

The logo for 3Doodler EDU. '3Doodler' is written in a blue, bubbly, outlined font. 'EDU' is written in a bold, yellow, sans-serif font.

# Design Challenge

## How Strong Is Your Geometry?

### Facilitator's Guide

#### The Challenge

Test the strength of volumes—both with and without cross bracing—using only the 3Doodler pen and plastic strands.

#### Overview

⌚ Total Time: 50 minutes (1 Class Period)

This Design Challenge asks participants to create various volumes and solids to test their strength. This Challenge is good for building a foundation of 3Doodling skills in creating shapes, welding plastic together and designing for durability.

## ⌘ Challenge Background

### 💡 Take It Further

Make several of the same shapes and play with the amount of cross pieces needed to make your structure durable.



Fig. 1



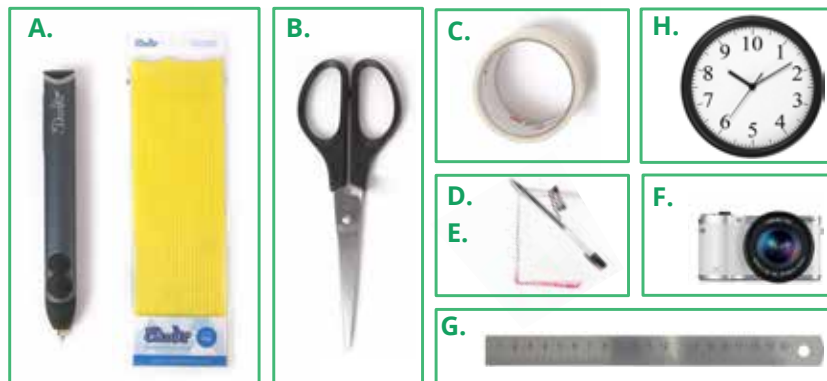
Fig. 2

Have you ever seen an X used between two columns? In construction, cross bracing provides structural support to create a stronger and more stable shape. Cross bracing is used to deal with lateral, compressive and seismic forces in architecture. Arches, squares and trapezoids are all made stronger with the use of cross bracing.

## ✂ Materials & Tools

### 🕒 Before You Start Doodling

We recommend using a DoodlePad or clear tape placed over paper as a foundation to keep your Doodles in place and so that you can peel them off with ease.



- A.** 3Doodler Pens and Plastic Strands of various colors (one per student, or have students work in pairs or small groups)
- B.** Tools (from your 3Doodler box) plus needle-nose pliers or scissors for snipping plastic ends
- C.** Clear plastic tape or DoodlePad for Doodling foundation
- D.** Paper for Doodling foundation and extra sketching/note-taking space
- E.** Drawing utensils (markers, pens or pencils)
- F.** Camera or video recording device to document the Challenge and results
- G.** Metal or wooden ruler to measure and Doodle straight lines
- H.** Stopwatch, clock or device to keep track of time

## ☰ Challenge Organization

### 📷 Challenge Documentation

Take photos & videos of your process using a camera. Document what to do and what not to do. Share your experience with the online community using #3DoodlerEDU!

Challenges are organized into 50-minute periods so they can fit into a traditional classroom structure, or be combined into a single workshop with breaks in between activities. This Challenge is designed to have participants work in short sprints to quickly explore the concepts.

## 🖥️ Class 1: Build, Test & Reflect

🕒 Total Time: 50 min.

### 🧱 Build (🕒 35 min.)

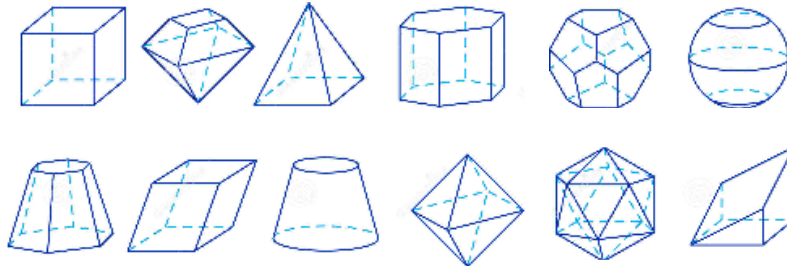


Fig. 3

### ✂️ Remember to Snip Those Ends

We recommend pliers or scissors for snipping plastic ends. Make sure to keep your plastic ends clean to prevent clogs and jams. Snip plastic after removing it from the 3Doodler pen to make sure it's clean for the next time.

**Step 1:** Select a volume to 3Doodle and make it no larger than three inches in any direction. You will make three versions of the same shape with the same dimensions.

**Step 2:** On graph paper, draw a measured pattern of all of the sides of the shape you will create. Make two copies of your pattern to repeat.

**Step 3:** Make all three of the same shape with only the most basic construction and **no cross bracing**.

**Step 4:** Set one shape aside. With the second one, add only one piece of cross bracing on each face of the shape. On the third one, add two pieces of cross bracing on each face of the volume.

### 📝 Facilitator's Notes

Because this Challenge is only one class period, participants should already have basic familiarity and practice using the 3Doodler pens. Cut up slips of paper and have participants select a volume to create three times using various levels of additional structure. The first shape should have only the most basic outline of the volume. The second shape should add one additional support strand and the third one should have two additional support strands.

### 🧐 Test & Reflect (🕒 15 min.)

**Step 1:** Gather around a display table and test your shape by placing increasingly heavy objects on it. Time how long it takes for each shape to collapse.

**Step 2:** Consider and discuss how the structures differ and what makes one stronger than another.

## 🔍 More Information:

For further information and inspiration about cross bracing, visit:

- <https://www.youtube.com/watch?v=wkOlz6XI9ic>
- <http://www.wisegeek.com/what-is-cross-bracing.htm>
- <http://goo.gl/JP8Kam>

### 🖼 Images:

Cover Page: [https://upload.wikimedia.org/wikipedia/commons/4/4d/John\\_Hancock\\_Center\\_2.jpg](https://upload.wikimedia.org/wikipedia/commons/4/4d/John_Hancock_Center_2.jpg)

Fig.1: <https://goo.gl/Dz0IKP>

Fig. 2: <https://goo.gl/33wzN>

Fig. 3: <http://tccl.rit.albany.edu/knilt/images/3/34/Graphic2.png>