

Developed by Participants in the 2007 [Great Lakes Maritime Transportation Summer Teacher Institute](#) sponsored by the Great Lakes Maritime Research Institute (www.glmri.org)

Balance and Ballast Water

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Topic: How The Great Lakes Maritime Industry can teach about differentiation of objects, properties of matter and motion of objects.

Target Grade - Secondary Special Education Science Class.

Lesson Overview - The shipping industry uses ballast water to keep the boats buoyant and balanced depending of the cargo the boat is carrying. By exploring how boats remain balanced and floats student will achieve an understanding of the characteristics of the states of solids and liquids, and buoyancy.

Objectives – At the end of the lesson the students will be able to:

- 1) Explain why ships made of solid metal can float on liquid water,
- 2) know that Archimedes Principle explains this,
- 3) apply why this is useful knowledge (Shipping industry, or personal reasons such as a fishing boat).

State/National Standards Addressed -

Extended Grade Level Content Expectations and Benchmarks - Science

Strand: Using Physical Science Knowledge (P)

Standard: Matter and Energy (ME)

P.ME.P.EB.IV.1.m.2ADDh

Differentiate between common objects according to weight, length, or temperature.

Key concepts: Useful properties—waterproof, lightweight, temperature, lengths, size.

Real-world contexts: Raincoat, rubber boots, flotation device, heading pad, cooking and food preparation (pan is hot), indicating texture/temperature preference.

P.ME.FI.EB.IV.1.m.4ADDh

Describe the arrangement and motion of molecules in solids, liquids, and gases.

Key concepts: Arrangement—regular pattern, random. Distance between molecules—closely packed, separated. Molecular motion—vibrating, bumping together, moving freely.

Real-world contexts: Common solids vs. liquids, such as in cooking—boiling water, freezing materials; expansions—roads, bridges.

Extended Grade Level Content Expectations and Benchmarks - English Language Arts

Strand 1: Writing, Speaking, and Expressing

EHSCE.SI.1.1.4a

Write or scribe a complete sentence to express ideas (e.g., describe an event or object).

Michigan Curriculum Frameworks

Science

Strand IV: Using Physical Science

Standard 3: Motion of Objects

IV.3

Explain how forces are needed to speed up, slow down, stop or change

direction of a moving object.
Key Concept: Buoyancy

List of Needed Materials – Text book; pencils; paper; clear plastic contained filled with water; piece of wood, metal, rock; sculpting clay, and marbles.

Room Arrangement – The room is arranged in “Horse Shoe,” So all seats look up to the front o the room. There two tables in the front that can be used to hold supplies and to show demonstrations.

New Vocabulary –

Buoyant force/Buoyancy: The ability of liquid or gas to push up on an object that is in the liquid or gas.

Ballast: Any heavy material carried temporarily or permanently in a vessel to provide desired draft and stability.

Ballast water: Water used to balance a ship.

Displacement: When water goes higher when something is placed in it.

Archimedes Principle: The law that a body immersed in a fluid is buoyed up by a force (buoyant force) equal to the weight of the fluid displaced by the body.

Cargo: What the ship is carrying.

Background Information – The Glencoe Physical Science textbook, pages 224-227, 234-235 supported information on this topic. Information was also obtained from Simple Machines, Matter, and Motion student workbooks pages 3 -15. Information about ballast water and Great Lakes shipping was gained from the presentation *Exotics and Ballast Water* by Dale Bergeron and Doug Jensen through the Minnesota Sea Grant on July 30, 2007.

Pre-Assessments – Ask questions about which of the following materials: piece of wood, metal, or rock will float in water. Have class come up with answers why. Review concept of density.

Focus Questions – Why do some object float? Why do some objects sink? How can things made out of metal float? What is balance? How does balance effect a floating object?

Attention Getter – The educator will drop each of the following object into the water. The students will have to guess which objects will float and which ones will not.

Describe Classroom Activity – After the attention getter the teacher will have a pair of student try to sculpt a rough boat shape from the sinking clay lump that will float. After the boat floats, the class will load the boat with marbles on one side. After the boat sinks, the student will balance the boat with water (The educator will assist in forming two simple compartments in the clay boat).

Assessment – The class will complete a lab report after finishing the activity. The next class period, after a short review, the class will take a short quiz on the previous day’s activity.

Extensions/Enhancements – A way to enhance this lesson would be to see some sort of shipping or large boat actually on the water. Students could bring in pictures from a cruise vacation to show the class the ship. The photographs from the Great Lakes Maritime Transportation Summer Institute can also be used to illustrate the immense size of these vessels that float on the water.

Resources -

Bergeron, D & Jensen, D (2007). *Exotics and Ballast Water* (presentation). Minnesota Sea Grant.

Gattlieb, J (1996). *Matter, Motion , and Machines* . Texas: Steck-Vaughn.

McLaughlin, C & Thompson, M (1997). *Physical Science*. Ohio: Glencoe/McGraw-Hill.

Name: _____

Date: _____

Block: _____

BOUYANCY AND BOATS LAB

Materials:

Clear plastic contained

Piece of wood

Metal

Rock

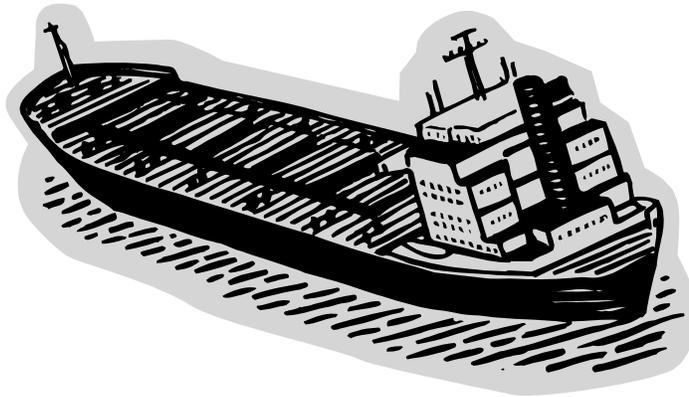
Sculpting clay

Marbles.

Metal bowl

Directions:

Experiment to see which of the above materials will float. Sculpt a boat shape out of clay that will float in water. Load your boat with marbles. Use the idea of ballast water to balance boat.



Questions:

1. What materials

floated? _____

2. How did you get clay to float? _____

3. What property of water let the objects float? _____

4. What is the scientific law that explains this? _____

Name: _____

Date: _____

Block: _____

Properties of Liquid Quiz

Multiple Choice:

1. A state of matter that has buoyancy is?
A. Solid B. Plasma c. Liquid
2. Things that are less dense than water will easily_____.
A. Float B. Dissolve C. Sink
3. When water moves when stuff is in it it is called this.
A. Movement B. Splash C. Displacement
4. When the shape of a metal is hollow and able to displace a lot of water it will_____.
A. Still sink B. Float C. Turn upside-down
5. The reason ships float is called this.
A. Newton's Rule B. Archimedes Principle c. Socrates Oath

Short Answer:

In a complete sentence, write how you made the clay float in the boat lab, and why it worked. What was your cargo and ballast?

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Ballast water is seawater used as ballast to balance a ship, and is pumped in or out to add or reduce weight for stability. The problem is that this seawater is picked up in one port, and discharged in another. This introduction of invasive species new to a region are establishing a large presence and wreaking havoc on the ecosystem in a multitude of ways, causing insurmountable damages. All ships whether cruise, cargo or tankers must comply by September 8, 2017, according to stipulations of the original Ballast Water Treatment Convention which stated that regulations would enter into full for Introduced Native Ballast water treatment systems 5. The rules for compliance. Invasive marine species carried in the ballast water of ships pose significant risks to the environment, the economy and human health. To reduce the spread of invasive organisms and pathogens, a number of international, national and regional authorities have enacted regulations for the management of ballast water on vessels travelling between different ports.Â Regulations B-4 and D-1 : Ballast Water Exchange and Ballast Water Exchange Standard Effective as a voluntary measure in certain regions since 2009, Regulations B-4 and D-1 establish a standard for ballast water exchange to minimize the spread of invasive species. The ballast water is a key element in keeping the shipâ€™s stability and seaworthiness. The Ballast waterfunction is most important in cargo loading.Â in shallow water areas, raising the vesselâ€™s bow for sailing in storms, trimming the stern to balance the fuel consumption enroute , lowering the air draft of vessel in certain operations, and minimizing hull tensions. In terms of biosecurity, the ballast water in maritime transport can act as. Many modern ships now equipped with ballast water treatment system to filter and treat ballast water as per IMO regulations. Learn about the different ballast water treatment technologies.Â A typical ballast water treatment system on board ships use two or more technologies together to ensure that the treated ballast water is of IMO standards. Physical Separation/ Filtration Systems Ballast Water Treatments. Physical separation or filtrations systems are used to separate marine organisms and suspended solid materials from the ballast water using sedimentation or surface filtration systems. The suspended/filtered solids and waste (backwashing) water from the filtration process is either discharged in the area from where the ballast is taken or further treated on board ships before Ballast water is pumped in to maintain safe operating conditions throughout a voyage. This practice reduces stress on the hull, provides transverse stability, improves propulsion and manoeuvrability, and compensates for weight changes in various cargo load levels and due to fuel and water consumption. While ballast water is essential for safe and efficient modern shipping operations, it may pose serious ecological, economic and health problems due to the multitude of marine species carried in shipsâ€™ ballast water. These include bacteria, microbes, small invertebrates, eggs, cysts and larvae of

Ballast water reduces stresses on the vessel's hull, balances off for the weight loss due to consumption of water and fuel, provides better manoeuvrability with sufficient vessel draft, including ship propeller immersion, and also helps in improving living conditions of the crew aboard by reducing vibrations and uncontrolled vessel's movements. Why is Ballast Water in Discussion? While ballast water remains indispensable for safe, secure and effectual shipping operations, it has been scientifically researched and proven by expert authorities that ballast water is a significant path for the tra So, ballast water is used for balancing the ship and maintain the waterline at its optimal level. When the ship has been loaded, if its overall weight is lesser than its maximum weight, ballasts need to be filled until getting in enough water to reach the optimal waterline. Why ballast water has to be treated? What are the invasive species? Ships are carrying water in their ballasts all around the world, they are ballasting (pumping out water) from one port and they are de-ballasting (discharging back to the sea) in a different port with a different marine eco-system. The problem is, they are Sample of Form Of International Ballast Water Management Certificate. What is Slop tank requirements of an oil tanker as per MARPOL? What is Standard discharge connection as per MARPOL? What is Balance Type Rudder used on ships? What is regulation for Flooding Alarm System in passenger ship as per SOLAS? What is meaning of Turning ability of ships? 2 Anticipated Ballast Water Treatment System Sensors and Measurement Equipment for Physical/Chemical Indicator Monitoring.12. 3 List of Possible Treatment Performance Measures and Analytical Methods for Biological Indicator Compliance Monitoring.17. Maintaining the flow normally requires that the filter is regularly cleaned, and it is the balance between flow, operating pressure and cleaning frequency that determines the efficacy of the filtration process.