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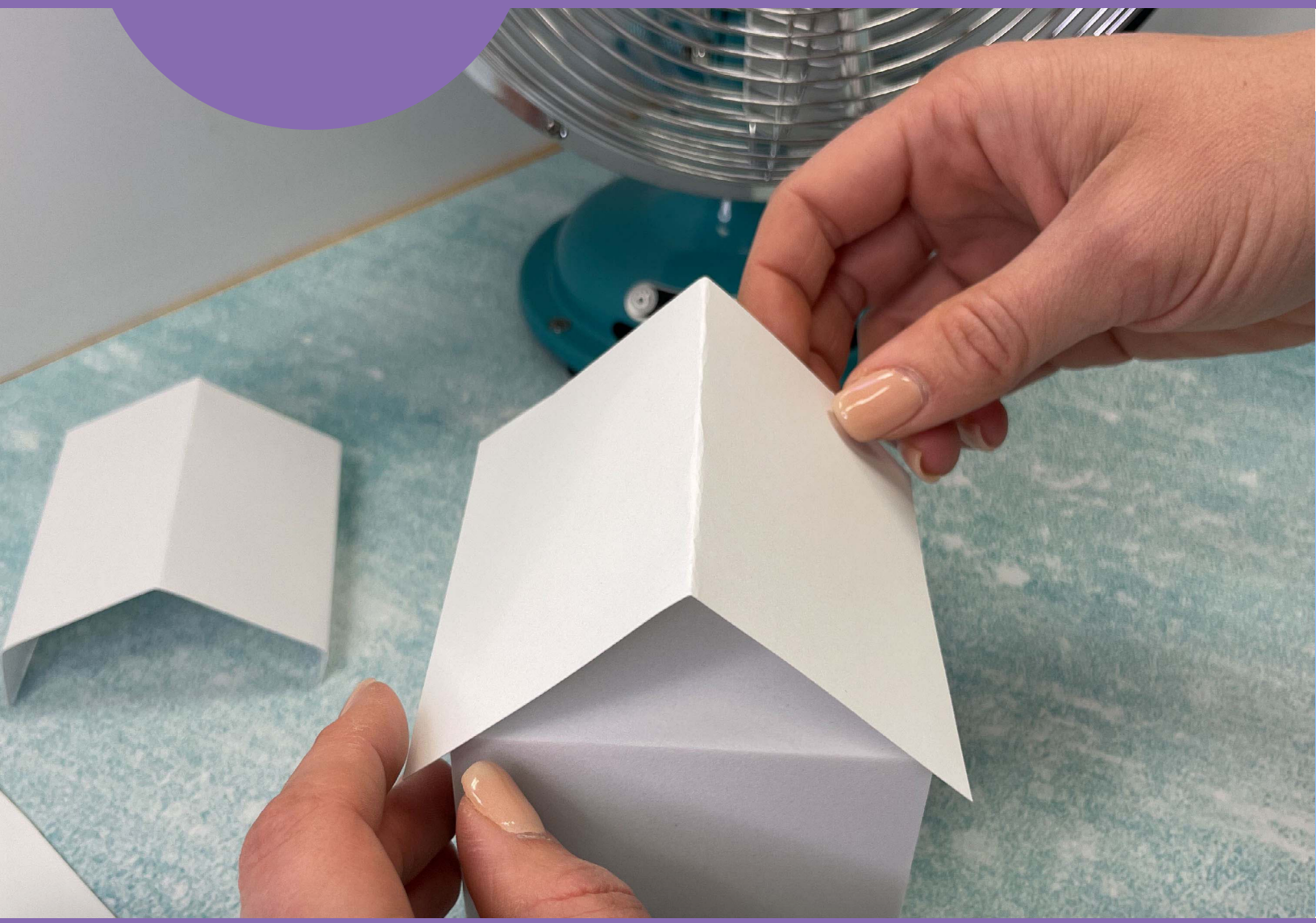
SCIENCE, TECHNOLOGY, ENGINEERING & MATHEMATICS

#SeaworthySTEM

Brace Against the Wind

Grades 3-5

Teacher Guide



Seaworthy STEM™ in a Box Series

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Brace Against the Wind

Teacher Guide for 3-5

Seaworthy STEM™ in a Box Educator Kit description:

Seaworthy STEM™ in a Box activities are a Navy initiative to provide enhanced Naval-relevant, standards aligned, hands-on activities to K-12 teachers and students. Components of this program include, curated sets of classroom activities that aim to build deep conceptual understanding in Naval-relevant content areas. The kits also includes comprehensive lesson plans, material lists, scientific background information, STEM related literacy books, and student activity sheets. The Seaworthy STEM™ in a Box program is designed to support teachers as they select content, acquire materials, and implement more hands-on STEM activities in their classrooms. Increasing student access to hands-on STEM activities, also increases awareness of STEM career paths, engage students in STEM, and support development of student's abilities in STEM content.

The Seaworthy STEM™ in a Box kits were designed to guide students through the scientific inquiry-based theory and the engineering design process. The content and Naval-relevant activities are aligned with the Next Generation Science Standards. The topics and content covered within the lessons are connected and scaffolded based on distinct grade bands (K-2nd, 3rd-5th, 6th-8th, and 9th-12th).

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Table of Contents

Lesson Title: Brace Against the Wind

Time:
1 Class period (45-60 minutes)

Student Objectives:

Students will gain knowledge about severe weather and the negative impacts it can have to our cities. Students will work together to design and build paper houses to withhold severe winds. Students will utilize the iterative design process to secure a roof to a paper house that will not blow away.

Lesson Overview:

This lesson is designed to teach students that severe weather; such as hurricanes, can have a negative impact on civilization. Students will learn about environmental engineers and their research to develop structures that can withstand severe weather conditions. Designing safe weather shelters are crucial to protect people and vehicles such as boats. Students will learn about different shapes and types of roof designs. Students will use the re-design method to find the best roof solution to withstand high winds. The students will likely conclude that a hip roof is best solution to use.

Next Gen Science Standards:

4-ESS3-2
3-ESS3-1

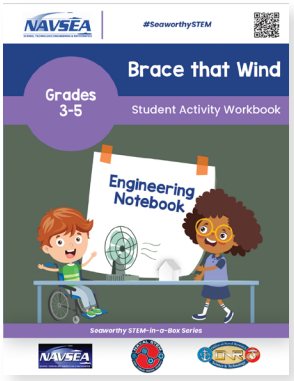
Notes

Materials and Equipment List:

- ☑ White card stock
- ☑ Cardboard desk divider (Testing area)
- ☑ Fan (Testing area)
- ☑ Scissors
- ☑ Markers
- ☑ Toy boat
- ☑ Stopwatch

Student Activity Sheets/Handouts:

Brace That Wind Student Activity Workbook



Technology Tools:

Stopwatch

Suggested STEM Related Literacy Book:

Feel the Wind by Arthur Dorros

Pre-Procedure:

1. Place the fan on a table. Use Desk divider to create a controlled testing area for paper houses.

Procedure:

1. Students will be given a brief introduction about severe weather, especially hurricanes and the negative impacts to man-made structures.

2. Students will be given the following task and goal to achieve a secured safety shelter.

    A. **The Task:** To create a safe shelter for the toy boat by securing the best roof to withhold extreme weather conditions.
    B. **The Goal:** The roof must stay on the shelter for a minimum of 30 seconds.

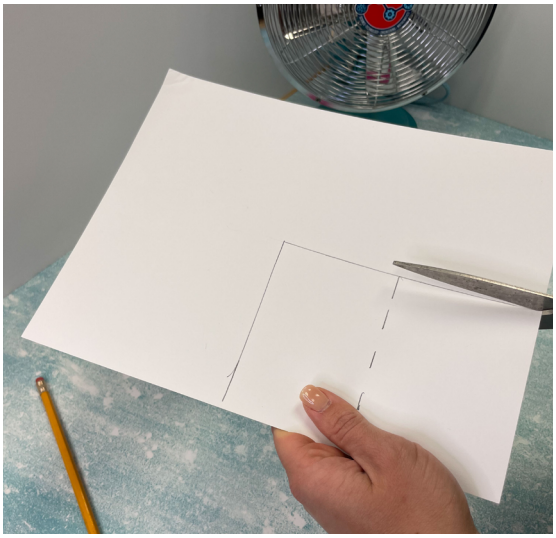
3. Use the following rules for each team during the challenge.

    C. **The Rules:**
    - No tape. (Tape may be used to build and keep the body of the structure maintained but no tape may be placed on the roof.)
    - You may fold or cut paper in anyway.
    - The front of the roof must be placed in the same direction of the front of the house.

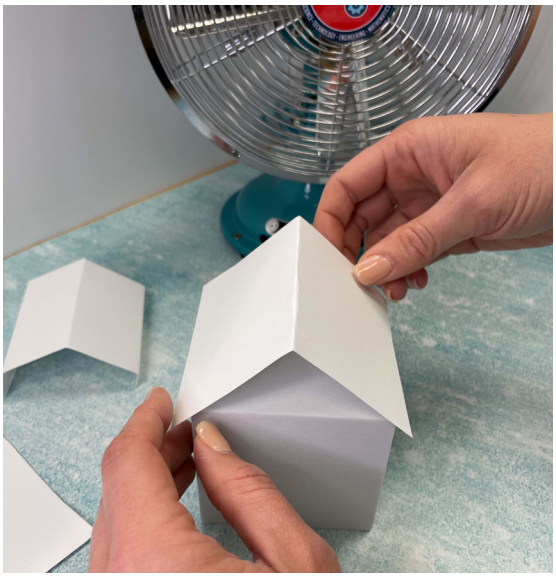
4. The teacher will give students the materials listed and split the class into teams.

Remember to place the boat inside the safety shelter when testing.

5 Give students 15-20 minutes to plan, design, and experiment on making a model shelter that will withstand the hurricane fans. Students can use the structural roof guide in the engineering notebook for help.



6 The teacher will facilitate the testing area and help students test their design. Students will use the stopwatch to time the structure withholding the high winds.



Helpful tip:
You can use tape to secure the body of the house to the table. No tape on the roof.

7 Students will be given time to re-design their model house if a failed attempt in experimenting. (Remember, if the roof falls off before the 30 second goal than the team must go back and redesign a new roof.)

8. The teacher will walk around the room to ensure that all of the groups are using the redesign process in their attempt to find a solution to the problem.

9. After experimenting, the teacher can lead students into writing their observations and conclusions on the activity sheet.

10. The teacher can have a whole group discussion with the class focused on the prompts in the margin.

11. The teacher can finish this activity with the suggested STEM literacy book.

The teacher can have a group discussion with the following questions:

Why or why not did your shelter stay in place?

Do you think the shape of your design is important?

Do you think different materials would improve your design?

What type of materials would you use for your next experiment?

Vocabulary Terms:

- Aerodynamics: The study of the motion of air, particularly when affected by a solid object like an airplane
- Drag: The aerodynamic force that acts opposite to the direction of motion
- Gable Roof: A roof with two sloping sides and a gable at each end
- Hip Roof: A roof with the ends inclined, as well as the sides
- Lift: The aerodynamic force that moves an object upwards

Scientific Background:

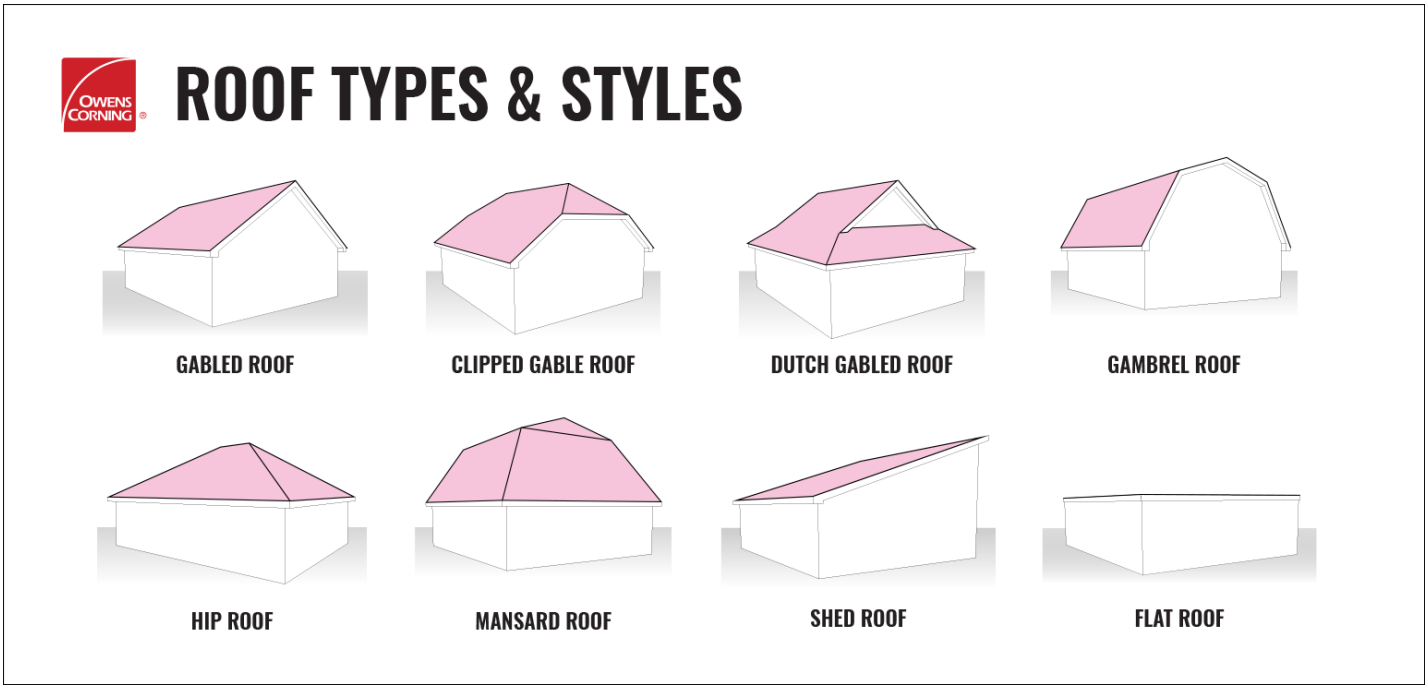
Engineers study climate, air pollution, and weather to address problems which might occur over the course of a building's life. It is crucial for architects and engineers to create and maintain buildings that are strong enough to withstand severe weather. Designing buildings can be similar to designing airplanes when it comes to aerodynamics. For this activity, students will determine the best type of roof for their shelter. The best result is to use a hip roof. Hip roofs are widely considered to be amongst the strongest types of structures.

A hurricane is a type of storm that forms over warm ocean water. It is also called a tropical cyclone. The warm water provides the energy that fuels the storm. A hurricane starts with a small area of low pressure, which means there is less air in that area than in the surrounding air. This low-pressure area causes the surrounding air to rush in, which creates wind. As the wind continues to blow, it causes more air to rise and more wind to form. This cycle continues and the storm grows bigger. When a hurricane reaches sustained winds of 74 miles per hour (119 kilometers per hour) or more, it is classified as a hurricane. Hurricanes are very powerful and can cause a lot of damage. They can produce strong winds, heavy rain, and storm surges (a rise in sea level caused by the storm) that can cause flooding.

STEM Related Career:

- Meteorologist
- Environmental Scientist
- Civil Engineer

Reference Photos:



https://www.ohioexteriors.com/8-common-roof-types

Fun Fact!

When a ship tips due to wind or waves, there is a righting motion caused by several engineered elements that brings the vessel upright once more. This includes the structural weight including placing heavier equipment and cargo below deck to create a low center of gravity. However, there comes a point in which a ship cannot correct itself and will capsize. This is the tipping point or angle of vanishing stability. Knowing at what angle a ship can safely roll and when it is in danger are crucial for naval architects and pilots alike as they work to keep the lives of those on board safe.

Fun Fact!

Even though we are designing paper houses in this experiment, builders wouldn't want to use paper to build an actually shelter! When building a safety shelter, engineers and architects use mental to build the structure's roof. A metal roof can weather hurricane-force winds up to 160 mph, making it the most wind-resistant solution. Metal roofing systems are expensive but they last longer and are more durable than any other types of roofing.

Notes

The Seaworthy STEM™ in a Box curricula was developed through collaborative efforts of a team of individuals at the Naval Surface Warfare Center Carderock Division and Albert Einstein Distinguished Educator Fellows via an inter-agency agreement with the U.S. Department of Energy for the Albert Einstein Distinguished Educator Fellowship (AEF) Program. We are grateful to the following Content Specialists who contributed their knowledge and expertise by researching and writing on selected topics: Suzanne Otto, Stephanie Klixbull, and Thomas Jenkins. We'd also like to acknowledge the contributions of AEF participant Ms. Deborah Reynolds, the inaugural AEF Educator at Carderock that helped inspire the design of Seaworthy STEM™ in a Box content. With the help of Albert Einstein Fellow, Melissa Thompson, and Carderock Outreach Specialist, Ashlee Floyd, special additions to the curriculum such as career portfolios, workforce trading cards, and in-house short story publications are included that reflect the diversity of NAVSEA Sites.

It is the goal of the SeaWorthy Curriculum to embrace NAVSEA technologies from sites nationwide to empower the youth of our nation to purse STEM-centric career pathways. The views and opinions of the Content Specialists expressed herein do not necessarily state or reflect those of the AEF Program, the U.S. Department of Energy, or the U.S. Government. Reference herein to any specific commercial product, process, or service by trade name, trademark, service mark, manufacturer, or otherwise does not constitute or imply endorsement, recommendation, or favoring by the AEF Program, the U.S. Department of Energy, or the U.S. Government.

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