



# Science 2.0

April/May 2014, Using Web Tools to Support Learning

Martin Horejsi

## Teaching STEM with a 3D Printer

If students aboard the starship *Enterprise* were studying the organelles of a cell during a biology lesson, they might use the “replicator” to actually build a large model of a cell in three dimensions. That sure beats using candy or fruit to represent lysosomes, ribosomes, and the like, as has been done in many a traditional classroom. But we don’t need to wait for Star Trekkean visions of the future to come true to use this kind of modeling in science class. Turns out that the replicator—otherwise known as a 3D printer—is already here.

Today, as hardware costs drop, 3D printing in education is going mainstream. A computer-based three-dimensional object is “printed” using a sequential, layered deposition of material to build a physical model. If printing a picture is a 2D process, producing an image with only height and width, printing an object adds the third dimension of depth through successive passes of the printing device, adding one layer atop another. Most of us are familiar with the subtractive creation of objects, whether by Michelangelo’s chisel or the grinding and drilling common in manufacturing. In contrast, 3D printing is additive, like cake decorating.

With the right equipment, you can even place an existing object on a turntable to scan with a digitizer; then, after a few seemingly magical steps, a 3D printer hums to life and, minutes or hours later (depending on the complexity of the object and the speed of the printer), a replica of the object appears—as though beamed down from space.

### Unlimited potential

The number of ways 3D printing could be used across the curriculum seems unlimited. For example, all the organelles of the cell could be printed at scale. Students could then study this three-dimensional cell, handling the parts, with greater intimacy than through the eyepiece of a microscope.

Or the classic owl pellet lab could be played in both directions, as the students print various rodent skeletons, disarticulate them, and mix the bones with paper pulp, forming faux undigested food balls that owls regurgitate and then running the lab in the traditional way. Students can also create models of proteins and other molecules to visualize their 3D structure. Digital textbooks, with some tweaks, could be linked to a 3D printer so that topics covered literally materialize off the screen.

The technology raises some interesting questions. For ex-

ample, if you had one 3D printer, could you print another one with it? Could one 3D printer take the place of a whole room full of spare parts? The answer to that one is very close to yes. In fact, NASA is planning to fly a 3D printer to the International Space Station for that purpose. Imagine fulfilling the need for a replacement part with little more than an e-mail from Ground Control (see “On the web” for a related video).

Back on Earth, someday soon easy and reliable 3D printing will fundamentally change the options available in the classroom. Teachers and students will not only be able to print obvious things like models, manipulatives, and lab equipment (see “On the web” for an online source of downloadable designs) but will also design and print their own creations.

“You can go from idea to creation in a short amount of time,” as well as create multiple iterations if you want to make changes to your design, says Lisa Blank, professor of science education at the University of Montana, who is promoting 3D printing in STEM education.

### From novelty to necessity

At the moment, 3D printing in education is still somewhat of a novelty, garnering the most excitement in physical science and engineering classes. But creative applications of 3D printing in biology are rapidly expanding that curriculum as well. It is not hard to imagine a time when 3D printing is ubiquitous. Consider the years 1959 and 1995. The first saw the introduction of the photocopier; the latter was the year internet access in schools became widespread. Today you can hardly imagine a school without either.

*Martin Horejsi (martin.horejsi@umontana.edu) is an associate professor of instructional technology and science education at the University of Montana in Missoula.*

### On the web

Classroom-ready 3D printers: [www.makerbot.com](http://www.makerbot.com)

Downloadable object designs: [www.thingiverse.com](http://www.thingiverse.com)

Educational ideas and support for 3D printing: <http://curriculum.makerbot.com>

Video interview with a NASA 3D print project manager:

<http://bit.ly/1hpVVfC>