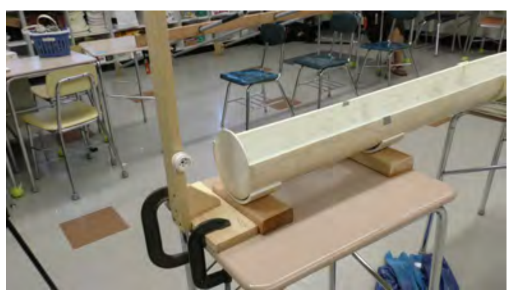
Triremes "How to Build Your Vessel" - Hands-On-Activity
Triremes Inquiry Unit
Please refer to the Triremes Hands-On-Activity Power Point found here

Materials Needed

- The "Battle of Salamis" iPhone/iPad/iPod Touch app, free download here: (iTunes)
- Create student teams (2-3 students in a team, or whatever works best for your classroom.)
- Foam core board or tin foil (for building the vessel) enough for each team of students.
    - Should you decide to use foam core, each team should be given a 10"x10" sheet of foam core to work with. Please check with your art department to see if they have any scraps!
- X-acto knives to cut foam core, safety gloves, and safety glasses*, one for each student team.
- Tape to hold the vessel together (electrical or duct tape), enough for each student team to work with while creating their boats. Teams should use the same "type" of tape, as the type of tape used could affect the weight of the boat.
- 1 paper clip for each team to attach to the end of their boats. (This paper clip can signify the ram of the triremes).
- **Optional Pulley** - (The paper clip, may also be used if you decide to create a pulley system to test the boat's speed. Please review the Triremes pilot video to get a sense of how a pulley system may be created. Your school's technology department may be able to assist with this type of pulley system or with some other form of pulley system that they may create for you to test the students' boats' speed.


- The pulley system that was used in the pilot video included: a "cut in half" PVC pipe, which was filled with water and secured on desks, with a pulley system on one end. The pulley system at the end of the secured PVC pipe, used 4 X 4's for height, fishing wire, 2 indented rollers that the fishing wire wrapped around and moved. One indented roller was located up high on the 4x4, the other one was level with the PVC pipe, a weight was used on one end of the wire to keep it weighted to the ground and a paper clip was attached to the end of the fishing wire, which would then connect to the paper clip attached to the students' boat. (See above.)

- Check with your school's tech department or with an engineering class to work with you to create a pulley system to test the students' boat for speed. Speed was an important component to the Trireme. If you are able to get such a pulley system designed, be sure that when each boat is tested for speed, that some weight is placed in it, IE. pennies, and that each boat has the exact same amount of weight. This will keep all boats on the same playing field when determining which boat is the fastest, and it will also show how speed is not only affected by the boat design itself, but also by the amount of weight it can withstand.

- Weights to test the vessels (pennies or fishing weights work well) Number needed will depend on each specific boat design. Two handfuls of pennies should be enough.
- Bucket filled with water to test how much weight each boat will hold before it sinks. (A bus tub would work well.) This is your "testing tank."
- Optional: Pulley with fishing wire. (*See notes above*.)

Instructions

- Have students review "Triremes Hands-On Activity Power Point"
- Review and distribute Classroom Activities: "Trireme Design" and "Building Your Vessel" found below. (These activities may also be found within the Triremes Inquiry Unit.)
- Have students design their boats based on the above noted Triremes Hands-on-Activity Power Point and on the Trireme Design classroom activity.
- Have students test their boats for maximum load/weight as shared in the "Building Your Vessel" and determine a "winner", although all students win for building a boat!
- Optional Pulley: *See above, for testing the speed of each boat.*

Below you will find some sample photos of students designing their boats and of finished boats.

*When engaging in the IEEE REACH hands-on activities, or IEEE REACH inquiry units/ lesson plans, please proceed with caution and use all reasonable safety precautions. Please be advised that IEEE shall not be responsible for any injuries or damage related to the use of these hands-on-activities, or lesson plans, or any activities described herein.

Trireme Design:

Understanding the Math and Science of Floatation

Foam Core Vessel Design: Follow the instructions in the *Trireme Hands on Activity PPT* Feel free to use a calculator.

Sketch your vessel. Include sizes and buoyancy calculations on the next page.

idea #1

idea#2

Calculations Worksheet

Volume in cu inches (L x W x H) =
Volume in cu feet (cu / 1728) =
Pounds of water displaced (vol x 64) =
Mass of vessel =
Convert grams to lbs (g/453.6) =
Determine Load (water displaced - weight of vessel) =

IEEE REACH

CLASSROOM ACTIVITY – BUILDING YOUR VESSEL

REVIEW Trireme Hands on Activity PPT.

Building your Vessel

1. If you have access to the Battle of Salamis app, open it to begin this step. Swipe to the left and click on "The Trireme"; then click on the button in the top right corner and look at the directions as it loads. Take a moment and use the 3D graphic to explore the construction of this amazing vessel. Although we are not actually constructing a trireme, you should note both the complexity and simplicity of this design before you begin to study the math and science behind floatation and start to make your own vessel.
2. Meet with your design team and examine your sketches and design plans. Choose ONE design that you believe will give you maximum speed and cargo weight. In this team competition, the winners' vessel will carry the heaviest load and attain the highest speed.
3. Build your vessel using foam board, duct tape, and an exacto knife. Remember a paper clip needs to be attached to the front for testing.
4. Bring your vessel to the "testing tank." One team member should hold the vessel while another places the weights inside. Remember to periodically let go to see if it still floats. As soon as it starts taking on water, you have reached your max. Consider shifting the load and spreading out the weight to maximize the results of your test.

Testing Results:
Success? Yes?___No?___ Why or why not? ___________________________________

Load capacity:__________________ Maximum Speed:_____________________

Now after your first test add the ram and test again:
How did this impact your results? Why?

Evaluation Worksheet

1. Did your product come out as planned. If no, what did you change?

2. What was the difference between your estimated load and actual load?

3. Why do you think this difference exists?

4. If you could go back and rebuild this prototype, what changes would you make for improved performance and aesthetics?

5. Knowing what you do about the Athenian trireme and having experienced real-world design and execution, what have you learned about the complexity and sophistication of their vessels?

6. What do you think were the design elements that made the Greek Trireme such a formidable force?