A guide to 3D print cubes

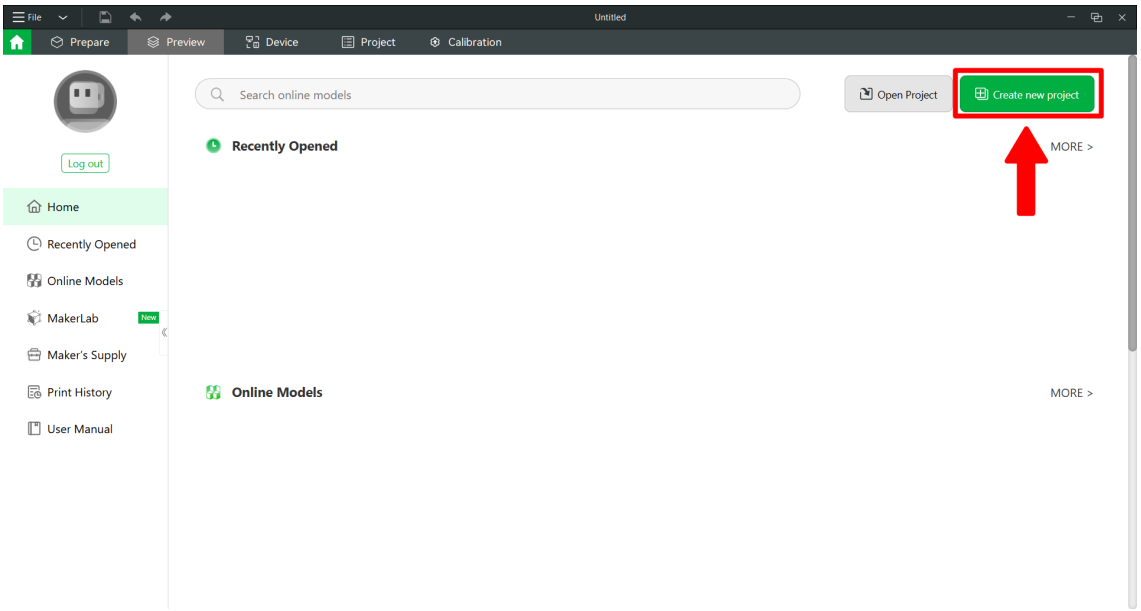
In this guide, we will explore how to 3D print the cubes provided in the website https://math.uni.lu/cube. The 3D files of these cubes were created by me, Gabriel Raposo Madeira, using FreeCAD, an open-source CAD software.

Each 3D file contains two solids that make a cube when joined together at one face. To hold the solids together we rely on magnets placed inside them. By detaching the two parts of the cube, one reveals the hidden face, which is a cross section of the cube. Each cube displays one of the following cross sections of the cube:

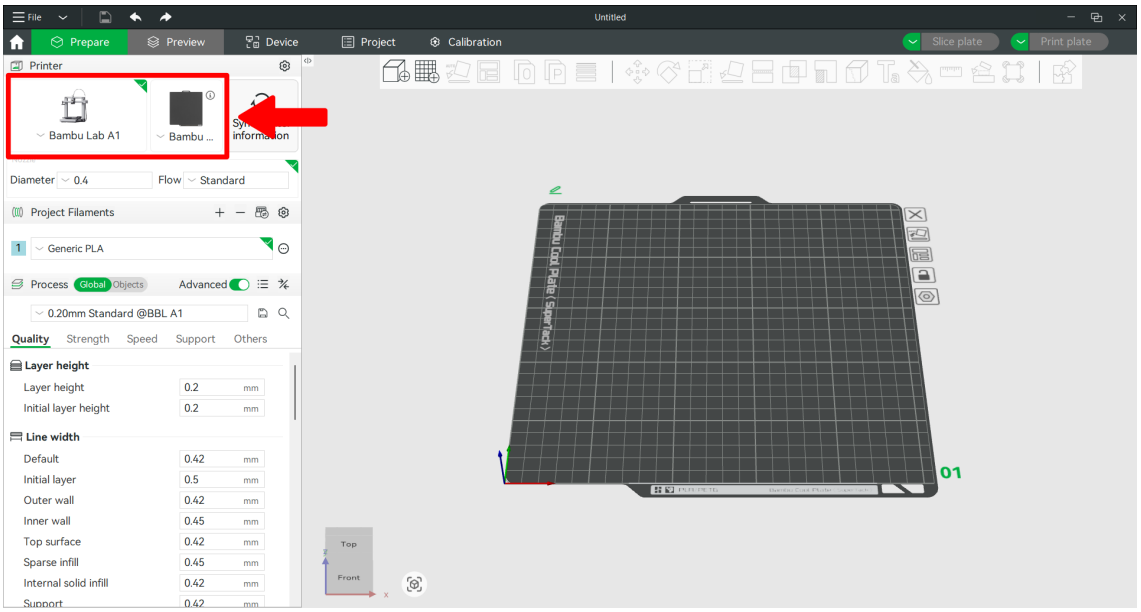
- Equilateral triangle,
- Square,
- Rectangle,
- Rhombus,
- Trapezoid,
- Pentagon and
- Regular hexagon.

After downloading the STL files available from the website, we open the slicer. A slicer is a software that analyzes a 3D file, in this case an STL file, and gives the instructions on how to print the file to the 3D printer based on the geometry of the 3D object. In this guide, we will be using the BambuStudio slicer, which works very similar to Orca Slicer.

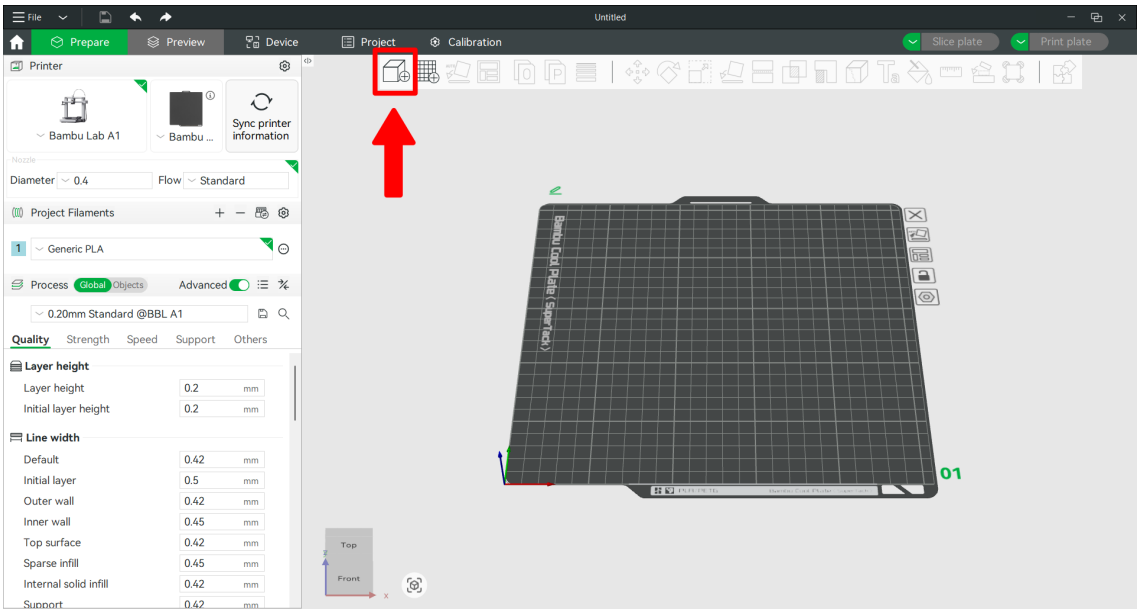
Once the slicer opened, we click on "Create new project".



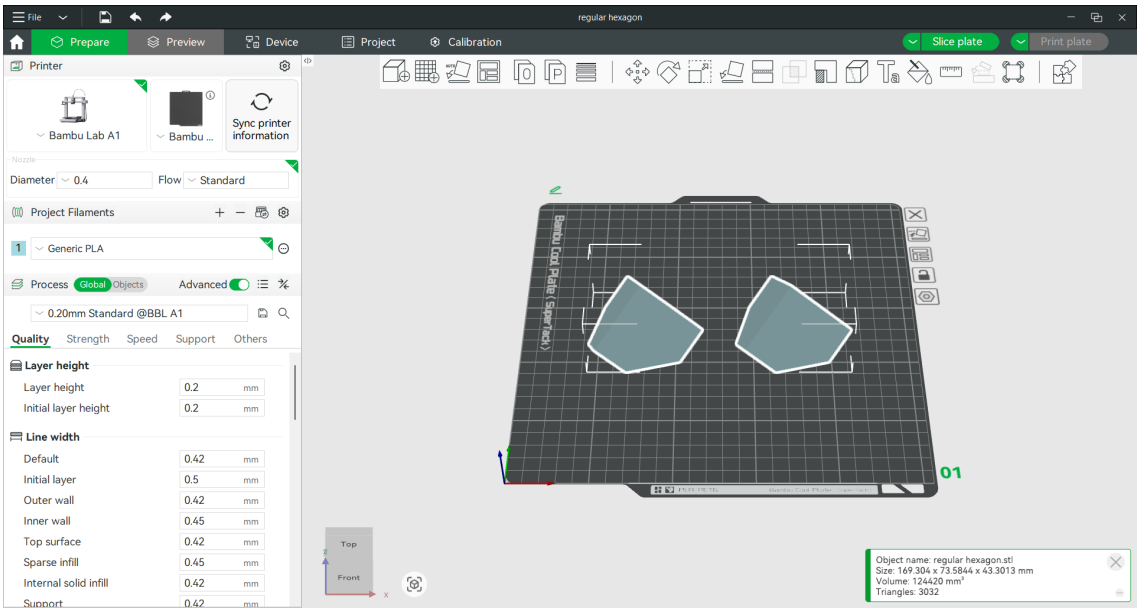
Inside the project, we should select or verify the printer and the build plate we are using.



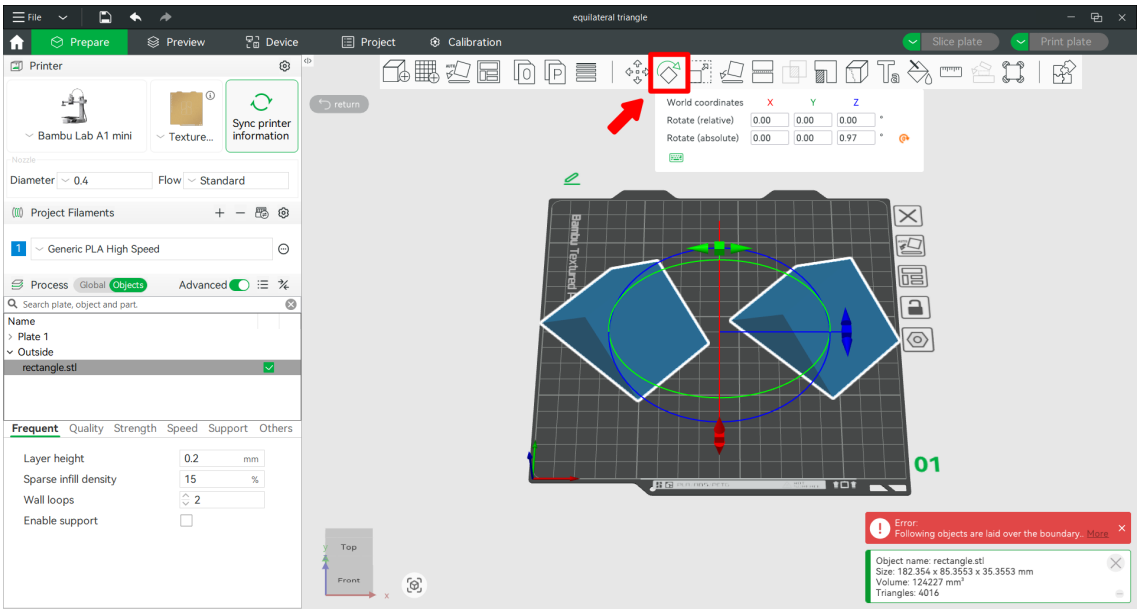
Then, we import the STL file we want to print by clicking on the button with a cube and a plus sign.

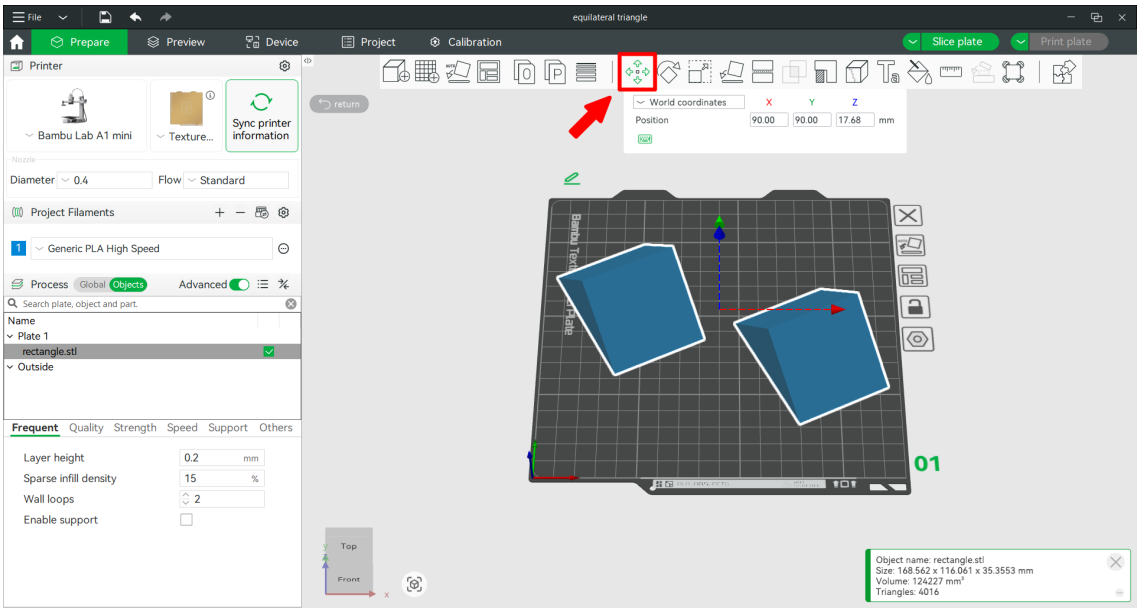


Once the STL file selected, which in our case is the equilateral triangle STL file, we can see the two parts of the cube on the virtual build plate in the center of the screen.

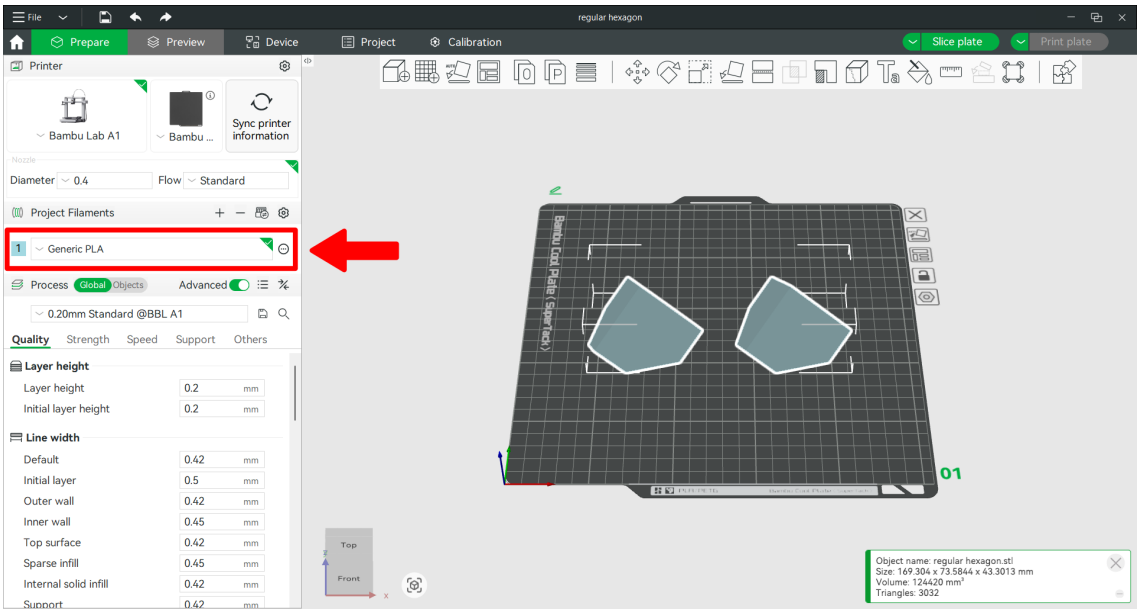


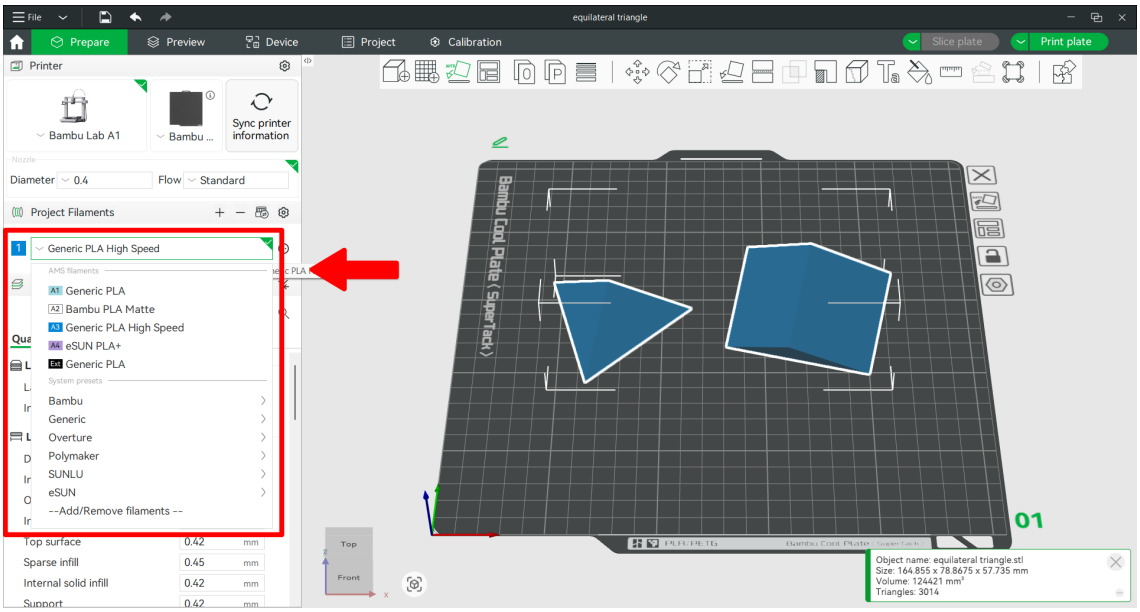
In case the 3D printer used has a smaller build plate, we can use the button with a rotating square and the button with four arrows to adjust the position of the 3D object in the build plate in order for it to fit. Here is an example with the rectangle STL.



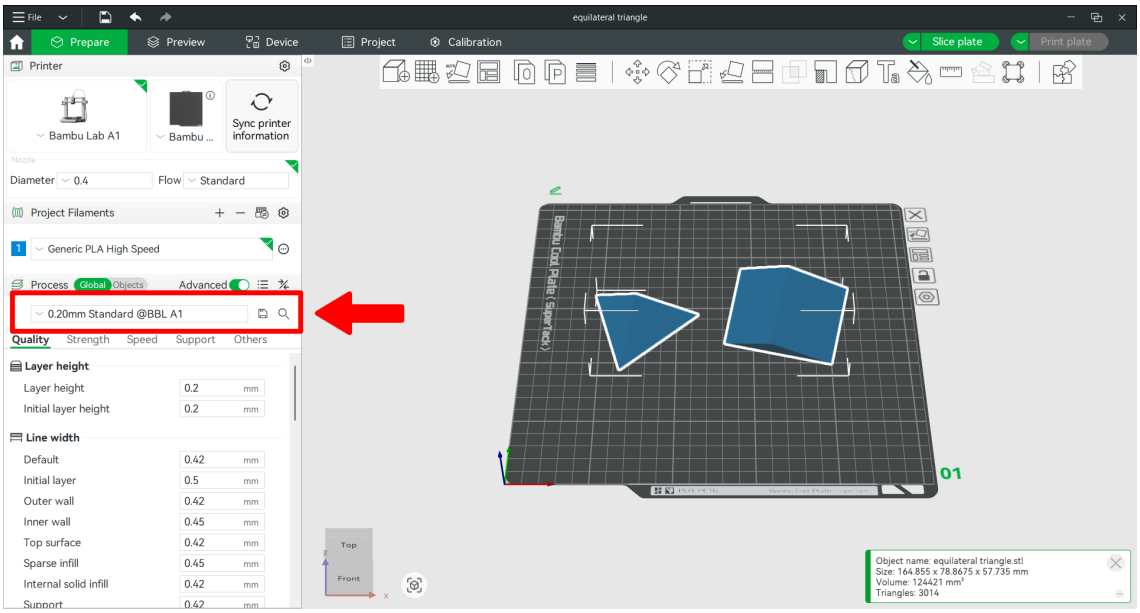


Now, we go back to the equilateral triangle STL. The next step is to select the filament for printing. There are many different materials that we can use such as polylactic acid (PLA) or polyethylene terephthalate glycol (PETG) among others. In this guide, we are only going to use PLA as it is a non-toxic material which is safe to print in a room. For other materials, it is important to check the safety measures as some materials require an enclosure to print. In the drop down menu on the left, we select the material we want to print with, in our case we are going to use PLA High Speed.

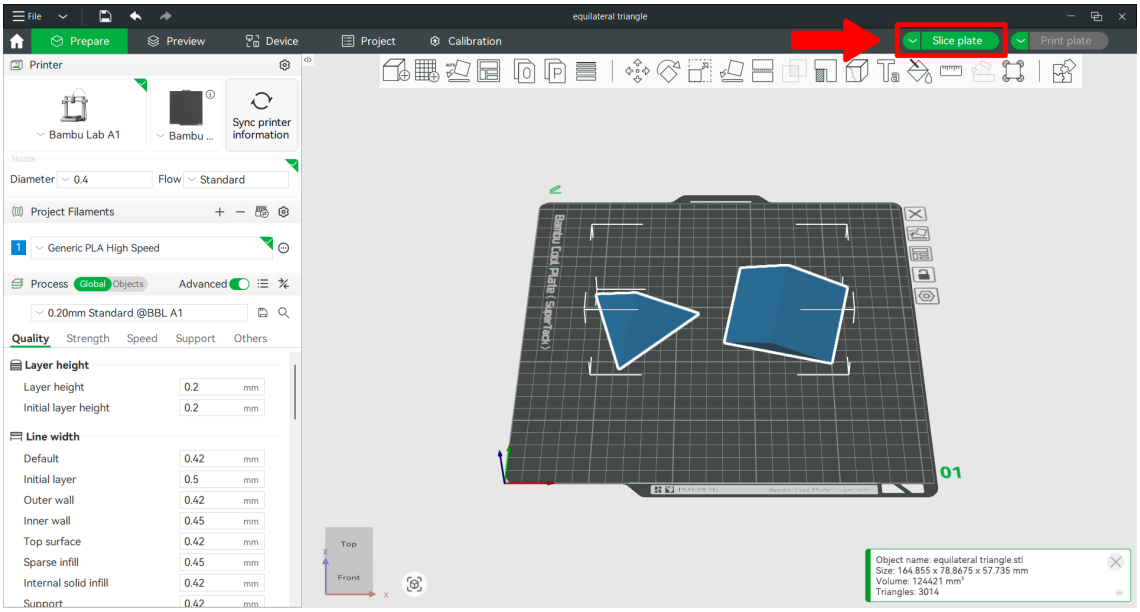




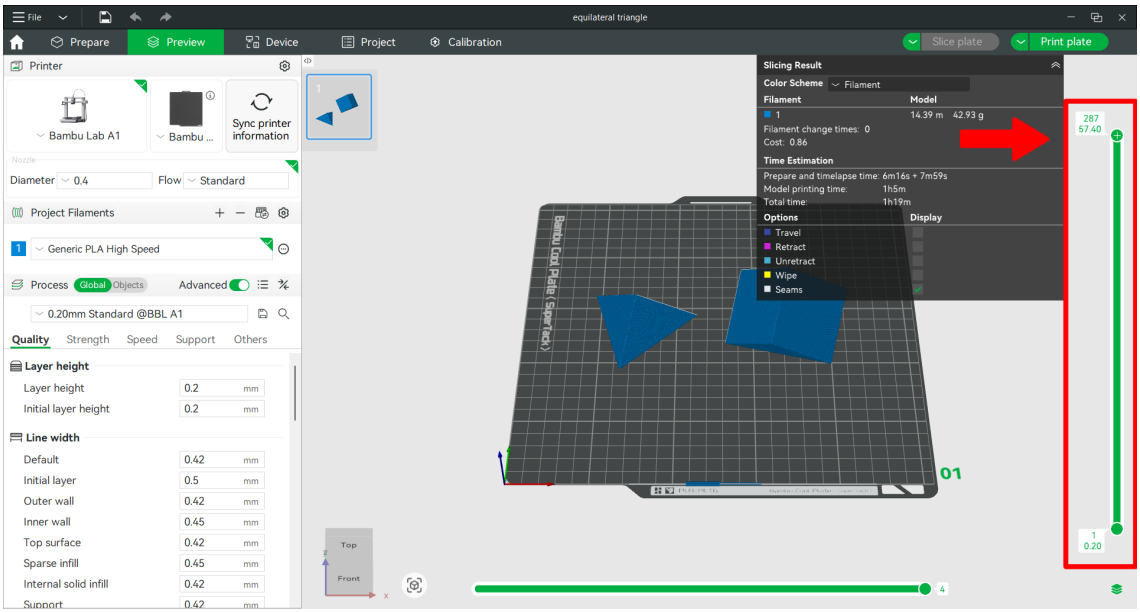
Next, we select the quality preset at which we want to print our STL file. The different presets correspond to the layer height at which the printer will print the 3D object. A greater layer height results in more visible layers in the print and a smaller layer height results in a more clean looking print at the cost of a longer print time. For our cube, we will select the default preset at a layer height of 0.20 millimeters.

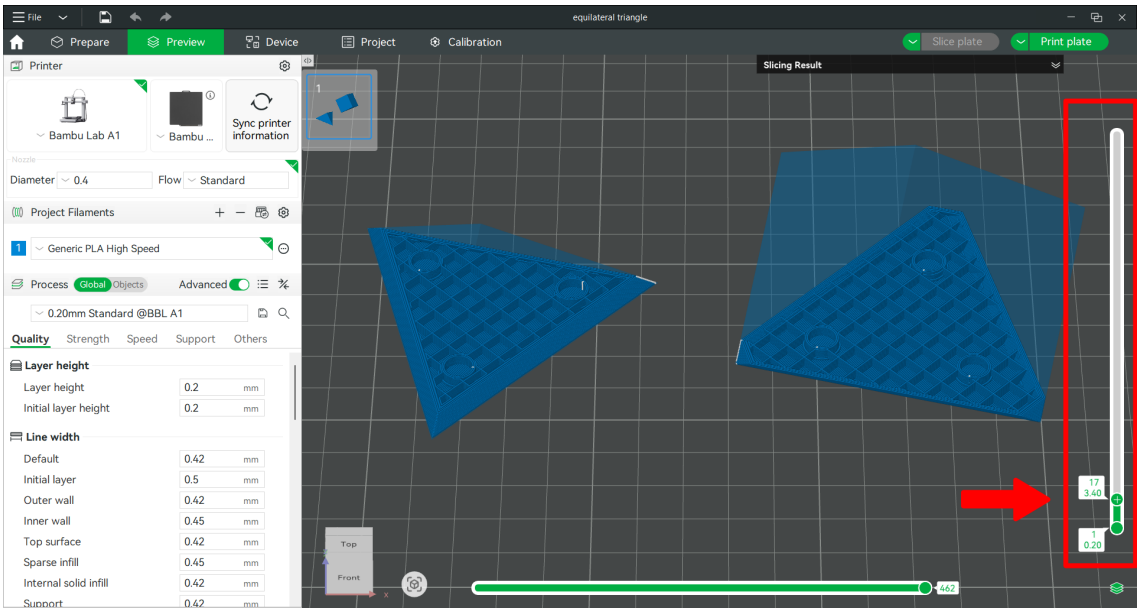


Next, we will slice the 3D object by clicking on the "Slice plate" button.

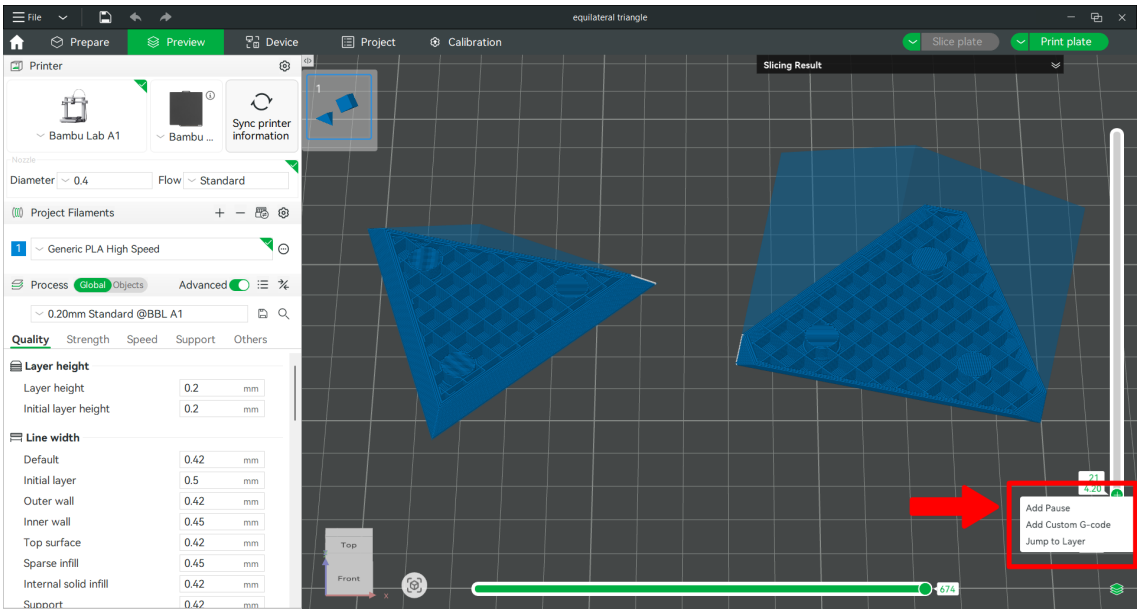


Once the plate is sliced, we use the slider on the right. We hold the plus button on the slider and slide it down until we see the holes in the inside of the cube where the magnets will be placed later on.

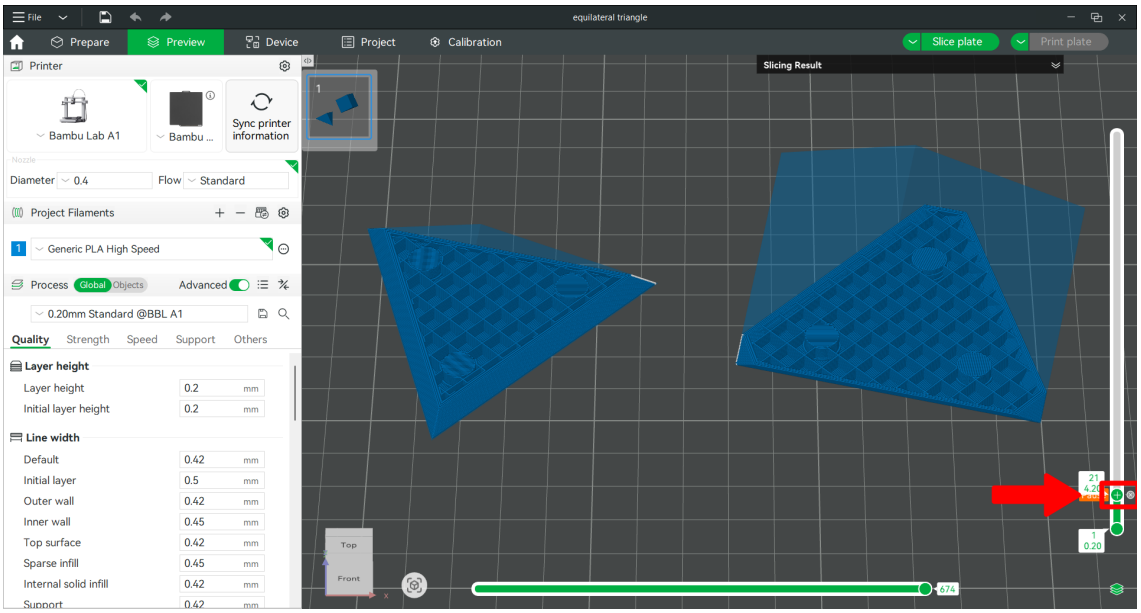




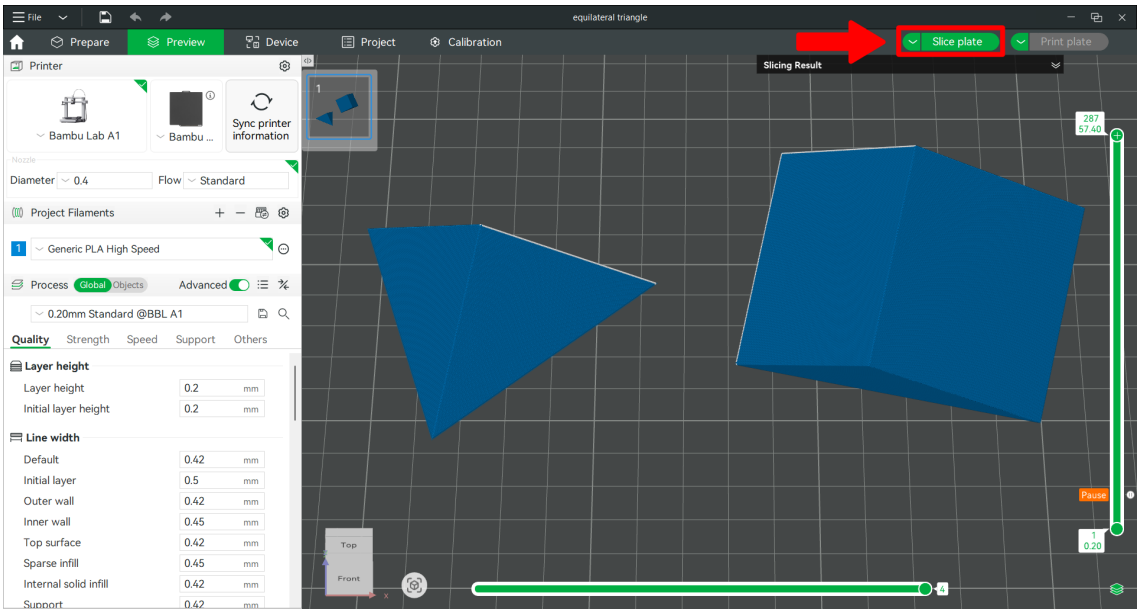
Then, we slide the plus button up until we reach the first layer at which the holes will be covered and we right-click on the plus button. In our case, we slide the plus button to layer 21.



Once we have right-clicked on the plus button, we click on "Add Pause". This will tell the printer to pause the print at the beginning of the selected layer. Once this is done a small grey circle containing an "x" should appear next to the plus button.

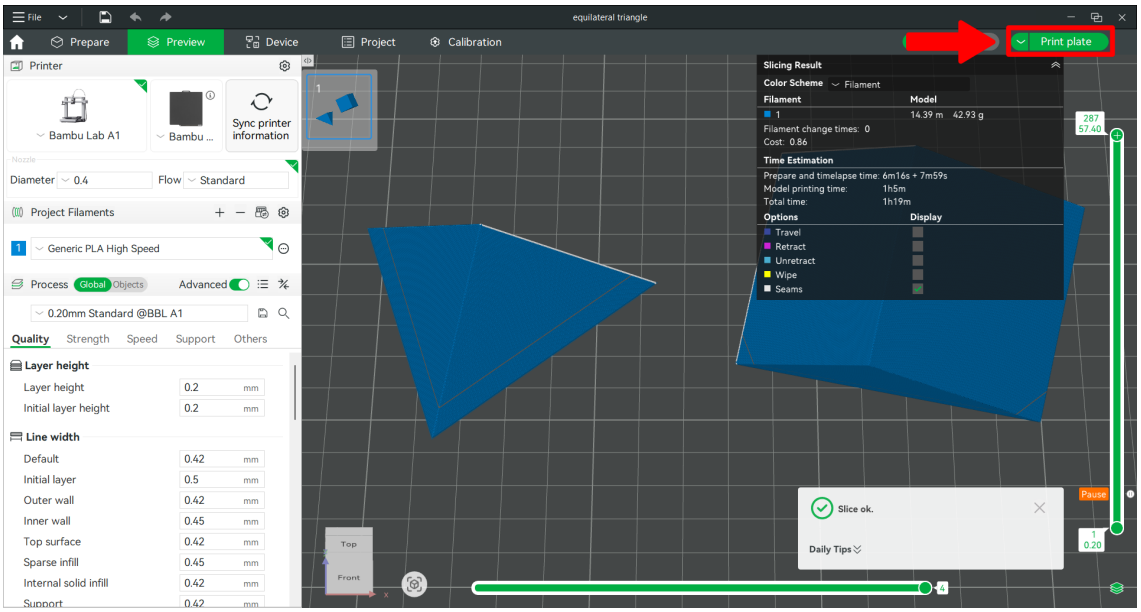


Next, we can slide the plus button to the top of the slider and we click again on the "Slice plate" button. This will create new instructions for the printer taking into account the pause in question.

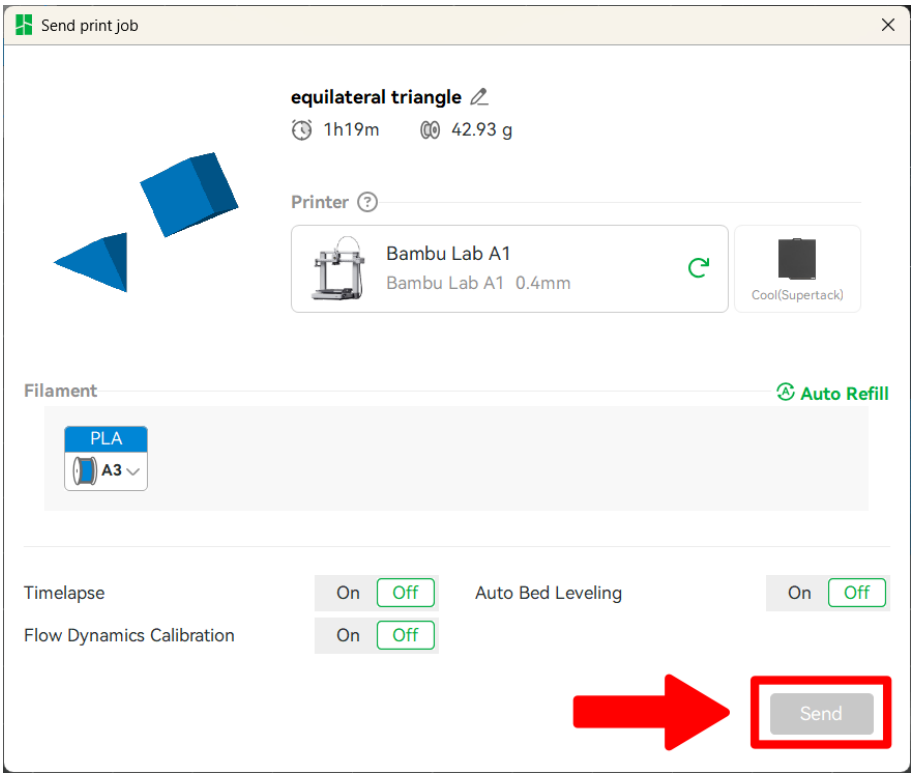


Once the plate is sliced, we can see in the black box the quantity of material that will be used for the print and the time that the print will take, in our case 42.93 grams of filament will be used and the print will take a total duration of 1 hour and 19 minutes.

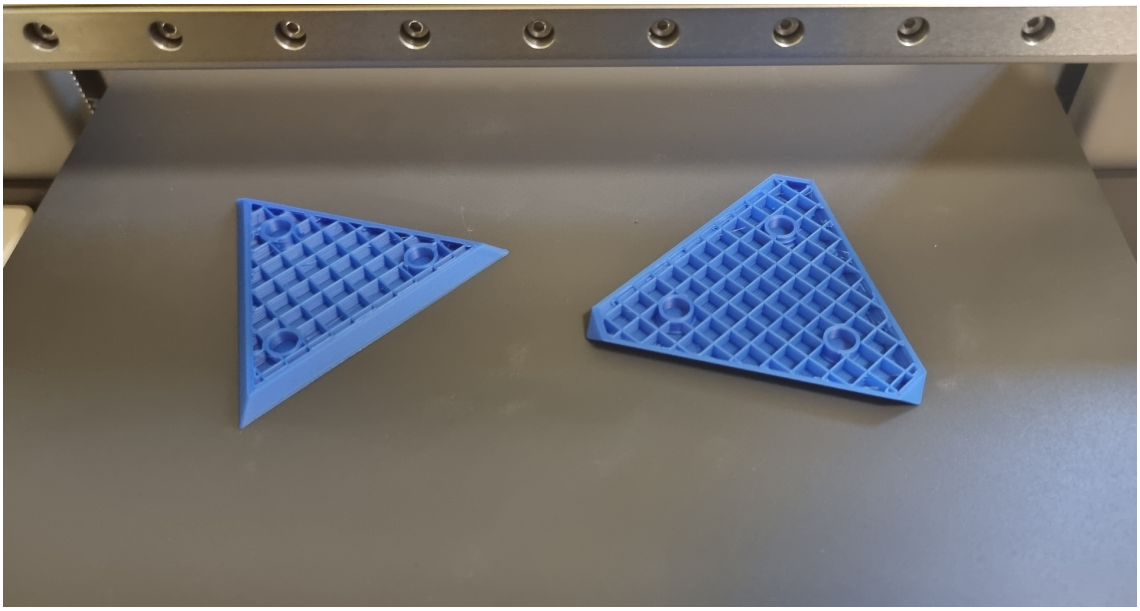
Now that the 3D object is ready to print, we click on the "Print plate" button.



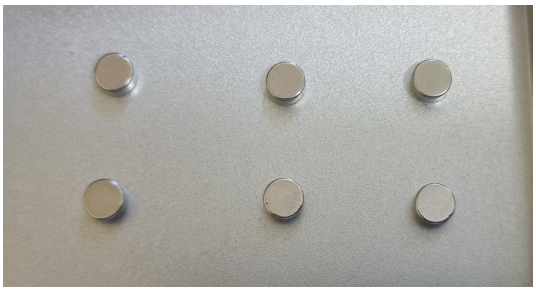
Then, a new window should open. In this window, if the 3D printer is already calibrated, "Auto Bed Leveling" and "Flow Dynamics Calibration" can be switched off, otherwise they must be switched on. Finally, we check that the 3D printer is on and then we click on the "Send" button, which will send the 3D project to the 3D printer.



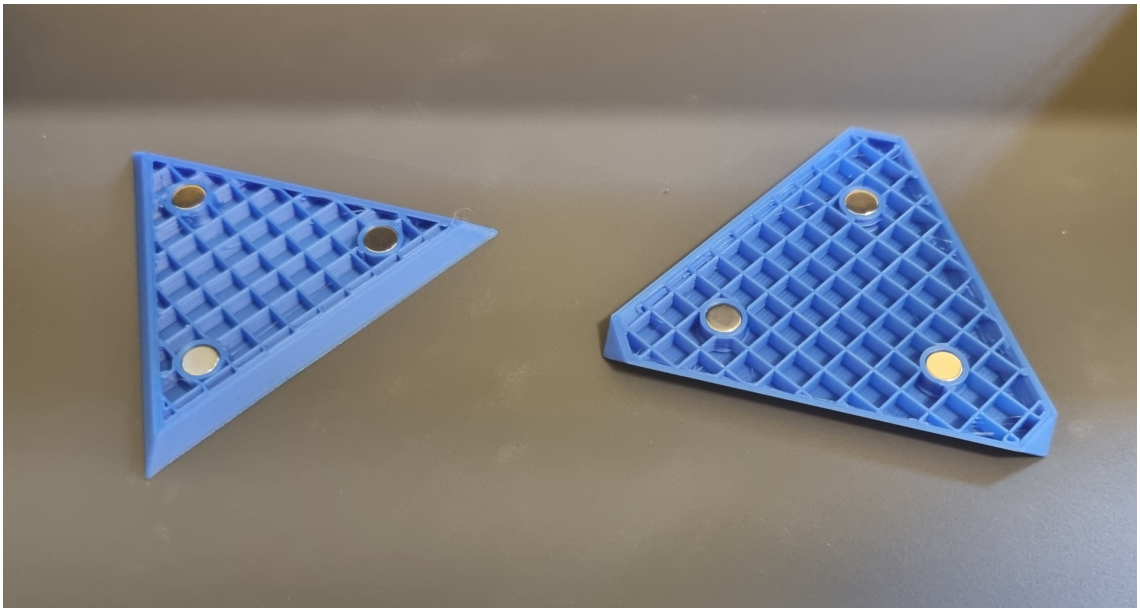
After this, the 3D printer will start printing the cube in question until it reaches the layer where we requested a pause, in our case at the beginning of layer 21, and we see the following.



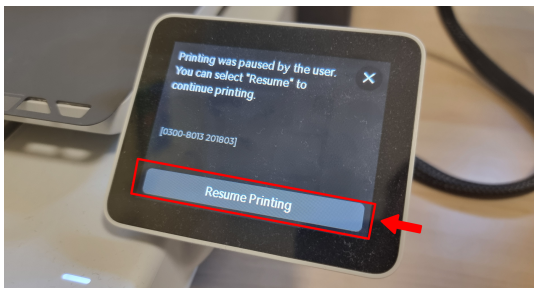
Now, we will insert the magnets in the holes. For this print, we need six cylinder-shaped magnets of 6 millimeter diameter and 3 millimeter height.

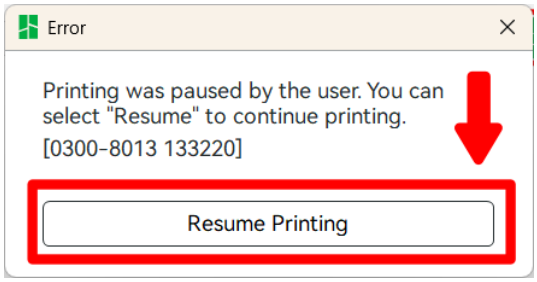


The next step is very important as we will need to place the magnets correctly in the cube so that the two parts will correctly stick together. It is important to not remove the parts from the build plate, we are just going to place the magnets inside without moving the parts, otherwise the print will fail. The three magnets that are going inside a given part of the cube must be all equally oriented and the three magnets from one part must be oppositely oriented with respect to the three magnets of the other part. To do this, we take another magnet, which we call test magnet. It is important to keep the test magnet in the same orientation at all times for this to work. Next, we approach the test magnet to the first three magnets, if all magnets are attracted to the test magnet, we know that they are all correctly positioned, otherwise we have to turn them around. Once all magnets are correctly oriented, we put them in the first part of the cube while keeping their orientation. Next, we take the other three magnets and this time, the magnets should be pushing away from the test magnet. If this is not the case, we have to turn around the magnets that are being attracted by the test magnet. Once all magnets are correctly oriented, we can put them in the second part of the cube while keeping their orientation. It is supposed to be a tight fit, so it is important to apply a little bit of pressure to get the magnets inside. Once the magnets are all inside, we see the following.

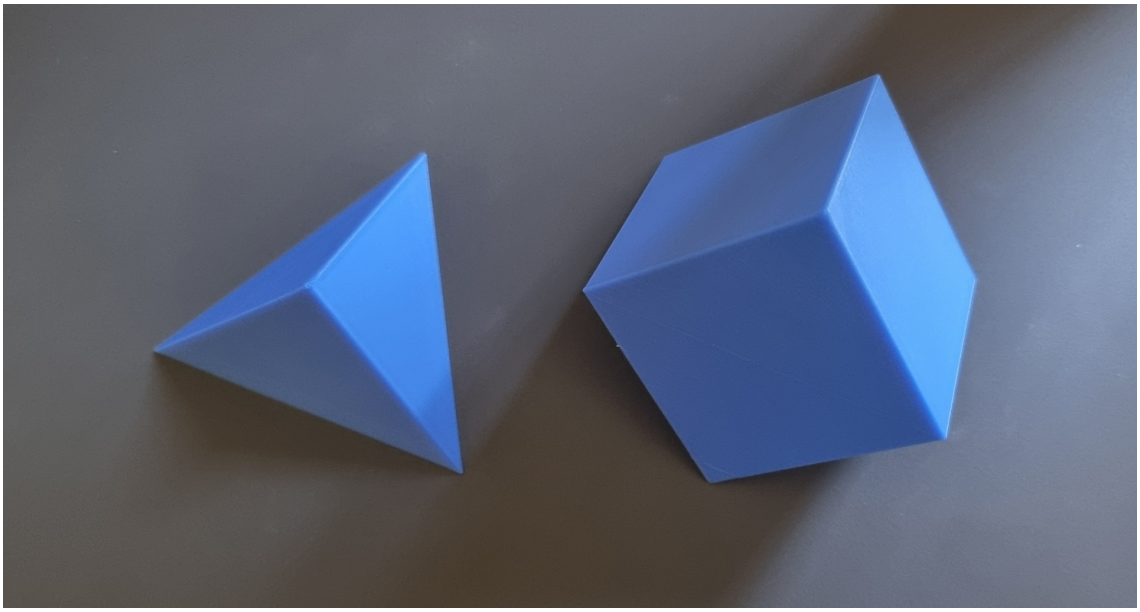


Next, we need to resume the print. To do this, we click on the "Resume Printing" button on the 3D printer screen or we click the one that appears in a window inside the slicing software.

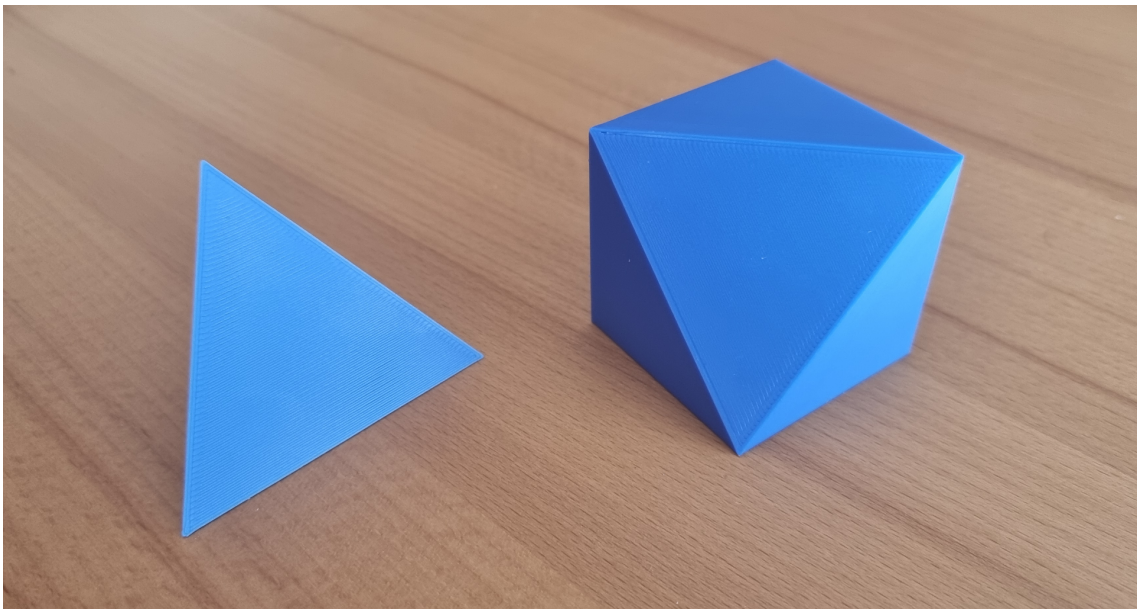


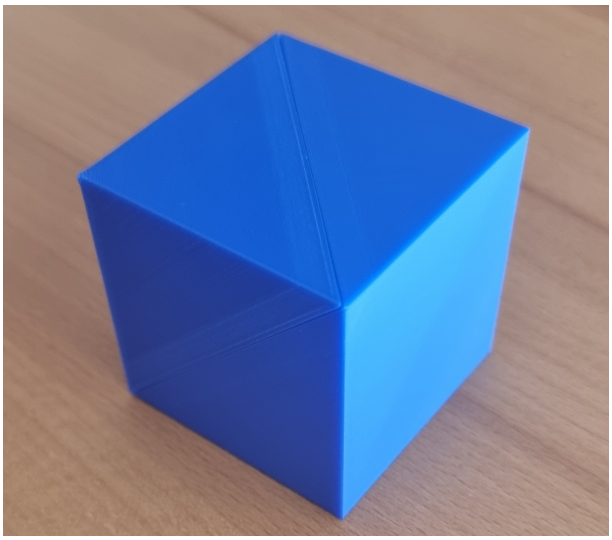


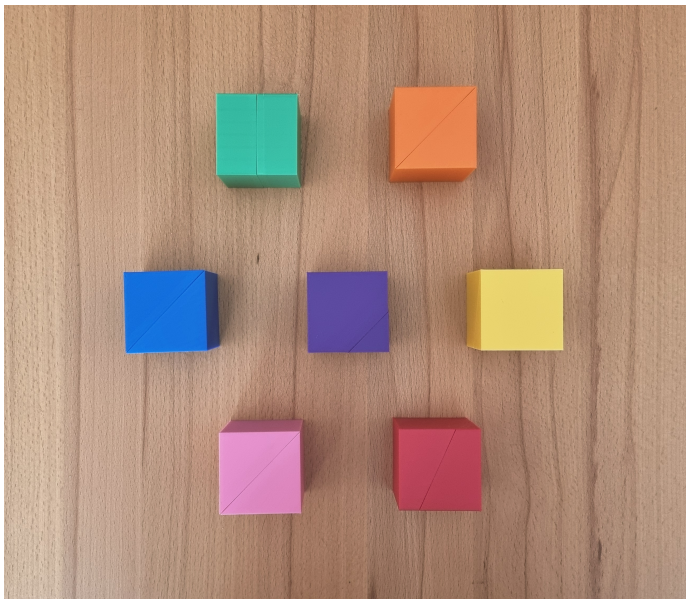
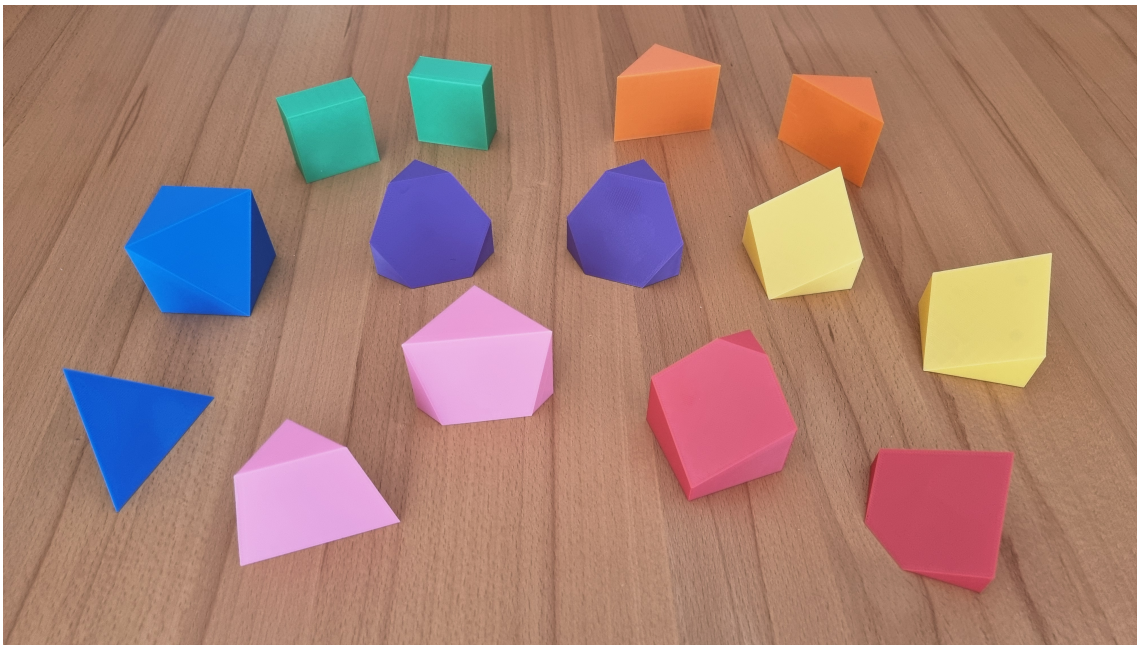
After this, the print will continue. The 3D printer will cover the holes with the magnets and will complete the two parts of the cube. Once the print is finished, we will see the following.



After carefully removing the two parts of the cube with a scraper from the build plate, we have the following final result.





The procedure for printing the other cubes available in the website is exactly the same as the one for this cube.

Here you can see two pictures of the seven 3D printed cubes.