

Make:

Making Makers

Kids, Tools, and the Future of Innovation



AnnMarie Thomas
foreword by **Dale Dougherty**

Making Makers

How can we raise children who are creative, lifelong learners? Author Dr. AnnMarie Thomas was inspired to answer that when she tried to guide engineering students through design projects. She often met students who were well-read, excelled at test-taking, and were certainly intelligent—but they'd never made anything with their hands. This held her students back.

AnnMarie interviewed dozens of adult makers to find out what childhood experiences helped lead to their becoming “makers of things.” Her exploration led all the way back to the childhood of her subjects and applying what she knew to help her own young children become makers.

Is your child a Maker? How will you help her maintain her curiosity? How will you encourage his persistence? This book shares stories, examples, and resources to inspire you and the kids in your life to create something the world has never seen before.

Written for parents and educators, *Making Makers* taps into the early memories of famous Makers, including:

- » **Chris Anderson, co-founder of 3D Robotics**
- » **Mitch Resnick, creator of Scratch**
- » **Molly Black and Sarah Grudem, co-founders of Sassy Knitwear**
- » **Dean Kamen, founder of DEKA Research & Development and FIRST**
- » **Lenore Edman, co-founder of Evil Mad Scientist Laboratories**
- » **Amon Millner, director of the EASE Lab at Olin College**
- » **Nathan Seidle, founder of SparkFun Electronics**
- » **Luz Rivas, founder and executive director of DIY Girls**

“Who needs books on happiness when you can read Making Makers?!
Thomas brilliantly and playfully draws us into one of the best of all possible worlds, a world that shows how play and making cultivates the best in us, both individually and collectively.”
—Linda Stone, Former VP, Microsoft

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AnnMarie Thomas



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by AnnMarie Thomas

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For Sage and Grace

Contents

Foreword		vii	
Preface		ix	
1		Makers	1
2		Curiosity	9
3		Playfulness	23
4		Risk	37
5		Responsibility	51
6		Persistence	65
7		Resourcefulness	79
8		Generosity	95
9		Optimism	109
10		Maker Moms/Dads/Teachers/Neighbors/Friends	121
A		The Makers in This Book	133
		Index	141
		Acknowledgments	145

Foreword

The goal of Maker Faire is to “make more makers,” so since 2006, we have gathered makers together and celebrated what they do. In 2013, there were 100 Maker Faires around the world, and a growing number of attendees are families. From the very first, we understood that meeting makers and seeing their projects inspired others to see themselves as makers. We invited everyone to get involved by creating and sharing projects based on their own interests and skills. While I knew Maker Faire would appeal to adults, I was surprised to see how kids were fascinated by the amazing variety of projects; they wanted to participate, and they wanted to become makers themselves. Sometimes, their own interest surprised their parents too!

At Maker Faires, parents were noticing how their children liked to play with cardboard as well as wood, how they liked to learn to use tools and how they liked to tinker. I suspect that some of these practices had fallen by the wayside—what seemed obvious and good to do for generations had been lost, forgotten, or just taken for granted. There is little hands-on learning found in classrooms. On playgrounds or outside of school, there is very little time for unstructured play. It wasn't clear how a child could become a maker without adult involvement. Fortunately, parents have begun to discover that making is something to do together for fun while also being an authentic form of learning.

At Maker Faire Bay Area in 2014, I had a conversation about making and parenting that has stuck with me. Mike Neden, a professor of technology and engineering education at Pittsburg State in Kansas, was hanging out in the booth for Rokenbok, a 3D construction kit for kids. As parents and their children interacted with the kit and began building things, Mike found that parents asked questions about how kids learn, and more specifically, how they might learn to become engineers and scientists. Many of the parents asking questions had these careers and were working in Silicon Valley. Mike's comment to me was that these parents weren't sure how they themselves became engineers and scientists and were wondering how their own children might become them too. They understood the value of what they had learned to do—and how they thought—and they wanted to pass that on to their children. I've also met and talked to parents, particularly those like Julie Hudy, who we call Maker Moms. They recognize in their children the interest

in and capability for making things. Because these parents are not makers themselves, they want to know how to support their children, whose experiences and interests are so unlike their own.

I am proud to publish this book by AnnMarie Thomas. It is a guide for parents who want to engage their kids as makers, but it is not a how-to guide or a self-help book. It offers insight into what we call a “maker mindset,” which is a way of engaging with the world and gaining access to a toolset that is both mental and physical. The maker mindset can be used to change the world for the better. Dr. Thomas, a maker, a teacher, and a mother, helps us learn from makers so that all of us can foster the qualities we value most in them. It is clear that what many appreciate about making is not just the finished product, but also the character traits that the process helps develop.

Making is more than hands-on projects, but it starts with them. You can find lots of guides that tell you or your child how to learn electronics, woodworking, welding or sewing. You can find a variety of ways to engage children in building practical skills and developing original ideas. Yet what happens with a child’s hands and what he or she creates are not nearly as important as what happens inside the child. This is what Piaget, a pioneer in our understanding of child development, called “cultivating the experimental mind” in his book *To Understand is to Invent*. He talked about a kind of active education that would “*lead the child to construct for himself the tools that will transform him from the inside—that is, in a real sense, and not just on the surface.*” We can give our children access to tools and the time to practice using them to develop creative and technical projects. Yet, as parents who are makers, our most important project is helping our children become creative, lifelong learners. We need adults to facilitate these experiences and to create makerspaces in their communities that are accessible to all children.

Making more makers is what each of us can do, and what we must do together. These are the children who will make the future.

—Dale Dougherty
Founder and CEO, Maker Media

Preface

How are you going to design something if you've never built anything?¹

— **WILLIAM GUILFORD (UNIVERSITY OF VIRGINIA
ENGINEERING PROFESSOR)**

In the fall of 2011, as I was taking a break from grading my students' assignments, I found myself stopped by the preceding quote in an engineering education magazine. After six years of teaching undergraduate engineering design classes, I shared Dr. Guilford's sentiment. In my classes, I found that the truly innovative designs most often came from students who were able to couple rigorous analysis (which is the focus of many engineering programs) with a practical knowledge of how machines work. The latter is knowledge that comes primarily from taking things apart, putting them together, and learning what has worked (or not worked) in other devices. While I can assume that all of the first-year engineering majors that I teach have taken a math class, I can't assume that they've spent time taking things apart or building things. As someone who reveled in making things (out of wood, out of cardboard, out of fabric, out of sand, out of... anything) as a child and teenager, I had a hard time wrapping my head around the idea that many young adults, particularly those who were going into a field of study focused on creating things, had so little experience actually making things.

I read Guilford's article the same week that I attended World Maker Faire in Queens, NY. This event celebrated the creators of things ranging from robots to costumes. The engineering professor in me saw some incredible examples of technology, but more than anything, what I noticed were the people who were passionate about creating things and sharing their knowledge with others. The excitement was infectious and evident in attendees of all ages. Throughout the fairgrounds, there were opportunities for children and adults to learn skills like soldering, energizing conversations about the intricate details of various 3D printers, makers young and old showing off the things they'd made, and a pervasive air of curiosity.

1. Mary Lord, "Seeing and Doing," ASEE Prism, September 2011.

That sense of curiosity and collaboration is what I wish for all of my students, as well as for my own children.

I am definitely not alone in my desire to encourage children to actively create the world around them. Makerspaces, places where people get together to use tools and work on projects, are popping up around the world. We're seeing them in libraries, schools, community centers, and homes. Project instruction sharing sites (like Instructables and Make: Projects) allow users to freely share step-by-step directions for making everything from playful electronic gadgets to furniture to tomato soup. The Maker Movement, and the self-identified makers who are at the heart of it, are celebrating many of the qualities and actions that educators have long been trying to promote: lifelong learning, self-directed learning, communication, collaboration, creativity, and design. At a time when there is an increased emphasis on STEM (science, technology, engineering, and mathematics) in the PK-12 curriculum, the growth of the Maker Movement presents great opportunities for increasing technical literacy and reintroducing people of all ages to the arts of making and tinkering. The kids I watched at World Maker Faire, and at every Maker Faire I've attended, are asking great questions and doing "real" projects with the purest of motivations: they are curious and having fun. They aren't attending because it's a homework assignment, or learning to solder because it might be on a test. To be honest, most of them probably aren't even sure why learning to solder is useful yet; they just know that if they learn to do it in the Learn to Solder tent they'll get to wear, and keep, a cool blinking-light badge. But they'll leave the faire with more than just that badge. They'll leave knowing *what* soldering (or sewing, or woodworking, or cooking, or drop spinning...) is and that *they* can do it.

Which brings me back to Dr. Guilford's question: "*How are you going to design something if you've never built anything?*" I'd add to that and say "*How are you going to build something if you've never taken something apart?*" How are you going to come up with interesting ideas and solutions if you've never been allowed to play with physical and digital bits and pieces? It takes a playful, curious person to take things apart and imagine new ways to put the parts back together. This describes most makers, but also almost every young child that I've met. Anyone who has been around a roomful of children with access to a pile of craft or building materials has likely seen the happiness that typically accompanies such endeavors. Youthful creativity combined with readily available materials often leads to a whirlwind of wonderful things.

It usually doesn't take much effort, or the creation of any incentives, to convince young children to jump in and start making. As the age of the group gets older,

though, the dynamic sometimes changes. We start to hear more questions: “Why should we do this?” “Am I doing this the right way?” I’ve made Squishy Circuits (a method for using conductive and nonconductive play dough to sculpt working circuits) with people of all ages, and I’ve rarely had a child turn down the opportunity to try it out. With adults, though, I’ve often seen reticence or protests of, “I’m not good at that sort of thing.”

It’s not coincidental that many authors who write about innovation, creativity, and design talk about the importance of approaching challenges with a childlike enthusiasm. Ursula Le Guin, an author who is known for her imaginative fantasy and science fiction writing, once worded this as “*The creative adult is the child who has survived.*” Unsurprisingly, many people that I speak to about making share this approach. When I asked Amon Milner, a maker/educator who I will introduce you to in [Chapter 5](#), what a “maker” was, he replied that “[*all*] people are makers. And the conditions in which people can grow up and have that supported and still do it into adulthood is a very special person... Every [*child*] is a maker and some get to stay that way longer.” Perhaps, then, this isn’t a book about *making* makers, but rather a book about how to encourage children to *remain* makers even as they grow up.

How do we empower children to become, and remain, makers? I think it’s fair to say, particularly in the United States, that we’re not doing such a good job at this. A 2009 study by Nuts, Bolts & Thingamajigs (the Foundation of the Fabricators and Manufacturers Association) polled U.S. teenagers and found that 83% of them spent less than two hours a week doing hands-on projects “such as woodworking or models,” and 27% spent zero time per week working on such endeavors.² Interestingly, the same year, another study came out from the Kaiser Family Foundation finding that 8- to 18-year-olds spent an average of more than 50 hours per week on entertainment media.³ While a lot can be learned through entertainment media, it sometimes seems like it is easier to find a cooking video game than it is to find a middle or high school that still teaches cooking. Are we giving children opportunities to create content, rather than just consume it? As Mitch Resnick, director of the MIT Media Lab’s Lifelong Kindergarten group, points out, “*computers will not live up to their potential until we start to think of them less like televisions and more like paintbrushes... In my research group at the MIT Media Lab, our goal is to*

2. The Foundation of the Fabricators & Manufacturers Association, International, “Teens Turn Thumbs Down on Manufacturing Careers” November 16, 2009.


3. Victoria J. Rideout, Ulla G. Foehr, and Donald F. Roberts. “Generation M²: Media in the Lives of 8- to 18-Year-Olds” (Henry J. Kaiser Family Foundation, 2010).

develop new technologies that follow in the tradition of paintbrushes, wooden blocks, and colored beads, expanding the range of what children can create, design, and learn."⁴

Once upon a time, spaceships resided primarily in movies, books, and the dreams of children, some of whom, after spending their teenage years working on their cars and tinkering, grew up to become the men and women who made manned—and unmanned—spaceflight possible. I believe that it is essential for us to empower today's children with the tools and skills they need to make *their* dreams tangible. The Maker Movement is a shining example of how we can do this.

4. Mitchel Resnick. "Computer as Paintbrush: Technology, Play, and the Creative Society," In *Play = Learning: How Play Motivates and Enhances Children's Cognitive and Social-Emotional Growth*, ed. D. Singer, R. Golikoff, and K. Hirsh-Pasek (Oxford: Oxford University Press, 2006), (2006): 192–208.

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Makers

What is a “maker”? Quite simply, makers make things. Some makers build robots, some sew clothes, some prepare food, some design tools, some construct houses. “Maker” isn’t a title conveyed after passing some test or degree program; rather, it is a self-identification. It’s also not, by any stretch of the imagination, a new concept.

Humans have always been makers. Our survival is directly tied to our ability to create, or find, food and shelter, though we as a species shouldn’t allow ourselves to feel too special because of this. From birds weaving elaborate nests, to beavers building dams, and spiders creating traps for their food, we are just like every other species in our biological need to make. What does set us apart, perhaps, is that we’ve reached a point where many people grow up without the ability to personally create any of the things (food, clothing, shelter) that they need for survival. Similar to its poll of teenagers mentioned earlier, Nuts, Bolts & Thingamajigs surveyed 1,000 U.S. adults in 2009, and found that 58% have never made or built a toy, and 60% admit to avoiding handling major household repairs.¹

In the United States, the pride in creating things is such that President Barack Obama specifically mentioned makers in his 2009 [inaugural address](#):

Our journey has never been one of short-cuts or settling for less. It has not been the path for the faint-hearted, for those that prefer leisure over work, or seek only the pleasures of riches and fame. Rather, it has been the risk-takers, the doers, the makers of things—some celebrated, but more often men and women obscure in their labor—who have carried us up the long rugged path towards prosperity and freedom.

I was delighted to hear this characterization of makers. Rather than focus on “eureka!” moments and successes, the president honors the hard work, lack of

1. The Foundation of the Fabricators & Manufacturers Association, International. “Americans Don’t Tinker Around with Hobbies, Home Repairs, Poll Shows,” November 16, 2009.