

StEm

Title: Hurricane House

Grade Level: 5

Duration: Four 45 Minute Inquiry Monday Classes



<p>Objective: Students will design a structure that can withstand the wind field from an approaching hurricane.</p>	<p>Focus Concept/s: Forces Model Building</p>
<p>Essential Question/s: How can we help to minimize wind damage to structures within the path of a hurricane?</p>	<p>Connected Benchmark/s SC.5.N.1.1 - Define a problem, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types such as: systematic observations, experiments requiring the identification of variables, collecting and organizing data, interpreting data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions. SC.5.N.2.1 - Recognize and explain that science is grounded in empirical observations that are testable; explanation must always be linked with evidence. SC.5.P.13.1 - Identify familiar forces that cause objects to move, such as pushes or pulls, including gravity acting on falling objects. SC.5.P.13.2 - Investigate and describe that the greater the force applied to it, the greater the change in motion of a given object.</p>
<p>Vocabulary:</p> <ul style="list-style-type: none"> • Force • Hurricane • Civil Engineer • Blueprint • Client • Model • Request for Proposal • Prototype 	<p>Suggested Materials:</p> <ul style="list-style-type: none"> • Hair dryer or similar wind producing device • 4 index cards • 4 Straws • 4 Craft sticks • ½ stick of clay • 4 Pipe cleaners • fabric scraps • Saran wrap (you determine the amount...keep it consistent for each group of students) • Tape or glue • Science Notebooks and graph paper.

Problem/Challenge (Engage):

- **Set the Stage:** Read the Book- *The Three Little Pigs- a Graphic Novel* on Myon.com
- Present to students the following scenario:
- Mama Pig realizes two of her little pigs need help building a home. They have relocated to live in Tampa, Florida. Her biggest concern is that in Tampa, there are hurricanes with winds that blow 120 mph. This has much more force than what the Big Bad Wolf produced. She has contracted you and your partner as the head civil engineers for this project. She wants you to build her a model of a house using the given materials. She will then test the strength of your house. If your model can withstand her wind test then you and your partner may receive the contract.
- Explain to students that they will become Civil Engineers. Give students the "Becoming a Civil Engineer" Career Profile sheet. Have the students read the career profile from: (from <http://www.discoverengineering.org/>). (Sheet is attached at the end of the lesson plan), it reads:
 - What would it feel like to have the expertise to build a school that could withstand an earthquake, a road system that puts an end to chronic traffic jams, or a sports stadium that offers everyone a great view? As a civil engineer, your job would be to oversee the construction of the buildings and infrastructure that make up our world: highways, skyscrapers, railways, bridges, and water reservoirs, as well as some of the most spectacular and high-profile of all engineering feats—think of the world's tallest building, the towering Taipei 101 in Asia, or the Chunnel, the 31-mile-long tunnel beneath the English Channel. Civil engineers are fond of saying that its architects who put designs on paper, but engineers who actually get things built.
- Have the students paste the career profile in their notebooks.
- Discuss with students the career choice of becoming a civil engineer. How do these engineers impact the world around them?
- Introduce students to the Design Challenge Planning Sheet and have them complete the 1st section by writing the problem/challenge. Depending upon your student's abilities, separate students into teams of two to complete this design challenge.

Brainstorm/Investigate (Focus Concepts):

Students will utilize their design challenge planning sheet to brainstorm two possible solutions to the problem/challenge. For each brainstormed idea, they should explain the strengths and weaknesses of each. If students need suggestions, have them examine the materials to help with their brainstormed designs. Students do not need to use all of the materials in the materials list. However, they are on a budget and may not use more than what the materials list calls for.

Plan/Design (Blueprint):

Once students have brainstormed their ideas, they will need to select their first choice and create a blueprint of their design that will be their prototype. This can be created within their student notebooks or completed on a piece of graph paper. Remind students that blueprints are detailed outlines or plans of action. They should include sizes and dimensions of materials including length, width, height, etc.

Pass out the Request for Proposal or RFP paper for the student- read through the proposal with the students.

(Teacher Note- A Request for Proposal or RFP is an invitation to suppliers or builders to submit a plan or proposal to provide a product or service to a client.)

Discuss with your students:

Who is your client?

What type of product do we need to create?

Why should we create a model as the prototype for the client?

What have others done to solve this problem?

What are the item specifications and restrictions?

Show students the different materials they have to work with.

Remind students they must estimate how much of each material they need.

Build/Test:

During this phase of the design process, students are actively involved in the creation of their prototype according to their blueprint. Once groups have completed building their prototype, they may begin to test them. Determine an area in the classroom that has been arranged to model hurricane force winds using a wind powered device such as a hair dryer. Place an X on the table or counter out of masking tape. This area will mark the spot in which the team's prototype will be placed. From the center of the X, measure out a distance of 30-45cm and place a piece of tape in a horizontal line from the X. This will mark where the hairdryer will be placed to simulate the hurricane type winds. Students will record data according to the steps outlined below.

***Teacher note: It may be necessary to test ahead of time the power of the wind producing device from a desired distance to ensure a fair amount of wind to test the prototype. Too much wind and no student designs may work and the same goes if there is not enough wind. Test the force using an assortment of the student materials to see how the wind affects the items. You will want to keep the amount of wind pretty consistent for all engineering teams. The distance may need to be adjusted based upon your discretion.

Collect/Analyze Data:

Prior to testing, students need to create some sort of data collection chart. Remind students that data can include both quantitative and qualitative data. Examples of quantitative data could include: time (until first piece of material is blown away in their design, how long the structure lasted in the position before moving, etc. Qualitative data could include things such as the movement of the structure as the winds affected it, other observations that could be made as a result, etc.

Reflect on Improvements:

Once students have had the opportunity to test and collect data on their design, they can reflect upon the results as it relates to their individual designs in their notebooks or on their planning sheet. Questions such as: Was it the best solution? Would one of the other ideas have been better? Why or why not? What would you have done differently? How would you improve your design?

If time permits, students could improve their designs or choose an alternate from their brainstormed ideas to build, retest, collect data, and reflect. Explain that this is the process engineers go through in the real world.

Evaluate/Justify:

Have engineers defend their product. Have them write a brief summary of why their prototype is the most effective and why Mama Pig should select their proposal. Have engineers think about what their materials represented in their prototype- what types of materials would you need in the final structure?



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Request for Proposal

Proposal must be submitted as a model.

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Engineers will develop a working prototype of a home structure that will withstand hurricane force winds with little to no damage.

As a civil engineer you want to make sure your design has the least amount of damage and is appropriate for the type of environment and weather in which the structure is to be built. Some things to think about:

- The direction in which the wind can blow.
- Types of materials that can withstand a large force pushing against it.
- The materials available under a tight budget
- The shape of the structure and how it may be affected by the wind.

Item Specifications:

- All structures will be tested with the same wind.
- All teams have access to the same materials for their prototypes
- Engineering teams will create a prototype of their product to present to the Project Manager (your teacher).
- Blueprint must be drawn with the materials labeled.

Will your engineering team win the bid from Mama Pig for the Hurricane House?

