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TRY THIS AT HOME!

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Watch, Learn, Do

Observing my father make things when I was young instilled confidence in my own abilities.

Growing up, I was given specific advantages as a maker. My father, the painter Lee Savage, was a living example of a committed maker: painter, animator, illustrator, director. My primary memory of him, growing up, is of him painting every day for hours in his studio out back, and living in a house populated with art made by close friends.

When, for my sixth or seventh birthday, I wanted a race car for my teddy bear, Gus, he made one out of fiberglass for me. He built a succession of decks behind our house, built the addition on his studio, and fixed the chairs he broke leaning back too far. I watched it all.

His studio was a laboratory of excellent primary building materials: mat board, Rapidograph pens, acetate (which he used to paint cels for animated spots he did for *Sesame Street*), armature wire, and masking tape. I was never turned away for want of an art material.

By the age of 12, I had permission to use my father's charge account at the local hardware store. At 18, when I moved into Manhattan, he let me charge art materials on his account at the art store. I was stoked. When I got ambitious, and asked for things like 20 sheets of corrugated cardboard, the answer was always yes. I never abused this privilege. It honestly never occurred to me.

I don't imagine that my father set out to create an artist. But I'm pretty sure he figured that everyone has a responsibility to learn how the world went together, and much of that learning is simply paying attention.

My twin boys, Addison and Reilly, are now approaching 11. I don't spoil them, but I do want them to be makers. So I don't end up building a ton of stuff for them.

But: I've bought models for them, and shown them how to put them together. I'm always using one or the other as an assistant for my projects, whether fixing something in the house or my car, or putting together a piece of a costume. They've spent the day at work with me many times. They



like to watch, and love to help, and already I can see the fruits of these efforts starting to bloom.

I can see both boys learning to put something they want to make into their heads. I can see them trying, failing, succeeding, and trying again to get that thing made.

They're both showing a facility for music. I'm encouraging the spit out of this. The ability to enjoy doing a thing excellently, the ability to enjoy the *work* involved — to know that trial and error and even failure may lie ahead, but that they aren't enough to inhibit your forward progress — this is what I hope to teach them.

Part of gaining the courage to plug ahead with anything is acquiring the confidence that you're going to be able to understand what's going to go on. The more things you build and make, the more things you take apart and break, the more you understand many of the critical workings of the world. The more you pay attention, the more that attention pays you back.

Adam Savage is an American industrial designer, special effects designer/fabricator, actor, educator, and co-host of the Discovery Channel television series *MythBusters*. He lives in the San Francisco Bay Area with his wife, Julie, and two sons.

READER INPUT

Young makers, DTV praises, a melted museum, and a CRAFTer's lament.

✉ MAKE, Volume 19, is by far my favorite issue. The only thing I like more than a week in the shed with my tools and MAKE magazine is a week in the shed with tools, MAKE, and my son! Not only were there lots of projects for him *and* me, but he especially enjoyed the photos of young people who enjoy building too. (Dad says: good examples.) My wife and I hope this continues to be a regular feature. Great job! Thanks for remembering the younger builders, like my son, Marty.

—*Matthew and Marty Ruane, Richland, Wash.*

✉ Thank you for an incredible magazine. I love it! In fact, we use MAKE in our museum's Science Center for inspiration and to design experiments and exhibits for our visitors.

At the Science Center we have opened an exciting and very special exhibition about global climate change. Visitors have to put on rubber boots as the exhibition floor is covered with 10cm of water to illustrate the effect of increasing sea level.

Enormous melting ice cubes symbolize the melting of the Arctic ice cap. The visitors use remote controlled boats to visit kiosks representing different geographical places around the world. By entering one of the kiosk's harbors with the boat, the visitor can start a short movie featuring a climate witness. The exhibition is very inventive and exciting, just like MAKE.

—*Jon Haavie, Oslo, Norway*
Norsk Teknisk Museum, tekniskmuseum.no

✉ I really enjoyed the *Make*: television program on how to make a DTV antenna [Episode 4 at makezine.tv], and I tried it. We were having problems getting TV reception on our old antenna. The signal strength was only 18%. After building the DTV antenna, all channels came in sharp and clear with a signal strength of 65%.

I only made a few changes on the one I built. Where the coat hangers crossed, I used heat-shrink

tubing instead of electrical tape, and for a better connection, I used 2 washers where the transformer connects, sandwiching the connections between them. Thanks for the good and useful project.

—*Len Hart, Niangua, Mo.*

✉ I am one of the sad saps who received MAKE as the consolation prize when CRAFT folded. This was not a chance for me to experience something new, since I was already a MAKE subscriber. I read that MAKE had planned on expanding to satisfy what CRAFT was doing, and for the last few issues since the end of CRAFT, I have felt satisfied. Now, with Volume 19, I feel like you have shaken off all former CRAFT subscribers to return to a more digital/tech-heavy focus. As far as some constructive criticism, here are things that I'd like to see:

- More projects that lean towards mechanical skills to balance out the digital.
- More projects about food/alcohol/beverage science and production.

Oooooorr, you could scrap that and just bring back CRAFT. I would still subscribe to both.

—*Emily Armstrong, Troy, N.Y.*

EDITOR'S NOTE: Emily, we're glad you're sticking with us and we remain committed to featuring all kinds of making in MAKE. Naturally Volume 19, the Robots issue, had lots of technology; we hope you'll enjoy this new issue focused on projects for Kids of All Ages. And don't forget about our content-rich website, craftzine.com, updated daily.

MAKE AMENDS

In Volume 19, page 79, "My Robot, Makey," the 0.1 μ F capacitor is Jameco part #151116, not #15229. Thanks to reader Joseph E. Mayer for catching the error.

Also in Volume 19, we omitted Daniel Klaussen, who tested the instructions for the Speed Vest project, (page 100). Thanks, Daniel, for all your help!

Learn by Making

For more than seven years, Tom Zimmerman has volunteered in San Jose, Calif., schools, engaging students in hands-on activities and teaching science and technology. This summer, Zimmerman was recognized as the first-ever California Volunteer of the Year by Governor Arnold Schwarzenegger and First Lady Maria Shriver. He called it a “fairy tale day.”

Zimmerman is an IBM research scientist and a frequent contributor to MAKE — his Hydrogen-Oxygen Rocket project is featured in this issue (page 90). Much of what he’s written for the magazine originated as projects he developed for his students: an electronic drum kit, a mini Mars rover, and a digital microscope.

He created an Extreme Science after-school program to provide 60 Latino high school students with hands-on experience in science, technology, engineering, and math (STEM). And he’s particularly proud of his efforts to introduce girls to power tools. He also runs a summer camp, which this year featured workshops on building wind turbines and a geodesic dome. “I’m happy to have the opportunity to share the joy of designing, building, and teaching,” he enthuses.

In Boston, Ed Baafi runs the Learn 2 Teach, Teach 2 Learn (L2T) program during spring and summer at MIT and at the SouthEnd Technology Center and its FabLab. The idea behind L2T is that the best way to demonstrate that you’ve learned something is to turn around and teach it to others.

“We pay high school students to learn, build, and teach at over a dozen community centers,” says Baafi. One group developed a solar device charger, and another student, Mark Williams, has been perfecting his electric violin, which we blogged on makezine.com, to his great amazement.

A seventh-grade teacher explains why she came to Maker Faire this year:

I try to incorporate some hands-on activities and labs into the classroom. I am still dissatisfied with the learning environment I am able to provide to my kids. The “holy grail” for me is to facilitate communities of independent learners, engaged in projects, assignments, discussions, etc. that

motivate and challenge them. To this end, I’d like to make more stuff, and to have my students be makers.

Our communities are made up of makers like Zimmerman and Baafi as well as teachers and parents who see the importance of helping kids become makers.

But it’s become clear that making is missing from schools and from the lives of even the best students. “I have had freshman engineering students who have never used power tools,” says AnnMarie P. Thomas, an engineering professor at the University of St. Thomas in St. Paul, Minn.

How can we create more opportunities for kids to make things? How do we create spaces inside schools or out in the community that support self-directed, hands-on projects?

Making is a way to engage kids in learning. It’s not work but a form of play. “There is a kind of magic in play,” writes Stuart Brown in his new book, *Play*. “It’s paradoxical that a little bit of ‘nonproductive’ activity can make one enormously more productive and invigorated in other aspects of life.”

Making is a way to enjoy trying to do new things (and often failing repeatedly) while learning more than any written test can measure. “Allowing children to build with real tools,” says Thomas, “gives them confidence and a skill set that they can build on for years to come.”

This magazine will do its best to advocate for the role of making in education. Makers themselves are an untapped resource for schools, especially as mentors. I know many makers who are exploring ways to share what they know and love with kids of all ages. Makers bring more than knowledge and experience — they bring endless enthusiasm, which they easily pass on.

If you’re interested in making and education, get involved in your own community. Join me and others at Make: Education (makered.makezine.com) to share ideas, stories, and techniques for helping more kids learn by making.

Dale Dougherty is the editor and publisher of MAKE magazine.

Baby Hacking

Having a child to build things for is the maker's dream, and the maker's curse. I had a son seven months ago. It is every bit as wonderful, and every bit as exhausting, as everyone will tell you. As a hacker, a maker, and a builder, I find that it's definitely a humbling experience. This is, quite literally, my life's work — in the strict biological sense.

It's also humbling because he is so much cooler than anything else I'll ever make (or half make). So far he's done little more than transform from a strictly input/output device to an interactive robot; all the same, watching his operating system boot up makes any code I've ever written look trivial.

In observing his every movement, I can only be jealous of the evolutionary mechanism design-and-optimization that is his every muscle, digit, earlobe, and nostril. Because this is the pinnacle of my making, I'm rattled, but I'm also inspired, because he just set the bar so much higher.

If you suffer from inventor-itis, as I do, the first thing you notice about the baby world is that everything is broken. All the products on the shelf are pathetic. They're toxic and poorly made. The bed options are hopeless. Those clumsy, bulky, awkward, ugly things called strollers are terrible. Car safety seats? I wouldn't trust them to a high-school egg-drop competition. Enter the maker mother and father: time to get a fixin' on it.

But there's a downside. Time vanishes when you have a kid. Those moments of peace, contemplation, and low-level hand-eye tasks you used to have alone at the workbench? Obliterated. There is now a screaming, giggling attention magnet that's the cutest thing in the world. You haven't slept in weeks.

Hacksawing with the kid in the sling on my chest? I don't think so (or at least my wife has trained me not to think so!). Actually getting things built on time? That's a whole other story. My wife axed my goal of building the ultimate stroller, when the baby arrived and there was still no stroller. (Perhaps for the next kid, I wistfully think.) And my folding origami toy box concept will likely remain a dream.

So far I've managed to build a co-sleeper (a mini bed that attaches to our bed) with the help of a friend. Most are hideous and cheaply made — there

was one in a design magazine somewhere that we liked, but it was only a concept! So I made it real, a bamboo and aluminum masterpiece.

Our cargo tricycle wasn't designed with an infant sunshade, so my father and I fixed it. My wife supplied beautiful Marimekko fabric so the outcome wouldn't be embarrassing at the new mothers' group, and the result is a magnificent, aerodynamic sunshade made by two engineers with PhDs.

I find myself working on children's toys out of compulsion. I have redefined the pinnacle of invention as "the next Lego." It's crazy and arrogant to believe that you could do it, but that won't stop me from trying. I'm sure you know what I mean. I want my child to have amazing experiences, to grow up in a world of objects that are beautifully designed and thoughtfully made. Toys that are significant and memorable, not disposable.

Perhaps that's the hidden desire I'm talking about. It's not that my own childhood wasn't magical (it was; my father used the best tools of his day to make me ride-on wooden horses, pedal-powered cars, and knitted 8-foot-high unicorns).

My love, and passion, and exuberance, and creative desire are overflowing, and every sheet of plywood or steel that I look at is some incredible object that I can make for him. Inflatable safety barriers for car seats? Easy. I'll do it for him. Custom stuffed-animal-creation software? I'll do it for him. An algorithm-based paper airplane generator? I'll code it for him.

And that baby stroller? It was going to be made from aircraft-grade aluminum poles, cast-zinc universal connection pieces so it could be reconfigurable, and Abec 11 bearings with large-diameter rollerblade wheels (for low rolling resistance). It would fold into something smaller than a Swiss Army knife yet be sturdy as a tank.

All the drawings are still in my head. But the baby needs feeding, my wife needs a break, I need some sleep, and the stroller needs one of you non-parent makers to make it for us. Unfortunately, until you have a child, you probably won't quite understand why.

Saul Griffith is a new father and an entrepreneur. otherlab.com

MADEON EARTH

Report from the world of backyard technology



Photography courtesy of Bekonscot Ltd. (2009)



A Major Model Village

Why are models so fascinating? Psychologists haven't spilled much ink over the question, but just about everyone visiting Bekonscot, the world's oldest model village, is quickly spellbound.

The whole thing began by accident in the 1920s when **Roland Callingham's** wife issued an ultimatum: either the model railway in the house goes, or I do. It appears that Callingham didn't want to part with either, so he bought four acres of meadows next to his house in Buckinghamshire, England, near London, and proceeded to build an outdoor model railway, along with a model world to go with it.

With the help of model rail manufacturer Bassett-Lowke (still in existence), Callingham's ad hoc team built a robust Gauge 1 line at $\frac{1}{32}$ scale. Amazingly, one of the locomotives from 1929 is still running — still doing 2,000 (real, not model) miles a year.

The initial rail line skirted the new swimming pool that Callingham had dug for his tennis guests to cool off in. The earth from the pool excavation formed mounds on which the first model houses were built to complement the growing train line.

The houses were built to a different scale of 1 inch to 1 foot, now standard for many model villages.

Bekonscot opened to the public in 1929 and was an immediate success, even receiving several royal visits. It has expanded to fill nearly two acres with 400 yards of railways, six villages and seven stations, hundreds of buildings, and thousands of figurines — all made on-site by modelers and engineers, many of whom work there for decades.

Bekonscot is a charming snapshot of Britain in the 1930s, but it also encapsulates much of the history of industrial civilization. It has a coal mine, an oil refinery, an airport, a racecourse, a hospital, a farm, a funfair (carnival), churches, and schools, as well as lakes, a fishing harbor, and a yacht marina. It is a sensual and intellectual *tour de force* that's attracted nearly 15 million visitors, given more than £5 million (\$8 million) to charity (in today's money), and been the inspiration for countless other model villages around the world.

—Julian Darley

» Bekonscot Model Village: bekonscot.com



WALL-E World

Before the Disney/Pixar film *WALL-E* premiered in 2008, replicas of its robot star were already showing up on the internet. That's because at least one replica builders' group had a head start.

Scot Washburn explains: "I found an early trailer for *WALL-E* and posted it to the R2-D2 Builders Club around the end of September 2007. There was such a positive response that ... on October 8th, I created the WALL-E Builders Club."

The club has grown to nearly 700 passionate bot replica builders who mainly exchange information online, but sometimes meet at nerdy conventions.

So, what inspires grown men (almost exclusively) to spend hundreds of hours and thousands of dollars to replicate a cartoon robot?

"He's a very sympathetic character," says club member Guy Vardaman, a web developer from Burbank, Calif. "He's innocent-looking — yeah, those large eyes. But he also looks somewhat rugged, with his tank-tread drive and all of those scrapes and dents on his body. He looks realistic, too; like you can believe he'd actually work."

Maybe that's what launched a thousand WALL-Es: he looks easy to make, at least as a static replica. Articulated WALL-Es, with a working drive, sound effects, and radio control, are harder to come by.

"My WALL-E will be radio controlled, so he'll move around on his treads," says William Miyamoto, 42, a stay-at-home dad and actor from Los Angeles. "I plan on articulating his head and arms. He will also have a sound system so he'll say things and play sounds on command."

The club is collaborating to design a track drive that members can replicate. Members point out a myriad of benefits to working in a group, such as the pooling of talent, expertise, and purchasing power, plus the trading and sharing of parts.

But there are also the more human aspects. As one member put it: "When you're building something that takes months or years to finish, you can run out of steam. The encouragement of the group can make all the difference." —Gareth Branwyn

❖ WALL-E Builders Club: makezine.com/go/wall-e