Tornado Modeling Challenge

(These pages may be freely copied)

Tornado Modeling

Target Audience: 2nd Grade

Introduction:

Students will learn how scientists use models and then explore a tornado model at the Maryland Science Center.

After their visit, they will combine their observations with informative text to help them design and test a building that can withstand the most common strength of tornado for Maryland.

Time:

What is a Model? pre-visit activity: 1 class period, 30 minutes

Exploring Our Tornado Maryland Science Center visit and post-visit: 15 minutes

Tornado-Proof Design Challenge post-visit activities: 2 class periods, 90 minutes

Lesson Objectives:

Students will discuss how models are used by scientists.

Students will explore how a model tornado forms and dissipates.

Students will read informative text about tornados.

Students will compare a model with informative text to form an argument.

Students will draw a graph based on tornado data.

What is a Model?

Time:

30 minutes; completed before visiting the Maryland Science Center.

Lesson Objective:

Students will discuss how models are used by scientists.

Next Generation Science Standards:

2-ESS2-1: Scientists study the natural and material world.

2-PS1-4: Scientists search for cause and effect relationships to explain natural events.

Materials:

- Examples of models: paper airplane, toy car, video animation, driving game, fish tank, solar system, globe, etc.

Procedure:

Take students on a model hunt around the classroom or throughout the school to find examples of models. Before going on your model hunt, explain that models represent how something looks or acts in the real world. Scientists use models when something may be too difficult to examine or experiment with because of its size, how fast or slow it is, how far away it is, or how dangerous it is. Examples of models on your hunt could include: a paper airplane, a globe, or a video animation of how something works.

Exploring Our Tornado

Time:

5 minutes during a visit to the Maryland Science Center.

10 minutes after visiting the Maryland Science Center.

Lesson Objective:

Students will explore how a model tornado forms and dissipates.

Students will read informative text about tornadoes.

Common Core State Standards:

CCSS.ELA-LITERACY.W.2.8: Recall information from experiences or gather information from provided sources to answer a question.

CCSS.ELA-LITERACY.RI.2.10: By the end of year, read and comprehend informational texts, including history/social studies, science, and technical texts, in the grades 2-3 text complexity band proficiently, with scaffolding as needed at the high end of the range.

Next Generation Science Standards:

2-ESS2-1: Scientists study the natural and material world.

2-ESS2-2: Patterns in the natural world can be observed.

S-ESS2-3: Obtain information using various text, text features, and other media that will be useful in answering a scientific question.

Materials:

- *Explore Our Tornado* recording sheet
- *How Do Tornadoes Work?* informative text

Procedure:

Before visiting the Maryland Science Center, review why scientists use models. Provide each student with an *Explore Our Tornado* recording sheet. Each chaperone group should observe the tornado model during their visit to the Maryland Science Center.

After their visit, the class should read the informative text and then discuss the following questions, using the information gathered from the text and their exploration of the model tornado:

1. What happened when you blocked the air from the side columns?
2. What happened when you blocked the air from the top or bottom of the model?
3. Does the model tornado work exactly like a real tornado?
4. Why do you think it might be important to model how a tornado forms?

Explore Our Tornado Recording Sheet

1. Visit the SpaceLink exhibit on the second floor of the Maryland Science Center. Find the model of a tornado.
2. Use your hands to change how the tornado moves.
3. Draw or write your observations below:

What happens when you use your hands to block the air from the sides?

What happens when you block the air from the top or bottom?

What do you think is making the model tornado spin?

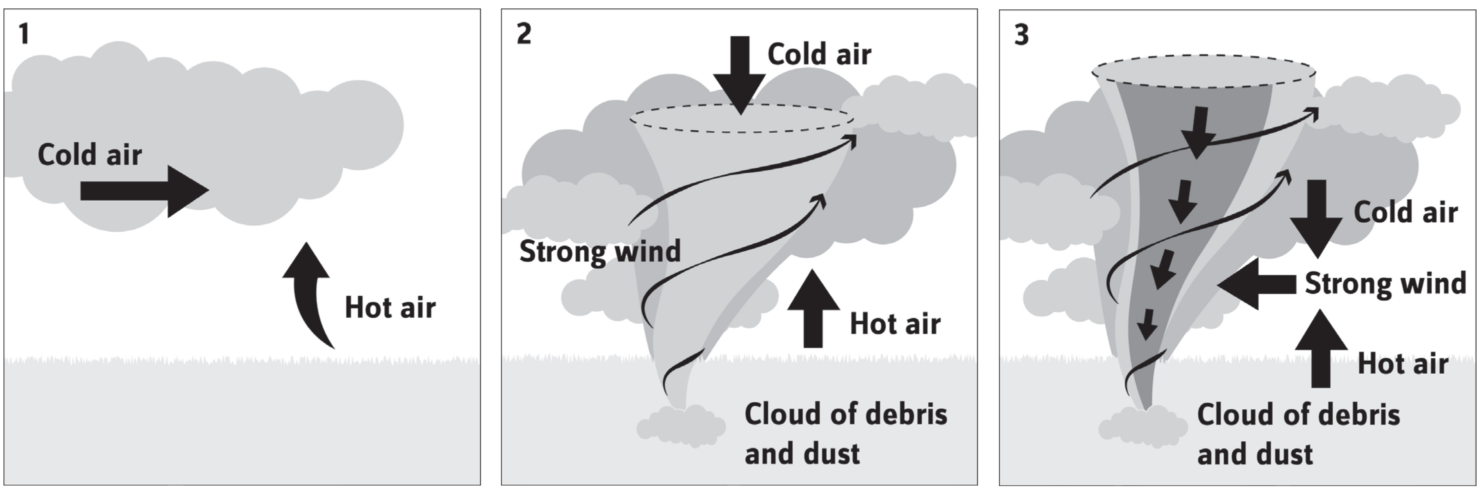
How do Tornadoes Work?

A tornado is a rapidly spinning column of air that can form during thunderstorms. Tornadoes are rare because three conditions need to happen for them to form:

1. Warm wet air coming from one direction must meet cold dry air coming from the opposite direction. When the two air masses come together, they create strong, spinning winds.

2. The warm air rises, pushing the spinning winds up into the atmosphere. The cold air is forced down toward the ground to take its place.

3. The air will start to spin in large circles on the ground. If the air spins closer together in smaller and smaller circles, the wind will move faster and form a tornado.



Meteorologists are scientists that track storms. In order to find a tornado, they use computers, satellites, and weather balloons. These tools look for the three weather conditions that are needed for tornadoes to form, and measure their strength. The strength of the tornado is measured on the F-scale, or Fujita Scale. This scale ranges from F0 tornadoes that cause a little damage, to F5 tornadoes which cause a lot of damage.

Tornado-Proof Design Challenge

Time:

90 minutes or two 45 minute sessions; completed after visiting the Maryland Science Center.

Lesson Objective:

Students will compare a model with informative text to form an argument.

Students will draw a bar graph based on tornado data.

Students will design and test a model building that can withstand high winds.

Common Core State Standards:

CCSS.MATH.CONTENT.2.MD.D.10: Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.

CCSS.ELA-LITERACY.SL.2.1: Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

CCSS.ELA-LITERACY.W.2.8: Recall information from experiences or gather information from provided sources to answer a question.

Next Generation Science Standards:

2-PS1-2: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

2-LS2-2: Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

ETS1.C - Engineering Design - Optimizing the Design Solution - Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

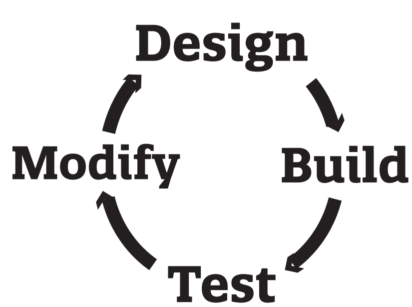
Materials:

- *Tornadoes in Baltimore* data and graph template
- Pencils or markers
- Disposable plate base, 1 for each group
- Building supplies (options include: craft sticks, straws, aluminum foil, cardboard, clay or playdough, tape, disposable cups)
- Yardstick
- 3-speed fan
- *Student Design Sheet*
- *Design Challenge* letter

Procedure:

The Maryland Science Center needs to design a small building next to the museum that will be able to withstand the most common category of tornado for the city. Introduce the design challenge by reading the Maryland Science Center letter aloud. Explain that each group will follow a version of the Engineering Design Process that engineers use to help solve the Maryland Science Center's problem. Groups will then use what they know about tornadoes to design a building that can withstand the most common strength of tornado.

Engineering Design Process



Design and Build (45 minutes)

1. Split the class into groups. Each group should create a bar graph using the provided template to represent each F-scale category of tornado (F0 to F2) that has affected Baltimore, Maryland. Which category of tornado affects the Maryland Science Center the most: F0, F1, or F2?
2. Pass out the *Student Design Sheets* and the same amount of building materials to each group. Remind groups that they are limited to the material provided. Encourage students to consider how the design and material of a house affect its ability to withstand high winds.
3. Have the students draw a plan of their design before building. Each group should build a structure on the disposable plate base. Allow approximately 15 minutes for building.

Test and Modify (45 minutes)

4. Set up the testing area by placing a 3-speed fan on the ground. Test each building model by placing it on the floor one yard away from the fan, using a yardstick as a guide. Turn the fan on the first speed (F0), and then test on each subsequent speed until the building falls or moves.
5. Encourage students to modify and test their buildings again. Their building models should be able to withstand the second fan speed (F1).
6. Groups should record their results from the tests and draw their final design on the *Student Design Sheet*.
7. As a class, discuss how the fan and buildings act like models, and then talk about the challenges each group faced and the ways they overcame those challenges. Why would an engineer design a model before constructing a real building?

Extensions:

- Solve put-together, take-apart, and compare problems using the tornado data.

- Have students write a letter to the Maryland Science Center explaining how their building will be protected from tornado damage.
- Design buildings to withstand other natural disasters. Flooding can be tested using water in a large container or sink. Heavy weight from snow or ice can be tested using playdough layers or coins on the roof.
- Have students add a scale and measurements to their building sketch.

An assessment rubric for the project is included at the end of this packet.

Maryland Science Center
601 Light Street
Baltimore, MD 21230

Dear Class,

The Maryland Science Center's temporary storage facility blew down in a storm sending beakers, microscopes, and safety glasses everywhere! Now that you know a lot about tornadoes, we need your help to design a small storage building next to the museum that will be able to withstand high winds.

Please help us figure out the most common category of tornado that affects Baltimore. Then, design a model structure that can stand up to these high speed winds. Finally, test your design to make sure that it is a good solution to our problem.

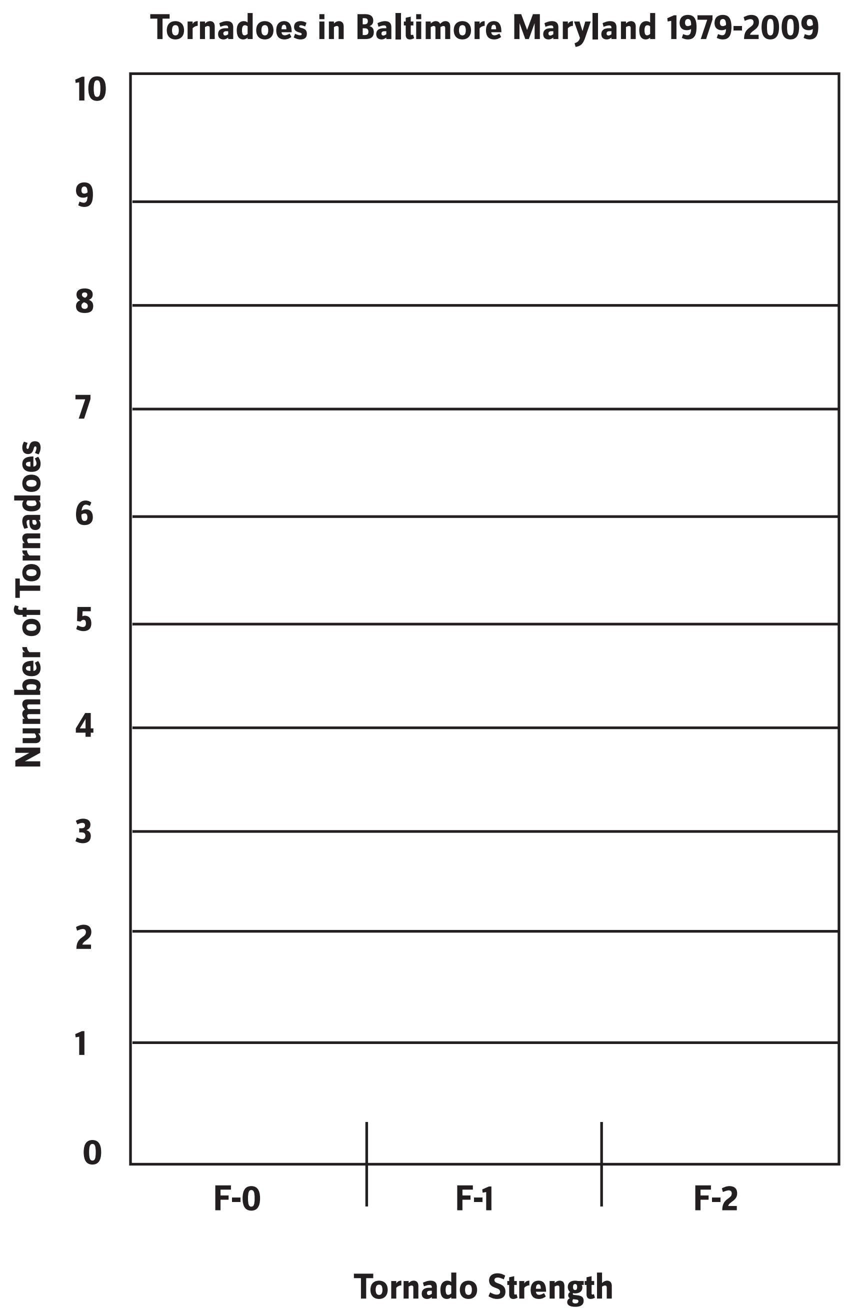
Thank you for all of your help. We can't wait to see what you come up with!

Sincerely,
Your friends at MSC

Tornadoes in Baltimore, Maryland: 1979 - 2009

Create a bar graph showing the number of F-0, F-1, and F-2 tornadoes that have hit Baltimore, Maryland.

Month	Year	Strength
June	1979	F-2
September	1979	F-2
June	1990	F-0
October	1990	F-1
October	1990	F-2
September	1993	F-1
November	1994	F-1
July	1995	F-1
July	1995	F-0
July	1996	F-0
July	1996	F-1
November	1996	F-1
March	1997	F-0
July	1999	F-0
May	2000	F-1
September	2001	F-2
June	2007	F-0
June	2007	F-0
June	2009	F-1



Student Design Sheet

Team Members:

____

Imagine & Plan: What will your model look like? What materials will you use?

Create: Use the provided materials to build and test your model.

Improve: What changes can be made to your design to make it better fit the needs of the Maryland Science Center?

Design Challenge Rubric

Team Members: ______________________________

Engineering Principles	Points Earned	Possible Points
Ask · Found the most common tornado for Baltimore City – 1pt · Designed a model structure for high speed winds – 1pt · Tested the design to ensure it is a good solution – 1pt		3
Imagine & Plan · No evidence of plan – 0pts · Limited, vague sketches – 1pt · Sketches and plans reflect understanding of the engineering design process – 2pts · Sketches and plans reflect understanding of the engineering design process and attention to the client's needs – 3pts		3
Improve · No evidence of further development – 0pts · Uninformed or unreasoned changes were made to the model – 1pt · Informed structural changes were made to the model – 2pts · Informed structural changes were made to the model; final design addressed client's needs – 3pts		3
Total Points Earned =	/	12

Key Terms

Model: Represents how something acts or looks in the real world. Examples include a diagram, drawing, physical replica, diorama, dramatization, or storyboard.

Tornado: A rapidly spinning column of air that can form during thunderstorms.

Fujita scale: Measurement of the strength of a tornado based on the destruction it causes. The scale ranges from F0 tornadoes that cause little damage, to F5 tornadoes which cause massive damage.

Engineer: The process of, or the person who, uses a combination of science, mathematics, and art to design or build something useful to solve a problem.