THE CAPITAL WHEEL AT NATIONAL HARBOR™

TEACHER RESOURCE GUIDE

GRADES 6-8: OVERCOMING GRAVITY

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WELCOME TO THE CAPITAL WHEEL!

ARRIVAL AND ENTRY

Please allow ample time for parking and obtaining tickets. To secure your group tickets, please contact us at 301-842-8650 or info@iconattractions.com.

SAFETY

To have the best adventure possible, please abide by all safety precautions posted and given by our staff. If you have any questions during your experience, please speak to any member of our team.

ADDITIONAL INFORMATION

For information on The Capital Wheel and our education programs, visit our website: www.thecapitalwheel.com

DIRECTIONS

We are conveniently located at National Harbor, just a 15-minute drive or water taxi ride from the heart of the nation's capital.

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

Design and develop a device capable of using multiple simple machines to reduce direct student effort and accomplish the task of lifting as many "passenger" objects into the air for an extended time frame. Once completed, celebrate your success with a spin on The Capital Wheel!

SCIENCE STANDARDS:

NGSS Correlation:
MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4
Common Core Correlation:
ELA/Literacy: RST.6-8.1, RST.6-8.3, WHST.6-8.7
Mathematics: MP.2, 7.EE.3, 7.S.P.

OVERCOMING GRAVITY!

GRAVITY is known as the force which pulls objects in the universe toward each other. However, in our daily lives we experience gravity most as the force at work in pulling us downward towards the earth. So for you to experience the thrill of its scenic views the Capital Wheel must overcome the force of gravity which on earth pulls you and all objects (regardless of their mass), at the rate of 9.8 meters per second squared or 9.8 m/s2 .

IN THIS CHALLENGE you will develop and test a mechanism that like the Capital Wheel, must overcome gravity to lift a "passenger" off the ground. In a challenge similar to what the engineers of the Capital Wheel faced, your device will need to provide lift to "passengers" who will vary in mass and height (Marshmallows, table-tennis spheres and small marbles). Your device must lift the "passengers" to a height of at least 5 cm, provide this lift for at least five seconds and do so with as little physical assistance (i.e. touching the device) from you and your team as possible. (Time of physical assistance/contact with the device will be measured in seconds and subtracted from the time of lift for evaluation of performance).

IN ORDER TO SUCCESSFULLY ACCOMPLISH this feat of engineering your team will need to understand and apply the use of simple machines. Simple machines are devices that are used to modify motion and force to the advantage of the user in order to perform work. Examples include: inclined plane , lever, wedge, wheel and axle, pulley, and screw.

REMEMBER that in this challenge your goal is to assemble your device in such a way that when operated most of the required functions take place with little to no assistance from you or your team. This can be accomplished in variety of ways, be sure to sketch out a plan with your team before you build!

OVERCOMING GRAVITY!

OBJECTIVE:

Design and develop a device capable of using multiple simple machines to reduce direct student effort and accomplish the task of lifting as many "passenger" objects into the air for an extended time frame.

SUGGESTED MATERIALS (PER TEAM)

- Paper Towel Rolls
- Aluminum Foil 15cm x 15cm
- Scissors
- 3-5 Small Paper or Plastic Cups
- 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
- 1-2 Sheets of 8.5x11 Cardboard
- 30-60cm of String
- 2-3 Balloons
- 5 Straws
- 5-10 Brass Fasteners
- 1-2 Electric Motors
- 1-2 AA or 9V Batteries
- Malleable Wire (i.e. Copper)
- 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 device. It is suggested that students receive at least three separately timed attempts to demonstrate their device. The goal for each attempt is to lift as many of the designated "passengers" as possible at least five (5) cm, for at least five (5) seconds. Of the three runs, only the run with the longest time while at least one of the passenger(s) are above five (5) cm 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.

OVERCOMING GRAVITY!

EVALUATION

At the end of construction time (30-50 min.), students will test their devices under the instruction of their event supervisor. Before the device is tested, 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 device. (Use of additional materials beyond the suggested list are at the discretion of the event supervisor).

Each run (three in total) will be evaluated based on the parameters of centimeters above the staring surface/plane and time of lift (in seconds). Additionally, the time of physical contact with the device measured and subtracted from the time of lift.

Team Number	Student Names	Number of passengers lifted at once (For Tie- Breaks)	Height of lift above 5cm (cm)	Time in Seconds passengers were lifted* (Use the best of the three runs trials)	Time in Seconds team maintains physical contact with device (Subtracted from time of lift)	Score = (Height of lift above 5cm + Time in Seconds passengers were lifted - Time in Seconds team maintains physical contact with device)
1						
2						
3						
4						
5						

** In the event of a tie, the team with the greatest number of passengers lifted at once 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).*

OVERCOMING GRAVITY!

REFLECTION:

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

1. How did you and your teammates decide to approach solving the problem presented in this challenge?
2. What was the best thing about your design? What would you have changed & why?
3. Explain what types of simple machines your team used in its design.
4. Explain what types of simple machines the Capital Wheel utilizes.
5. If you had an unlimited budget what kind of device would you make?
6. What was the main concept or idea you learned from this experience today?

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

INCLINE PLANE An inclined plane consists of a sloping surface; used for raising heavy bodies.

MECHANICAL ADVANTAGE force-amplifying effectiveness of a simple machine

INERTIA the resistance an object has to a change in its state of motion.

REFERENCES:

PhysicsClassroom.com, http://www.kingsford.org/khsweb/staff/Bertoldi/physicsvoc/phy1.htm, http://dictionary.reference.com/, http://www.nextgenscience.org/msps-e-energy , http://www.britannica.com/technology/simple-machine, http://www.engineeringtoolbox.com/power-d_1289.html