KATHERINE BARRETT

> "The world has enough *things*. We want to teach the kids the tools they need to realize what's already in their imagination"
>
> *– Cam Turner (far right), Maker Club, Kitchener, Ont. (with his eight-year-old son, Owen)*

Playtime Hacked

Kids' makerspaces blend art and technology to reuse and repurpose.

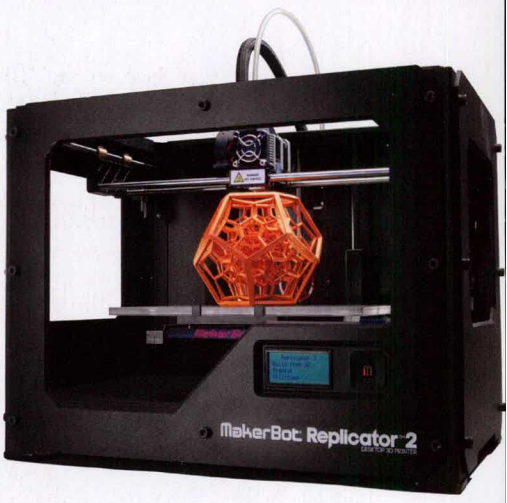
IT'S AFTER SCHOOL on the south shore of Nova Scotia, and a handful of kids have gathered in the two-room public library in Lunenburg. Some flip through books, some tap on computers, but none seems to notice the new black box near the checkout desk. Roughly the size of a microwave oven, but with a gaping hole where the door should be, the box looks half-built and boring – until Jeff Mercer presses a button.

A metal platform rises from the bottom of the box. A robotic arm jolts to life and starts spewing orange plastic from a tiny spout. The kids gravitate to the zip-zip


CENTURION
The Beat

"The whole premise of this technology has been to foster creativity. ... I think there's a great kind of pent-up need: We've got into the computer age and everything is on a screen or remote, we've kind of missed the tangible result"

– Chuck Hull, inventor of 3D printing, CNN.com interview



of high technology. They gather, lean closer and watch the black box synthesize a precise interlocking nut and bolt, seemingly from nothing.

"That's so cool!"

"How does it do that?"

"Where does that orange stuff come from?"

Christina Pottie explains. The box is a Makerbot Replicator, a desktop 3D printer. It is reading instructions from a digital card and "printing" layers of corn-based, petroleum-free plastic to produce a usable 3D object. She displays other things the printer can make: a linked chain, a bracelet, an iPhone case. The kids are hooked.

The Makerbot at the Lunenburg library is one of sixteen 3D printers distributed by the Nova Scotia government in 2013 to rural and urban locations around the province. The printers have gone to libraries and Community Access Program sites with the idea of creating public makerspaces: collaborative meeting places that blend high-tech and craft to foster local, DIY solutions.

Mercer and Pottie, public services librarian and outreach/e-services coordinator, respectively, are running with the idea. They've helped raise additional funds to buy two larger 3D printers and set up Shape Space at the public library in Liverpool, NS. Last summer, they organized a free maker camp for 10 to 12 year olds. Kids learned to create 3D images using SketchUp modelling software and print their inventions on the Replicator. The larger 3D printers at Shape Space have helped drafting students at the Nova Scotia Community College make prototypes of their designs. And Shape Space is only getting started: "The sky's the limit," Mercer says of kids, imagination and technology.

Makerspaces sprouting up in Nova Scotia are part of a fast-growing maker movement in Canada and around the world. Public libraries and community-run clubs are encouraging both kids and adults to "do it yourself" by teaching skills such as electronics, programming and woodworking. Many makerspaces also encourage participants to "repair it yourself" by providing tools to solder and sew, and even to print one-off spare parts on the 3D printer.

Today's maker movement has roots in the DIY counterculture of the 1960s and 70s and, further back, the ideals of the Arts and Crafts movement. Both of those valued artisanship and ingenuity, and favoured the customized over the mass-produced. The launch of *Make Magazine* in 2005 gave voice and venue to a new generation of makers, hackers and tinkerers.

The first Maker Faire was held in 2006 in San Mateo, California. Self-described as the greatest show-and-tell on Earth, the event gave makers an opportunity to demonstrate innovations in technologies and crafts ranging from blacksmithing to textile repurposing. Maker Faires have since been held across the world, including official 'flagship' faires in New York, California and Michigan, as well as hundreds of independent, community-run mini-Maker Faires. Big or small, the idea is the same: to inspire creativity through hands-on, DIY skills, and to share those skills with like-minded makers of all ages. Indeed, Maker Faires are family events. More than 50 per cent of the nearly 200,000 attendees to the flagship faires in 2013 brought their kids.

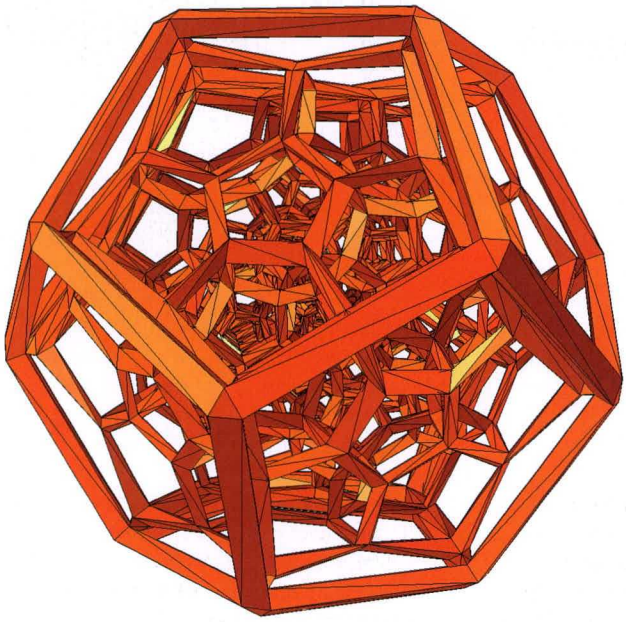
Canada's first makerspace dedicated to kids and teens opened in Toronto in 2012. Makerkids offers workshops, camps and "open make" sessions that combine high- and low-tech. Kids can learn robotics, 3D printing and programming for Arduino – small, hackable circuit boards that control other electronic devices like televisions or lighting fixtures. They can also learn basic sewing, electronics and woodworking.

Every makerspace is different, a reflection of the community it serves. Many focus on new technologies, especially 3D printers, scanners and related software. A few, such as the Makery in Nova Scotia and the Makehouse in British Columbia, specialize in traditional handcraft skills like stitching, weaving and upholstery. The makers, too, are motivated by diverse values and principles. The *Maker Movement Manifesto*, published last September by TechShop CEO Mark Hatch, emphasizes collaboration and openness: makers form a community of shared tools, designs and ideas. For some makers, artistry is key, for others it's self-reliance, and for still others, the primary motivation is environmental.

At the kids' Maker Club in Kitchener, Ontario, an environmental ethic is explicit on the website: "We'll be adding Repair and Repurpose to the classic Reduce, Reuse and Recycle phrase. The DIY and maker ethic is about finding new uses for the things we have as well as repairing things that break." Number four of the six Maker Club ethics advises: "Every garbage day is an opportunity."

The idea for Kitchener's Maker Club hatched in late 2013. Entrepreneur and dad Cam Turner and his eight-year-old son Owen wanted something more than the usual after-school offerings. "We thought it would be cool to have a club where we just made stuff," Cam Turner says. Inspired by Makerkids in Toronto, Turner soon connected with Mozilla's Hive Waterloo, an organization that teaches youth

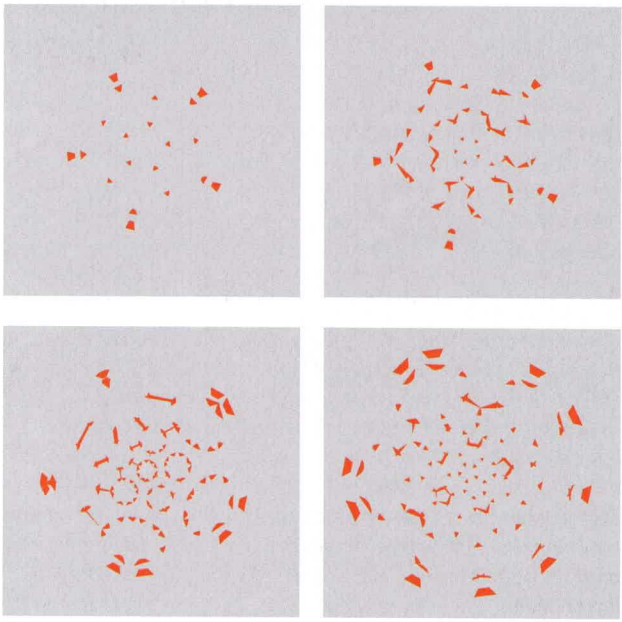
How Desktop 3D Printers Work



Step 1 – Design

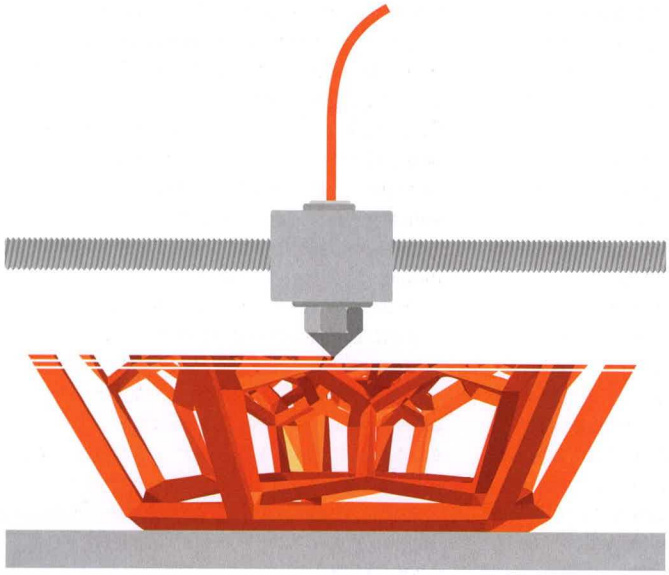
An artist creates a model of the object to be printed using 3D design software. Real-world objects can also be recreated using a 3D scanner.

3D model above: 120 Cell (nested dodecahedrons) by George Hart



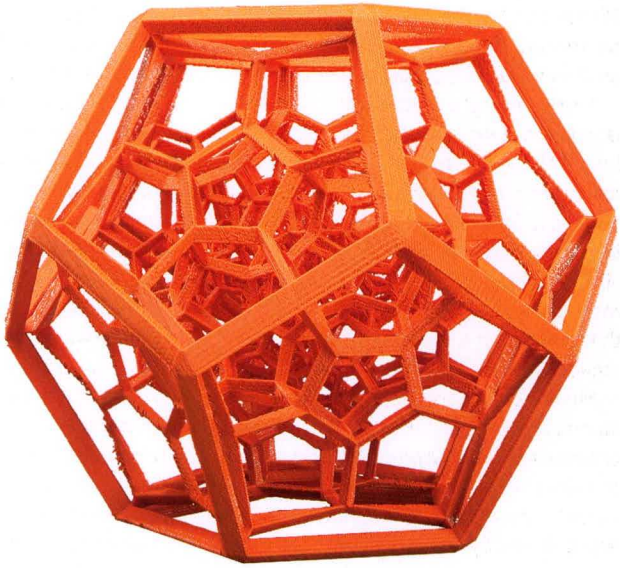
Step 2 – Processing

Software slices the 3D object into a stack of 2D cross-sections. These cross-sections are further processed to created a set of coded instructions that guide the motion of the 3D print head.



Step 3 – Printing

The 3D printer extrudes a plastic filament through a heated nozzle. The object is built from the bottom up as the printer moves the print head to draw each two-dimensional slice in order. Common plastics used are PLA (Polylactic acid) or ABS (Acrylonitrile butadiene styrene). Industrial 3D printers often use other approaches to build up an object, including laser sintering, in which layers drawn by a powerful beam of light that hardens a liquid resin or fuses powdered metal.



Step 4 – Finishing

The quality of the output differs between different models and makes of 3D printer. The resolution of a printer is determined by the smallest voxel, or 3D pixel, it can produce. In this finished model, the layered nature of the printing is made obvious in the texture of the surface and roughness of some of the model's edges. 3D printed models are often finished by hand, being trimmed, sanded, painted and/or sealed.

about technology, as well as Kitchener's THEMUSEUM, which is now the Maker Club's home.

For their first event, Turner and his friends scavenged family toy boxes and held a toy-hacking workshop. All club events are open to kids between eight and 14 years old, as well as their parents. But Turner says toy-hacking has a particular draw: kids disassemble old toys, then sew, solder and hot-glue the parts back together to make something new. "It's a great way to pull parents into the conversation about making and show them that it doesn't need to be complicated." It's also a great way to exercise the Repair and Repurpose ethic. "The world has enough *things*," Turner says. "We want to teach the kids the tools they need to realize what's already in their imagination."

The Maker Club is one of many makerspaces in southern Ontario's "tech triangle" – formed by Kitchener, Waterloo and Cambridge. Kwartzlab in Kitchener, for example, is a not-for-profit organization funded mainly by memberships fees. The modest space has a range of events, artists in residence and a weekly open house, and is outfitted with laser cutters, 3D printers, wood lathes and knitting machines. Like makerspaces across Canada and elsewhere, Kwartzlab caters mainly to adults – those members old enough to work with tools that cut and burn. But Kwartzlab recognizes the potential of makerspaces for kids. They've held "Hacky Halloween" events where kids carve pumpkins and fit them with flickering LED lights and hacked micro-controllers. According to co-director Doug Moen, Kwartzlab plans to have a dedicated kids' makerspace by the end of 2014.

It's easy to see the appeal of kids' makerspaces for organizers, parents and the kids themselves. Like the video game sensation *Minecraft* (which is also on offer at Makerkids in Toronto – and which you can read more about on page 21), maker activities are open-ended. There is no "right" product and few instructions beyond those needed for safety and cooperation. Making is also wildly inventive. Want to mix robotics and pumpkins? Go ahead.

Compared with long-established youth clubs like Scouts and 4H, maker clubs are less bound by conventional disciplines, rule books and, of course, uniforms. In fact, a US organization called Hacker Scouts has stated the link between makers and Scouts explicitly. Building on traditional Scouting principles of moral character, mentorship and leadership, Hacker Scouts teaches STEAM – science, technology, education, arts and math – through a variety of maker skills. Hacker Scout locations, called guilds, divide into 5- to 10-member sub-groups to work on mentored projects and earn badges in programming, electronics, art, textiles and other fields. Open Lab days offer non-members a chance to work on similar projects with the guidance of local experts. The organization formed in 2012 and has since spawned guilds across the US. Recently, under threat of litigation from the Boy Scouts of America, Hacker Scouts changed its name to Curiosity Hacked.

Although Curiosity Hacked has yet to reach Canada, Calgary-based maker Jim Akeson is devising his own version. In 2012, he founded Scoperta, which means "discovery" in Italian. The organization had a whimsical beginning: Akeson and fellow hackers created a motorized armchair from old furniture and wheelchair parts – think your grandfather's favorite recliner on wheels. The result was a huge hit at the Stampede, and Akeson connected with other maker communities from Calgary's Protospace and Beakerhead to create more chairs. In the process, he recognized an opportunity and a need: inventing and teaching open-source electronics.

Scoperta now functions as the "kids' wing" at Protospace, says Akeson. Through extracurricular and in-school workshops, Scoperta shows kids in elementary through high school the basics of robotics and electronics – and armchair driving when safe and appropriate. Plans are also underway to develop an electronics curriculum so that teachers not formally trained in technology can nonetheless incorporate circuit boards and soldering into art, science and other classes.

Scoperta encourages kids to imagine and build with recycled parts whenever possible. "We teach the kids where to find used parts and show them that things like broken Roombas or cordless drills can be reused. Sometimes these old machines just need a battery," says Akeson. Like most makerspaces, Scoperta works closely with several local organizations – the lines between one makerspace and another are often blurred – and kids showcase their creations at school science fairs and gatherings like the Western Canada Robotics Society's Robot Games. For example, one young maker, Nita, has repurposed a broken Roomba as a toy companion for her school science fair project. Another, Lauren, fashioned floor-cleaning brushes with a custom circuit board and sold her invention to Calgary mini Maker Faire attendees in September 2013.

Akeson hopes this fusion of electronics education and high-tech repurposing will spread to Scoperta outposts across Canada. "I want to connect other makerspaces, to help them reach their potential," he says, "while also teaching kids the creative potential of electronics and robotics."

That the kids' maker movement in Canada will gather steam – and STEAM – appears inevitable, especially as schools and public libraries jump on board. But whether the movement holds to an earth-friendly course remains less certain. Handing down basic skills like sewing and woodworking may encourage kids to fix and build rather than race to the mall. Newer technologies such as 3D printing also offer the possibility of environmental options: locally produced, customized, biodegradable repair parts, for instance. But current 3D printers are energy gluttons and the world doesn't really need another plastic bracelet or iPhone case, corn-based and biodegradable or not.

Christina Pottie at Nova Scotia's south shore libraries likens the current stage of high-tech makerspaces to the early days of desktop computers. Public libraries often housed a community's first PC; they now house the first Makerbot. "We're in the business of sharing information," she says, "whether through books, computers or printers." And as 3D printers and other new technologies come down in price and become, like books and PCs, regular household items, kids will no doubt want access to this new genre of information.

How will they use it? To churn out products or also to craft new knowledge? Infused with an ethic of moderation, conservation and sharing, the new generation of makers has the potential to build on traditional DIY skills and forge – sew, solder and glue – stronger links between the maker and environmental movements. A\J

Katherine J. Barrett is editor-in-chief for *Understorey Magazine*, managing editor for the US-based magazine *Literary Mama* and an A\J editorial board member.

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