



## **3D Printers in the Haverford Maker Arts Space**

The Haverford Maker Arts Space is happy to provide 3D printing access and services to students, faculty and staff, who are engaged in academic, clinical and research-related projects. Below is a description of how to get an object 3D printed.

### **Learning or requesting a print?**

There are two tracks for a 3D print. You can simply request a 3D print be done and come in during Open Studio Hours, in which case, this is under the umbrella of our 3D printing services information below. *Or*, you can learn the process and set up your own prints. This requires training! You need to request training.

### **3D Printing Requesting Services**

If you have a 3D printing project that is academic, clinical and research-related you can have a 3D print setup during open studio hours. You need to come in for this and let us know what you would like. A student worker or the Maker Arts Space Education and Programs manager will help you with setting up your file.

You can also pick up your print during Open Studio Hours.

Hours change each semester so check the [website](#).

### **3D Models For Printing**

There are a lot of ways to create a 3D printable model. This document will not cover that. But in short, you can either create a file yourself or find one online. We have workshops on this. Ask [dwatson1@haverford.edu](mailto:dwatson1@haverford.edu) about them.

We will not be able to create a file for you, you must do the design work ahead of time or find the model online. Here is a resource for finding files:

<https://www.thingiverse.com/>

**Do you have to be there for 3D print set up?**

Yes, you need to be there, during open studio hours. A student worker will help set up your print but you need to be there for the first 30 minutes. Hours change each semester and can be found [here](#).

### **The 30 Minute Rule**

You must stick around for the first 30 minutes of your 3D print. After that you have to notify the student worker you are leaving and they will assume responsibility for the print.

We do this to do our best to catch any 3D printing failures before they become a big deal and possibly damage the 3D printers.

### **When We Set Up Your File**

It's a collaboration so it is important that you are there to help us set up your print. We also rely on you to pay attention to your print in the beginning 30 minutes (the time it is most likely to fail).

We will use the most economical settings to ensure the lowest cost possible. Please note that we reserve the right to prioritize projects, and that academic/research projects will always take priority. We also reserve the right to say the project is not feasible and cannot be done in the Maker Arts Space.

### **The Other 30 Minute Rule**

Jobs will not be set up 30 minutes prior to closing of Open Studio Hours. If you show up at 7:35PM and the space closes at 8PM the student workers will not set up your job that night.

### **3D Printing Priority**

The 3D printing during open studio hours are generally first come first served. However, when a class is in the maker space that focuses on 3D printing, the priority of the 3D printers will be given to students who need to finish a class project related to the VCAM Maker Arts Space. We will let you know if this is the case.

## **3D Printing Learning Learning How To Use 3D Printers**

Alternatively to having a student worker set up your 3D printing job you may gain access to using the 3D printers during the open studio hours. You gain access through training and once you show a competency with the 3D printers you will be granted use of machines during Open Studio Hours. You may not attempt to use a 3D printer if you have not yet been trained even if you have prior experience. *I ask that students who think they will be 3D printing a lot ask to be trained rather than rely on our 3D printing service.* email [dwatson1@haverford.edu](mailto:dwatson1@haverford.edu) for training information.

Please do not start a job at the end of the Open Studio Hours. If there are 30 minutes or less in a shift please wait until the next open studio to begin a job. It is your

responsibility to ensure a 3D print works. Most failures occur in the beginning of a print. As someone setting up the job you must catch these failures and stop the print so it does not cause damage to the 3D printers.

If you start a print during Open Studio Hours you must stick around for at least 30 minutes after the print starts. You must do this to again be present while a print is starting out and catch a failure. If you choose to leave the print once it is running, after those first 30 minutes, you must inform the technician or a student worker. If the 3D print lasts longer than the open studio hours the student worker will pause the print and someone will resume the print in the morning.

Please get special permission from the technician if your job is going to run longer than 10 hours.

Training will be comprehensive and after the initial lesson expect several walk throughs where trainer and yourself can go through the process of setting up a print together. Once you feel you can run the machine safely on your own please request access. The Maker Arts Space technician will ask you to set up a print without any assistance. Upon doing this successfully you will be granted access to that specific 3D printer (not all 3d Printers as some require different training).

To schedule a training contact [dwatson1@haverford.edu](mailto:dwatson1@haverford.edu)

### **File Format**

To print a file, it must be exported as a Standard Tessellation Language file, with an STL extension (.stl). This .stl file must be watertight with manifold edges and no inverted triangles. Files can be fixed for free using a cloud service such as Microsoft's 3D printing platform netfabb: <https://netfabb.azurewebsites.net/>. If the .stl file you give the Haverford Maker Arts Space is not compatible with our printers we may use software to attempt to repair it, in which case we will notify you first. There are other file formats which work but if you are starting out start with the most common, the STL.

### **Ultimaker 5s**

The lab has three Ultimaker 5s. The 3D model must fit within the build envelope that is *Left/Right Nozzle (single material)*: 330 x 240 x 300 mm (13 x 9.4 x 11.8 inches)

We use **Cura** to process files which gives us very specific control of infill (density of 3D print) and support structure. We will generally attempt to use as little filament as possible, so if your structure needs to be durable please let us know. We will assume it is a prototype/proof of design unless told otherwise.

### **Form 2**

The form 2 is a desktop SLA Stereolithography printer. It's build size is 145 x 145 x 175 mm (5.7 x 5.7 x 6.9 in). This is a high definition resin printer. It is

accessible but it can only be used after explicit approval from the Maker Arts Space technician.

**What materials are available?**

PLA plastic (limited colors, please inquire), Photopolymer Resin for Form 2

**How much does it cost?**

3D printing for academic, clinical, and research projects for Haverford students is currently free. We will, however, ask that students who frequently request use of the 3D Printers supply the lab with filament. Email [dwatson1@haverford.edu](mailto:dwatson1@haverford.edu) about what kind and where to buy filaments.

**Additional Notes**

- Be prepared to make changes to your design if we are unable to print it.
- Please ensure that file sizes remain under 100MB.
- The mesh or surface of the 3D model must be watertight and a solid. More technically, all faces of the object must construct one or more closed volume entities. When the faces are not fully closed, they produce gaps or holes in the model and those holes and gaps will keep the model from printing correctly.
- It is not the responsibility of the student workers to design printable projects; however, if interested in learning how to design a model using a CAD or 3D modeling software there are workshops available which address these skills. Please check the Haverford Maker Arts Space website for the workshop schedule.