EXOTICS

This lesson and its corresponding activities are targeted to grades 5-9 and subject areas English language arts, science, social science and fine arts. Most of the activities and the following background information may be adapted to other grade levels.

The earth is populated by a huge variety of organisms. Organisms tend to live in one general location and are somewhat restricted from spreading to new areas by ecological barriers such as mountains, oceans, deserts and rivers. Some organisms are not even structured to travel long distances. They are well adapted to the place that they live.

Despite the barriers, some organisms do travel and become established far from their native habitat. For instance, seeds may be blown or carried by ocean currents to new areas. Humans are often involved in relocating species, intentionally or accidentally, to areas where they did not previously exist. For example, between 1960 and 1991 ships and shipping activities alone accounted for 21 percent of the total new releases of exotic species into the Great Lakes. Organisms introduced into habitats where they are not native are called exotic species.

Just because a species is introduced to a new habitat does not mean that it will survive. Climatic factors alone may be enough to ensure that the species will not be successful. However, sometimes a species will thrive in its new surroundings. It may be released from predators, parasites, pathogens (disease-causing organisms) and/or competitors that were present in its native habitat. More than 140 terrestrial and aquatic invaders have become so entrenched in the Great Lakes region that eradication of them is impossible.

Sometimes introducing a species adds economic benefits, such as the fishery provided by rainbow trout. However, often the addition of different species may cause economic and/or ecologic catastrophe. These biological invaders can upset the delicate balance existing between native organisms. Sometimes these species will explode in numbers and crowd out native species. Native species may no longer be able to survive. Once established in an area, exotics can rarely be eliminated.

Illinois' aquatic habitats include several exotic species. They have had varying impacts on native organisms. Following are brief descriptions of six of these "Aquatic Exotics."

Purple Loosestrife
Purple loosestrife (*Lythrum salicaria)* is a plant that appeared in the Great Lakes region in 1869. It is believed to have reached Illinois in the mid-1940s or 1950s. It is native to wetlands in Europe and Asia. Originally intended to be an ornamental plant, it has since become a severe pest, spreading along marshes and lake shores. Each plant is capable of dispersing up to 21,000 seeds per square meter and about 2 million seeds annually. Plants may also grow from roots and broken stems. Generally the plant is spread by seed escapes from gardens and nurseries. Once in wetlands, seeds are easily spread by moving water and wetland animals. The plant thrives on moist, disturbed soils, often invading after some type of construction activity. In wetlands, it forms dense, impenetrable stands which are unsuitable for cover, food or nesting sites for many native animals.

Burning, spot spraying and other techniques to control it have been tried with limited success. Several European insects that attack only purple loosestrife are being tested as possible long-term biological controls. In Europe the plant has nearly 100 species of insects that feed on it while in Illinois nothing native is known to eat it. In 1985, Illinois joined with Wisconsin, Minnesota and Indiana in classifying purple loosestrife as a noxious weed and banning its planting.

Zebra Mussel
The zebra mussel (*Dreissena polymorpha)* is native to the Caspian Sea region of Asia. It was accidentally brought to the Great Lakes from Europe by ships in 1986. Since then it has spread through all of the Great Lakes and into many major rivers and inland lakes.

This bivalve mollusk is fingernail-sized with yellowish or brownish shells marked with wavy bands. Able to reproduce at about age one year, it lives for approximately three years. Female zebra mussels can produce 30,000 to 1 million eggs per year. Breeding occurs between May and October. External fertilization is used, with males and females releasing reproductive cells into the water. Within hours the fertilized eggs develop into free-swimming larvae called veligers that quickly begin to form shells. About 99 percent of the veligers die from environmental conditions or are eaten. After about 10-15 days the postveliger zebra mussels settle to the bottom and attach to a substrate.

Zebra mussels filter water to remove plankton for food. They are often found attached near the incurrent siphon of native mussels, where food is taken into the shell. In this manner they may be assured of a fairly constant food supply. They may filter up to one liter of water per day. This amazing filtering capacity is partly responsible for improved water quality where zebra mussels are present. The change in water clarity is also responsible for a change in fish populations. The food particles not eaten by these mussels are combined with mucus and discharged as “pseudofeces” onto the lake bottom. This material may benefit bottom feeders while reducing the plankton food chain for upper water species. Zebra mussels are eaten by diving ducks and freshwater drum, but not at a rate that controls the population of these mussels.

Zebra mussels attach to water intake pipes of power companies and water treatment plants. They may also clog the cooling systems of boat engines. The impact is very serious and costs millions of dollars for cleanup and repairs. A survey showed that between 1989 and 1995 zebra mussel problems cost power plants and industrial facilities nearly $70 million. Zebra mussels may attach to living mussels and snails. When there are many zebra mussels attached to these organisms, the mussels may not be able to open their shells to feed or reproduce. Snails have been unable to reproduce due to heavy mussel loads and are possibly the organisms most affected by the zebra mussel. Snail numbers have declined greatly in areas where heavy zebra mussel infestations occur.

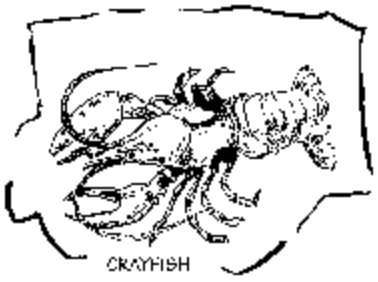
Microscopic veligers may be transported in livewells or bilge water. There is concern that veligers may be transported on SCUBA diving gear. Adult zebra mussels can attach to boats or boating equipment that sit in the water.

Rusty Crayfish

The rusty crayfish (*Orconectes rusticus*) is native to streams in Michigan, Indiana, Ohio, Kentucky and Tennessee. Spread by anglers who use them as bait, these crayfish reproduce rapidly and eat large amounts of lake and stream vegetation. Native species of fish and crayfish are thus denied cover and food. Displacement of native crayfish by these aggressive invaders has been well documented. The displaced individuals are either consumed by predators or forced to move to other areas.

The rusty crayfish was first collected in Illinois in 1973 from the Illinois River at Peoria and until 1985 was known from only nine locations. Since then the species has spread throughout the northern half of Illinois and can be found in almost all of the major rivers in that part of the state.

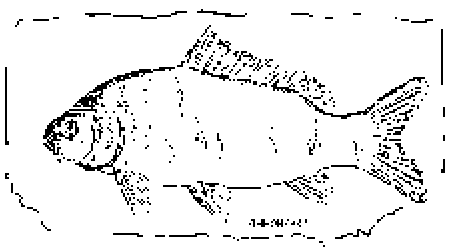
This crayfish is easy to identify by the single rust-brown spot found on each side of the back of the shell. Mating occurs in the fall with oviposition, the egg-laying process, in late spring.



Current Illinois law prohibits the possession and sale of live rusty crayfish. Its strict enforcement represents the only means currently known to slow the spread of the rusty crayfish.

Common Carp

The common carp (*Cyprinus carpio)* was brought to North America by European immigrants in the late 1800s as a food fish. The fish is native to Asia. About 120 healthy fish in the original introduction reproduced to more than 258,000 within a few years. The fish became established in nearly every waterway in the country. Carp are found statewide in Illinois in all types of aquatic habitats.



Carp are easy to recognize by the two pairs of barbels near the corners of the mouth, the downward opening mouth and a sawtoothed spine in both the dorsal and anal fins. Carp eat plant and animal material. Aquatic insects are the most important component of the diet, and they may occasionally eat other fish species' eggs. Spawning occurs in the spring with eggs scattered over debris and vegetation on water bottoms. Females lay 790,000 to 2 million eggs which hatch in 12 days. The average life span for carp in Illinois is seven to eight years.

Carp become so abundant in some habitats that they are accused of competing for food and space with more desirable fishes. Their feeding habits result in a general deterioration of the habitat through increased turbidity and destruction of aquatic vegetation. Although there is some basis for these complaints, the carp's detrimental aspects are often overrated. Carp provide a good fight for anglers and some people value the meat.

Rainbow Trout

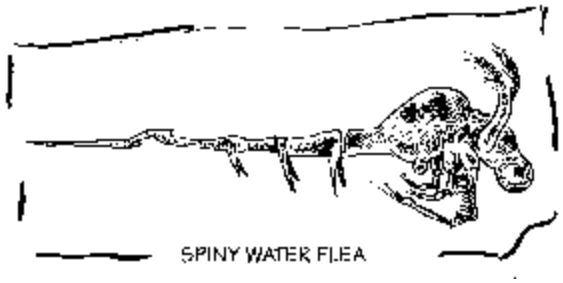
The rainbow trout (*Oncorhynchus mykiss*) was introduced to Illinois waters as a sport fish species in the 1920s. A native of west coast streams from California to Alaska, it has been transplanted to nearly every state and several

other continents. It is currently found in Lake Michigan and other lakes and streams in the state where it has been stocked. It does not naturally reproduce in Illinois waters. These fish survive best where the water temperature remains more or less continuously below 70EF.

Rainbow trout are identified by their adipose fin, small black or brown spots along the upper body and tail and a faint pink line along each side of the silvery body. These trout feed primarily on insects, snails and fishes and live for about six years in the wild. Rainbow trout generally reproduce from October through February in hatcheries. It takes about 50 days for hatchery trout to complete incubation, and the fish will be reared to 10 inches in about 16 months. Fish are stocked in dozens of Illinois lakes and ponds in the spring and fall.

Spiny Water Flea

The spiny water flea (*Bythotrephes cederstroemi)* is native to lakes in northern Europe. This exotic crustacean was transported in freshwater or mud in the ballast water of ships to Lake Huron in 1984 and spread to the other Great Lakes within three years. These freighters carry grain to Europe but return empty to the United States. To stabilize the empty freighters, large amounts of water are carried in ballast. Small planktonic organisms, and even fishes, are pumped in with the ballast water and may survive the voyage. When ships take on cargo in the United States, the ballast water and anything in it is discharged. Normally oceangoing ships take on salt water as ballast (and salt water organisms) so a freshwater organism like *Bythotrephes* would not be in the ballast water. However, in



the spring, St. Petersburg, Russia, is a freshwater port due to runoff from snow melt, and freshwater organisms may be taken into the ballast tanks.

Even though its average length is only 0.4 inch, young fishes are reluctant to eat this species because of the long spine on its tail. The spine often comprises more than 70 percent of the animal's total length and contains from one to four pairs of thornlike barbs. The head consists of a single large eye filled with black pigment. Also present are a pair of mandibles which are used to pierce and shred prey. The animal has four pairs of legs, with the first pair being longer than the others. The first pair of legs is used for catching prey, whereas the other legs grasp the prey as it is being consumed. Behind the head is a pair of swimming antennae, used for propulsion. The ability to swim allows it to encounter prey frequently and be independent of current movements. Like all crustaceans, the spiny water flea must molt its exoskeleton as it grows. However, this animal is unique in that it sheds only the exoskeleton covering its body but not that over its spine.

The spiny water flea exhibits parthenogenesis. Using this method of reproduction, the female may make up to 10 clones of herself asexually. If weather conditions are optimal, the process may only take two weeks. Since males are not needed for parthenogenesis they are rarely found when food is plentiful, or when environmental conditions are good. Sex of offspring is determined by environmental

factors instead of genetics. When conditions begin to worsen, females produce male offspring. These males are able to mate with surviving females to produce resting eggs. The resting eggs are released and fall to the lake bottom where they can survive the cold winter. In spring or early summer, the eggs hatch into females to start parthenogenesis again.

The spiny water flea eats smaller herbivorous crustaceans like *Daphnia*, as many as 20 per day. *Daphnia*, however, are also an important food item for juvenile fishes and some crustaceans. Therefore, the spiny water flea is competing with these organisms for food. Reductions in these prey species' numbers may lead to reductions in the numbers of their predators as well.

In Europe, populations of spiny water fleas are controlled by predation from large fish species. Examination of stomach contents has revealed that adult yellow perch, walleye and salmon consume spiny water fleas. If the spiny water flea turns out to be a preferred food of perch and other fishes, it may actually benefit fish populations.

Spiny water flea eggs and adults may be spread in bilge water, bait buckets and livewells. Also, fishing lines and downriggers will often be coated with both eggs and adults. Collected on a fishing line they look like gobs of jelly with black spots.

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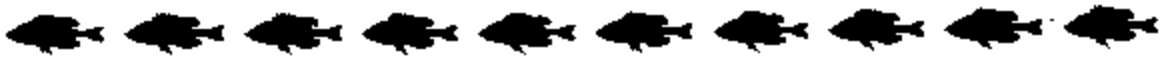
See related CD-ROM component: *Illinois Aquatic Exotic Fact Sheets.*



UNIT 3, LESSON 2
ACTIVITY 1

DON'T HAVE A CLUE

SUGGESTED GRADE LEVELS: 5-6
SUBJECTS: English language arts, science, social science, fine arts
SKILLS: analysis, discussion, drawing, inference, media construction, reading, reporting, small group work, writing
CORRELATION TO ILLINOIS LEARNING STANDARDS: English language arts 1C, 3C, 4A, 4B, 5C; science 12B, 13B; social science 17C; fine arts 26B

OBJECTIVE
Students will make inferences based on facts about zebra mussels.

METHOD
Working in cooperative groups, students fill in the missing pieces to an account of the effects of zebra mussels.

BACKGROUND
Zebra mussels may negatively impact the ecological balance of the Great Lakes and inland waterways. The sport fisheries in the Great Lakes have changed because of improved water clarity. The zebra mussel's amazing water filtering capacity is partly responsible for improved water clarity, but other factors such as tougher pollution laws and better technology are helping to keep the water clean. Research is being conducted to examine effects of the zebra mussel invasion on native mussel populations.

Although the following story, "What Happened to Lake Michigan?," is fictional, the facts and basic story line are scientifically based. This is an interactive lesson where students must work together to understand the problem. The fact cards provide information and background knowledge. No single fact card is sufficient to answer the questions.

MATERIALS
for each group: two copies of the story "What Happened to Lake Michigan?;" fact card sheet masters (copied and cut apart); copy of "Don't Have A Clue Observation Sheet;" pencil

PROCEDURE
1. Divide the class into cooperative groups of three or four students. Provide copies of "What Happened to Lake Michigan" for each group to read.

2. Hand out the "Don't Have a Clue Observation Sheet" to each group and have students read the questions to themselves. Next, distribute two or three fact cards per group member. Students are to silently read their fact cards.

3. One person from the group will be the recorder. Have a student read a question to the group. Students should answer the question based on their own knowledge and the information on the fact cards. The recorder will write the answer on the observation sheet after the group discusses options and agrees on a response. Continue in this manner until all questions are answered.

4. When the groups are finished, conduct a class discussion on each question and allow each group to contribute its collective answers. Come to a class consensus when determining answers.

EXTENSIONS
1. Have the students adapt/modify the game by creating more fact cards or create a similar game for another exotic aquatic species.
2. Rewrite or change the story to make it locally based.
3. Have the students teach the game/adaptation to another class.

EVALUATIONS

1. Each group will present its answer to each question during class discussion. Answers should indicate some skill in finding and summarizing information.
2. Students should be asked to write their own clue game and play that game with each other.
3. Students will create and illustrate a comic book based on the story .

Adapted with permission from: Illinois-Indiana Sea Grant Program, Purdue University, University of Illinois at Urbana-Champaign, *Zebra mussel mania traveling trunk* (Urbana, Illinois 1995).

WHAT HAPPENED TO LAKE MICHIGAN?

Melanie had grown up near Chicago, and she had spent most of her summers sailing, swimming and fishing in Lake Michigan. Melanie moved away from Chicago in 1980. In 1993, she and her husband, Mike, moved back to her home town, where they moved into a condominium high above Lake Michigan's impressive shoreline. Melanie noticed that the water in the harbor was much clearer than when she was a child. She was surprised to see a lot of plant life in the water that she had never observed before.

One day while they were sailing, Melanie told Mike that, when she was in high school, she remembered boats coming in and out of the harbor filled with walleye and smallmouth bass. As Melanie was remembering the good old days with Mike, they passed her family's favorite vacation spot, a secluded beach where they camped every summer, and they noticed a nasty odor. Melanie and Mike also noticed that the only boats they saw on the lake were sailboats and yachts--no fishing boats.

On their return trip home they stopped at Fred's Fresh Fish Shop to purchase, what else, fresh fish. Melanie was disappointed to learn from Fred, a local fisherman, that he didn't have any walleye left.

He informed her that the local fishing industry has gone through many changes. At this time, the only fresh fish he had was fish shipped in from elsewhere.

FACT CARDS

DON'T HAVE A CLUE
FACT CARD 1

An adult zebra mussel filters approximately one liter of water per day.

DON'T HAVE A CLUE
FACT CARD 2

Due to increased water clarity, sunlight penetrates the water causing increased growth of vegetation.

DON'T HAVE A CLUE
FACT CARD 3

A zebra mussel was found in St. Clair, Michigan, in 1988. The species reproduces rapidly. One female mussel can produce 30,000 to 1 million eggs per year.

DON'T HAVE A CLUE
FACT CARD 4

Walleye generally are found in murky water where they can hide and attack their prey.

FACT CARDS

DON'T HAVE A CLUE
FACT CARD 5

During dusk and dawn, the water is full of shadows. In this environment, walleye can hide and attack their prey. Many people no longer fish for walleye during the day.

DON'T HAVE A CLUE
FACT CARD 6

When zebra mussels die, they wash up on the shoreline and begin to decay.

DON'T HAVE A CLUE
FACT CARD 7

Because they find their prey by sight and chase them down, smallmouth bass like clear water.

DON'T HAVE A CLUE
FACT CARD 8

Walleye, which have eaten more small fish than were being produced, have diminished their current food source.

DON'T HAVE A CLUE OBSERVATION SHEET

Group member names _____

1. Why was the lake much clearer when Melanie returned in 1993?

_____

_____

_____

2. What factors could have caused the increase in vegetation?

_____

_____

_____

3. An odor was observed on the beach. What could have caused it?

_____

_____

_____

4. Who or what could have been responsible for the decreased number of walleye?

_____

_____

_____

5. What changes has the local fishing industry gone through?

_____

_____

UNIT 3, LESSON 2
ACTIVITY 2

THE MUSSELS ARE COMING

SUGGESTED GRADE LEVELS: 7-9
SUBJECTS: English language arts, science, social science
SKILLS: inference, mapping, media construction, writing
CORRELATION TO ILLINOIS LEARNING STANDARDS: English language arts 3C, 4A, 5C; science 13B; social science 17A, 17C

OBJECTIVES
Students will: 1) illustrate the spread of zebra mussels in North American waters; and 2) postulate reasons for this expansion.

METHOD
Students use color-coding to plot the arrival date of zebra mussels in locations throughout North America. Students discuss spread patterns of this species.

BACKGROUND
Zebra mussels probably entered North American waters in 1986, in Lake St. Clair. They were discovered in June 1988.From Lake St. Clair, Michigan, the mussels moved downstream towards the St. Lawrence Seaway. By fall 1989, they were found throughout the coast of Lake Erie, and in 1990, they colonized Lake Ontario and the St. Lawrence River. It is believed that these colonizations were made by veligers, which were carried downstream by water currents, and by adults attached to boat hulls.

Simultaneously, zebra mussel sightings were made in upstream areas --at locations as far as Duluth harbor in Lake Superior and Sturgeon Bay in Lake Michigan. These colonizations were probably a result of adult zebra mussels hitching a ride on the hulls of ships and boats. Veligers cannot be dispersed upstream over such long distances.

The lake most drastically colonized is Lake Erie, because it is shallower than the other Great Lakes and very rich in phytoplankton .Outside the Great Lakes, zebra mussels have been sighted in three major drainage basins: Hudson; Mississippi; and Susquehanna (see attached map). The first sighting was in the Hudson River in late May 1991. Colonization of the Mississippi River basin occurred next, confirmed by a sighting in the Illinois River in June 1991. The mussels were spotted in the Susquehanna River in August 1991. Zebra mussels also have been sighted in the Ohio, Tennessee and Arkansas river systems. Scientists have estimated that two-thirds of the United States and parts of southern Canada will eventually be colonized by zebra mussels. They have been spotted in 18 states so far. The range of zebra mussels will be determined by water temperatures. Because the mussels are intolerant of water temperatures above 90EF, they are unlikely to extend deeply into the south and southwest. Nevertheless, the Great Flood of 1993 helped the mussel spread as far south as Louisiana. It also pushed the mussel over levees, up rivers and drainage ditches and into sewage treatment plants.

MATERIALS
copies of maps for each student; copies of “Spread of Zebra Mussels” sheet for each student; colored pencils, highlighters or crayons

PROCEDURE
1.Give each student one copy of each of the maps and “Spread of Zebra Mussel” sheet. Be sure that each student has either colored pencils, crayons or highlighters.

2.Tell the students that the following abbreviations are used: SUP = Lake Superior, MICH = Lake Michigan, HURON = Lake Huron, ERIE = Lake Erie, ONT = Lake Ontario.

3.Students are to mark the maps to identify when sightings were made at the various locations. Use a different color for each year and mark the month when the zebra mussel was first sighted at each location.

4.Discuss any obvious patterns or trends. Discuss possible methods of transport.

EXTENSIONS

1. Obtain an Illinois map (available free from Illinois Secretary of State's offices) and chart the spread of zebra mussels within the state. Add information found about zebra mussels in your area.

EVALUATIONS

1.Using their maps, students should write a brief summary account of the spread of the zebra mussel, postulating methods of transport for this species, particularly how it travels upstream and how it moved into inland lakes. Have students hypothesize how the flood of 1993 may have contributed to the spread of this invader. Have them relate how this rapid spread could be detrimental to the environment.

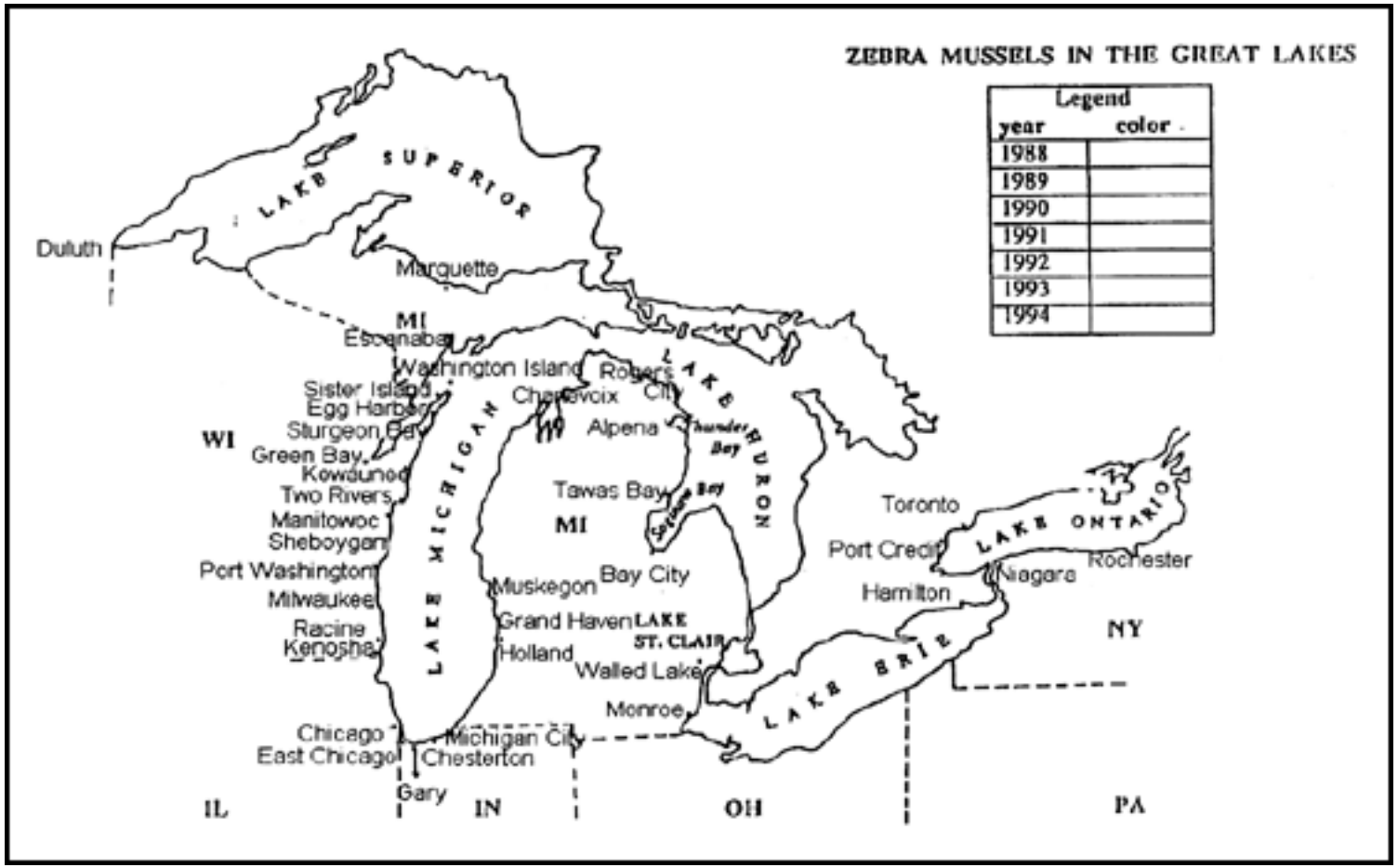
2.Students will turn in completed maps for evaluation. Maps should be neatly marked and show ability to follow directions and locate points.

Adapted with permission from: Rivers Curriculum Project, *Alien invaders: a zebra mussel issue investigation* (Southern Illinois University, Edwardsville, Illinois ©1994).

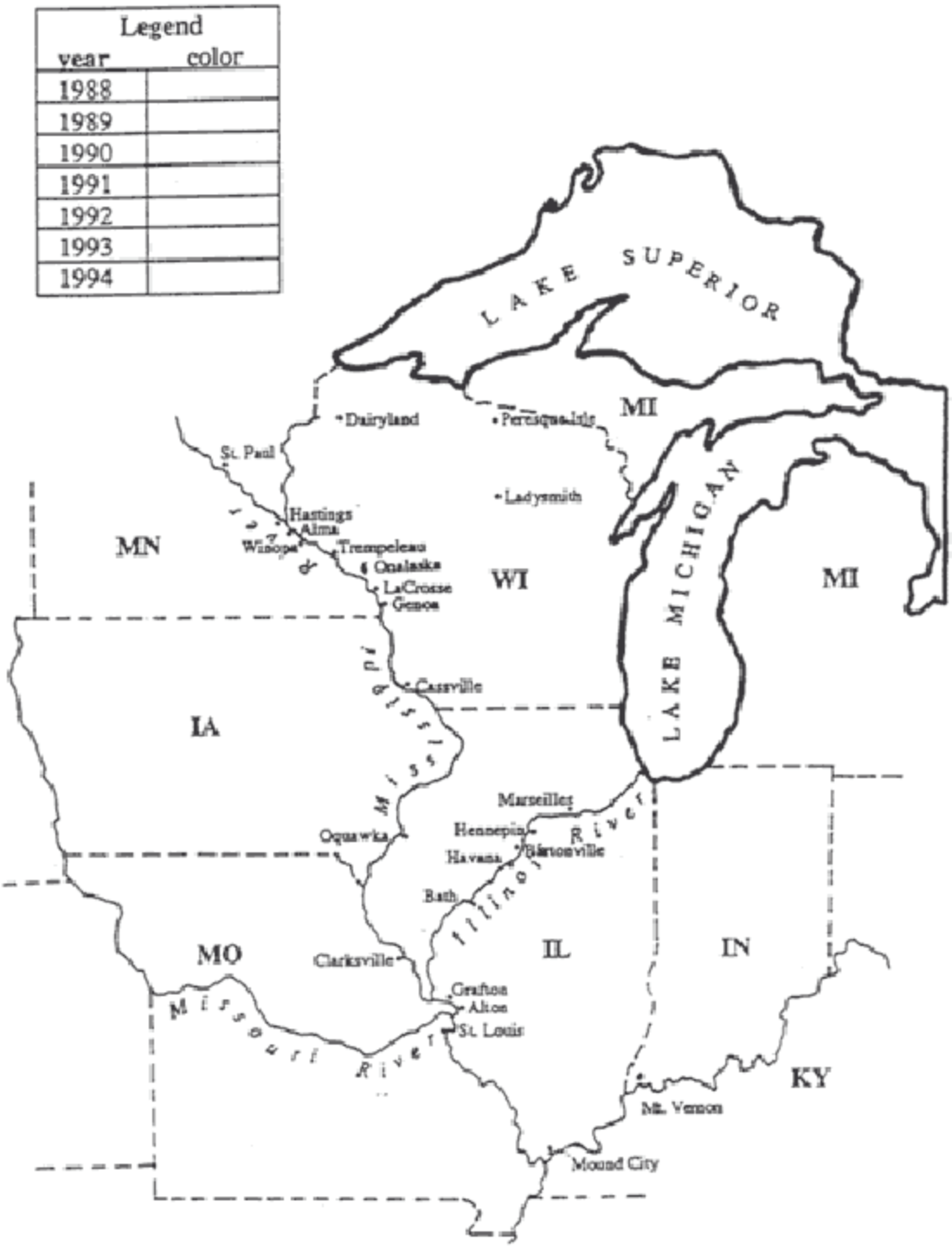
SPREAD OF ZEBRA MUSSELS IN NORTH AMERICA

MONTH/YEAR/LOCATION OF FIRST CONFIRMED SIGHTING

06/88	Lake St. Clair
08/89	Sturgeon Bay, WI (MICH)
10/89	Lake Erie (shade entire shoreline)
12/89	Monroe, MI (ERIE)
04/90	Duluth, MN (SUP)
05/90	Saginaw Bay (HURON)
05/90	Bay City (HURON)
06/90	Kenosha, WI (MICH)
06/90	Thunder Bay, MI (HURON)
06/90	Alpena, MI (HURON)
06/90	Hamilton, Port Credit, Toronto and Picton, Canada (ONT)
07/90	East Chicago, IN (MICH)
07/90	Chicago, IL (MICH)
07/90	Gary, IN (MICH)
07/90	Rochester, NY (ONT)
08/90	Grand Haven, MI (MICH)
08/90	Chesterton, IN (MICH)
08/90	Niagara, NY (ONT)
10/90	Sheboygan, WI (MICH)
10/90	Oneida Lake, NY (Hudson River)
10/90	Binghamton, NY (Susquehanna River)
11/90	Holland and Muskegon, MI (MICH)
02/91	Manitowoc, WI (MICH)
04/91	Kewaunee, WI (MICH)
04/91	Racine, WI (MICH)
05/91	Escanaba, MI (MICH)
06/91	Green Bay, WI (MICH)
06/91	Bath, IL (Illinois River)
07/91	Milwaukee, WI (MICH)
07/91	Albany, NY (Hudson River)
08/91	Port Washington, WI (MICH)
08/91	LaCrosse, WI (Mississippi River)
09/91	Havana, IL (Illinois River)
09/91	Alton, IL (Mississippi River)
09/91	Marseilles, IL (Illinois River)
10/91	Mound City, IL (Ohio River)
10/91	Mt. Vernon, IN (Ohio River)
10/91	Beacon, NY (Hudson River)
11/91	Tawas Bay, MI (HURON)
12/91	Charlevoix, MI (MICH)
01/92	Genoa, WI (Mississippi River)
01/92	Oquawka, IL (Mississippi River)
01/92	Hennepin, IL (Illinois River)
01/92	Clarksville, MO (Mississippi River)
01/92	Bartonville, IL (Illinois River)
02/92	Rogers City, MI (HURON)
02/92	St. Louis, MO (Mississippi River)
04/92	Two Rivers, WI (MICH)
05/92	Michigan City, IN (MICH)
06/92	St. Paul, MN (Mississippi River)
07/92	Hastings, MN (Mississippi River)
07/92	Alma, MN (Mississippi River)
07/92	Winona, MN (Mississippi River)
07/92	Trempeleau, WI (Mississippi River)
07/92	Onalaska, WI (Mississippi River)
08/92	Cassville, WI (Mississippi River)
09/92	Evansville, IN (Ohio River)
09/92	Concord, OH (Ohio River)
10/92	Egg Harbor, WI (MICH)
10/92	Peresque Isle, WI (inland lake)
10/92	Marquette, MI (SUP)
10/92	Dairyland, WI (inland lake)
10/92	Portsmouth, OH (Ohio River)
10/92	Parkersburg, OH (Ohio River)
07/93	Louisville, KY (Ohio River)
07/93	Sister Island, WI (MICH)
08/93	Ladysmith, WI (inland lake)
08/93	Walled Lake, MI (inland lake)
08/93	Grafton, IL (Mississippi River)
09/93	Washington Island, WI (MICH)
09/93	Greenville, MS (Mississippi River)
09/93	Vicksburg, MS (Mississippi River)
09/93	St. Francisville, LA (Mississippi River)
09/93	New Orleans, LA (Mississippi River)
09/93	Gore, OK (Arkansas River)
09/93	Pine Bluff, AR (Arkansas River)
09/93	Chattanooga, TN (Tennessee River)
09/93	Lenoir City, TN (Tennessee River)

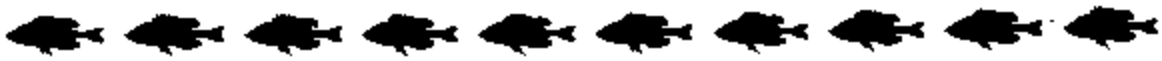

ZEBRA MUSSELS IN THE GREAT LAKES
Legend
year
color
1988
1989
1990
1991
1992
1993
1994
LAKE SUPERIOR
Duluth
Marquette
MI
Escanaba
Washington Island
Sister Island
Egg Harbor
Sturgeon Bay
WI
Green Bay
Kewaunee
Two Rivers
Manitowoc
Sheboygan
Port Washington
Milwaukee
Racine
Kenosha
LAKE MICHIGAN
Chicago
East Chicago
Gary
IL
IN
Michigan City
Chesterton
Charlevoix
Alpena
Thunder Bay
Saginaw Bay
Tawas Bay
MI
Muskegon
Bay City
Grand Haven
Holland
LAKE HURON
LAKE ST. CLAIR
Walled Lake
Monroe
OH
LAKE ERIE
PA
NY
Toronto
Port Credit
Hamilton
Niagara
Rochester
LAKE ONTARIO

ZEBRA MUSSELS IN THE UPPER MISSISSIPPI RIVER SYSTEM



Legend	
year	color
1988	
1989	
1990	
1991	
1992	
1993	
1994	

ZEBRA MUSSELS IN OTHER RIVER SYSTEMS



UNIT 3, LESSON 2
ACTIVITY 3

AQUATIC EXOTICS

SUGGESTED GRADE LEVELS: 5-8
SUBJECTS: English language arts, science, social science, fine arts
SKILLS: description, drawing, mapping, media construction, public speaking, reading, reporting, research, small group work, writing
CORRELATION TO ILLINOIS LEARNING STANDARDS: English language arts 1C, 3C, 4A, 4B, 5A, 5C; science 12A, 12B, 13B; social science 17A, 17C; fine arts 26B

OBJECTIVES
Students will: 1) recognize some of the aquatic exotic species that are found in Illinois; 2) trace the origins of these species and describe their effects on native species; and 3) evaluate the appropriateness of introducing new species.

METHOD
Students use reference materials to develop reports on and posters of Illinois aquatic exotic species. Students map the location of point of origin and distribution in Illinois of these species. Students discuss the pros and cons of species introductions.

BACKGROUND
The earth's organisms tend to live in one general area and are somewhat restricted from spreading to new areas by ecological features such as mountains, oceans, deserts and rivers. Some organisms are not even structured to travel long distances. They are well adapted to the place that they live.

Despite the barriers, some organisms do travel and become established far from their native habitat. Humans are often involved in relocating species to areas where they did not previously exist. For example, between 1960 and 1991 ships and shipping activities alone accounted for 21 percent of the total new releases of exotic species into the Great Lakes. Humans may introduce new species intentionally or accidentally. These organisms that are introduced into habitats where they are not native are called exotic species.

Just because a species is introduced to a new habitat does not mean that it will survive. Climate alone may be enough to ensure that the species will not be successful. However, sometimes a species will thrive in its new surroundings. It may be released from predators, parasites and/or competitors that were present in its native habitat. More than 140 terrestrial and aquatic invaders have taken up residence in the Great Lakes region since its settlement by Europeans.

Sometimes introducing a species adds economic benefits. However, often the addition of different species may cause ecological catastrophe. These biological invaders can upset the delicate balance existing between native organisms. These species may explode in numbers and crowd out native species. Native species may no longer be able to survive. Once established in an area, exotics can rarely be eliminated.

MATERIALS
for each group: copy of "Aquatic Exotics Research Record Sheet;" world map; copies of *Illinois Aquatic Exotic Fact Sheets*; Illinois map; other reference materials and tools including copies of the teacher information section (Unit 3, Lesson 2) with specifics on aquatic exotics; poster board; drawing/coloring materials

PROCEDURE
1. Divide the class into cooperative groups of three or four students. Assign one aquatic exotic species to each group to research by giving the group a copy of one of the *Illinois Aquatic Exotic Fact Sheet* cards and other pertinent information (from the Teacher Information, Unit 3, Lesson 2) on the species. Students should divide the tasks for the group among themselves: reader; recorder; illustrator; presenter. Everyone should be involved in discussion and research.

2. Hand out the "Aquatic Exotics Research Record Sheet." As discussion about the species occurs, the recorder should fill in this sheet. Encourage students to access information sources other than those provided.

3. Hand out copies of the world map and Illinois map. Have students map the location of the species' native lands on the world map and the current location of the species in Illinois.

4. Give poster board and art materials to each group. The group will develop a plan to illustrate the species and pertinent facts about it and produce a poster.

5. Students will prepare an oral presentation on the species and present it to the entire class. The presentation should include the collected information, maps and poster. Other students should take notes on each species. Important facts could be printed on the chalkboard. Include a question and answer session.

6. Using the data presented, conduct a discussion about the positive and negative aspects of species introductions.

EXTENSIONS

1. Have the class make additional reports on Illinois aquatic exotic species. Species that might be included are *Daphnia lumholtzi* (a type of water flea), the Chinese mystery snail, sea lamprey, alewife, ruffe, rainbow smelt, salmon, round goby and Eurasian watermilfoil. Or as an alternative, mix these species in a list of native Illinois aquatic species and let students research which are exotic and which are native.
2. Have students investigate the differences between "reintroducing" (white-tailed deer, wild turkey, river otter) species and "exotic" species. Can reintroductions cause problems?

EVALUATIONS

1. Students should be evaluated on their research record sheet, maps, poster and presentation. Class notes may also be turned in for evaluation.
2. List three reasons why an aquatic organism might be introduced to an area. For each one, explain why you think this is or is not a valid reason for introducing a species.

Adapted with permission from: Illinois-Indiana Sea Grant Program, Purdue University and the University of Illinois at Urbana-Champaign. *Zebra mussel mania traveling trunk* (Urbana, Illinois 1995) and Council for Environmental Education Council, *Project WILD Aquatic* (Houston, Texas ©2001).

AQUATIC EXOTICS RESEARCH RECORD SHEET

Group member names_____

_____

1. Common name of species_____

2. Scientific name of species_____

3. Description of species_____

_____

_____

4. Method of introduction_____

_____

_____

5. How the population spreads_____

_____

_____

6. Impact on native species_____

_____

_____

7. Interesting facts_____

_____

_____