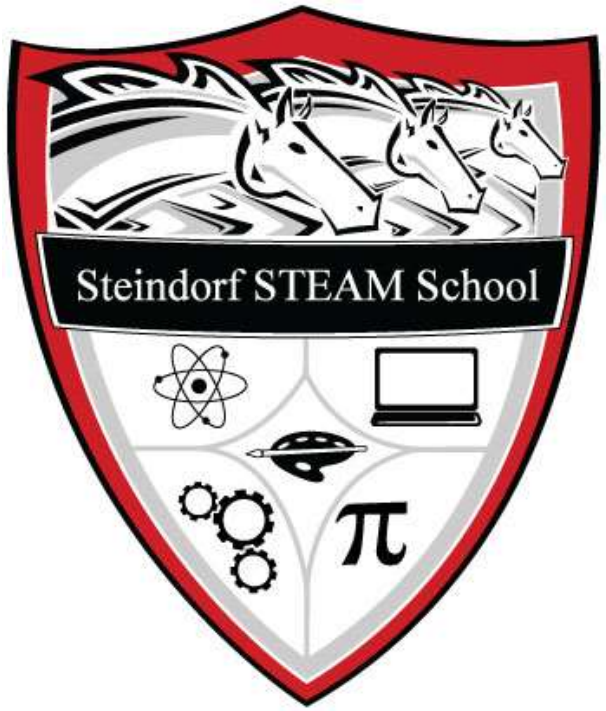


STEAM Education for Every Child

Rick Schertle

Steindorf K-8 STEAM School

San Jose, CA

schertler@cambriansd.com

www.cambriansd.org/makerlab

Digital 2018 Taipei

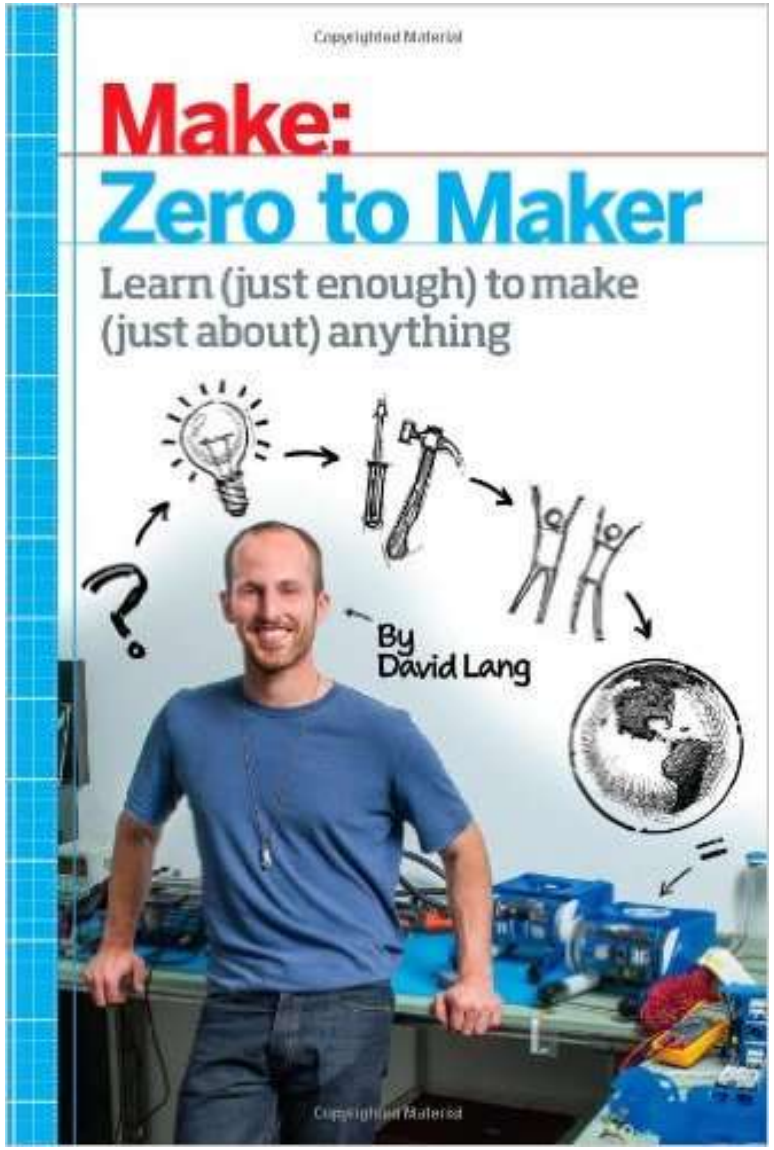
A focus on Maker Education…

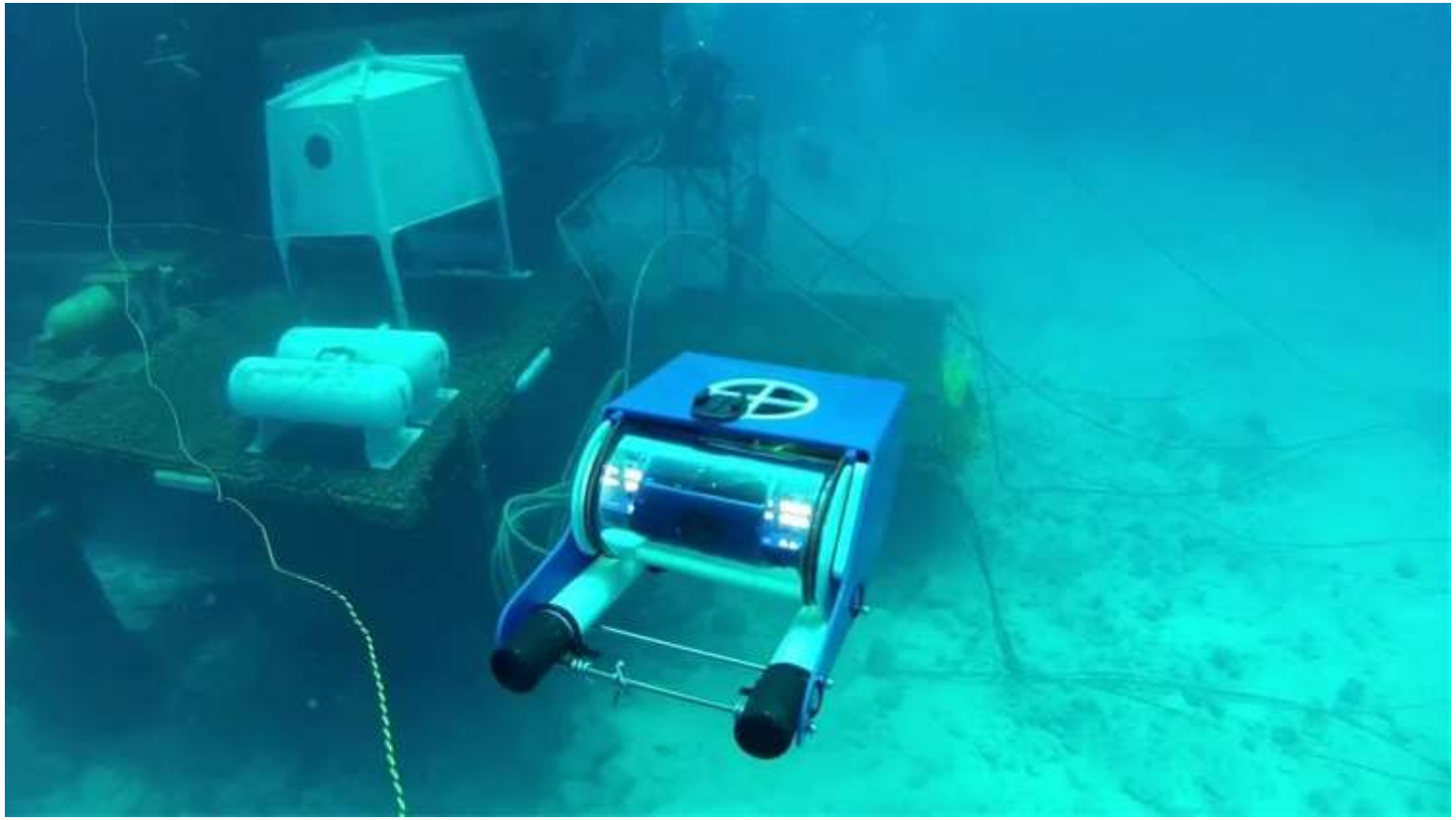
Who is a Maker?

Are You a Maker?

Digital 2018 Taipei

Who is a Maker?





“America was built by makers — curious, enthusiastic amateur inventors whose tinkering habit sparked whole new industries”

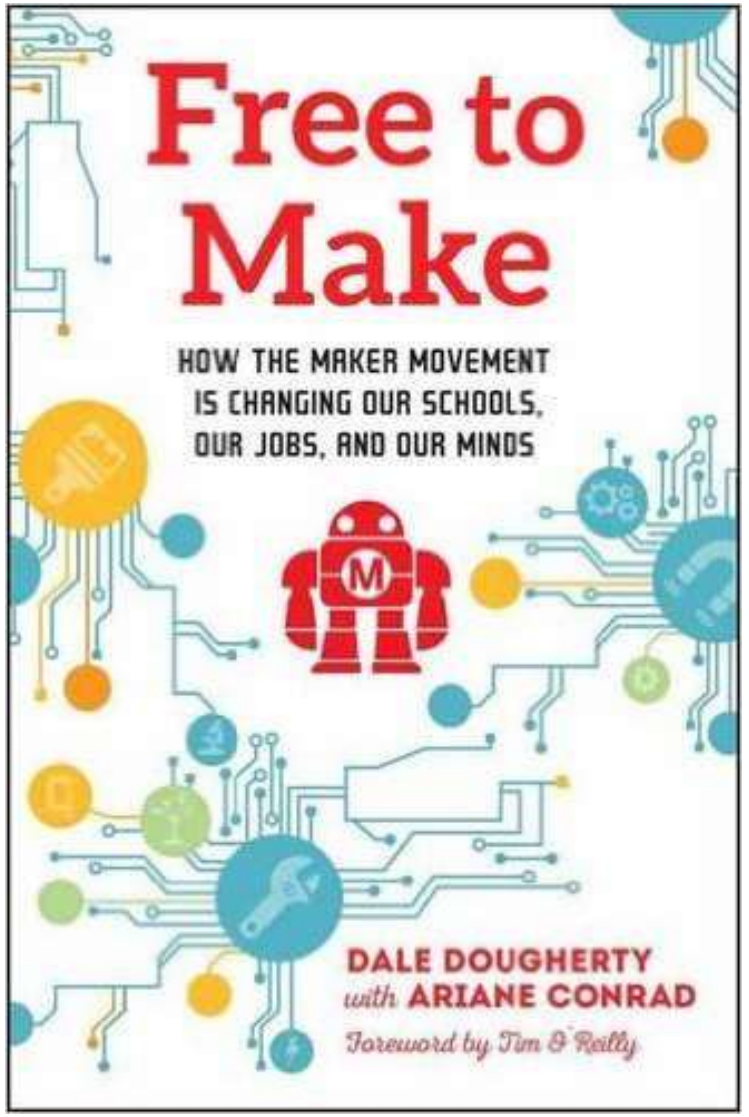
Dale Dougherty

Founder and CEO Make: Magazine & Maker Faire

From Dale's Book

A maker is someone who creates and shares projects.

- A maker…
  - Is **creative**
  - Is **not afraid of failure**
  - Is **playful**
  - Makes all kinds of things for personal, social and commercial purposes
  - Values **making** and **creating** over using and consuming
  - Can be **any age** and from **any culture**
  - Loves to **share** their projects



Making is in our human DNA – We were born to make.

Who is a Maker?

- Maker Faire – Where Makers Share!
- Maker Faire's Slogan…

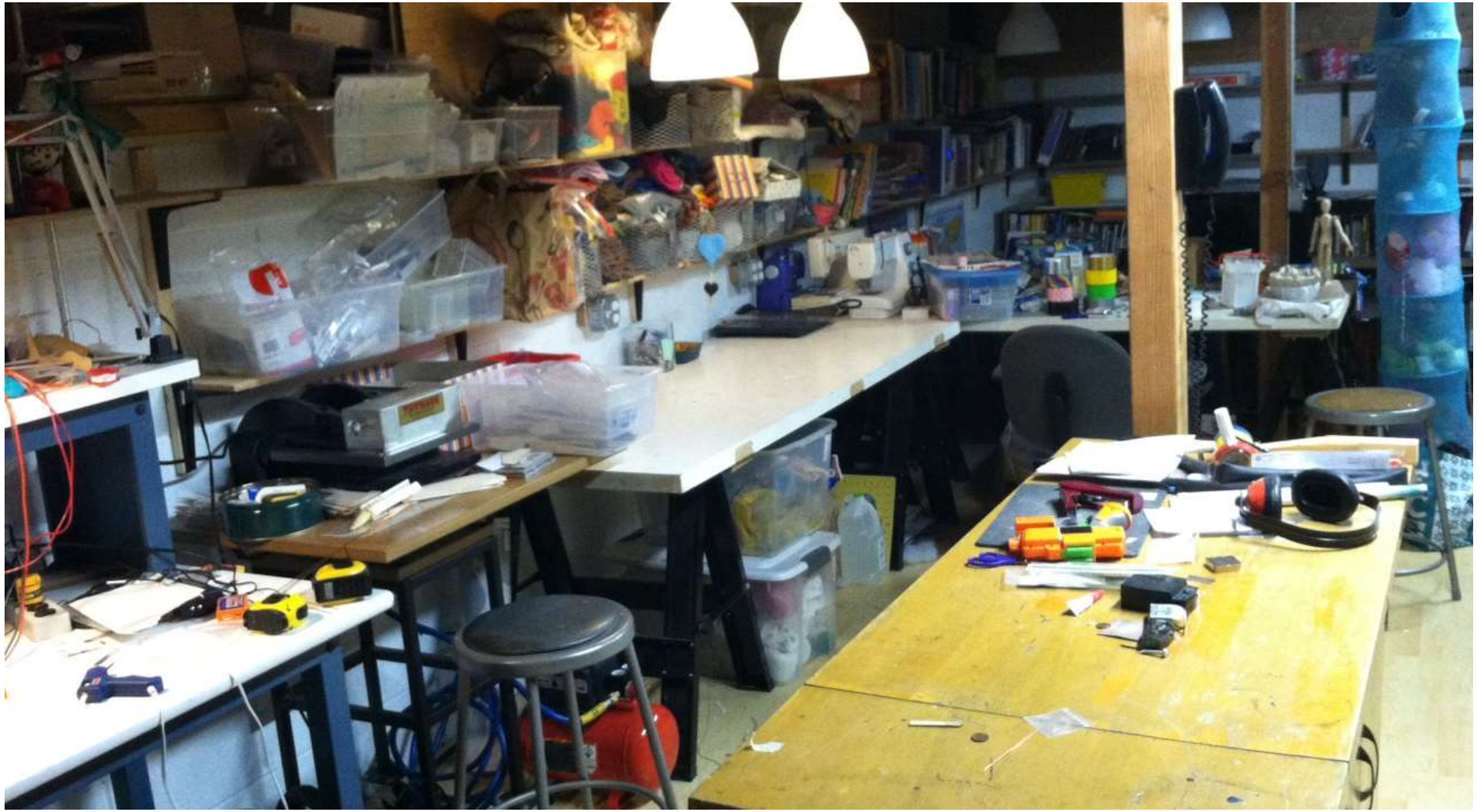
What we'll cover from here…

- My Maker Story
- Taking Making to the Classroom
- Practical Tips on Starting a Maker Program for ALL kids

My Journey as a Maker

- As a kid…

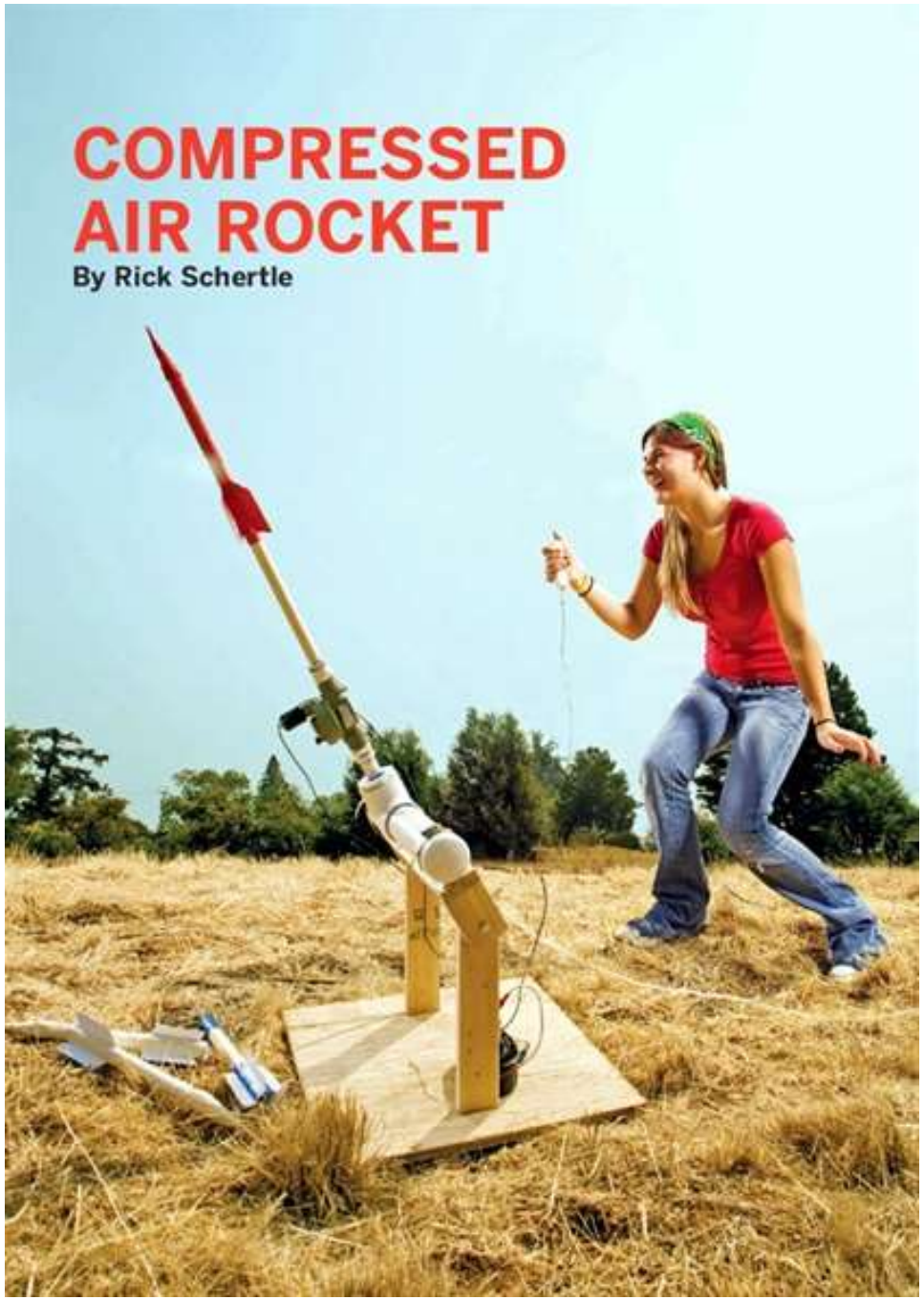
Family Maker Space



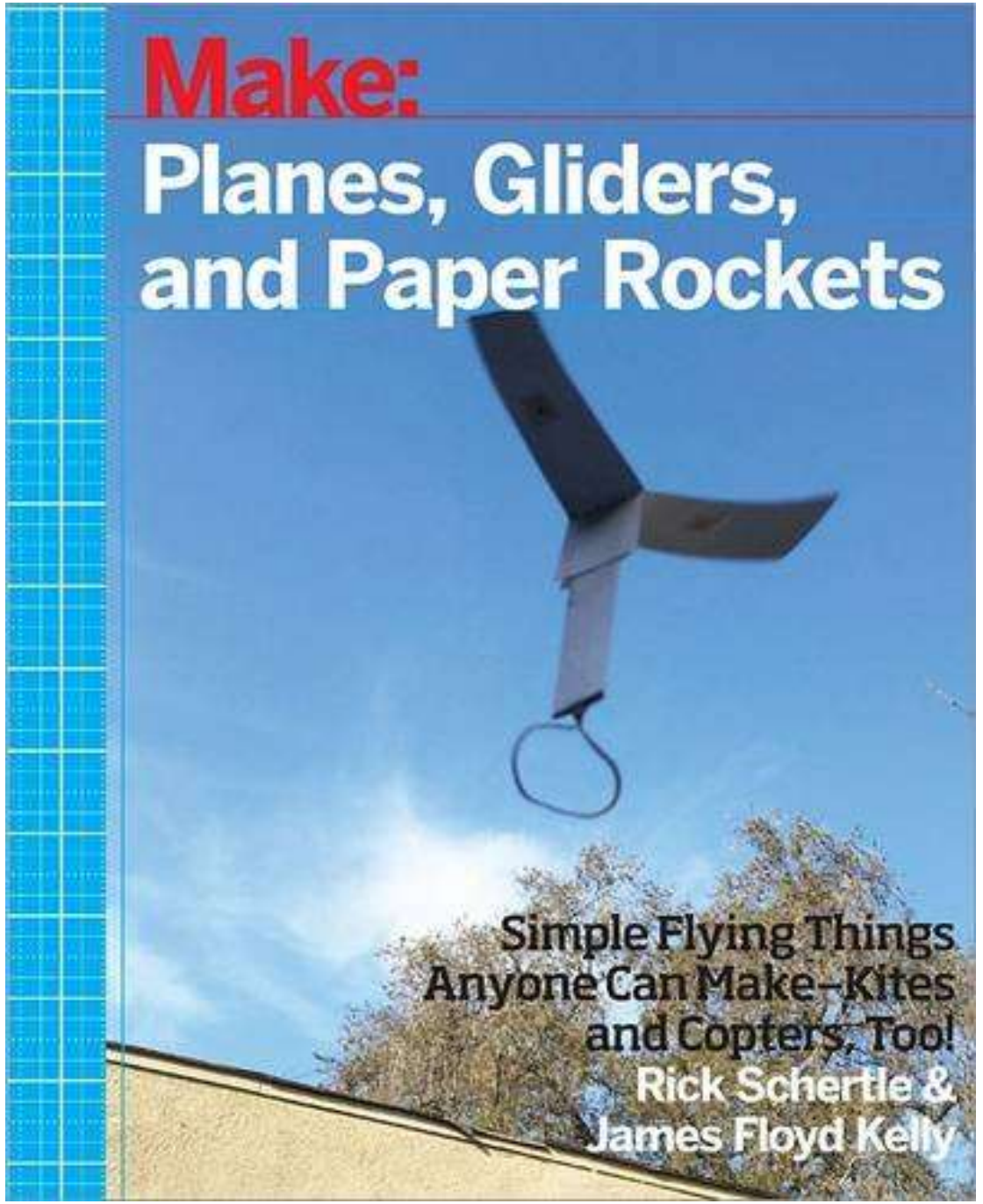
My Journey in the modern “Maker Movement”

First hearing about Make: Magazine from Brian…

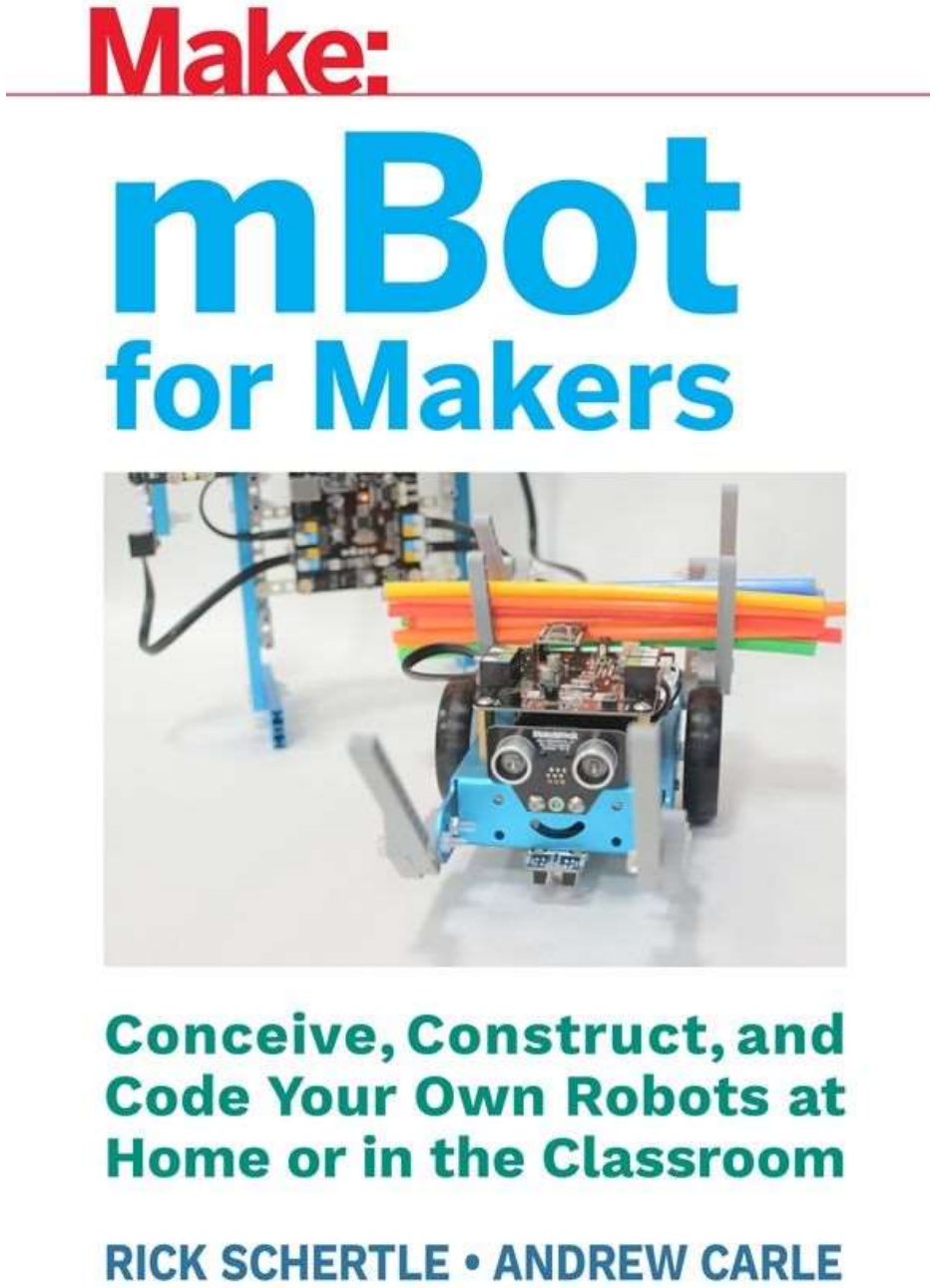
Make:
technology on your time
www.MAKEZINE.com
Paper Air Rockets Blast 200 Feet!
page 102 »
DIY MUSIC: 10 ROCKIN' INSTRUMENTS TO BUILD & PLAY page 53
VERY SKILLED!
WAY HARD-CORE!
RAISE YOUR GOBLET OF ROCK!
POWER STANCE!
THE GUITAR ZEROS SHOW YOU HOW TO MOD YOUR GUITAR HERO CONTROLLER INTO A REAL INSTRUMENT!
PLUS:
» Evil Computer Mouse Prank
» Giant Smoke Ring Cannon
» 2-Mile Camera Remote
» Penetrating Magnet Magic
O'REILLY
makezine.com


COMPRESSED AIR ROCKET
By Rick Schertle

Dozens more articles - then my first book published 2015!



Second Book
2018



Air Rocket Works… from Personal to Commercial

AirRocketWorks.com

High Pressure Rockets for Fun and Science

NASA

ULA®

United Launch Alliance

PAPER & TAPE **ROCKET** TEMPLATE

AirRocketWorks.com

1 CUT & FOLD

Use the cut and fold lines to prepare the components of your rocket:

CUT ————————————

FOLD -

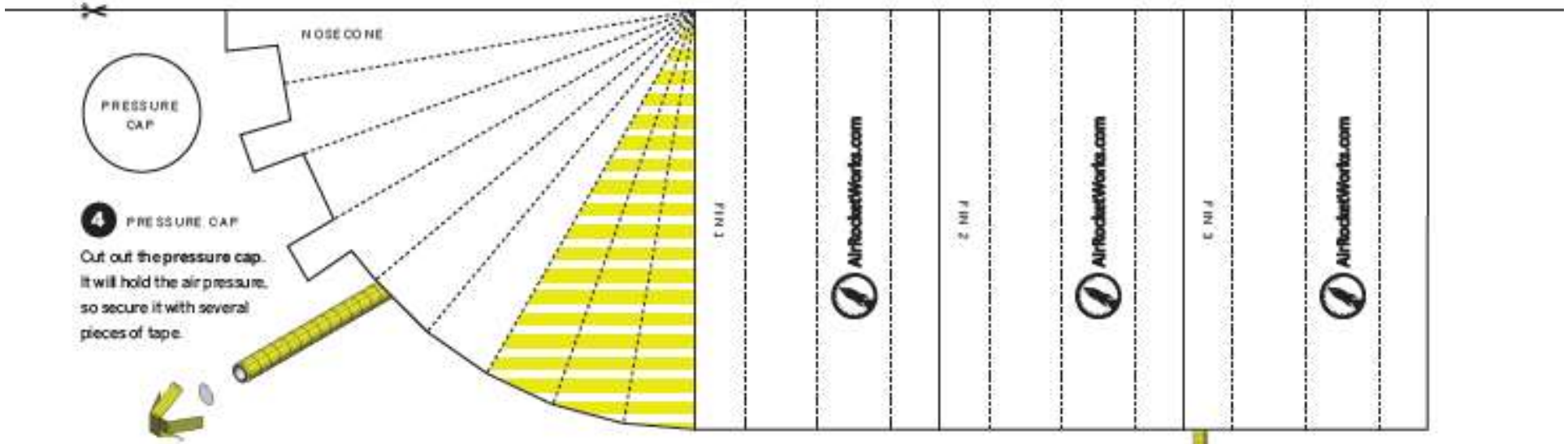
This rectangular portion of paper will become the **body tube** of your rocket. *You will use this entire 8.5 x 11 sheet of paper (no scraps) to make the rocket.*

2 WRAP BODY TUBE

Read step 3 before proceeding. Wrap the **body tube** paper (this sheet) around the 1/2-inch PVC pipe, aligning with one end of the pipe. Add a piece of tape to the top, middle, and bottom. ***Important: Do not tape the paper to the PVC pipe.***

3 TAPE BODY TUBE

Wrap the entire **body tube** with tape, overlapping the tape as you move down the length of the tube.



4 PRESSURE CAP

Cut out the **pressure cap**. It will hold the air pressure, so secure it with several pieces of tape.

5 NOSECONE

Cut out the **nosecone**, and roll it into a funnel shape, overlaping to hide the stripe pattern. Tape along the seam. Set aside.

6 CUT & FOLD FINS

Cut out the three **fins** and fold each into a 'W' shape.

7 ATTACH FINS

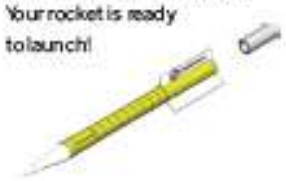
Tape the smaller tabs on the **fins** to the **body tube**. *Trim the shape of the fins, if desired.*

8 FINAL ASSEMBLY

Read step 9 before proceeding. Take all paper scraps (including instructions), and crumple into a cone-shaped lump. Pack this lump into the **nosecone** and tape it over the **pressure cap** onto the **body tube** of the rocket. Cover the **nosecone** with tape.

9 DECORATE

Decorate your rocket. ***Slide the rocket off of the PVC pipe.*** Your rocket is ready to launch!



MAKE: PROJECTS

High-Pressure Foam Rocket

Toy or not, this rocket really packs a punch.

By Rick Schertle Time Required: 1–3 Hours Difficulty: Easy

Print this Project

December 18, 2012, 11:00 pm PDT

Calling a rocket that sprints over 100 feet into the air a "toy" might be a bit of a stretch. Toy or not, this rocket really packs a punch. Fly it using the Compressed Air Rocket launcher from MAKE Volume 15 (get the kit at makezine.com/go/launcherkit) or a stomp rocket launcher (makezine.com/go/stomplauncher).

PARTS / TOOLS

- Packing tape, clear (optional)
- Duct tape Fun colors are now available.
- Zip tie, 8"
- Foam sheet, 2mm thick, 9"×12" available at craft stores or online
- Foam pipe insulation, ½" inside diameter You can build 8 rockets with a 6' piece (instructions here are for one rocket).

ADVERTISEMENT

Rocket Party Taichung!

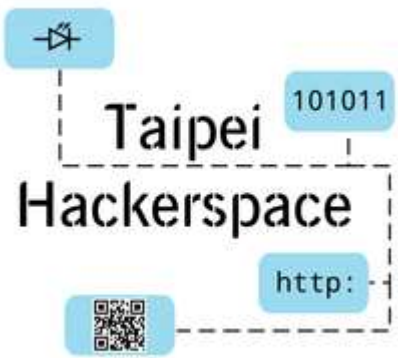
Rocket Party Taichung!

MAKERBAR
TAIPEI

DO!T

OpenLab
TAIPEI

FabCafe
what do you fab?



FUTUREWARD

SERVICES LOCATIONS EVENTS NEWS ABOUT US CONTACT BOOK A TOUR

Facebook Instagram For Members 繁體中文

WORKING TOWARD A BETTER FUTURE

Choi in Taichung

Maker Faire® A place where makers share, collaborate and get inspired!

BAY AREA Maker Faire® MAY 18–20 2018

Maker Faire® Taipei 2018

2018.11.2 fri - 4 sun

台北創客嘉年華

華山1914文化創意產業園區(東二四連棟.中四AB棟)

11/2為專業人士及媒體日

主辦單位 Make:Taiwan

What happens on Monday when kids head back to school after being inspired at Maker Faire?

Maker Spaces in Schools!

Laura and Steve in Taichung

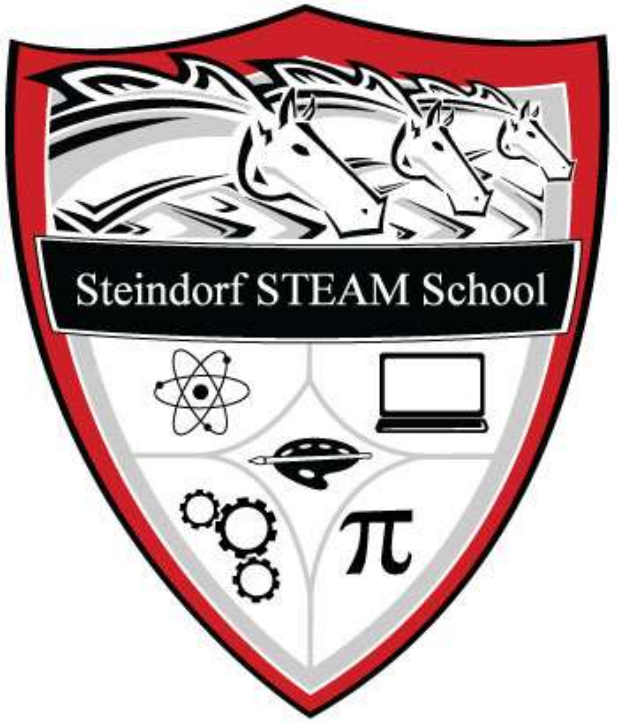
Make:
火星
自造計劃
加入DIY太空專案
Make:
格蘭·今原：
這機器人幾乎要殺了我！
34
Make:
虛擬實境玩創意
Make:
ROBOTS,
DRONES
01
Make:
升級你的
自造力
Make:
生物駭客
的瘋狂實驗
請勿在家嘗試

當機器人遇上開放原始碼：遙控捕蠅草 • 火星機器人 • 微型陽光探索機器人 • 迷你太陽能倉鼠球機器人
Make:
3D列印GoPro加農砲攝影機！
流言終結者
格蘭・今原：
這機器人幾乎要殺了我！
+34
動手做專題
FLORA NEO GEO定位手錶
氣動火箭滑翔機
窯烤烤爐
光刻金屬元件
CNC開放原始碼傳價
國際中文版 Vol. 15
MAKER MEDIA
www.makezine.com.tw

PROJECTS
氣動火箭滑翔機
Air Rocket Glider

When my Maker World and Teacher World Collided!

- 23 years teaching middle school – US History, World History, Language Arts, Computers and Media Production
- 2016 started at Steindorf K-8 STEAM School in same district as Maker Lab Teacher!
- Serving 500 – K-8 kids every day!



A
HEALTH OFFICE

What I'm doing now…

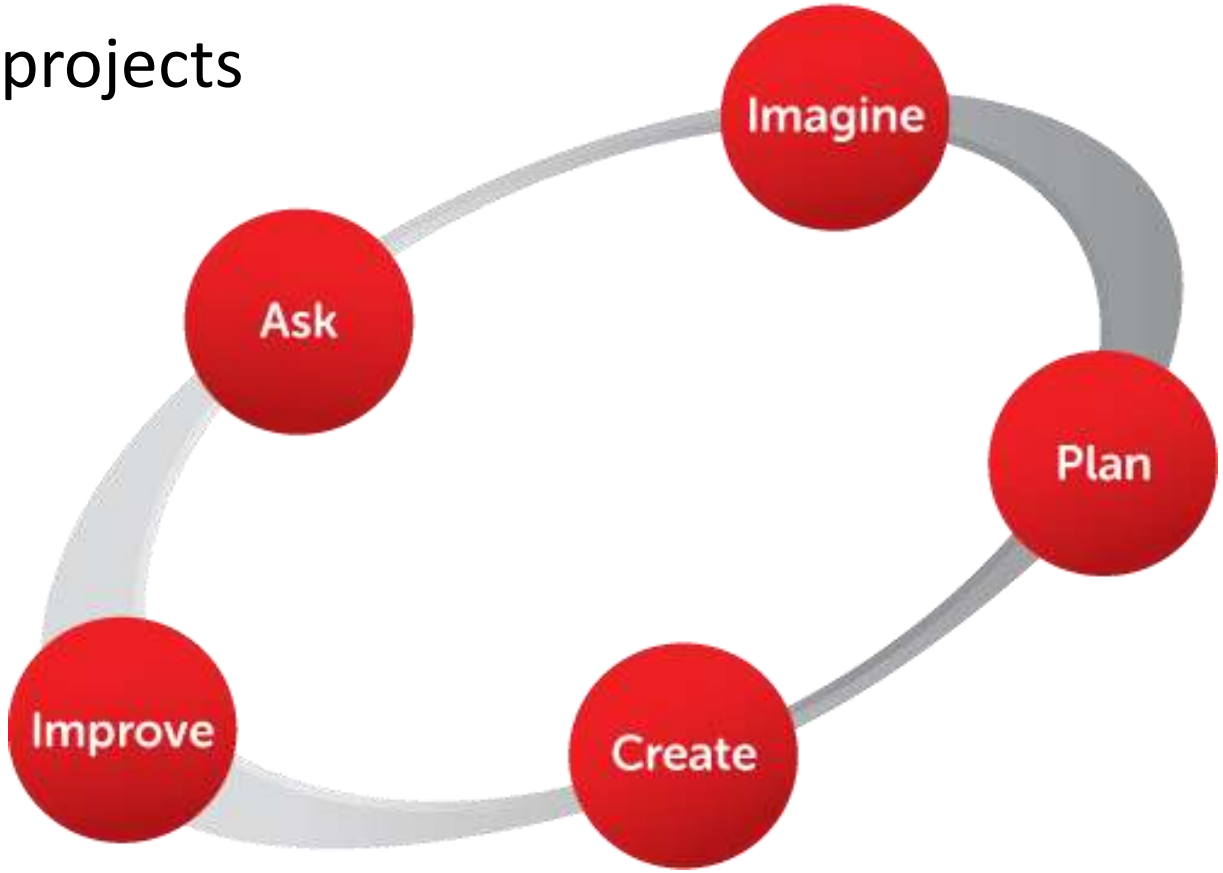
- 500 kids a week!
- One teacher – me ☺
- Very small budget (public school)

Let's take a look at…

- Program
- The Space
- Tools
- Resources

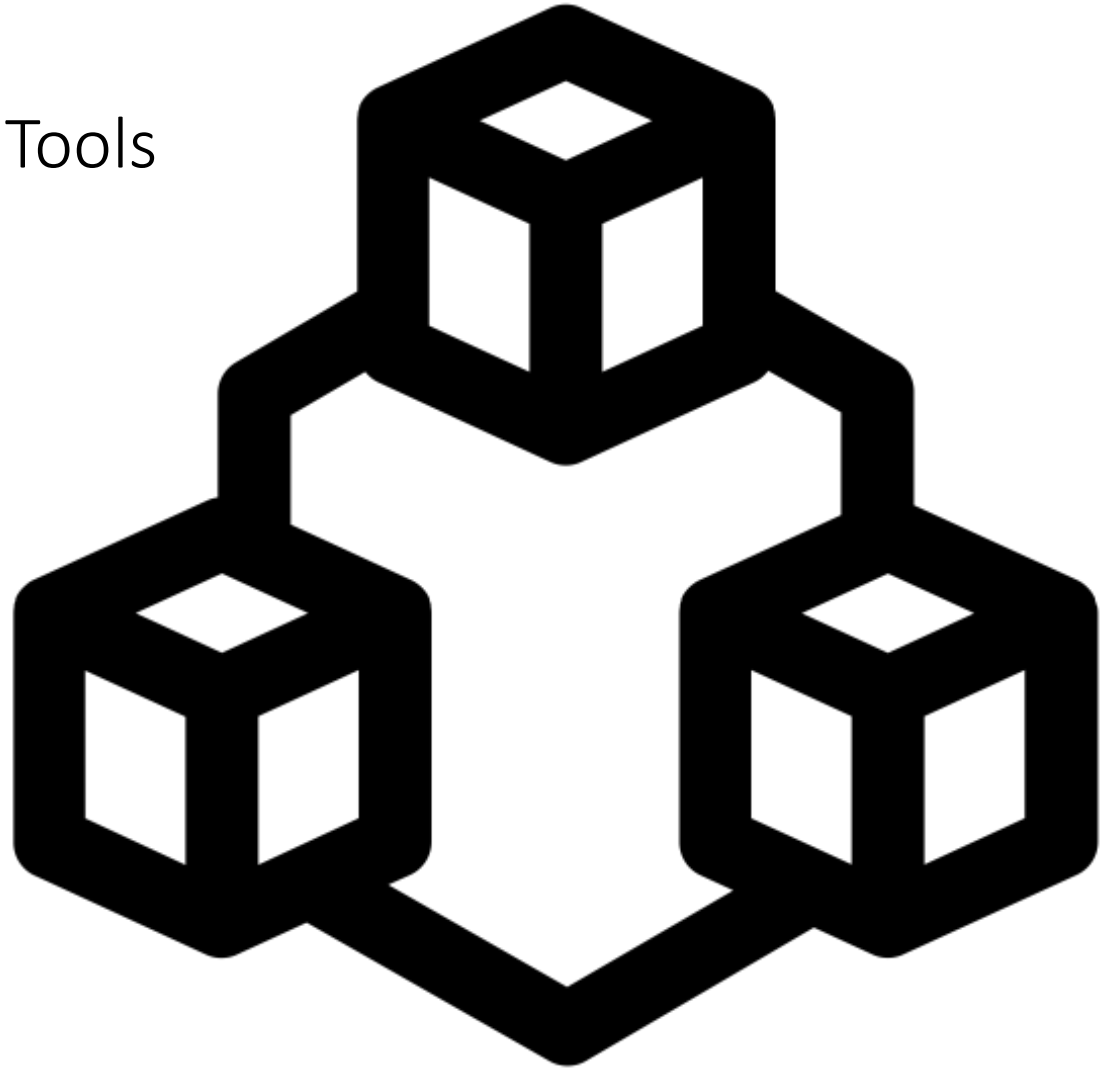
Kid's Maker Mindset

- All kids can learn to be makers
- Programs should be active, hands-on and collaborative
- Kids build skills that are applied to projects
- Problem solving.



Program

Determines your Space Needs and Tools



Models of Programming in Schools

- Programming of a Maker Space
  - Mobile Maker Carts
  - Rotating Stations within a Workshop
  - Scheduled Classes
- Currently at Steindorf I Teach…
  - Middle School (twice a week as part of their regular schedule)
    - Two 6th grade
    - Two 7th grade
    - Three 8th grade
  - K-5
    - K-2 (every other week for an hour)
    - 3-5 (every week for an hour)

Maker Lab – Current Middle School Program

- Balancing teaching skills, working on projects to practice skills, kid-chosen projects and supporting PBL's
- Core Projects – To Start (for all middle schoolers)
  - 6A – Structural Engineering
    - Marble Paper Roller Coasters and Bridge Building
  - 6B – Electrical Engineering
    - Tinker Kits (analog circuits) and Arduino/Breadboarding
  - 7-1 – Robotics and Sensors
    - mBots – mCore – sensors – Arduino programming
  - 7-2 – Makey Makey and Scratch Programming
  - 7-3 – Aero Engineering
    - Dragonfly Helicopters – Air Rockets – Gliders/Airplanes
  - 8 – VEX Robotics

Maker Lab – Program (woven in)

- Woodworking
  - Hand tools – Measuring, Clamping and Cutting
  - Power tools - drill press, sander, scroll saw, power drill
- Design and Fabrication – Software and Hardware
  - Tinker CAD (for .STL files) – 3D Printer
  - Inkscape (for vector files) – Laser Cutter
  - Easel - CNC Router – Heavy Duty Wood Cutting
  - Cameo Silhouette – Paper Cutting

Project Guides

MAKER CLASS

LASER CUTTER

PROJECT GUIDE

PROJECT GUIDE

MY SYMBOL

Create a symbol that represents you. Choose a shape from a library of shapes. Use the laser cutter software to adjust your shape and cut the shape out using the laser cutter. Then, add your name and decorate to create a symbol that is uniquely yours.

MATERIALS

Cardboard
Paint, Pens, Other Decorating Materials

EQUIPMENT

Laser Cutter

SOFTWARE

RetinaEngrave3D

PROCESS STEPS

Choose Your Shape

Adjust Shape in Software

Laser Cut the Shape

Decorate Your Shape

© Rick Schertle (Steindorf STEAM School) and Eric Albertson (BoonRaccoon, LLC)

Maker Lab – Middle School (future)

- Electronics
  - IoT (Particle Chip)
- Quads and Fixed Wing R/C Airplanes
  - UAV's
  - Game of Drones
- Electric Go Carts
  - Power Racing Series
- Advanced Robotics and Automation (PLTW)
  - Vex EDR (building on 5th grade, VEX IQ)

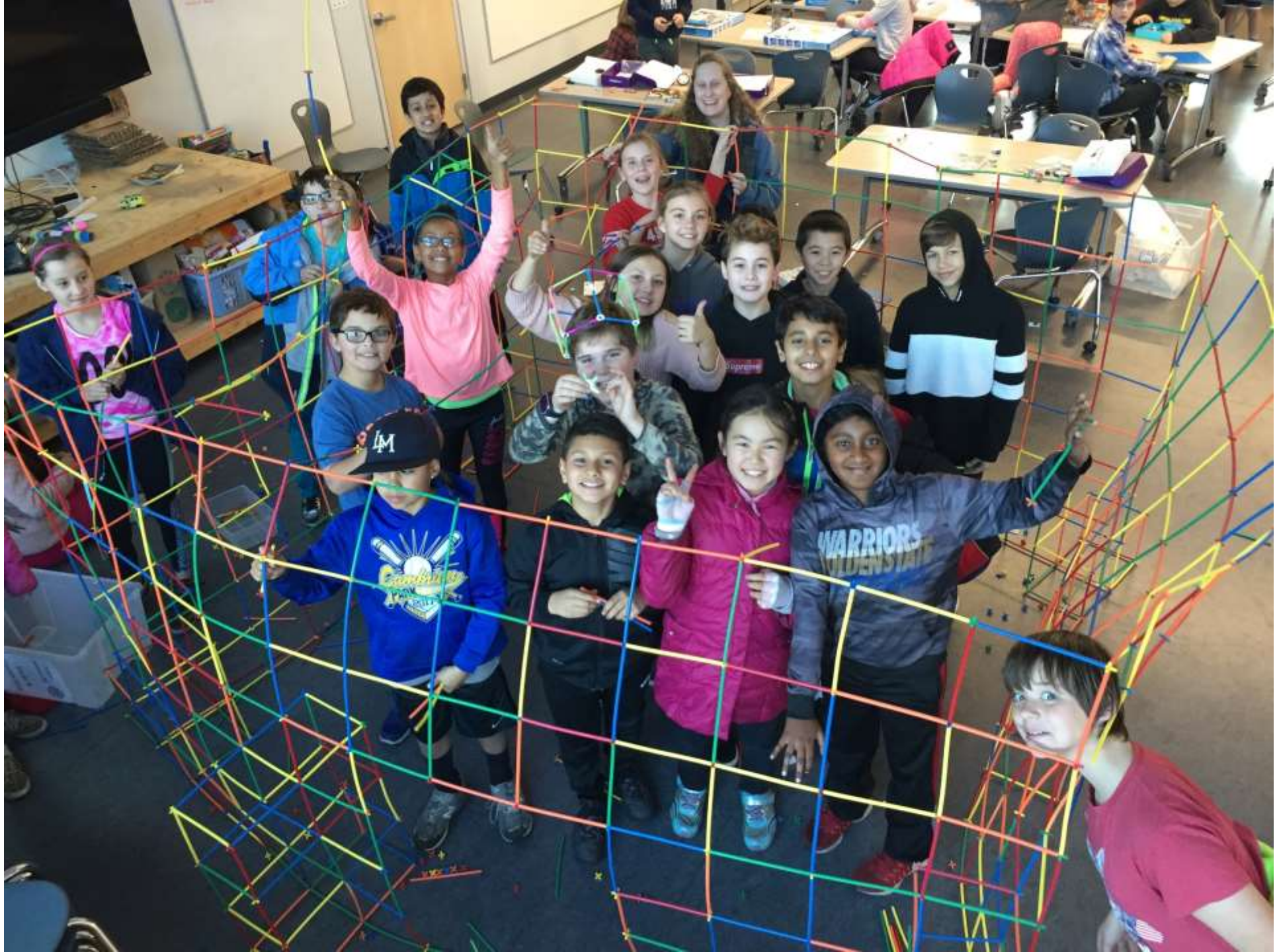
Maker Lab: Current K - 5 Program

- Tinkering Stations (in groups of 8)
  - Marble Runs
  - Lego Engineering
  - Little Bits
  - Snap Circuits
  - Dash Robotics
  - Strawbees
  - Sticks and Connectors

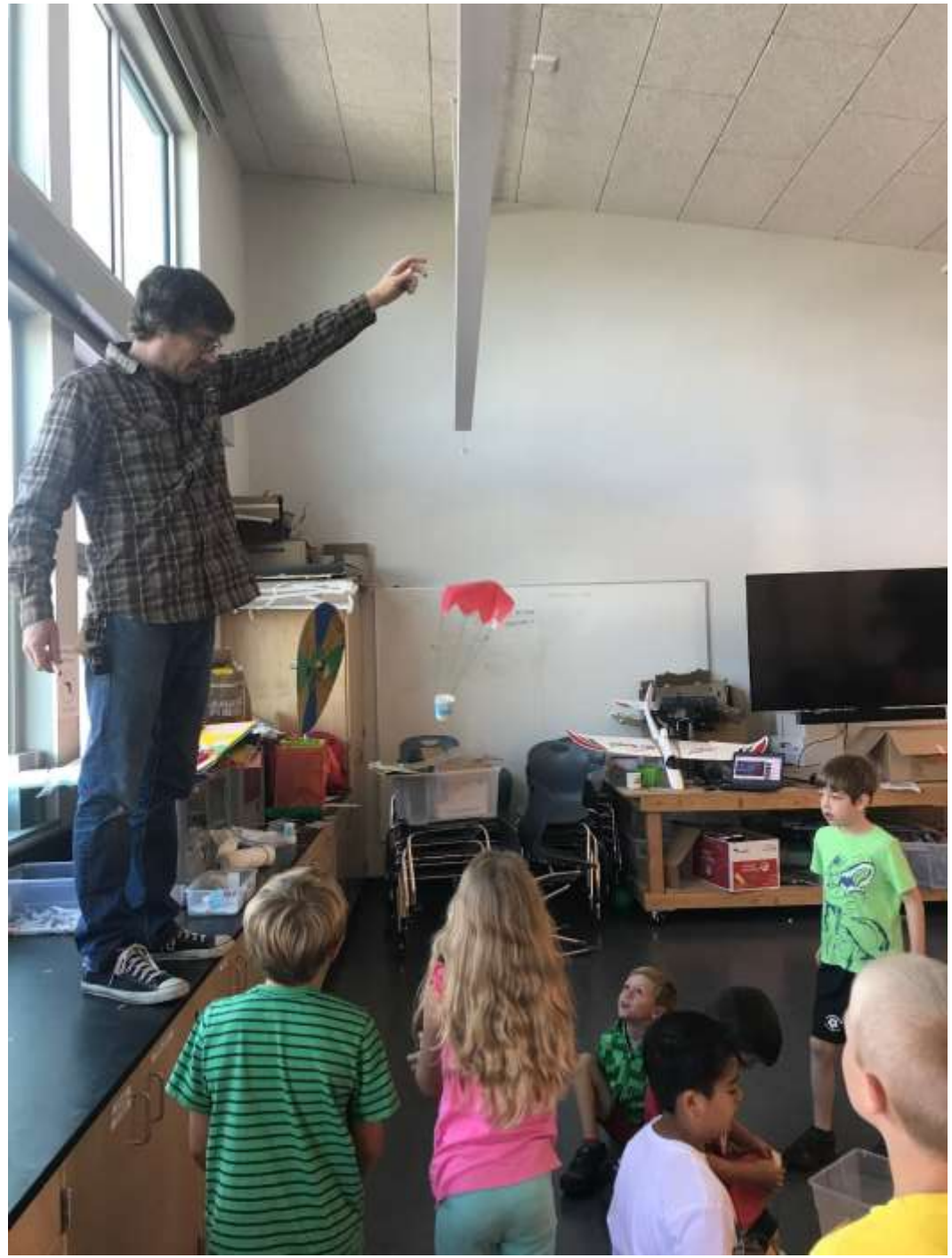
EXIT

littleBits.cc
littleBits

GAP


WARRIORS

PBL Support for K-8

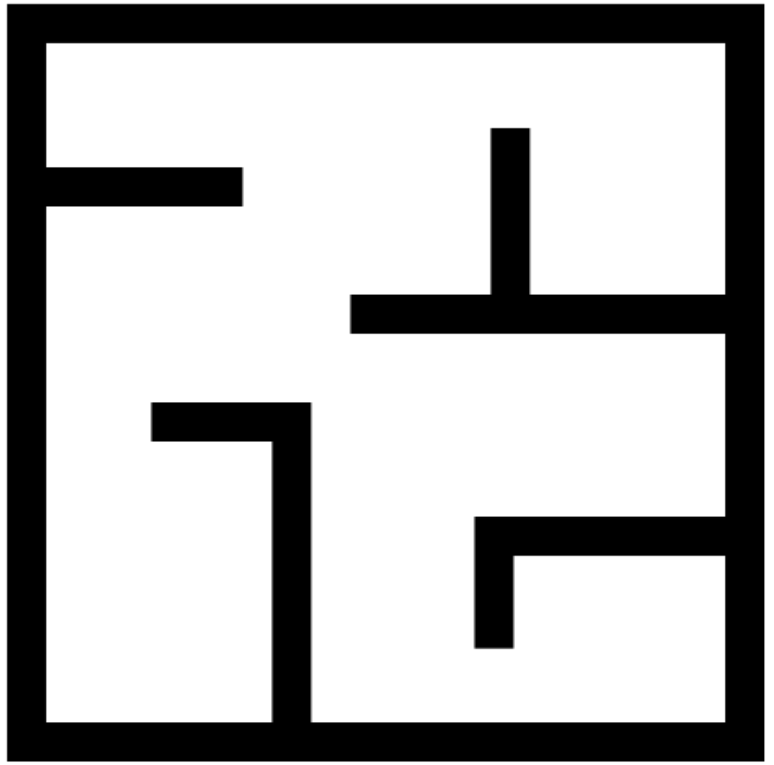


WARRIORS

Wall
Maker Lab

The Space

- A look at some different spaces both big and small… Maker Education can work for ALL kids no matter your space size or budget!



“Maker Corner” in my Old Classroom

nysci
Maker
Space

1,200 sq. ft.

Makin' It Mobile

4 locations

40 projects

56 students

Ages 8-15

15 weeks

Kristan Hutchison
Makin' It Club Manager

Imagination Unlimited

www.imagination4kids.com

San Jose, CA

(custom 14’ x 16’ CNC workshop)

washington maker workshop

Raise a CNC’ed Maker Space Shed

DIY build in Make: 40

What my classroom first looked like…

Over 3000 sq. ft. double-wide classroom

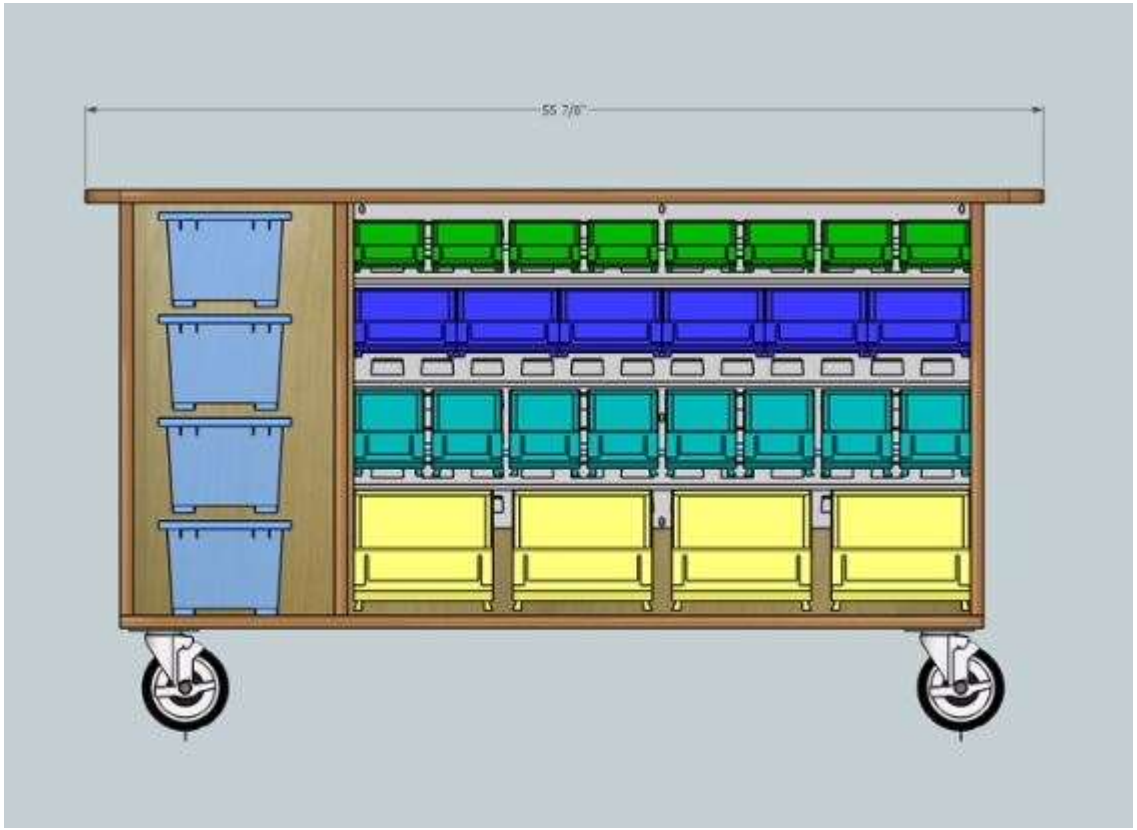
THANK YOU WONDERFUL
STUDENT FAMILIES!

EXIT

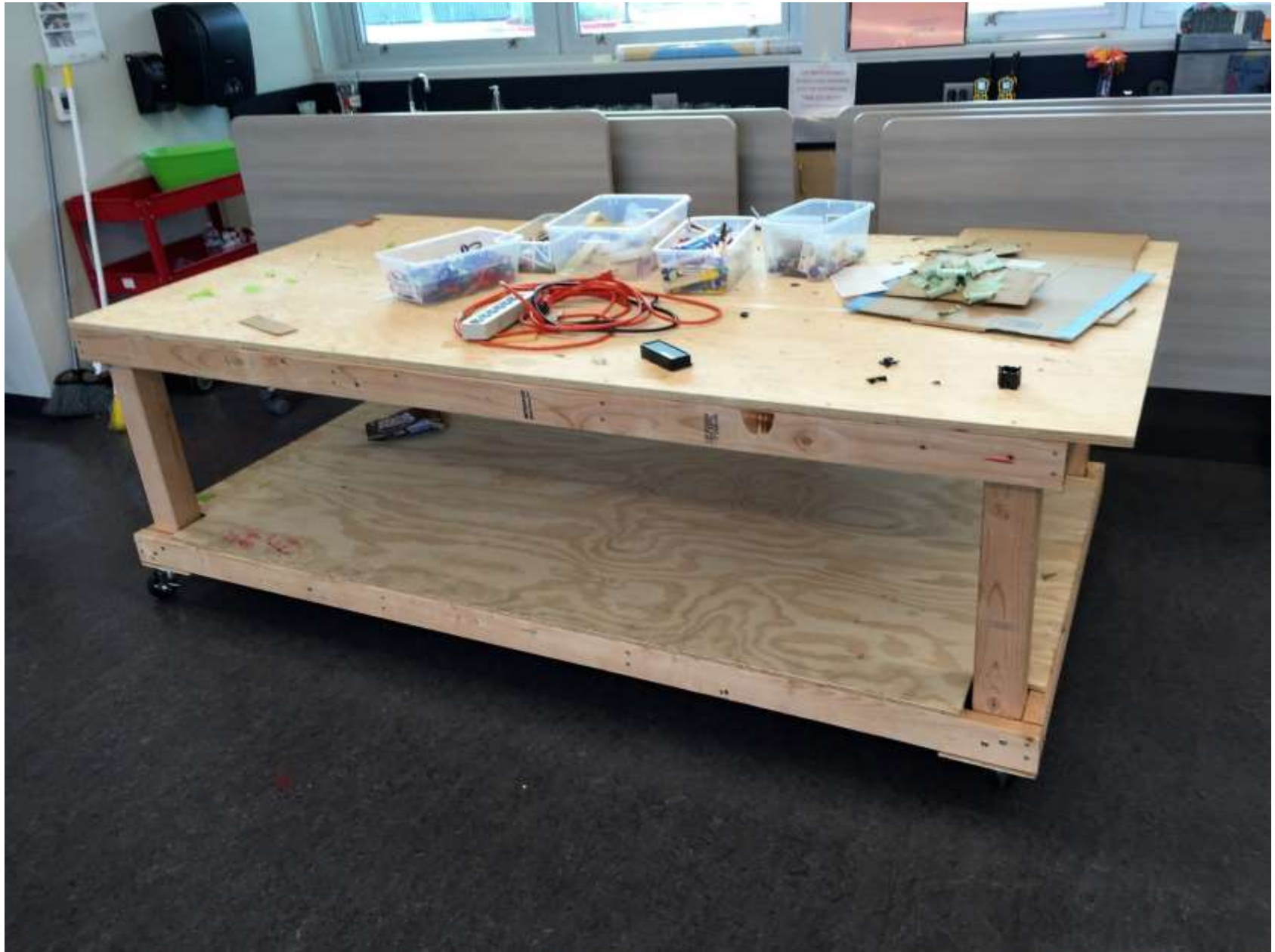
Commercial Mobile Maker Carts

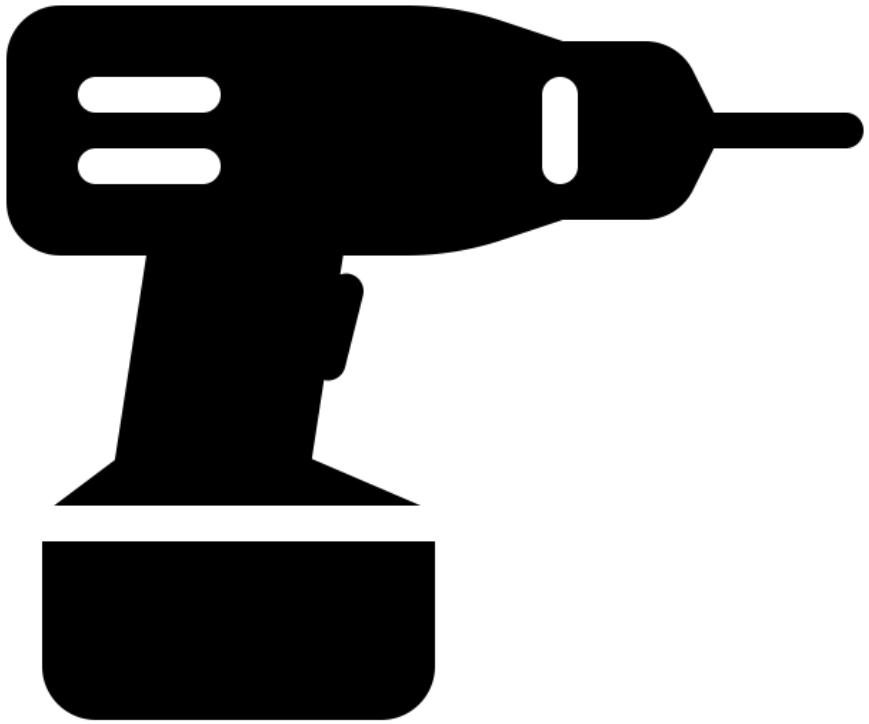
DIY Mobile Maker Carts

Lendy’s Custom DIY Cart

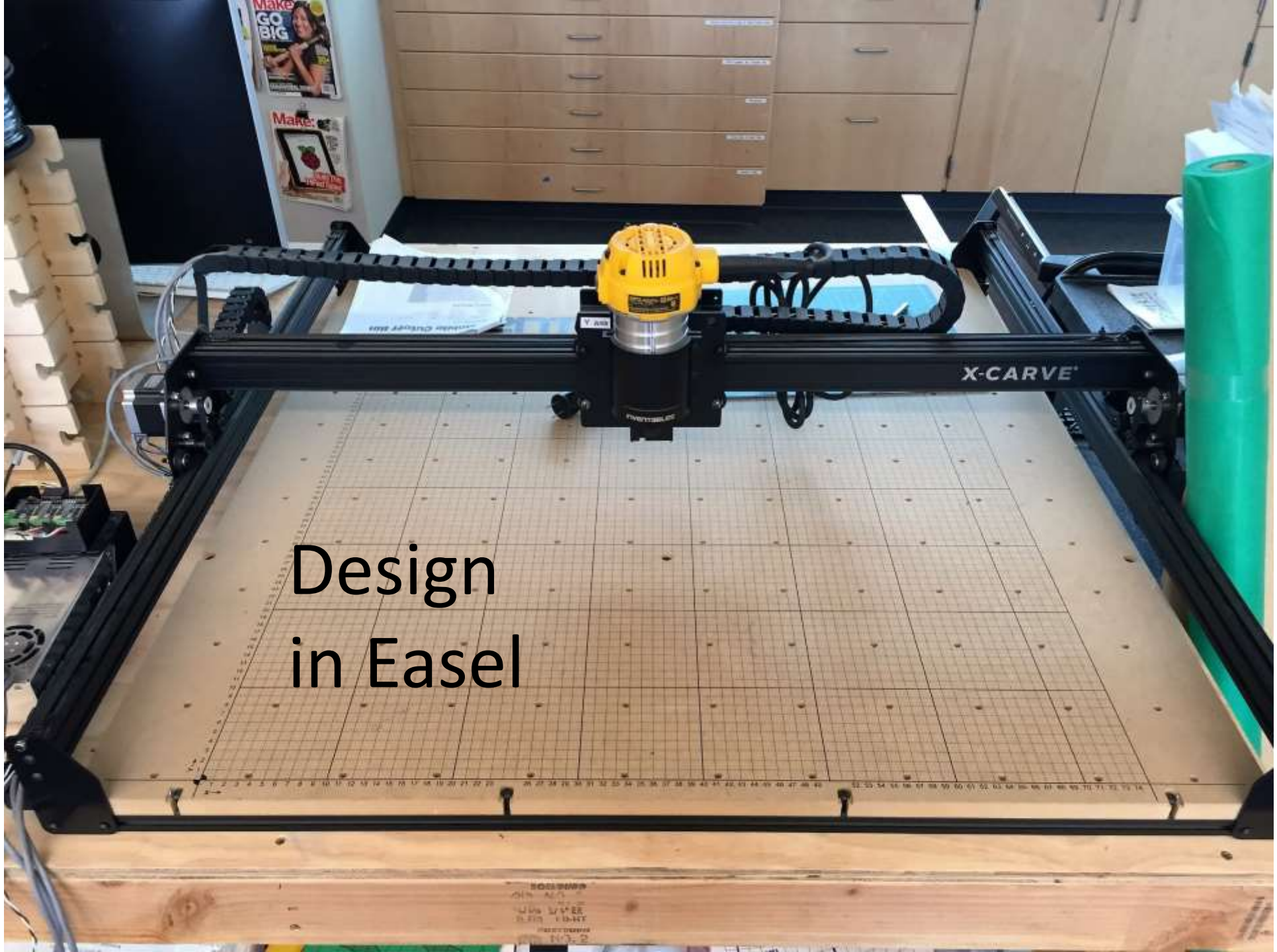


My $150 Huge Workbench





Tools



Design
in Easel

Design in TinkerCAD

Design in
Inkscape
Full Spectrum
LASER

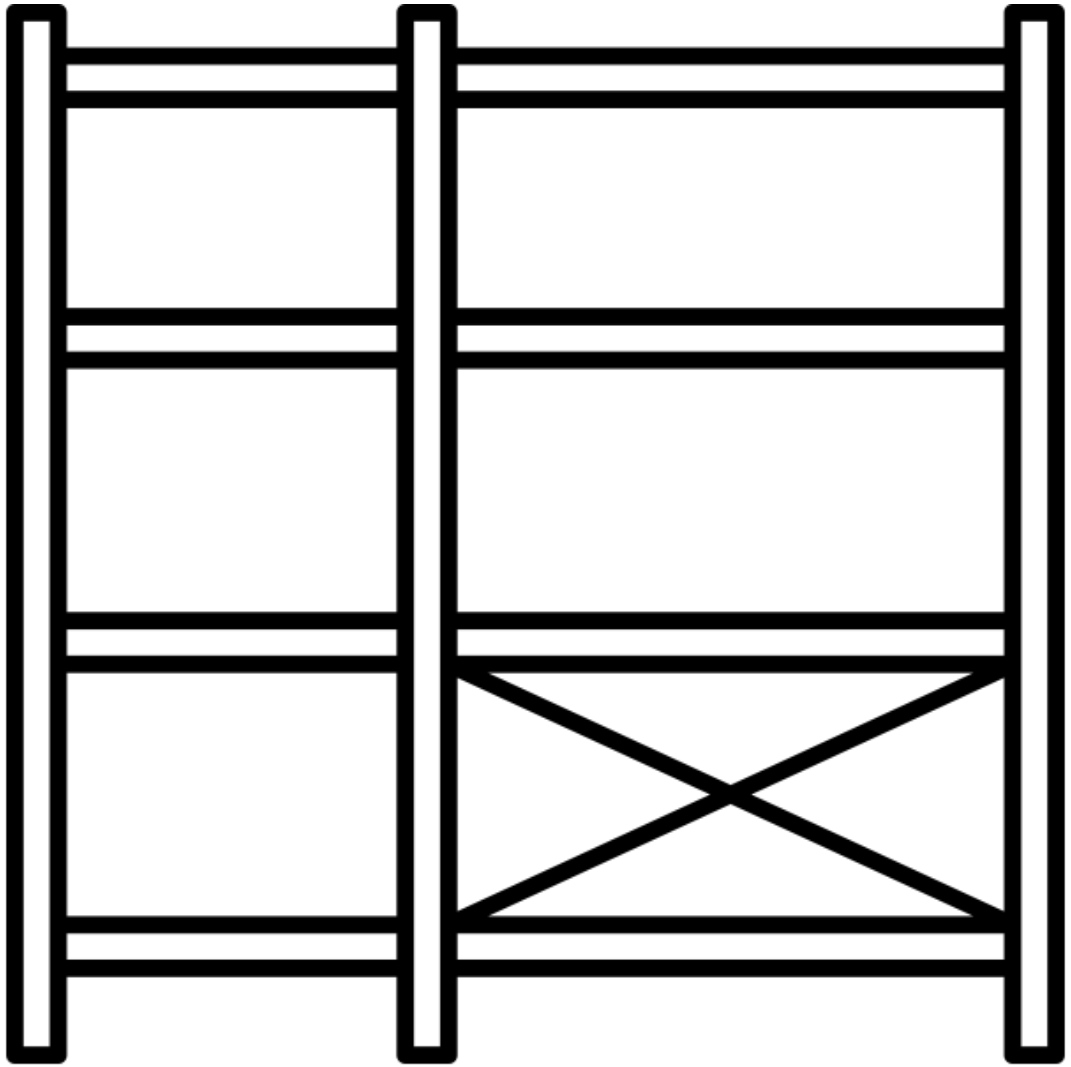
MONT/ROSE
FILA

CAUTION

Tool Wall
RAGE
Scholastic Book Fairs

Favorite Low-Tech Tools

Favorite Low-Tech Materials



Storage

Good Miniature Golf website
Box (laser cut)

HUNTER
Tool
Wall
STORAGE

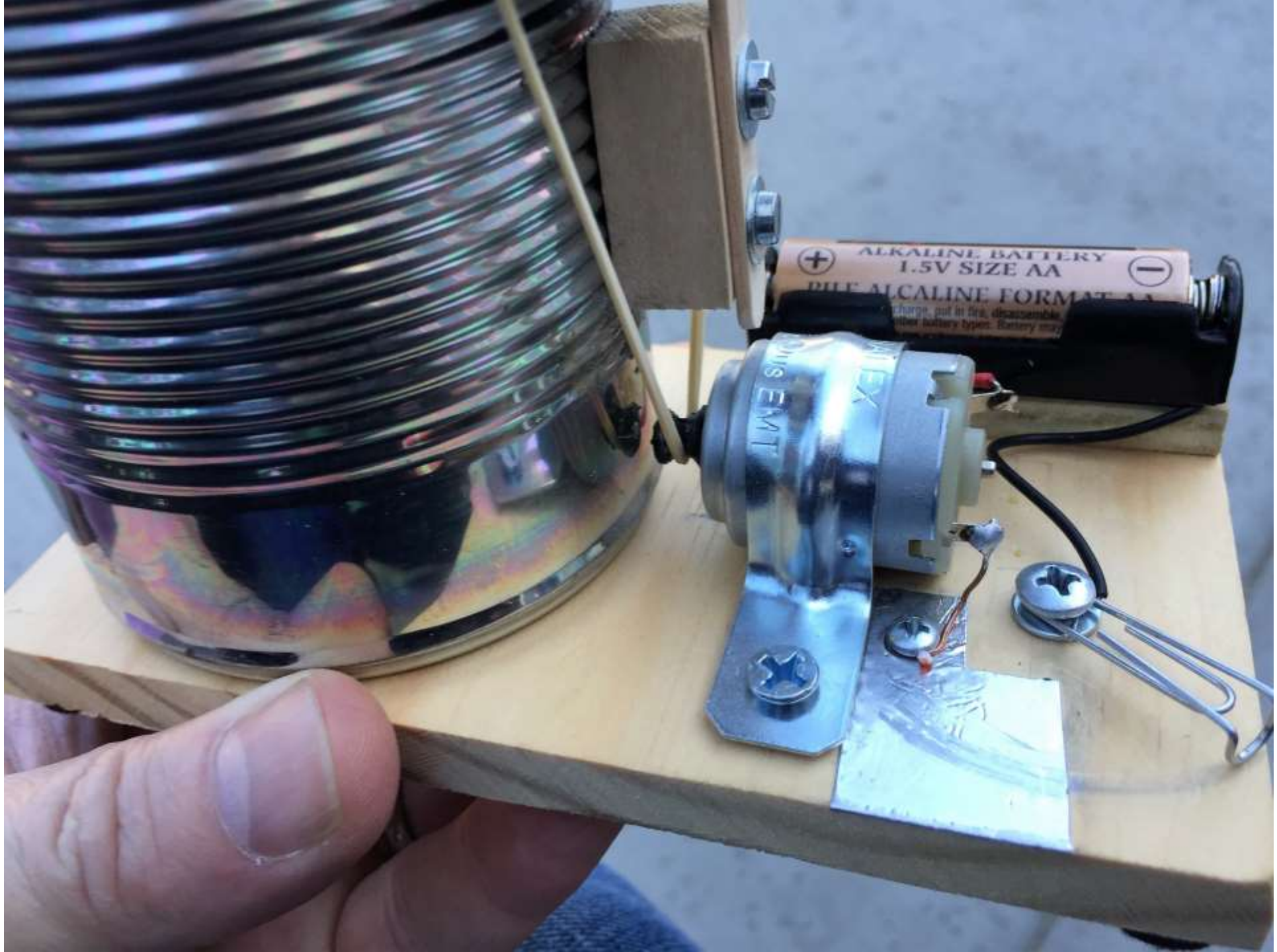
In Action!

Tool Wall

FUTURE FLIGHT CREW
UNIVERSITY OF UTAH
HEALTH CARE

PEACE
LOVE
EXIT

JSA


ALKALINE BATTERY
1.5V SIZE AA

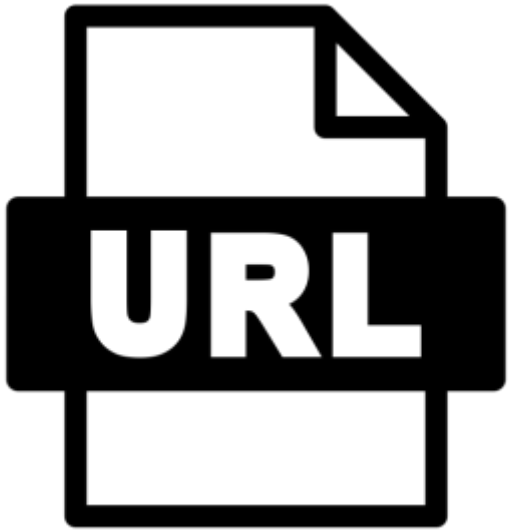
NO EXCUSES

JOAN
EMPIRE
STRIKES BACK

WILL RETURN

SNOOPY
FRANCE
7

INAUGURAL YEAR
EST. 2016
STEAM SCHOOL



Resources

Web Resources: **www.cambriansd.org/makerlab**

.cambriansd.org/domain/494

MAKER LAB

- WELCOME

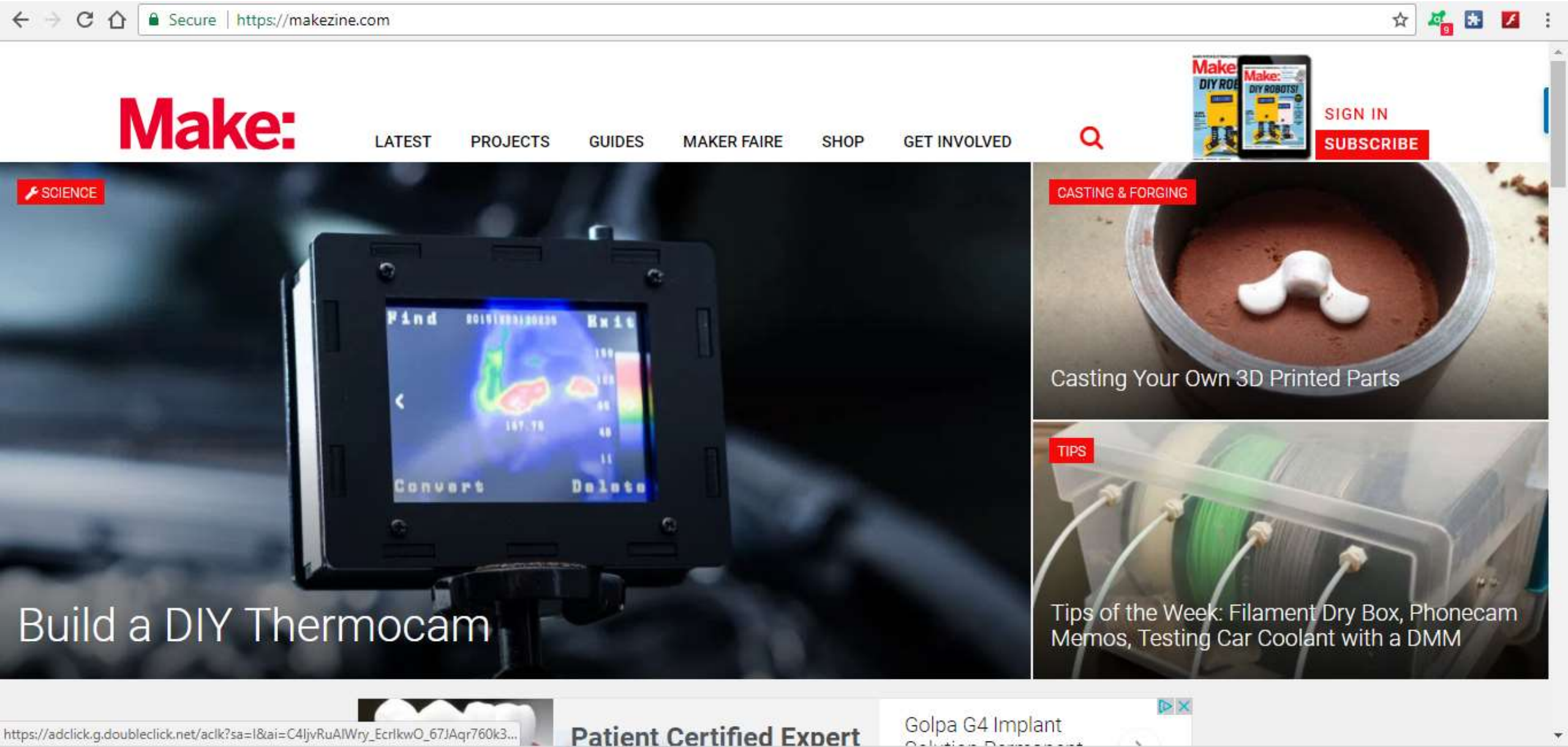
Edit

Welcome to the Steindorf Maker Lab!

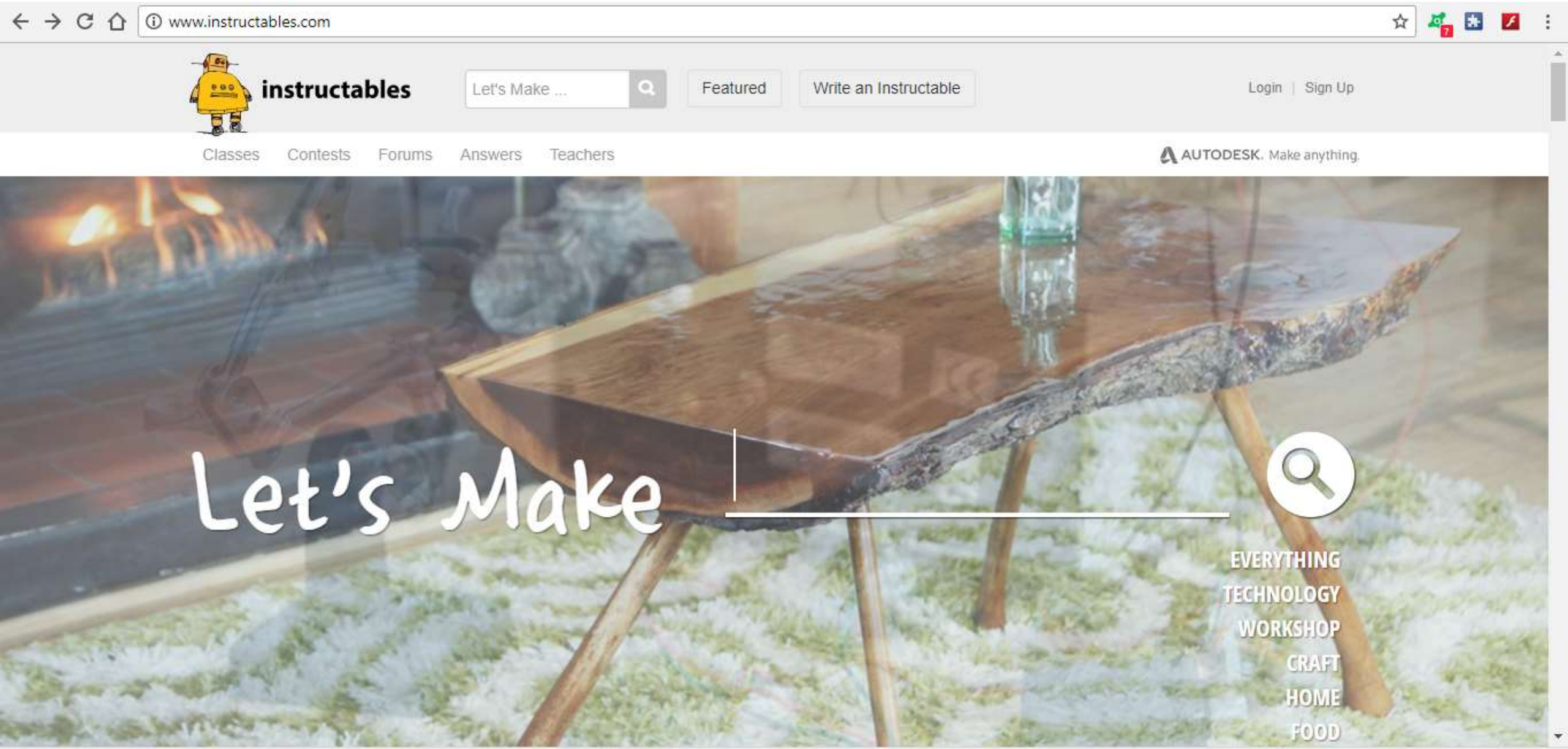
The Maker Lab is a creative space staffed by Cambrian teacher Rick Schertle - schertler@cambriansd.com. The over 3000 square foot double wide lab classroom is an area for K-8 students to create, learn, build, share and play. Core units include but are not limited to electronics, robotics, mechanics, construction, flight, programming, woodworking and fabrication. See Rick's Back to School Night Presentation here. This year, Rick teaches three 6th grade and one 7th grade classes three days a week as well as facilitates K-5 STEAM integration.

Program for Middle School

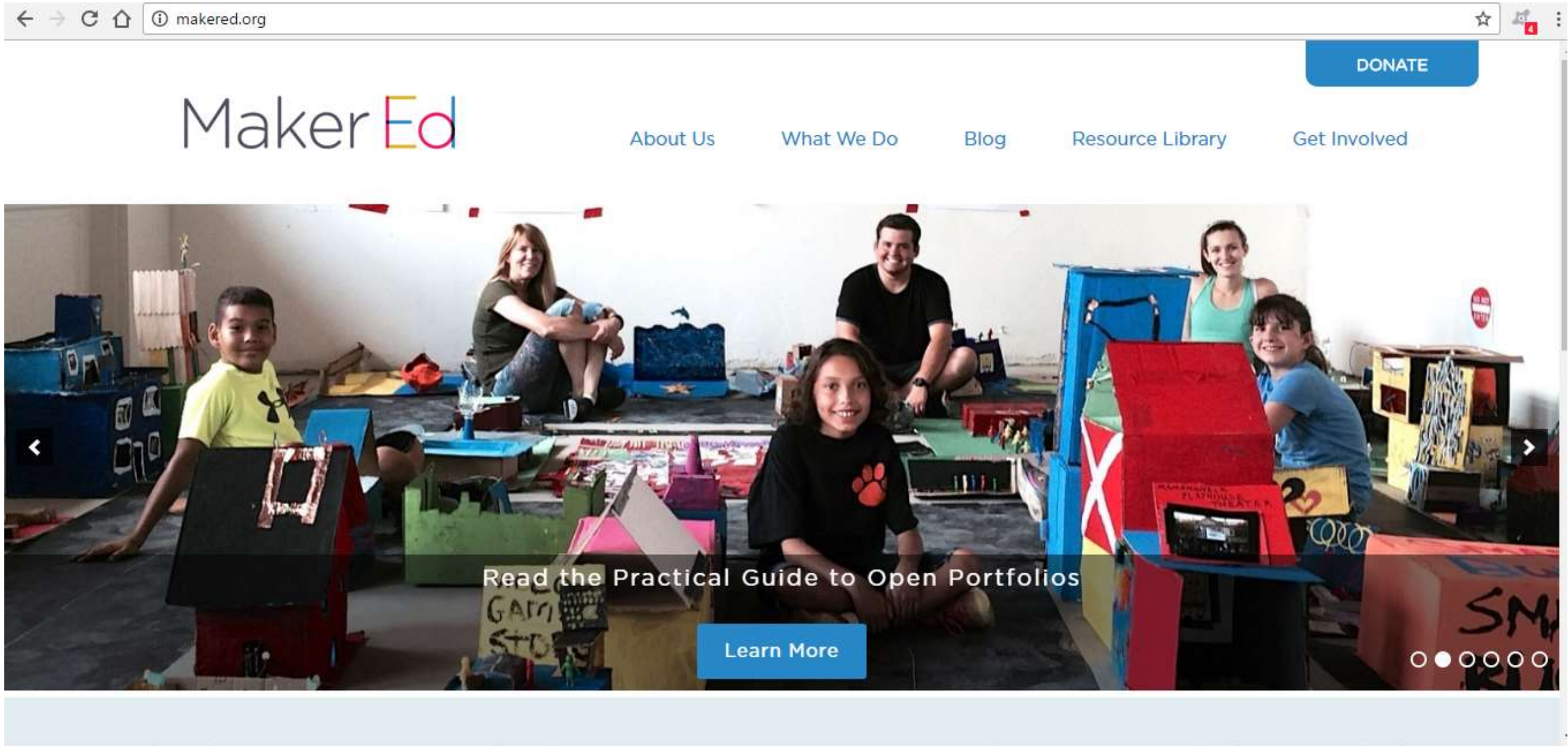
makezine.com



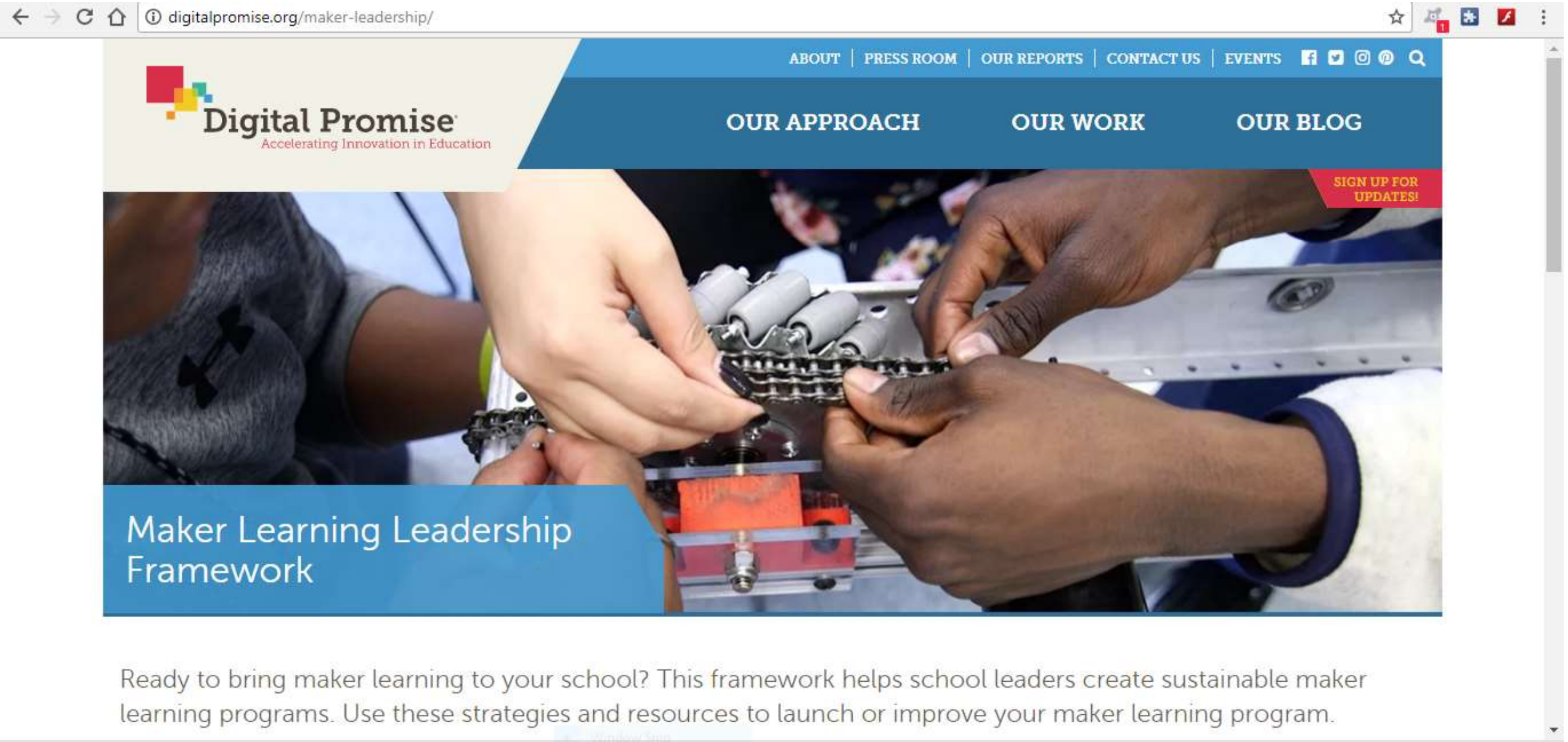
instructables.com

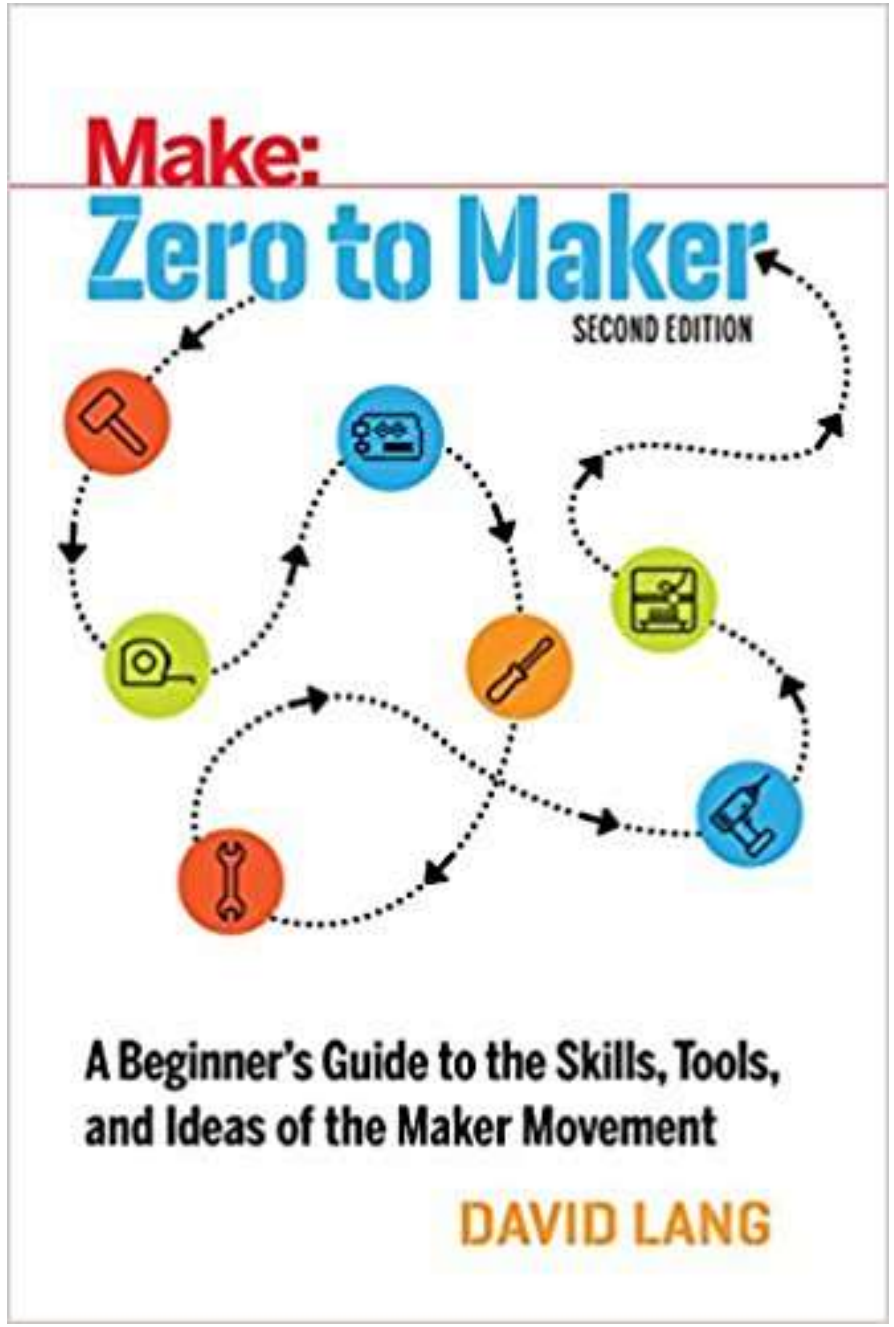


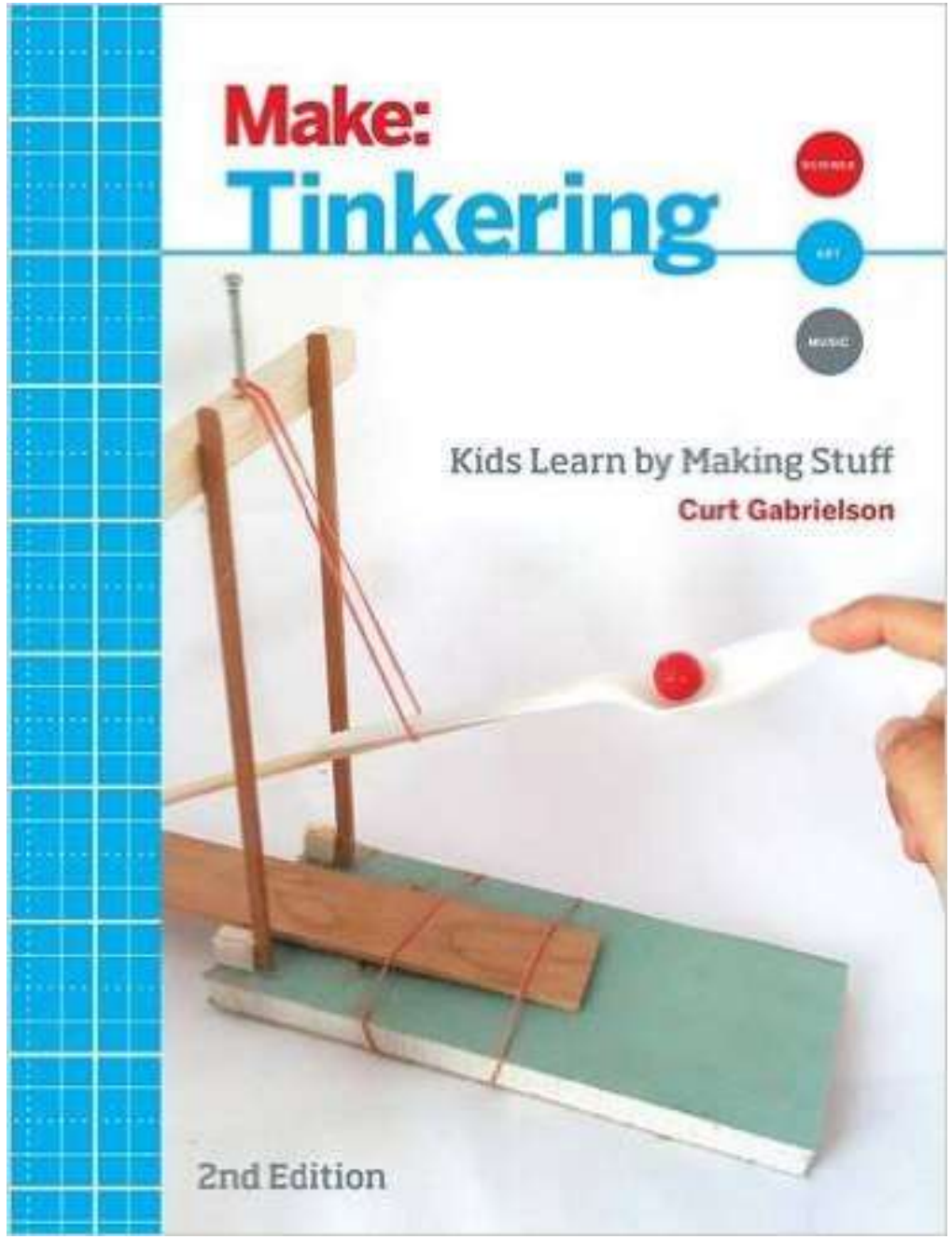
makered.org

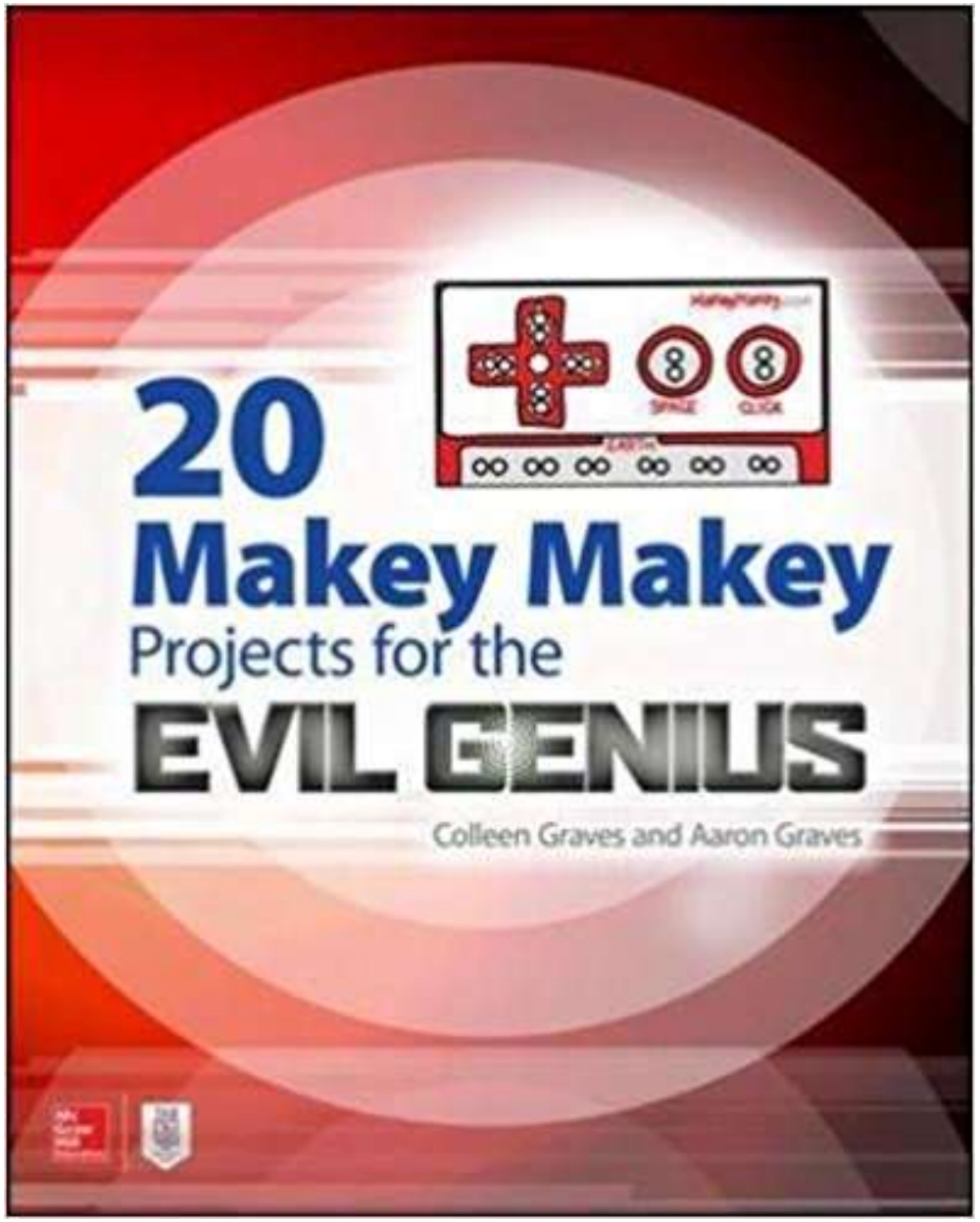

makered.org
DONATE
MakerEd
About Us
What We Do
Blog
Resource Library
Get Involved
Read the Practical Guide to Open Portfolios
Learn More

digitalpromise.org/maker-leadership/




Make:
Zero to Maker
SECOND EDITION
A Beginner's Guide to the Skills, Tools, and Ideas of the Maker Movement
DAVID LANG

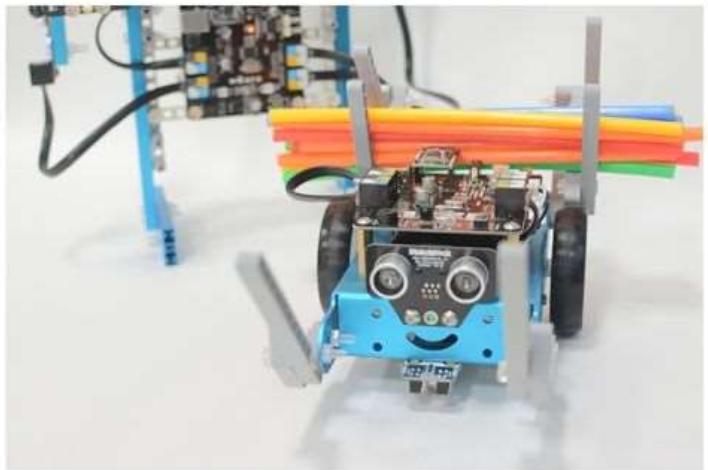

Make:
Tinkering
Kids Learn by Making Stuff
Curt Gabrielson
2nd Edition


20
Makey Makey
Projects for the
EVIL GENIUS
Colleen Graves and Aaron Graves

Copyrighted Material
Inspiring Makers to Experiment, Create, and Learn
The Big Book of
MAKER SPACE
Projects
Colleen Graves and Aaron Graves
Copyrighted Material

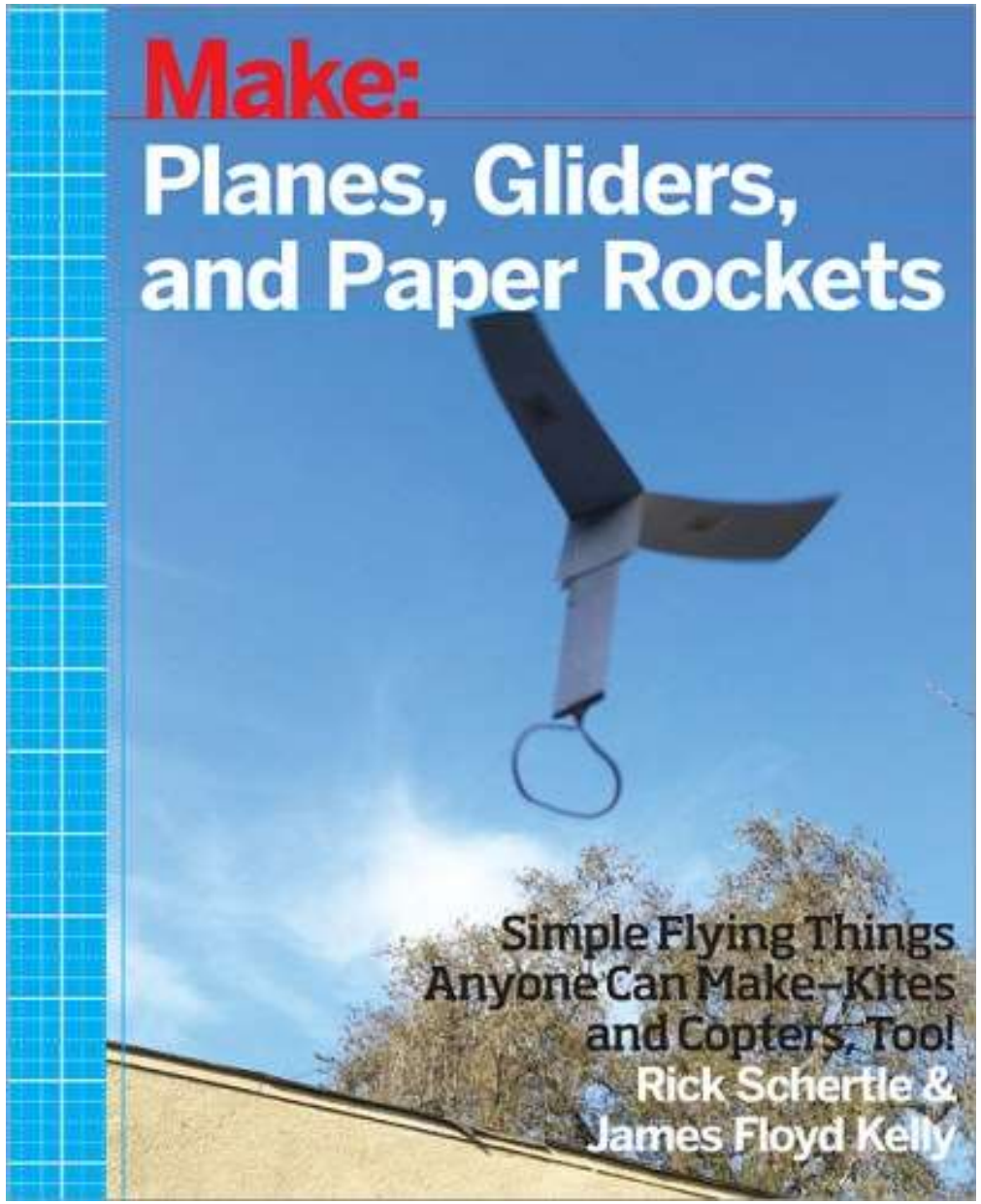
Make:

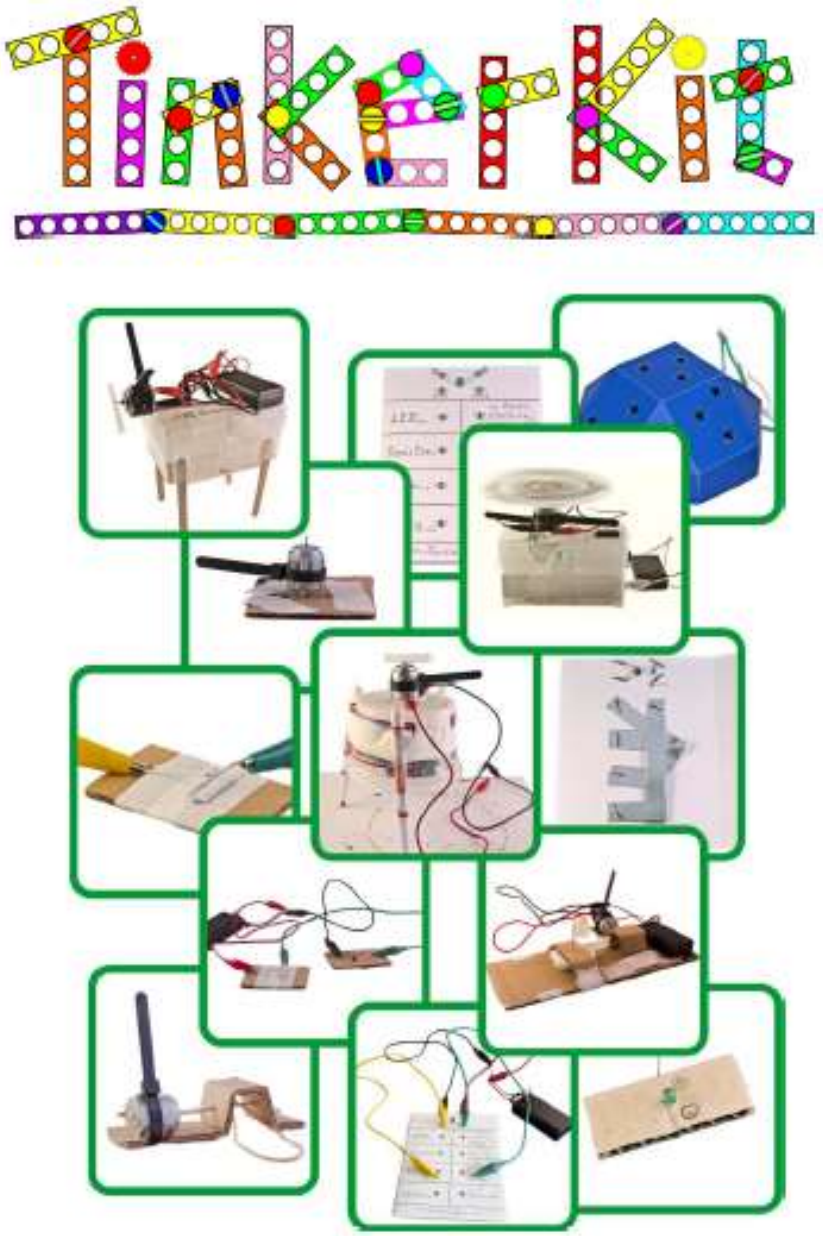
mBot for Makers



Conceive, Construct, and Code Your Own Robots at Home or in the Classroom

RICK SCHERTLE • ANDREW CARLE





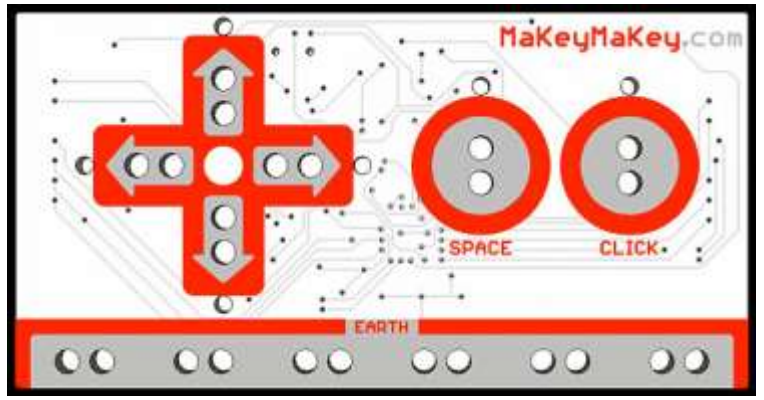
Tinker Kits Include:

- Electric Motor
- Craft sticks (5)
- Alligator Cables (4)
- Toothpicks (3)
- Battery Holder with On/Off Switch
- Paper Clips (5)
- AA Batteries (2)
- Hot Glue Stick
- Releasable Cable Ties (4)
- Cardboard Square
- LED’s (3 colors)
- 56 Ohm Resistor
- Handy Storage Box
- Cork
- 28 Page Full-Color Tinker Kit Manual

Just add your own masking tape and some creativity and you’re ready for hours of tinkering fun!

If you had $1000 to get started…

- Glue Guns! (less than $5 each)
- Tinker Kits (30 for $150)
- Makey Makey Boards ($50 each, have kids work in teams - Needs to be connected to a laptop for programming with SCRATCH)
- SCRATCH (Free at: https://scratch.mit.edu/) Graphical programming interface to use with Arduino and Makey Makey boards.
- BBC micro:bit
- Hand tools
- DIY Cart and Storage Bins



More of my Favorite Stuff!

As your budget grows…

- Laser Cutters – Full Spectrum or Glowforge
- Scroll Saw – harborfreight.com
- Paper Marble Rollercoaster - paperrollercoasters.com
- Strawbees – www.strawbees.com
- Sparkfun Inventor Kits – www.sparkfun.com
- Air Rockets – www.airrocketworks.com
- mBots – makeblock.com
- Makey Makey – makeymakey.com
- Scratch – scratch.mit.edu
- DIY R/C Airplanes - brooklynaerodrome.com

STEINDORF MAKER LAB

Rick's Maker Space Highlights

schertler@cambriansd.com

Books for Ideas:

- The Big Book of Maker Space Projects
- Tinkering
- 20 Makey Makey Projects for the Evil Genius
- Make: Planes, Gliders and Paper Rockets
- mBot for Makers

Websites for Ideas and Planning:

- Maker Ed: makered.org
- Make: makezine.com
- Steindorf Maker Lab: **www.cambriansd.org/makerlab**
- Instructables – www.instructables.com
- Digital Promise - digitalpromise.org/maker-leadership/

Events for Inspiration

- Maker Faire! – www.makerfaire.com

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- SCRATCH (Free at: https://scratch.mit.edu/) Graphical programming interface to use with Arduino and Makey Makey boards.
- Hand tools – www.harborfreight.com
- DIY Cart and Storage Bins

Parents can donate many of the materials below to build projects from the books listed above using the tools listed above.

- Cardboard Tubes
- Cereal Boxes
- Craft Sticks
- Aluminum Foil
- Masking Tape
- Rubber Bands

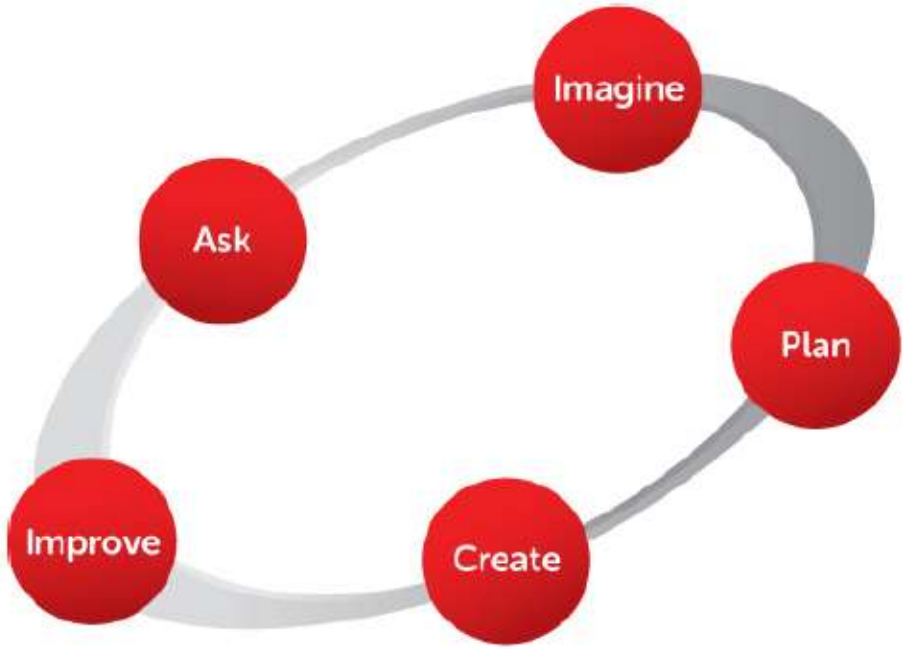
As your Budget Grows

- mBots, sensors and mBot Book – www.makeblock.com & amazon.com
- Sparkfun Inventor Kits – www.sparkfun.com/products/14189
- Particle Chips (For IoT Projects) - store.particle.io/
- VEX Robotics - www.vexrobotics.com
- Laser Cutter - fslaser.com
- Marble Paper Roller Coasters – paperrollercoasters.com/
- Strawbees - strawbees.com
- Engineering is Elementary – eie.org
- Air Rockets and Gliders – www.airrocketworks.com
- Dewalt Scroll Saw - www.dewalt.com

The resources listed above provide for **Open Ended** making experience on a budget, for whole classes of kids. Projects, tools and materials here encourage **Design Thinking** with many different outcomes. For updates to this document go to: **www.cambriansd.org/makerlab**

The Engineering Design Process

*To solve engineering problems, engineers follow a series of steps called the "**Engineering Design Process**"*



***ASK:** What is the problem? How have others approached it? What are your constraints?*

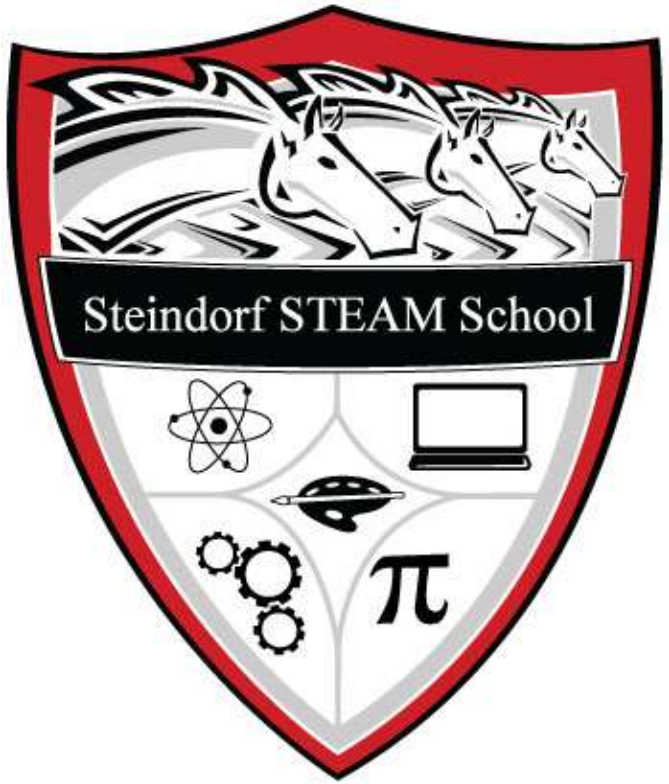
***IMAGINE:** What are some solutions? Brainstorm ideas. Choose the best one.*

***PLAN:** Draw a diagram. Make lists of materials you will need.*

***CREATE:** Follow your plan and create something. Test it out!*

***IMPROVE:** What works? What doesn't? What could work better? Modify your designs to make it better. Test it out!*

More details at: www.eie.org/eie-curriculum/engineering-design-process



Rick Schertle

Steindorf K-8 STEAM School

San Jose, CA

schertler@cambriansd.com

www.cambriansd.org/makerlab

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