Activity Four: MUSSEL TO MUSSEL

TIME: (2) 45-minute lessons

SCIENCE PROCESS SKILL: Classifying

SCIENCE CONCEPT: Native and introduced species of mussels must both be recognized.

BENCHMARKS: Students should: Know that a great variety of kinds of living things can be sorted into groups in many ways by using various features to decide which things belong to which group.

Understand that, for any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.

OBJECTIVE: Students will demonstrate the ability to differentiate between native mussels and zebra mussels.

WHAT YOU OUGHT TO KNOW

Almost 300 different species of native mussels have been identified from streams, rivers, lakes, and ponds of North America. They are important, both economically and ecologically. Zebra mussels compete with native mussels for food, space, oxygen, and other necessities. Some competition may not be bad if the teams are fair, but, because zebra mussels reproduce so quickly, they often will "out compete" the native mussels (and other native organisms as well). Zebra mussels may eliminate native mussels completely from many rivers and lakes. To preserve our native mussels and control or eliminate zebra mussels, we need to be able to tell the good guys (the native mussels) from the bad guys (the zebra mussels). Several characteristics and features can be used to tell the difference between each native mussels and zebra mussels.
WHAT'S THE CONNECTION??

TO LANGUAGE:
Write a constructed definition for each vocabulary word from given materials.

TO MATHEMATICS:
Find the differences in length of freshwater and zebra mussels.

TO ART:
Sketch the mussel of their choice. Construct a shell poster.

TO SOCIAL STUDIES:
Read about the shell industry along the Mississippi River.

WORDS OF WISDOM
Classification, diversity, life cycle, mother of pearl, organic detritus, parasitize, sedentary, sediments, species (native, exotic, and introduced), scientific and common names, shell species (see also glossary on page 5).

RESOURCES AT THE READY

<table>
<thead>
<tr>
<th>Material</th>
<th>In Kit</th>
<th>In Notebook</th>
<th>Teacher Provides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection of Shells</td>
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<td>Story 4.1</td>
<td></td>
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<tr>
<td>Shell button set</td>
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<td>ZM Journal</td>
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<td>Game 4.2 boards</td>
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<td>Dry Erase Markers</td>
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<td>Rulers</td>
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<td>Freshwater Mussel Guides</td>
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TIME TO EXPERIENCE ZEBRA MUSSEL MANIA

DAY 1 (USE DAY 2 TO FINISH UP IF NECESSARY)

1. Read aloud to the class Mr. Boepple's story, Story 4.1, and distribute buttons for each group of students to observe. Buttons included in the kit are made from either shells or plastic; you may want to add a few buttons of your own. Buttons on white side of strip are mussel shells; buttons on blue side are made of newer plastic materials. Have the students decide which are the shell buttons. In their journals have them write a description of the shell button and the plastic button and how they can tell the difference between the two or between others in the kit.

2. Have the students discuss the story of Mr. Boepple. What were some characteristics they saw in him that made him a good business person? What were some of his characteristics that made him a bad business person? He used mussel shells for buttons. What other uses could be made for shells? Make a list of uses for shells. What changes have been made in modern medicine that would make it almost impossible for Mr. Boepple to die today with a cut foot?

3. Explain that just as they have learned to distinguish the shell button from other buttons, shells can be classified into groups by common appearances or differences. Their next task will be to classify a group of shells by common characteristics.

TEACHER DIVIDES THE CLASS INTO 4 GROUPS TO CLASSIFY SHELLS
CLASSIFYING THE SHELLS

1. Each group should take a shell set and shell classification guide (Record Sheet 4.2 found in the box). Have each group sort the shells into groups that look alike. They will notice that the shells have numbers. The number will be used later in sorting the shells and to help learn their names. Have them write, in the zebra mussel journal, descriptions of each shell. Encourage them to use a ruler. Discuss how their shell groups were formed-by size, by color, by shape, by shell type, etc. Accept all answers in this discussion.

2. Explain that most shell keys are developed around a binary (two division) key. They are now going to classify the shells using Record Sheet 4.2, Mussel to Mussel Shell Classification Game.

3. The teacher should already have the questions written on the game sheet. The questions are found on the Teacher's key 4.3 found in the notebook. Please use the Dry Erase Markers provided with the box. Show students the procedure for developing the key. First have them place all the shells in one group. Place shells in the big rectangle on Record Sheet 4.2. The questions are either a yes or no that will divide the shells into groups. Physically divide the shells into those two groups. Place the shells or write the numbers of the shells whose answer is yes in that rectangle; and the number whose answer is no in that rectangle. Have the students pretend that the lines are a path on which the shells are carried to the next rectangle. Have the students keep dividing the shells by asking the questions that the teacher put on the game board. With the remaining 5 or 6 grouped shells at the end of the game board, have the students make up their own questions that would further separate the shells.

4. When finished, have each group share their classification. Discuss how the groups vary, or are the same? Why were decisions made about the grouping?

5. MATCHING GAME
Hand the groups the picture guide to Freshwater Mussels of the Upper Mississippi River. Have them try to find the correct names to the numbered shells and write them down in their journal. Tell them they will be able to find the names to all of the shells except for five of them (#'s 1, 2, 5, 7, and 11). Of these five it is their job to find the "BAD GUY". The BAD GUY (zebra mussel shell #5) will have stripes on it like a zebra.

6. Write the description of their remaining 5 shells and identify which one they think is the Bad Guy.
7. Give the students the Teacher's Key 4.4 to see if their classifications of the numbered shells was correct and make changes if necessary. If they had any wrong, have them describe why they classified as they did.

8. Tell them which one was the Bad Guy (Shell #5). Discuss why the Zebra mussel is a bad guy. Use in the discussion the "Points to Consider." Students should record these in their journal.

9. Discuss the story on shell #13. Shell 13 is unlucky because this mussel can no longer be found alive in the Illinois River. The other shells, however, can still be found at locations along the river where they once were abundant. Can the students develop some explanations for the disappearance of that species. Find out which mussels in your region are endangered. Discuss how the zebra mussel could wipe out other native mussels.

10. Go over Words of Wisdom and record in the journal.

THINK

POINTS TO CONSIDER
WHY IS THE ZEBRA MUSSEL THE BAD GUY

* Zebra mussels clog intake pipes to water treatment plants and other industries. This can be very costly and may shut water off to hundreds of people.

* Zebra mussels can attach to boat hulls and slow boats down. They can also clog up the boat's motor and cause it to over heat. This can ruin the motor.

* Zebra mussels can attach themselves to other native mussels. They prevent the native clam to open or close its shell. It also steals all of the native clam's food.

* A single zebra mussel can filter up to one liter of water a day. They filter out the food for other organisms. This disrupts the food chain.

* They filter the water so well that they can make the water clearer. Clear water isn't always healthy water.

* They reproduce very quickly and they reproduce massive numbers.
WHAT DID YOU LEARN

You should be able to observe the students interact in groups as they classify the shells and compare and contrast freshwater mussels with zebra mussels. Each student should have the required information and drawing in the journal.

WAIT, THERE'S MORE...

* The students can bring in other shells or mussels (including freshwater and saltwater species) to add to your collection. Are they freshwater or marine species? Have them find the names of each from shell books.
THE STORY OF UNLUCKY SHELL NUMBER 13

Once upon a time, the Illinois River was full of the Ebony Shell (*Fusconaia ebena*). That was not too long ago because the shells of the mussel can still be found on the river banks. But, it has not been found alive for a number of years. The species has an unusual habit of needing to host on the skipjack herring (*Alosa chrysochloris*) for a few weeks before settling on the river bottom and growing old. Because of dams on the Illinois, herrings cannot move up the river. No herring, no Ebony Shells. Old, empty shells tell the sad story of human interference. The thick shell lasts so long after the animal has died. Does your river have evidence of endangered shell species? Ask?
ZEPRO
MUSSELS

WORDS OF WISDOM
ACTIVITY 4: MUSSEL TO MUSSEL

CLASSIFICATION: systematic arrangement in groups or categories according to established criteria

DIVERSITY: variety

LIFE CYCLE: the series of changes in form undergone by an organism in development from its earliest stage to the recurrence of the same stage in the next generation

MOTHER OF PEARL: the hard, pearly internal layer of certain bivalve shells, such as abalone and the three ridge mussel

ORGANIC DETRITUS: dead animal or plant materials or debris

PARASITIZE: to obtain benefit from another organism at that organism's expense

SEDENTARY: remaining or fixed in one spot

SEDIMENTS: soil, sand, and minerals that settle at the bottom of a body of water

NATIVE SPECIES: species that naturally occur or live in a particular area or region

EXOTIC SPECIES: the organisms that are foreign, not native, to a particular location

INTRODUCED SPECIES: a population placed into a particular area or region that the species is not native to

COMMON NAME: the familiar name used by everyday people to refer to any species

SCIENTIFIC NAME: the Latin name used by scientists to describe species

MOLLUSK (SHELL SPECIES): members of the phylum of invertebrates that include bivalves, snails, and squids
MUSSEL TO MUSSEL
STORY 4.1

MR. BOETTPEL'S SHELLS

Hundreds of years ago, the American Indians and the Pilgrims lived off the land. They ate freshwater mussels. Sometimes they would find a treasure inside one of the mussels—a pearl that they could use to make jewelry. The mussels were easy to find, but they almost never had a pearl inside. Because the pearls were so rare, they became very valuable. The biggest pearls were worth the most money. People began to find pearls inside the mussels in the Mississippi River Valley during the 1850's. The pearl hunters became very rich. People began to race to find as many pearls as possible. This caused the disappearance of most of the freshwater mussels in the Mississippi River Valley.

In 1888, John Boepple came from Germany to hunt for freshwater mussel. John was not looking for pearls. Instead, he wanted to make buttons out of the shells. It would have been too expensive to bring the shells to Germany, so he decided to make the buttons in America. One day he was bathing in the Illinois River when he cut his foot on a sharp object. He had cut his foot on one of the freshwater mussel shells that he had been searching.

During the next few years he struggled to learn English; and he collected as many shells as he could. Then in 1891, using the shells he had spent years collecting, Boepple set up his first button making business in Muscatine, Iowa. Two local businessmen helped him get started. They had the money to run the business, and Boepple had the skill to make the buttons. The men soon began to argue. The investors wanted to make as many buttons as quickly and cheaply as they could. John Boepple wanted to make a quality product, but he needed the businessmen's money. Eventually, the dispute caused Boepple to look for new partners. (The first two partners tried to run their own button making business. They failed without Boepple because they knew nothing about making buttons.)

Boepple did not take long to find new partners that were very wealthy. They let him run his company as he wanted it run. The business flourished. The only problem was that Boepple had to collect the mussel shells by hand. This was a very slow process. Help was soon on the way because people began to discover pearls in the shells. Just like 40 years earlier, word began to spread about how rich a person could become by finding pearls. Soon farmers, shopkeepers, and businessmen began wading into the shallow rivers and streams hoping to get rich. Boepple was now able to buy the shells he needed to make his buttons.

In 1897, someone invented a new tool called a brail. The tool allowed mussel hunters to harvest mussels in deeper water from boats instead of wading into shallow waters. People crowded the rivers to find the mussels. Soon violence broke out. Pearl hunters robbed each other and fought over hunting space. Even though hunters rarely found pearls, they knew they could make a profit by selling the mussel shells to the button makers. As more people hunted for shells, more shells became available to make buttons.
The new button makers were not as concerned about quality as John Boepple. Everyone thought there would be an endless supply of shells. Button makers became more wasteful and used the shells more foolishly. Factories were springing up everywhere. New machines made buttons faster and cheaper. Boepple became very worried about the poor quality of the buttons being made. There were many arguments, and again, the person who knew more about making buttons than anyone else in the country was forced out of business. Boepple was left with nothing.

Seventeen years had passed since John Boepple first started making buttons. Again, shell collectors and button manufacturers became concerned about the natural supply of shells. History had repeated itself. In 1908, the mussels again became very difficult to find. The few that were found were too small to be useful for button-making. Finally, in 1911 the United States government asked John Boepple to help find ways to increase the mussel population.

Boepple traveled to Indiana in search of new ways to replenish the mussel supply. He waded in Indiana's rivers looking for mussels. Just as he had done so long ago on the Mississippi River, he cut his foot on a shell on the river bottom. This time the ending was not a happy one. After several months, John Boepple died from blood poisoning from he cut. This German-American immigrant had valued the freshwater mussel more than any person in the world. Ironically, he became victim of the very thing that had given him his life's work.

Written by Cherie Van Camp * Adapted from: The Founding and Early History of the Pearl Button Industry by Michael G. O'Hara, Muscatine Community College, Muscatine, Iowa
ZEBRA MUSSELS

MUSSEL TO MUSSEL: SHELL IDENTIFICATION SHEET
TEACHER'S KEY 4.4

Zebra Mussel Watchers' Names:

Identification for Native Mussel Shell Collection:

1. Blue Mussel
2. Asiatic Clam
3. Washboard Clam
4. Maple Leaf Clam
5. Zebra Mussel
6. Pimpleback Clam
7. Silty Hornsnail
8. Pink Heelsplitter Clam
9. Yellow Sand Shell
10. Three-horned Wartyback
11. Ponderous Campeloma
12. Three-ridge Clam
13. Ebony Shell
**ZEBRA MUSSELS**

**MUSSEL TO MUSSEL: FRESHWATER AND ZEBRA MUSSEL LIFE CYCLES OBSERVATION SHEET 4.6**

Zebra Mussel Watchers' Names:


<table>
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<tr>
<th>Compare zebra and freshwater mussels</th>
<th>Contrast</th>
<th>Zebra mussels</th>
<th>Freshwater</th>
</tr>
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</table>
MUSSEL TO MUSSEL: FRESHWATER AND ZEBRA MUSSEL LIFE CYCLES
TEACHER'S KEY 4.6T

Zebra Mussel Watchers' Names:

_____________________________

_____________________________

Note: Snails are closely related to mussels, but are different in that they have only one shell. Another difference is that they can be terrestrial (live on land) or aquatic (live in water).

<table>
<thead>
<tr>
<th>Compare zebra and freshwater mussels</th>
<th>Contrast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both have 2 shells</td>
<td><strong>Zebra mussels</strong></td>
</tr>
<tr>
<td></td>
<td>Longest is 4.5 cm</td>
</tr>
<tr>
<td>Both live in rivers and streams</td>
<td>Has byssal threads</td>
</tr>
<tr>
<td>Both have shells made of calcium carbonate</td>
<td>Distinct striped pattern and color of shell</td>
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<tr>
<td></td>
<td>Thinner shell</td>
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<tr>
<td></td>
<td>Usually attach to hard substrate (on something solid); Shell attaches permanently after settlement</td>
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<tr>
<td></td>
<td>As adults, less than 2 inches</td>
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<td></td>
<td>More offspring</td>
</tr>
</tbody>
</table>

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ACTIVITY FIVE: HOW BIG ARE YOUR MUSSELS?

TIME: (1) 45-minute lesson

SCIENCE PROCESS SKILL: Measuring and graphing

SCIENCE CONCEPT: Zebra mussels vary in length and size.

BENCHMARKS: Students should: Know that, when people care about what is being counted or measured, it is important for them to identify the units (three degrees Fahrenheit is different from three centimeters; three miles is different from three miles per hour).

Graphically display numbers to spot patterns that are not otherwise obvious, such as comparative size and trends.

Spread data out on a number line to see what the extremes are, where they pile up, and where the gaps are. A summary of data includes where the middle is and how much spread is around it.

Keep records of their investigations and observations and not change the records later.

OBJECTIVE: Students will measure and graph the length of the ventral side of a sample of zebra mussels.

WHAT YOU OUGHT TO KNOW

Zebra mussels are found in a variety of lengths. They range in length from less than 1 mm or larger. Length measurements are made along the ventral side of the mussel, which is the straight edge. The enclosed Illinois Natural History Survey (INHS) sheet shows actual length data from three samples at one site on the Illinois River. The purpose of this activity is to determine the frequencies of shell lengths and to visually illustrate those frequencies by the use of graphs.
WHAT'S THE CONNECTION??

TO LANGUAGE:
Write a journal entry about the life of a zebra mussel. Have the students take the viewpoint of the zebra mussel.

TO MATHEMATICS:
Calculate the average length of the sample of shells for each group and then for the class. Calculate the percentage of the numbers for each length. Discuss other ways to graph and have the students construct a pie graph for the group sample.

TO ART:
Make an enlarged drawing of zebra mussel using the grid method.

TO SOCIAL STUDIES:
Read an Illinois map to find the location of each zebra mussel sample site on the Illinois River (described in this activity). Consult monitoring agencies in your state to construct your own map of sample sites.

WORDS OF WISDOM
Centimeter (cm), data, maximum, millimeter (mm), minimum, percentage, ventral line (see also glossary on page 5).

RESOURCES AT THE READY

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<th>In Notebook</th>
<th>Teacher Provides</th>
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</thead>
<tbody>
<tr>
<td>Measuring Cups</td>
<td>Sheet 5.1</td>
<td></td>
<td>Graph Paper</td>
</tr>
<tr>
<td>ZM shells</td>
<td>Sheet 5.2</td>
<td></td>
<td>Illinois map</td>
</tr>
<tr>
<td>Metric Rulers</td>
<td>Sheet 5.3</td>
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<td></td>
<td>ZM Journal</td>
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</table>

For each group
(1) Measuring cup
Zebra mussel shells
(1) Metric ruler
Graph paper
Length Frequency Chart Data Sheet 5.1
Length Frequency Bar Graph 5.2
Grid Data Sheet 5.3
Zebra mussel journal
GETTING YOUR ACT TOGETHER

Read the Illinois Natural History Survey Zebra Mussel Length Frequency Bar Graph 5.2 to familiarize yourself with the length frequency of live zebra mussels. This information is actual data taken from three samples along the Illinois River. You should prepare a larger summation chart of the information so that students can compare data.

TIME TO EXPERIENCE ZEBRA MUSSEL MANIA!!

1. Go over the Words of Wisdom and have them record them in their zebra mussel journal.

2. Each group should become familiar with Data Sheet 5.1, the Zebra Mussel Length Frequency Chart. On this data table students will record zebra mussel shell length, number, total, and frequency (or percentage).

3. One student from each group should measure 100 ml of zebra mussels with the measuring cup and bring them back to the group.

4. Students will measure each shell in millimeters (mm) along the ventral line and tally the number of each one on the data table.

5. Students should total the number of shells for each length by adding up the tallies.

6. Students should total the number of all shells and then compute the percentage for each length. They then can determine the maximum and minimum lengths for each sample. (Note: Teacher should note these lengths on the board.)

7. Show the students the Illinois River Data (Bar Graph 5.2). Ask them to compare their sample to that made by scientists of the Illinois Natural History Survey. Were the percentages similar?

8. Each group should construct a graph based upon their data table illustrating the percentage of each length.
9. Each group should share measurements from their data sheet on the class summary sheet. Determine the class total percentages and maximum and minimum lengths. Is there a difference between data from the different working groups? Variation could well occur, which is the reason multiple samples are used to define a population.

10. Discuss the following questions:

a. What was the length of most of your zebra mussels?

b. What length of zebra mussels had the fewest numbers?

c. Give an explanation of the distribution of the lengths of the zebra mussels.

WHAT DID YOU LEARN???

Can the students accurately measure a zebra mussel? When comparing the data table to the graph, are the zebra mussel groupings accurate? Can each student complete a graph and place the variables on the proper axis?

WAIT, THERE'S MORE...

Study other species' populations: measure lengths of tree leaves, snail lengths, other shell lengths, seed sizes, dandelion flower or flower stalk sizes, heights or weights of students in class and school.
WORDS OF WISDOM
ACTIVITY 5: HOW BIG ARE YOUR MUSSELS?

CENTIMETER (cm): a metric unit of measure equal to 1/100 meter (about the width of your finger)

DATA: facts, figures, or information from which conclusions can be drawn

MAXIMUM: the greatest number, degree, or quantity

MILLIMETER (mm): a metric unit of measure equal to 1/1000 of a meter; 10 mm equals 1 cm

MINIMUM: the smallest number, degree, or quantity

PERCENTAGE: a given part or amount in every hundred

VENTRAL LINE: a longitudinal line along the lower side of a zebra mussel
<table>
<thead>
<tr>
<th>Length</th>
<th>Number</th>
<th>Total</th>
<th>Percentage</th>
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<td>30 mm</td>
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</table>

maximum length ______  minimum length ______ Total shells ______
Researchers from the Illinois Natural History Survey made random collections of zebra mussels from the Illinois River near Peoria, IL on three dates in 1993. The samples were returned to the laboratory where the length of each shell was determined. These length data were sorted into 1-mm length intervals. Numbers of zebra mussels from each collection in each interval were tabulated, and the percentages of shells in each interval were calculated (see the table below). Percentages were then used to construct the three length frequency distribution graphs below.

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<th>Length Interval (mm)</th>
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<th>Number</th>
<th>Percent</th>
<th>13 July 1993</th>
<th>Number</th>
<th>Percent</th>
<th>10 August 1993</th>
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### Graphs

**1 July**

**13 July**

**10 August**

![Length Frequency Graphs](image-url)
ACTIVITY SIX: FILTERING FOOLS

TIME: (1) 45-minute lesson
This activity can be done by half the class at the same time as Activity
Seven is done by the other half of the class. Consider doing as outside
activity.

SCIENCE PROCESS SKILL: Inferring and model building

SCIENCE CONCEPT: Zebra mussels use a biological siphon to
filter large quantities of water.

BENCHMARKS: Students should:
Know that scientific investigations may
take many different forms, including
observing what things are like or what is
happening somewhere, collecting specimens
for analysis, and doing experiments.

Know that seeing how a model works after
changes are made to it may suggest how the
real thing would work if the same were
done to it.

Use numerical data in describing and
comparing objects and events.

OBJECTIVE: Students will construct a model to simulate how
zebra mussels remove nutrients and particles from
the water.

WHAT YOU OUGHT TO KNOW
Zebra mussels use water filtration to collect the nutrients needed to sustain life and
grow. An adult zebra mussel can filter approximately one liter of water per day. A
positive effect of this filtration is the increased clarity of the water filtered by the
zebra mussels. However, on the negative side, the zebra mussels interrupt the food
web for other forms and change the ecosystem of the aquatic habitat. Additionally,
even if the water is clearer, that does not mean the water is better.
WHAT'S THE CONNECTION??

TO LANGUAGE:
Research and write reports on another animal using filtration.

TO MATHEMATICS:
Calculate the amount of water a given number of zebra mussels can filter.

TO ART:
Design a filter that would keep zebra mussels from entering industrial pipes.

TO SOCIAL STUDIES:
List where filters are used in your home, industry, business, etc.

WORDS OF WISDOM
Filter, filtration, liter, nutrient, siphon, submerge (see also glossary on page 5)

RESOURCES AT THE READY

<table>
<thead>
<tr>
<th>Material</th>
<th>In Kit</th>
<th>In Notebook</th>
<th>Teacher Provides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter models</td>
<td></td>
<td>Sheet 6.1</td>
<td>(8) 2-liter clear bottles</td>
</tr>
<tr>
<td>Cotton balls</td>
<td></td>
<td>Sheet 6.2</td>
<td>water</td>
</tr>
<tr>
<td>Buckets</td>
<td></td>
<td>ZM Journal</td>
<td>Plastic cups</td>
</tr>
<tr>
<td>Measuring cup</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dirt</td>
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</table>

For EACH group:
Two 2-liter drink bottles, clear (one for mixing dirt, one for 100 ml of water)
One filter model (made of film canister and tubing)
Several gallons of water
(13) Cottonballs
Bucket for the waste water
(4) clear plastic cups
Measuring cup
Dirt
Filtering Fools Data Sheet 6.1
Filtering Fools Observation Sheet 6.2
Zebra mussel journals
GETTING YOUR ACT TOGETHER

This will be a wet and messy activity. You may want to consider doing this activity outside. You will probably need to have a mop on hand in case of spills. You will need to have an adequate supply of water nearby, or you will want to prepare for the lesson by having the water brought into the classroom. From the cafeteria, collect buckets, pickle jars, vegetable cans, even milk jugs to use for water, cleaning up, and collecting dirty water.

NOTE: You will want to consider teaching this lesson simultaneously with Activity Seven, "All Clogged Up." Copy one data sheet per group. Practice using the "zebra mussel filter model" ahead of time so you can explain and demonstrate its use to the students.

TIME TO EXPERIENCE ZEBRA MUSSEL MANIA!!!

1. Go over Words of Wisdom and have them record in journal.

2. Have students draw and label the zebra mussel filter model in their zebra mussel journals.

3. Have each group mix exactly 15 ml (1 T) of dirt with 2 liters of water. Shake to disperse the dirt.

4. Students should observe this water and record their observation under the unfiltered water category on the Filtering Fools Data Sheet 6.1.

5. Shake the 2-liter bottle well. Then add 100 ml dirty water to a clean 2-liter bottle and screw on the zebra mussel filter model.

6. The first time don’t add any cottenballs, then secure the cap and tubing and begin the filtering action. The filtered water should be collected in a clear plastic cup. Save this water for comparison. Record the results of the filtration under the zero cottonball column.
7. Now add 2 cottonballs to act as a filter. Save the cottonballs used in each filtration to compare the colors. Save these cottonballs on a paper towel.

8. Compare clean cottonballs with the two cottonballs used to filter the cup of dirty water.

9. Predict how the water will appear if it is filtered using four cottonballs.

10. Repeat the activity using four, then six cottonballs.

11. Lay the cottonballs taken after filtering in order on the paper towels. Have the Reporters for each group prepare a presentation for the other groups completing Activity 7 (if you decide to do Activity 7 simultaneously). They should demonstrate the procedure and show the results gathered.

12. Empty the water and clean the equipment, including any spilled water.

13. Discuss with the class their results comparing the number of cottonballs with the success in filtration. The millions of zebra mussels found in rivers and lakes act in the same way as the cotton filters, except the mussels eat the food trapped in their filters. Because there are so many zebra mussels, tremendous amounts of materials can be removed from the water. One zebra mussel can filter up to a liter of water each day.

14. Have each group answer questions on the Filtering Fools Observation Sheet 6.2. Discuss the answers.
WHAT DID YOU LEARN??
Did the students complete the worksheet correctly?

Is each student able to make some comparison of the filter model to the zebra mussel?

Can each student relate the huge number of zebra mussels to the large amount of water they are capable of filtering?

WAIT, THERE'S MORE...
* Find and display filters that are used by people.

* Research how other mussels and organisms collect food using the filtering process. Make a list of these filter feeders.

* Lake Erie and Lake Michigan have become clearer because of zebra mussels. Find out how this was done.

* Instead of cottonballs, try using sand, gravel, or other types of soil.
WORDS OF WISDOM
ACTIVITY 6: FILTERING FOOLS

FILTRATION: a treatment process for removing solid matter from water by passing the water through sand or man-made filter

LITER (L): a metric unit of liquid measurement; it is equal to 1.06 quarts

NUTRIENT: any substance assimilated by living things that promotes growth

SIPHON: an opening through which water enters and leaves an object, such as a mussel; some species can use this activity as a means of propulsion; also a means by which a liquid is transferred from one object to another, such as to siphon water into a bottle

SUBMERGE: to completely immerse in water
### Filtering Fools

**Data Sheet 6.1**

**Zebra Mussel Watchers' Names:**

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<tr>
<th></th>
<th>0 Unfiltered Water</th>
<th>100 ml filtered with 2 cottonballs</th>
<th>400 ml filtered with 4 cottonballs</th>
<th>400 ml filtered with 8 cottonballs</th>
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<tr>
<td><strong>Describe the water:</strong></td>
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<tr>
<td><strong>Describe how zebra mussels affect water, based on cottonballs above:</strong></td>
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</tbody>
</table>

- 0 zebra mussels
- 2 zebra mussels
- 4 zebra mussels
- 6 zebra mussels

---

**Diagram:**

- 2 cottonballs
- Screw the zebra mussel filter model on bottle.
- Add the dirty water to a clean 2-liter bottle.
- Repeat steps using 4 then 6 cottonballs.
- Save filtered water for comparison.
FILTERING FOOLS OBSERVATION SHEET 6.2

Zebra Mussel Watchers' Names:

__________________________________________  ________________________________________

1. Compare the cottonball filters. Did the 2, 4, or 6 filters remove more material from the water?

__________________________________________

2. How does this filtering demonstration relate to the zebra mussel?

__________________________________________  ________________________________________

3. Write a paragraph telling why filtering of zebra mussels has such a great impact on a body of water.

__________________________________________  ________________________________________

4. List at least 5 ways that filters are used by people.

__________________________________________  ________________________________________  ________________________________________  ________________________________________  ________________________________________
FILTERING FOOLS OBSERVATION SHEET 6.2: 
TEACHER’S KEY

Zebra Mussel Watchers' Names:

1. Compare the cottonball filters. Did the 2, 4, or 6 filters remove more material from the water? 
   The six cottonballs removed more material from the water.

2. How does this filtering demonstration relate to the zebra mussel? 
   Zebra mussels filter like the cottonballs do except they eat the food they filter. The more Zebra mussels, like cottonballs, the more stuff gets filtered.

3. Write a paragraph telling why filtering of zebra mussels has such a great impact on a body of water. 
   A zebra mussel can filter a liter of water a day. When it filters, it takes food out of the water for other animals to use. The more zebra mussels there are, the less food there is for other animals. The other animals will starve. This will affect the food chain.

4. List at least 5 ways that filters are used by people. 
   Coffee filters, oil filters, air conditioners filters, water filters, gas filters, light filters, on camera, etc.