



TEACHER RESOURCE GUIDE

GRADES 9-12: MOVING ACROSS THE POTOMAC





ARRIVAL AND ENTRY

SAFETY

ADDITIONAL INFORMATION

DIRECTIONS

Just minutes away from all three area airports, The Capital Wheel at National Harbor is directly accessible via the Woodrow Wilson Bridge, the Capital Beltway, I-95, I-495 and I-295—with interchange and multi-lane fly-off ramps exiting exclusively into the community from Maryland, Virginia and D.C. We're right on the water... yet a world away.

EDUCATIONAL OBJECTIVES

Construct and measure the speed of an air-powered boat capable of racing others boats of its type in time trial competition. Once completed, celebrate your success with a spin on The Capital Wheel!

SCIENCE STANDARDS:

NGSS Correlation:

HS-ETS1-1, HS-ETS1-2, HS-ETS1-3, HS-ETS1-4

Common Core Correlation:

ELA/Literacy: RST.11-12.7, RST.11-12.8, RST.11-12.9

Mathematics: MP.2, MP.4





STUDENT ACTIVITIES

POTOMAC CROSSING: OVERVIEW

MOVING ACROSS THE POTOMAC!

ONE OF THE GRAND SIGHTS you'll see while on the Capital Wheel is the Potomac River. Discovered in 1608 by Captain John Smith, who called the river "Patawomeke" after an Algonquian Indian land site named for the area that is now known as Washington, D.C. The Potomac River is approximately 400 miles long from its beginning headwaters to its mouth in the Chesapeake Bay. In this activity students will simulate crossing the Potomac River while measuring the speed of model boats they design, which use air to provide motion.

THE MOTION of the model boats in this challenge can be explained using Sir Issac Newton's Third Law of Motion: "For every action there is an equal and opposite reaction". This simply means that whenever something is pushed it pushes back with the same amount of force, just in the opposite direction.

IN THIS CHALLENGE the air from your balloon is providing the "push" which will send your boat in the opposite direction "across the Potomac" or down the track.

REMEMBER your goal is to assemble your boat in such a way that when this push is provided from the air in your balloon that your boat makes it down track first!





STUDENT ACTIVITIES POTOMAC CROSSING

MOVING ACROSS THE POTOMAC!

OBJECTIVE:

Construct and measure the speed of an air-powered boat capable of racing others boats of its type in time trial competition.

SUGGESTED MATERIALS (PER TEAM)

- 1-2 Plastic or Styrofoam Bowls
- 30 cm of wax paper
- Scissors
- 2-3 Popsicle Sticks
- 30 cm/1ft. of Duct tape
- 1-2 Sheets of 8.5x11 Paper
- 1-2 Sheets of 8.5x11 Cardstock Paper
- 30-60cm of String
- 1 Balloon
- 1 Straw
- 1 Large Sink/Tub/Mini-Pool of water with a length of 30 cm or 1ft (For Judging)
- Stopwatch (For Judging)
- Metric Ruler (For Judging)

COMPETITION

After receiving their materials, each team of students (2-4 suggested) will be given time to construct their air powered boat vehicle. It is suggested that students receive at least three separately timed attempts with their boat. The goal for each attempt is to go as fast as possible across a 30-60cm (1-2ft) track to the finish line. Of the three runs, only the run with the fastest time will be reported for scoring.

BEFORE YOU START

Consider providing students with the opportunity to think through their process before they take action. This will allow them the best opportunity to use their time and materials efficiently, thereby maximizing their results!

The Engineering Design Process is a useful tool in helping students processes their ideas:

- Ask Questions
- Research
- Generate Ideas
- Sketch Desired Design Requirements
- Plan
- Build a Prototype
- Test & Observe
- Improve & Redesign

This process is not prescriptive, meaning that it does not have to be followed exactly as written. It is just a tool to help guide your students to a more productive engineering experience.





STUDENT ACTIVITIES POTOMAC CROSSING

MOVING ACROSS THE POTOMAC!

EVALUATION

At the end of construction time (30 min.), students will test their boats under the instruction of their event supervisor. Before the boat is released the supervisor should confirm it has been safely constructed and poses no harm to onlookers. Students may use any of their given materials to construct their boat.

Each run (three in total) will be scored based on time it takes for it to travel the set track. The final recording should be the run with the fastest time in seconds.

Team Number	Student Names	Mass of Boat in grams (g) (For Tie-Breaks)	Distance of Track in cm	Time in Seconds* (Use the best of the three runs trials)	Speed of Boat = Distance/Time
1					
2					
3					
4					
5					

** In the event of a tie, the team with the lightest boat will be declared the winner. If a tie still exists after this, a "run-off" round should be conducted (Repeat until all ties are broken).*





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REFLECTION:

After the event have students discuss/write about the following:

1. What went well? What would you have changed & why?
2. Are there devices in everyday life that function like the one you designed/constructed?
3. If you had an unlimited budget what kind of device would you make?
4. How did you and your teammates decide to approach solving the problem presented in this challenge?
5. What was the main concept or idea you learned from this experience today?
6. Review the vocabulary words, how does your work connect with the words listed?

THRUST to push forcibly; shove; put or drive with force.

MASS A measure of the amount of matter in an object.

BOUYANCY the ability or tendency to float in water or air or some other fluid.

SPEED a measure of how far an object traveled over a period of time (distance/time, ex: miles/hour)

ACCURACY A description of how close a measurement is to the true value of the quantity measured.

REFERENCES:

PhysicsClassroom.com, <http://www.kingsford.org/khsweb/staff/Bertoldi/physicsvoc/phy1.htm> <http://dictionary.reference.com/>
<http://www.nextgenscience.org/msps-e-energy>





STUDENT ACTIVITIES POTOMAC CROSSING

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EXTEND

Solve the Following:

$$\text{Speed} = \text{Distance (m)} / \text{Time (s)}$$

1. A boat travels across a stretch of the Potomac in 6.8 s. The boat's speed is 11.7 m/s. What is the distance the boat traveled?
2. In slow, but steady traffic, a car travels across a 50 meter stretch of the Woodrow Wilson bridge in 15 min. What is the speed the car was traveling?
3. A student decided to swim across a 300 m stretch of the Potomac at 15 m/s. Assuming all goes well, how long does it take the student to complete the trip?
4. A boat travels across a stretch of the Potomac in 40 s. The boat's speed is 500 m/s. What is the distance the boat traveled?
5. A student's boat travels across a 3 meter bin of water in 15s. What was the speed the boat was traveling?





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GRAPH THE RESULTS OF YOUR TRIALS:

