

Bridge Building Overview: This is a 2.5 week lesson. Students will be asked to build a bridge with the following requirements:

- 1.) Constructed with no more than 50 popsicle sticks
- 2.) Span at least 12 inches
- 3.) Allows a tennis ball to be easily rolled across it
- 4.) Have a stable, flat surface on which a cookie sheet can be rested (for testing purpose)
- 5.) Hold as much weight as possible!

In the first week, students will design and build their own bridge. In the second week, we will test them and ask students to consider what aspects can be improved in their design. Aspirationally, the second week will also be used to complete construction of their redesigned bridge (this is ideal so that the glue can dry completely before testing). The third week is for completing construction and testing the redesigned bridge.

Week One: Initial Build

Purpose: This week, students will build their first bridge. These bridges should be constructed with as little guidance as possible from the mentors. However, the mentors should make sure that the bridge design will meet the first four of the five requirements above.

Materials:

- 50 popsicle sticks per group
- One bottle of wood glue
- Binder clips (for clamping bridge construction)
- Newspaper (to protect work area)
- String cut to 12 inches (or a meter stick) for measuring bridge span
- Cookie sheet (to prep for testing)
- Boxes, tissue paper, and sharpies (for storage and labeling)

Instructions:

1. Discuss the following:
 - a. Why do we build bridges?
 - b. What are some common features of bridges?
 - c. What are bad things that can happen to bridges?
 - d. What can we do to prevent those bad things?
2. Make sure the students understand the five requirements listed on their worksheet.
3. Have the students work together to draw a bridge design on their worksheet. I have provided space to sketch the bridge from three sides in the hopes that they will think through the design of the entire bridge. It may be a good idea to ask them to at least estimate how many popsicle sticks their design requires.
4. Build the bridge! A few tips:
 - a. Use binder clips to hold popsicle sticks together while the glue dries
 - b. Manage your materials! We don't want to end up with some very sad half-built bridges
5. Label the bridge with your students names and store for next week.

Week Two:

Purpose: This week, we will begin by testing the students' prototype bridge. Then we will discuss improvements to the design and build a second bridge.

Materials:

- Same material as above
- Adjustable dumbbells
- Two textbooks to rest the bridges on or testing
- Cameras for slow motion playback

Instructions:

1. Test your bridge: We will have two testing stations that will be shared amongst the whole group.
 - a. Set two textbooks on the ground such that the spines are separated by 18 inches
 - b. Place the bridge such that it spans the space between the books
 - c. Place the cookie sheet on top of the bridge
 - d. Prepare the slow motion video capture
 - e. Starting with the three pound weight, place the weight on the bridge. **BE PREPARED TO CATCH THE WEIGHT IF/WHEN THE BRIDGE BREAKS.** If the bridge holds the weight, continue adding weight in three pound increments.
2. Review slow motion video footage. Hopefully the video footage or the damage to the bridge indicates a particular failure mode.
3. Ask students what can be changed about their design to limit the possibility of the same failure.
4. Have students draw a new or modified design on their worksheet.
5. Build again!

Week Three:

Purpose: Final construction and testing of redesigned bridges.

Materials:

- Same materials as above
- Blow dryer for setting glue from last minute construction

Instructions:

1. If necessary, finish bridge build.
2. Test redesigned bridge as in week 2.
3. Complete final analysis on week three worksheet.