Act0: Quick Hacks for starting you as an electronic hobbyist, and later, a fellow “maker”.

“I knew how to do basic soldering, but reading a schematic and putting a simple circuit together was not something I would have been comfortable doing. I always wanted to have a better understanding of electronics so I could do some of the cool projects I would see on Instructables.com and in Make: Magazine. I had purchased a few books over the previous years, but none of them gave me what I was needing — some hands-on training with easy-to-understand explanations of how things worked and why. ” - James Floyd Kelly

Learning by Discovery

Let's start by putting the electronics components together on a circuit board with the **right** way. Turn on the power supply and observe the output to figure out what is going on with the circuit. This process of learning by discovery creates a more powerful and lasting experience. This work both ways, who will forgets when the circuit caught fire or the EUREKA moment when the circuits work properly?

Learning Objectives

At the end of this studio session of making a LED lux circuit, I will learn how to recognise the polarity of LED, decoding resistor values, solder the electronic components on a strip board, calculate the amount of current required using Ohm's Law, use divide and conquer approach to break up a complicated project to a few manageable task, assemble partially completed PCB, analyse circuitry and conduct troubleshooting with the Digital Multi Meter, experiment with the hardware to determine the desired outcome.

Caution

Sometimes mistakes were made. Mistakes are the best of all learning processes. In the controlled lab environment, there are some opportunities for you to burn things out and mess up the circuitry, this is how you will learn the limits of components and materials.
The DC supply in the circuit describe will be using low voltages (<12v) and low currents (<0.02A), there’ll be no chance of electrocution, as long as you know the limit of the current (or the system) Do not attempt to push it to the maximum "*just to test things out*". That is not experiment, but rather, **ignorance**. If the ways in the experiment was follow as describe, there will be no risk of burning yourself or starting of fires in the lab.

Interesting Reading List

A Curriculum of toys

Real tools for kids

Mentoring kids into Makers

Act0.10 Getting acquainted with the Arsenal (as an electronic hobbyist that is)

Name & Describe the function of each tool, starting from noon position in clock wise.

Image Src: CuriousInventor.com

Act0.11: Tools you really need at the bare minimum to start an electronic project.

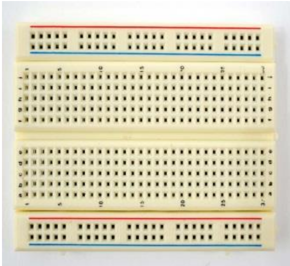
image source: http://www.ladyada.net/resources/equipt/index.html

Needle Nose Pliers: Useful for pre-bending leads, pulling out components during de-soldering, and a lot of other things.
Wire Cutters: Used to trim leads close to the board after soldering .
Third-Hand Clamps: Oftentimes just resting your board on a table will be fine, but the clamps are especially helpful when desoldering parts or soldering wires together. ***Thinking of making one?*** Check this out: http://www.instructables.com/id/Third-Hand-A-multi-use-helping-hand-for-electro/

Solder Sucker(or Solder Wick): The sucker is a spring loaded tube that vacuums out solder and the wick is a mesh braid of flux coated copper that soaks up solder during desoldering.
Digital Multimeter: Some multimeters have a continuity check that beeps if there is a complete circuit. This is very useful for making sure parts are connected or disconnected when there're a lot of wires and parts.

Act0.12: Parts you really need at the bare minimum to start an electronic project.






9V battery and battery clip, DC power supply for circuit.
1.5v battery AA size and battery holder, DC power supply for circuit.
Strip boards, for soldering the components of an electronic circuits.
Breadboards , for prototyping the electronic circuits without the need to solder the circuit.
Crocodile clips.
Components you will usually see in an electronic project.
Resistors, capacitors, LEDs,diode, microcontroller and much more.

Ponder:

1. What are the symbols used to represent the commonly used electronic components?
2. Sketch the symbol used for resistor, capacitor, LED, diode, DC supply.

Act0.13: Familiarization with the Digital Multimeter (DMM)

Common features of a DMM
L.H.S INPUT PROBE FOR MEASURING AC AND DC CURRENT TO 10 AMPERE
MID COMMON (return) PROBE FOR ALL MEASUREMENTS
R.H.S INPUT PROBE FOR MEASURING VOLTAGE, CONTINUITY, RESISTANCE, CAPACITANCE, FREQUENCY AND DIODE.

Features on the dial
AC VOLTS true rms (600.0 vac) & FREQUENCY (Hz) (0 Hz -50 kHz)
DC VOLTS (600.0 vdc)
AC & DC MILLIVOLTS (600 .0mV)
OHMS (40.00 MΩ)
CONTINUITY (600 Ω)
DIODE TEST (2.000 V) & CAPACITANCE (1000 nf)
AC CURRENT (10 AMPERE) & FREQUENCY (Hz)
DC CURRENT (10 AMPERE)

Connect the probes as per the diagram below for measuring V, R,

Figure 1-20. *To measure resistance and voltage, plug the black lead into the Common socket and the red lead into the Volts socket. Almost all meters have a separate socket where you must plug the red lead when you measure large currents in amps, but we'll be dealing with this later.*

Continue your reading on AC and DC on the recommended text Make: Electronics pg12.
Ponder: Describe the purpose of DC and AC.
What happens when AC is supply to a DC only circuit? Justify your findings with data collected from reading.

Procedure to measure voltage (V)

Parts required: DMM, 9V battery, 3V battery (2x 1.5V aa)

1. Configure the DMM probes to measure DC voltage, the black probe to **COM**, the red probe to **V**.
2. Turn the dial to DC volts and then measure the 9v battery .
3. Connect the red probe to the "+" end and black probe to the " –" end of the 9v battery.
4. Observe and record down the reading of the DMM.
5. Repeat step1-4 with 2x 1.5v AA batteries in a battery holder.

Ponder:

1. What happens when the probes connected to the   in reverse order?
2. What do you think will happen when the polarity of the circuit is reverse?
3. In your opinion, is reversing of the supply polarity of a circuit a VERY SERIOUS matter?
4. What can be done such that user will not accidentally reverse the polarity of the supply voltage?

Want MORE?! Check this out: http://www.ladyada.net/learn/multimeter/voltage.html

Procedure to measure resistance (Ohm)

Parts required: DMM, 1k Ohm resistor, 100k Ohm resistor, potentiometer 1k Ohm

1. Configure the DMM probes to measure resistance.
2. Turn the dial to Ohm and then measure a resistor.
3. Connect the red probe to the "+" and black probe to both end of the resistor.
4. Observe and record down the reading of the DMM.
5. Repeat step1-4 with
    a. Resistor that sports another type of colour band.
    b. Potentiometer, then turning the know from one side to the other..
    c. Pieces of wire with varying length.
    d. Measure the resistance on your dry skin.
    e. Repeat step c, but moisten your skin with little bit of water.
    f. Repeat step d, by increasing the distance between the probes.

Ponder

1. What is the relationship between the colour bands on the resistor and the resistance itself?
2. What do you think will happen when the polarity of the resistor is reverse?
3. In your opinion, is reversing of the supply polarity of a resistor in a circuit a VERY SERIOUS matter?
4. What is the relationship of the resistance measured on the human skin and distance?

Not enough of resistance stuff? Try this: http://www.ladyada.net/learn/multimeter/resistance.html

Fun stuff: http://shin-ajaran.blogspot.com/2010/06/diy-accidental-human-conductor.html

Procedure to measure continuity

Parts required: DMM, 0.1A fuse (20mm), 10A fuse (30mm)

1. Configure the DMM probes to measure continuity, the black probe to **COM**, the red probe to **V**.
2. Compare and contrast both of the fuses, record down your observations.
3. Turn the dial to Ohm and then press the button for testing continuity Connect the red probe to and the black probe to the both end of the 0.1A fuse.
4. Observe and record down the reading of the DMM.
5. Repeat step1-4 with 10A fuse.

Ponder:

1. What can be inferred when there is a beep sound from the continuity test?
2. Describe the purpose of continuity test.
3. In your opinion, what happens when a fuse is “blown” and how to verify the status of the fuse?
4. What can be done such that user will not accidentally blown the circuit with inappropriate current?

Want more? http://www.ladyada.net/learn/multimeter/continuity.html

FUNDAMENTALS

Volt basics

Electrical pressure is measured in volts. The volt is an international unit. A millivolt is 1/1,000 of a volt.

Number of volts	Usually expressed as	Abbreviated as
0.001 volts	1 millivolt	1 mV
0.01 volts	10 millivolts	10 mV
0.1 volts	100 millivolts	100 mV
1 volt	1,000 millivolts	1V

Ampere basics

We measure electrical flow in amperes, or amps. The ampere is an international unit, often referred to as an “amp.” A milliamp is 1/1,000 of an ampere.

Number of amperes	Usually expressed as	Abbreviated as
0.001 amps	1 milliamp	1 mA
0.01 amps	10 milliamps	10 mA
0.1 amps	100 milliamps	100 mA
1 amp	1,000 milliamps	1A

Continue your reading on voltage, amperage, and resistance on the recommended text Make: Electronics pg 10.

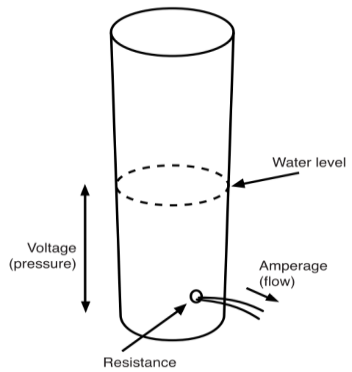


Figure 1-33. *Think of voltage as pressure, and amperes as flow.*

Act0.14: Your first soldering (on jumper wires)

Parts required: 2x crocodile clip (1 colour each), 1x slide switch, 1x 9v battery clip, jumper wires.
Introduction: You are required to use the slide switch to open/close a circuit with the DC supply.
Procedure:

1. Using the DMM, test the continuity of the slide switch.
2. Determine the colour of the wire from the battery clip where the switch will use based on the **direction of the current flow**.
3. From the test, determine which pin on the slide switch to be soldered with the jumper wires.
4. Prep the jumper wires by stripping 1” of the insulators both ends.
5. Heat up the solder iron, “**Tin**” the jumper wire with some solder.
6. Loop the tinned wire through the switch’s connector and solder it.

Check out page 105-107 of the recommended text on soldering wires

the heat for a little longer.

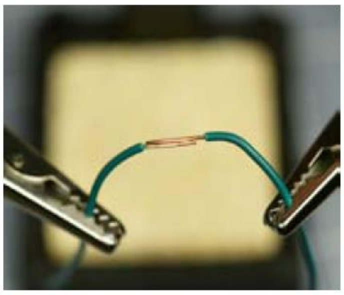


Figure 3-40

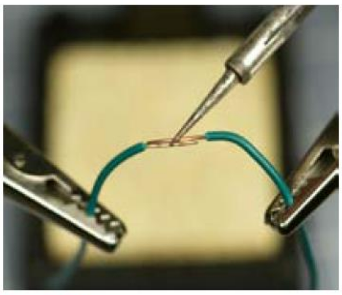


Figure 3-41

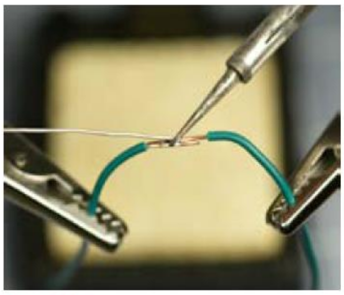
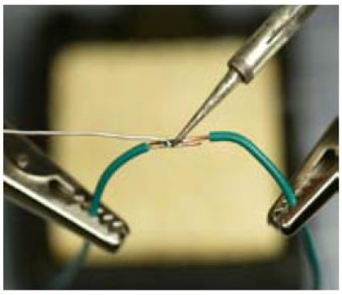
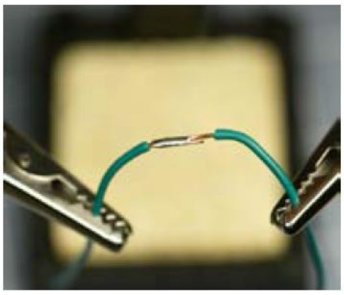


Figure 3-42





Ponder:

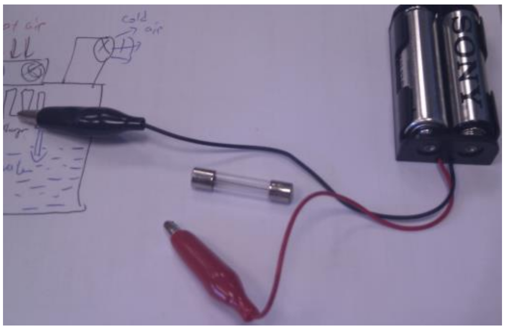
1. Describe the relationship between the current low, resistance and voltage using analogy.
2. Determine what constitutes an **Open circuit**, **Close circuit** and **Short Circuit**.
3. Sketch the wiring diagram in step2 with your newly acquired 9V DC supply with switch
4. Choose the type of test that could be done using the DMM to determine the scenario as describe in Step 3. Support your test with the expected outcome of the experiment.
5. What are the consequences of an exposed joint?
6. What are the steps to prevent risk identified in step 5. ?

Act0.15: Fun with fuse

Parts required: 10A fuse, 0.1A fuse, 3V battery, 9V battery

Introduction: You are required to **design** an experiment to discover the effect of short circuit on a fuse, using the fuses and DC batteries supplied.

Deliverables: A stand-up poster that describes this experiment.



Example: setup of this experiment.
Continue your reading on pg9-11 of the recommended text book

Procedure:

1. Determine the tests that are necessary prior to the start of this experiment.
2. Assess the necessary risk factor and possible mitigation associated with this experiment.
3. Establish the hypothesis associated with this experiment and the desired outcome.
4. Design the testing methodology for this experiment.
5. Collect the data, such as observation during experiments, readings recorded on DMM, temperature of the battery and more.

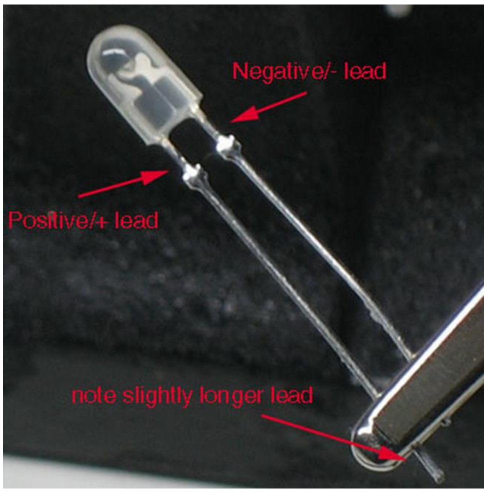
Ponder:

1. What is the relationship between the rating of the fuse and also the DC supply.
2. What are the risks involved if there is no fuse in a circuit.
3. What happens to the DC supply in an event of a short circuit.

Want to see some fireworks???? Check out my youtube video
http://www.youtube.com/watch?v=ywWS_nBmxRU
Want to see a LIVE ones ? Approach the TSO!
After the experiment ask yourself this Self-Reflection Question:

1. How did Thomas Edison invent the light bulb?
   http://inventors.about.com/library/inventors/bledison.htm
2. How related is it to our experiments today?

Act0.16: Your first electronic circuit



You will need
1x LED (of any single colour)
1x 1k Ohm resistor
3v battery (2x 1.5v AA battery in a holder)
Breadboard for prototyping
Procedure

1. Connect the circuit as per the schematic on the breadboard
2. Record the observation from this circuit.
3. Take note of intensity of the light.
4. If there is no light, first check the polarity of the LED as per the most LHS diagram, then conduct a continuity test on the circuit.

Image source: http://www.ladyada.net/

Ponder:
1. What is the resistance of the circuit on breadboard?
2. What are the voltage and the **measured** current across the LED using?
2. What happens to the LED light when the 1k Ohm resistor is replaced with a piece of wire?
3. What happens to the LED light when the 1k Ohm resistor is replaced with a 100K Ohm Resistor?
3. What is the relationship between the intensity of the LED light and the resistor?
4. Why there is a beeping sound during the continuity test with the circuit?
5. Improve your circuit with a switch to on/off the LED light.

Steps to measure current at page 21

FUNDAMENTALS

Decoding resistors

Some resistors have their value clearly stated on them in microscopic print that you can read with a magnifying glass. Most, however, are color-coded with stripes. The code works like this: first, ignore the color of the body of the resistor. Second, look for a silver or gold stripe. If you find it, turn the resistor so that the stripe is on the righthand side. Silver means that the value of the resistor

Continue the reading at Make: electronics page14-15

Using Ohm's Law

Ohm's Law is extremely useful. For example, it helps us to figure out whether a component can be used safely in a circuit. Instead of stressing the component until we burn it out, we can predict whether it will work.

Continue reading at page26 of the recommended text book

Act0.17: Fun with Ohm's Law

Introduction: You are required to **conduct** an experiment to discover the effect of voltage, current and resistance in a circuit with a LED; using the LEDs, resistors and DC batteries supplied.

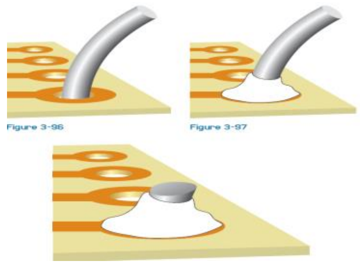
Deliverables: A stand-up poster that describes Ohm's Law using this experiment as the conclusion.

Procedure:

1. Modify circuit use in Act0.16 with 9V battery instead of 3V. Record your observations
2. Conduct the continuity for the circuit in step1. Record your observations.
3. Assuming 9v DC is required in this circuit. Determine the component(s) that need to be modified.
4. Using the measured value of the voltage and value of current across the LED from Act0.15. Assuming the same intensity of the LED light to be preserved, calculate the necessary resistance value.
5. Using the data from step 3, modify your circuit in step1. Record your observations.
6. Assuming the intensity of the LED is to be varied with a knob. Suggest a suitable rating component that would satisfy this requirement.
7. Based on step 6, measure the voltage across the LED when the knob is turn from one side to the other.

Ponder:

1. Describe the relationship between the current (I) , resistance (R) and Voltage (V) using Ohm's Law.
2. Explain & demonstrate the light up 3 LED of equal intensity by connecting it in **parallel**.
3. Explain & demonstrate the light up 3 LED with weaker intensity by connecting it in **series**.



Before you start to solder the circuit, it is best to read page 137-128 for some soldering tips& tricks.

Act0.18: Fun **Applying** Ohm's Law

Introduction: You are required to **research & develop** a circuit that demonstrates the effect of voltage, current and resistance in a circuit with as many as 4 LEDs as describe in the deliverables.

Deliverables:

1. A schematic that describes the circuit using standard electronic engineering notations.
2. A prototype that is implemented on the breadboard.
3. A working prototype circuit implemented on a strip board. The circuit would have 4 LED with different brightness ranging from 100%, 75%, 50%,25% of brightness based on the 9V DC supplied to the circuit.

Procedure:

1. Based on the circuit requirement, establish the **formula** of the circuit by applying Ohm's Law.
2. Sketch the schematic of the circuit with the appropriate value of the resistor, voltage supply and LEDs.
3. Verify the correctness of the schematic of the circuit by prototyping it on the breadboard and observing the output of the LEDs.
4. Implement the verified circuit on the strip board complete with wiring and soldering.
5. Verify the circuit on the strip board work accordingly as per the bread board prototype.

Continue your reading at page 28 of the recommended text

How Big a Resistor Does an LED Need?

Suppose that we're use the Vishay LED. Remember its requirements from the data sheet? Maximum of 3 volts, and a safe current of 20mA.

Ponder:

1. Suppose the same circuitry is required, but the DC supply increases to 24V 10A. What will be the changes necessary on the circuit?
2. Describe the relationship between the Power (P), current (I) , resistance (R) and Voltage (V) using **Joule's Law**.
3. Suppose you would want to mass produce this circuit. Is implementing it on a strip board a low cost and long term solution? What are the better options available?

Appendix/Reference

1. Make: Electronics
2. Electronics for Innovators
3. Instructables:
4. http://www.wired.com/geekdad/2011/07/geek-skills-101-make-electronics/
5. Makezine #29
6. http://www.electricneutron.com/measuring-instruments/description-of-the-multimeter

MAKING MAKERS

By AnnMarie Thomas, Engineer Educator

Real Tools for Kids

RECENTLY, WHILE LOOKING ONLINE FOR woodworking tools appropriately sized for my preschool daughter, I came across some construction sets geared toward children. Thinking fondly of the sets I had when I was little, I looked closely to see if I could find one suited for my kids.

I was intrigued by one kit that promised "real" construction play. While the kits that I played with in elementary school typically included glue, nails, and a rough picture of something I could build with a hammer and maybe a saw, this kit included foam "wood," plastic tools, and plastic nails. The promotional materials stressed that these are "real materials" and "real tools." Real: yes. Realistic: no.

The really surprising thing was that this toy is labeled for children ages 6+ and, on Amazon, has a manufacturer's recommended age range of 6–15. Minutes earlier I'd been confidently pricing hand drills and hammers. Now this toy seemed to be telling me I should wait on those tools until my daughter reaches middle school. So how old is old enough to hand kids real tools?

Making objects is similar to making music. We would think it outrageous to wait until a student reaches university to give them their first non-toy musical instrument. However, many students reach their first year of college without much experience with tools. I recently spoke to an engineering professor who mentioned that when he asked a class of 35 first-year engineering students how many had used a drill press before, not a single hand went up. How many had taken apart one of their toys when they were younger? Again, not a single student raised a hand. And that's in a roomful of future engineers.

The more I research children and tool use, the more I notice how things have changed. Kids were once trusted with real, metal tools. In the early 20th century, it was common for elementary schools to teach manual training. In 1900, Frank Ball, a teacher at the University Elementary School in Chicago, wrote, "At the present time no thoroughly equipped school is complete without its department of manual training or construction work." A book written in 1964 by John Feirer and John Lindbeck, of the Industrial Education Department at Western Michigan University, talks about outfitting elementary school shops and advises that the tools should be maintained well, since "the sharp, well-cared-for tool is safe, easy and fun to use." Very rarely these days do we hear "fun," "sharp," and "elementary school" in the same conversation.

As a parent and a teacher, I understand the fear of injuries, and suspect it's one of the reasons behind the decline in kids gaining hands-on skills. When it comes to tools, our risk aversion is causing more harm than good. The promotional video for the abovementioned "real" construction set showed how safe the tools are by having a child saw his hand with no injury. My 16-month-old daughter has plastic tools for now, but I'll definitely correct her if I see her sawing her arm. We don't do that with real tools, so I wouldn't want her to do it with her plastic tools.

Combine an eager child, real tools and materials, appropriate training, and supervision, and you'll be surprised by the results. More importantly, you'll see a young maker who is gaining a useful skill and confidence in her ability to bring ideas to life.

AnnMarie Thomas teaches in the engineering and engineering education programs at the University of St. Thomas in St. Paul, Minn. She's also the mother of two young makers.

MAKING TROUBLE

By Saul Griffith, Omnivorous Inventor

MENTORing Kids into Makers

DARPA IS THE DEFENSE ADVANCED Research Projects Agency. It used to be called ARPA, and it was ARPA who funded the creation of the internet. Think of DARPA as the high-risk R&D sector of the U. S. Department of Defense. Sometimes the things they fund sound crazy, and sometimes they even are, but I personally think that they fund the more ambitious science and engineering projects in this country and get great results. Google might be claiming credit for the autonomous car, but remember that the guy who is running that program cut his teeth in the DARPA Grand Challenge autonomous vehicle race.

I worked under some DARPA programs during grad school and have participated in their programs since being in the commercial sector. I was quite surprised, and in many ways delighted, when DARPA requested proposals for a program called MENTOR that is aimed at addressing the shortfall of well-trained scientists and engineers in the U.S. The goal is to excite and enable a new generation of hands-on makers who can collaborate and co-design more complex things than have ever been built before (at least that is my interpretation of their goals). I was even more surprised and delighted when the venerable Dale Dougherty — the Pied Piper of makers everywhere — and I successfully received an award to tackle this grand and noble goal through our companies O'Reilly Media and Otherlab.

We've been asked to achieve hands-on education in 1,000 high schools in the U.S., and even around the world, within 4 years, at an incredibly low cost. There are few educational programs that have ever gotten to that scale through voluntary participation, FIRST Robotics, a really great robot competition, being the exceptional exception. But can we do more than robots? Can we appeal to a broader audience? We believe we can (it's why we applied), and we believe it's about enabling the maker spirit in everyone, about better collaboration tools for makers, and about more self-directed learning.

Send us your ideas, your offers of help, your good and bad educational experiences.

I won't go into great detail about our exact proposal, but we do know that we need help. We have a solid set of plans, but the thing about getting a mandate to improve hands-on education is that, inevitably, one very quickly wants to fix everything. I think both Dale and I are barely containing our desire to shake things up, and our plans are getting more ambitious by the day, not less. We know that we will need *a lot* of help. This column will be my last traditional column of the Making Trouble variety; starting in the next issue, it will be a how-to.

So with these last few column inches, I send a request to all of you to send us your ideas, your offers of help, your good and bad educational experiences. Although we can't change our plan too much, I'd especially like to hear what you would do if you were tasked with reforming STEM (science, technology, engineering, and math) education. Send your ideas to mentor@otherlab.com.

First imagine you have infinite money to fix the problem (wouldn't that be nice?). Then imagine you have a smaller budget than the average high school newspaper. Makers, let's make education better, together.

Saul Griffith is chief troublemaker at otherlab.com.

MAKING TROUBLE

By Saul Griffith, Omnivorous Inventor

A Curriculum of Toys

EVERY PUNDIT CRIES THAT EDUCATION IS broken. I'll say all we really need are good toys.

What are the fundamental things kids should know to help them understand, enjoy, and someday improve the complex physical world we live in? Could a curriculum of engaging toys be so powerful that the role of schools is reduced to mere socialization?

Here's my start at a list of core life skills I think can be taught by toys and play. I'd love to hear your ideas at makezine.com/28/trouble.

Drawing and Sculpting. Communicating ideas visually is critical for future makers. You needn't be Rembrandt; just learn proportion, perspective, and representation in 2D and 3D. *Chalk and a sidewalk, pencil and paper, an Etch A Sketch if you must. Play-Doh, clay, sandboxes, food, aluminum foil, paper and origami.*

Joining Things. Gluing, nailing, soldering, welding, lacing, riveting, taping, stitching, screwing, and tying knots. Give kids some rope, or a log, a hammer, and a bag of nails. *Any DIY kit or craft project, ropes, kites.*

Shaping Things. Cutting, sawing, chiseling, whittling, sanding, grinding, drilling. Give kids real tools, not cheap copies. *Woodworking tools, craft projects, penknife, scissors.*

Forces. Gravity, levers, projectile motion, friction, pulleys, gearing, torque. *Mobiles, trebuchets, magnets, juggling, throwing, ball or board sports, sailing, seesaws, slides, bicycles!*

Fluids, Hydraulics, and Pneumatics. *Water guns, water balloons, boats and rafts, blowgun darts, bathtubs, rivers, beaches, lakes, dams, skimming stones, bike pumps.*

Electronics. Voltage, resistance, current, and blinky lights. *Battery-powered toys (hack them), 9-volt batteries (lick them).*

Structures. Trusses, compression, tension, architecture, how things stand up. *Blocks, cardboard forts, sticks and stones, sandbox play, Erector sets, Lincoln Logs, treehouses.*

Energy. Conservation and momentum, transformation, generation, storage, and consumption. *Marbles, batteries, rubber-band airplanes, bicycles, dirt bikes, slot cars, train sets, swings, skateboards, kites.*

Math. Counting, arithmetic, geometry — just about any toy has a math lesson in it. *Beads, marbles, dice, Monopoly, cards, Tetris.*

Laughter. Life has to be fun, and toys should help us laugh. *Soap bubbles, Slinky, P[…] the Tail on the Donkey, whoopee cushions.*

Natural Philosophy. The ways of the natural world, including geology and biology. *Magnifying glasses, magnets, telescopes, microscopes, buckets, nets, specimen boxes.*

Properties of Materials. Every toy is a materials science lesson, whether wood, plastic, or metal. *Oobleck, chemistry sets, cooking*

Magic and Illusion. I love magic because it challenges you to search for the illusion — it's an opportunity to learn about reason and the scientific method. *Magic sets, brain teasers.*

Your Body. Dance, sport, climbing, swimming, hiking, gymnastics. *Go to the park!*

Storytelling. Children tell stories and release their imagination through whatever toy is in their hands. *Dolls, stuffed animals, wooden trains, Lego, Play-Doh, imagination.*

Logic. Building a Lego model or knitting a hand puppet is an exercise in basic instructional logic: do this, then that; if this happens, do that. *Construction toys, craft projects.*

Until our school system is reformed, I think the burden falls on parents, guardians, and friends to teach children the skills of life. Let's share the lessons and experiences embodied in the best toys. (But subtly. Kids can smell didactic like a giant adult skunk.)

Saul Griffith is chief troublemaker at otherlab.com.