Mussel Life Cycle Card Game

Background Information:

This information is pulled from the Freshwater Mollusk Conservation Society
https://molluskconservation.org/MUSSELS/Reproduction.html

Mussels are nature's freshwater version of marine clams like those you can find on the beach. Technically, a freshwater mussel is a bivalved mollusk that lives in fresh water.

Mussels constantly pump water to feed and breathe. They filter out suspended particles in the water. Detritus, phytoplankton, zooplankton, diatoms, bacteria and other microorganisms are all filtered out of the water by mussels. This makes the animals exceptionally vulnerable to water pollution and degradation of the aquatic ecosystem.

Mussels are the longest lived invertebrates; some have been reported to live more than 100 years. More commonly, they live from 10 to 50 years depending on the species. Mussels have growth lines on the outside of the shell, like rings on a tree. In many cases, these growth lines represent years in the mussel's life.

Freshwater mussels have an unusual and complex mode of reproduction, which includes a brief, obligatory stage as a parasite on a fish. During the breeding season, females lay eggs and brood them inside specialized chambers in their gills called a marsupia. Males release sperm into the open water, which is then drawn into the females through their siphons. The sperm fertilizes the eggs. Inside the female mussel, fertilized eggs develop into microscopic larvae known as glochidia. Mussels need to "infect" a host fish with glochidia to complete the reproductive process. Once the glochidia are released from the female, they must attach to the gills or the fins of the right fish host and encyst to complete development.

Some mussels simply release glochidia into the water where they must haphazardly come into contact with their fish host as it swims by. Some female mussels have an extension of the mantel tissue that resembles a small fish. The mussel displays this tissue outside its shell between the valves and twitches it repetitively to attract its predaceous fish host—like a fishing lure. While attempting to eat the lure, the marsupial gills of the female mussel are ruptured, and the glochidia come loose and attach themselves to the fish. Other mussel species release small structures containing glochidia called conglutinates. These float freely into the water. Conglutinates look like prey items to the host fish; the host fish are infested when they attempt to eat them.

The process of encystment on the fish host occurs as the tissue of the fish grows over the glochidia. Metamorphosis takes place within days or weeks, depending on species and temperature. Glochidia transform into microscopic juveniles and drop off. If by chance they settle into suitable habitat, a new mussel bed is created.

Glossary

Bivalve: a mollusk with two shells

Glochidia: larvae of freshwater mussels that develops as an external parasite on fish

Host generalist: a mussel species whose glochidia can transform on a variety of fish species

Mantle: the soft tissue that lines the inner surface of a mussel shell

Marsupium: the part of the gill that is structured to protect mussel eggs and incubate glochidia

Valve: one of the two halves of the shell

You Will Need:

- Copies of the playing cards, printed onto card stock, if possible. Print one set of cards for every 3-6 students. Make sure to cut out the cards on the small black lines, not the colored lines.
- Scissors

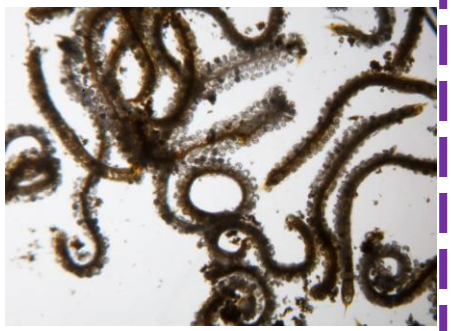
Directions:

1. This activity is best conducted after an anatomy lesson and reproductive strategies lesson of freshwater mussels.
2. Review the terms in the glossary with your students.
3. Put the students into groups of 3-6 for game play. Pass out one deck of cards per group of students.
4. The Mussel Life Cycle Card Game is played with the same rules as 'Go Fish'. The objective of the game is to collect all life cycle components of a species of mussel including: the adult mussel, habitat type, host, and reproductive strategy. See below for 'Go Fish' instructions:
    a. Deal five cards to each player.
    b. All remaining cards are placed face down in a pile.
    c. Choose a player to go first.
    d. On each person's turn, ask any player for a mussel life cycle card. For example: "Ranger Rick, please give me all your Spectaclecase cards." You must already hold at least one card of the mussel life cycle you ask for. If the player you ask has any cards of the requested rank, they must give all of their cards of the mussel life cycle to you. If you get one or more cards from the player you ask, you get another turn.

e. It starts again and you may ask any player for any mussel life cycle set you already hold, including the same one you just asked for. If the person you ask has no relevant cards, they say, 'Go Fish.'
f. You then draw the top card from the draw pile. If you happen to draw a card of the cycle you asked for, show it to the other players and your turn continues. Otherwise, it is the next player's turn. You add the drawn card to your hand.
g. When you collect a set of four cards of the same cycle, immediately show the set to the other players and place the four cards face down in front of yourself. That is a match.
h. 'Go Fish' continues until either someone has no cards left in their hand or the draw pile runs out.
i. The winner is the player with the most matches (sets of four).
j. Invasive species twist: add in the additional 8 cards depicting zebra mussels to each deck. Make these changes to game play: when someone asks for a card from your hand (that you have) you can also pass a zebra mussel at the same time. At the end of the game you lose one full set of mussel life cycle cards for every 1 zebra mussel card still in your hand.

5. After playing several rounds. Have students stop and select one mussel life cycle set they find interesting. Have the students illustrate and describe the life cycle of the mussel they chose.

Mussel	Habitat	Host	Reproductive Strategy
 Salamander Mussel ***Simpsonaias ambigua***	 **Salamander Mussels** live in **small colonies beneath rocks**, where their host is found.	 **Salamander Mussels** use **Mudpuppy Salamanders** as their host.	? The way **Salamander mussels** get their glochidia onto Mudpuppies is **unknown.**
Mussel	**Habitat**	**Host**	**Reproductive Strategy**
 Plain Pocketbook ***Lampsilis cardium***	 **Plain Pocketbook** can be found in **medium-sized streams to large rivers**.	 **Plain Pocketbook** are reported **generalists** but basses seem to be important hosts.	 **Plain Pocketbook** use a **mantel lure** that resembles a bait fish to attract their host.

Mussel	Habitat	Host	Reproductive Strategy
 Snuffbox ***Epioblasma triquetra***	 **Snuffbox** prefer **riffles** or the rocky or shallow parts of rivers or streams with rough water.	 **Snuffbox** use **Logperch** as their host.	 **Snuffbox** use **host capture** to infest their host. When the host fish touches the mantel, the mussel snaps its valves shut onto the fish's rostrum!
Mussel	**Habitat**	**Host**	**Reproductive Strategy**
 Creeper ***Strophitus undulatus***	 **Creepers** prefer **small streams**, but are also well established in the upper Mississippi River.	 **Creeper** are **generalists** but their glochidia are known to complete transformation without a host!	 **Creepers** package their glochidia into **conglutinates** to infest their host.

Mussel

Winged Mapleleaf
Quadrula fragosa

Habitat

Winged Mapleleaf prefer **riffles** or the rocky or shallow parts of rivers or streams with rough water.

Host

Winged Mapleleaf use **Channel Catfish** as their host.

Reproductive Strategy

Winged Mapleleaf use an **elephant trunk-like lure** that resembles a dead fish to attract their host.

Mussel

Black Sandshell
Ligumia recta

Habitat

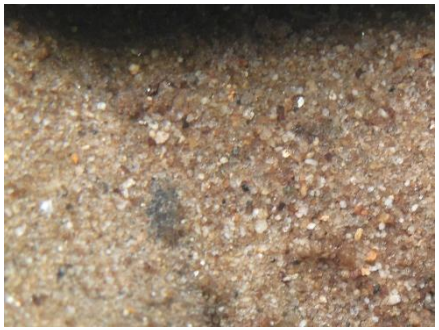
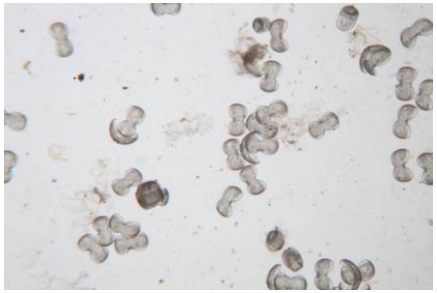
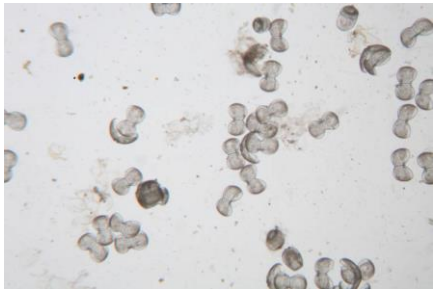
Black Sandshell live in **mixed stable sand, pebble, cobble, and gravel**.

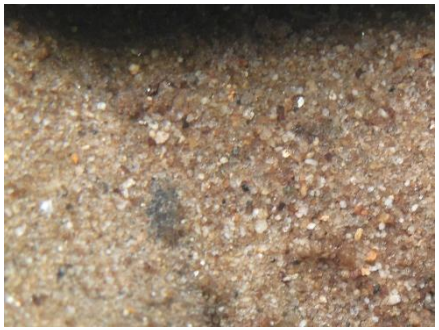
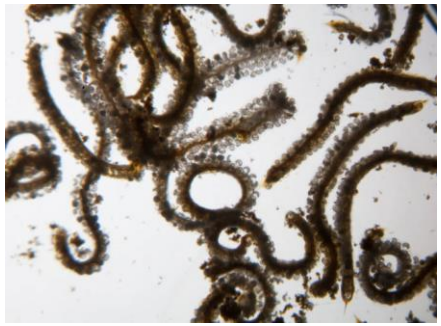
Host

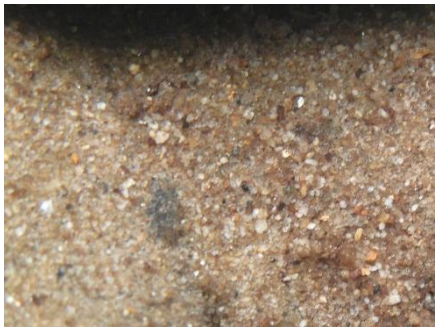
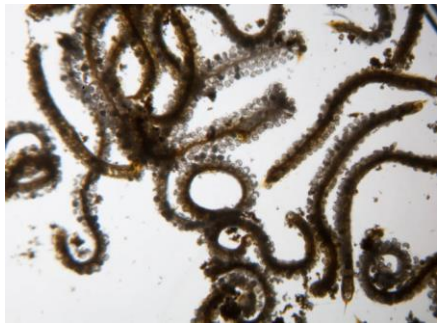
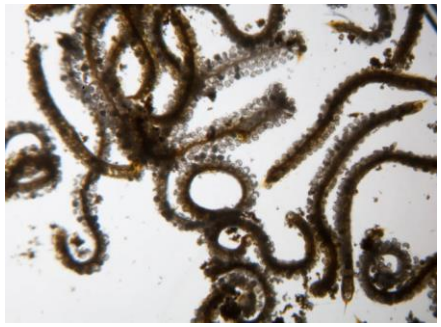
Black Sandshell use **Walleye** as their host.

Reproductive Strategy

Black Sandshell use a **mantel lure** that looks like a zipper to attract their host.

Mussel	Habitat	Host	Reproductive Strategy
 Washboard ***Megalonaias nervosa***	 **Washboards** live in **sand.**	 **Washboards** use **Channel Catfish** as their host.	 **Washboards broadcast** their glochidia into the current using a mucous web.
Mussel	**Habitat**	**Host**	**Reproductive Strategy**
 Lilliput ***Toxolasma parvum***	 **Lilliput** can be found in **fine sediment on pool edges**.	 **Lilliput** use **Bluegill** as their hosts.	 **Lilliput broadcast** their glochidia into the current using a mucous web.

Mussel	Habitat	Host	Reproductive Strategy
 Hickorynut ***Obovaria olivaria***	 **Hickorynuts** live in medium to large rivers in **sand.**	 **Hickorynuts** use **Lake Sturgeon** as their host.	? The way **Hickorynuts** get their glochidia onto Sturgeon is **unknown.**
Mussel	**Habitat**	**Host**	**Reproductive Strategy**
 Spectaclecase ***Margaritifera monodonta***	 **Spectaclecase** make their home in **cavities under large boulders**.	 **Spectaclecase** use **Mooneyes or Goldeyes** for hosts.	 The way **Spectaclecase** get their glochidia onto Mooneye or Goldeye is by **conglutinates.** The glochidia are held in a matrix of eggs in a tree-like shape.

Mussel	Habitat	Host	Reproductive Strategy
 Threehorn Wartyback ***Obliquaria reflexa***	 **Threehorn Wartybacks** live in **sand**.	 **Threehorn Wartybacks** use **Goldenshiners** as their host.	 **Threehorn Wartybacks** use **conglutinates** to get their glochidia onto Goldenshiners. The glochidia are held in a rubbery tube.
Mussel	**Habitat**	**Host**	**Reproductive Strategy**
 Sheepnose ***Plethobasus cyphyus***	 **Sheepnose** can be found in **mixed stable sand, pebble, cobble and gravel**.	 **Sheepnose** use **Goldenshiners** as their host.	 **Sheepnose** use **conglutinates** to get their glochidia onto Goldenshiners. The glochidia are held in a matrix of eggs that resembles flakes of dead fish flesh.

Zebra Mussels
Dreissena polymorha
Zebra Mussels are a non-native, invasive species in North America. They out-compete native mussels for food, can smother native mussels by attaching to them, and alter energy flow in aquatic ecosystems.

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