Chapter 4

# Absolutely Fab-ulous


### *Abstract*

*Our current levels of technology are enabling many things that were complete science fiction only a decade or so ago, but no modern technology is more capable of inciting futuristic predictions than 3D printing. The very idea that you can download a digital file and transform it into a physical, functional thing is science fiction turned technological fact. This chapter is a roundup of 3D printing options as they stand in 2012 and how said options might fit into libraries.*


There are interesting and exciting new opportunities for libraries coming in the form of a technology called 3D printing or, more colloquially, "fabbing." This technology is just becoming affordable at the consumer level, although it's been used for decades by corporations. As some have described it, 3D printing is at the stage that personal computers were in the 1970s. Kits for home computers existed, and you could buy different models, but they were largely toys for geeks who were trying to learn about their capabilities. However, we all know the history of where that "toy for geeks" went, and fabbing has the potential to redefine how we make and consume goods of all sorts.

The technology is conceptually simple, although in practice the theory gets played out in a number of different forms. The current high end in the fabbing world is a technology called *laser sintering*, and the low end is a much simpler method called *deposition printing*. Both rely on taking a raw, unformed material, designing a three-dimensional object, expressing it as a digital file, and converting the material to a real object that you can hold, use, mold, or otherwise interact with.

In the laser sintering process, the substrate to be "printed" is usually a fine powder that can be made of a large number of materials—plastic, ceramic, even some metals. Multiple lasers are passed through the material in three dimensions, fusing the material together particle by particle until an entire structure is formed. The device is then turned off, and the object is removed from the residual powder as a single, complete structure. This process gives the best resolution of prints, as the degree of detail available for the structure is limited only by the fineness of the powder and the precision of the laser. Which is to say, you can produce remarkably delicate structures using this process.

The other major 3D printing process is deposition printing. This is far simpler in both concept and practice and is the least expensive way to print in 3D at the current time. With this sort of fabber, you have a print head that is composed of a heating element that liquefies a form of plastic wire that is fed into it and deposits very fine amounts of said plastic onto a printing platform. The print head typically moves in two dimensions across the platform, and then either the platform or the print mechanism moves in a third dimension, creating an object with depth. Something printed with a deposition printer is printed in very thin layers of liquid plastic and then built up slowly.

With particularly high-end sintering printers, you can even introduce multiple colors into the substrate with dyes, allowing for full-color objects to be printed.

Even just a few years ago, any 3D printer was extremely expensive, and the software and hardware required to operate one was difficult to use and required a high degree of effort and skill. Now, you can purchase a kit to build your own deposition printer for just a bit over $500, and the software is largely straightforward (if needing a bit of trial and error to learn) and most important, free. You can design an object using the free version of Google Sketchup,

export it, and print it to a printer that costs less than a high-end laptop, and be holding a physical expression of your model in minutes or hours.

*Google Sketchup*
http://sketchup.google.com

There are numerous 3D printers available for purchase in kit form, but the industry leader for individuals doing this is MakerBot Industries. MakerBot is a company that manufacturers a printer called the Replicator (figure 4.1), which comes pre-assembled and ready to print in two varieties. The first is a "single extruder" model, which means that it can print in a single color at a time from a single spool of plastic and has one print head for deposition. The second is a dual extruder, which (as the name implies) has two print heads that are capable of printing in two different colors simultaneously. Both are the same size and have the same-size printing platform, capable of printing an object that is up to 300 cubic inches in size, or about the size of a loaf of bread.

The MakerBot Replicator is available in single-extruder for $1,750, and dual-extruder for $2,000.[1]

MakerBot also runs a website called Thingiverse, which is maybe the world's largest collection of 3D object models for printing. Need a new chess piece? Someone has already uploaded it for you, ready for you to download and print. Want to alter the piece to be a different size, or you want your knight to have a unicorn horn? Easy enough—you can alter the files in a free program after they are downloaded. Want to print bookmarks with your library logo embedded in them? No problem—and if you edit the file and upload it with your logo, anyone in the world can re-use your work and print your bookmark for themselves.

**Figure 4.1**
MakerBot Replicator

*Thingiverse*
www.thingiverse.com

One easy way of thinking about the power of 3D printing is to imagine that, in the same way that books democratized information and the Internet has democratized communication, 3D printing is going to democratize production of goods.

There are other companies making printers of varying degrees of complexity and completeness. One company, RepRap, is dedicated to working to design a printer that is capable of printing itself—or rather, printing the parts that you need in order to print another, effectively making the printer self-replicating. Table 4.1 shows a list of current companies and models of 3D printers available now.

| Company | Product | Website | Price |
|---|---|---|---|
| BotMill | Glider 3D Printer (fully assembled) | http://botmill.com/index.php/3d-printers/glider-105.html | $1,395 |
| Ultimaker | Complete Ultimaker Kit | http://blog.ultimaker.com/ | $1,500 |
| Bits from Bytes | RapMan 3.2 3D Printer Kit | http://www.bitsfrombytes.com | $1,390–$2,170 |
| RepRap | Mendel (RepRap II)<br>Prusa (Mendel variant)<br>Huxley (RepRap III) | http://reprap.org/ | varies |
| Printrbot | Printrbot | http://printrbot.com | not currently for sale |
| Solidoodle | Solidoodle 3D Printer (fully assembled) | http://www.solidoodle.com/ | $700 |
| Shapercube | Shapercube 3D Printer Kit | http://www.shapercube.com/ | $1,400 |

**Table 4.1**
3D printers other than MakerBot Replicator

All 3D printers have their pros and cons, but if your library is interested in playing with 3D printing, I would recommend going with MakerBot printers. They have the largest community around them and solid support for the product. MakerBot was one of the first to commercialize 3D printing and is a very safe choice for libraries.

The software needed for 3D printing can range from the very simple (Google Sketchup) to incredibly complicated and expensive (Autodesk Maya). Many, many models, especially those with simple geometries (boxes, triangles, etc.) can easily be created in Google Sketchup, while more complicated organic shapes can be done in the equally free Blender. Sites such as the MakerBot-run Thingiverse are becoming storehouses for models that others have created, a sort of catalog of things that you can download and print or alter to your own whims.

*Google Sketchup for MakerBot*
http://wiki.makerbot.com/google-sketchup

*Autodesk Maya*
http://usa.autodesk.com/maya

*Blender*
www.blender.org

Things that you can print from Thingiverse range from a replica dinosaur skull to custom Lego bricks to a two-color globe. There are a plethora of gears, slides, and other functional pieces that you can use to repair things. You can even print your own functional geared clock and build it. It's amazing how many objects there are that you can download and be holding in your hand via a 3D printer.

*Thingiverse Models*

*Dinosaur skull*
www.thingiverse.com/thing:14248

*Custom Lego brick*
www.thingiverse.com/thing:13531

*Two-color globe*
www.thingiverse.com/thing:15658

*Clock kit*
www.thingiverse.com/thing:7976

There are members of the maker community that are pushing the limits of these printers even now. There are groups working to make it possible to print using recycled plastics, such as that from two-liter soda bottles or plastic milk containers. There was even a Kickstarter project for a recycling mill that would take old plastic and extrude it into the correct diameter plastic to feed directly into a deposition printer.[2]

## Why Should Libraries Care?

There has been a rise over the last year or so in the idea of the library as a creative space for making things,[3] and the 3D printer is a natural match for this effort. In my opinion, however, the better argument for acquiring a 3D printer is that libraries have adopted the role of providing universal access to technology over the last couple of decades. There are plenty of communities where the public library is the best place to go for Internet access and to use a computer to type your resume or to print out your taxes. These are all technologies that we've come to expect to see in libraries, and they are there because they were all extremely expensive at one time and the library acted as a collective buyer, spreading the cost of access to these expensive technologies over the entire community. This allowed people who could not otherwise have afforded to use a computer to have access to one. 3D printers are at exactly this point in their development. They are just a bit too expensive for the average person to own, but they are a potentially transformative technology that the public needs to be aware of. Moving towards providing access to hardware such as a MakerBot Replicator is simply fulfilling the role that libraries took up long ago.

My very favorite answer to the question "Why should libraries care?" comes from a wonderful blog post by Andromeda Yelton, entitled "Libraries / Makerbots / Augmented Reality / Wonder," where she discusses having ordered a 3D printed art piece:

> Isn't that what libraries were always for? Secrets in the world, hiding in plain sight, waiting for you to stumble upon them and have your world opened with one heartstopping lightning bolt, look around in new ways? . . .
>
> So this is how I'd answer that question, the question of why. Because discovery is wonder. Because possibility is love. Because, amid the stacks and silent places, the forests and convention centers, there are secrets whispering to us, licking at the edges of our minds and asking to transform us. Because information and imagination were ever thus, and associating that with books was a wonderful historical coincidence: not a shackle.[4]

Libraries need to not only educate and inform, but inspire and transform. And this technology has the ability to do all of these things.

## Where Does This Take Us?

The ultimate goal of this fabrication technology is very much like the Replicator on Star Trek: The Next Generation: the ability to construct items at an atomic or molecular level so that you can create any object or substance at will. Such creation will be fed by the equivalent opposite: a machine that can recycle objects into their component molecular or atomic parts. Such a device is sometimes called a universal or molecular assembler, and these first crude steps are paving the way to make this science fiction a reality.

## Notes

1. "MakerBot Replicator," MakerBot Store, accessed February 17, 2012, http://store.makerbot.com/replicator-404.html.
2. Tyler McNaney, "Filabot: Plastic Filament Maker," Kickstarter, posted December 19, 2011, last updated February 13, 2012, www.kickstarter.com/projects/rocknail/filabot-plastic-filament-maker.
3. See, for example, John Kalish, "Libraries Make Room for High-Tech 'Hackerspaces,'" NPR, December 10, 2011, www.npr.org/2011/12/10/143401182/libraries-make-room-for-high-tech-hackerspaces.
4. Andromeda Yelton, "Libraries / Makerbots / Augmented Reality / Wonder," Andromeda Yelton: Across Divided Networks (blog), January 30, 2012, http://andromedayelton.com/blog/2012/01/30/libraries-makerbots-augmented-reality-wonder.