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**Cargo Ship Salinity Challenge**

**Situation:** A large cargo ship has an opportunity to deliver a valuable shipment to a freshwater port. The captain of the ship will earn a large commission if he accepts this job offer. He has not yet accepted the offer because he is unsure of how his ship, built to travel the world’s oceans, will fare in freshwater. The ship fully loaded weighs about 25,000 tons, in our scale model that is 750 grams.

**Problem & Career Focus:**You are a marine engineer challenged with designing a prototype of a cargo ship. You will use this prototype to conduct an experiment to determine how freshwater and saltwater affect a cargo ship’s buoyancy. You will use your finding to advise the captain of whether or not he should accept the job offer.



**Things to consider*:***

* How can I use scientific investigation to create and test a hypothesis?
* How does salinity affect buoyancy?
* What qualitative and quantitative data do I need to collect as evidence?
* What boat design will hold the most mass?

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| **Criteria**   * The boat must float. * The cargo must be inside the boat. * The inside of the boat must remain dry to protect the cargo. * You must complete an investigation to test your boat design in both saltwater and freshwater for each test trial. | **Constraints**   * Must use the materials provided * Must complete in the time frame assigned by your teacher * Must work in engineerings pairs (groups of 2) |
| **Materials:**   * 15 cm of heavy duty aluminum foil measured off the roll (length=15cm) | **Tools:**  **Use any of the following...**   * Scissors * Mass (gramstackers, pennies, lima beans, or marbles) * Digital Scale |

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| Student: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | Assignment: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | |
| Integrated STEM Disciplines  (**check all that apply**) |  | **4** | **3** | **2** | **1** | |
| **X** | **Science** | **All components of scientific investigation are applied and evident** in diagrams, models, and throughout group discussions using **scientific vocabulary**. | **Several components of scientific investigation are applied and evident** in diagrams, models, and throughout group discussions using **some scientific vocabulary;** with minimal misconceptions. | **Numerous components of scientific investigation are missing.** Diagrams, models, and group discussions are limited; the use of **scientific vocabulary is minimal.** | | **Scientific investigation is not utilized.** Diagrams and models are missing. Group discussions lack scientific understanding and **scientific vocabulary is not used.** |
| **X** | **Technology** | Prototype/Process depicts evidence of advanced innovative research and **meets all criteria and constraints.** | Prototype/Process depicts evidence of research and meets **most of the criteria and constraints.** | Prototype/Process lacks evidence of research and **many** of the **criteria and constraints are not met**. | | Prototype/Process lacks evidence of research and **most** of the **criteria and constraints are not met.** |
| **X** | **Engineering** | **All components** of the **engineering design process** were followed. **STEM notebooks include** documented research, diagrams, and data collection. | **Most components of the engineering design process** were followed.  **STEM notebooks include some** documented research, diagrams, and data collection. | **Few components of the engineering design process** were followed. **STEM notebooks include minimal** research, diagrams, and data collection. | | The **engineering design process was not followed**. **STEM notebooks were not used** to document research, diagrams, and data collection. |
| **X** | **Math** | **Accurate knowledge of mathematical processes** is evident and applied to quantify the success of the prototype. **Includes data from multiple trials used to make inferences about future trials.** | **Basic knowledge of mathematical processes** is evident and applied to quantify the success of the prototype.  **Includes data from multiple trials.** | **Limited knowledge of mathematical processes** is evident and applied to quantify the success of the prototype. **Little to no data is collected.** | | **Mathematical processes are not evident or applied**. |
| **X** | **21st Century**  **STEM Skills** | **All** 21st century STEM skills were applied during the learning process. | **Most** 21st century STEM skills were applied during the learning process. | **Half** of the 21st century STEM skills were applied during the learning process. | | **Few** of the 21st century STEM skills were applied during the learning process. |
| **/ Total Points** | | | | | | |