# Building and Operating a 3D Printer

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## Introduction

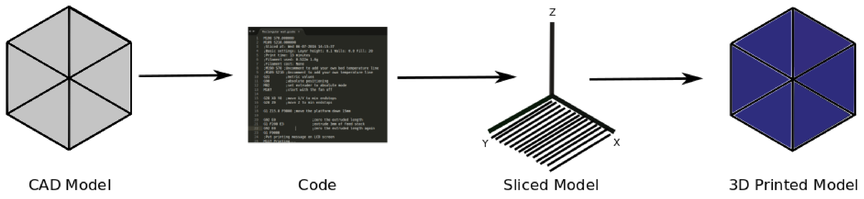
You might be asking: How does 3D printing connect to engineering and computer programming? Technological advances allow us to rethink production using advanced engineering and computer programming techniques. Engineering involves using math and science to solve problems. Engineering helps us design solutions through problem solving, designing, and building. Computer programming involves developing instructions in the form of "computer code", that tell a computer to do certain tasks. Combining the two together makes 3D printing possible. 3D printing turns digital 3D models into solid objects by building them up in layers. 3D printing makes very custom designs possible. 3D printing has applications ranging from medical implants, like hearing aids and ribs, to fashion design. 3D printing is a faster and cheaper way of manufacturing products that would normally take up to months of building.

## Assembly Procedure

1. 3D printer arrives unassembled in a kit
2. Go through printer packing list and make sure everything in the printer kit is there
3. Follow the instructional videos on the SD card that show you how to assemble the pieces for the print bed, fan, frame, and extruder
4. Figure out where the y, z, and x axes are located
5. Follow wiring instructions to attach the x, y, and z motors to the control board. Also follow the wiring instructions to attach the hot bed, limit switches, and the fans to the control board
6. Once you're done with wiring, plug-in the printer and see that there are no errors
7. Debug until you have no errors, then start making your design

## Methods & Materials

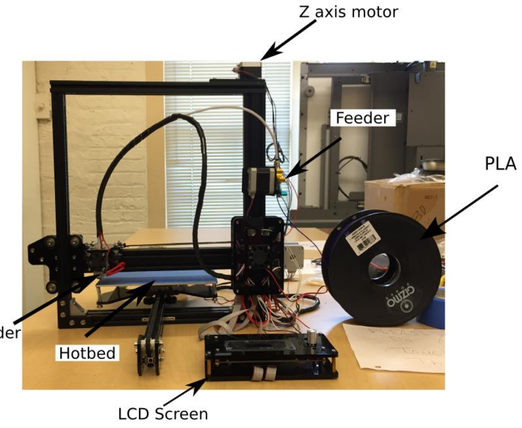
- First, we had to assemble the 3D printer using a kit named He3D E13 Aluminum Extrusion.
- Then, I came up with a simple idea of creating a rectangular wall to demonstrate how 3D printing works. To design the rectangular wall, I used computer-aided design (CAD) program to make a 3D model.
- Then, I used a program named Cura to help prepare my design before it went into printing. Cura "slices" your 3D model into many thin layers and translates each layer into printer movements using a programming language called g code.
- After creating the g-code file for my design to tell the 3D printer how to move, I copied the file onto an SD card.
- Finally, I inserted the SD card into the printer controller, warmed up the printer and PLA, then started the print run until it finished layering my design.

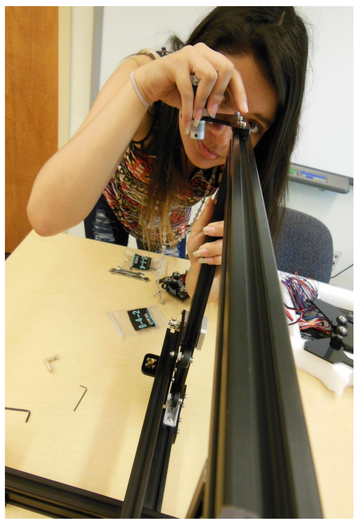


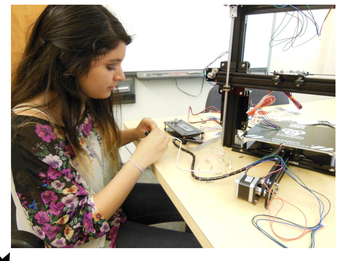

CAD Model | Code | Sliced Model | 3D Printed Model

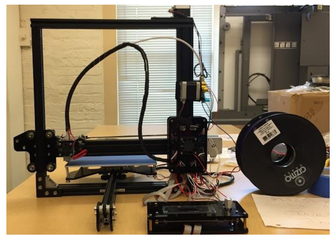
## Results

I combined electrical and mechanical engineering skills to build a 3D printer. I also designed a plus and minus sign with a turtle on the top using Autodesk Inventor, a type of CAD software. I prepared the plus and minus sign for printing using Cura which converted the CAD model to g code. Then I uploaded the g code to the 3D printer to print a physical model.







## Conclusions

During my time in the RISE internship, one of my goals was to learn something I didn't know I could learn. I ended up learning a lot of things like what a 3D printer is, and how to build a 3D printer. I also learned how to code and how to apply computer programming to real applications. I also learned how to connect wires to a motor and the main control board with pretty confusing instructions and how to problem solve to get the printer to work properly. One of the most interesting things I learned was figuring out the names of tools and parts and how they are used. For example, I learned what a t slot is, how to use calipers, and how to use a leveler. I never knew tools like calipers and t slots existed until I came into the lab and started assembling the printer.

## Acknowledgements

I would like to thank Emma Lejeune, Kristina Granlund-Moyer, Christian Linder , Ryan Cohen, Kyle Douglas, and Racquel Hagen for all the help they have given me. Without them I don't think I would have learned a lot. I would also like to acknowledge the National Science Foundation for funding this research. These wonderful people made me see a different side of the world that I didn't think I could possibly see.