



Geometric Build Kit

Kindergarten – Mathematics – Geometry

The Geometric Build Kit is a 3D printing-friendly bundle of parts and educative manipulatives to teach Kindergarten students about two- dimensional and three- dimensional shapes, its components and relative position through hands-on creative and collaboratively activities.

Kit allows to create a myriad of parts and shapes by combining them with commonly used plastic straws. Designed to fit 2017 Common Core State Standards for Mathematics.

Created by Vicente Gascó.

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A. Overview

Students will learn to identify and describe geometric shapes using pre-made 3d printed kits and plastic straws to create both 2D and 3D geometric shapes. Finally, students will work in groups to analyze, compare differences, similarities and discuss the created shapes, its components and their relative position in relation to one another.

B. Subjects

Kindergarten – Mathematics – Geometry

C. Objectives

- Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).
 1. Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to.
 2. Correctly name shapes regardless of their orientation or overall size.
 3. Identify shapes as two-dimensional (lying in a plane, “flat”) or three-dimensional (“solid”).
- Analyze, compare, create, and compose shapes.
 4. Analyze and compare two- and three-dimensional shapes, in different sizes and orientations, using informal language to describe their similarities, differences, parts (ex., number of sides and vertices / “corners”) and other attributes (ex., having sides of equal length).
 5. Model shapes in the world by building shapes from components (ex., sticks and clay balls) and drawing shapes.
 6. Compose simple shapes to form larger shapes.

D. Standards

Objectives are aligned according to:

- Common Core State Standards for Mathematics (K.G. page 12)
- Massachusetts 2017 Mathematics Curriculum Framework (March 2017 – K.G. page 31)
- New York State Next Generation Mathematics 2017: Learning Standards for the New York State Education Department (NY-KG page 24)

E. Preparations

Kits need to be 3D printed beforehand. Plastic straws and scissors (unless straws are pre-cut).

F. Lesson Steps

1. In class, students will learn about geometric 2D shapes and 3D geometries, its elements and how to describe them.
2. Students are introduced to the 3D printed kit.
3. Students are challenged to choose a shape and pick the pieces needed to build it.
4. Students are then challenged to turn their two-dimensional shape into a three-dimensional one and pick the parts needed.
5. Groups are formed so students can discuss and compare their shapes.

6. Shapes are exhibited together to the class and discussed, including different sizes, orientation and position in relation to each other.

G. 3D Printing Instructions

For kit parts the next settings are recommended:

Layer Height: 0.1mm to 0.2mm (100 to 200 microns)

Perimeters: 3

Infill Percentage: 20-25% for sturdy parts

No supports, brim or raft needed on any of the parts.

PET material recommended if printer is capable but PLA also works.

For the solid 2D / 3D shapes you can get more creative. Thicker layers for less printing time. If you drop top / bottom layers and infill to 0 and perimeter to 5 you can get nice hollow parts also.

Recommended settings:

Layer Height: 0.25mm (250 microns)

Perimeters: 3

Infill Percentage: 10-15% for sturdy parts

No supports, brim or raft needed on any of the parts.

PET material recommended if printer is capable but PLA also works.

Colors

You can mix and match colors. Print 2D parts in one color and 3D parts in another for easier recognition.

Straw Fitting:

Parts are designed to fit the most commonly used plastic straw size, considered 'Jumbo' size by the manufacturers, they're usually 6.3mm in diameter. If your straws have another dimension, you can rescale the parts as the next table shows:

Straw Dimension	Scale
7.1mm	112.9%
6.3mm	No scale
5.3mm	83.87%

H. Printing List

Parts needed according to shape for correct assembly:

Number of Planes	Shape	File Name	How many needed
2D			
	Square	square_90degrees	4

	Hexagon	hexagon_120degrees	6
	Rectangle	square_90degrees	4
	Triangle	square_90degrees triangle_45degrees	1 2
	Triangle	triangle_60degrees	3
	Triangle	hexagon_120degrees triangle_30degrees	1 2
3D			
	Cube	cube_90degrees	8
	Pyramid	pyramid_base pyramid_top	4 1

Note: All solid shapes not need to be printed once, except the 'Sphere' which needs to be printed twice (two halves).

I. About the Creator

Vicente Gascó is a product designer, educator and entrepreneur specialized in additive manufacturing (3d printing) and digital fabrication technologies. In the past four years, he has established himself as a 3d printing pioneer in Puerto Rico. He founded Tredé in 2013, a product design studio specialized in 3d printing and digital fabrication. Vicente currently teaches the only 3d printing in class in Puerto Rico and directs Atlantic University College's Fabrication Lab.