

## Activity: Paper Bridge, Part 1

### **Lab 1: Can you build a bridge that holds 100 pennies using 1 sheet of paper?**

A bridge must support its own weight (the dead load) as well as the weight of anything placed on it, like the pennies (the live load). Your paper bridge must span 20 centimeters. The sides of your bridge will rest on two books and may not be taped or attached to the books or the table. Live load must be over the span.

#### **What You Will Need**

- plain paper
- ruler
- 2 books or blocks
- at least 100 pennies *or other small weights*



**Record your answers to all questions on the answer sheet.**

1. Describe how you think the bridge should be constructed in order to support its dead load plus the live load of the pennies. Draw on what you have learned about bridges thus far.
2. Discuss possible ideas with your partner before you start building. What can you do to the paper to make it stronger? When you have decided on a design, construct your bridge.

Place the bridge across two supports that are 20 cm apart. Remember that the space below the bridge must be clear to allow boats to pass!

3. To test your bridge, load it with pennies one at a time, until it collapses. Measure and record the mass that the bridge held.
4. Describe how well your bridge supported its dead load and the live load you placed on it. Was the bridge as strong as you thought it would be? Where did it fail?
5. Redesign your bridge and test it again, using a new sheet of paper. How does your second attempt compare? How can engineers test their plans for building a full-size bridge?
6. Is there a difference in the load your bridge can hold if you put the load in the center of the bridge compared to spreading it out along the bridge? Make a prediction, test it, and record your results.

**Lab 2:** Can you build a stronger 20cm bridge if you have new knowledge, additional materials, and relaxed requirements? Unless specified, requirements are the same as for the first bridge.

Materials/Requirements Bridge 2	Materials/Requirements Bridge 3	Materials/Requirements Bridge 4
Two pieces of copy paper No cutting or tearing	A piece of heavyweight paper No cutting or tearing	A piece of copy paper Scissors 6 Paperclips You may cut and have up to two footings/columns that touch the ground.

Each materials list includes books or blocks, a ruler (tool, not building material), and paper.

**Bridge 2:**

7. Describe your bridge's construction.
8. How much did this bridge hold(mass)?
9. Where/how did this bridge fail?

**Bridge 3:**

10. Describe your bridge's construction.
11. How much did this bridge hold(mass)?
12. Where/how did this bridge fail?

**Bridge 4:**

13. Describe your bridge's construction.
14. How much did this bridge hold(mass)? \_\_\_\_\_
15. Where/how did this bridge fail?

**Conclusion:**

16. Which of the three bridges held the most mass?
17. Why, do you think, this is so?

### **Lab 3: What combination of materials and design makes the strongest paper bridge?**

Over the last several days, you have experimented with different bridge materials and designs. You are becoming an expert paper bridge builder. Now you will face the most difficult design challenge yet. You will run experimental trials during the first day of this activity and build and test your bridge during the second day. *Read the requirements carefully and be sure to follow them.*

The materials/tools:

- 3 pieces of copy paper
- 20 cm string
- 10 cm tape
- 1 paperclip
- Scissors (a tool not to be used as a material)

The requirements:

The bridge must span 25 cm (a copy paper is 28 cm).

You may cut, tear, bend, and fold your paper.

The bridge may not be fastened or pinned at the ends with tape, weight, or any other means.

The string may be fastened to the books, table, and/or bridge.

No part of the bridge may touch table under the span, i.e., no footings.

The live load must be distributed atop by a block of wood provided by the teacher.

The assessment:

"The weight that your bridge held" is defined as the total weight at collapse minus the last weight addition.

When all weights have been recorded, the teacher will develop a grading scale.

Paper Bridge Lab Answer Sheet

Name:

Lab 1

Period:

1.

2.

3.

4.

5.

6.

Lab2  
Bridge 2

7.

8.

9.

### **Bridge 3**

10.

11.

12.

### **Bridge 4**

13.

14.

15.

### **Conclusion**

16.

17.