BlocksCAD : Making a cup

inspired by this [BlocksCAD tutorial](#)

Learning

In this project you will learn
- How to rotate shapes
- How to create a container
- How to combine shapes

In this worksheet, read everything. Things you must DO are marked with ☐ to tick when done. *Hints are in italics*

Project
It is not actually very practical to use a 3D printer to print crockery although there are now printers which print with clay suitable for firing. Nor is it really safe to use this plastic (PLA) for food, mainly because the rough surface can harbour nasties.

We will start by making a simple cup like this one:

A usable cup would take a while to print so ours will be more like dolls' house crockery!

Start a project in BlockSCAD

☐ Go to the BlocksCAD web site https://blockscad.einsteinsworkshop.com/#

☐ Register an account where your work will be saved if you want

☐ Go to Projects then New.

☐ Give the project the name 'Cup'.

Make the cup body.

☐ Locate the Cylinder shape in the Toolbox (3D Shapes tab) and drag it into the workspace. This will make the outside of the cup. *(Left button down and drag with the mouse).*

☐ By default the radius1, radius2 (locked to equal radius1) and height are set to 10 (mm). Change radius1 to 40 and the height to 90. Leave the cylinder 'not centered' and Render
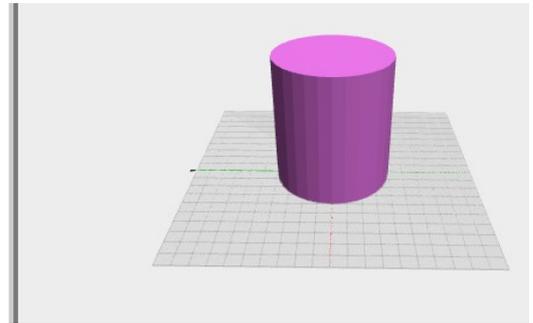
☐ To make the inside, you will subtract a smaller cylinder. You can make this by duplicating the first cylinder (right-click and 'Duplicate') .

☐ Change the radius to 37 and leave the height at 90

☐ Get a Difference block from 'Set Operations' and put the larger cylinder in the first slot , the smaller cylinder in the second. Now Render.
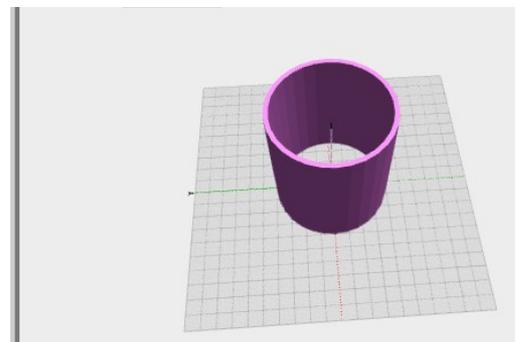

What we get is a tube rather than a container! We did this before when making the Olympic rings *(a ring is a very short tube!)*

Think how to give it a base.

You could add a base but it is easier to move the smaller cylinder upwards to leave the bottom of the cup.

☐ Find the Translate block in 'Transforms' and add this around the smaller cylinder. *You will need to re-attach the blocks – the Translate around the Cylinder inside the Difference*

☐ Set the z value to 3 so that it is raised 3 mm up and Render again
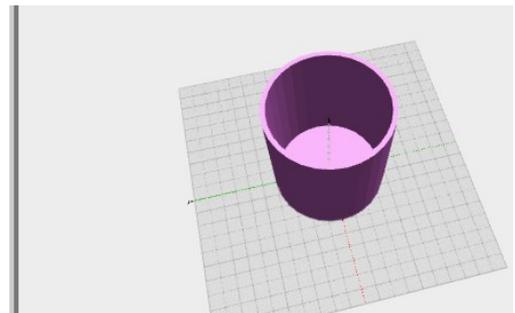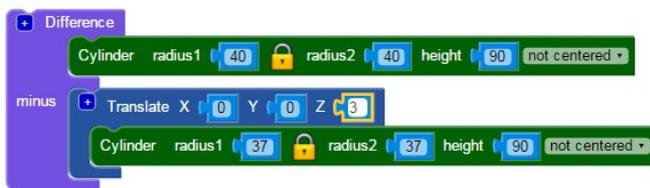
Now we have the basic cup. Note that the walls and base are now 3mm thick.

Making the handle:

☐ First, lets hide the body by right-clicking on the Difference block and selecting 'disable block' *This means that the body will not be rendered which makes it easier to see the new part. We can 'enable block ' when we want to have both parts.*

☐ To make the handle we can use part of a tube or ring. Make the tube 10mm high and with a radius of 40 and a wall thickness of 5. You already know how to do this. It should look like this:
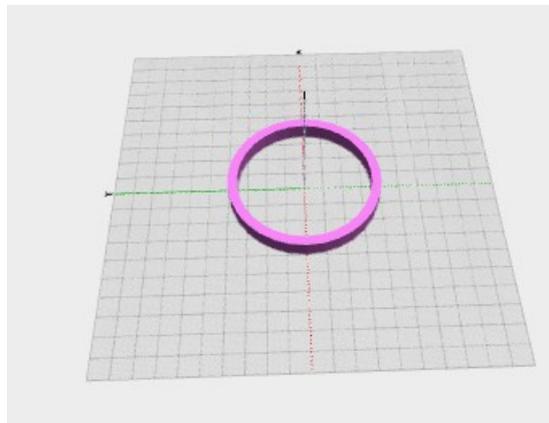
The handle is vertical so we need to rotate it. Rotation is confusing but we can

always experiment. First we need to know which axis to rotate round – Here we want to rotate about the x axis. Then we need to know how many degrees to rotate – to get it vertical we rotate by 90 degrees.

☐ Get the Rotate block from Transforms and wrap it round the Difference block (the ring) . Change the X value to 90. Render
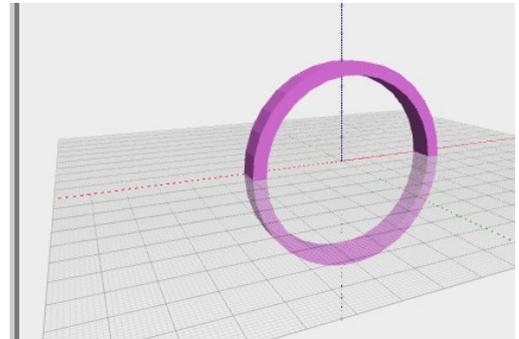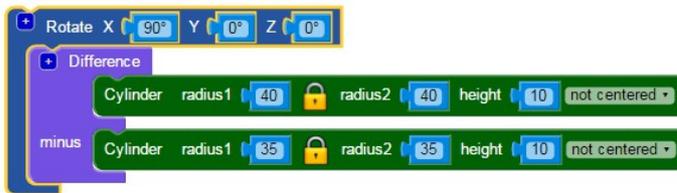
To fit it on the cup, this ring needs to be moved upwards and sideways

☐ It will help to see where the body is now so enable the block which creates the cup. Right-click and 'enable block'

☐ Drag the Translate block around the Rotate and move the handle up in the Z direction and back (minus) in the X direction so it fits on the side of the body. You will get something like this:
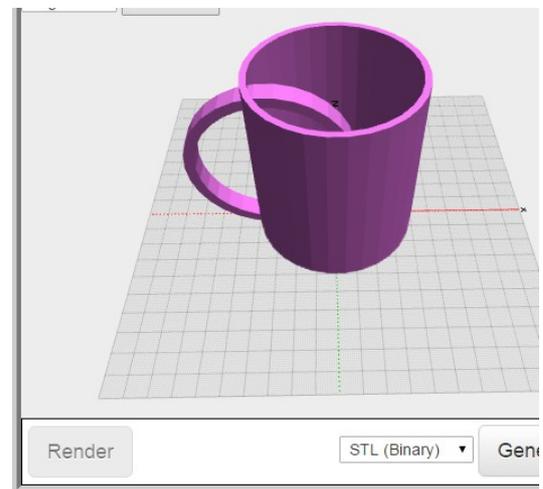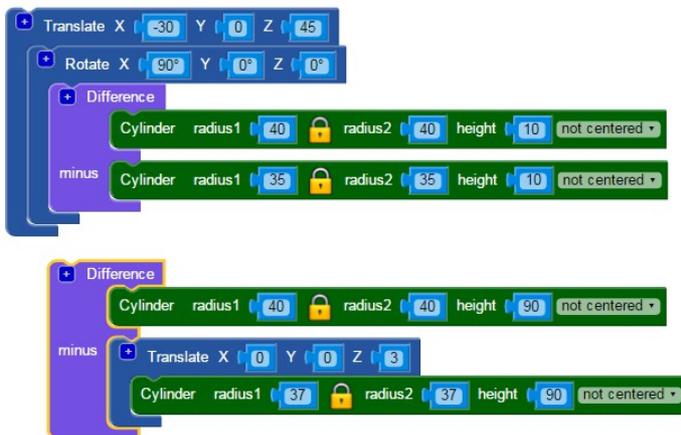

I suppose even this is a cup with a handle but it would be hard to clean, so we need to get rid of the part of the handle inside the cup. To do this we are going to rearrange the parts.

First we will combine the handle with the outside of the cup.

☐ Find the Union block in Set Operations. This block combines two or more shapes together.

☐ Put the handle in one slot and the outer cylinder in the other *Move the outer cylinder from the Difference block*

☐ Then put this combined block back in the Difference block where the outer cylinder was.
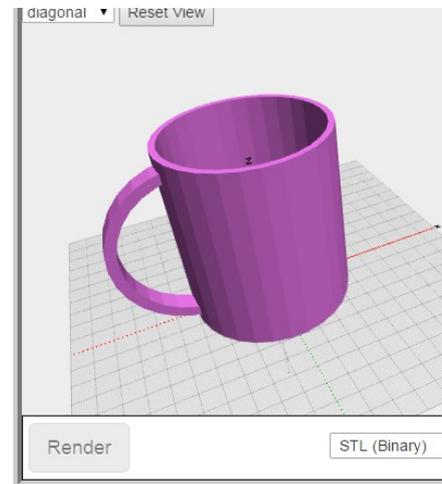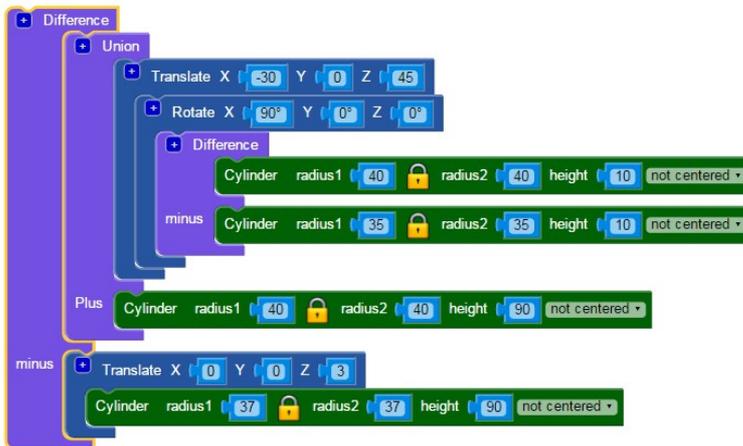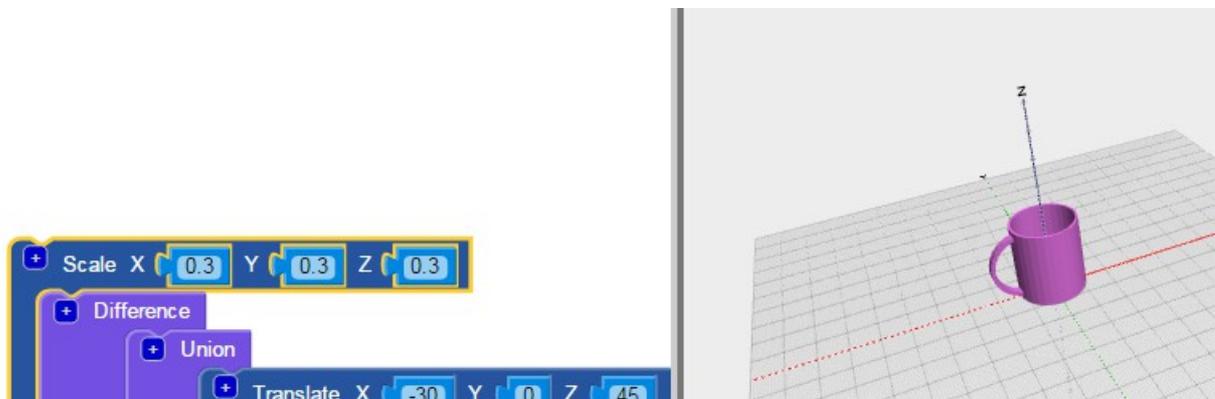

And now we have our basic cup!

Scaling

This cup is 90 mm high and would take a long time to print. To make a smaller version, you can scale the whole object:

☐ Find the Scale block in Transforms and put it round the whole cup. Change all the numbers to 0.3 and Render. You will see the cup scaled to about a third of the size.

☐ What will be the wall thickness now? _____

☐ Here we have scaled each dimension equally. What happens if you scale the X dimension by 0.3 and the Y dimension by 0.5 ? _____

Smoother sides

Circles are approximated by a number of straight sides. In this cup we have about 32 sides. You can increase or decrease that number with the Sides Transform.

☐ Add this block around the cup. You see the default is 8 . Render to see how this changes the shape.

☐ Experiment with the number of sides : 6, 4, 50

☐ Sides changes the number of sides in all the shapes so the handle changes to but you can put a separate Sides block around the handle to make it smooth when the cub is angular
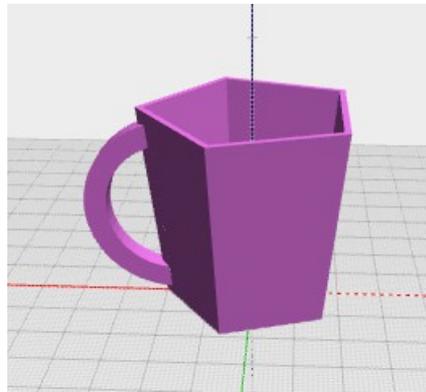
Challenges

Sloping sides

The cup would look better with sloping rather than straight sides, like this one:

To do this, we can make the radius of the top of the cylinders greater than the radius at the bottom.

☐ On the outer cylinder block, click the lock symbol to allow radius1 and radius2 to be different

☐ change radius2 to 50 and Render.

☐ You see that the wall thickness increases towards the top. To keep the same wall thickness, increase radius2 of the inner cylinder so the wall thickness is the same at the top as the bottom

Now the cup will look more like the printed example above.

Two Handled cup

Some cups have two handles, one opposite the other .

☐ Make this cup.

Name your cup

It is hard to put your name around the sides of the cup (You may be able to figure out a way!). However we could put our name on the bottom using 3D text which is remove from the bottom of the cup.

☐ Using 3D text, make a text shape with your name 2mm high. Position the text so it fits on the bottom of the cup and remove it from the cup. Render and turn the cup upside down to read the text.

You will find that the writing is reversed !

☐ Rotate the text so that the bottom of the cup is readable.

Measuring cup

Make a measuring cup by cutting a ring in the cup at a height so it marks a specific amount.

Pythagoras Cup (difficult)

Pythagoras is famous for his theorem about triangles and he was a great mathematician and engineer. He is supposed to have invented the Pythagorean Cup , a joke cup which contains a syphon. This is an extra central closed tube with openings at the bottom and a separate inner tube which comes out the bottom.

You have all the blocks needed to make this object so you might like to try to make one. In cross-section it will look like this:
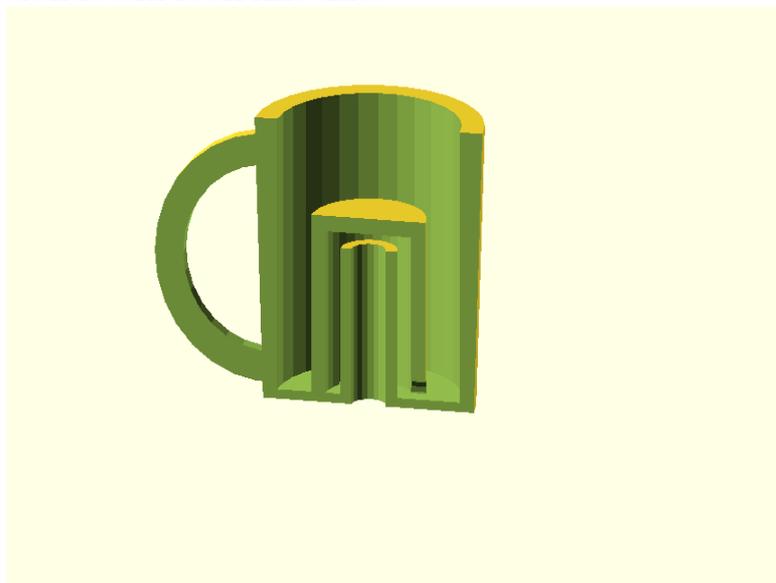
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January 2016