River Navigation Today: Locks, Dams and Barges

SUGGESTED GRADE LEVELS: 3, 4, 5, MS

SUBJECTS: Science, Social Science

SKILLS: computation, organizing information, comparison, critical thinking, graphing, interpretation, mapping, observation, small group work, comparing and contrasting, writing

CORRELATION TO NEXT GENERATION SCIENCE STANDARDS: MS-ESS3-4, 3-5-ETS1-1, MS-LS2-1, MS-LS2-4, MS-LS2-5

Objectives

Students will: 1) learn why locks and dams are built and how they work; 2) understand why locks, dams and barges are vital to river trade and navigation; 3) realize some of the environmental impacts of the locks, dams and barges in the Great Rivers region; and 4) improve mapping skills.

Method

Students will graph the water level of the navigation pools on the Mississippi River and the mile markers where the locks and dams are located. Students will map the location of the 27 locks and dams on the upper Mississippi River. Students will participate in an activity to demonstrate the capacity of different vehicles used for trade on the water, roads and rails.

Background

The Mississippi River begins in Lake Itasca, Minnesota, and ends in the Gulf of Mexico at the Louisiana coast. The Mississippi River system, which makes up more than 9,000 miles of the 25,500 navigable inland waterways in the United States, has historically been used as a source of transportation, food and other supplies. Today, it still functions in these ways, but increased demands of trade and transportation require more control over the ways and times that the river can be navigated.

Through the early 1800s, the river was wide and traveled in many different paths rather than one channel. Some places in the river could be impassable for water traffic during dry times of the year because the water level would be very low. Obstacles were constantly changing in the river. River captains had to navigate around submerged trees, rocks and sand/gravel bars and traverse rapids that could easily capsize a vessel. Sometimes the water level would be too high for boats to safely navigate the river.

In order to attempt to solve these problems, in 1829 the U.S. Army Corps of Engineers (USACE) was charged with maintaining the channel of the Mississippi River. The USACE is a group of soldiers and civilians who "Provide vital public engineering services in peace and war to strengthen our Nation's security, energize the economy, and reduce risks from disasters" (Mission). Their duties include building facilities and maintaining them, dredging inland water channels, designing structures that can withstand storms and hurricanes and participating in national disaster cleanup.

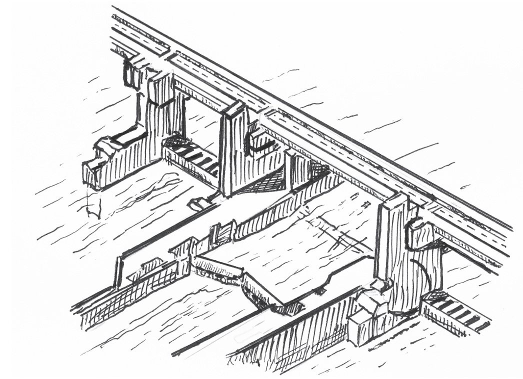
This process began with removing snags in the river. They also eliminated obstacles, like rapids, rocks and side channels that the river meandered through. Levees were used to contain the river in a set channel. Jetties were used to direct the current to a particular area in order to clear away sediment that had been deposited by the river. The USACE believed that a four-and-one-half-foot deep channel would be best to bypass the rapids that existed on the river. Congress approved a six-foot deep channel for the Mississippi River in 1907, but in the 1920s a nine-foot deep navigation channel was decided to be the new standard.

In 1900, the USACE connected the Illinois River to Lake Michigan by opening the Chicago Sanitary and Shipping Canal, reversing the flow of the Chicago River. Originally intended to allow Chicago's garbage to flow into the Illinois River instead of Lake Michigan, the canal was a boon to Chicago in many ways. This and other canals provided a direct shipping and trade connection to link ports throughout the Great Lakes all the way to New Orleans. It has subsequently proved problematic. Not only are trade goods and recreational vehicles able to traverse this route but so are invasive aquatic organisms that can cause havoc in the ecosystem.

Vocabulary Words

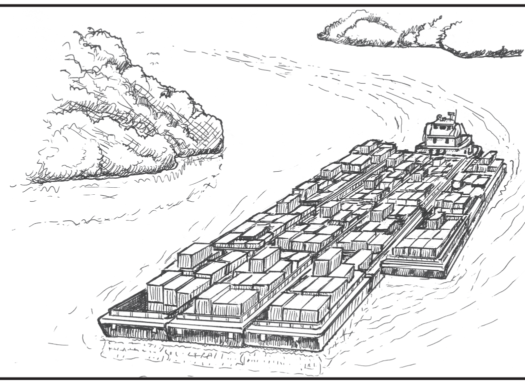
lock – gate system used to allow boats and barges to pass around a dam at a safe water level

dam – wall-like device used to control water levels in order to allow navigation at all times of the year

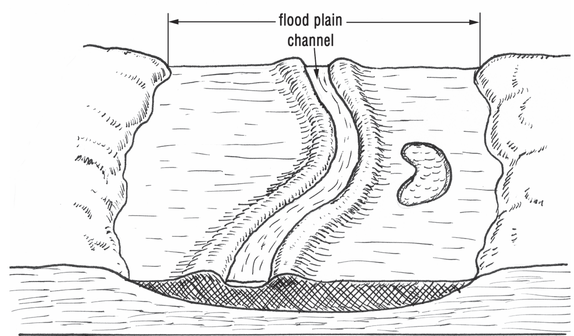


barge – flat-bottomed boat used to transport dry and liquid cargo on bodies of water

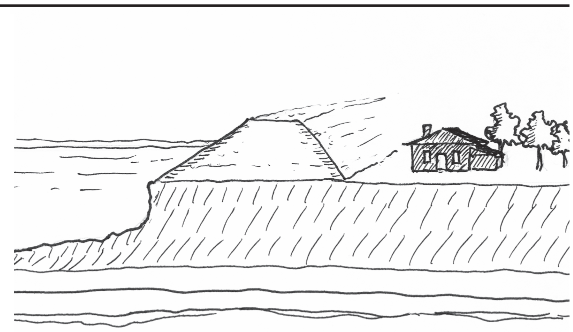
tow boat – used to move barges since most barges are not self-propelled



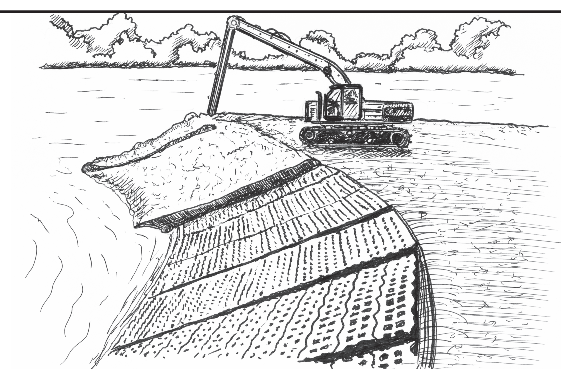
channel – the physical path of the river



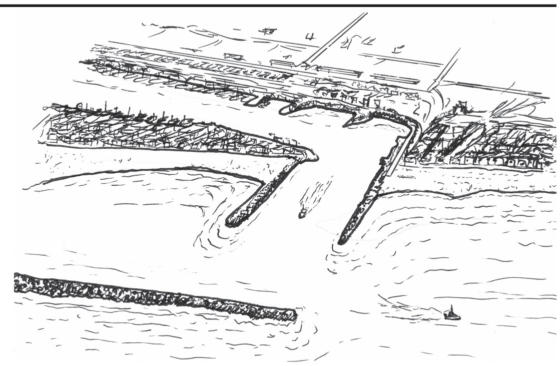
levee – wall or slope used to control water levels and keep the channel in a set path



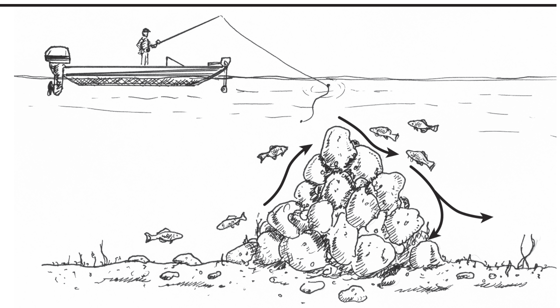
revetment – cement or wooden structure used to absorb the energy of the water and to prevent flooding and erosion



jetty – stone or dirt structure used to direct current or prevent shoreline erosion



wing dam – man-made obstruction that extends into the river a certain distance instead of blocking the entire channel



The River and Harbors Act of 1930 made not only the nine-foot navigation channel a necessity, but it also stated that the navigation channel had to be 400 feet wide for multiple-barge tows. This standard was accomplished by creating 23 locks and dams on the upper Mississippi River in 1930 to add to the three that were already in use. In the 1950s Lock and Dam 26 in Alton was built, which was later replaced by the Melvin Price Lock and Dam (East Alton) in 1990. Lock and Dam 27 in Granite City was also added in 1953.

A lock and dam system is used to lift or lower a boat as it moves upstream or downstream allowing it to pass into the next part of the river without a steep incline in the river channel. A dam makes a pool of water behind it. This pool is higher in elevation than the water below the dam. Boats must be raised or lowered through a lock to progress safely upstream or downstream around the dam. A boat or barge enters the lock at one end and the gates of the lock are closed. Then, the boatmen wait for the operators to raise or lower the water level inside the lock depending on whether they are going upstream or downstream. After the water level has changed, the gate at the other end of the lock is opened allowing the boat to exit and continue on the river.

There are different types of dams used by the USACE to try to maintain the navigation channel of the Mississippi River. Locks and dams were first used to bypass or get over sets of rapids, but they are now used to make the river more navigable. Wing dams and closing dams are submerged piles of rocks or concrete used to control the directional flow of the channel; whereas the dams used in the lock and dam system of the upper Mississippi River (the portion of the Mississippi river upstream from Cairo, Illinois) are used to control water levels. They are not used to control flooding, though, even though they maintain the proper depth for boating and inland waterway barge trade. These locks and dams allow the upper Mississippi River to be passable in every region year-round to transportation and trade vessels to keep the 46 million tons of traffic per year on the river moving.

Usually tow barges are responsible for trade and transportation on the river. A 5,000-horsepower tow boat can move 15 barges, which can carry 1,500 tons each. The entire tow and barge is 105 feet wide and 1,100 feet long and moves at eight miles per hour. They can carry both dry cargo, like agricultural products and supplies, coal, steel and aggregates, and liquid cargo, like petroleum products, oils and agricultural chemicals. Dry cargo is the most prevalent making up 85 percent of the barge fleet in the U.S.

2007 U.S. Domestic Waterborne Traffic

Commodity	Tons – Internal Waterways (millions)	Percent Change from 2006 – Internal Waterways
Coal	177.5	0.0
Coal Coke	4.6	-18.9
Crude Petroleum	32.5	-0.5
Petroleum Products	132.3	4.3
Chemical and Related Products	51.0	4.0
Forest Products	6.0	20.0
Pulp and Waste Paper	<50,000 tons	-20.9
Sand, Gravel, Stone	77.6	-11.3
Iron Ore and Scrap	9.5	-15.0
Non-Ferrous Ores and Scrap	6.2	7.6
Sulphur, Clay, Salt	6.7	-10.0
Primary Manufactured Goods	27.0	-12.6
Food and Farm Products	77.5	5.3
All Manufactured Equipment	8.8	-8.2
Waste and Scrap (Anything Else not Classified)	1.2	-17.7
TOTALS	621.9	-1.0

Barges are often the best mode of trade transportation because they are able to carry one ton of cargo 576 miles per gallon of fuel compared to only 155 miles for a truck and 413 miles by rail. The capacity of a barge is also 15 times that of a rail car and 60 times that of a truck, meaning that a barge can carry 1,500 tons, a rail car 100 tons and a truck 25 tons. Barges are more economical and environmentally friendly than rail or truck transportation. Trade transportation by barge releases 33 percent less pollutants than diesel trains and 373 percent less than diesel trucks. The pollution emitted is released in remote locations. Motor noises are reduced because the engine of the boat is below the water line. Barges are a safer mode of transportation with less accidents, fatalities and injuries than truck or rail transport. They are less likely to spill their contents and cause little congestion. As more trucks are driven on highways, more stress is put on their infrastructure, creating the need for constant maintenance of roads and bridges, amounting to about $100 billion dollars annually.

As water traffic increases, several problems can arise. Habitats in the backwaters, secondary channels and floodplains may be cut off due to building structures to maintain the navigation channel. The fish species diversity in the main channel declines and submersed vegetation cannot grow. The bank habitat reduces in quality, and freshwater mussels can be negatively affected. Historic sites and over 2,000 archeological sites along the river are in danger from increased shoreline erosion. Currently, seawalls, bulkheads and revetments are being constructed to try to stop shoreline erosion. They are all wall-like structures that will temporarily keep the soil and sand on the banks until a long-term plan can be developed.

Locks and dams are often looked upon as problems for the natural environment. They keep species of fish and mussels from moving along the river, decreasing the biodiversity of the river. Excessive vegetation and sediment build up on the upstream side of the dam. Locks and dams stop the normal cycle of flooding on the river, a cycle many animals use to access floodplains for nesting, resting and rearing of their young. Structures to prevent erosion and therefore, the build-up of sediment are being installed along the river, and plans are being developed to create a passage for fish and other aquatic organisms to pass through the locks and dams. These solutions can help maintain or increase diversity in the river.

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Materials

writing materials; copies of "Upper Mississippi River Map," "Graphing Template" (two copies per group), "Graphing Locks and Dams," "Barge Traffic Through Locks and Dams 25, 26 and 27" (three pages), "Questions for Barge Traffic Charts" and "Animal Fact Sheets" (four pages); U.S. atlas; coloring utensils; container that will hold at least 16 cups; other small containers; measuring cup; dried corn kernels, dried beans, dry rice or other filling material

Procedure

1. Explain what barges are and why they are important. Talk about navigation on the Mississippi River and the issues associated with it. Ask students why the Mississippi River is controlled and how we control it. Discuss whether the Mississippi is actually under our control. Ask students who controls the navigation of the river and why. Discuss the different types of dams and the other ways that the U.S. Army Corps of Engineers changes river navigation.

2. Pair the students and give each pair a copy of the graphing information and two copies of the blank graph. Have each group graph both the water pool level of the locks and dams

and the number of miles from the beginning of the Mississippi to where the lock is located. Help them understand how the river affects the surrounding community, river traffic and the environment.

3. Have the students map the location of the 27 locks and dams on the upper Mississippi River using an atlas and the city information given in Procedure #2 as resources.
4. Discuss what products are shipped on the Mississippi River. Begin the "Barge vs. Rail Car vs. Truck" activity. Find a container that will hold at least 16 cups, a measuring cup and some material, like beans, cereal or rice, which you can use to show how much cargo a barge can hold in comparison to a rail car and a tractor-trailer. Prior to the demonstration, use a measuring cup and fill the container with 16 cups (or other increments and measurements according to the chart included) of dried corn kernels or other filling material. Show the students that the container full of corn is a barge and every cup you remove represents one rail car. Explain that it takes 16 rail cars to equal the amount of dry cargo that a barge can carry. Continue with the other numbers included in the chart. It is recommended to prepare containers prior to the demonstration. Repeat the demonstration for liquid measurements, if desired. Discuss why trade through the inland waterways is important for the economy and the environment.
5. Give the students copies of the "Barge Traffic Charts Through Locks and Dams 25, 26 and 27" (three pages) and "Questions for Barge Traffic Charts" pages to complete while examining the number of barges of different product types that move along the rivers. Discuss the results.
6. Have students list five possessions in their home. What are they made of? How are those items related to the raw products that go up and down the Mississippi River? Discuss the affect on students and their family if there was no way to control the navigation of the Mississippi River.
7. Ask the students what would happen if barge traffic increased more than its current levels. What effects do barges have now on the animals, resources and surrounding areas? Do the locks and dams affect animal habitats? How do they change the area? Explain that the four animals (American eel, American white pelican, ebonyshell mussel and skipjack herring) in the attached fact sheets are just a few examples of the animals and plants that can be affected by locks, dams and barges. Have the students do research on one of the animals included in the fact sheets. Conduct a debate to decide whether locks and dams do more good than harm.

Evaluations

1. Students should turn in the graphing activity worksheets.
2. Have the students design their own dam to your specifications. Let them choose between drawing a blueprint or building a model out of clay, etc.
3. Write a report about the navigation changes that have taken place in Illinois since the Native Americans (1700s) were in this region.
4. Have a debate about how the Great Rivers region would be affected if the connection between Lake Michigan and the Illinois River system is blocked to stop the spread of invasive/exotic aquatic species.

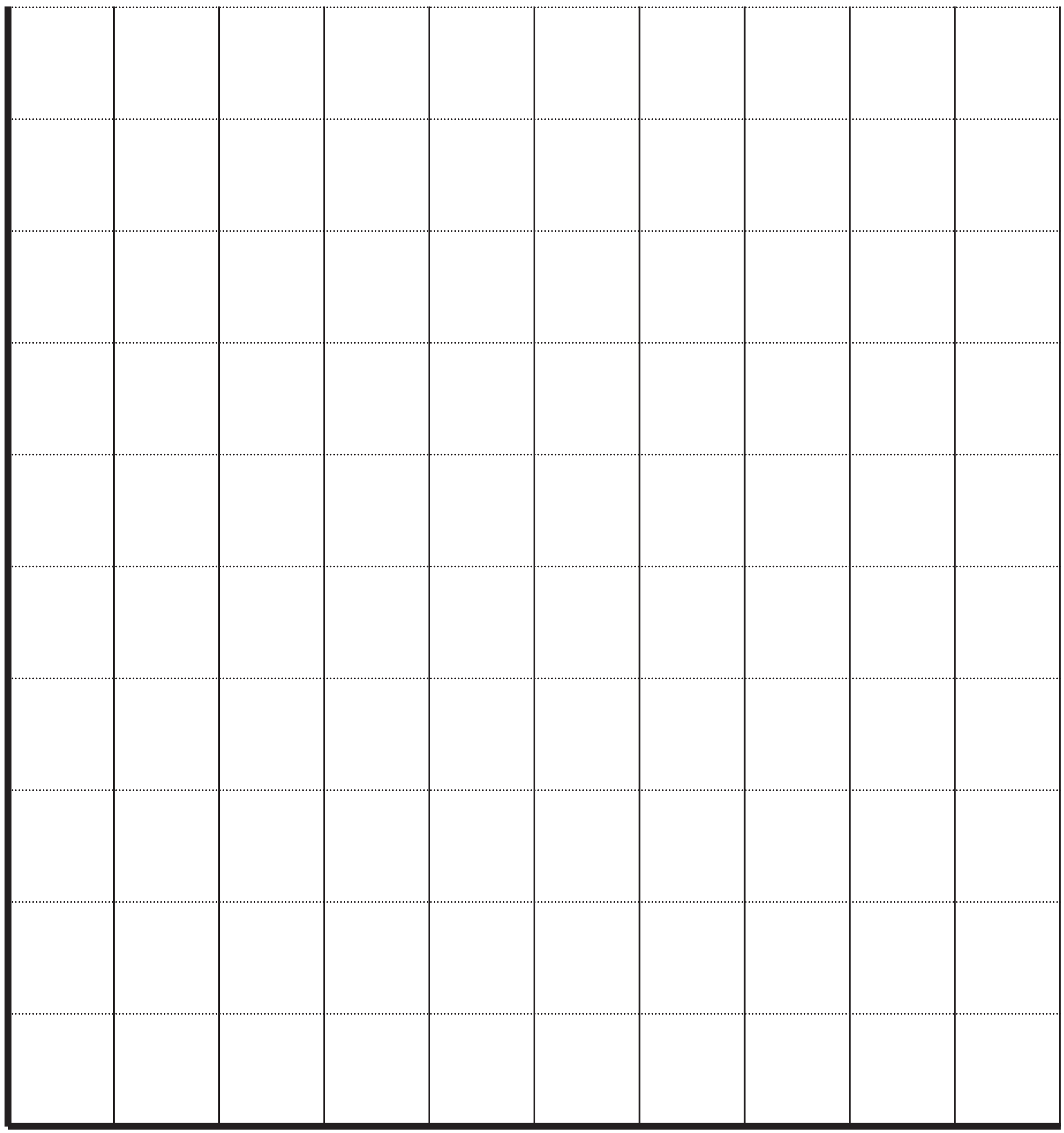
Extensions

1. Complete a poster project on some world records for locks and dams (smallest, largest, etc.).
2. Research the ways that other countries use to lift or lower boats when there is no lock and dam system present.
3. Why does the building of locks and dams create a problem for freshwater mussels, fishes, red-eared slider turtles, herons and other animals in the region?

This work was supported in part through an internship to Danae Boesdorfer provided by the National Great Rivers Research and Education Center.

Lock Number	Lock Location	Mile on Mississippi	Pool Elevation
1	Minneapolis, Minnesota	847.9	725
2	Hastings, Minnesota	815.2	687.2
3	Welch, Minnesota	796.9	675
4	Alma, Wisconsin	752.8	667
5	Minnesota City, Minnesota	738.1	660
5A	Fountain City, Wisconsin	728.5	651
6	Trempealeau, Wisconsin	714.3	645.5
7	La Crescent, Wisconsin	702.5	639
8	Genoa, Wisconsin	679.2	631
9	Lynxville, Wisconsin	647.9	620
10	Guttenberg, Iowa	615.1	611
11	Dubuque, Iowa	583	603
12	Bellevue, Iowa	556.7	592
13	Fulton, Illinois	522.4	583
14	Le Claire, Iowa	493.3	571.98
15	Rock Island, Illinois	482.9	561
16	Illinois City, Illinois	457.2	545.19
17	New Boston, Illinois	437.1	535.87
18	Gladstone, Illinois	410.5	528.02
19	Keokuk, Iowa	364.2	518
20	Canton, Missouri	343.2	480
21	Quincy, Illinois	324.9	470
22	Saverton, Missouri	301.2	460
24	Clarksville, Missouri	273.3	449
25	Winfield, Missouri	241.5	434
26	Alton, Illinois	200.6	419
27	Granite City, Illinois	185.3	398

U.S. Army Corps of Engineers. 2010. “Water Levels of Rivers and Lakes.” http://www2.mvr.usace.army.mil/WaterControl/new/layout.cfm.




LAKE SUPERIOR
MI
Dairyland
Ladysmith
St. Paul
Hastings
Alma
Trempeleau
Onalaska
LaCrosse
Genoa
MN
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MI
LAKE MICHIGAN
Cassville
IA
Mississippi River
Marseilles
Hennepin
Bartonville
Havana
Oquawka
Bath
Illinois River
MO
IL
IN
Clarksville
Grafton
Alton
St. Louis
Missouri River
KY
Mt. Vernon
Mound City

Barge vs. Rail Car vs. Truck

Units to Carry 1,750 Tons of Dry Cargo	
Mode	**Number**
Barge	1
Rail Car	16
Truck	70

Units to Carry 27,500 Barrels of Liquid Cargo	
Mode	**Number**
Barge	1
Rail Car	46
Truck	144

Comparison
One 15-Barge Tow
216 Rail Cars + 6 Locomotives
1,050 Large Tractor-Trailers

National Waterways Foundation. 2008. "Waterways: Working for America."
www.waterwayscouncil.org/study/NWF%20PowerPoint.ppt.

Name: ____

1. What are the two main products that travel downstream on the Mississippi River? Why do they go downstream instead of upstream?

2. Are more empty barges going upstream or downstream? Why? Why would barge companies allow the barges to travel empty? Wouldn't they make more money if they hauled products both upstream and downstream?

3. Why does more coal go upstream than downstream? Why does more corn go downstream than upstream? What factors could play a role in the direction of travel for each commodity?

4. What kinds of products can coal and corn be used to make?

5. Why does the number of barges for the same product differ above, at and below the confluence of the Mississippi, Illinois and Missouri rivers? For example, the number of downstream barges containing corn above the confluence is 4,988, at the confluence is 9,590 and below the confluence is 9,640.

6. Pick a product on the chart to research (not coal or corn). Find out where the product originated, where it is going, and what it could be used for.

Barge Traffic Through Lock and Dam 25 (Above Confluence)

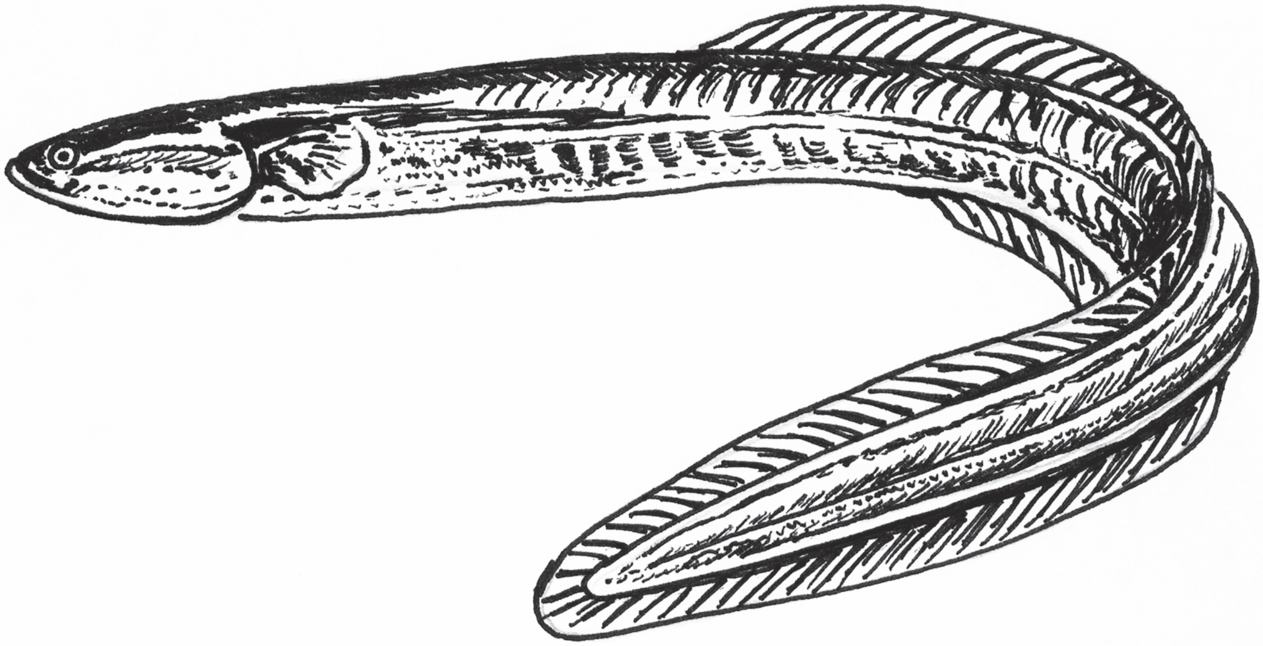
	Commodity	Number of Barges (2008)	Number of Barges (2009)	Total Tons (2008)	Total Tons (2009)
Upstream Traffic	Empty	4,605	7,437	0	0
	Coal	2,109	1,811	3,286,333	2,776,578
	Steel Products	126	65	197,887	97,474
	Food and Farm Products	17	13	26,727	20,100
	Fresh Fish and Other Marine	1	4	1,600	6,100
	Wheat	3	7	4,872	10,900
	Corn	43	26	71,174	39,500
	Rye, Barley, Rice, Sorghum and Oats	10	5	15,677	7,900
	Soybeans	32	72	49,947	109,155
	Vegetable Products, Oilseeds	9	24	14,194	37,400
	Animal Feed, Grain Mill Products, Flour	14	21	22,227	32,780
	Agriculture By-Products	63	41	102,464	70,100
Downstream Traffic	Commodity	Number of Barges (2008)	Number of Barges (2009)	Total Tons (2008)	Total Tons (2009)
	Empty	1,232	789	0	0
	Coal	49	134	72,621	208,406
	Steel Products	7	6	10,640	11,040
	Food and Farm Products	91	114	139,245	179,225
	Fresh Fish and Other Marine	15	4	22,500	6,300
	Wheat	134	147	205,178	230,720
	Corn	4,988	6,435	7,662,071	9,939,165
	Rye, Barley, Rice, Sorghum and Oats	27	53	42,010	82,110
	Soybeans	1,975	2,931	3,029,372	4,534,392
	Vegetable Products, Oilseeds	52	59	80,075	88,208
	Animal Feed, Grain Mill Products, Flour	849	1,090	1,305,470	1,686,956
	Agriculture By-Products	16	10	26,096	15,740
Total Upstream		7,032	9,526	3,793,102	3,207,987
Total Downstream		9,435	11,772	12,595,278	16,982,262

Barge Traffic Through Lock and Dam 26 (At Confluence)

	Commodity	Number of Barges (2008)	Number of Barges (2009)	Total Tons (2008)	Total Tons (2009)
Upstream Traffic	Empty	9,406	15,521	0	0
	Coal	3,405	2,658	5,480,776	4,068,623
	Steel Products	1,243	495	1,969,886	767,432
	Food and Farm Products	45	48	70,493	75,353
	Fresh Fish and Other Marine	3	4	4,694	6,100
	Wheat	59	32	90,781	49,617
	Corn	100	103	160,844	156,791
	Rye, Barley, Rice, Sorghum and Oats	34	31	54,788	48,625
	Soybeans	63	111	99,232	169,449
	Vegetable Products, Oilseeds	43	32	68,716	51,750
	Animal Feed, Grain Mill Products, Flour	56	61	88,926	94,183
	Agriculture By-Products	133	62	212,139	103,062
Downstream Traffic	Commodity	Number of Barges (2008)	Number of Barges (2009)	Total Tons (2008)	Total Tons (2009)
	Empty	3,941	3,268	0	0
	Coal	718	1,031	1,147,912	1,582,664
	Steel Products	313	169	500,845	261,964
	Food and Farm Products	148	183	234,869	293,548
	Fresh Fish and Other Marine	19	4	30,109	6,300
	Wheat	266	338	418,045	525,346
	Corn	9,590	12,557	15,148,719	19,385,481
	Rye, Barley, Rice, Sorghum and Oats	93	73	148,058	114,310
	Soybeans	2,973	4,141	4,700,562	6,413,691
	Vegetable Products, Oilseeds	63	61	99,164	91,608
	Animal Feed, Grain Mill Products, Flour	1,854	2,049	1,939,545	3,165,982
	Agriculture By-Products	79	47	128,035	70,440
Total Upstream		14,590	19,158	8,301,275	5,590,985
Total Downstream		20,057	23,921	25,495,863	31,911,334

Barge Traffic Through Lock and Dam 27 (Below Confluence)

Upstream Traffic	Commodity	Number of Barges (2008)	Number of Barges (2009)	Total Tons (2008)	Total Tons (2009)
	Empty	11,072	17,280	0	0
	Coal	3,361	2,633	5,212,847	4,044,258
	Steel Products	1,358	551	2,067,022	840,569
	Food and Farm Products	47	50	72,071	78,553
	Fresh Fish and Other Marine	4	4	6,200	6,100
	Wheat	55	38	85,306	59,210
	Corn	87	52	135,096	76,799
	Rye, Barley, Rice, Sorghum and Oats	36	30	54,753	46,729
	Soybeans	69	84	103,436	127,405
	Vegetable Products, Oilseeds	47	35	67,880	56,550
	Animal Feed, Grain Mill Products, Flour	62	43	97,877	66,883
	Agriculture By-Products	133	73	207,133	119,569
Downstream Traffic	**Commodity**	**Number of Barges (2008)**	**Number of Barges (2009)**	**Total Tons (2008)**	**Total Tons (2009)**
	Empty	4,271	3,588	0	0
	Coal	704	1,007	1,096,884	1,549,641
	Steel Products	458	220	711,081	339,352
	Food and Farm Products	165	182	256,225	292,100
	Fresh Fish and Other Marine	19	4	30,002	6,300
	Wheat	253	333	390,638	518,128
	Corn	9,640	12,653	14,997,281	19,540,961
	Rye, Barley, Rice, Sorghum and Oats	90	85	139,917	132,310
	Soybeans	2,945	4,278	4,594,189	6,620,877
	Vegetable Products, Oilseeds	65	81	99,426	122,308
	Animal Feed, Grain Mill Products, Flour	2,379	2,542	3,691,622	3,938,264
	Agriculture By-Products	83	49	132,674	73,564
Total Upstream		16,331	20,873	1,078,966	5,522,625
Total Downstream		21,072	25,022	2,129,824	33,133,805



American eel

SCIENTIFIC NAME: *Anguilla rostrata*

LIFE HISTORY: This nocturnal fish is born in the sea, moves to freshwater streams to mature and returns to the ocean to reproduce. It grows to a maximum length of 60 inches with the average size being 2.5 pounds and 16-33 inches in length. The female is larger than the male. The body of the eel is snakelike with no pelvic fins and covered in tiny scales. The head is pointed, and the lower jaw extends beyond the upper jaw. The body is yellow or brown on the back and sides with a yellow or white belly. The adults live in permanent streams and spend 5-20 years in freshwater before returning to the sea to breed. Larval eels live in the ocean for about a year before transforming and migrating to freshwater. These creatures are carnivores that feed on insects, fishes, fish eggs, worms, clams, frogs and decomposing animals. They breathe through their skin and gills. They also cover their body with mucous to protect themselves from predation and drying out.

AFFECTS OF LOCKS AND DAMS: Locks and dams cut off female eels from their natural habitat. Some are also killed in the turbines of hydroelectric plants as they travel downstream. Because locks and dams maintain a channel for commercial fishing, they have been historically over-fished.

Illinois Department of Natural Resources. 2010. *Illinois Fishes: Volume I* Poster.

U.S. Fish and Wildlife Service. 2010. "The American Eel." http://www.fws.gov/northeast/newsroom/facts.html

American white pelican

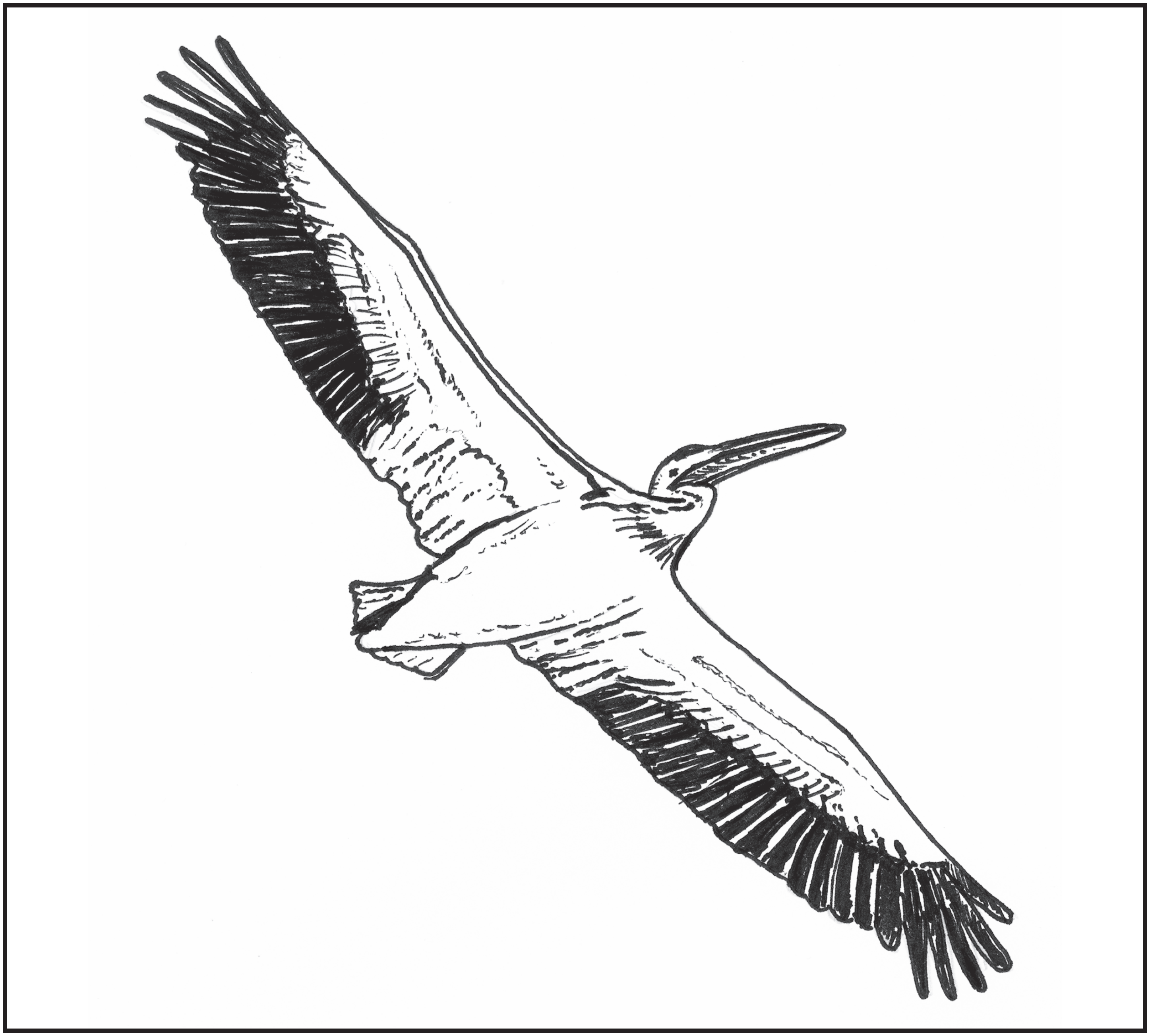
SCIENTIFIC NAME: *Pelecanus erythrorhynchos*

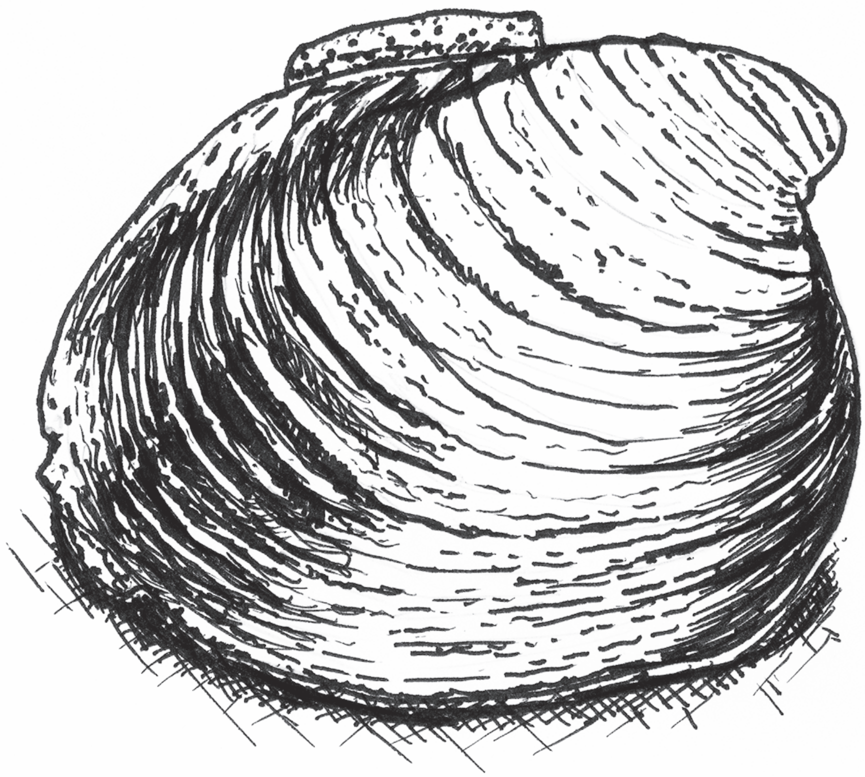
LIFE HISTORY: With a nine-foot wingspan, the usually silent American white pelican is a large bird with an orange bill and expandable throat pouch. It is migratory, moving north in March and south between September and November. Pelicans hunt together in shallow lakes for fishes, crayfish and salamanders. They circle fishes or push them toward the shoreline. Then, the prey is scooped up by their bill and swallowed.

As soon as the birds meet and form a colony, they pair up, court and nest next to a couple in the same stage of breeding. Both sexes build a nest and incubate the two eggs to hatching. When the young are 10-11 weeks old, they leave the nest.

AFFECTS OF LOCKS AND DAMS: The locks and dams on the upper Mississippi River have increased the habitat for these birds. The migration path of the birds has been altered by the creation of these structures, allowing the birds to nest in Illinois along the Mississippi River. The pools created by the locks and dams also provide them with prime hunting grounds.

Seattle Audubon Society. 2008. "Bird Web: American White Pelican." http://www.seattleaudubon.org/birdweb/bird_details.aspx?id=33.





ebonyshell mussel

SCIENTIFIC NAME: *Fusconaia ebena*

LIFE HISTORY: This long-living freshwater mussel with a brown/black heavy, round shell can reach up to four inches in length. The inner shell is white and once was harvested by commercial button-makers. It lives in large rivers in sand or gravel with other species of mussels in mussel beds. The ebonyshell is sedentary but can slowly pull itself across the aquatic floor using its "foot." It is a filter feeder on bacteria, protozoans, algae and other organic matter.

When reproducing, males release sperm into the water, which is drawn into the female through the incurrent siphon. The sperm fertilize the eggs inside the female's body. The young develop to an intermediate stage, the glochidia, and are released into the water. The young attach to this species' fish host, the skipjack herring (*Alosa chrysochloris*), and live as parasites until they develop into juvenile mussels. Then, they detach and fall to the streambed.

AFFECTS OF LOCKS AND DAMS: This species once was one of the most abundant in the upper Mississippi River system, but it is quickly declining. The commercial button industry and pollution are partially to blame for the decline of this species, but a main reason for their decline is the blocking of the skipjack herring by locks and dams. The skipjack herring, a migratory fish, is the primary host for ebonyshell glochidia. Dams also increase sediment buildup in the river, choking the mussels on the bottom of the river.

Minnesota Department of Natural Resources. 2010. "Ebonyshell." http://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=IMBIV17060.

skipjack herring

SCIENTIFIC NAME: *Alosa chrysochloris*

LIFE HISTORY: This fish has a slender and compressed body that can be gray/silver in color. It has a pointed snout and protruding lower jaw with teeth on both the upper and lower jaws and the tongue. It can grow to 21 inches in length. It prefers clear, fast-flowing habitats in large rivers and feeds in large groups. Small fishes, plankton and insects compose its diet. Other names for this fish are blue herring, golden shad, river shad and shad.

AFFECTS OF LOCKS AND DAMS: This fish is the sole reproductive host for the ebonyshell mussel (*Fusconaia ebena*) and the elephant-ear mussel (*Elliptio crassidens*). Lock and dam structures keep most of these fish from migrating north in early spring because they cannot get past the dam, and they cannot use bypass canals. This stops the reproduction and life cycle of these two species of freshwater mussels. In order to assist the recovery of this species and the mussel species that depend on it, natural resource organizations must stock the fish in water above the dams.

Plans are being developed to provide a fish passage through the dams to prevent the extinction of the mussel species that are affected. These lifts or ladders will allow the fish to pass through the dam.

Minnesota Department of Natural Resources. 2010. "Skipjack Herring." http://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=AFCFA01030.

Wisconsin Department of Natural Resources. 2009. "Skipjack Herring." http://dnr.wi.gov/org/land/er/biodiversity/index.asp?mode=info&Grp=13&SpecCode=AFCFA01030.