

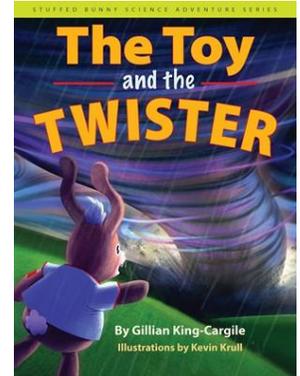
# TORNADO SHELTER ENGINEERING CHALLENGE

## LESSON OVERVIEW

Grade Level K-4

1-2 hours of class time

In this lesson, students will design, build, and test model buildings that could be used to keep people safe during a tornado. A great book to pair this activity with is *The Toy and the Twister*, written by Gillian King-Cargile and Illustrated by Kevin Krull.



## STANDARDS

NGSS K-ESS3-2	Ask questions to obtain information about the purpose of weather forecasting to prepare for, and respond to, severe weather.
NGSS ESS3.B	Natural Hazards -Some kinds of severe weather are more likely than others in a given region. Weather scientists forecast severe weather so that the communities can prepare for and respond to these events. (K-ESS3-2)
NGSS K-2-ETS1-1	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.
NGSS K-2-ETS1-2	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.
NGSS K-2-ETS1-3	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
NGSS 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.
NGSS 3-5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
NGSS 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.
NGSS 3-ESS3-1	Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.
NGSS 4-ESS3-2	Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

## OBJECTIVES

- Students will modify an empty paper towel roll so that it does not blow over when placed in front of a table fan.
- Students will apply the Engineering Design Cycle to ensure that they successfully build a structure that can remain standing when placed in front of a table fan.
- Students will engage in multiple tests in order to make observations that can lead to the best possible final design for their structures.
- Students will share their creations with their peers in order to determine what the most successful structures have in common

## MATERIALS

- Craft sticks
- Straws
- Notecards
- Construction paper
- Masking tape
- Scissors
- Empty paper towel rolls
- Small table fan

## PROCEDURES

**STEP 1:** Divide the students into groups.

Students may work on this activity independently or in groups of 2-3. The main goal of this activity is for students to think about what adjustments need to be made to buildings to ensure they remain standing in the event of a tornado. The “building” they will modify in this case is the empty paper towel roll. You will want to begin this lesson by spending some time discussing tornados and how their strong winds can be devastating to people’s homes and to buildings.

**STEP 2:** Perform a demonstration.

To start the activity, demonstrate what happens when an empty paper towel roll is placed in front of a small table fan. You will need to determine a set distance from the fan where they paper towel roll should be placed, both before it is modified and after. This distance will depend on the strength of your fan. In this first demonstration, they should notice the paper towel roll get blown away when it is placed in front of the fan.

**STEP 3:** Distribute the materials.

Each student or group of students should be given the following materials:

- 4 craft sticks
- 4 straws
- 4 notecards
- 1 sheet of construction paper
- Masking tape
- Scissors

**STEP 4:** Employ the Engineering Design Process.

Students will use their assigned materials to modify their paper towel roll so that it remains standing when placed in front of the fan (it is okay if the roll moves backward, as long as it does not topple over). Give students time to brainstorm and discuss what modifications may make the paper towel rolls sturdier.

Encourage them to create diagrams showing the materials/shapes/modifications they may want to test. As they build their structures, allow the groups to use the fan to test the effects of their modifications. Encourage students to continually make improvements to their rolls based on their tests. It is recommended that students receive at least one hour to implement the engineering design process for this activity.

**STEP 5:** Test the designs.

Once your students have finished modifying their paper towel rolls, it is time to test them to see what rolls are now able to remain standing when placed in front of the fan. Have each student/group bring their structure up to the front of the room so that the rest of the class can see what they designed. Allow each student/group to take a few minutes to explain their design and why they think it won't blow over when placed in front of the fan. Then, place each structure in front of the fan at your designated distance and turn it on. Again, it is okay if the structure gets blow backwards a little bit, as long as it does not topple over.

**STEP 6:** Have a class discussion based on the following questions.

- What did all of the structures that did not blow over have in common?
- What changes did you make based on the tests you performed throughout the building process? Do you think you would have gotten as good of a structure if you were not able to test it?
- If you lived in a place that gets a lot of tornados each year, how would you want your house to be built?
- What are some other things that can be done to stay safe in the event of a tornado?

An extension activity would be to have the students record video of the structure for a few and write down their observational data about the impacts of the wind on the various designs, documenting structural design elements that need to be improved or work well.

What is a Tornado?

A tornado is a dangerous natural weather phenomenon in which a rapidly spinning column of air travels along the Earth's surface. Many areas in the United States, including the Midwest, see storms that produce tornados every year. Homes in these areas need to be built extra sturdy so that they are not as likely to collapse in the event of very strong winds.

## RUBRIC

	Target (3)	Meets (2)	Partially Meets (1)	Does Not Meet (0)
STRUCTURAL DESIGN	Does a great job showing an understanding of design for a purpose.	Does an okay job with showing an understanding of designing for a purpose.	Tries but has great difficulty showing an understanding of the design process.	Does not show an understanding of design.
USE OF MATERIALS	Inventively chooses materials that are interesting and support the project's purpose.	Appropriately chooses materials to support the project's purpose.	Chooses materials but some work against the purpose of the project.	Does not choose appropriate materials.
COLLABORATION	Works well with others and discusses ideas in a fair, respectful, encouraging way and is considerate of the feelings of others.	Works okay with others and discusses ideas in a fair, respectful way, but may not have been encouraging. Considers the feelings of others.	Works with others, but did not contribute a fair share of work OR was discouraging and did not consider the feelings of everyone.	Did not work well with others and/or discusses ideas in an unfair, disrespectful way.
REQUIREMENTS	Meets all of the requirements for the project.	Meets most of the requirements for the project.	Meets some of the requirements for the project.	Does not meet the requirements for the project.
DEMONSTRATION OF KNOWLEDGE OF CONTENT IN DISCUSSIONS AND ACTIVITIES	Does a great job showing an understanding of the content covered in class.	Does an okay job with showing an understanding of the content covered in class.	Tries but has a difficult time showing an understanding of the content covered in class.	Does not show an understanding of the content covered in class.
Total				/15