Fish in the Seine

Time

Part I – two 45-minute periods, Part II – one or two 45-minute period(s), Part III – two 45-minute periods

Vocabulary

aquatic, benthic trawl, channel, channelization, dam, dissolved oxygen, electrofishing, flood, floodplain, habitat, habitat generalist, habitat specialist, ichthyologist, niche, pool, population, pristine, riffle, run, sediment, seine, snag, species, species richness, turbidity, water quality

Objectives

Students will:

- ☐ identify fish according to their characteristics.
- ☐ recognize correlations between habitat quality and animals present.
- ☐ identify changes in the Missouri River.
- ☐ describe methods biologists use to gather data on the Missouri River.

Method

Students will research fish characteristics, diet, and habitat and graph data on charts. *Part III* allows students to sample a local fish population, collect data, graph the results, and compare them to the Corps of Discovery's results.

Materials

graphing paper
pictures or drawings of different fish and fish anatomy
writing materials
copies of *Student Worksheet I* for each small group
copies of *Student Worksheet II* for each student
Part III:
(materials for making a seine)

- two 6, 8, or 10-foot long by 3 or 4-foot wide fiberglass window screening or ¼-inch netting
- four 4-inch wide strips of canvas (6, 8, or 10 feet long)
- four 4-inch wide strips of canvas (3–4 feet long)
- 4 broom handles or wooden dowels (4–6 feet, both need to be same size)
- thread
- sewing machine

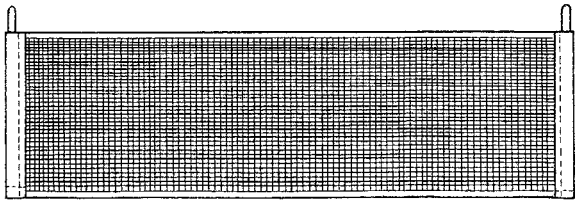


Illustration from the Homemade Sampling Equipment, Water Quality Series Booklet 2, Tennesse Valley Authority

Directions

1. Sew 6, 8, or 10 foot long (depending on your net size) strips of canvas to top and bottom of the net.
2. Make two 1-inch castings at either end of net with the 3 or 4-foot strips of canvas making sure to sew bottom end of casting shut as shown.
3. Insert broom handle or wooden dowel.

Background

Nicknamed the Big Muddy, the Missouri River is the longest river in the United States, covering 2,341 miles. It drains one-sixth of the continental United States. Historically, it had floodplain forests, turbid water, braided streams, and numerous **snags** (underwater structures that may be manmade – stake piles, cedar trees or natural – fallen trees), sandbars, rapids, and varying flow patterns that made travel difficult. The Corps of Discovery encountered these navigation problems on their long journey.

While the Missouri was treacherous for navigation, it contained excellent **habitat** (arrangement of food, water, shelter or cover, and space suitable to animals' needs) for wildlife including deer, mallards, plovers, mussels, mosquitoes, and catfish, often noted in journals of the Corps of Discovery.

On August 15, 1804, Lewis, Sgt. Floyd, and nine other men sampled the fish **population** (number of a particular species in a defined area at a given time) in a small tributary northeast of present day Macy, Nebraska. The men used a type of brush net made of willow and bark as a seine. Lewis noted their first attempts to sample the fish populations to be successful, catching 308 fish. He identified the species as pike, salmon, bass, perch, redhorse, catfish, and silverfish. The next day Lewis went out with a dozen men and sampled the fish community again. This time they caught about 800 fish. Lewis recorded pike, brook trout, white bass, catfish, buffalo, red horse, bass, channel catfish, and many minnows.

The Missouri River has undergone many changes since Lewis and Clark traveled it. Steamboat traffic began in 1819 and peaked in 1869. People started removing snags in 1832. This activity peaked during 1885-1910. In 1901, 17,676 snags, 69 drift piles, and 6,073 overhanging trees were removed (Pierce, 2003).

While the Upper River (in Montana) still is **pristine** (unspoiled), the Middle River (through eastern Montana and North and South Dakota) and Lower River (along Iowa and through Missouri) has been altered. From 1937-1963 the Corps of Engineers impounded the Middle River for navigation, flood control, hydro power, irrigation, and recreation. In 1912, the **channelization** (straightening) of the Lower River began. In 1945, Congress mandated construction of a nine-foot channel from the confluence of the Missouri and Mississippi to Sioux City, Iowa. This **channel** (deeper part of a moving body of water where the main current flows) has been maintained ever since.

Historically, the Missouri had a main channel with a large **floodplain** (land near a stream/river which flood water spills onto) and many braided streams, sloughs, and varying water flow. The alteration of the river has increased its depth, **turbidity** (the amount of light that can get through the water column due to the amount of suspended sediments in water that make the water muddy or cloudy) from channelization, and summer flow from upstream **dams** (impoundments). Since dams upstream control water flow, variation in the river's flow is greatly reduced. The stable water flow allows navigation on the river, but decreases backwater habitat during spring **floods** (the abnormally high stream/river flow that overtops the banks of a stream/river) and **aquatic** (growing, living in, or frequenting water) plant growth in the summer's dry season. Channelization also has resulted in the loss of secondary channels, sloughs, and backwater, which in turn resulted in a loss of habitat for fish.

Today, biologists study fish communities through various methods including **electrofishing** (using an electric current to temporarily stun the fish so they can be identified, weighed, and measured), **benthic trawls** (dragging a net on the river bottom to gather fish), and **seining** (dragging long nets through the shallows to capture fish) to name a few. The Corps of Discovery's brush net was a crude seine.

Scientists may look for **species richness** (number of species present in an environment) when studying a fish community. Typically a higher quality environment has greater species richness. Different **species** (individuals that are more or less alike and are able to breed and produce fertile

offspring under natural conditions) occupy different **niches** (function of an organism or population within an ecological community). A more diverse community has more niches available, so more species are present. Species may be **habitat generalists** (may live in a variety of habitats) or **specialists** (require specific conditions to live).

One habitat specialist is the brook trout. It needs cool water with lots of **dissolved oxygen** (molecules of oxygen gas dissolved in water). Largemouth bass can live in many different types of habitats. They are generalists.

The results of a recent study performed by the Iowa Cooperative Fish and Wildlife Research Unit and Iowa State University shows species richness is higher in the channelized Lower River than the upper and middle sections, but there are more exotic (non-native) fish. Populations of native fish are declining.

A second study by the US Geological Services Bureau and Environmental Protection Agency determined that the Missouri River along the channelized section is actually less turbid than it was historically. They cited many explorers' quotes on the fast current of the main channel and the large amounts of **sediment** (fine soil and other particles that settle to the bottom of a liquid) in their drinking water. These explorers reportedly saw sandbars form in front of their eyes.

For more information on Lewis and Clark's journey up the Missouri River, refer to *Iowa's Water,* page 2.

Procedure

Part 1

1. Share *background information* on the Corps of Discovery and the Missouri River.
2. Initiate a discussion of former habitats of the Missouri River and animals that lived there.
3. Divide the class into small groups. Make and distribute copies of *Student Worksheet I* to each group. Assign one fish from the *Student Worksheet I* to each group.
4. Have students research characteristics of the fish, ways to identify it, its habitat, and its diet.
5. Allow time for students to share their results in class and to complete the missing sections of *Student Worksheet I*.

Part II

1. Make copies of *Student Worksheet II* and distribute to students.
2. Discuss the Corps of Discovery's population sampling of the Missouri River. Initiate a classroom discussion of the results.
3. Have students calculate species richness from the Corps of Discovery's population sampling.
4. Have students graph data from the table.
5. Allow time for students to complete the worksheet.

Part III

1. Obtain (or create – see the *Materials section* for directions) two seines.
2. Select a small, fairly shallow, slow-moving stream with a fish population near your school as the sampling site for this activity. Be sensitive to the impact you may have on stream banks and beds, spawning and nesting sites, and vegetation. Have students establish ethical guidelines for their sampling activities. If the stream is not a public site, obtain permission to visit it. Advise students in advance to dress for the setting – old (sturdy) shoes and shorts or jeans are best.
3. At the sampling site, brief students on habitat courtesies, working from their own list of ethical guidelines for sampling activities. Instruct them on how to minimize damaging the habitat and encourage care in their collecting techniques. Emphasize that all wildlife is to be returned to its habitat unharmed. Designate two to three people as recorders. These students will write down the species of fish collected. The remaining students will assist in seining the stream.

4. Have students identify different habitats in the stream. **Pools** are deeper than adjacent areas. Water flow is slowed and the bottom is usually made of very small particles. **Runs** are sections of a stream or river with moderate current and fairly uniform water flow. **Riffles** have fast current and are typically shallower than a run or pool. The water surface is broken up due to flowing over rocks.
5. Have one group of students take one seine and stand in the water, extending the seine across the width of the stream if possible.
6. The second group should walk on the shore, entering the stream a small distance from the stationary seine. Have the second group walk the seine to the first group. It is important to keep the bottom of the seine on the bottom of the stream to prevent fish from escaping.
7. After the second group meets the stationary group, have students bring the bottom of their nets to the surface to see what fish they caught.
8. Have all students assist in identification using fish identification guides. A guide is available on the web (www.iowadnr.gov/education/cdfiles.html#fish). If small fish are difficult to identify, group them into minnows, darters, or a combination. The Topeka shiner, a federally endangered fish, may be found in the Raccoon, Boone, and Rock drainages in Boone, Calhoun, Dallas, Hamilton, Green, Lyon, Osceola, Sac, Webster, and Wright counties. Teachers that can identify the Topeka Shiner should note the location, date, number and any other information and send to Daryl Howell, Iowa DNR, 502 E. Ninth Street, Des Moines, IA 50319-0034, 515/281-8524. Recorders should record the data and note where fish were collected (pool, riffle, run). Immediately release all fish after identification. Following the ethical guidelines established by the group, seine in different locations and different directions (upstream, downstream).
9. Have students figure species richness and graph results from their population sampling. Compare their results to the Corps of Discovery's.

Evaluation

Part I

1. What are some differences between fish? (shape of mouth, body shape, etc.)
2. What do fish eat? (answers should vary depending upon fish)
3. Where do fish live?
4. What is a habitat generalist? What is a habitat specialist? What are examples of both of these?

Part II

1. What is the species richness of the fish community in the Corps of Discovery's study?
2. How many habitat generalists did the Corps of Discovery find? How many habitat specialists? Does this tell us anything about the quality of the river? Why or why not?
3. How has the Missouri River changed since the Corps of Discovery traveled it?
4. What are some ways to improve the quality of the Missouri River for fish and other aquatic animals? (practice soil conservation, allow some of the flood plain to return to it's natural state, reduce activities that cause non-point source pollution)

Part III

1. What was the species richness of your sample? How does this compare to the species richness of the Corps of Discovery sample? What are some possible reasons for differences? (different nets, different streams, changes in water quality)
2. What species of fish did you collect? How does your list compare with the Corps of Discovery's?
3. Did you find any exotic species? (carp, zebra mussels, etc.)
4. Did you find more fish in pools, runs, or riffles?
5. What types of fish did you find in pools (habitat specialists or generalists)? Why?
6. What types of fish did you find in runs (habitat specialists or generalists)? Why?
7. What types of fish did you find in riffles (habitat specialists or generalists)? Why?

8. Can you create any hypotheses about this stream's **water quality** (condition of water) from this study? What are they? How could you prove them? (more studies, collect data from different areas, etc.)

Extensions

Invite a local DNR fisheries biologist or county conservation board naturalist to bring fish for a demonstration and discuss ways to identify fish and sample populations.

Adopt the stream where you seined fish.

Collect other data (pH, dissolved oxygen, nitrates, and phosphates) and see if there are correlations between these and the species present. Measure these in other streams and compare the results.

Make this activity a bi-annual event for your class. Note differences in species found at different times of year.

Research more about the Corps of Discovery's journey. Numerous websites and books are available on the subject. Visit www.pbs.org/lewisandclark for additional lesson plans regarding their travels.

Teacher Aids

Posters

"Aquatic Life." Ill. Brian Wignall. 1989. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

"Benthic Macroinvertebrates." Ill. SB Lauterbach. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

"Fish Iowa! Fish Posters." Ill. Maynard Reese. 1994. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

"Life in a Stream." Ill. Brian Wignall. 1989. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

CD Rom

"Biodiversity of Iowa: Aquatic Habitats." 2001. Des Moines: Iowa Department of Natural Resources' Aquatic Education Program.

"Canaries of the Deep, The Plight of the Fresh Water Mussel." 2003. Geode Resource Conservation and Development Incorporated.

"Living Landscape." Conservation Technology Information Center.

Books

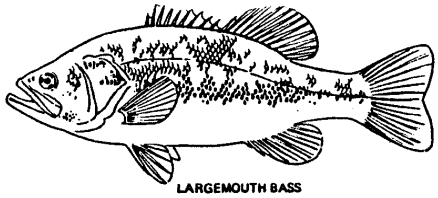
Clark, W. and M. Lewis. 2002. The Definitive Journals of Lewis and Clark Up the Missouri to Fort Mandan. Edited by G. Moulton. Lincoln: University of Nebraska Press.

Iowa Department of Natural Resources. 1987. Iowa Fish and Fishing. Des Moines.

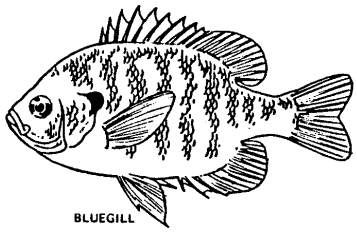
Zim, H.C. and A.C. Martin. 1987. A Golden Guide to Pond Life. New York: Golden Press.

Student Worksheet I: Fish in the Seine

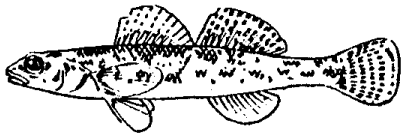
Common Name:
Scientific Name:
Habitat:
Description:
Food:
Importance:


LARGEMOUTH BASS

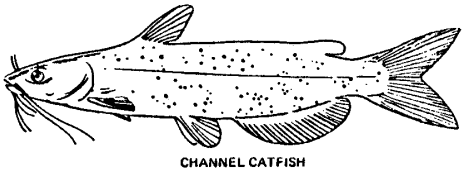
Common Name:
Scientific Name:
Habitat:
Description:
Food:
Importance:


BLUEGILL

Common Name:
Scientific Name:
Habitat:
Description:
Food:
Importance:


JOHNNY DARTER

Common Name:
Scientific Name:
Habitat:
Description:
Food:
Importance:


CHANNEL CATFISH

(Illustrations courtesy of the Illinois Department of Natural Resources)

Student Worksheet II: Fish in the Seine

Lewis and Clark recorded 31 species of fishes in their journals and notebooks during their journey up the Missouri River and down the Snake and Columbia Rivers. On August 15, 1804, Clark and 10 men used a seine and caught "318 fish of different kinds, i.e., pike, bass, salmon, perch, red horse, small cat, and a kind of perch called silverfish on the Ohio" (*The Definitive Journals of Lewis and Clark Up the Missouri to Fort Mandan*, 2002).

The next day Lewis and 12 men caught the fish listed in the following table. Some of the fish were misidentified. Through their drawings and descriptions, **icthyologists** (people that study fish) can identify the fish more correctly. However, not all identifications came with descriptions and drawings. The possible current names included in the table, are guesses from fisheries biologists, historians, and water quality specialists. Study the table and answer the questions.

Species Collected	Possible current name	# Collected
pike	walleye – *Stizostedion vitreum,* northern pike – *Esox lucius*	79
salmon resembling trout	mooneye – *Hiodon tergisus,* goldeye – *Hiodon alosoides,* brook trout – *Salvenlinus fontinalis**	8
salmon trout	mooneye – *Hiodon tergisus,* goldeye – *Hiodon alosoides* brook trout – *Salvenlinus fontinalis**	18
rock	northern rock bass – *Ambloplites rupestris,* warmouth – *Lepomis glulosus*	1
flat back	flathead catfish – *Pylodictus olivaris,* blue catfish – *Ictalurus furcatus*	1
buffalo	bigmouth buffalo – *Ictiobus cyprinellus,* smallmouth buffalo – *Ictiobus bubalus,* black buffalo – *Ictiobus niger*	approximately 64
red horse	black redhorse – *Moxostoma duquesnei,* golden redhorse – *Moxostoma erythurum,* silver redhorse – *Moxostoma anisurum,* shorthead redhorse – *Moxostoma macrolepidotum,* river redhorse – *Moxostoma carinatum,* greater redhorse – *Moxostoma valenciennesi*	approximately 65
bass	smallmouth bass – *Micropterus dolomieui,* largemouth bass – *Micropterus salmoides*	4
cat	channel catfish – *Ictalurus punctatus,* bullhead (yellow, black, brown) – *Ictalurus* sp.	490
silver fish	golden shiner – *Notemigonus crysoleucas*	71**
shrimp	crayfish – Family *Cambaridae*	1

* the brook trout is not believed to be the correct species

** No amount was given for silver fish. This number was calculated by adding the total number of species caught and subtracting that number from 800 (the number of fish Lewis stated catching).

Student Worksheet II: Fish in the Seine

1. Species richness is figured by adding the number of different species in an environment. For example, if there were 68 bluegill, 49 channel catfish, and 25 largemouth bass in a pond, the species richness would be 3 (bluegill, channel catfish, and largemouth bass.) What is the species richness of Lewis' sample from above?

2. Which of these animals are habitat specialists (animals that must have a habitat with certain conditions)? Which of these animals are habitat generalists (animals that can live in almost any habitat)? HINT: Research where animals live…trout are habitat specialists because they must live in cold water streams, catfish are habitat generalists because they can live in many types of habitats: rivers, lakes, or ponds.

3. Graph the number of habitat generalists and habitat specialists. Label the x-axis, "Type of Species." Label the y-axis, "Number of Species."