

# Civil Engineering: The Science Behind Bridges: Paper Bridge

## Hands-On Activity

### Summary:

Students will use 1 sheet of paper to design and create their own system of support for stacks of books. They can change the height, quantity, thickness, width, and placement of the supports. As they stack an increasing amount of books onto their structure, the weight of the load will ultimately crush the supports where then the students can analyze their results and mistakes.

### Engineering Connection:

Civil engineers design bridges, buildings, and many more architectural marvels we see everywhere. This activity gives the students the freedom to design and critically think which arrangement would be the best. They can personally observe their mistakes and what improvement would have led to a stronger design. Ultimately students can discover the difficulties of designing a working and standing design for themselves.

### Learning Objectives

After this lesson, students should be able to:

- Explain how different designs lead to different results
- Explain how integral support is.
- Communicate what strategy is the best after observing the activity and contrasting different designs and efforts.

### Materials List

- 1 Sheet of paper per student
- Scissors
- Books
- Glue, Stapler, Or tape.

### Worksheets and Attachments

- [Presentation Slides](#) (Slide 7)

### Introduction

Have you ever wondered how many tunnels, buildings, and bridges are still standing? How do their supports hold all that weight and not crumble from the gigantic load placed upon them? Before an idea is implemented into the real world models are used. They help engineers, architects, and scientists alike all find out what the best design for a new project will be. In this activity, you will be the designer of a new structure. Your job is to create your own unique support and then test it out. Both compression (When an object is being pushed against itself), and gravity will be your enemies. Try to see how far you go and how creative you can be!

### Procedure

Before the activity:

- Gather a sheet of paper and some scissors.

Students:

1. Each will cut up their paper to create their supports.
  - a. However high, thick, wide, or quantity they desire is up to them
2. Roll up each cut of paper into their supports.
3. Seal or secure them together with either tape, glue, or staples. (Preference or availability depends on the student)
4. Set up the supports in the pattern or arrangement desired.
5. Start stacking books on top of the supports.
6. Go as high as possible, counting the number of books before it collapsed.
  - a. Take a picture as you go. It allows you to be able to demonstrate what you were able to accomplish afterward.

## Vocabulary/Definitions

**Perpendicular** - *At an angle of  $90^\circ$  to a given line, plane, or surface.*

**Tension** - *The state of stress where an object is being pulled apart*

**Compression** - *When an object is being pushed against itself*

**Load** - *A heavy or bulky thing that is being carried or is about to be carried*

## Assessment

### Pre-Activity Assessment

Class discussion: Ask their opinions on what arrangement they think would be best. What would be the best way to secure their support? What is the best type and shape of pillars?

### During the Activity

Have students predict how many books they can hold or engage them by talking about how their progress is so far.

### Post-Activity Assessment

Communicate and present each of the students' towers. (A way to do this is to send the pictures of their towers to an email or a program such as Microsoft Teams to be able to see them all). Then, analyze the faults and successes of their designs. What traits did the strongest designs have? What trait did the weakest have? How did each variable dictate the outcome?

## Safety Concerns

- If stacked too high books may fall over and hit someone. Be vigilant and wary of how high and stable your book tower is.

## Activity Extension

Expand the parameters of the activity by changing the type of paper, quantity, and quality. Perhaps instead of a paper supported tower, the supports would be solid, leaving the balance and organization as a variable.

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## Supporting Program

SYIP 2020 Summer Internship Program partnered with the Academy of Engineering at Hialeah Gardens Senior High School.