Who is this Mussel Pretending to be?

Grades: 9-12

Activity Overview
Freshwater Mussels use mimicry to lure fish in order to facilitate their young (glochidia) attaching to the fish. Glochidia are larval mussels that parasitize fish by attaching to their gills to develop. This lesson will introduce students to this phenomena and its role in the life cycle of freshwater mussels.

Objectives
Students will be able to define what it means to be a mimic and explain it in the context of mussels.

Standard Connection

State
9.4.3.3.5

3. Evolution by natural selection is a scientific explanation for the history and diversity of life on Earth.

Explain how competition for finite resources and the changing environment promotes natural selection on offspring survival, depending on whether the offspring have characteristics that are advantageous or disadvantageous in the new environment.

NGSS
HS-LS4-4

Construct an explanation based on evidence for how natural selection leads to adaptation of populations. [Clarification Statement: Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a change in gene frequency over time, leading to adaptation of populations.]

Materials

National Geographic Article and Video on Mussel Mimicry
Images of Mussel Lures (see resources section)

Additional Teacher Resources:

Mussel Life Cycle MNDNR
Mussel Life Cycle Virginia Tech

Teacher Background

Evolution by natural selection has produced some remarkable behaviors and structures found in living organisms.

There are three requirements for evolution by natural selection:

1) Variation in the trait of interest.
2) Individuals possessing a certain form of the trait survive or reproduce better than others (selection).
3) The trait must be heritable (must be passed down from parents to offspring).

All of these must be met for a population to evolve over time.

One example of a set of traits that are shaped by natural selection is mimicry. Mimicry occurs when one species resembles another for the purpose of protection or reproduction. This can be in either appearance or behavior. For example, viceroy butterflies are excellent mimics of monarchs. Because of this mimicry of monarch color patterns, predators avoid eating viceroy butterflies.

In the case of native freshwater mussels, mimicry is used as part of their reproductive cycle. Freshwater mussels reproduce sexually. Sperm is released by the male directly into the water and enters the female via the incurrent siphon. After fertilization, the eggs develop into a larval stage called a glochidium (plural glochidia).

Freshwater mussels then use mimicry to tempt fish close to them. They produce lures that look like items that fish may like to eat like crayfish or minnows. Once the fish is close, the mussel shoots its glochidea out and they attach to the fish and feed on its blood. When they are mature, the mussels drop off of the fish, and establish themselves in new areas of the river or lake. In this way, freshwater mussels are "using" their fish hosts not only for nutrition for their young but also for transportation to new sites.

In this lesson students will explore the concept of evolution by natural selection using mimicry in native freshwater mussels as an example. Students will observe how mussels mimic other organisms and then make a decision about how this trait would be beneficial evolutionarily.

Procedure

1. Make sure that students know the difference between camouflage and mimicry.
2. Give them the examples that in mimicry there are often three roles:
    - Mimic – a species that experiences increased fitness by resembling another species
    - Model – the species being mimicked
    - Dupe – the species being "duped" by the mimic
3. Show students the National Geographic video of mussel mimicry. Teachers may want to take some additional time to explain glochidia and their role in the life cycle of mussels. The National Geographic article could also be read in addition to watching the video.
4. Have students brainstorm food items for freshwater fish. Examples could include: minnows, crayfish, plants, worms, leeches, scuds, insects, etc. Keep a list on the board as a bank of ideas for the students. If needed, teachers may want to project images of the food items if all students are not familiar with them.
5. Hand out the Mussel Mimicry Worksheet to students. Project or show printed images at the end of the lesson plan. Leave each image up for a few minutes while students sketch what they see and describe what organism it is a mimic of. Ask for a few explanations of what the students see and then reveal the image on the next slide of the actual organism.
6. As part of the debriefing students need to start connecting this mimicry to survival over time and evolution. In the debrief, make sure to highlight that mussels do not "decide" how to be but that selective pressure instead is causing these changes over a long time.
    - What are the three components of evolution by natural selection?
    - What would the advantage to be this type of mimicry?
    - What could be possible disadvantages to this type of mimicry?
    - What selective pressures acted upon the mussels?
    - Why would each of these mussels have evolved to mimic a different species?
    - Mussels do not have eyes or the ability to see. How are they able to mimic the fish and other species so closely?

Assessment

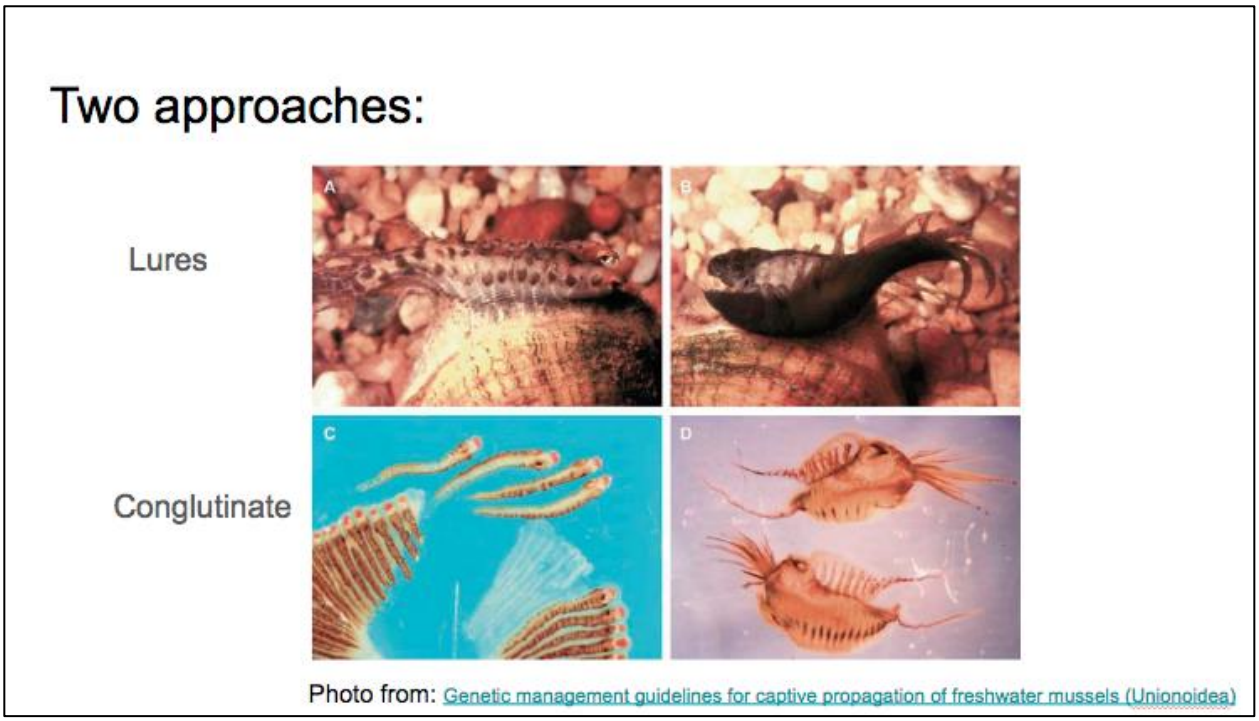
Collect the worksheets and check for understanding. Keep in mind that although the students may be wrong, they may have come up with a good argument for their line of thinking.

Extension

1. Students craft their own models to mimic freshwater fish foods. Clay, yarn, or any variety of other household material would work well.
2. Students make a flowchart or comic strip outlining the life cycle of freshwater mussels.
3. Check out other lessons developed on this theme. For example, Michigan State University, The Hunger Games: Hiding in Plain Sight--Exploring evolution-using mimicry
    - http://kbsgk12project.kbs.msu.edu/blog/2012/10/03/the-hunger-games-hiding-in-plain-sight-exploring-evolution-using-mimicry/

Lesson Resources

Mussel Lure Images for Activity



MINNESOTA ZOO

1. Who is this mussel pretending to be?

Plain pocketbook mussel:
Freshwater Mussels of the Mississippi

Minnow

B. u.

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TAKE THE CHALLENGE TODAY!
MNZOO.ORG/DIGITALMUSSELS

MINNESOTA ZOO

2. Who is this mussel pretending to be?

Rainblow mussel:
https://freshwaterspecies.wordpress.com/tag/freshwater/

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Crayfish

MINNESOTA ZOO

3. Who is this mussel pretending to be?

Snuffbox mussel:
Freshwater Mussels of the Mississippi

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Snuffbox mussel:
Freshwater Mussels of the Mississippi

Insects

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MINNESOTA ZOO

4. Who is this mussel pretending to be?

Winged Mapleleaf mussel:
Freshwater Mussels of the Mississippi

http://www.in-fisherman.com/catfish/blue-catfish/blue-catfish-baitfish-and-mussels/2/

4. Who is this mussel pretending to be?

Winged Mapleleaf mussel:
Freshwater Mussels of the Mississippi

http://www.in-fisherman.com/catfish/blue-catfish/blue-catfish-baitfish-and-mussels/2/

Dead Fish

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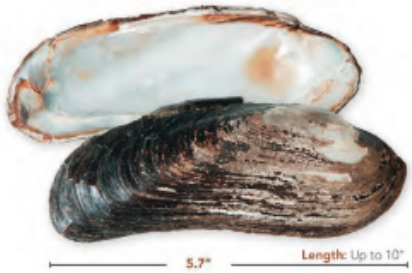
MINNESOTA ZOO

5. Who is the mussel pretending to be?

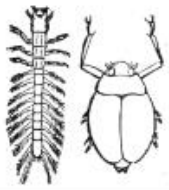


Spectaclecase mussel:
Freshwater Mussels of the Mississippi

5. Who is the mussel pretending to be?

Spectaclecase mussel:
Freshwater Mussels of the Mississippi

Aquatic insects



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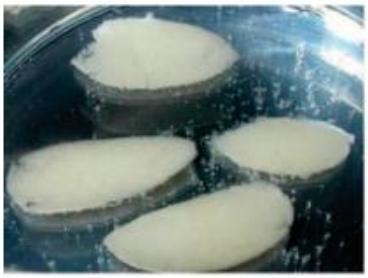
MINNESOTA ZOO

6. Who is the mussel pretending to be?



Pistol Grip mussel:
Freshwater Mussels of the Mississippi

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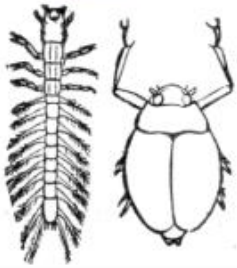
Freshwater Mussels of the Mississippi

Aquatic insects