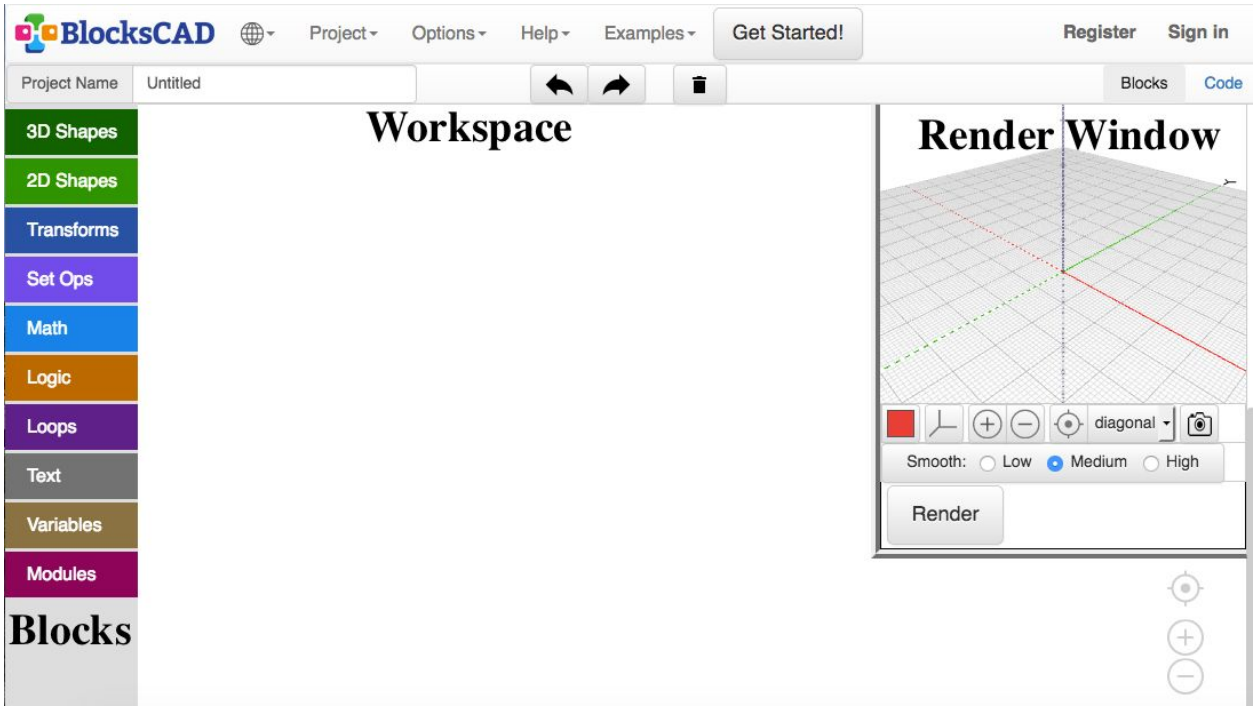
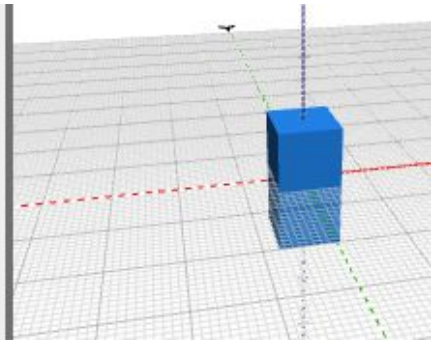
Design Your Own Fidget Toy Using BlocksCAD

BlocksCAD is a programmatic blocks-based computer automated design tool that allows you to design 3D objects for 3D printing. Before we get started, watch this short video as an introduction to the BlocksCAD tool: https://www.youtube.com/watch?v=5RNKVn7IijM

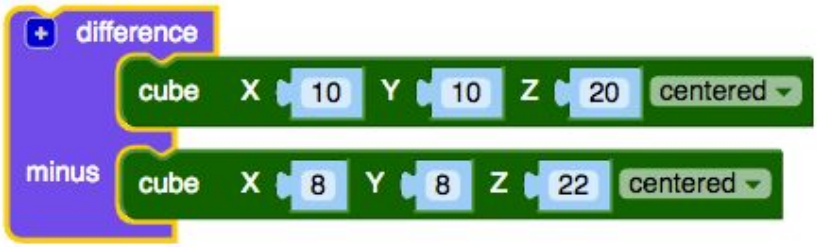


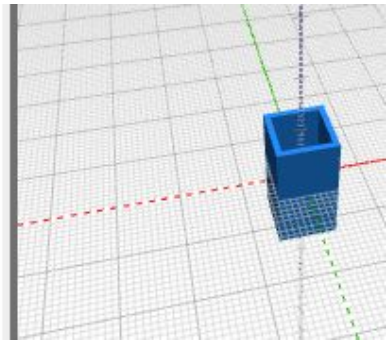
1. Fidget toys are self-regulation tools to help with focus, attention, calming, and active listening. They give tactile students something active, yet subtle, to do with their hands while in a learning space. In this lesson, we will be making a caged ball, which can slide around, making it the perfect 3D print to fidget with.
2. To make a caged ball, we must first make the cage. We start with a centered rectangular prism, which can be whatever height (Z) you would like it to be. Notice, the length (X)

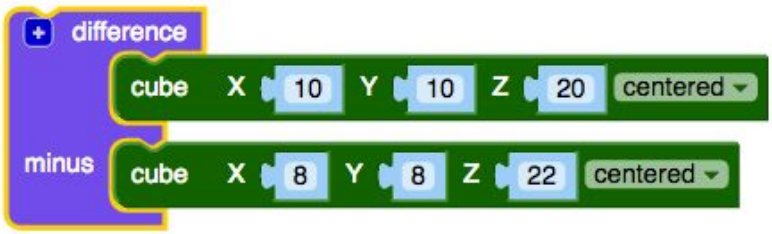
and width (Y) must be equal in order for a spherical ball to fit snugly without falling out.

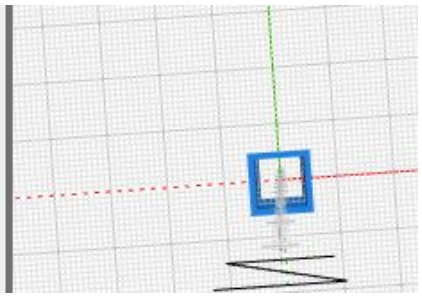


3. Now that you have your starting rectangular prism for your caged ball, you will want to make “windows” or “cutouts” through which the ball can be seen. This requires the use of the difference block. The difference block takes a shape and subtracts one or more shapes from it.
    a. *Something to consider:* For this example, we have decided that the edges of our cage will be 1mm. Your design can make them thicker, but any thinner than 1mm is not very structurally sound during printing and after printing (especially if you’re fidgeting with it)!
4. To create the first set of windows (on the top and bottom of the cage), you want to take the difference between the initial rectangular prism (10x10x20) and a rectangular prism that is smaller (in both X and Y) and longer (Z) (8x8x22). This gives you a hollow box that looks like this:

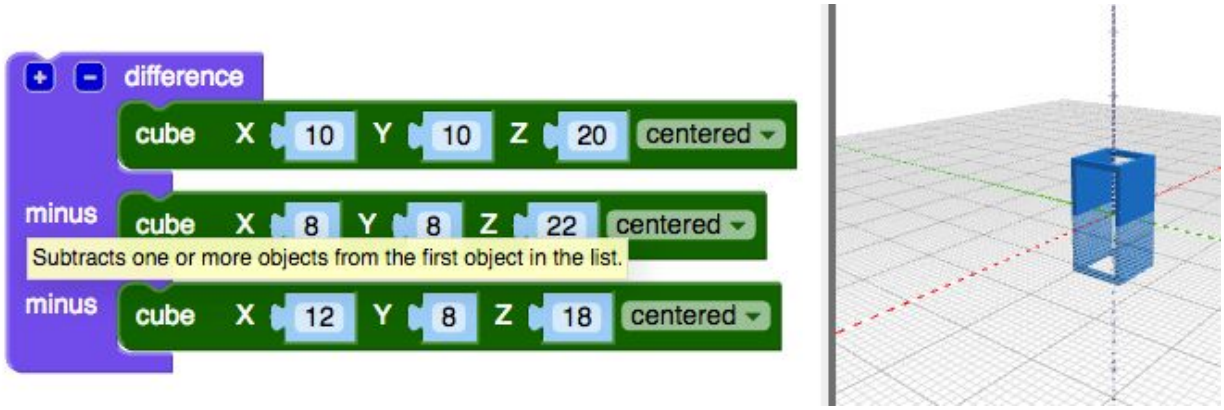


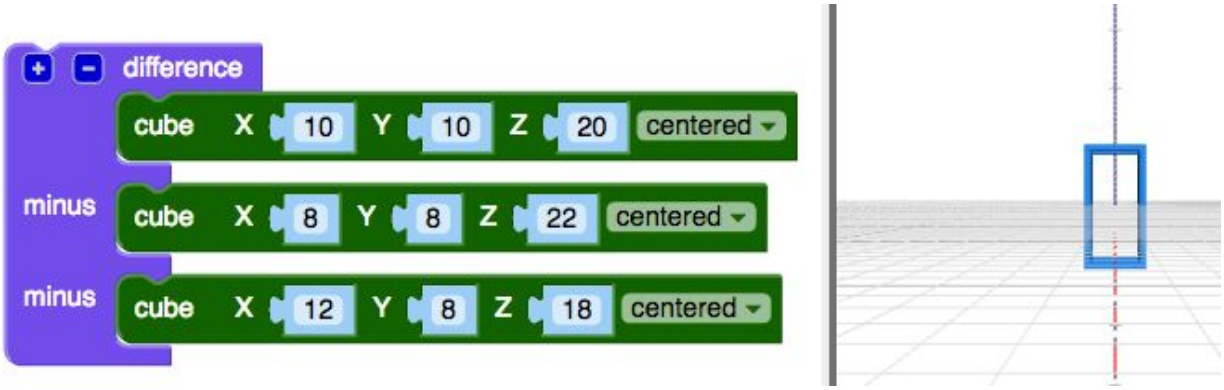




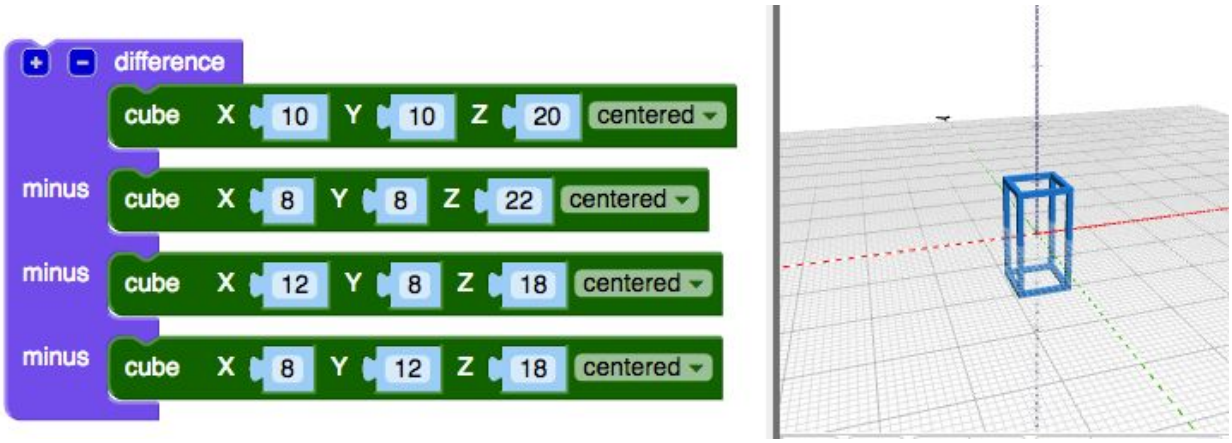


5. Notice that the box above is still solid on four sides. To create cutouts on the other sides, you need to take the difference between the initial rectangular prism (10x10x20) and a rectangle that is longer in X, narrower in Y, and shorter in Z (12x8x18). This, combined with the previous cutouts, will give you a box that looks like this:



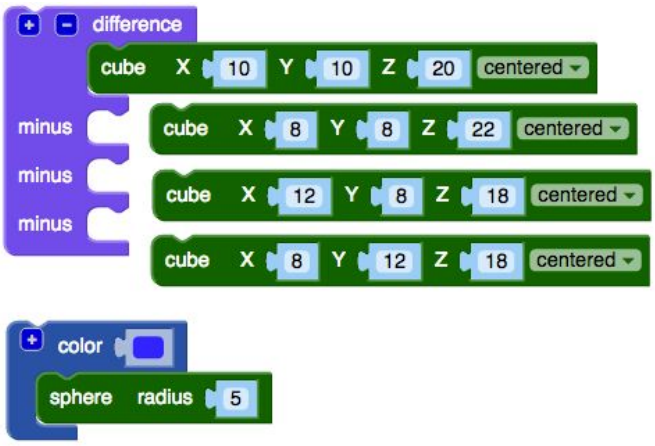


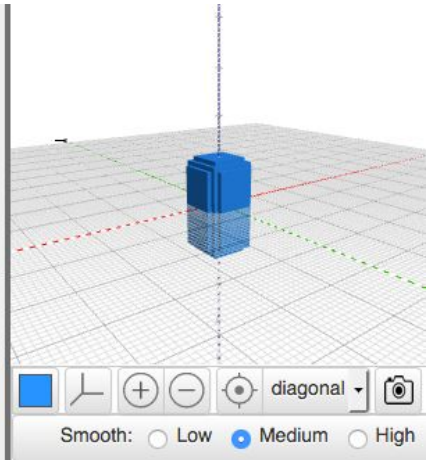
6. This box still has two solid sides. In order to create the last two cutouts, you need to take the difference between the initial rectangular prism (10x10x20) and a rectangular prism that is narrower in X, longer in Y, and shorter in Z (8x12x18). After doing this final subtraction, you will have a fully cutout cage that looks like this:



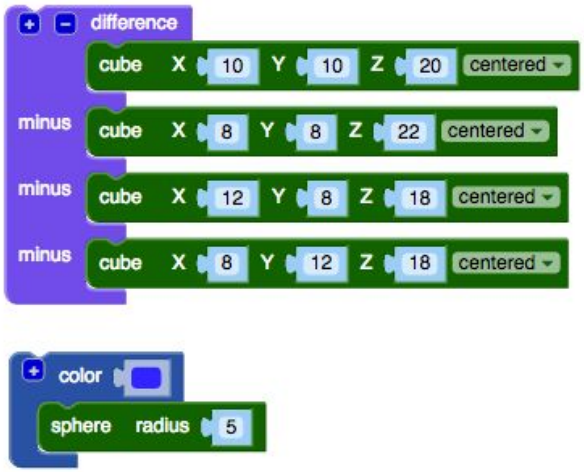
7. If you or students are having trouble visualizing what sized rectangular prisms should be used to create the cutouts, it is worth seeing the boxes outside of the difference block. This will help you or your students visualize what shapes are being “subtracted” from the initial rectangular prism. Here is a visual for what the code looks like when the blocks are

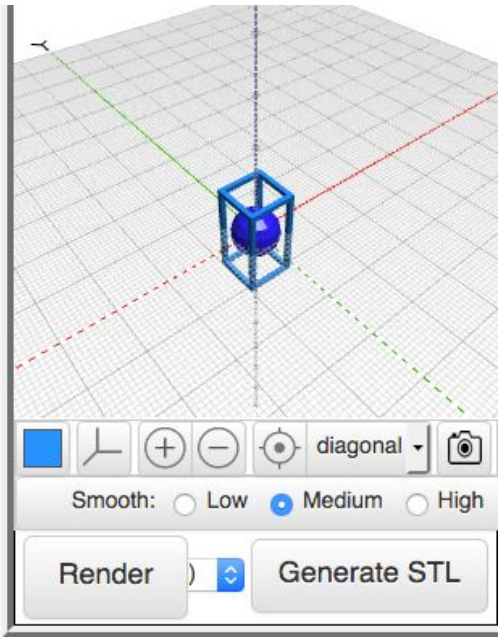
not placed in the difference block:





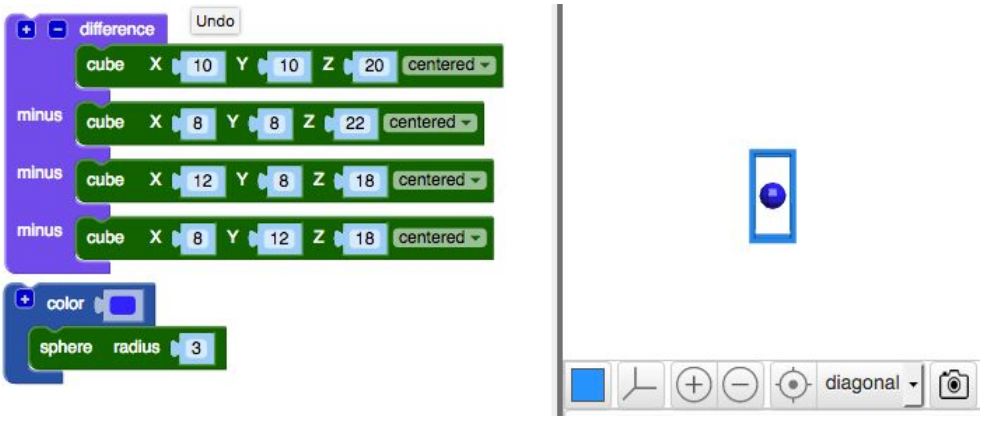
8. The last step of this design is to add the ball into the cage. You want the ball to fit snugly inside the cage, without getting stuck or falling out, and with enough freedom to roll around within it.



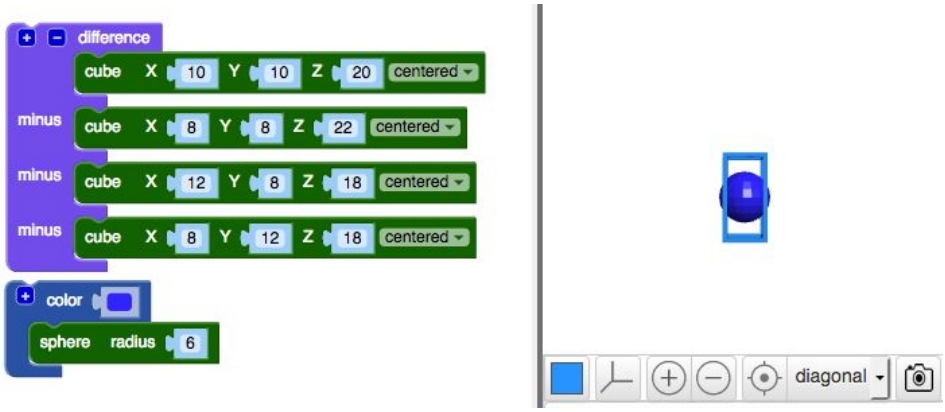


9. Want to check to see if you ball will fall out of the cage? Try moving it around using the “Translate” block from the Transformations menu. Move the ball to the end of the cage and see if there will be room for it to fall out.
    a. In the example shown in Step 8, the radius of the ball is 5, giving a diameter of 10mm. This will fit snugly inside the box, but will not fall out of the 8mm cutouts.

b. In the example below, the ball is too small (a diameter of 6mm), and will easily fall out of the 8mm cutouts.

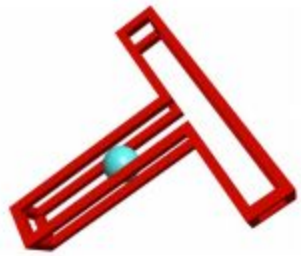


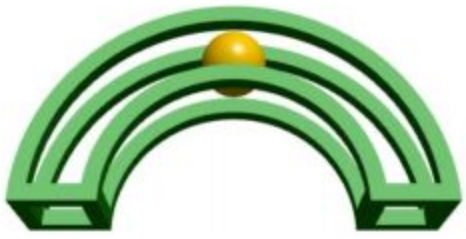
c. In the example below, the ball is too large (a diameter of 12mm) and sticks out of the sides of the cage, making it more likely to get stuck.



10. To print your design, simply click the “Generate STL” button in the render window. This will export your design and save it as an .stl on your computer. From there, you can import it into any slicing program and print it on any 3D printer!

This design too easy for you? Try something a little more challenging:





For more information about BlocksCAD for the classroom, please contact: info@blockscad3d.com

Common Core Math Standards

- CCSS.MATH.CONTENT.HSN.Q.A.2 - Define appropriate quantities for the purpose of descriptive modeling.
- CCSS.MATH.CONTENT.HSN.Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- CCSS.MATH.CONTENT.HSG.CO.A.2 - Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
- CCSS.MATH.CONTENT.HSG.CO.D.12 - Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).
- CCSS.MATH.CONTENT.HSG.MG.A.3 - Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Next Generation Science Standards - Engineering Design

- HS.ETS1.2. - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

ISTE Standards

- ISTE.1.B. - Engage students in exploring real-world issues and solving authentic problems using digital tools and resources.
- ISTE.3.A. - Demonstrate fluency in technology systems and the transfer of current knowledge to new technologies and situations.