FAQ

What is PolyJet Technology?

PolyJet 3D printing is similar to inkjet document printing. But instead of jetting drops of ink onto paper, PolyJet 3D printers jet layers of liquid photopolymer onto a build tray and cure them with UV light. The layers build up one at a time to create a 3D model or prototype. Fully cured models can be handled and used immediately, without additional post-curing. Along with the model material, the 3D printer also jets a gel-like support material specially designed to uphold overhangs and complicated geometries. It is easily removed by hand and with water.

What model materials are available?

We offer all 7 materials that are sold by Stratasys. We can't print rubber-like material or biocompatible material or digital materials.

- VeroClear RGD 810 – like PMMA (acrylic/plexiglass)
  colorless (grey tint at thicknesses > 10 mm)
  highest printing resolution

- High-temperature RGD 525 – like acrylonitrile butadiene styrene (ABS)
  white opaque
  withstands 75 – 80 °C

- DurusWhite RGD 430 – like polypropylene, polystyrene or HDPE
  white opaque.

- VeroBlackPlus black, opaque

- VeroWhitePlus white, opaque
- VeroGray gray, opaque
- VeroBlue blue, opaque

What temperatures can the materials withstand?
All of the materials, except the High-temperature RGD 525 start to melt around 42-45 °C. RGD 525 can withstand 75-80 °C. This may require a post-printing heat treatment step.

What solvents can the materials withstand?
We are currently testing this. Check back with our web page for any information
http://www.cnf.cornell.edu/cnf5_tool.taf?_function=detail&eq_id=195&gtitle=PACKAGING%20%26%20MISC%20PROCESSING&area=PACKAGING%20%26%20MISC%20PROCESSING&cacName=ObJet%20Pro%203D%20Printer&labUser=&_UserReference=CBEB3F962DADB78F52B848F9

Is the printed material biocompatible?
There is a biocompatible material offered by Stratasys, but it can't be printed on our ObJetPro 30. We are currently testing whether the materials that we offer are biocompatible. It's likely that the devices will need post treatments like parylene coating to seal the surface and sterilization. Some CNF users are using VeroClear devices for long-term tissue culture studies. Contact Beth Rhoades (Rhoades<a>cnf.cornell.edu) for more information.

Can printed devices be plated with metals or etched?
We don't know yet. We are currently testing printed devices in protocols for low-temperature sputtering and electroplating. The materials can not be etched in our clean room tools.

Where can I learn more about the materials and printer?
Objet makes the printers, and Stratasys sells them plus the materials. More information can be found on their website: http://www.stratasys.com/. There is an entire entire line of printers and materials if you are curious.

Can more than one model material be printed in a device?
Sorry, no. One model material plus the support material can be printed in a job.

Can the support material be omitted?
No. Any spaces with overhangs must be filled by support. However, straight channels that are open-ended can be oriented with the open port facing up during printing. In this case, the printer will not fill the space completely. This adds to the print time if this is not the shortest orientation for printing.

What CAD program can I use?
The printer will accept any .STL file. Simply export the file in .STL format from any popular 3D CAD program. The .STL file will likely lose the exact scale that you require. So make note of a critical dimension (such as the overall length of height). This dimension will be entered into the printer when we set up the job. We provide free access to AutoDesk Inventor 2014 to CNF users. The catch is that it is available only in the CAD room in Duffield Hall. Sorry, but we can't provide access over the internet.

How long does it take to print a device?

Print time is determined by the number of vertical layers and the overall area covered on the print tray. So the taller the device, the longer it takes. Quick jobs take about an hour including warm-up time. A solid iPhone-sized device would take 4 to 6 hours depending on the material. Opaque materials are printed in vertical layers of 28 microns, and the clear material is printed in 16-micron layers.

Can I get trained to use the printer?

Yes. That is our typical mode of operation. A CNF user can bring their .STL file for a small device, and in a couple of hours, be trained with a device in hand. We also provide help with learning the basics of 3D CAD using AutoDesk Inventor 2014. There is free access for CNF users in our CAD room in Duffield Hall.

What is a CNF USER?

A CNF user is a person who has a project and account (billing and liability information) to make something at the CNF. They get access to the CNF facility by passing a safety orientation, and then they get trained to use the tools themselves. A few users with very simple projects such as 3D printing can get approved by the User Managers to have staff carry out the work. They become remote CNF users with no access to the facility. For printing, they set up a remote project and account and send instructions for the printing to be done by the staff.

How do I become a CNF user?

We are open to anyone with a feasible project. See (http://www.cnf.cornell.edu/cnf5_steps.html) for setting up an account. Most CNF users use the tools themselves so they take a safety orientation and various tool trainings. Occasionally, people who have very simple projects (including 3D printing) forego access to the facility. They follow the same steps for setting up their account, and forego safety orientation and tool training.

Can I have CNF staff print my device?

Yes, if you don't mind paying for the staff labor, too. You must still have a project and an account at the CNF. Our streamlined process involves setting up a remote printing project account (http://www.cnf.cornell.edu/cnf_remotework.html). Once all the paperwork is sorted, we'll accept your .STL files and a printing job order form (see form) and print your device. You can pick it up or have it sent via FedEx.

How much does it cost for CNF staff to print my device?

We charge for the material, the time the tool is used and the staff time. Most of the cost is due to the material and the time to print, and that depends on (1) the size of your device, (2) your choice of material and (3) the orientation of the device as it prints. Small printed devices have been clips, shallow trays or fluidic molds that are less than 1 cm tall. They use a couple grams of material and an hour to print. The cost is about $90 for academic users (those paying through an academic account) or $200 for non-academic users (personal, government or industrial accounts).

For example: To print something the size of an iPhone, someone paying through an academic (university) account would pay $230 to $280:

- $65 worth of ink
- $110 in staff time
- $55 for a 3-hour run or $100 for a 5-hour run depending on the material.

If the iPhone were flipped up on end to print, it would take over 18 hours to print and cost much more to print, so we normally orient devices to print as quickly as possible unless there are small openings that must remain clear of support material.

Can I have someone besides CNF staff design and print my device?

Yes, there are CNF users who offer fabrication services. They are called contractors, and they can use the 3D printer. They vary in their availability, fees and services. We have a listing of several active contractors at our web page that you can contact (http://www.cnf.cornell.edu/cnf_remotework.html).

How do I clean a printed device?

A support material is printed in the open spaces of the device to keep features from collapsing. This material is designed to swell in water so that it can be physically removed.

A typical cleaning involves these steps:

1. 5 to 30 minutes - soak in soapy water
   Remove the support by picking and spraying with water.
2. 5 to 30 minutes - Repeat the soak in soapy water.
   Repeat picking and spraying as needed.
3. 5 to 30 minutes - soak in 2% NaOH to loosen any remaining support residue
   Wash and wipe away the support residue.

Can printed devices be used for casting PDMS (silicone)?

Yes, with antistiction and/or parylene coating, the devices can be used as molds. There is a tendency for vertical sidewalls to be rough and to continue to outgas during the molding process, so some post-printing treatments will be required. See the next question.

What are some common post-printing treatments for the devices?

The following procedures can be performed at the CNF. These are typically done by the user (not staff).

- High-temperature RGD 525 can be baked to make to resist low heat (75-80 °C).
- Devices can be put in a vacuum for outgassing. This is useful (and sometimes necessary) for coating devices with parylene, silanes and/or preparing for cell culture.
- Devices that will be used as molds will likely require antistiction treatment. FOTS ((1H,1H,2H,2H-Perfluorooctyl) trichlorosilane) is an excellent antistiction coating and can be used as a release layer for molds.
- Some materials withstand low-temperature metal deposition such as sputtering of a seed layer followed by electroplating.

What are the minimum feature sizes that can be printed?

Features down to about 500 microns can be printed accurately depending on the orientation and geometries that are involved. Some orientations are better for reproducing small openings or protrusions. For example, features that are smaller than 500 microns may be sloped or rounded, especially if they are not very tall. These features are also fragile, and they can be broken during cleaning. Take a look at our pages about devices and critical feature parameters (*FEATURE CONSIDERATIONS and DEVICE GALLERY pages),* or contact the tool managers.

Who do I contact if I still have questions?

Beth Rhoades (rhoades<at>cnf.cornell.edu) and Daron Westly (westly<at>cnf.cornell.edu) manage the printer.