NAVIGATION : Traveling the Water Highways!

GRADE SCHOOL EDITION

PIPELINE DREDGE

Bob's Beach

DIRT MINE

WILLIAMS LOCK & DAM

Lock

DAM

OPEN HOPPER BARGES

Mike's LUMBER MILL

Andrews Point Light

COASTAL PORT

Lane Shipping

TANK BARGES

TOWBOAT

WELCOME TO Vetter County

RIVER PORT

THORP GRAIN CO.

COVERED DRY CARGO BARGES

DECK BARGE

OIL

SCHNEIDER OIL

OIL TANKER

BREAK BULK SHIP

CONTAINERSHIP

CRUISE SHIP

TUGBOAT

HOPPER DREDGE

HARBOR

Water Table

FRESH WATER

SALT WATER

US Army Corps of Engineers

NAVIGATION is travel or transportation over water. Many different kinds of boats and ships are used on rivers and oceans to move people and products from one place to another.

Navigation was extremely important for foreign and domestic trade and travel in the early days of our country before cars, trucks, trains, and airplanes were invented. In those days, rivers were used as "roads" to connect inland settlements to river and coastal ports. Communities established at these commercial ports became important economic, cultural, and social hubs in the development of our Nation.

Many of the products we use and eat today are still transported by vessels on deep oceans and relatively shallow rivers or inland waterways. Towboats push barges (labeled in red) loaded with products such as grain, coal, and petroleum up and down rivers to loading and unloading facilities. Activities at a deep-water coastal port might include the loading or unloading of large commercial ocean-going vessels with lumber, oil, or cargo in large containers. Ocean-going vessels (labeled in yellow) maneuver in deep coastal harbors with the help of tugboats.

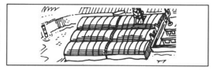
Navigation activities in the United States take place at more than 400 ports and along more than 25,000 miles of waterways. Some of the ports and waterways making up the extensive navigation network in this country are shown on the map below. Most rivers in the western part of the United States are not used for commercial navigation. Some of these rivers are used instead for recreation, irrigation, and generation of electricity. Shallow harbors or rivers are made safe for navigation by dredging or the construction of locks and dams.

Ports and Navigable Waterways of the United States

River Vessels:

The most common way of transporting products on rivers is by TOW. A tow consists of one TOWBOAT and one or more BARGEs. Towboats push different kinds of barges, depending on the cargo. Three of the four basic types of barges are shown below. The fourth type is a DECK barge, which carries almost any kind of equipment, materials, or products that can be tied down and do not need protection from the weather.

COVERED DRY CARGO barge: Carries bulky solid cargo, such as dry cement, fertilizer, and farm products (corn, wheat, and soybeans) that need protection from the weather.



OPEN HOPPER barge: Holds bulky products, such as sand, gravel, or coal, that do not need protection from the weather.

LIQUID CARGO (TANK) barge: Transports liquid products such as chemicals, petroleum, oil, and molasses.

Ocean-Going Vessels:

Many products are traded with other countries by using deep-water ocean ports. Products that come into the country are called imports and those that are shipped to other countries are called exports. Trucks, trains, tows, and pipelines transport products into and out of ocean ports. Some of the large, ocean-going vessels in the deep-water harbor are shown below.

CONTAINERSHIP: Transports products stored in 20- to 45-foot-long containers that are stacked inside the ship and outside on the deck. Some ships carry as many as 5,000 containers.

TANKER ship: Holds chemicals, petroleum products, oil, and other liquids.

BREAK BULK ship: Carries bulky cargo such as lumber, packages of fertilizer, and boxes of fruit. Break bulk cargo is usually loaded and unloaded on portable platforms ("pallets").

Dredging:

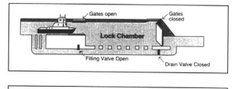
Sediment (gravel, sand, and silt) is deposited naturally in a harbor or river channel when a river slows down. Accumulated sediment reduces the channel depth and can make the waterway unsafe for navigation. Mechanical and hydraulic dredges are used to deepen and widen channels filled with sediment and deposit the sediment in an approved location. Mechanical dredges shovel or scoop up bottom materials and place them on a barge or scow. The two hydraulic dredges shown on this poster use pumps to remove a mixture of water and sediment ("slurry") from the channel bottom. The HOPPER DREDGE is an ocean-going vessel used to dredge sediment from the bottom of a deep-water channel or coastal harbor. Dredged material is stored in "hopper bins" inside the ship before disposal in the open sea or other location.

PIPELINE DREDGE: Vessel commonly used to dredge sediment from the bottom of shallow rivers or calm coastal waters. Dredged material is pumped from the river or ocean bottom and flows through a floating pipeline to shore. The dredged material commonly is used to restore eroded beaches.

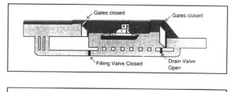
Locks and Dams:

Dams are built on shallow rivers to hold back water and form deeper navigation "pools." Most pools in the United States are maintained at a constant minimum water depth of 9 feet for safe navigation. Dams make it necessary for river vessels to use a series of locks to "step" up or down the river from one water level to another. The three steps in the "LOCKING THROUGH" process are shown below.

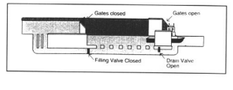
For a boat going downstream, the lock is first filled by opening the filling valve. The drain valve and upstream and downstream gates are closed, so the level of the water in the chamber rises to the upstream level. The upstream gate opens and the boat moves in.



To lower the boat, the gates are closed behind it, the filling valve is closed, and the drain valve is opened. The higher water in the lock chamber drains to the downstream level within minutes.



The downstream gate is then opened and the boat moves out on the lower water level. The process is reversed for a boat going upstream.



ACTIVITY
River Profile

Introduction

Locks and dams are necessary structures for safe travel on rivers with shallow water. The upper part of the Mississippi River (north of St. Louis, Missouri) is controlled by 29 dams. Tows and other vessels use locks to navigate around the dams. In this activity, the students use building blocks to simulate elevation changes in a river with dams. A map (aerial) view of the river is compared with the profile, or cross section, of the same stretch of river. A river's profile shows the river surface and bottom, dams, and navigation pools.

Objective -- Students will:

Learn to correlate a river's map view with its side view (profile).

Materials

1. For each group of students and the instructor: 20 rectangular wooden blocks (11 of the blocks should be twice as long as the other 9).
2. Pencil and paper.

Teacher Preparation

1. Display the poster "Navigation: Traveling the Water Highways" several days before conducting this activity.
2. Discuss the importance of locks and dams. Explain the locking through process with the class (see adjacent panel).
3. Divide the students into groups of 3. Separate blocks into sets of 11 long and 9 short blocks for each group and the instructor.

Procedure

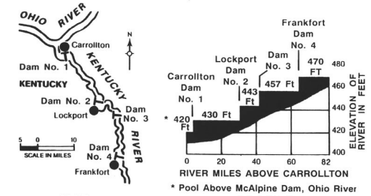
1. Instructor: Use the cross-sectional diagram (profile) of the river below to "build" a river channel with four dams out of wooden blocks. Ask the students to observe while the river is built and discuss the four obstacles (dams) that a coal tow would encounter on this river. Explain that the tow must "step" up or down the river where the dams are located. Ask the students to show you where the locks should be constructed. (Answer: parallel to the navigation pool and perpendicular to the dam)

2. When the river model is finished, ask the students to look at the blocks from the top. Explain to them that they are looking at a map or aerial view of the river. Have the students look at the river from the side. Explain that they are now looking at a profile, or cross section, of the river.
3. Hand out blocks to each group. Ask each group of students to build a river model. Challenge the students to design and construct their own river models. Have each group draw a rough sketch of its river profile. Compare the similarities and differences between the groups' river profiles.

Extension

1. Below is a map showing sections of the Kentucky and Ohio Rivers. The profile shows the elevations of the navigation pools along the Kentucky River south of its confluence (joining) with the Ohio. Have the students determine the difference in elevation between each pair of adjacent dams. (Answers: 1 & 2 - 13 ft.; 2 & 3 - 14 ft.; 3 & 4 - 13 ft.)

KENTUCKY RIVER MAP AND PROFILE



MAP PROFILE

DEFINITIONS

Barge - Long, unpowered, flat-bottomed boat used to transport cargo on water; pushed or pulled by a powered boat.

Dam - Barrier built across a river to create a pool of water for navigation, flood control, water supply, or power generation.

Domestic - Within the United States.

Dredge - Machine equipped with a scooping or suction device used in deepening and widening harbors and waterways.

Harbor - Sheltered part of a water body deep enough to provide anchorage for ships or boats.

Lock - Walled navigational structure to allow raising or lowering vessels from one water level to another.

Locking through - Using a navigation lock to "step" up or down on a river.

Port - Region or city having a natural or artificial harbor with equipment, facilities, warehouses, and berths for ships taking on or discharging cargo or passengers.

Sediment - Solid material (gravel, sand, and silt) that settles to the bottom of a river.

Towboat - Powerful boat with a flat bottom and flat front used to push barges on rivers and other calm waterways.

Tugboat - Powerful boat with V-shaped bottom and rounded front used to pull barges on open water or maneuver ships in ports.

Vessel - Boat or ship intended for navigation on water.

ACTIVITY
Comparing Different Modes of Transportation

Introduction

Transportation of domestic cargo by barge is relatively slow, but it is efficient and cost effective for moving large amounts of goods from one place to another. A comparison of the cargo capacities of a barge, jumbo hopper rail car, and large semitrailer truck is shown below.

Objective -- Students will:

Compare cargo capacities of barges, trains, and trucks.

Materials

1. 174 small objects such as blocks, marbles, or beads that can be carried easily by students.
2. Shoe box.

Teacher Preparation

1. Display the poster "Navigation: Traveling the Water Highways" several days before conducting this activity.
2. Divide the small objects into three groups of 58 each. Place one group of 58 objects in the shoe box for easy carrying. The shoe box represents the carrying capacity of a barge. Each object represents 26 tons of coal.

Procedure

1. Place the two groups of 58 objects and the shoe box (containing 58 objects) separately at one end of a room.
2. Select three students for participation in this activity. One student will represent a barge, the second student a jumbo hopper rail car, and the third student a large semitrailer truck. These students will carry the objects from one side of the room to the other.
3. Explain to the students that the barge, rail car, and truck will carry different numbers of objects across the room, depending on how much cargo each is able to carry on one trip. The student who represents the truck will carry only one object on each trip across the room. The student who represents the rail car will carry four objects per trip across the room. The student representing the barge will carry the shoe box containing all 58 objects in one trip. Each of the three students (representing different modes of transportation) should cross the room as many times as necessary to carry all 58 objects from one end of the room to the other.

Interpretive Questions

1. How many times did the truck have to cross the room to move all 58 objects? (Answer: 58); the rail car? (Answer: 15); the barge? (Answer: 1).
2. Does the barge, rail car, or truck carry the most cargo? (Answer: barge).

Poster Series

This poster is the sixth in a series of water-resources education posters developed through the Water Resources Education Initiative. The Water Resources Education Initiative is a cooperative effort between public and private education interests. Partners in the program include the U.S. Geological Survey and the U.S. Fish and Wildlife Service of the U.S. Department of the Interior, the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers, the Nebraska Groundwater Foundation, and the National Science Teachers Association.

The other completed posters in the series are entitled "Water: The Resource That Gets Used & Used & Used for Everything!", "How Do We Treat Our Wastewater?", "Wetlands: Water, Wildlife, Plants, & People!", "Ground Water: The Hidden Resource!", and "Water Quality: Potential Sources of Pollution." The posters in the series are designed to be joined to create a wall mural. A schematic of the wall mural including the topics for the completed and planned posters is displayed on this panel. The light-shaded spaces indicate the completed posters. The dark-shaded space represents this poster.

BIODIVERSITY	**WATERSHEDS**	**ACID RAIN or HAZARDOUS MATERIAL**
WETLANDS	**WATER USE**	**WASTEWATER TREATMENT**
OCEANS or NAVIGATION	**GROUND WATER**	**WATER QUALITY**

Water-resources topics are drawn in a cartoon format by the same artist. Posters are available in color or black and white. The reverse side of the color posters contain educational activities: one version for children in grades 3–5 and the other with activities for children in grades 6–8. The black-and-white posters are intended for coloring by children in grades K–2.

ORDERING INFORMATION

Copies of the first five posters in the series (see Poster Series panel) and the Navigation poster (color for grades 3–5 and 6–8 or black and white) can be obtained at no cost from the U.S. Geological Survey. Write to the address below and specify the poster title(s) and grade level(s) desired. A limited number of color and black-and-white posters entitled "Water: The Resource That Gets Used & Used & Used for Everything!" are also available in Spanish by writing to the address below.

U.S. Geological Survey
Box 25286
Denver Federal Center
Denver, CO 80225
Telephone: (303) 236-7477

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U.S. ARMY CORPS of ENGINEERS

The U.S. Army Corps of Engineers is responsible for the operation and maintenance of the Nation's waterways to ensure efficient and safe passage of commercial and recreational vessels. The Corps' navigation projects play an integral role in the Nation's economy by providing efficient means by which commercial shippers can economically transport foreign and domestic products.

U.S. DEPARTMENT of the INTERIOR

As the Nation's principal conservation agency, the U.S. Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This responsibility includes fostering the wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under United States administration.

GRADE SCHOOL