**Blow Blow Blow**

*Teacher Edition*

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**NGSS Alignment:**

MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

ESS3.B Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events.

**CCSS Alignment**

WHST.6-8.1 Write arguments focused on discipline content.

7.RP.A.1 Recognize and understand proportional relationships between quantities.

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**Objectives:**

- Students will analyze and interpret data from various sources.
- Students will design models, and evaluate their design based on data.
- Students will work cooperatively in teams.
- Students will write arguments to promote their design.

**Materials:**

- One copy of each map per group (4 maps using links below, or similar data maps)
- 1 cement block for each group
- 1 small toy man for each group
- Popsicle sticks
- Straws
- Construction paper
- Large roll of string
- Plastic bags
- Plastic Wrap
- Straws
- Rulers
- Hot glue gun and cartridges
- Masking tape
EXPLORING I

- Students will analyze tornado data to determine the specific states that are most in need of houses that are built to withstand tornado damage.
- Students will be organized into groups of 4 and given a map showing the average annual number of tornadoes per state within a certain time period. The NOAA map available at http://www1.ncdc.noaa.gov/pub/data/cmb/images/tornado/clim/ann-avg-torn1991-2010.gif is a great resource.
- Students will discuss the data shown in the map, and identify states that they feel are most in need of tornado protection.
- Groups will then be given a map showing the average annual number of tornadoes per 10,000 square miles. The NOAA map available at http://www1.ncdc.noaa.gov/pub/data/cmb/images/tornado/clim/avg-eff0-eff5-torn1991-2010.gif is a great resource.
- Groups will re-evaluate their previous findings, and redraft their list of identified states that are most in need of tornado protection.
- Groups will then be given a map showing the average annual number of EF3-EF5 tornadoes per state. The NOAA map available at http://www1.ncdc.noaa.gov/pub/data/cmb/images/tornado/clim/totavg-eff3-eff5-torn1991-2010.gif is a great resource.
- Students will discuss the data shown in the map, and redraft their list of identified states that are most in need of tornado protection.
- Groups will then be given a map showing the average annual number of EF3-EF% tornadoes per 10,000 square miles. The NOAA map available at http://www1.ncdc.noaa.gov/pub/data/cmb/images/tornado/clim/avg-eff3-eff5-torn1991-2010.gif is a great resource.
- Students will discuss the data shown in the map, and redraft their list of identified states that are most in need of tornado protection.

CONNECTING I

- What did you observe?
- Did you change your list of identified states?
- What made you change your list of identified states?
- What states do you feel are most in need of tornado protection?
- Is there any other information you would like to have in order to redefine your list again?
- How does the construction of buildings compare in states with a high risk of tornadoes versus those with a low risk of tornadoes?
EXPLORING II

- Regroup students into new groups of 4.
- Each group is given one cement block to use as the house’s foundation.
- Groups are given access to the supply table, stocked with materials listed above.
- Groups will be given one small toy man to use as a scale for building a house. The house must be built to the scale of the toy man, but can be any shape or size. Houses must include a roof, door, and window (made from plastic wrap). Groups will need to determine the design of the house as well as how to attach it to the cement in order to withstand a tornado.

CONNECTING II

- What were your biggest design challenges?
- What part of the design was your group most focused on?
- Why do you think your design will withstand the force of the tornado more than the others?
- Was there anything that your group didn’t agree on?
- Are there any other materials that you wished you would have used?

EXPLORING III

- Each group comes up to briefly explain their design, then places their house into the bottom of a deep trash can. Make sure that the small toy man is placed inside the house.
- Set up a camera so that it is facing the inside of the trash can and begin recording.
- Using a leaf blower, blow air at a 30° angle along the inside rim of the trash can. This should create a spiral effect inside the can.
- Repeat with each group, so that a separate video is recorded for each house.
- Watch the videos and students will record their observations in their journal.

CONNECTING III

- What did you observe?
- What happened to the toy man?
- Were there any materials used that seemed to stand up better than the others?
- Were there materials that did not hold up as well?
- Were there any design characteristics that worked or didn’t work?
- If you were to construct a house in real-life, in one of the states found to be in need of tornado protection, would your current design be successful?

APPLYING
- Regroup students into new groups of 4.
- Groups will create a 2-D model to scale (pencil and paper) for a real life house using design elements from the toy house activity that can withstand a tornado.
- Groups may add any additional external features to the house to enhance the protection efforts.
- Groups will need to present their design and explain the features that are included in the design to protect the house from damage.
- Teachers will give an explanation of 3D printing, and its uses in prototyping and manufacturing. More information on 3D printing is available at http://www.eigerlab.org/3dprinter.html as well as from various websites such as http://www.policymic.com/articles/25011/9-seriously-mind-blowing-things-you-can-make-with-a-3d-printer.
- Individuals will then construct a written argument showing why their design is better than all of the others. Students should include in their argument how having a 3-D printed prototype created and tested would help their design to be improved and eventually manufactured and sold to people living in the states determined to need the most tornado protection.

**EXPANDING**

- Students will research what is currently being done in order to construct homes that can withstand an earthquake.
- Students will research the specific natural hazards that affect the local community.
- Students will research the efforts currently being made in order to predict tornadoes more accurately.