

To Dredge or Not to Dredge?

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Grades: 7 & 8

Subjects: Science, Math and Language Arts

Time Frame: 2 class periods

Lesson Overview: Students will perform an activity/lab to find out what happens to ships and the amount of cargo they can carry as lake levels change. They will calculate the loss of cargo the ships can carry and the related financial loss. Students will be introduced to a typical controversy around dredging v. shipping centered in Green Bay, WI. Students will investigate the environmental concerns, costs and benefits of dredging, express their opinion in a persuasive essay.

Objectives

Students will be able to:

1. Investigate the economic costs of low lake levels and shallow harbors to the shipping industry.
2. Identify ways to improve low lake levels
3. Describe advantages and disadvantages to dredging
4. Express their opinion on dredging in a persuasive essay.

Wisconsin State Science Standards, grade 8:

- A.8.6 Use models and explanations to predict actions and events in the natural world.
- C.8.1 Identify questions they can investigate using resources and equipment they have available.
- C.8.2 Identify data and locate sources of information including their own records to answer the questions being investigated
- C.8.5 Use accepted scientific knowledge, models, and theories to explain their results and to raise further questions about their investigation
- C.8.6 State what they have learned from investigations relating their inferences to scientific knowledge and to data they have collected
- F.8.10 Project how current trends in human resource use and population growth will influence the natural environment, and show how current policies affect those trends.
- G.8.3 Illustrate the impact that science and technology have had both good and bad on careers systems, society, environment and quality of life
- G.8.5 Investigate a local problem to which there has been a scientific or technological solution including proposals for alternative courses of action, the choices that were made, reasons for the choices, any new problems created and subsequent community satisfaction

Background Information:

For more than 150 years, dredging for navigation purposes has taken place in the Great Lakes. The role of dredging in the Great Lakes involves the removal of accumulated bottom sediments from waterways to provide sufficient depth for vessel passage into and out of ports. It can also be done to deepen a channel for various water uses, such as waterfront construction, environmental remediation and placement of utilities. There are concerns over the environmental effects of dredging and disposal of the material that has been removed. There has been a decline in locations to safely dispose of the dredged material. This is especially true for the mouth of the Fox River in Green Bay that empties into the Bay of Green Bay or Lake Michigan. The sediments on the bottom of the Fox River and Bay have been found to contain high amounts of PCBs due to past discharges from the paper mills located on the Fox River. This is contrasted with the essential role that dredging plays in maintaining safe maritime transportation and commerce which support local businesses in the port city of Green Bay. As water levels in the Great Lakes continue to decline, requests for federal dollars to support dredging in the port of Green Bay are increasing and public interest in this dilemma is growing

Materials:

- Copies of newspaper articles from the Green Bay Press Gazette (search “dredging Green Bay” to find articles on both sides of the dredging issue)
- Empty 35mm Film Canisters (or? These are getting hard to find!)
- Popcorn – puffed or kernels?
- Plastic containers (~28 oz capacity)
- Water source
- Map of U.S. and Canadian Great Lakes Ports by Lake Carriers’ Association
- Great Lakes Dredging Crisis, Great Lakes Maritime Task Force
- Dredging and the Great Lakes by the Great Lakes Commission and Great Lakes Dredging Team

PROCEDURE

(NOTE: this lesson can be adapted to other port cities in the Great Lakes...many have similar dredging controversies.)

Introduction: Begin the lesson with a class discussion on what they know about their local Great Lake Port City, Green Bay. Ask the following questions to find out if students are familiar with maritime transportation in Green Bay.

1. How many ships come and go from the port of Green Bay each year?
2. List 5 products that are carried by the ships that enter and exit the port of Green Bay.
3. How much cargo, in tonnage, is moved through the port of Green Bay each year?
4. How much land space does the port of Green Bay take up?
5. Where is the cargo coming from and how is it used in Green Bay?
6. Where is cargo from Green Bay shipped to? What is it used for?

To help students with these answers, have them read a copy of the article from the Green Bay Press Gazette, “Green Bay port officials aim for education, August 26, 2007 (Appendix A) which will provide the answers and give them a brief introduction to our local maritime transportation. Or have students visit the Port of Green Bay website <http://www.portofgreenbay.com/>

Activity: Ask students what they know or have heard about declining lake levels. The investigation will help students understand the effect of low lake levels on maritime transportation.

Question: What effect does lower lake levels have on our port city and commerce?

1. Divide students into groups of 4.
2. Have each group gather the following materials: popcorn seeds, plastic container, and film canister.
3. Have students fill container with 500 ml of water
4. Fill canister with popcorn seeds counting the total amount put into the canister. Record the number (app. 450)
5. Place canister into the 500 ml of water and determine if it floats or sinks.
6. Construct a data chart to record if your canister floats as students decrease the water level by increments of 10 ml.
7. Continue drawing off 10 ml of water till it is determined the canister does not float.
8. Have students draw a diagram in their science notebooks of what they have just modeled. Label their model: water= lake level, container=the lake, canister=vessel, popcorn=cargo

Question: What could you do to make your ship float again without changing the water level? (Decrease the cargo load)

1. Have students decrease their cargo load by removing 2-5 popcorn seeds at a time checking time whether their ship still sinks or begins to float. Students should create a data table to record their ship activity as they decrease the popcorn seed numbers.
2. When students have found the number of seeds that their ship can carry at this water level ask them to find %loss of cargo

Question: What percent did you need to decrease your cargo in order for your ship to float? Apply what you have just modeled to the real world by learning about the shipping industry and how they must decrease their cargo to enter and exit certain ports.

1. Using the provided pamphlet called, "Map of the U.S. and Canadian Great Lake Ports", (Appendix B) choose a cargo to move. Find a port that the ship will leave and then choose a port it will deliver the cargo to.
2. Using the other provided pamphlet called, "Great Lakes Dredging Crisis", (Appendix C) calculate their loss of cargo carrying capacity from their ports you have chosen.
3. Answer the following questions.
 - What was your loss of tonnage in the cargo you decided to transport?
 - Describe an important way water levels affect the City of Green Bay commerce. Use the Great Lakes Dredging Crisis" information and find out how low our deep draft port and waterway is.
 - List three causes of water level changes in the Great Lakes.

Activity 2: After reviewing answers to the questions from activity 1, ask students which would be the easiest way to increase lake levels. Dredging? Any other way?

1. Read the article from the Green Bay Press Gazette, from July 21, 2007, "Area needs more funds for dredging, port officials say". (Appendix D)
2. List advantages of dredging for the port of Green Bay
3. What are possible disadvantages?
4. Distribute the booklet Dredging and the Great Lakes, produced by the Great Lakes Commission and Great Lakes Dredging Team, 1999. Use this information to list the advantages and disadvantages of dredging

Assessment

Students will choose a position that is based on their investigations and research and write a 5 paragraph persuasive essay. The essay will require an introductory paragraph describing the controversy, 3 paragraphs explaining one's position on the issue, and a concluding paragraph. See rubrics for scoring essay in the appendix of this lesson. (Appendix E)

Required Vocabulary:

- Cargo
- Dredging
- Ballast
- Vessel
- Draft
- Remediation
- Harbor, port
- Contaminated Sediments

Assessment:

Below is a list of various methods student achievement can be measured. These measurements can be as student progress, student processing and final student product.

- Ability to discuss material in class
- Class participation
- Science Notebook, data charts, taking good measurements
- Illustration of their model in their science notebook
- Math calculations
- Answers to review questions at end of activity 1
- Answers to questions using newspaper article
- Final assessment: student persuasive essay

Extensions:

- Have students research what products could be brought in and out of the port of Green Bay if dredging is done
- Have students research the cost and ability to get dredging done. Who pays for the dredging and is it cost-effective?
- Research other ways lake levels are controlled, local lock system

References

Case Studies Series. Great Lakes Dredging Team "Beneficial Use of Dredged Material in Brown County of Wisconsin." Last updated, June 27, 2003
<<http://www.glc.org/dredging/case/brown>

Great Lakes Commission and Great Lakes Dredging Team. Dredging and the Lakes. Duluth, MN. 1999 www.glc.org/dredging/dredgingBooklet.pdf

Great Lakes Maritime Task Force. Great Lakes Dredging Crisis. Toledo, Ohio April 2006.

Great Lakes News. www.great-lakes.net/news/inthenews.html

Lake Carriers Association. Map of U.S. and Canadian Great Lake Ports. Cleveland, Ohio. April. 2006 www.lcaships.com

Phelps, Nathan. "Area Needs more Funds for Dredging." Green Bay Press Gazette 21 July. 2007. Could no longer access online. I did find a press release.

Phelps, Nathan. "Green Bay Port Officials Aim for Education." Green Bay Press Gazette. 1 Sept. 2007.

Port of Green Bay, Brown County, WI <http://www.portofgreenbay.com/>

This website has "tons" of info about shipping at the port of Green Bay, including number of ships arriving, economic and environmental benefits of shipping, photos, etc. This would be a great website for your students to explore!

Green Bay port officials aim for education

3-mile stretch of river has \$88 million impact on local economy

By [Nathan Phelps](#)
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1 Sept. 2007

A pair of workers standing near the end of the dock along the Fox River watched the Great Lakes freighter Arthur M. Anderson begin its journey out of the Port of Green Bay Tuesday afternoon.

The Anderson is one of more than 200 ships that come and go from the port on an annual basis, and since early spring port officials and terminal operators have been working to educate the public about just where — and what — the port is.

During a tall ship festival hosted in downtown Green Bay last summer, Port of Green Bay Director Dean Haen said they surveyed 2,000 people from the immediate area and the region.

"Nobody knew where the port of Green Bay was ... and they think the port is a place you drive up to, that it's a building," he said. "But it's these three miles of river made up of these 14 businesses doing commerce."

The port runs from the mouth of the Fox River to the Georgia Pacific Broadway mill just south of the trestle bridge between Green Bay and Allouez.

Among the key goods moving through the port are coal, limestone, cement, salt and fuel oil.

"We want to start identifying where we are, who we are and what we do," Haen said. "We have an international port here and have an advantage over almost all of the cities in Wisconsin — other than Milwaukee and Superior."

Last year, 213 ships used the port, which handled 2.5 million metric tons of cargo, the third consecutive year of increases in that area. Looking back, the port handled about 3 million tons in 1970, 1.9 million tons in 1981 and 1.8 million tons in 1999, according to numbers from the port.

Haen said the port has an \$88 million impact on the local economy and directly supports 726 jobs.

Late last spring, the port began the new initiative telling its story to the public through a new Web site and billboards that went up around the area and is scheduled to run for three years with the 14 port terminal operators covering costs.

One of those businesses using the port is Great Lakes Calcium, run by Wes Garner, a fifth-generation family member. The firm employs 25 people processing calcium carbonate primarily for bulk sales around the state and region.

"It costs us as much to bring it in 400 miles on a ship from the quarry to Green Bay as it would cost us to put in a truck and ship it from Green Bay to De Pere," Garner said.

Calcium carbonate can be found in a number of agricultural uses, adhesives, coatings, glass, building supplies and environmental applications such as power plants, where it can be used to remove sulfur from the air stream, Garner said.

Great Lakes Calcium brings in about 15 shiploads — with a total of about 300,000 tons a year of calcium carbonate — from three quarries in Michigan and dry, crush, screen and sell the most of the product in bulk. About 5 percent of what they process is sold in retail locations for agricultural (under Hurlbut name) and other lawn and garden uses.

"We're able to be strong in a number of different markets that are completely unrelated to one another," Garner said. "You're going to find that most products that come through the port are distributed within 150 miles of Green Bay,"

He estimates they do about \$10 million of business a year.

Garner said he's not sure people are fully aware of the port and the businesses tied to it.

"Every time I have somebody come out to visit, they say, 'I never knew you were here,'" he said. "At the same time, anytime you watch a ship go down the channel, there are cars pulled over on the side of the road and they're watching. So there is some visibility of the port, but I don't think they realize what actually goes on."

Garner said in recent years, they have faced increased security costs after 9/11 and are also faced with lower water levels and increased demand for vessels on the Great Lakes, which pushed up their shipping rates.

In terms of Great Lakes port, Haen said, Green Bay is a "middle-tier" port, with Duluth /Superior at the top of the food chain with about 42.9 million tons of goods passing through there last year.

Haen said they are continually working on deals to bring additional business to the port. One potential area for that growth may be in the wind turbine sector, which requires open areas to move blades and components off ships and the port's location is idea for movement of parts to places in the Upper Midwest.

"We need to be out there actively selling Green Bay," he said. "It could even be as far as rolling the steel here and making the towers... but those are big issues that take state support and city support."

Rubric for Persuasive Essay

Persuasive Speech/Essay Content Rubric

Introduction	Body	Conclusion
<p>4 Advanced</p> <ul style="list-style-type: none"> ◆ Gains attention of audience in a unique /exceptional manner ◆ Clearly states position on issue in a thesis statement ◆ Provides an overview of three well-developed and documented arguments to support position 	<p>4 Advanced</p> <ul style="list-style-type: none"> ◆ Presents three well researched and documented arguments ◆ Arguments are organized in an effective manner which enhance the topic/position ◆ Opposing arguments are refuted in a thought-provoking manner 	<p>4 Advanced</p> <ul style="list-style-type: none"> ◆ Unique and memorable restatement of position on issue ◆ Presents a thorough and moving summary of main arguments ◆ Final statement leads audience to rethink position/ and or take action
<p>3 Proficient</p> <ul style="list-style-type: none"> ◆ Gains attention of audience in an interesting manner ◆ States position on issues in a thesis statement ◆ Provides an overview of three logical arguments to support position 	<p>3 Proficient</p> <ul style="list-style-type: none"> ◆ Presents three arguments to support position ◆ Arguments are organized in a manner which support the topic/position ◆ Opposing arguments are refuted as necessary to support position 	<p>3 Proficient</p> <ul style="list-style-type: none"> ◆ Clearly restates position on issue ◆ Presents a thorough summary of main arguments ◆ Final statement links to introductory lead
<p>2 Basic</p> <ul style="list-style-type: none"> ◆ Attempts to gain attention of audience through a lead statement which may be ties to the thesis statement ◆ Statement of position is not well developed in a thesis statement ◆ Provides an overview of less than three arguments to support position/or fails to adequately develop arguments 	<p>2 Basic</p> <ul style="list-style-type: none"> ◆ Presents some arguments to support position ◆ Organizational plan is not well thought out to support position ◆ Opposing arguments are weakly refuted, if at all 	<p>2 Basic</p> <ul style="list-style-type: none"> ◆ Restates position on issue ◆ Summarizes some of main arguments ◆ Weak final statement does not convince audience
<p>1 Minimal</p> <ul style="list-style-type: none"> ◆ Lacks a lead ◆ Lacks a clear statement of position in a thesis statement ◆ Fails to provide an overview of arguments to support position 	<p>1 Minimal</p> <ul style="list-style-type: none"> ◆ Presents poorly developed arguments to support position ◆ Lacks an organizational plan to support position ◆ Fails to present or refute opposing viewpoint 	<p>1 Minimal</p> <ul style="list-style-type: none"> ◆ Restatement of position on issue is unclear or lacking ◆ Main arguments are not summarized ◆ Final statement is unclear or lacking
<ul style="list-style-type: none"> ✓ Attention ✓ Position ✓ Overview 	<ul style="list-style-type: none"> ✓ Arguments ✓ Organization ✓ Refutes Opposing Ideas 	<ul style="list-style-type: none"> ✓ Restatement of Position ✓ Summary of Main Points ✓ Final Statement