

# Visualize and Create 3D Geometry

## Grade Span

1-7

## Subject Area

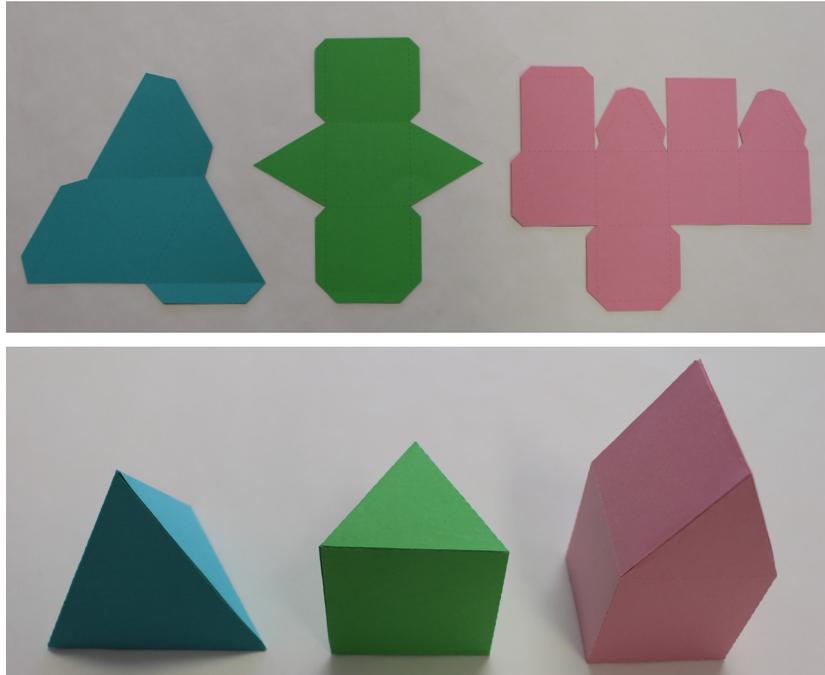
Math

## Materials

- Fab@School Maker Studio
- Digital fabricator or scissors
- 65 lb cardstock
- Glue or tape
- Colored pencils or markers

## Author

Patrick Condon,  
*Digital Media Engineer,*  
*FableVision Learning*



3D shapes are everywhere, and it's important to be able to construct and deconstruct them. Creating and understanding 3D structure can be confusing in your head or on paper, but this lesson and the tools available in Fab@School Maker Studio will have you building complex 3D geometry like a pro!

This lesson covers the visualization and design of 3D geometry in three steps: Platonic Solids, Prisms, and Complex Forms.

## Objectives

- Students will learn 3D geometry through three concepts: Platonic Solids (Regular Polyhedra), Prisms, and Irregular Polyhedra.
- Students will use Fab@School Maker Studio to design, fabricate, and assemble a Triangular Pyramid, Triangular Prism, and House shape.
- Students may then experiment by designing and combining their own shapes.

### Big Idea

Learn to visualize and design 3D geometry

### Driving Question

How can we combine 2D shapes to create 3D shapes?

### Learning Standards

#### CCSS Math

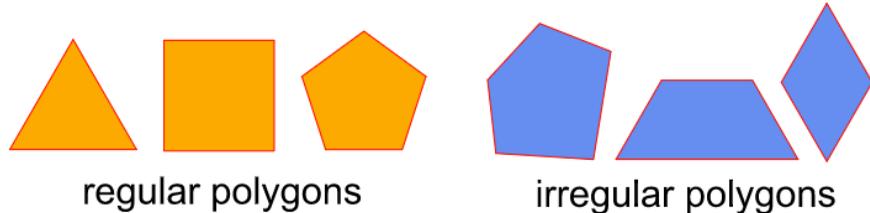
- [CCSS.MATH.PRACTICE.MP2](#)
- [CCSS.MATH.PRACTICE.MP4](#)
- [CCSS.MATH.PRACTICE.MP7](#)
- [CCSS.MATH.CONTENT.1.G.A.2](#)
- [CCSS.MATH.CONTENT.6.G.A.4](#)
- [CCSS.MATH.CONTENT.7.G.B.4](#)
- [CCSS.MATH.CONTENT.7.G.B.6](#)

#### MA DLCS

- [6-8.CT.e.2](#)

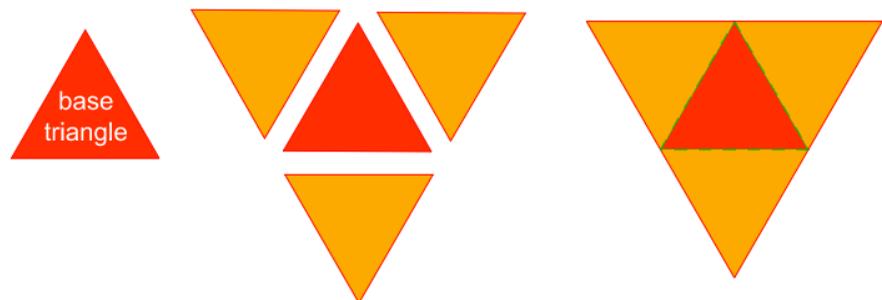
## Step 1 - Platonic Solids

A regular polygon is any 2D shape that has all equal sides and angles. Platonic Solids (Regular Polyhedra) are 3D forms that are constructed entirely out of regular polygons.



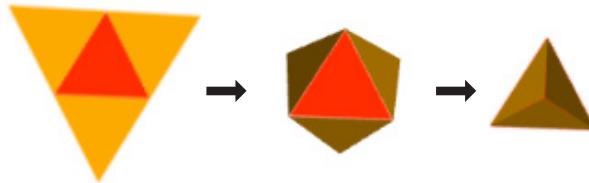
There are only five possible Platonic Solids of varying complexity. The most simple Platonic Solid is the triangular pyramid, which is constructed from four identical regular triangles. There is also the six-sided cube, eight-sided octahedron, 12-sided dodecahedron, and 20-sided icosahedron.

1. In a new Fab@School Maker Studio project, click on the Shapes button to open the Shapes pallet. Click the Triangle or drag it into the workspace.
2. Select the triangle, click the Copy and Paste buttons to create a copy of the triangle. Paste three new triangles, so that there are four total in the workspace.

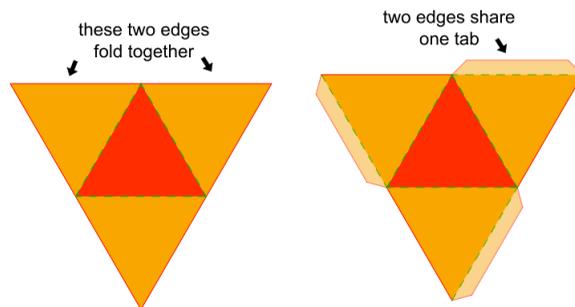


3. Make sure the **Magnetize** tool is activated. Choose one triangle to serve as the base of the pyramid. Rotate and Snap a triangle to the base triangle to create a shared green fold line between them. Do this for the two remaining triangles, so that the base triangle has all three edges snapped to another triangle.

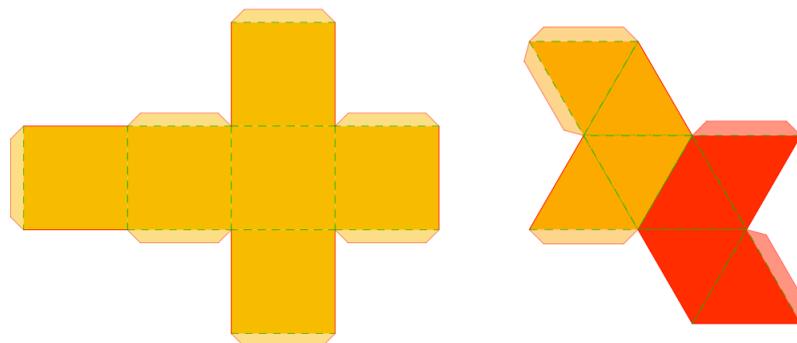
4. Open the 3D View and move the bottom slider form left to right. As the object folds, note where the edge of shapes that were not touching before begin to touch each other. Wherever there are two edges that touch when folded, there needs to be a tab for them to share so the shape can be assembled.



5. Open the Cut Fold Tab tool, select one of the pair of edges that touch in the 3D View, and add a tab to that edge. You may add more tabs than you need and remove during assembly if you are uncertain. Your triangular pyramid is now ready for fabrication and assembly.



6. Platonic Solids can be constructed from triangles, squares, and pentagons. How many solids can you make, using just one regular shape at a time? Here are maps for two more Platonic Solids:



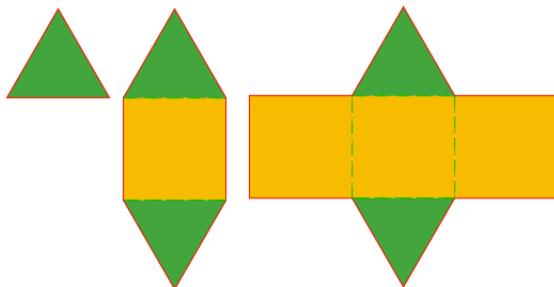
## Step 2 - Prisms

Prisms are forms with an identical shape on either end and rectangles bridging them to give the base shape thickness. Prisms are easy to make, even if they use more than one shape. Below is an example of how to visualize a Triangular Prism and a Rectangular Prism:

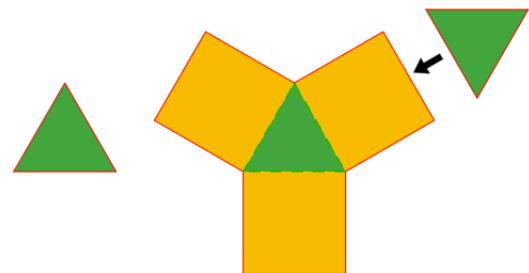


1. Click on the Shapes button to open the Shapes pallet. Click the Triangle or drag it into the workspace. Click the Square or drag it into the workspace. The triangle will be the base and top, and the squares will be the sides of the prism.
2. Snap the square to the bottom edge of the triangle. Snap another triangle to the opposite side of the square. Adding two squares to either side of the first square completes the map for the triangular prism. The length of the square can be changed to affect the height of the prism.

The prism can also be constructed by starting with a triangle base, snapping a square to each edge of the triangle, and adding a triangle to the opposite side of one square to close the shape. Both methods are pictured below:

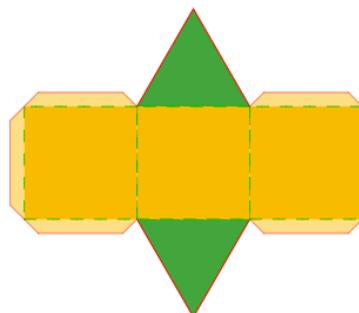


(Method 1)

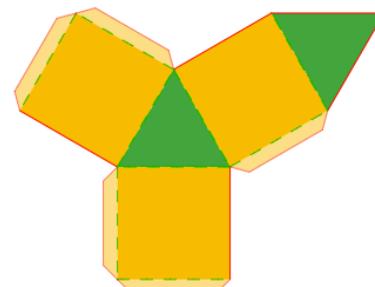


(Method 2)

3. Open the 3D View and move the bottom slider from left to right. Wherever there are two edges that touch when folded, there needs to be a tab for them to share so the shape can be assembled. Add tabs where they are needed. Examples for both are pictured below:



(Method 1)

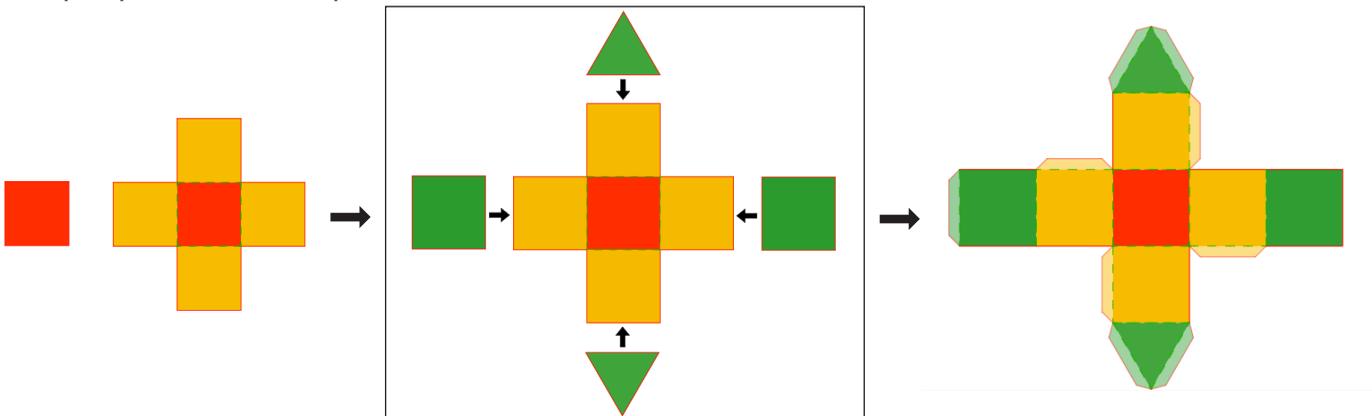


(Method 2)

### Step 3 - Irregular Polyhedra

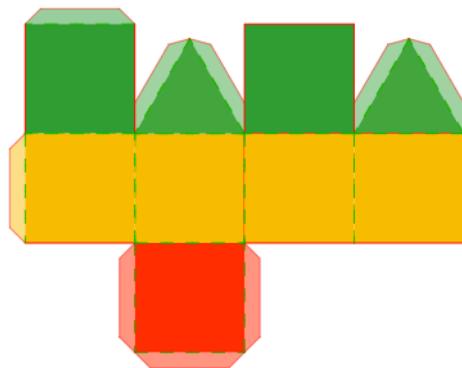
Once you have an understanding of Platonic Solids and Prisms, the world of 3D geometry opens up into a playground of imagination, experimentation, and discovery. To create complex 3D geometry, let's start by combining some of what we already know. We're going to make a house shape out of a Platonic Solid and a Prism working together.

1. The house shape only needs two triangles and seven squares to make. Click on the Shapes button to open the Shapes pallet. Click the Triangle or drag it into the workspace. Click the Square or drag it into the workspace.
2. The base of the house is a cube. Choose one square to be the floor of the house, and snap identical squares to all four edges of the floor to make the walls. You have now made a cube without a top.
3. The roof is a triangular prism. Snap a triangle to the top of a wall and to the opposite wall. Snap squares to the tops of the other two walls.



4. Open the 3D View and move the bottom slider from left to right. Wherever there are two edges that touch when folded, there needs to be a tab for them to share so the shape can be assembled. Add tabs where they are needed. Your house is now complete!

5. There are many other ways to design the house shape. A map for an alternate version is pictured below:



## Fab@School Maker Studio Tips

**Magnetize:** If you want shapes to automatically snap and create fold lines when you drag them together, be sure **Magnetize** tool is on. To learn more about the tool, have students watch the [Fab@School Maker Studio Shapes Tutorial video](#).

**Cut Fold Tab:** Use the **Cut Fold Tab** tool on the left toolbar to change lines and shape edges into cuts, folds, or tabs. To learn more about cut fold tabs, have students watch the [Fab@School Maker Studio Cut Fold Tab Tool Tutorial video](#).

**Math Tools:** Try using math tools like the **Grid**, **Ruler**, and **Protractor** on the left toolbar to measure elements of your design. You can also display the dimensions of a selected object by opening **Settings** on the top toolbar, and selecting **Show Dimensions** in the **General** tab.

**3D View:** Expand the 3D View tool in the lower right to preview your folded construction. Note that the first shape you place will be the base and the construction will fold from that plane. Tabs don't show in 3D View.