Paper Tower

Lesson Skill/Math Concept: Teambuilding, Measuring.

Academic Vocabulary:

- **Structure:** The manner in which something is constructed
- **Materials:** The substance of which something is made
- **Form:** Shape
- **Engineering:** Use of science and mathematics to design a structure
- **Force:** The physical power to influence movement
- **Gravity:** Natural phenomenon by which things are brought toward one another
- **Foundation:** The base on which a structure rests

Estimated Time: *45 minutes.*

Materials List

Class materials:

- Sheets of paper
- transparent or masking tape
- measuring tape.

Each team: (2-3 Students)

- one piece of 8 1/2 x 11-inch paper per student
- one foot of tape
- scissors
- pencil

Background Knowledge: Teacher can discuss forms used in engineering structures. The strength of a building material can depend on how it is used. Pleating or rolling paper can increase its stiffness. By crumpling, folding, and otherwise reshaping the flimsy flat sheets and by forming a wide base, students can make their sheets of paper in this activity stand up and reach unexpected heights.

Many forces are at work on towers. Gravity and the dead load of a tower will push down, the ground pushes back up, and small air movements push from the side. A foundation distributes the load into the surrounding ground material and can help balance the sideways wind force. The size of the foundation depends on the strength of the supporting ground. A foundation placed in rock can be smaller than a foundation placed in sand or mud.

RULES:

1. Each tower must be constructed from the paper and tape supplied by the teacher. No other materials or substitutions are allowed.
2. Contestants have a 45-minute period in which to construct their towers. Any modifications made to tower after the allotted 45-minute period will disqualify the tower.
3. Each tower must be free-standing; it must not be attached to or lean against any other surface (e.g. floor, wall, desk, etc.).
4. Towers must stand for 10 seconds.
5. Towers, whether standing straight/erect or sagging/curved, will be measured from base to highest vertical point. Towers that curve or sag may not be straightened and then measured; they will be measured to the highest vertical point while sagging or curving.

Introduction to the Activity: Hold up an index card and announce that you want to stand it up on a table; ask students if they think you can do this — they will probably laugh and say no. Stand the card on one edge so that it falls over. Ask: Is there anything I can do to make this card stand up? Students may suggest changing the shape of the paper by folding it, curving it into a column, or tearing the bottom to make "feet."

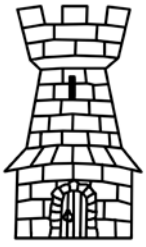
Explain that the students' challenge is to build the tallest tower they can using one sheet of paper per person and the given tape. They will need to get their towers to stand up on their own for at least 10 seconds. Reminding them of the index card, encourage consideration of how they might bend, fold, or tear the paper. Before they begin, students could be asked to predict just how tall a tower they will be able to achieve. What is their prediction based upon?

Before they begin, they should brainstorm all the ways they can alter the paper for better stability. Getting ideas from other groups is okay; this is not a competition, but rather a chance to learn from others' discoveries. The goal is to keep it stable, firmly planted on the desk or table top, making it as tall as possible.

Extensions

1. Allow students to modify their design and build a second tower by taking the best elements from the towers presented.

2. Modify the amount of materials allowed: Include a half of a file folder in the materials, more sheets of paper, more tape, or not use any tape.



Team Member Names

_____ _____

_____ _____

Paper Tower Worksheet

First Design

Team #	Tower Height
1	
2	
3	
4	
5	

Design 2

Team #	Tower Height
6	
7	
8	
9	
10	

Paper Tower Activity Questions

1. To what extent was your team successful in building a tower? What was the height of your tower?

2. What was the most difficult part of building the free standing tower? Describe a problem and your efforts to solve the problem.

3. What changes did you make after beginning construction?

4. What engineering changes would you make in building a new or better tower?