



Hurricane Engineering Design Challenge

Adapted from the Global Precipitation Measurement Mission by the NASA Goddard Space Flight Center

Objectives

Students Will:

- Design and Build a tall, freestanding tower that can support a tennis ball while withstanding the wind from a fan

Suggested Grade Level

4th – 12th

Subject Areas

Earth Science, Engineering, Physical Science

Timeline

30 - 60 minutes

Standards

4-ESS3-1 Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses

4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans

5-PS2-1 Support an argument that the gravitational force exerted by Earth on objects is directed down

5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment

3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost

3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved

MS-PS2-4 Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects

MS-ESS3-2 Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects

MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment



HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering

HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts

Background

Whether you live in an area prone to hurricanes or not, you've seen images of the destruction caused by such storms. Builders in areas at risk for hurricanes need to plan for that in their designs. Damage to buildings can come because of wind, storm surge, or heavy rainfall leading to flooding. For this activity, we focus primarily on wind damage. Some questions students can think about before designing their structures are questions engineers and architects often ask themselves before designing a building or bridge. Which combination of materials will accomplish the goal? What tower shapes could be used? Should the base be round? Square? Triangular? Think about the forces on the tower, wind from the side, and gravity pulling down. How should the structure be designed to resist them?

Vocabulary

Engineering, hurricane, base, freestanding, forces, gravity, simulation, destruction

Materials

- Index cards
- Straws
- Craft sticks
- Scotch tape
- String
- Pipe cleaners
- Rulers
- Scissors
- Fan
- Tennis ball
- Water bottle (optional)

Lesson

1. Split students into pairs or small groups
2. Show slideshow of various buildings from around the world with different design structures (ie: Eiffel Tower in France, CN Tower in Canada, Azadi Tower in Iran, water towers, El Faro Tower in Argentina, 30 St. Mary Axe in London, teepee, cathedrals, etc). These images can give students ideas about their structure



3. Provide guidelines: Students are challenged to build a **freestanding** (not taped to the table) tower that can support a tennis ball **as high as possible** off the ground (measured from the bottom of the tennis ball) while withstanding the wind from a fan. Optional challenge – add a spray bottle to represent rain. Materials available will be index cards, straws, craft sticks, pipe cleaners, tape, string, and scissors. Optional challenge – limit the number of supplies for each group
4. Design, plan, sketch structure (add time limit if necessary)
5. Use the listed materials to build structure (add time limit if necessary)
6. Test each groups' structure: measure height from table to tennis ball, then turn on fan and start timer

Extensions

1. Give each material a cost, and set a budget limit for each group to spend on items. They must complete the requirements while staying under budget.
2. Increase the height requirement of the tower.
3. For younger students, remove the tennis ball from the requirements and have them focus only on height and sturdiness of structure.

Resources

(n.d.). Retrieved from <https://pmm.nasa.gov/education/interactive/building-hurricanes-engineering-design-challenge>