Zebra Mussel Invasion Activity

Grade Levels: 4-6

Objectives: Participants will:

1. Explain why native freshwater mussels are important to ecosystems.
2. Identify the effects of zebra mussels on other aquatic organisms.
3. Describe three ways that zebra mussels can take over habitat in Nebraska waters.
4. List two or more ways in which human activity has introduced zebra mussels and two ways that people spread zebra mussels in Nebraska waters.
5. Describe other types of invasive species in Nebraska.

Materials Needed for Activity:

- Flagging tape or rope to create lake, stream or river boundaries (60 foot). Chalk may be used if on cement.
- 4-6 Stakes to keep flagging tape or rope in place outdoors.
- 2 hula-hoops
- 100 small soft balls/plastic balls
- 2 paperclips or other small objects
- Plastic boat or picture
- Flagging tape or copies of zebra mussel cards with string inserted in them (found at end of this document)
- 1 copy of each handout (found in this document)
- (Optional) Scissors (if using flagging tape)
- (Optional) Mussel or Clam shell
- (Optional) Zebra mussel shell
- (Optional) Tarps for students to sit on if outdoors.
- (Optional) Set of Nebraska Invasive Species Education Cards (Visit https://neinvasives.com/ to request)

Background Reading:

Native Mussels: The mollusks of Nebraska include snails and freshwater mussels. The snails can be further split into terrestrial and freshwater species. Recent work has determined that there are 30 species of freshwater mussel that have been identified from shells collected in Nebraska. Of these, 12 species are extinct and 7 are barely hanging on. Freshwater mussels reproduce by producing larvae that attaches itself to fishes. Here it develops into a juvenile and, via the fishes, travels and hopefully drops off into new habitats where it can grow and prosper. Mussels are an important food source for several different kinds of animals, including river otters and raccoons, as well as several fish species. Mussel shells form an important substrate (bottom material such as rocks, gravel or muck) to which algae and insect larvae can attach themselves. When present in large numbers, mussels can become a sort of underwater garden that attracts feeding fish. Mussels also filter and clean the water by removing undesirable particles and chemicals as they feed.

Duration: 40 minutes

Group Size: any

Setting: Indoors or Outdoors

Key Terms: Native mussel, invasive species, zebra mussel, food web, ecosystem, carrying capacity.

Background Reading continued:

Freshwater mussels filter oxygen and particles from the water, cleansing the water in the process and absorbing what they consume into their bodies and shells. Mussels are sensitive to changes in the environment, and serve as indicators of the health of lakes and rivers. Degradation of lakes and rivers from runoff of silt and chemicals – together with physical changes from damming, channelization and dredging and taken a toll on the native mussels. (Native means it is specie that naturally occurs in the environment). For this reason, freshwater mussels are now extinct or rare.

Invasive Species: A species that is not native in an ecosystem that can cause harm to the environment, the economy or human health.
Aquatic invasive species have certain characteristics that tend to make them successful:

- Rapid growth and reproduction: tend to grow quickly and produce a lot of offspring; many reproduce multiple times in one season.
- Asexual reproduction: some species need only one individual to reproduce; especially plants, which may need only a small plant fragment to start a completely new population.
- Adaptability: typically hardly and able to tolerate a wide range of environmental conditions, including degraded and polluted habitats and rapidly changing conditions that native species can't tolerate.
- No predators: Since these species are non-native, they often lack the natural predators that would keep their population numbers in check.

Zebra Mussels:
More recently, native mussels are especially threatened by the invasive mussel species known as the Zebra mussel. Zebra mussels are small mollusks, <2 inches in length, that attach to any solid object. The effects of zebra mussels are known to foul beaches, cover entire bed of a lake floor, clog water intakes, damage boats, harm native mussels and possibly interfere in lake food changes. A single zebra mussel female can produce more than 30,000 eggs, and the generations mature rapidly, making it difficult to control. A body of water with no detectable zebra mussels one year may have its bottom covered with them the next year. Zebra mussels live an average of about five years, so the mussel can filter 482 gallons over its lifetime. They will remove plankton (tiny plants and animals) that serves as food for fish and native species. Zebra mussels can form colonies so dense that they carpet the lake or river bottom in a layer several inches thick, eliminating habitat required by native mussels and other bottom-dwelling animals.

A firm surface that is not toxic can be colonized by zebra, including boat hulls and motors, trailers, docks, anchors and rocky beaches (have example pictures). They plug water intake ports, causing outboard motors on boats to overheat.
Zebra mussel control: clean, drain and dry

There are other types invasive species in Nebraska; wildlife, insects and plants that affect the natural habitat. Use the Nebraska invasive species education cards to learn more or visit https://neinvasives.com/.

- Plants:
  - Purple loosestrife (wetland/river plant)
  - Garlic Mustard (forest area plant)
- Insect
  - Emerald Ash Borer
- Wildlife
  - Eurasian Collared Dove

Activity By: Julia Plugge (Nebraska Game and Parks Commission) & Allison Zach (Nebraska Invasive Species Program.

Adapted from: the Great Lakes Aquarium & MN DNR MinnAqua Program Mussel Mania: http://glaquarium.org/resources/mussel-mania-cause-and-effect/

The Activity:

Before the activity:

1. Make a 60 foot circle (30-foot-wide in diameter), flagging tape, rope or chalk drawn. This area represents a portion of a lake or stream system.
2. In the circle, randomly place 2 hula-hops. This represents a portion of a lake or stream system.
3. Within each of the 2 hula-hoops, place a paperclip/small item inside each.
4. Print out enough copies of the zebra mussel card page and put yarn through each card for students to wear (if not using flagging tape).

Procedure:

- Ask students to name organisms that live in a lake in Nebraska. Pick a waterbody that may be near their school or area. (i.e.: Plankton, fish, turtles).
  After they have answered show Handout 2 and discuss that plankton are microscopic but an important food source for organisms in waterbodies.
- Show Handout 3. Define and describe native mussel. Optoinal: Show a mussel or clam shell.
- Show Handout 4. Discuss the ways native mussels benefit the aquatic ecosystem, including filtering water as they feed, and providing food for other animals, including many types of fish.
- Show Handout 5. Discuss zebra mussel impacts: (define ecosystem - a biological community of interacting organisms and their physical environment. Optional: Show students a zebra mussel in shell.
- Tell students that they will play a game. Each student will be an aquatic species trying to meet their habitat needs.

The Game:

Round 1: Establishing freshwater mussels

1. Tell the students that the rope/chalk circle is the boundary of a waterbody. (pick a lake or river– i.e. Platte River)
2. See Handout 1 for activity diagram. All the students become baby native mussels, called "glochidia", trying to find a great place to live. They have been traveling around the waterbody attached to the gills of host fish and have grown enough to strike out on their own so they're ready to drop off the fish's gills.
3. Have the students mill around to represent drifting in the current after leaving the host fish.
4. Call out "Stop!" Some students will be inside or touching the 2 hula-hoops. Inform students that anyone not standing in a hula-hoop must leave the circle. Explain that native mussels live in muddy or sandy bottoms, which are represented by the 2 hula-hoops. The others didn't survive.
5. The person nearest the paper clip inside in each hula-hoop has found the very best spot for good mussel survival and can sit down. Others do not survive (they can't attach well where they landed), they get eaten by a fish or other animal, they don't get enough food, must leave the lake. Emphasize that finding the right kind of lake or river bottom is very important for the native mussels, and this habitat need limits their numbers.
6. Identify 2 students as plankton movers. They are the water currents moving the plankton (food) into the area see Handout 1. They should sit outside the circle, facing away from the "lake or river". They will toss plankton (soft balls) at random over their shoulders.
7. The native mussels must catch the plankton in the air to simulate feeding, remaining seated within the hula-hoops as they play. Anything missed stays on the ground. The round ends when the plankton movers run out of plankton to toss.
8. *Ask the students what happens to the plankton that doesn't get eaten by the freshwater mussels.*
9. Assign 2 decomposers to pick up the plankton and return to the movers. See Handout 1.
10. Begin the game again and play for a short while so the decomposers become comfortable with their role.

Round 2: Adding native yellow perch and walleye to the lake

1. Tell the students that other animals live in balance in the ecosystem with mussels and plankton. Have the remaining students become fish in the lake see Handout 1.
   - Perch feed on plankton show Handout 6
   - Perch move around inside the circle and try to catch plankton in the air.
   - Perch may catch the plankton without overly interfering with or blocking the native mussels' feeding.
   - Perch may also feed from the bottom (by picking up stray foam plankton balls)
   - The decomposers can also continue to move plankton from the ground back to the plankton movers.
2. Begin the game again. Play the game until most of the plankton has been eaten by the perch.
3. After a few minutes pause the game.
4. Select 1 student to be walleye and add them to the game see Handout 1.
   - Walleye eat the perch show Handout 6.
   - Walleye can move around the circle and tag perch.
   - Once a perch is tagged they give their plankton to decomposers then return to the game.
5. Pause the game after a minute or two of play. Have the students reflect on how the lake is functioning. Is it in balance? (it should be in pretty good balance)

Round 3: Introduction of Zebra Mussels

1. Now the waterbody is going to become infested with zebra mussels, Show Handout 5.
2. This time when perch are tagged, they will give their plankton to the decomposer and then wait to be returned to the game by the instructor. They will become zebra mussels when they are returned to the game (zebra mussel card around their neck or put flagging tape around each student's arm).
3. Explain that zebra mussels compete with native mussels for food and space.
   - Zebra mussels can't live in the soft bottom like the native mussels, but must live on bard surfaces, like rocks, represented by the area outside the hula-hoops.
   - Zebra mussels filter-feed and eat plankton from the water, just as native mussels do.
   - Unlike perch, zebra mussels have very few predators that will feed on them.
4. Add zebra mussels to the lake 3 at a time (from the perch that are waiting outside the circle after being tagged by the walleye). <u>The zebra mussels must</u>*:*
   - Put 1 foot on a hula-hoop to represent they are attached to the native mussel.
   - Put 1 hand on another zebra mussel that has their foot on a hula-hoop because zebra mussels attach to each other.
5. Tell the group that, because zebra mussels must attach to hard surfaces to survive, they must put one foot on a hula-hoop or touch another zebra mussel that is touching a hula-hoop.
6. Assign 1 boat driver. Give them the plastic boat or a picture of a boat.
7. Have the boat driver enter the circle and tell zebra mussels they can move put one hand on the boat.
8. Continue until all the native mussels are smothered with zebra mussels or until everyone has had a chance to get back into the game.
9. Right before ending the game, have the boat leave the circle with zebra mussels attached to it. Tell the group the boater went to another waterbody. This ends the game.

Discussion/Wrap up:

Ask these questions:

- *What happened to the fish and native mussels as more zebra mussels were added to the lake?*

  Space became increasingly scarce while food became harder to find. Some of the fish and native mussels may have even starved because they couldn't get any food. The carry capacity (have students define) of the lake for fish and native mussels decreased as more and more zebra mussels were introduced.

- *Do zebra mussels have predators?*

  In their native range there is a fish called the round goby that keeps them in check. In Nebraska there are a few fish that will eat them but they will not keep them in check due to their high reproductive rate (each female releases 30,000 eggs each time they spawn).

- *How did zebra mussels affect the boat?*

  Because zebra mussels adhere to hard surfaces, they often clog boat engines. The larvae (veligers) will enter the boat engine then grow and if the engine isn't cleaned or kept out of water to kill them they can grow to clog it.

- *Why should anglers and boaters always drain water from their boats, minnow pails and live wells?*

  Zebra mussels and other aquatic invasive species can live out of water for up to 2 weeks in the summer and even longer in the right conditions. It is important to remove all water from the boat and angling equipment before using them in another waterbody. Clean, Drain and Dry boats between uses. Ensure live wells and engine plugs are pulled prior to leaving a waterbody to remove water. Clean and dry the boat before launching into another waterbody. Leave angling equipment and other boat equipment out to dry completely before use in another waterbody.

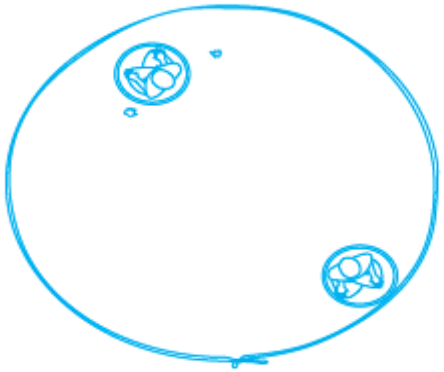
- Review the characteristics of invasive species
  - Rapid growth and reproduction
  - Asexual reproduction
  - Adaptability

- Discuss other invasive species in Nebraska and how they can be controlled (use the Nebraska Invasive Species Education Card Set or printed off images from https://neinvasives.com/). Show pictures of those invasive species that can be found in their area.
  - Plants
  - Insects
  - Other aquatic
  - Wildlife

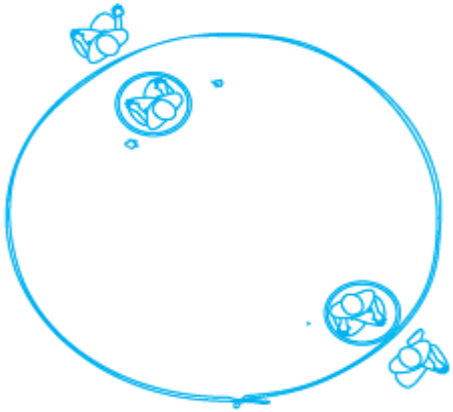
Handout 1. Activity Diagrams

Mussel Mania - Quick View

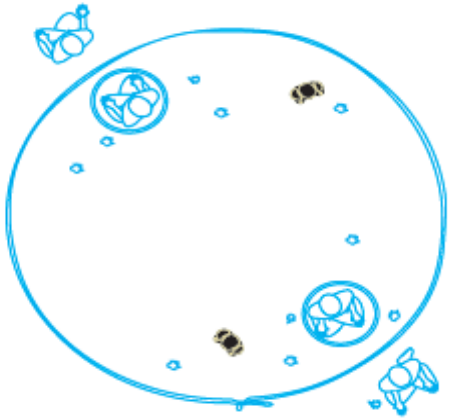
1. After floating off of a host fish, native mussels make a home only on a sandy or muddy part of the lake bottom.



2. Add plankton movers to send plankton around lake. Native mussels reach for their food.



3. Add decomposers to pick up plankton and return it to the plankton movers.



4. Add perch to the lake. The perch eat plankton, too.

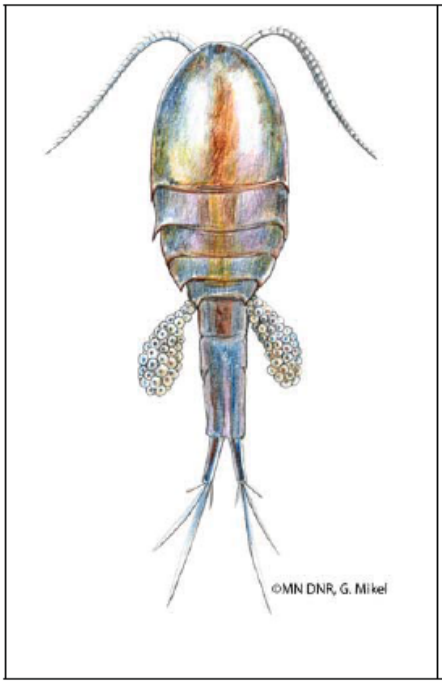
5. Add walleye to the lake to control the perch. Walleye eat the perch. Eaten perch give their plankton to the decomposters. The system should start to balance.

6. Perch who die come back as zebra mussels. Zebra mussels can live on any hard surface - including native mussels. The zebra mussels will clean the lake out of plankton.

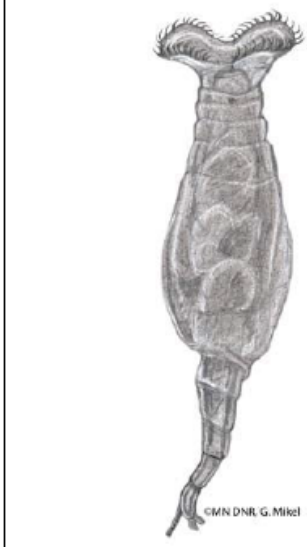
Handout 2. Examples of Plankton in Nebraska Waterbodies

Plankton Sheet

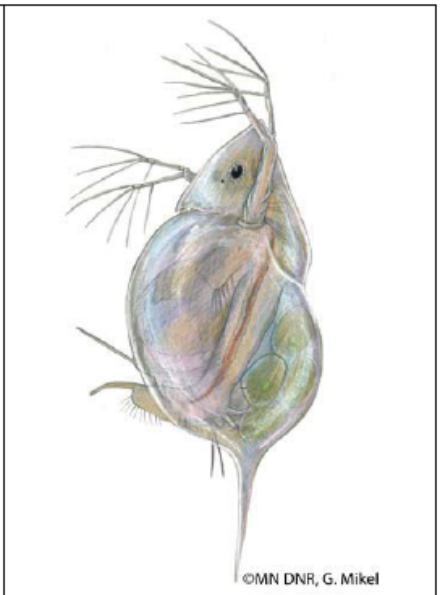
Plankton are tiny organisms. Many float freely (or drift) in the water, and are eaten by mussels and fish.



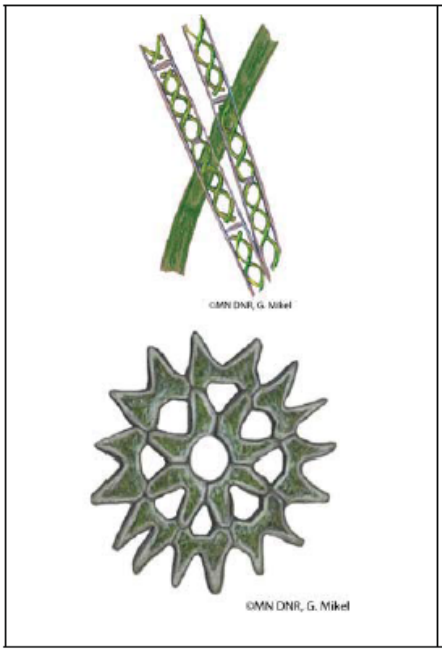
Cyclops
(Copepod)



Rotifer



Water Flea or Daphnia



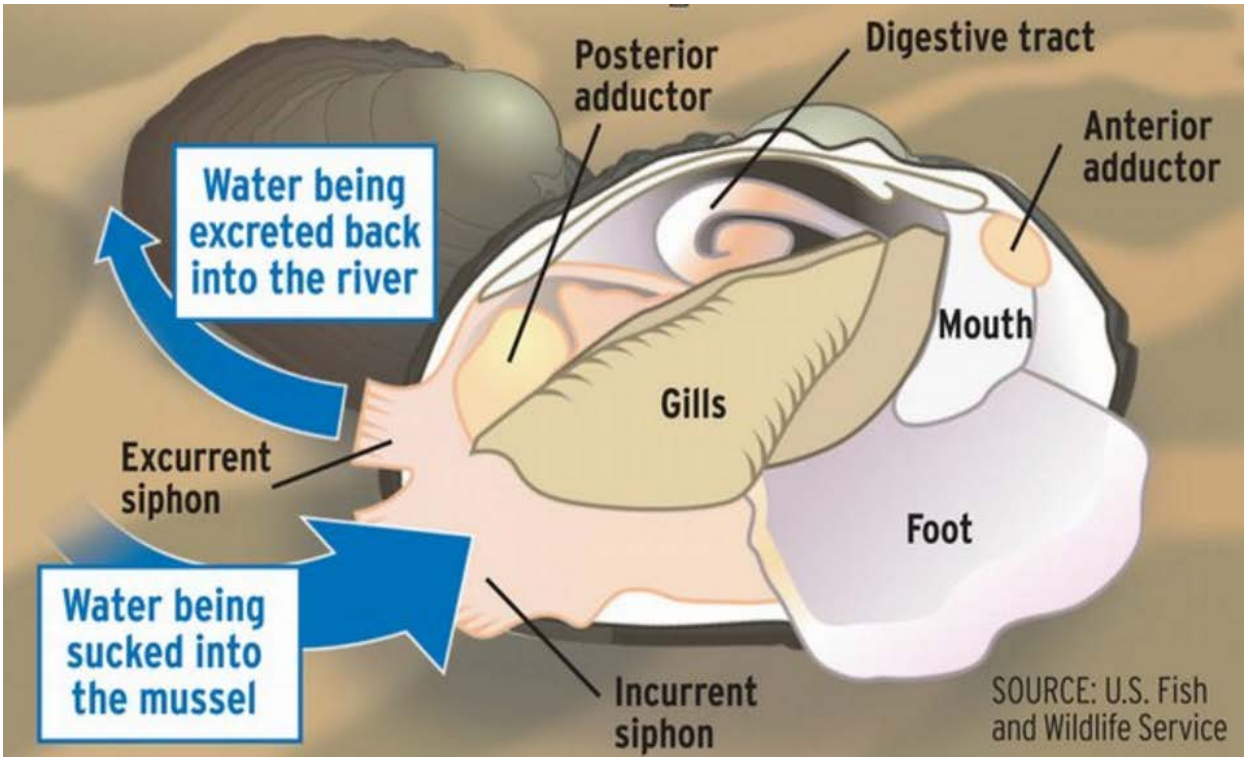
Spirogyra and Pediastrum
(Green Algae)

Toxic to humans and terrestrial animals

Anabaena
(Blue-Green Algae)

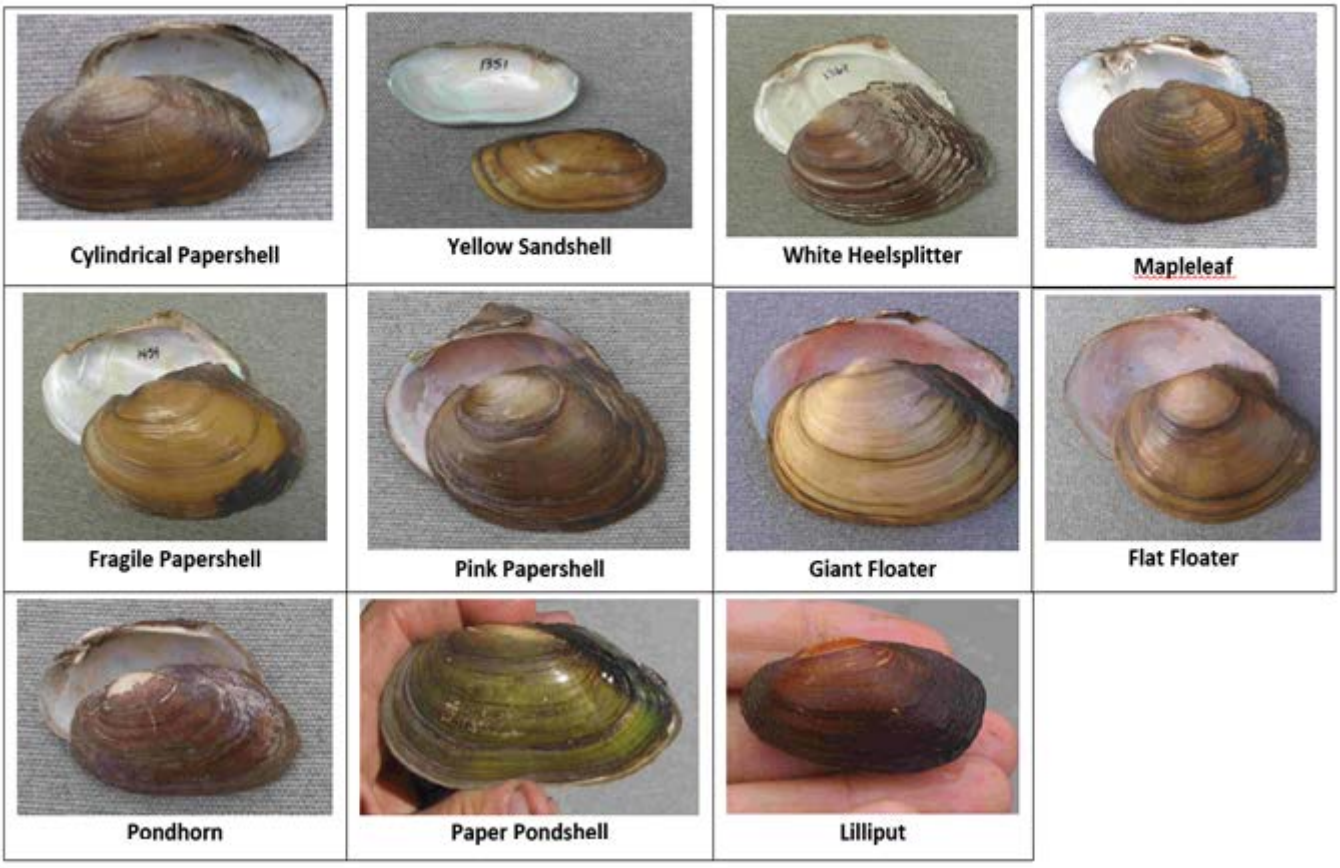
Diatoms

Handout 3. Native Mussel Anatomy

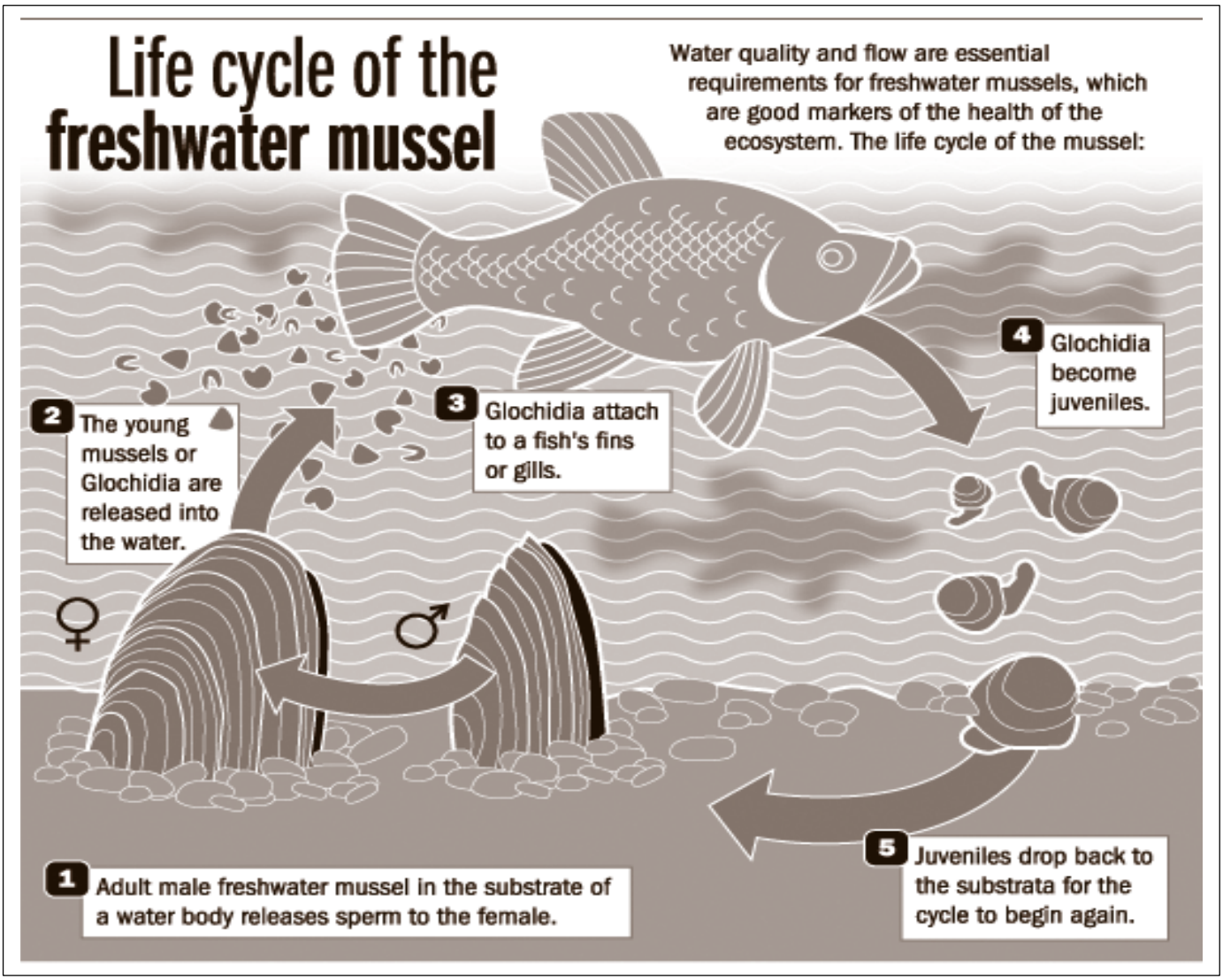


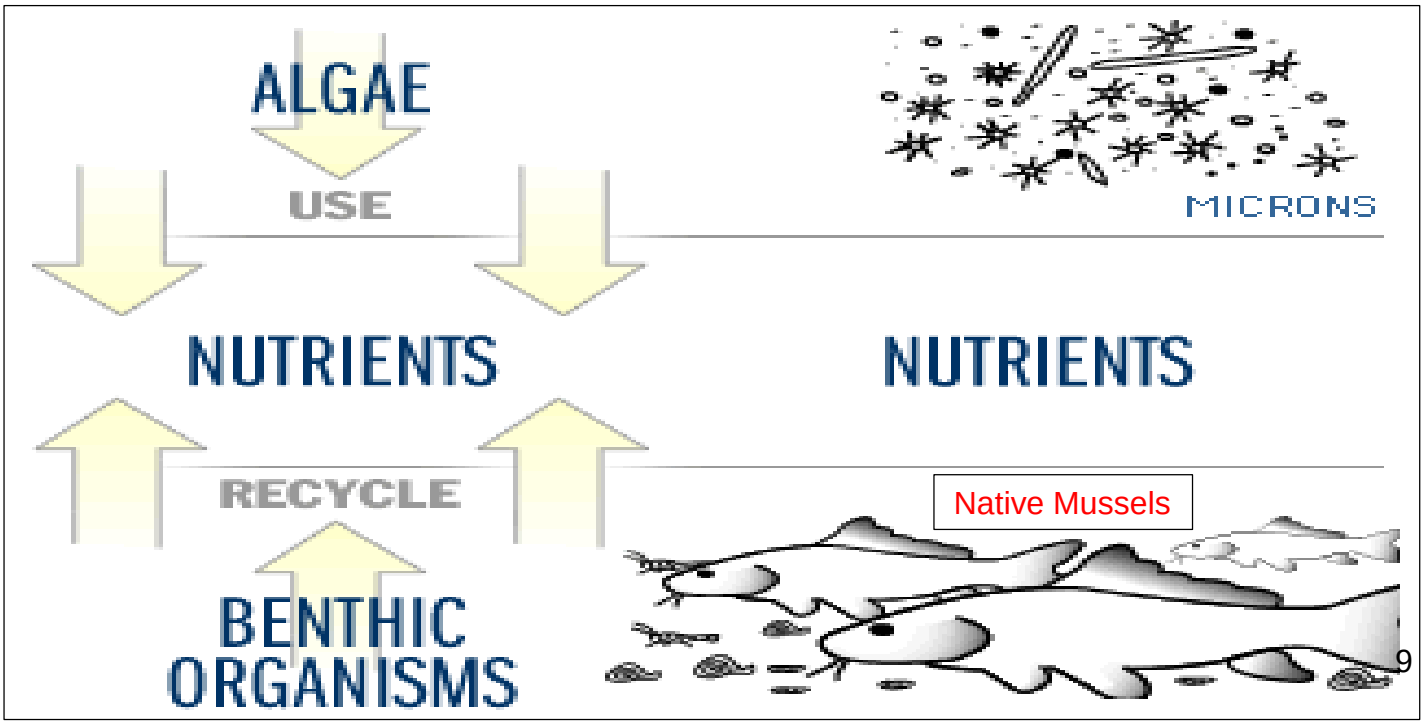
11 Common Native Nebraska Mussels:

There are 30 Native Mussel Species in Nebraska pictured below are the species that are least rare.

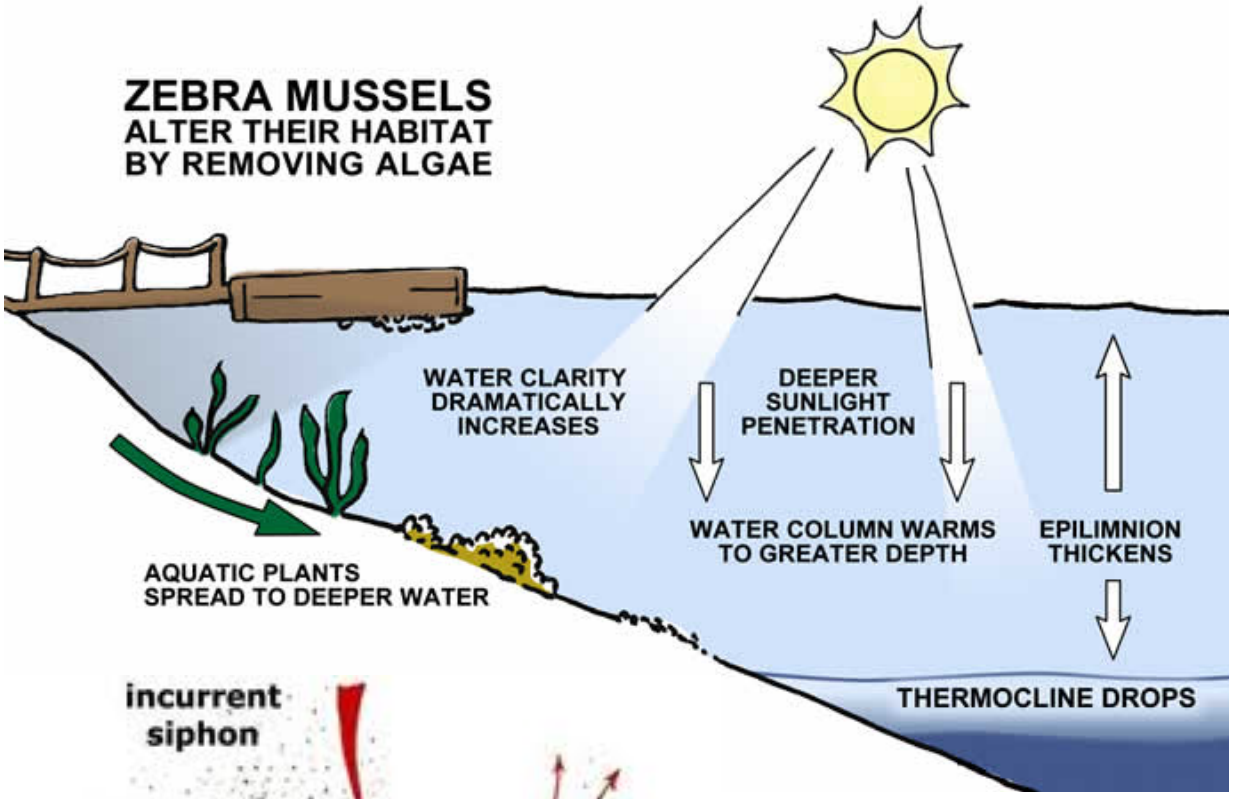


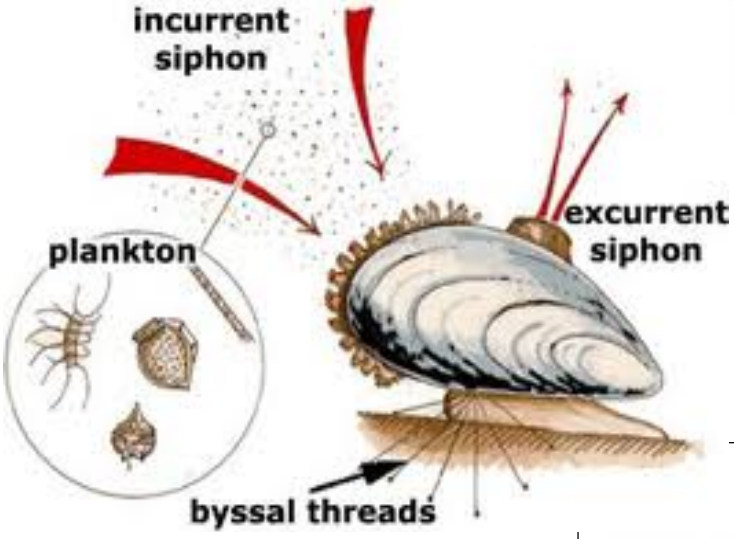
Handout 4. Native Mussel Lifecycle





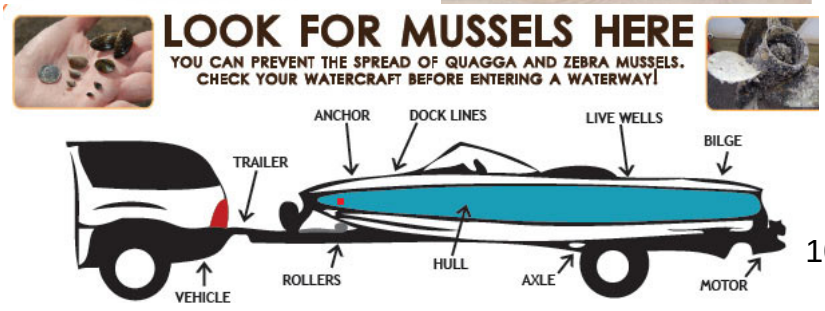
Handout 5. Zebra Mussel Overview



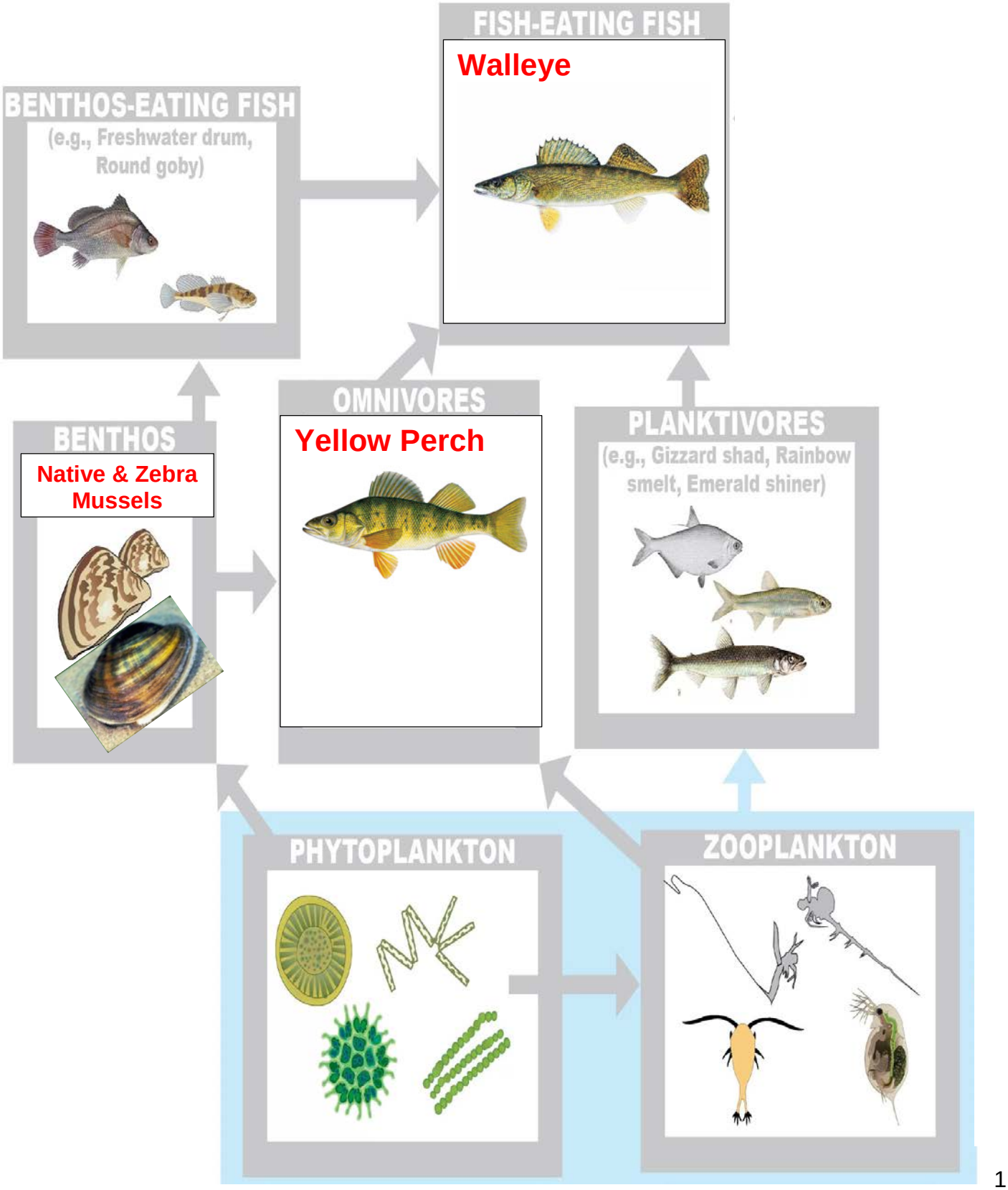


Zebra mussel (1 inch across)

Zebra mussels on a native mussel, clogging a pipe, and being moved in water on a boat



Handout 6. Perch, Walleye, Native Mussels & Zebra Mussels



Optional Zebra Mussel Cards: Print off this page (as many copies as needed) and cut out each card and put a string through each card so students can wear a card during the zebra mussel part of the activity.

Zebra Mussel

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