
   No — Pyrgulopsis

Part B

Get Informed

1. Pass out the student handout.
2. Present the "On the Trail of a Snail" PowerPoint presentation and show the New Zealand mudsnail video.
3. Have students answer the following questions about snails and mollusks as you are presenting the PowerPoint.
   1. **To what class of organism does the snail belong?**
      Gastropod
   2. **Did you know that gastropods are the second-most diverse class of organism in the world, with more than 40,000 living species? What is the most diverse class of organism?**
      Insecta
   3. **To what phylum does the snail belong?**
      Mollusca
   4. **What other familiar animal is also a gastropod?**
      slug
   5. **What are the main characteristics of mollusks?**
      All mollusks have a visceral mass, a mantle, and a foot. The visceral mass contains the digestive, excretory, and reproductive organs. The mantle is a covering. It may secrete a shell. The foot is muscular and is used for locomotion, attachment, and/or capturing food.
   6. **Does the New Zealand mudsnail undergo protostome or deuterostome development?**
      Mollusks undergo protostome development—mouth first, then the anus.
   7. **The New Zealand mudsnail is a resilient species; it possesses an operculum, a movable cover to the opening of the shell. What purpose does an operculum serve? Is it possible to observe the operculum?**
      The operculum allows the mudsnail to seal itself safely inside and survive temporarily extreme conditions, such as the gut of a fish or being out of water.
   8. **Although the New Zealand mudsnail can reproduce sexually in its native range, invasive populations are almost all females that reproduce through parthenogenesis. Parthenogenesis is a kind of clonal reproduction in which females can self-fertilize and bear live young without the presence of males or sperm. They can reproduce rapidly; some estimates indicate that one female can clone and produce more than 312,500,000 offspring in one year. Like New Zealand mud snails, quagga and zebra mussels are also invasive freshwater mollusks. However, quagga and zebra mussels undergo sexual reproduction**

rather than clonal reproduction. Females release their eggs and sperm simultaneously into the water, become fertilized and develop into microscopic-sized larvae that eventually attach to the substrate and develop into adult mussels. Compare and contrast mudsnail reproduction with that of the quagga mussel. How is each method adaptive? How does each aid in their respective invasion success?
Parthenogenisis is efficient because no males are needed! This rapid clonal reproduction helps the species increase in abundance very quickly. However, all the offspring are genetically identical. Sexual reproduction requires males and females but it increases genetic variability in the population, which helps the population survive in case of a disease, extreme habitat conditions, or other selective pressures.

9 **The presence of an operculum allows the New Zealand mudsnail to survive ingestion by a fish. How do you think this fact affects:**
a. The mudsnail's ability to invade?
A fish can increase the mudsnail's invasive range by ingesting it, moving upstream, and then excreting it.
b. Nutritional value to the fish?
The fish will be unable to get nutrients from a mudsnail because the fish cannot break down and digest the snail.

Part C

Predict the Risks

1 Collect organisms from a nearby stream if feasible. If not, then you can utilize drawings and descriptions of the kinds of organisms commonly found. Download these resources on MenaceToTheWest.org. Click on Lessons.
2 Give the organisms (or photos of the organisms) to students and have them record their observations on the student page. Students will be filling out a table in which they describe a characteristic of a native aquatic organism and how it may be interacting with the NZ mudsnail.
3 You may wish to have students construct a food web to help them develop a hypothesis they would like to test.
4 Following the steps on the student page, ask students to make a prediction, state a hypothesis, and outline an experiment to test the hypothesis.
5 If feasible, students can proceed with the scientific process and carry out their experiments. Please share your students' experiences and outcomes of their experiments on the Menace to the West "Share your Project" page.

CONCLUSION AND EVALUATION

Use the following questions to assess what your students have learned.

1 **Why is the NZ mudnsnail such an effective invader?**
By being extremely small, it can easily hitchhike a ride or waders, boats, or other equipment. When it closes its opurculum, it can retain moisture and stay alive many hours out of water or nestled in wet gear. It reproduces very quickly and produces many offspring through the process of parthenogenisis.

2 **What are the key characteristics for identification?**
Look for a very small snail, the length of a grain of rice (4–6 mm). It is brown, smooth, and has 4–5 whorls.

3 **What is the underlying principle behind a dichotomous key? How did you apply this principle when identifying the NZ mudsnail?**
A dichotomous key is a method for determining the identity of something by matching a characteristic to a series of possible choices that lead you to the correct name of the item. Dichotomous means "divided in two parts." At each step of the process, the user of the key must compare a characteristic to two possible choices, and each alternative leads to another question pair until the item is identified.

In the snail example, we first divided the snails by size, then by color, then by number of whorls, then by the ratio of the size of the first whorl to the second.

4 **What are some ways the NZ mudsnail could impact your local aquatic ecosystems?**
Answers will vary but include: Competing with native invertebrates for food, thus reducing the number of native invertebrates, thus changing the food source for the predators, such as fish, ducks, or eagles.

5 **Do you think it would be possible to remove all the NZ mudsnails from a creek, pond, or lake?**
It would be very difficult, due to their small size and the difficulty of accessing aquatic environments. You could control them by poisoning an entire lake, but that would have other negative consequences such as killing all the native organisms.

6 **What are some precautions we can take to prevent NZ mudsnails from invading other areas?**
Always inspect your water gear or fishing equipment after fishing, exploring, or boating in the water. Clean, drain, and dry your boat and gear.

7 **What are some things we could do as a class to raise awareness about invasive species in our school or our community?**
There are many possible projects from adopting a local stream or natural area to study and restore, to creating posters about invasive species to post in the school halls. Many more ideas can be found on MenaceToTheWest.org under the "Take Action" tab.

ADDITIONAL RESOURCES

Aquatic Invasions: Menace to the West
NZ mudsnail species Guide
http://seagrant.oregonstate.edu/sites/seagrant.oregonstate.edu/files/invasive-species/toolkit/nz_mudsnail.pdf

Aquatic Invaders
Video on the New Zealand mudsnail
https://www.youtube.com/watch?v=s8l55WzMZR4

US Fish and Wildlife
US Fish and Wildlife Fact Sheet on NZ Mudsnails
https://www.fws.gov/columbiariver/ans/factsheets/mudsnail.pdf

United States Geological Survey
USGS Nonindigenous Aquatic Species Fact Sheet
https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=1008

STANDARDS ADDRESSED

Common Core

Earth and Space Sciences (Grades 9-12)
- Earth and Human Activity HS-ESS3-4

Life Sciences (Grades 9-12):
- Ecosystems: Interactions, Energy, and Dynamics HS-LS2-6, HS-LS2-7

Next Generation Science Standards

Mathematics (Grades 9-12)
- Abstract and Quantitative Reasoning MP.2
- Reason quantitatively and use units to solve problems HSN.Q.A.2

Science and Technical Subjects (RST) (Grades 9-12)
- Integration of Knowledge and Ideas 11-12.7

Writing (WHST) (Grades 9-12)
- Research to Build and Present Knowledge 9-12.7

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