Column Challenge	Grade 3 – Strong and Stable Structures

Lesson Plan

Safety Notes: Use a towel or blanket to protect your work surface from dents.

Description

How strong is paper? Fold and bend paper to see if different shapes lend more strength to a material. Investigate why columns are an effective building element for strong and stable structures.

Materials

- 3 sheets of 8 ½" x 11 paper (you can recycle scrap paper!)
- Masking tape or scotch tape
- A load (a can of soup)
- a piece of cardboard larger than the base of the can of soup
- A towel or blanket

Science Background

We depend on structures to be strong and stable so that we can use them safely. We need reliable load-bearing structures (structures that can support weight) to have houses and buildings, bridges, tunnels, and vehicles.

Columns are among the oldest building elements. Columns are really good at resisting pushing forces (compression) that can take place in a structure, such as when a structure is supporting a load.

Columns do have their limits, and can fail or collapse. They can buckle or be crushed. Crushing happens when the weight of the load is more than the compressive strength of the column can handle. Usually, when a column fails, it's because it's not stable, not because it isn't strong enough. Stability is usually related to the shape and thickness of the column, and if the load is balanced on top of it. Shorter, thicker columns are more resistant to bending than long, narrow columns. If a load is not balanced on top of the column, it is putting more force on one side of a column than others, which can cause a column to buckle.

Does the shape of a column matter?

Activity Procedure

- The goal of this activity is to test three different shapes of columns made out of paper. We are going to test them by seeing if they are going to support a load (a soup can) without collapsing.
- Build a triangular column by folding one paper into thirds (like a letter that you want to fold so it will fit into an envelope) and taping the edges together. Balance the column

on one end, and test it by placing the piece of cardboard on top of the column and then placing your load (can of soup) on top of the piece of cardboard. What happens?

- Build a square column by folding one paper into quarters (in the same way we did for the triangular column, making folds that go across the shorter length of the paper). Tape the edges together to make your column. Balance the column on one end, and test it by placing the piece of cardboard on top of the column and then placing your load (can of soup) on top of the piece of cardboard. What happens?
- Build a cylindrical column by rolling the paper into a tube and taping the edges. Balance the column on one end, and test it by placing the piece of cardboard on top of the column and then placing your load (can of soup) on top of the piece of cardboard. What happens?

Debrief

Shapes play an important role in a column's stability. The more closely a load is applied to the centre of the top of a column, the more stable that column will be. Cylinders are used most often when building columns because, without corners, the shape means that when a load is centred on top of the column, the centre of the load is equally distant from the edge of the column on all sides — so no part of the column should be weaker than the rest. With a square or a triangle, some edges of the shape are closer or farther from the centre of the material. Cylindrical columns are less likely to buckle.

- The square and the triangle columns collapsed. Do you think we could make a column with straight sides that would support our load?
- How important do you think the size of your cylinder is? What would happen if we used a wider or narrower cylinder?
- Why do you think columns are useful in buildings? For example, Science North has concrete cylindrical columns in the building and supporting the ramp. Why do you think columns were used?

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