

BlocksCAD SnowFlake Step-By-Step Lesson Guide

Overview

Project Description:

Students will create a 3D design for a snowflake by writing a program to rotate a shape around an axis (using a loop). By changing the shape to be rotated, and the number and size of the rotations, you can easily customize the snowflakes.

To do this lesson in BlocksCAD, students will have to learn how to

1. Create Shapes
2. Translate (move) shapes around a three-dimensional coordinate system
3. Rotate shapes
4. Use a loop to repeatedly rotate our shape to create a snowflake

We'll go through all these in the process of creating a very simple snowflake.

We recommend that educators first go through these simple steps to get familiar with the lesson, and then go through the same steps with students to teach them how to use BlocksCAD. After you've done these steps together, students can then customize their snowflakes to make amazing & intricate designs!

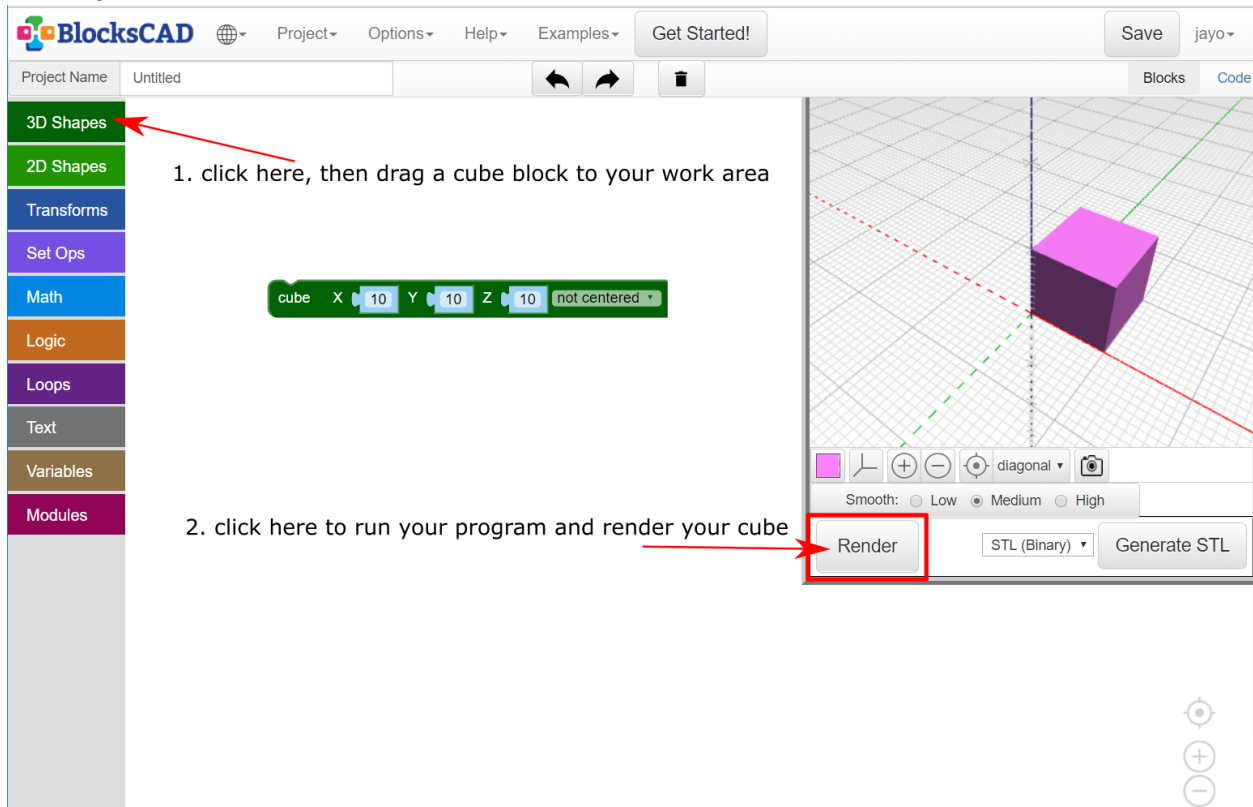
We have a series of YouTube videos at our YouTube channel that show how to do all the skills necessary to do this project (Shapes, Translation, Rotation, Loops). Visit it at <https://www.youtube.com/channel/UCovK2cRljoaZNzRwpQP2sFg>

Lesson Plan and Activity

We are including a step-by-step process to create a simple snowflake. We recommend that you do this with your students to teach them the basics, and then let them go wild customizing their snowflakes!

1 - Creating Shapes

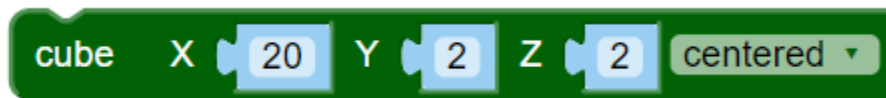
To create a cube shape, click on the “3D shapes category”, then drag a cube out onto the white working area.



The screenshot shows the BlocksCAD software interface. On the left, a vertical sidebar contains various categories: 3D Shapes (highlighted in green), 2D Shapes, Transforms, Set Ops, Math, Logic, Loops, Text, Variables, and Modules. A red arrow points to the '3D Shapes' category with the text '1. click here, then drag a cube block to your work area'. Below this, a code block is shown: 'cube X 10 Y 10 Z 10 not centered'. On the right, the 3D workspace shows a purple cube on a grid. A red arrow points to the 'Render' button in the bottom right corner of the workspace with the text '2. click here to run your program and render your cube'. The 'Render' button is highlighted with a red box. Other interface elements include a menu bar at the top with 'Project', 'Options', 'Help', and 'Examples', and a 'Save' button.

You can change the numbers for the X, Y, and Z dimensions of the cube.

Next we'll change the cube to be long, skinny, and flat, and then **center** it. Here's what the cube block looks like now:



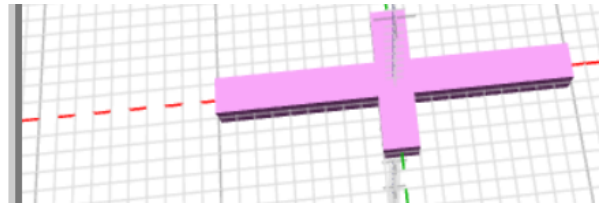
Make sure to hit the “Render” button every time you change your blocks so that you'll see the result of your changes.

Let's add a second cube that is long in the Y dimension. When you render the two cubes, you'll see this:

```

cube X 20 Y 2 Z 2 centered
cube X 2 Y 8 Z 2 centered

```



2 - Translate (move) shapes around a three-dimensional coordinate system

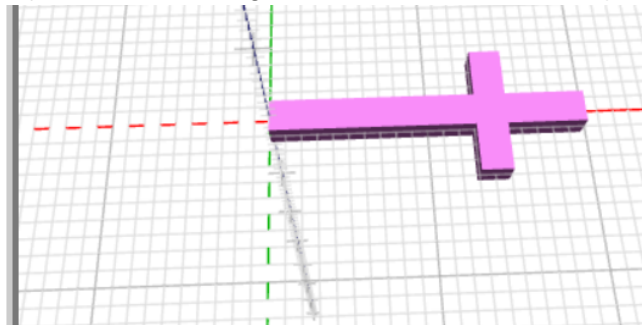
Next, we'll move the cubes so that they make a lopsided cross-shape with one corner at the origin. To move shapes, we'll need the "Translate" block - 'translate' is the mathematical word for moving a shape in space. You'll find the Translate block in the "Transforms" Category (the third category - it is dark blue).

To use the translate block, snap it around the shape you want to translate, and enter how much you want to move it in the X, Y, and Z directions (decimals and negative numbers are allowed).

```

+ translate X 10 Y 0 Z 0
cube X 20 Y 2 Z 2 centered
+ translate X 14 Y 0 Z 0
cube X 2 Y 8 Z 2 centered

```



3 - Rotating Shapes

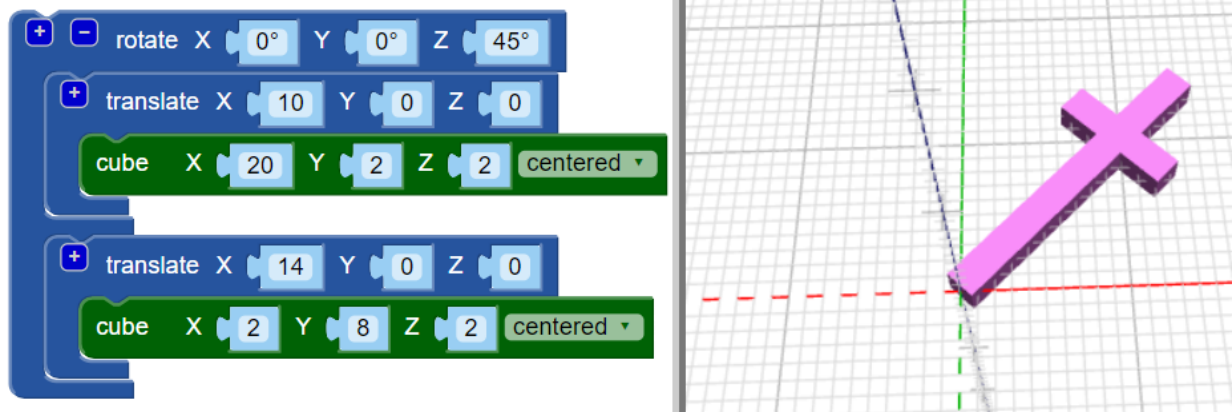
To rotate a shape (or shapes), we'll need a rotate block (all rotations are in degrees). That is the second block found in the "Transforms" category. To put more than one shape inside, click the "+" icon in the upper left of the block.

Shapes can be rotated around the X, Y, or Z axes. Students are often confused which axis to rotate around at first. Encourage your students to use trial and error - first rotate a shape around the X axis, and see if it was what they wanted. If not, set the X rotation back to zero and then try the Y axis, and repeat with all the axes until you find a rotation that was what you wanted!

Notice also that shapes don't rotate around the shape's center, but around the origin of the coordinate space (0,0,0).

You can also watch (and show your class) this video for more information on rotating shapes. (link to rotation, part one and rotation, part two)

Rotating our cubes by 45 degrees around Z would look like this:



4 - Using a Loop to repeat the rotation in a ring

In programming, we can repeat an action over and over by using a “loop”. The loop block in BlocksCAD looks like this (found in the “loops” category):

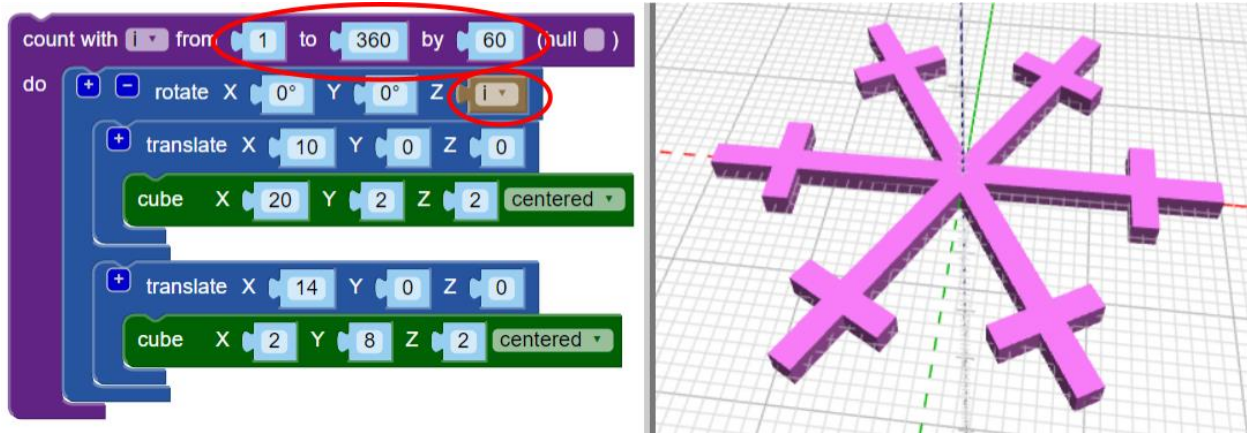


It works by counting with an “index variable”, *i*. The variable *i* is just a label for our count. If we have our loop count from 1 to 3 by 1, it would repeat 3 times like this:

Count #:	1	2	3
Value of <i>i</i> :	1	2	3

We'll use the variable *i* in our program as we rotate our shape.

Put the rotated shape from step 2 into a loop block. Change the loop block to count from 1 to 360 by 60 (this will give us our rotation angles: 1, 61, 121, 181, 241, 301). Lastly, go to the “variables” category and get the variable “*i*” and put it in your rotate block. Your code will look like this:



Congratulations! You've made a simple snowflake. Now the fun begins!

Snowflake Customization

You can customize your snowflake in many ways. Here are some ideas to get you started:

- Change the shape you rotate. You can make very fancy shapes by arranging cubes, and also check out the torus - you can configure this shape to be triangles, squares, etc by changing the number of sides the torus has. Keep the number of torus faces small so that rendering doesn't take too long.
- Change how many degrees to rotate by so that you get a different number of copies of the shape. This can be a great math exercise for your students - teach them that to figure out how many degrees to count by, they can divide 360 by the number of copies of their shape they want. If they want 9 copies of the shape rotated around, they'd calculate $360 / 9 = 40$. Count by 40 degrees in the loop, and they'll see 9 copies of their shape.
- Use two or more shapes, each with their own number of rotations.
- Advanced: Create an angle variable and use the Math block to calculate the exact angle of rotation required for a defined number of loops.