Wright-Patterson AFB Educational Outreach

K-12 STEM

WPAFBSTEM.com

DIY Air Force Activities:

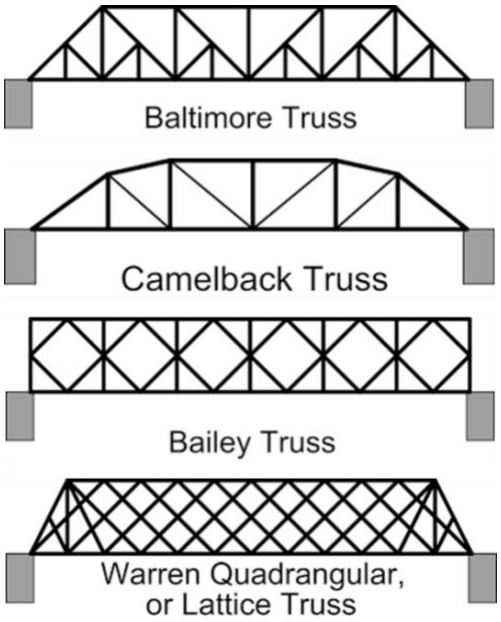
Building Bridges

WOW DIY

WIZARDS of WRIGHT

Materials:

- toothpicks (or craft sticks)
- wood glue or school glue
- wax paper
- 2 bricks or blocks
- paper and pencil
- empty jug (1/2 to 1 gallon)
- water



Bridges are marvels of engineering. Human-kind has been building bridges for centuries. The earliest bridges were likely fallen logs and stepping stones, and slowly evolved into the impressive structures we have today. The Romans were especially well known for their constructions, many of which are still standing. The two main forces behind bridge construction are compression (squeezing, inward) and tension (pulling, outward). A balance of these forces allows a bridge to stand and bear a load. There are many types of bridges, but for our challenge today we will focus on the truss bridge. A truss bridge is constructed from a system of diagonal bars that form triangles, called trusses. Triangles are a very strong shape! There are many different types of truss bridges, a few of which are shown to the left. Your challenge today is to create your own truss bridges and test their load bearing capacity (how much weight they can hold). Compete with yourself or friends!

Directions:

1. Use your pencil and paper to plan your design. This is a very important step! Feel free to do some more research on bridge design for inspiration!
2. Print out graph paper (it helps you keep your structure straight and to make sure both halves line up). Place wax paper over top and tape it down. You could use a spare piece of cardboard for support.
3. Begin to build! Dip the end or side of one toothpick in the glue to connect it to another. Working on the wax paper keeps it from getting messy and allows you to pull the paper off and trim excess glue. It is best to build each side, let them dry, and then connect them at the bottom, followed by the top. You can use single toothpicks or double them up! Building with craft sticks is simpler, while toothpicks present more of a challenge.
4. Once you have constructed your bridge, give it 24 hours for the glue to set.
5. Now place each end of your bridge on your bricks or blocks so it bridges the gap!
6. You can set an empty jug on top and add water incrementally to test how much weight your bridge can hold. You can estimate that one milliliter of water weighs 1 gram. Feel free to substitute weights!
7. Record how strong your bridge was. How could you improve it?

Air Force Associations:

Often the bridges built by the Air Force are theoretical, bridging the gap between cultures rather than rivers or canyons. However, in 2018 The Air Force Academy partnered with the White River National Forest in Colorado to improve the McCullough Gulch Trail Bridge. The cadets designed and installed the new bridge while earning an engineering academic credit.

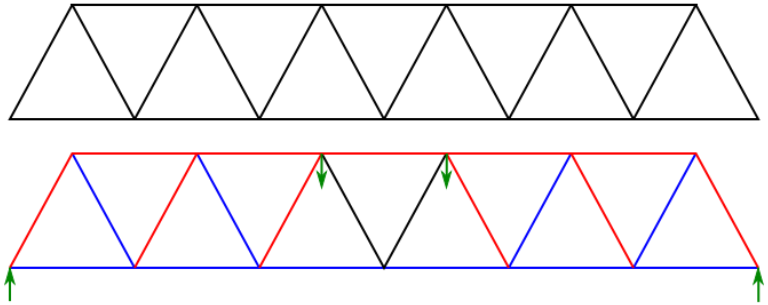
https://denver.cbslocal.com/2018/07/24/air-force-academy-trail-bridge-breckenridge/

WIZARDS of WRIGHT

LEADERS IN STEM EDUCATION

A basic truss bridge, called a Warren truss, is shown to the right along with a simple force diagram. The red lines are under compression, the blue lines are under tension, and the black are under no stress when the bridge is not bearing a load. The green arrows represent the force from gravity pushing down in the center and from the support contact on the outside edges.

https://commons.wikimedia.org/wiki/File:Warren_truss_bridge_with_forces.svg



Begin with a simple design (such as the one to the left) and then create more complicated bridges and see which holds the most weight. You could also have a competition with friends to see who can design and build the strongest bridge!