STEM Program

Da Vinci Bridges

Have you heard about Leonardo Da Vinci's self-supporting bridge and ever wondered how this bridge defies gravity? Make your own model using paddlepop sticks, and a larger one if you have access to traditional wooden spars.

Did you know that building a no rope bridge is a requirement for Outdoor Adventure Skills (OAS) Bushcraft Stage 5 - Pioneering [I have built a structure that doesn't need ropes to construct.]

The Scouts that tested these instructions wanted you to know that even though these are good, easy to follow instructions, it still might take a few goes to get this to work. So if at first you don't succeed, then try again! You will get there eventually.

Plan

What you will need

- Paddlepop sticks (coloured, OR plain to be marked).
- NB: This could be with chopped wooden dowel or larger pieces, just be aware of the weight of the items in case they fall.
- Skewers (optional)
- Markers (optional)
- Weights for testing (e.g. books)
- Larger wooden spars (if you are going to make a full scale model)

Do

Method

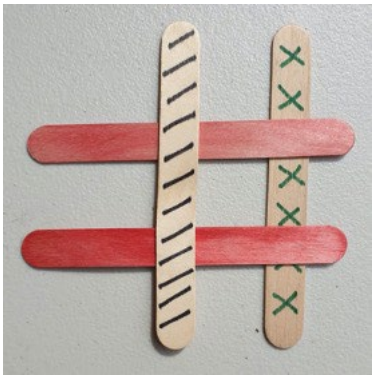
- We've coloured our sticks to make it easier to see how each step works. We're using red and blue sticks to lay horizontally, and "slash" and "cross" sticks to lay vertically. You will be weaving the sticks from left to right.
- Follow the instructions below to build the first section of bridge.
- You can stop here or keep going to make your bridge longer. To keep going see the tips section for help.

Review

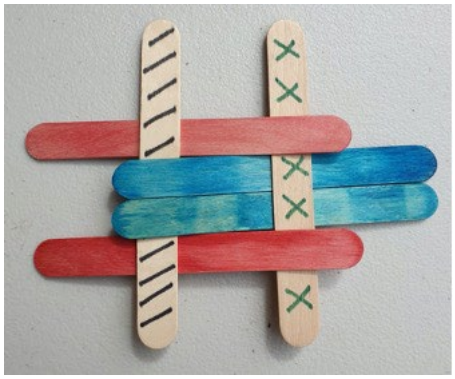
Test some variables

- Good questions to ask about your materials or your bridges are: How much do they flex? How stiff is it? What is its yield stress (how much load can it take before it breaks)? If the bridge broke, what broke? Did a stick splinter, or did the sticks simply pop apart?
- Now you have modelled this with paddlepop sticks, how about making this with larger wooden spars. Make sure you have adequate supervision and have two people carrying each spar.

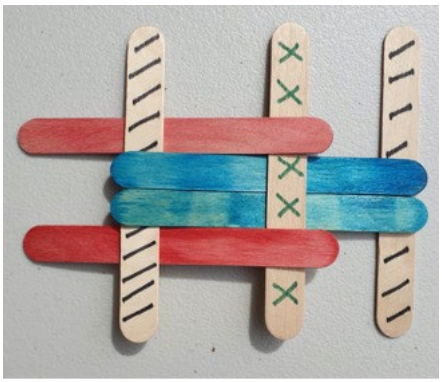
Method Details



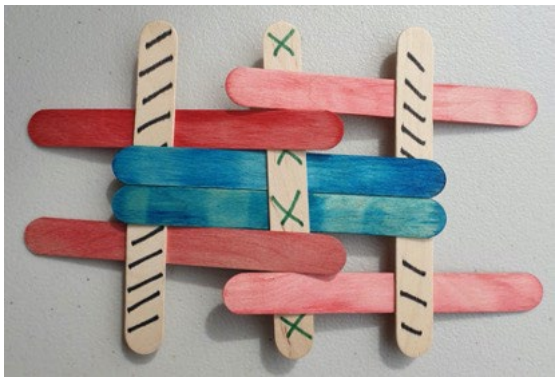
1. Lay out four sticks as pictured. The “slash” stick lays on top of the red sticks, whilst the “cross” stick lays underneath them.



2. Add two additional sticks (blue) by weaving them under the “cross” stick and over the “slash” stick. You may need to hold the “slash” stick in place while doing this.



3. Add a seventh stick (another “slash” one) by sliding it underneath the two blue sticks.



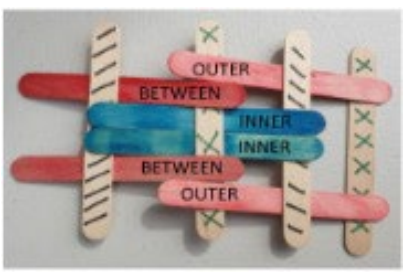
4. Weave sticks 8 & 9 (red sticks) under the “slash” stick and on top of the “cross” stick. If you slowly let go of your bridge after you get these sticks into place, it will raise itself up so that the blue sticks make a platform parallel to the ground.

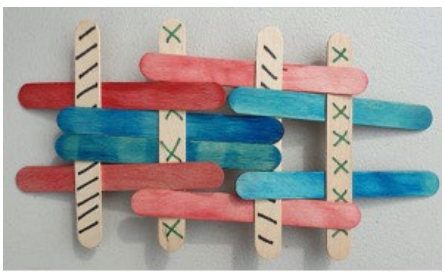
Tips

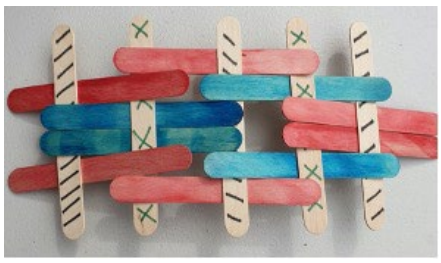
It often helps to slide the new stick in at an angle to start with.

Notice the bridge starts to lift off the surface as soon as you add the blue sticks. Continually hold the bridge flat while you add new sticks, this will allow you to more easily add sticks without worry of your bridge tipping over/falling apart.

Once you understand the pattern you can keep the bridge going further. Notice how the “slashes” and “crosses” alternate, and the horizontal red and blue sticks follow a pattern. Reds always go under “slashes” and over “crosses”, where blues always do the opposite, over “slashes” and under “crosses”. Look at the photos below and you’ll notice they also repeat a pattern of “in between,” ”inner” and then “outer”. (We’ve labelled the first image to make this clearer.)







Why Does This Happen?

The structure is held together by its own weight without requiring any ties or connections, in fact when a downward force is applied to the structure the braced members are forced to interlock and tighten together through the structural concepts of shear forces and bending.

- We have used tongue depressors in these photos, but you can use sticks of the same size OR a combination of different sizes. E.g. Paddlepop sticks for the reds and blues, skewers for the “slashes” and “crosses”.
- At each joint what holds the bridge together is the frictional force between the sticks, which is increased by the fact that they are pushing against each other.
- The choice of materials is pretty important. The “crosses” and the “slashes” experience a lot of shearing force, while the reds and blues experience bending. Picking materials that are good at resisting those specific forces will help make your bridge as strong as possible.

Resources

Build a Da Vinci Bridge with Your Kids – Lesson Plans (craftgossip.com)

YouTube Video: Leonardo Da Vinci Bridge

Variables & fair testing; teaching the heart of science experiments : Fizzics Education

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Science of Outdoors

The Science of Outdoors is a National Science Week project, undertaken in collaboration with Fizzics Education. These instructions and supporting videos were prepared by Scouts for Scouts.

Scouting has always been strong on STEM skills. Maths to calculate catering quantities and navigate, the science of water purification, the physics of abseiling, and the engineering of pioneering structures – they all have their place. In the current program for our youth members, STEM and Innovation forms one of six Special Interest Areas that enable Scouts to set goals and pursue their own ideas.

SciScouts OUTDOORS

Fizzics Education

national science week 2021

An Australian Government Initiative

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