

High Rise Challenge

Theme: Force~ Wind Effects on High Structures

Time: One Week

Grade: 2nd

Standards

NGSS:

K-2-ETS1-1 Engineering Design

Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool

K-2-ETS1-2 Engineering Design

Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

K-2-ETS1-3 Engineering Design

Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

3-PS2-1 Motion and Stability: Forces and Interactions

Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

CCSS:

RI 2.1 Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text

W.2.3 Write narratives in which they recount a well-elaborated event or short sequence of events, include details to describe actions, thoughts, and feelings, use temporal words to signal event order, and provide a sense of closure.

W.2.6 With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers.

W.2.8 Recall information from experiences or gather information from provided sources to answer a question.

SL.2.1. Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion).

SL.2.5. Create audio recordings of stories or poems; add drawings or other visual displays to stories or recounts of experiences when appropriate to clarify ideas, thoughts, and feelings.

2. MD.A.1. Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.

LEARNING OBJECTIVES

- Students will research and design a tower that can withstand wind.
- Students will utilize the Engineering Design Process.
- Students will identify what a structure needs to withstand force.
- Students will measure with a yardstick to meet specific height criteria
- Students will test the structure against the wind from a fan.
- Students will analyze data and draw conclusions based on evidence.
- Students will identify the scientific factors that affected the tower structure.
- Students will make revisions to structure after some reflection
- Students will present their structure to one another using a demonstration with a fan.
- Students will write to develop meaning and understanding.

ESSENTIAL QUESTION:

How can we as engineers design a tower that can support a tennis ball at least 18 inches off the ground while withstanding the wind from a fan?

JUSTIFICATION:

This lesson will be introduced as a STEM lesson. This lesson will develop students' understanding of structures, their stability, and the effects of the wind on those structures. Students will make real-world connections by engaging in several experiences throughout this activity.

PRIOR KNOWLEDGE: **Day One a.m.**

Begin by introducing the vocabulary, then ask the students the following question.

“What do you know about wind force?”

Have a brief discussion creating an ongoing anchor chart of student responses.

KWQL= what we know, what we want to know, what questions do we have, and what did we learn.

Show brief video clip 1:53 min.

Nye, B (8 April 2009) Bill Nye the Science Guy <https://www.youtube.com/watch?v=uBqohRu2RRk>

Engage:

Introduce scholars to the idea of the force of the wind on a tall tower through phenomenon.

~ “The Former Astro Tower Swaying in the Wind” Bruce Sherman (May 2013)

www.youtube.com/watch?v=ILVb9cQ-7JM

Explanation:

Begin with the 25:15 minute video to introduce stability of structures.

Nye, B. (published on YouTube 2016) “Bill Nye the Science Guy Structures”

https://www.youtube.com/watch?v=fp1bVWHYE_I

Why is it important to build a stable structure?

*Turn and Talk - Students will share responses with partners.

Students will take a Brain Break and go outdoors to observe the effects of wind on trees, electric poles, etc. The teacher will facilitate their outdoor exploration by asking “How does wind affect the movement of the tall structures around us?”

Interpretation:

Day One p.m.

Next, begin with “The Former Astro Tower Swaying in the Wind” Bruce Sherman (May 2013). www.youtube.com/watch?v=ILVb9cQ-7JM and then begin the lesson.

Stop and Jot - What are the effects of force on tall structures?

All students will write a short constructed response.

VOCABULARY:

Students will be introduced to vocabulary thru discourse. Student task to create a Four Square of to include word and a drawing of the meaning after discussion of the following words.

stability- the state of being stable (firm)

force- an interaction that causes a push or pulls that changes the motion of something else

tower- a tall narrow building or freestanding structure

wind- the natural movement of air from a particular direction.

Application: Day Two a.m.

Briefly discuss what was learned the day before. Have scholars complete a Stand, Share, Sit.

Each student of the group has an opportunity to speak about one thing they remember from the prior day’s learning objectives.

Divide into teams of two or three. Before you begin designing, brainstorm answers to the following questions.

- How can we use our materials to make a tower that’s at least 18 inches tall?
- How can we use flexible materials, such as paper and string, to make a tower that is strong enough to hold up a tennis ball?
- How can we keep our tower from tipping over?
- How will we design our tower to resist the push of the wind and the pull of gravity?

Record and sketch your ideas in your design notebook.
Answer the following written responses in your notebooks:

My design idea is...

My group decided on...

As you brainstorm designs for your tower, think about other structures and how they stand up. For example, a tent combines flexible and rigid materials to make a frame and covering that can stand on its own.

Day Two: p.m.

BUILD, TEST, REVISE

Students will be given time to begin building their tower using the following materials. The only constraint is the tower must be 18 inches tall and hold a tennis ball while withstanding the wind from a fan.

- **Building surface (hardwood floor)**
- **Electric fan**
- **Paper (copier paper and/or newspaper)**
- **Straws**
- **String**
- **Tape (masking or duct)**
- **Tennis ball**
- **Skewers or Popsicle sticks**

Once you've got a tower to test, put it one foot away from the fan. (If your tower is hard to move, bring the fan over to the tower.) See how your tower responds when you turn the fan speed on low. When we made ours, we had to debug some problems. For example, our tower tipped over, our tennis ball kept falling off, and the weight of the tennis ball bent our tower. If any of these things happen to you, figure out a way to fix the problem so that your tower works as expected.

Perspective-

Students will discuss and share out responses regarding the following question.

What are the strengths and weaknesses of your tower?

Students will give a written response to the prompt...

Through my observation my tower can/can't...

Students will have time to brainstorm a possible solution and to revise their structure for a retest. The scholars will use various speeds of the fan to complete observations and testing purposes for a variety of data.

EXTENDED ACTIVITIES:

- Strengthen your tower so it can support a tennis ball when the fan speed is set to high.
- Build a tower that can support a baseball, softball, or soccer ball instead of a tennis ball.
- Make a tower that can support a tennis ball that's 36 inches off the ground.

RESOURCES:

CCSS (2018) Common Core State Standards

<http://www.corestandards.org/>

NGSS Lead States (2013) Next Generation Science Standards: For States, By States (insert specific section title(s) being used if not referring to entirety of the NGSS)

www.nextgenscience.org/

MCTighe, J. and Wiggins, G. (2004) UbD Professional Development Workbook

WGBH Ed. Foundation (2007) Design Squad: High Rise Challenge

https://pbskids.org/designsquad/pdf/parentseducators/ds_pe_event_guide_high_rise.pdf