

**Project Build:**

**Designed to Survive**

**Activity Station Signs**

# WINDY CITY TOWER

Using **ONLY**:

- 4 sheets of paper and
- 2 yards of tape

build a tower that can **hold a metal washer at least 14" above the ground** and withstand as much wind as possible, without sliding or toppling over. Your structure must be **freestanding**-- no taping it to the ground or other surfaces!

*Too easy? Try making a tower that is at least 20" tall or using less materials!*

# RELEVANT TERMINOLOGY

**Lateral force**: A force in a horizontal direction that pushes against a wall or building. *Ex: wind.*

**Wind load**: The force of wind as it pushes and pulls on a building.

**Wind tunnel testing**: A means of testing how a building, car, or aircraft will do when a certain amount of wind is generated. It enables engineers to study how the wind moves around the object they are testing.

# WHAT IS THE SCIENCE?

- Wind is a lateral force. It blows sideways. When wind blows on a building, it puts pressure on it. But the pressure is different depending on what part of the building it is blowing on and different parts of a building respond differently when the wind blows on them, too.

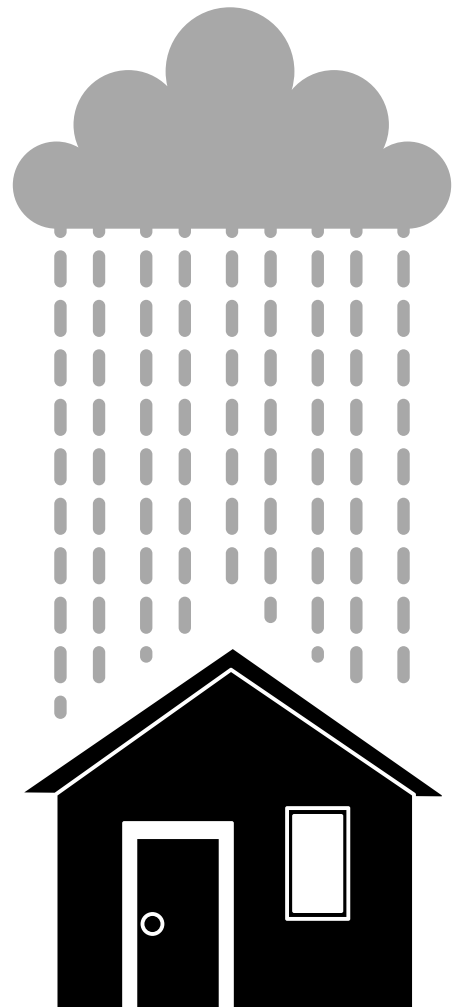
*For example: a gust of wind hits the glass in a window and sometimes makes the window rattle. That same wind, when it blows on a chimney, whooshes around the sides of the chimney instead of slamming into it, so it makes less pressure.*

- Scientists and engineers use tools such as mathematical formulas, computational fluid dynamic computer software, and wind tunnels to predict the effects of wind more accurately than ever before. Before the advent of technology, predicting how wind would affect a structure was much more difficult.

# WATERPROOF THE ROOF

## Your goal:

Using the available materials, construct a roof that will protect your cardboard house from getting wet.



# RELEVANT TERMINOLOGY

**Absorption**: Soaking up a particular substance, either a liquid or gas. It's what a towel does to the water on your body when you dry off.

**Capillary action**: The ability of a liquid to flow in narrow spaces without the help of gravity. This ability is due to attractive forces between molecules. It's why blood can flow through the narrowest veins and capillaries in our body.

**Climate**: The average weather in a given area over the course of several years. For example, a desert has a dry climate, and a tropical rainforest has a hot, wet climate.

**Material science**: The discovery or creation of new materials, usually solids.

# WHAT IS THE SCIENCE?

Engineers who design roofs and the materials for them must consider weather conditions for buildings in a particular climate. For example, in a place where it rains a lot, an architectural engineer would want to design a steep sloping roof so that water rolls off of it rather than sitting on top of it. That is why most roofs are sloped in cold and wet climates.

A materials engineer, on the other hand, is more interested in what the roof is made from so that the materials used allow for water to easily run off the roof rather than be absorbed by it. To do this, a materials engineer would need a deep understanding of roofing materials that easily repel water, like rubber. That is why most roofs, especially those designed for cold, wet climates, include multiple layers of materials that work together to repel water and eliminate absorption.

# QUESTIONS TO ASK:

- Do you think that engineers often change their original plans during the construction process? What do you think this might do to their construction budget?
- If you could have selected some building materials that were not made available to you, what would you have selected and why?
- If your roof design were used on a real building, do you think it would require frequent maintenance? Why or why not?



# SURVIVING STORM SURGE

Using the available materials, try to make a structure as flood-proof as possible!

Will you build up on stilts?

Will you build a barrier?

Do you have other ideas?



# THINGS TO THINK ABOUT

What are some different causes of flooding?

What are some barriers preventing people from flood-proofing their homes?

How do you think civil engineers are working to prevent flooding?



Flooding from Hurricane Florence, September 2018



During and after shots of Hurricane Katrina flooding, 2005



Flooding in Venice, 2012



Workers install a V trench to direct runoff