

# LEONARDO'S BRIDGE

Build a robust bridge without glue, fasteners, or rope!



## Curriculum topics

- Forces & Motion
- Engineering/Design

## Subjects

- Engineering
- Physical Science

**Grade range:** 6 – 8

**Who we are:** Resource Area for Teaching (RAFT) helps transform the learning experience by inspiring joy through hands-on learning.

Make a self-supporting bridge designed by Leonardo da Vinci. Be amazed by the ingenious simplicity of his creation! Use Leonardo's idea to inspire a student design challenge.



**Share Your feedback!**

<http://bit.ly/RAFTkitsurvey>

# Materials

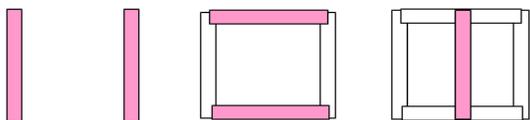
Materials in the kit may vary but generally, this kit contains the following:

- Paint sticks, 10"-12" (18)
- Not included/optional: Weights, scale, ruler

## To Do and Notice

1

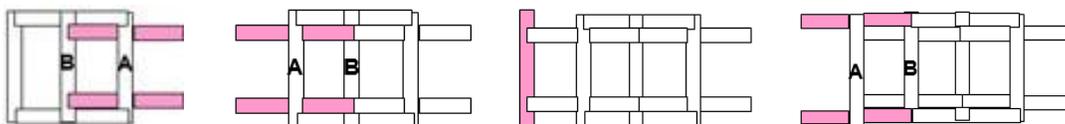
On a flat surface, place two paint sticks (beams) parallel to each other as shown below. Place two more beams on top of the first two to form a square.



For more support with assembly, access this video - <https://bit.ly/3FngJp1>

2

Put the next beam in the middle of the square on top of the others (see above). Use your left hand to gently lift beam **A** 1-2 inches off the table. Be careful not to shift the other beams.

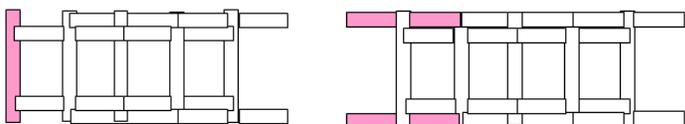


3

Use your right hand to carefully slide a new beam under A and over B (see above). Do the same thing with a 2<sup>nd</sup> beam as shown. Now repeat this process by sliding two beams under **A** and over **B** on the other side.

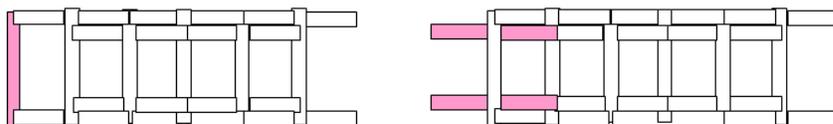
4

To make the bridge longer, add another cross beam as shown above. Slide two beams under **A** and over **B**. Add another cross beam (shown below). Slide two beams under **A** and over **B**.



5

Add another cross beam as shown below. Slide in two final beams. You are **done!**



6

Once the bridge is completed, test it by pressing down with one or two fingers near the center of the span. Look for any shaky connections and make sure the pieces are accurately aligned.

7

Now place a suitable weight on top of the bridge. Start with about ½ kg (1lb) or so. Use a ruler to note how far the bridge deflects (drops) under the weight. Be careful not to overload the bridge.

8

Optional: Calculate the efficiency by dividing the weight of the supported load by the weight of the bridge (below). You may need to first weigh all 18 beams together (unassembled) on a scale.

$$\text{Efficiency} = \text{Weight of supported load} / \text{Weight of the bridge}$$

9

Now try to dismantle the bridge and rebuild it without instructions. You can do it!

10

**Share** your bridge exploration with RAFT! Submit photos/video via email at [education@raft.net](mailto:education@raft.net) or on social media ([Facebook](#), [Twitter](#), [Instagram](#)).

## Core Content Skills:

### Science & Engineering (NGSS)

Developing and Using Models, Planning and Conducting Investigations, Generating and Comparing Solutions, Testing Variables, Forces and Motion, Types of Interactions, Stability & Change, Cause & Effect

### Social Emotional Learning

- Self-awareness
- Self-management
- Responsible decision-making

# The Content Behind the Activity

Modern bridges are built with high-strength materials and carefully-selected fasteners. Design considerations include the weight of the bridge and the load it carries as well as stresses caused by wind and earthquakes. Bridge components are subject to **tension** (pulling), **compression** (pushing), **torsion** (twisting), and **shear** (forces that act at an angle).

Leonardo's arched bridge is brilliant in that the design is self-supporting, requiring no fasteners. Leonardo envisioned using nothing but large logs to build his bridge. The bridge's own weight holds it together. As weight is added to the bridge, its structural elements are forced more tightly together, making it even stronger!



## Reuse

This kit uses 100% reusable materials designed for other uses. To continue making a positive impact in reducing waste, reuse these materials in other projects. Additionally, any unused materials can be collected and delivered back to RAFT.

## Feedback

Please comment on this kit by taking this short survey: <http://bit.ly/RAFTkitsurvey>. Let us know of any material concerns (missing, broken, or poorly fitting parts) as well as any suggestions for improvement.

Visit <https://raft.net> to view related activities!

Bridging the Gap  
Gravity Defying Frog  
Brace Yourself

## Resources

- RAFT Leonardo's Bridge assembly support video - <https://bit.ly/3FngJp1>
- How are bridges so strong? - <https://bit.ly/3ozN5Gf>