

To Dredge or Not to Dredge

I. Objectives: Students will use the local environment of the Savannah River and it's deepening to learn about density, buoyancy, Archimedes Principle, sonar, dissolved oxygen and respiration.

II. Materials:

*Video Clips--*A Window into the World of Dredge Alaska*...3:30 min (https://youtu.be/HU3zJQ4eq_Y), *New CGI of How Titanic Sank*...2:41 min (<https://youtu.be/FSGeskFzE0s>), *Dissolving O2 in Wastewater*...1:31 min (<https://youtu.be/6thCFEWWsrw>), (<https://youtu.be/6thCFEWWsrw>), *Recipe for Conservation*...:57 min (<https://youtu.be/Ggj1QluEf6A>), *Raising the Big Guns*...3:42 min (https://youtu.be/M7oxor_XGVs), *The Boy Who Could See Without Eyes*-- (show 3 min from 9:14 – 12:11) https://youtu.be/TB_yrWppP0c, *Submarine Sonar Sound* (<https://youtu.be/dL-jrqN2iRw>)

*Photos—map of the Savannah River and dredging area, large cargo ship, side scan and multi-beam sonar of CSS Ga site, CSS Georgia ship, types of dredge ships, core sample, dissolved oxygen injection system, tugboat, etc.

III. 8th Grade Standards:

GPS—S8P1-students will examine the scientific view of nature d. distinguish between the physical and chemical properties of matter as physical (i.e. density, melting point, boiling point) or chemical (i.e. reactivity, combustibility). f. recognize that there are more than 100 elements and some have similar properties as shown on the Periodic Table of Elements. S8P4—Students will explore the wave nature of sound and electromagnetic radiation. d. Describe how the behavior of waves is affected by medium (such as air, water, solids).

Core Knowledge—Physics A—motion (velocity, speed) C—density and buoyancy (buoyant force, Archimedes experiment, predict if an object will float or sink) Sound Waves—General properties (speed, interference) Chemistry of Food and Respiration—Energy in animals (respiration)

IV. Procedure

A. The Savannah River—Show map of Savannah River and review location in Georgia

1. Brainstorming the Problem

**What are the uses of the River?* Answers include: fishing, transportation, drinking water, wildlife, industry, tourism, cargo ships, etc. Discuss the influence of tides.

*Give students the scenario of a large cargo ship traveling down the Savannah River. The river is currently 42 feet deep at low tide, but the hull (bottom) of the incoming ship fully loaded with cargo reaches down 43 feet below the water level. (Show the location of the Savannah River ports and discuss their economic importance. Show and discuss the size of the cargo ships utilizing the River and discuss TEU's of cargo.)

**How will it be able to travel down the river to deliver its goods?* Possible answers: The ship will wait until high tide when the river will be deeper. The ship is unable to, so will go to another Port. The Savannah River is deepened to allow ships of this size to transverse it.

2. Testing Buoyancy

* *Why do ships float?* Review buoyancy and Archimedes Principle. (Optional activity—give students a variety of items and have them predict and then test to see if they will float or not.)

* *Activity*—Each group will have one 35 mm film canister, popcorn seeds, a plastic container, water, and a measuring cup or graduated cylinder. Fill the plastic container with 500ml of water and count/ fill the canister with popcorn seeds (approximately 500). Place the canister into the container of water and determine if it floats or sinks. *Why does this happen?*

-Students will construct a data chart to record if the canister floats as they decrease the water level by increments of 10ml. Continue drawing off 10 ml of water until it is determined the canister does not float. Students should also draw a model of the experiment labeling water = river level, container = river, canister = cargo ship and popcorn = cargo.

* *Question: What could you do to make your ship float again without changing the water level?*

Decrease the cargo load...students should decrease the load by removing 2-5 popcorn seeds at a time checking whether their ship still sinks or begins to float. They should also create another data table to record this. Determine the % loss of cargo.

B. Dredging the River

1. Finding a Solution

* *If the Savannah River is deepened to the proposed 47 feet how will they accomplish this?* Dredge the river to remove the extra sediment.

* *What is dredging?* Discuss dredging with the students and the two types: mechanical (ex: bucket, scallop, grab and backhoe or dipper) and hydraulic (ex: cotton suction, plain suction, and trailing suction). Show the video for the dredge Alaska. (see Appendix for background information)

Which would be used for deepening the Savannah River? Why? hydraulic due to depth and need to remove bottom material that is tightly packed.

* *Is this a one-time process? Why or Why Not?* No, to maintain the necessary depth of the river new sediment washed in from upriver and the river banks must periodically be removed.

2. Potential Problems—*What are some concerns regarding the Savannah Harbor Deepening Project?*

Possible answers:

* *What types of sediment is there and what is the best way to remove it? Where will it be put after removal?* (Show photo of core sample and discuss particle sizes, etc.—See extensions below)

* *Are there any objects buried underneath the sediment and how will they be removed?* (Show photo of CSS Georgia sketch and sonar scans.

* *Explain how sonar works. Complete the included worksheet on mapping the ocean floor to calculate speed and determine the shape of the ocean floor.*

* *Discuss conservation efforts and danger of removing explosives. Show videos demonstrating some of removal process and actual artifacts recovered and Titanic video to demonstrate how the site is used to determine how the ship sank.*

* *What effect will this have on the wildlife?* (Discuss concerns regarding changes in salinity and dissolved oxygen, where to put the dredge material, potential death/ injury during the process, etc.)

3. Optional: Dissolved Oxygen

* *show the video clip for the dissolved oxygen injection system that will be utilized in the SHEP project. Using dissolved oxygen kits, obtain a water sample and using the Winkler method, determine the value of dissolved O₂.*

V. **Extensions**

- A. Conduct a *simulated town hall meeting*. Students will pick or be assigned various participants (i.e. Ports Authority, City Manager and/or Budget Director, Mayor, community members, local fishermen, environmentalist, etc.) and let them research and discuss the opposing sides of the issue to determine if dredging the River will be the solution, is there a compromise and how to proceed with their decision.
- B. Perform *economic calculations* to show the current value of the Ports to the community, increase in shipping traffic and amount of cargo, the cost of the dredging operations, and the historical changes and uses that have occurred along the River. Basic River data over time, such as the volume of water, number/distribution of plant/animal species and changes in sediment type/ buildup can also be researched and explored.
- C. Create and analyze a *core sample*. Collect various samples of sediment material (i.e. dark sand, light sand, soil, small gravel, etc.). Place one cm of one of the materials into a plastic cup and mist with a spray bottle of water until damp, but not soaking. Add a second material 1 cm deep on top of the first and mist with water. Continue adding layers until 4-5cm deep. Use a clear plastic straw to extract a core sample by pushing the straw straight down through the layers of the cup. (If you hit rock, consider how a drill bit is possibly damaged or no longer able to drill when it reaches this layer.) Place your finger tightly over the end of the straw and withdraw it from the cup and observe the layers.
- D. Incorporate additional *historical information* on the Civil War in Savannah, including why and how the *CSS Georgia* was built, how it was used, why it was scuttled and why/how it will be conserved.
- E. Students can *write a newspaper editorial or persuasive essay* expressing their opinion on the environmental concerns, costs and benefits of dredging.
- F. Participate in the *Georgia Adopt-a-Stream program* to conduct monthly chemical monitoring on a nearby waterway. This includes determining the pH, salinity, temperature, dissolved oxygen, visibility and overall health of the environment.
- G. Utilize the following *lesson plans* from the Museum of Underwater Archeology website: *How Can You Find a Shipwreck in Murky Brown Water, From Corrosion to Conservation* and *The Worm That Eats Ships*.

VI. **Resources:**

Websites—Museum of Underwater Archaeology (MUA) (www.themua.org/CSSGeorgia), CSS Georgia (<http://1.usa.gov/1G6S2Hn>), SHEP (<http://1.usa.gov/1fhPEb3>), Georgia Adopt-a-Stream (www.georgiaadoptastream.com), dissolved oxygen information (www.eco2tech.com), New Georgia Encyclopedia (www.georgiaencyclopedia.org), Georgia Ports Authority (www.gaports.com), types of container ships (<http://www.globalsecurity.org/military/systems/ship/container-types.htm>), National Oceanic and Atmospheric Association (www.oceanexplorer.noaa.gov), Sea World education (www.seaworld.org),