



# Energy and Our Rivers

## Teacher Guide

### BACKGROUND

Part of understanding the energy picture in the United States is to understand how energy sources and materials are transported to the locations where they are needed. *Energy and Our Rivers* for intermediate and secondary students was developed in partnership with RiverWorks Discovery to focus on the use of America's river systems as an important means of transporting energy sources.

This guide and the activities primarily focus on building student knowledge of the role rivers play in America's energy picture. Students should have a previous introduction to coal, petroleum and petroleum products, biodiesel and ethanol. Teachers are encouraged to use NEED's energy curriculum portfolio to support students' background knowledge as needed. Teacher and Student Guides are available to download from [www.NEED.org](http://www.NEED.org).

### Activity 1: River Settlements

#### ★ OBJECTIVE

Students will understand that cities developed along rivers in the United States so that settlers would have easy access to transportation for people and goods.

#### 📄 MATERIALS (for each pair of students)

- *The U.S. at Night* picture, page 13
- *Major Rivers and Cities* map, page 14
- United States political or road maps
- *River Settlements* worksheet, page 35

#### ☑ PROCEDURE:

1. Assign students a partner to work with.
2. Explain that students will work together to complete an activity examining a picture and map of the United States. The picture is of the U.S. at night, the map shows rivers and cities. Have students complete the River Settlements Worksheet.
3. After students complete the activity, have a class discussion about why students think cities were built on rivers. They can also share their ideas about what conditions (other water sources along overland routes, railroads) brought about the establishment of a city in a particular location.

#### 📖 EXTENSION

Assign students a river city in their state or region to research for a "Then and Now" comparison. Students should find out when the city was founded, what factors led to the decision to establish a city in that particular location, who the first settlers were, where they came from, and how they got to the destination, or what transportation they used to get to their destination. Students should also research milestones in the city's development, and current information about the city including the current population, what attracts new residents and tourists to the city, and industries that support the local economy. Students' research can be presented in a variety of ways including a traditional report, visual/multimedia presentation, or timeline.

### Activity 2: Energy in Flowing Water

#### ★ OBJECTIVE

Students will understand that the upper, middle, and lower courses of a river have different energy levels which affect how the river can be used.

#### 📄 MATERIALS (for each group)

- 1 Foam pipe insulator
- 1 1.5 Gallon water container with a spout (or other water source)
- 1 Stopwatch
- ½ Small cork to serve as a boat
- 1 Protractor
- Whiteout (or white paint)
- Water
- 1 Container to catch water
- Copies of student work pages
- *Energy in Flowing Water*, page 36

#### 🔧 PREPARATION

1. Cut a one inch wide strip down length of each foam insulator so it forms a long trough.
2. Use whiteout or white paint and mark one end of each insulator "top" with a starting line for students to use as a mark to drop the cork each time.

## PROCEDURE

1. Ask students, What effects how fast water flows?
2. Inform students that they will work in groups and each person should be assigned a job that is described on the worksheet.
3. Divide students in groups of five or six.
4. Groups should collect their materials and follow the directions on the worksheet.
5. After students have completed the activity and calculations, hold a class discussion. Questions to ask the class include: In which investigation did the boat move the fastest? Which investigation had the slowest travel time? What do the different pipe set-ups represent in real life?
6. Explain that the different slopes represent three parts of a river, the upper, middle, and lower courses. As the slope of the land over which a river flows flattens out, the river's energy level lowers and the flow of the river is slower. Ask students, What type of geographic area do you think the upper course of a river is located? (mountainous, uplands) What do you think the land is like in the middle course of a river? (some smaller hills, some flatter areas) What type of geographic area do you think the lower course is located on? (flat areas, lower elevations)
7. Give students topographic maps, or have them use online topographic maps, to look at the topography over the course of a river. Have students examine the topography of a local river. Students should indicate where they think the river flow changes between the upper, middle, and lower courses.

## Activity 3: Build the Best Barge

### OBJECTIVE

Students will design, build, test, and evaluate barges to achieve the highest possible load carrying capacity and efficiency.

### MATERIALS

#### **Construction Supplies for the Class:**

- Tape
- Aluminum foil
- Staples
- Construction paper
- Straws
- Popsicle sticks

- Copies of *Build a Barge Challenge*, pages 37-38

- Multiple pieces of the following to serve the barge body:
  - Foam board
  - Cardboard
  - Poster board
  - Corrugated plastic in 24" x 6" pieces

#### **Testing stations:**

- Large tub
- Water
- Balance/scale

**Note:** You may need to alter the size of the barge depending on the space you have for testing the barges.

### PROCEDURE

1. Challenge the students to build a barge that is 3.1" wide, 15" long and 1.5" deep. Their task is to design a barge that will carry the greatest capacity, while staying within a \$10.00 budget. For every 100 tons the barge carries, teams will be paid \$2.00. If the barge sinks, teams will receive no money. Money earned can go toward making improvements or expanding the fleet.
2. Students plan their design and build their barges. They need to track their expenses on their budget sheet and stay within budget. Students may test their design, but will not be paid for test cargo. They will only be paid for cargo carried in the final test.
3. After initial tests, students may modify their design if they have enough money. Students should use the *Build a Barge Challenge* worksheets to work through their planning, design, and construction.
4. Once teams are satisfied with their design, the official testing of the barge can occur. At this time, teams will be paid for successfully carrying cargo.
5. Students reflect on their design and the related outcome. What made their design successful or unsuccessful? What would they change in the future? Students should also make a business plan for expanding their fleet.

## NOTE

Map locations are approximate. Sources for the maps include the Energy Information Association, U.S. Army Corps of Engineers, and the Bureau of Land Management.

## Activity 4: Examining Locations of Energy Resources

### OBJECTIVE

Students will identify where energy resources are located and begin to understand how geography impacts transportation options.

### MATERIALS

- Examining *Locations of Energy Resources*, page 39
- Each group will receive a packet consisting of the following:

GROUP	RESOURCE MAPS (on white paper)	PLANTS (transparencies)	ALL GROUPS RECEIVE (transparencies)
1	<i>The Corn Belt</i> , page 18	<i>Ethanol Plants</i> , page 19	<i>Inland Waterway Systems</i> , page 15 <i>Major Railways</i> , page 16 <i>Major Interstates</i> , page 17
2	<i>Oil and Gas Fields</i> , page 20	<i>Oil Refineries</i> , page 21	
3	<i>Coal Mines</i> , page 22	<i>Coal Power Plants</i> , page 23	

### PREPARATION

- Determine how many of each map you will need. Copy resource maps onto white paper and all other maps onto transparencies.
- Make copies of the *Examining Locations of Energy Resources* worksheet for each student.

### PROCEDURE

1. Divide students into six groups (each resource will be analyzed by two groups). Give each student a copy of the *Examining Locations of Energy Resources* (page 39), and each group their packet of maps. Beginning with the resource maps (*Coal Mines*, *The Corn Belt*, or *Oil and Gas Fields*), have students note any general observations about where their resource is located. Is it spread evenly throughout the country, or is it concentrated in a certain area? Why might this be?
2. Instruct students to take out the second map, either *Coal Power Plants*, *Ethanol Plants*, or *Oil Refineries*, and place the transparency over their resource map.
3. Students should compare the resource location to the location of the plants or refineries where the resource is needed. How close is the resource to the plant/refinery? How easy would it be to get the resource to where it is needed? How might the resource be transported?
4. Next, students layer the *Major Routes of the Inland Waterway System* map on top of the others. Note: it may be helpful to tape the maps in place.
5. Students compare the locations of the resources and plants/refineries to the major rivers. Is the resource and/or plant/refinery located close to one of these major rivers? Do you think transporting the resource by barge would be an option? Why or why not?
6. Students repeat steps 4 and 6 to compare their resource and plants/refineries to the Major Railways and Major Interstates.

**Optional:** Allow students to use additional resources online or in atlases to analyze other geographic features of the region(s) where their resource is located. Students can analyze elevations, climate, soil types. Students should determine which features seem to be most important to their resource.

## Activity 5: Analyzing Transportation Options

### ★ OBJECTIVE

Students will analyze the differences between transporting coal by truck, train, and barge, by comparing modes of transportation and transportation routes.

### 📄 MATERIALS

- Copy of *Analyzing Transportation Options*, pages 40-41
- Internet access

### ☑ PROCEDURE

1. Divide students into small groups.
2. Assign each group a coal power plant and a coal mine pair from the table below.

COAL MINE LOCATION	COAL POWER PLANT LOCATION
Decker, MT	Centralia, WA
Wright, WY	Pensacola, FL
Wright, WY	Cassville, WI
Galatia, IL	New Florence, PA
Knottsville, KY	Stocks County, NC
Mousie, KY	Ghent, KY
Dallas, WV	St. Clair, MI
Friedens, PA	Muleshoe, TX

3. Students use a variety of resources to analyze different transportation options and estimate costs.

**Optional:** Have students research transportation options for other resources or materials.

## Activity 6: Op-ed

### ★ OBJECTIVE

Students will use knowledge gained in this unit to write an op-ed article about improving locks and dams on the rivers.

### 📄 MATERIALS

- Samples of op-ed pieces that you or your students have collected and brought in.

### ☑ PROCEDURE

1. Share with students that people write op-ed articles to share their opinion on a topic and perhaps try to change the opinions of the people reading their article.
2. Students read samples of op-ed articles. Discuss common features, such as the opening sentence as a hook, what opinion the author presented, how persuasive the author was, the evidence used to support the author's opinion, and how the author closed the article.
3. Assign students the task of writing their own op-ed article about why or why not the locks and dams on the inland waterway system should be improved.
4. Remind students to use evidence to support their opinion. Op-ed articles are not very lengthy so students should focus their message. A suggested length is 500-700 words.

### 📖 MATH EXTENSION

In *Energy Transportation Math*, page 42, students solve word problems related to transporting energy sources and products.

### ENERGY TRANSPORTATION MATH ANSWER KEY

1. 1,155,000 gallons
2. 480 gallons
3. 64,166.7 galls
4. 133.7 cars
5. 39 tanker cars
6. \$480,750.00
7. A little over two hours