MACGILLIVRAY FREEMAN'S

DREAM BIG

ENGINEERING OUR WORLD

GRADE K:

REACH FOR THE SKIES

Grade level: Kindergarten

Lesson length: 75 minutes (can be broken into smaller parts)

Students investigate shapes and material properties as they build the highest structure they can. They also learn about the ways natural disasters such as typhoons and hurricanes create powerful forces that push and pull on buildings.

In the Film

Shanghai Tower looms 128 floors tall. It is the second tallest building in the world. When engineers built it they had to make sure that its structure could support that great height. But they also had to make it capable of withstanding extremely high winds: the tower is in an area of frequent typhoons, with winds that can reach 215 miles per hour.

NGSS Disciplinary Core Ideas

K-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-PS2.A Forces and Motion

Pushes and pulls can have different strengths and directions.

NGSS Engineering Practices

K-ETS1.A Defining and Delimiting Engineering Problems

Asking questions, making observations, and gathering information are helpful in thinking about problems.

Before beginning to design a solution, it is important to clearly understand the problem.

K-ETS1.B Developing Possible Solutions

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.

Key Words/Vocabulary

Structural engineers: Engineers who design and build bridges, buildings, dams, and other structures.

Structurally sound: What we call a building that is safe for people to be in and that doesn't have anything wrong with it, such as big cracks in it or a tendency to lean over.

Three-dimensional shape: An object that has height, width, and depth, like an apple or a person.

Typhoon: The name used in Asia for a hurricane.

Materials

Per class:

- ☐ Images of Shanghai Tower
- ☐ Ruler or tape measure
- ☐ Box fan

Per student:

- ☐ My Tall Tower Plan handout

Per pair of students:

- ☐ 20 pieces of uncooked fettuccine
- ☐ 1 large piece of newspaper
- ☐ 5 straws
- ☐ 1 yard of transparent tape
- ☐ 20 marshmallows

Teacher Prep Notes

Use uncooked noodles and marshmallows to make some shapes ahead of time to show students before you begin the research phase. Make two triangles and two squares. When it's time to demonstrate how to make three-dimensional shapes out of two-dimensional ones, add the two triangles together vertically so that they join at their apex to create a pyramid. Place two squares vertically and add two horizontal pieces to the top and bottom to create a cube.

Prepare information about typhoons and other natural disasters to share with your students, especially in terms of the pressure such events put on buildings.

Clear a large space so that students can put together their towers on the floor. Alternatively, make sure that pairs have lots of flat surface area on tables to build.

To Do

Determine the Problem or Question to Solve: 15 minutes

1. Before watching the film *Dream Big*, give students an overview of what they are about to experience. This film is about engineering and the ways that engineering can inspire, challenge, and enrich our lives. Give students the following questions to think about as they watch the film:
   a. Of all the structures engineers created in this film, such as bridges, towers, and dams, which one amazed you the most?
   b. Why was this structure so special to you?
2. Debrief as a whole class after viewing the film. Allow students to reflect on the guiding questions you gave them.
3. Remind students about the Shanghai Tower featured in the movie and display the pictures of it. Ask students what they remember about this building.
4. Introduce the design challenge: students will work with a partner to build the tallest building they can, just like the engineers did in *Dream Big*. They will learn how engineers use shapes and materials to support tall buildings and to keep them strong in high winds.

Research and Gather Information: 20 minutes

1. Hand out bags of prepared materials to pairs of students. **Caution:** For safety, be sure to inform participants not to taste or eat any of the materials during this activity.
2. Have students make a triangle and a square with the noodles as the sides and marshmallows as the joints. Ask students to stand the shapes up vertically, and apply pressure to the top. What are the students' observations?
3. Tell students that they can make three-dimensional shapes by adding together two-dimensional shapes. Show students how to make a pyramid and a cube with the shapes you have already made. Have them take turns applying pressure to the pyramid and triangle and reflect on the strength of each.
4. Remind the students that what makes the Shanghai Tower special, other than its tall height, is its ability to stand up in the strong winds of typhoons. Teach about natural disasters such as typhoons and the resulting high-speed winds that blow on buildings and other structures built by engineers, causing them to fall or rip apart if they aren't strong enough.
5. Have students blow on the three-dimensional noodle structure to see how the wind they create affects it.

Plan a Solution: 10 minutes

Ask pairs to look at their My Tall Tower Plan handout, which gives them a place to draw. Instruct students to make a drawing that will guide them as they build their own tower. Show them how tall 2' is and let them know that their own tower needs to be that tall!

If students are unfamiliar with the concepts of criteria and constraints in engineering, take the time now to introduce these two fundamental ideas. Engineers look at challenges through the lens of criteria (what does my device have to do?) and constraints (what are the limitations I face in making, testing, and using the device?). Spend some time as a whole class brainstorming the criteria and constraints of this particular engineering challenge.

Make It: 15 minutes

Once students have drawn their plan, it's time to begin building. Encourage students to use the noodles and marshmallows to make the frame and to use the newspaper and straws to add structural support and strength. As students are building, visit each pair, reviewing what they learned about the strengths of different shapes and how they are using shapes in their design. Allow students to make mistakes along the way and struggle. When they do, ask questions about what the students are observing and ask guiding questions accordingly to lead them to a solution. Avoid offering solutions yourself. Instead, encourage students to test ideas as they build.

Test: 10 minutes

- ☐ Have students remove their hands from the building. Ask, can it stand up on its own?
- ☐ Show students how to measure their building to see if it reaches 2'. Then tell each pair to measure the height of their building.
- ☐ Place a fan in front of the buildings and turn it on low. Ask students what they see happening to their building.

Evaluate: 5 minutes

Allow students to reflect on the following questions:

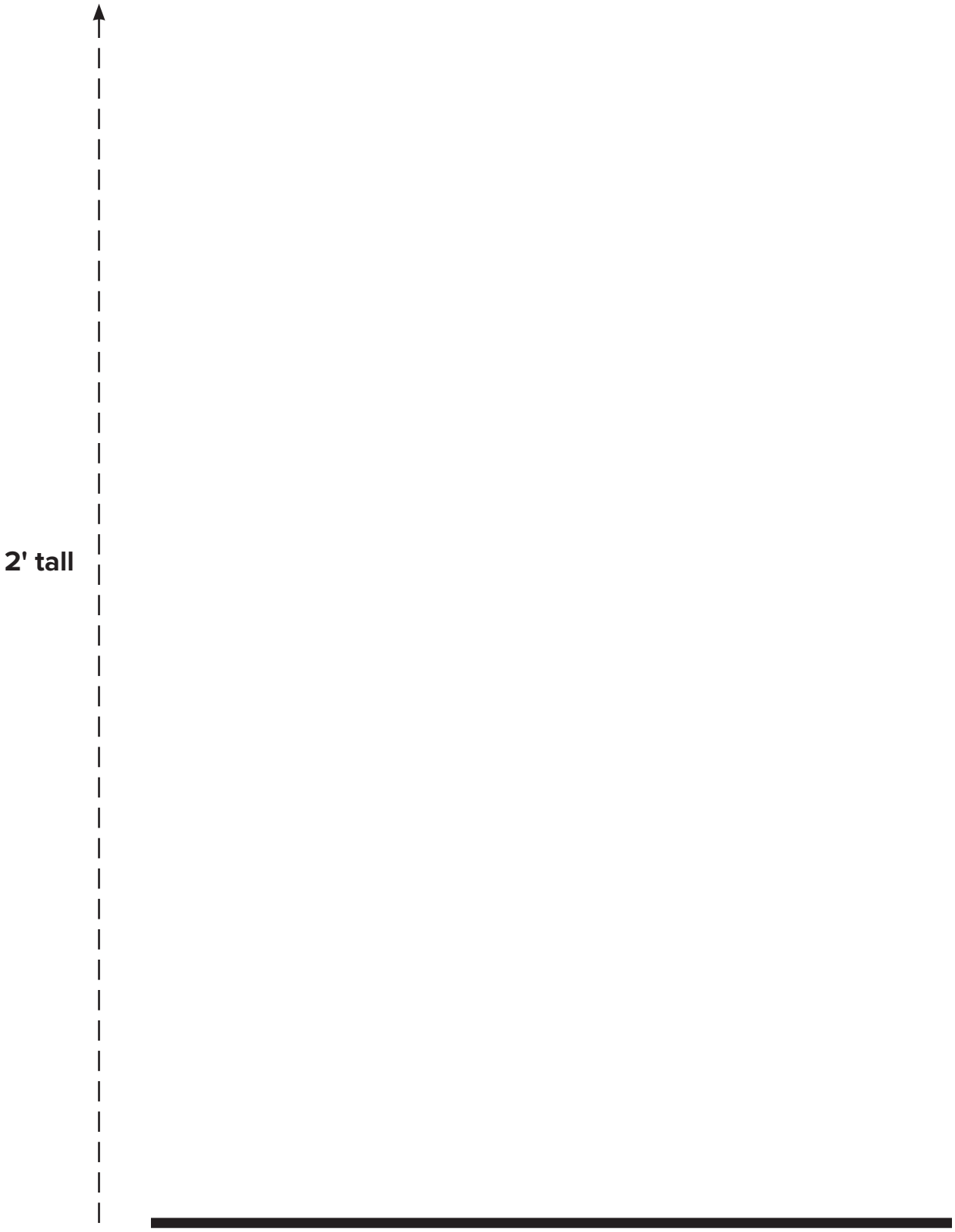
1. What do all the tallest towers have in common?
2. What do you think made them strong?

Taking It Further

Practice shape and number sense by challenging students to count the number of triangles and squares within the frame of their building.

Document your students' work through our social media outlet: #dreambigfilm

MY TALL TOWER PLAN



DREAM BIG VIDEO SERIES

WATCH *HOLDING SWAY: WIND ENGINEERING*

On a breezy day, the top of a skyscraper might move a few inches back and forth. But the high winds of a typhoon can make a skyscraper sway two feet or more! Discover how engineers tricked the wind when they designed the super-tall Shanghai Tower in China, where typhoons roar. Go to discovere.org/dreambig/media-assets and visit Educational Webisodes.

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