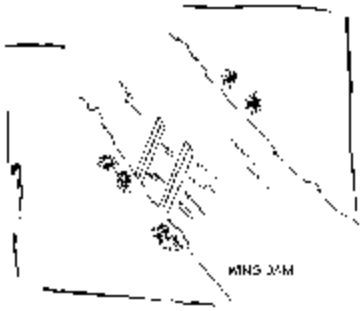
RIVER NAVIGATION TODAY- LOCKS AND DAMS

SUGGESTED GRADE LEVELS: 6-8
SUBJECTS: English language arts, mathematics, science, social science
SKILLS: comparison, critical thinking, evaluation, graphing, inference, interpretation, observation, prediction
CORRELATION TO ILLINOIS LEARNING STANDARDS: English language arts 1C; mathematics 6B; science 13B; social science 16E, 17A, 17C

BACKGROUND
Historically, the rivers of Illinois have provided navigation routes for the movement of trade goods. These transportation routes still exist today for such commodities as grain, coal, chemicals, petroleum, raw goods and finished goods.

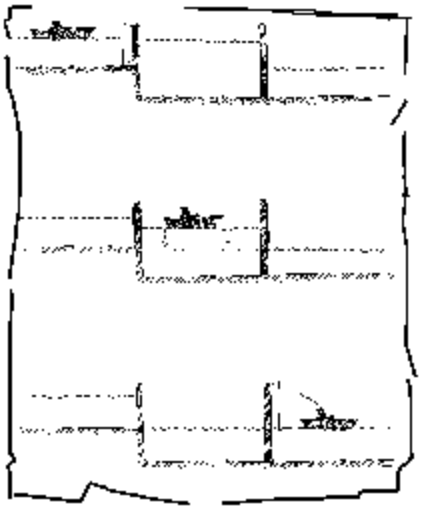
Because of the very nature of rivers, however, moving goods along them is not easy. Rivers may rise during floods, fall during droughts, change their course through natural meandering and fill with sediments to become shallow in certain areas.

Since the early 1800s the U.S. Congress has authorized changes in major river systems designed to make transportation more reliable. Originally the changes included removing snags, sandbars and rock rapids. Some attempts were made to confine river flow to the main channels. These efforts were not always successful in increasing the reliability of transportation.



In the late 1800s Congress began authorizing the U.S. Army Corps of Engineers to maintain river channels of established depth on some of the major rivers. For example, the Corps was directed to maintain a 4 1/2-foot navigation channel in the upper Mississippi River (from St. Paul, Minnesota to Cairo, Illinois). Brush and rock wing dams were built perpendicular to the shore to direct streamflow toward the center of the channel. Other structures designed to slow shore erosion and meandering were also built.

During the early 1900s, Congress authorized that a 6-foot navigation channel be maintained on these major rivers. Later that recommendation was changed to the current 9-foot navigation channel. To maintain the 9-foot depth, a series of dams had to be constructed. The river channels would also need to be dredged on a regular basis to remove sediments. Between 1930 and 1950, for example, 27 navigation locks and dams were constructed along the upper Mississippi River. The river elevation changes from 720 feet above sea level at St. Paul to 395 feet above sea level at St. Louis. The locks and dams made it possible for loaded barges to travel the upper reaches of these rivers easier and cheaper. Other locks and dams were built along the Ohio River and Illinois River.



Navigation dams are designed to maintain the 9-foot navigation channel. They are not designed for flood control purposes and have little effect on high water. The dams impound water that would naturally flow away. They divide the river into large flat reaches that cause permanent covering of flood plain areas that otherwise would flood only seasonally or occasionally. In areas where the river is naturally deep enough to maintain the proper navigation channel, such as the Mississippi River between East St. Louis and Cairo, no dams were built.

The locks associated with the navigation dams allow all boats, from tows and barges to canoes and pontoon boats, to travel upstream or downstream without having to traverse steep inclines. As an example, if you are riding upstream in a pontoon boat, and you want to go to the next river pool, you must go through a lock. You enter when the gate is opened on your end of the lock. The gate at the other end of the lock will be closed. After entering the lock, the gate that you just came through is

closed. Water flows into the lock until it reaches the same level as the water in the river pool you wish to enter. The gate is opened, and you continue your journey upstream. When you come back, the opposite process occurs. Instead of adding water when the gates are closed, water is released so that your boat is lowered to the level of the downriver pool. The process is sort of like an aquatic elevator or escalator for boats.

The Corps of Engineers is responsible for maintaining and operating the locks and dams. All locks and dams have observation areas where you may watch boats "locking through." Many of them also have interpretive areas.

The locks and dams can have effects on the environment.

- They slow the natural velocity immediately upriver from their location so that organisms adapted to fast flowing water are replaced by those adapted to slow flowing water.
- Dams trap sediments that would otherwise flow farther downstream. More dredging may be necessary to keep the navigation channels open. Pool 19 on the Mississippi River, the oldest manmade river pool, has lost 58 percent of its volume since its dam was built in 1913. Sediments accumulate here at the rate of 15 cm per year. It is estimated that by the year 2050 this pool will have lost 80 percent of its original volume. Where to place dredged sediments is often a related problem.
- Nutrients may be trapped reducing the fertility of areas further downstream that were once productive.
- Because sediments may not reach the mouth of the river, delta areas may shrink.
- Pollutants may be trapped and build up in these areas.
- Dams may block the migration routes of some aquatic species, which affects these species directly and others indirectly. Changes in river structure have affected the 118 plus species of fish and nearly 50 species of mussels that reside in the Mississippi River. The 40 percent of North America's waterfowl and shorebirds that migrate through the Mississippi River corridor have also been affected.
- Terrestrial habitats in the floodplain may be lost and species diversity reduced.

In a typical year, many millions of tons of goods are moved along Illinois' major rivers. The transport of these goods is necessary for Illinois' economy to prosper. We must keep working toward a balance between economic and environmental prosperity.

MATERIALS

writing materials; copies of "Barge Traffic Activity" and maps; Illinois state map (available free of charge from Secretary of State's offices)

BARGE TRAFFIC ACTIVITY

Using the attached maps and a map of the state of Illinois, answer the following questions related to barge movements along the rivers of Illinois[1]. Before continuing this activity familiarize yourself with the locations of Lock and Dam 25 and Lock and Dam 27 on the Mississippi River, the La Grange Lock on the Illinois River and Lock and Dam 52 on the Ohio River.

1. In this typical year, what commodity provided the greatest demand for barge traffic on the river (only the top three categories are shown)? Was most of this product shipped upstream or downstream? Why?

2. Refer only to data for Lock and Dam 25, Lock and Dam 27 and the La Grange Lock when answering this question. All figures are in 1,000 tons (Ktons). During the reporting period, 6,413 Ktons of coal went upstream through Lock and Dam 27. Reports from Lock and Dam 25 and the La Grange Lock, which are upriver, record only a total of 6,005.9 Ktons of coal passing upstream. What happened to the other 407.1 Ktons of coal? Give at least two possibilities for the disappearance of the coal from the records.

3. From the farm products barge traffic map, which general direction did the farm products flow - upstream or downstream? Why? Using these results only, which would be a larger grain exporting port - Chicago or New Orleans? How did you determine the answer?

[1] All data are from annual totals released by the United States Army Corps of Engineers.

4. Barges transported 7,369 Ktons of chemicals upstream through Lock and Dam 27 in this reporting period. The amount of that total continuing upstream on the Mississippi and Illinois Rivers was 6,467.7 Ktons. Assuming that a large amount of this difference was not shipped up the Missouri River, what could you speculate about the nature of the Granite City/Alton area along the Mississippi River?

5. In terms of the total number of barges, do shippers along the Illinois and Mississippi Rivers depend more on receiving goods by barge or shipping goods by barge? How would a major flood, in which barge traffic on the rivers is closed, affect the following people: barge captain; grain elevator owner along the Illinois River; commercial fisherman; recreational boat manufacturer; recreational boater; recreational fisherman; breakfast cereal consumer; barge owner; manager of a power plant that burns coal; chemical plant operator?

6. Which river has more barge traffic, the lower Ohio River (from Cairo through Lock and Dam 52) or the lower Mississippi River (from Cairo through Lock and Dam 27)?

EXTENSIONS

1. Conduct a search for historic photographs of river resources or uses in your area. Make a display of the photographs. Interview longtime residents of the area to add to your knowledge of local history and the stories behind the photographs. Hold an open house for all local residents or display the photographs/stories in a business for others to see.
2. Continue the data collection for the sites used in the barge activity. After receiving data from several years, compile the data into graphs to show trends. Barge traffic information may be obtained from the U.S. Department of Transportation - Bureau of Transportation Statistics, 400 7th Street SW, Room 3430, Washington, DC 20590 (phone 202/366-DATA). Ask for *United States Waterway Data* CD-ROM. There is no charge for the item. It is updated annually.
3. Assume that an impoundment averages 15 feet deep at its construction. If the impoundment receives sediments at the rate of 6 inches per year, how many years will it take to reduce the average depth to 6 feet?
4. Using the information about mussels, barges and locks and dams provided in this *Aquatic Illinois* kit, hypothesize how the construction of locks and dams and the use of barges and tows could cause mussel populations in the river to decline. Suggest ideas to try to save the mussel populations from extinction.

EVALUATIONS

1. Have students write a report comparing how rivers have changed over time. Express the view of each of the following people: a Native American in the early 1700s; a river boat captain from the late 1800s; a barge captain from the 1990s. Be sure to include such items as water quality, flooding, ease of transportation and uses of the river.
2. Have students develop a list of river users and identify potential impacts of each on water quality and water quantity.
3. Have students assume that you live along a major river in Illinois. The U.S. Army Corps of Engineers has determined that to ease transportation problems for barges on this stretch of the river a new lock and dam should be built at your town. Hold a debate to present the benefits and detriments of constructing this structure.
4. Have students look at maps of Illinois, North America and other continents. Most major cities are located along a river. Why?

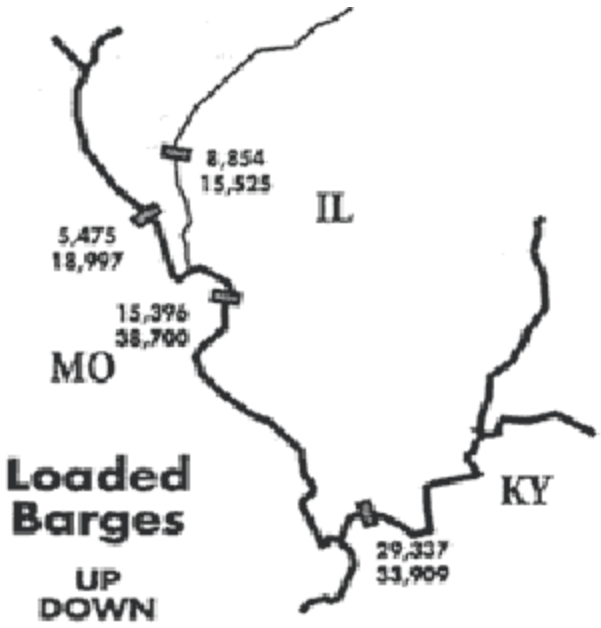
REFERENCES

Middleton, Pat. 1993. *Mississippi River activity guide*. Heritage Press, Stoddard, Wisconsin. 30 pp.

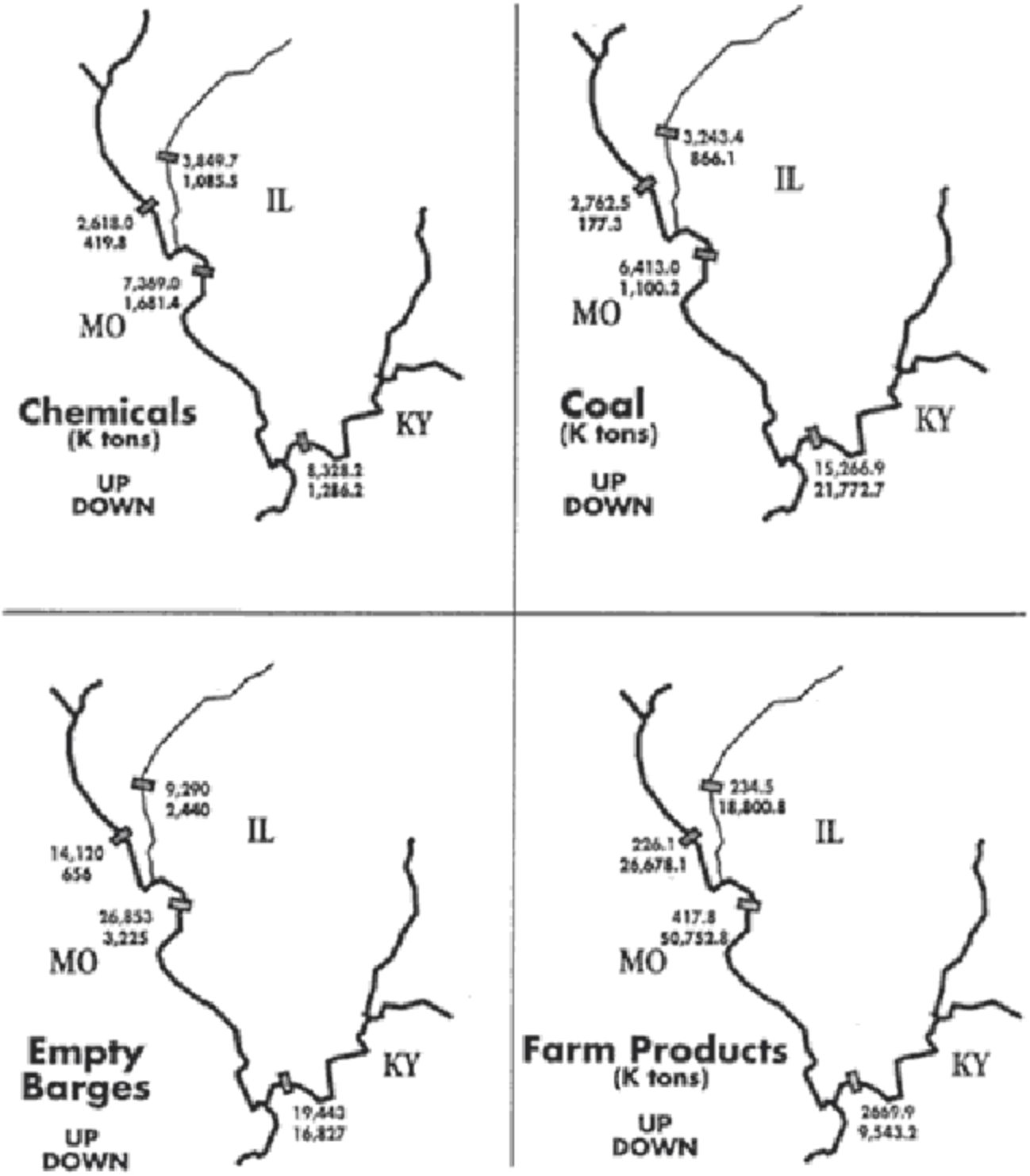
The Waterways Journal. 1996. "What's moving on the rivers," February 12.

United States Environmental Protection Agency. 1991. *Always a river*. U.S. Environmental Protection Agency Office of Research and Development, Cincinnati, Ohio. 284 pp.

Upper Mississippi River Conservation Committee. 1993. *Facing the threat: an ecosystem management strategy for the upper Mississippi River*. Upper Mississippi River Conservation Committee, Rock Island, Illinois. 16 pp.


8,854
15,525
IL
5,475
18,997
15,396
38,700
MO
KY
29,337
33,909
Loaded
Barges
UP
DOWN


Peoria
Springfield
La Grange
Lock
IL
Lock & Dam
25
Alton
Granite City
St. Louis
Lock & Dam
27
E. St. Louis
MO
Cairo
KY
Lock & Dam
52
Selected Lock
and Dam
Locations


3,849.7
1,085.5
IL
2,618.0
419.8
7,389.0
1,681.4
MO
Chemicals
(K tons)
UP
DOWN
KY
8,328.2
1,286.2
3,243.4
866.1
IL
2,762.5
177.3
6,413.0
1,100.2
MO
Coal
(K tons)
UP
DOWN
KY
15,266.9
21,772.7
9,290
2,440
IL
14,120
656
26,853
3,225
MO
Empty
Barges
UP
DOWN
KY
19,443
16,827
234.5
18,800.8
IL
226.1
26,678.1
417.8
50,752.8
MO
Farm Products
(K tons)
UP
DOWN
KY
2869.9
9,343.2