Open Polytechnic
KURATINI TUWHERA

$10 MULTIMETERS: RECLAIMING THE 'MAKER CULTURE' OF AMATEUR SCIENCE

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PRESENT BY MICHAEL FENTON, M.Sc., Dip. Tchg., MRSNZ

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OUTLINE FOR THIS TASTER SESSION

- Introduction
- Reclaiming the Maker Space
- Aiming high – student outcomes
- Meeting a need
- Get Making!
- Bonus material

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WHO AM I?

- Programme Leader / Lecturer / Writer
- Science Teaching / Mathematics Teaching
- Registered teacher
- Research and industry experience
- Game design/coding, robotics, biology, chemistry, physics, calculus
- Ministry of Education eLearning Fellow
- Microsoft Innovative Teacher
- 2014 DEANZ eLearning Excellence Award
- 2015 Prime Minister's Education Excellence award
- Director/consultant, Focus Consultancy

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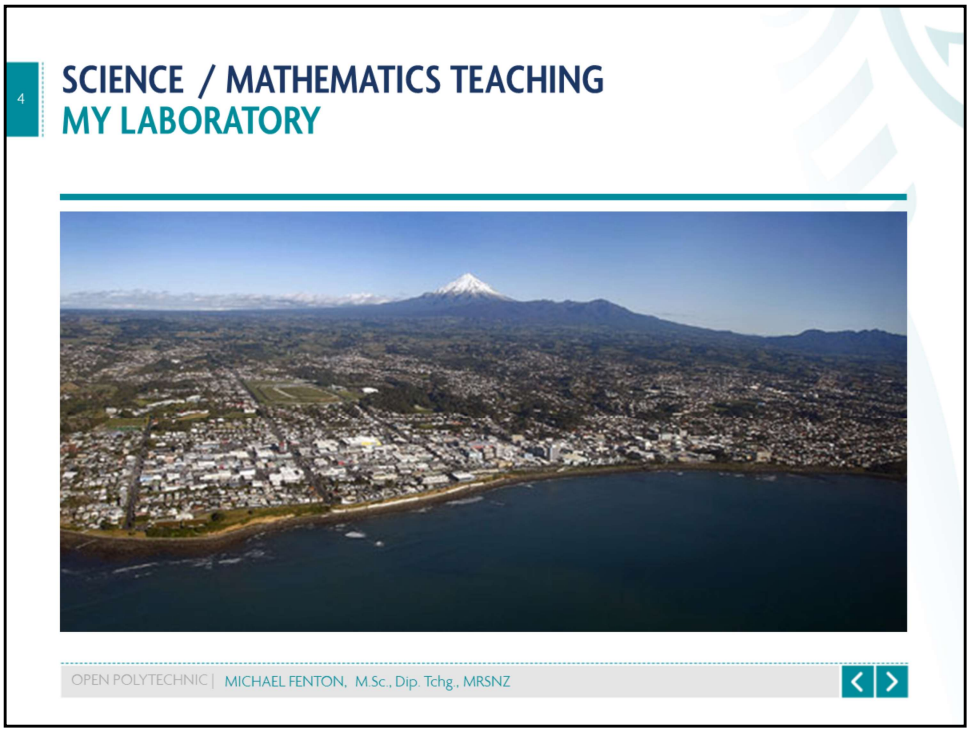
www.NexusResearchGroup.com



New Plymouth, Taranaki, North Island, New Zealand

The Taranaki region does not have a tertiary institute with science or teaching expertise / programmes

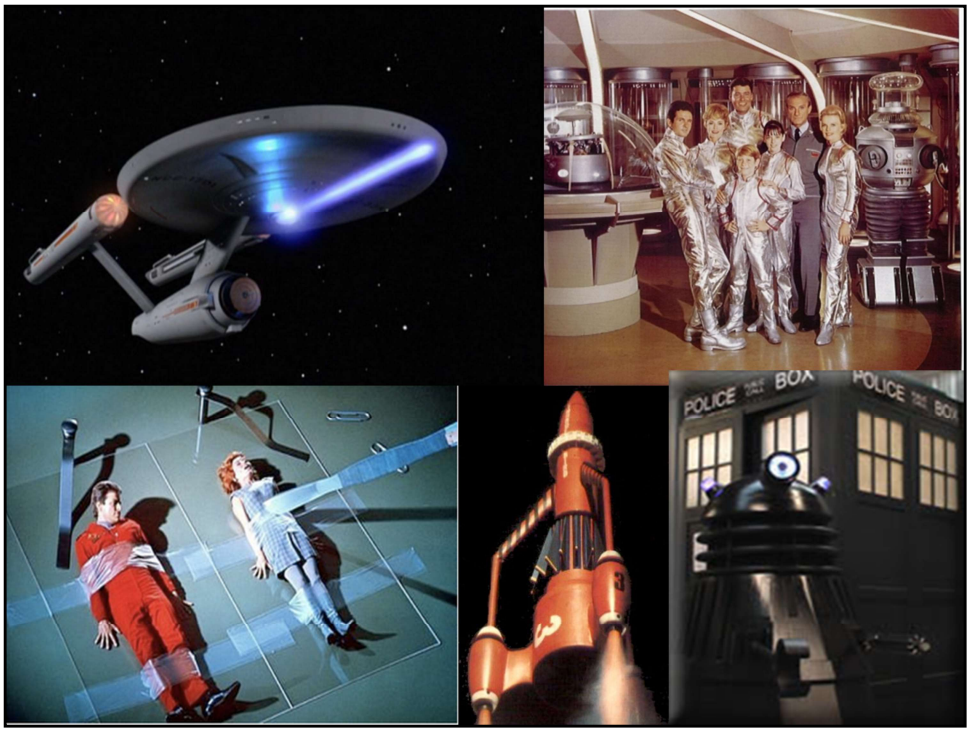
I am fortunate to have my own laboratory at home where I prototype DIY home made science equipment for Primary and Secondary teaching.

I also design and build robots of all sizes and visit schools around the region as one of the organisers of the Taranaki Science and Technology Fair

How did I get involved with teaching, education research and leading Science and Mathematics education at a national level?

How does my industrial and research experience influence my decisions about what I teach and how I teach?

Ultimately, how does this impact on student learning?



For me, being a child of the late 60's and early 70's, scientists were heroes, not lab geeks or nerds!

They were fit, athletic, and knew how to save beautiful monsters from ravenous maidens!

Science was cool, immensely exciting and called upon the cunning and creativity of its heroes to save the situation!

As a research scientist with industrial experience who retrained as a teacher, it has been interesting to note the assumptions about science that many of my colleagues have. Even at Secondary level, hearing that "science is rather dry and boring" from other science teachers was not unusual.

How many of you have a vision of what a "typical" scientist looks?

How many of you would doubt that school children could ever contribute anything meaningful to the scientific community?

Don't you need a degree to do that? And a lab?

For me science topics are meant to be investigated as if we are trying to confirm these concepts, not just rote learn them…that is part of the nature of science.

AIMING HIGH – STUDENT OUTCOMES

When I first entered teaching after leaving the University sector I decided to keep hold of my own authentic experiences in science…so I set up and operated the first school-based research group in New Zealand, founded in 1997. My wife Dr Christine Fenton and I encouraged students to “Question everything” .

This was not a science club…but a chance for students to work in an authentic setting with authentic roles and responsibilities to publish findings, attend conferences, and see what science is really all about!

Dr Sir William Pickering was our Patron; former head of NASA.

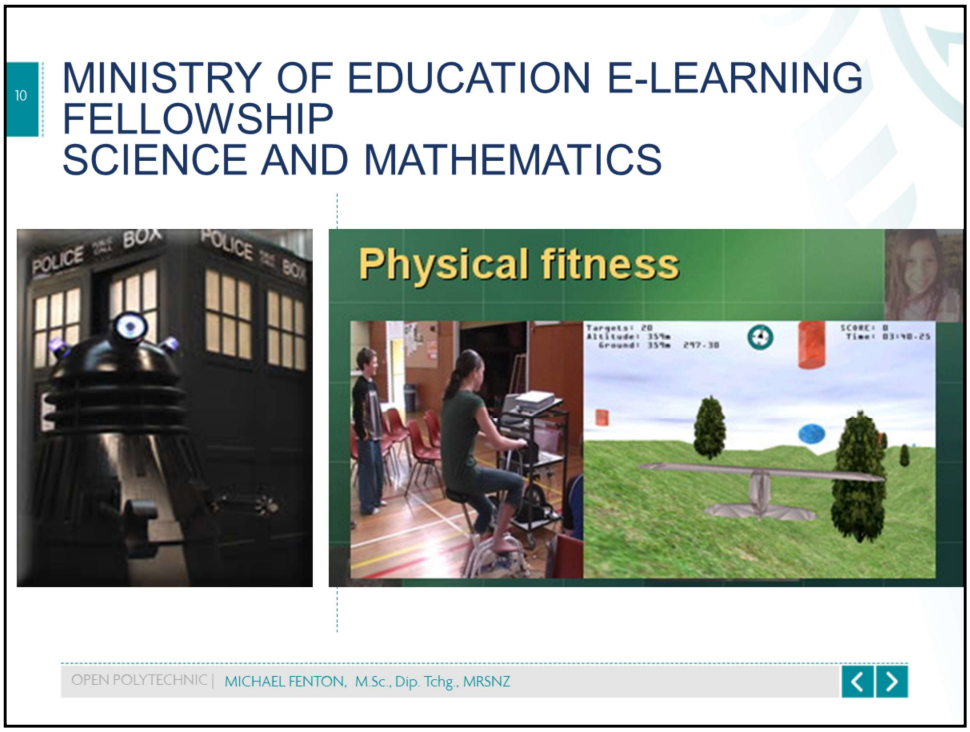
www.NexusResearchGroup.com

Why do I believe our children at Primary and Secondary level have so much untapped potential?

Part of this comes from being a scientist, part comes from being a parent, but most comes from believing that science is as simple as “noticing something worth noticing”…and then finding out more.

I build a lot of my own science equipment, largely by trial and error, and try to link it with ICT to make some interesting and very cool projects. Imagine making a heart beat sensor for 20 cents, and seeing your own heart beat on a computer screen!

What if you made this into a game using free game design software, and teach your class how to do this for themselves!

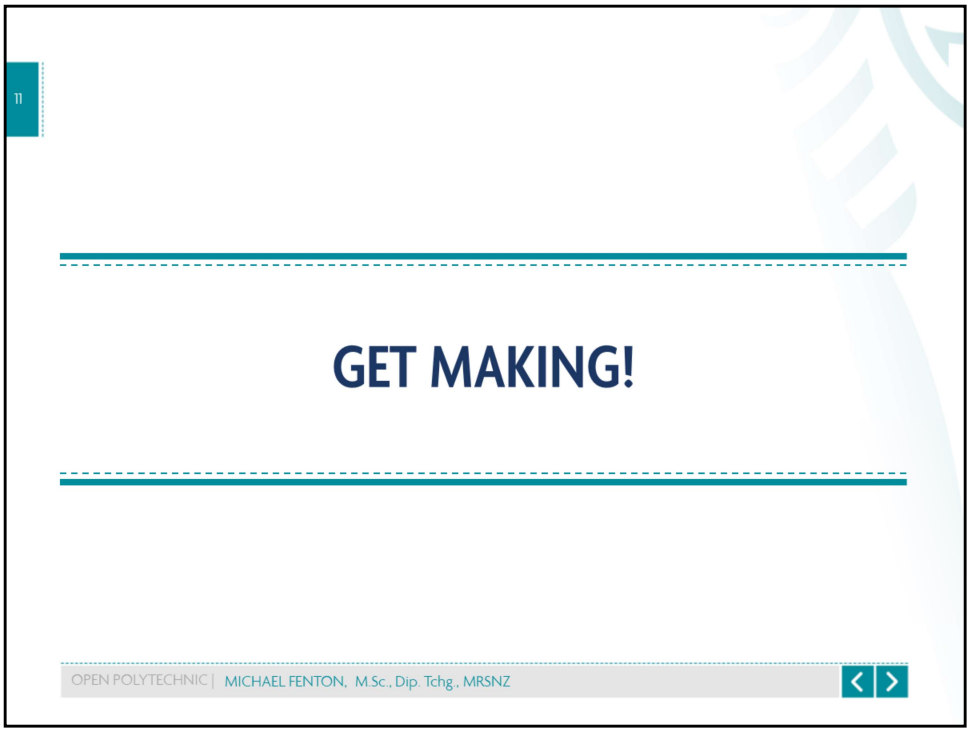


I worked with a class of Year 7 and Year 8 students and wrote up my research which was presented in Kuala Lumpur when I represented New Zealand at the Asia Pacific Microsoft Innovative Teachers Conference.

It was a hugely successful trial, demonstrating access to low-cost science equipment permitted authentic open-ended investigations and meaningful student-led learning.

Fenton, M. (2009, May 26th - 29th). RIGEL - Learning from Life: Communities of learning via a connected curriculum. Microsoft Partners in Learning Regional Innovative Teachers conference, Kuala Lumpur, Malaysia.

But teachers needed to be shown how to really look at the world as citizen scientists and understand what to observe and how to record and process their observations! What if students AND teachers could learn to do this together?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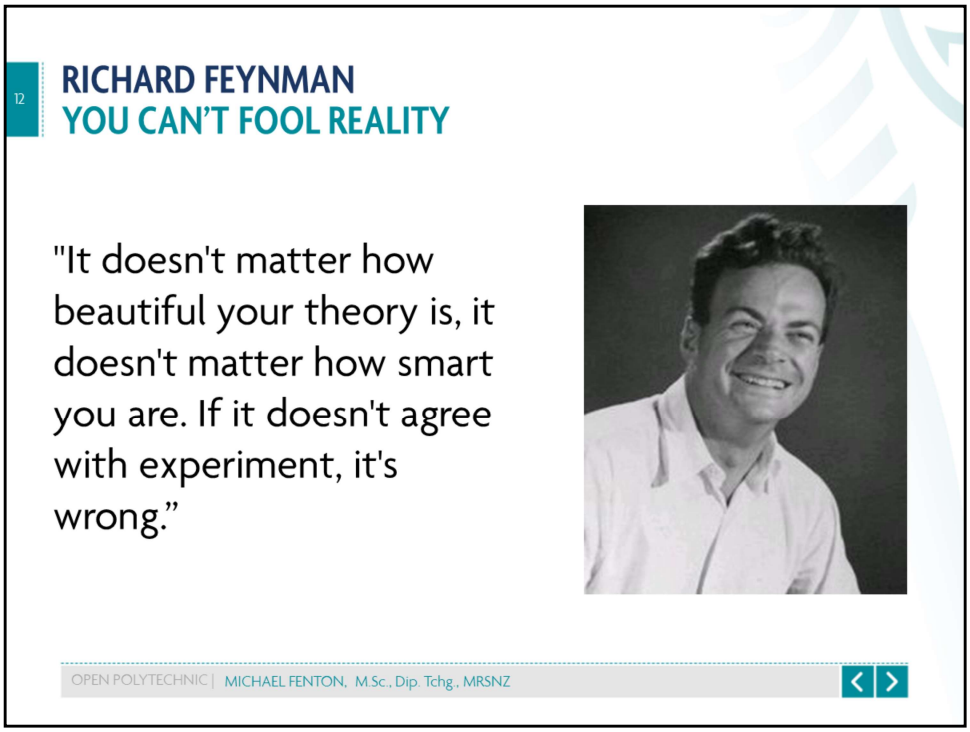
GET MAKING!
OPEN POLYTECHNIC | MICHAEL FENTON, M.Sc., Dip. Tchg., MRSNZ



Why is authentic science important?

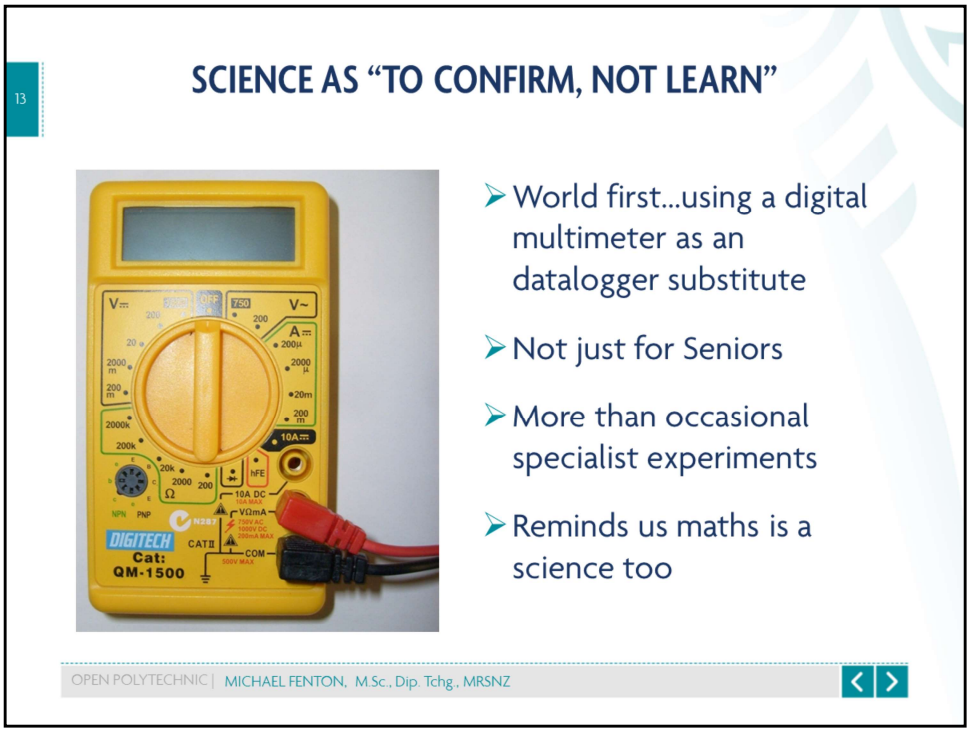
Why is hands-on science important?

Going to the library or going online is not research…it is just passively accepting in an uncritical way second-hand information.

"I did some research in the library…"

Far too many low quality science sites online.

Teachers often share resources, perhaps unaware of factual inaccuracies, health and safety issues, etc



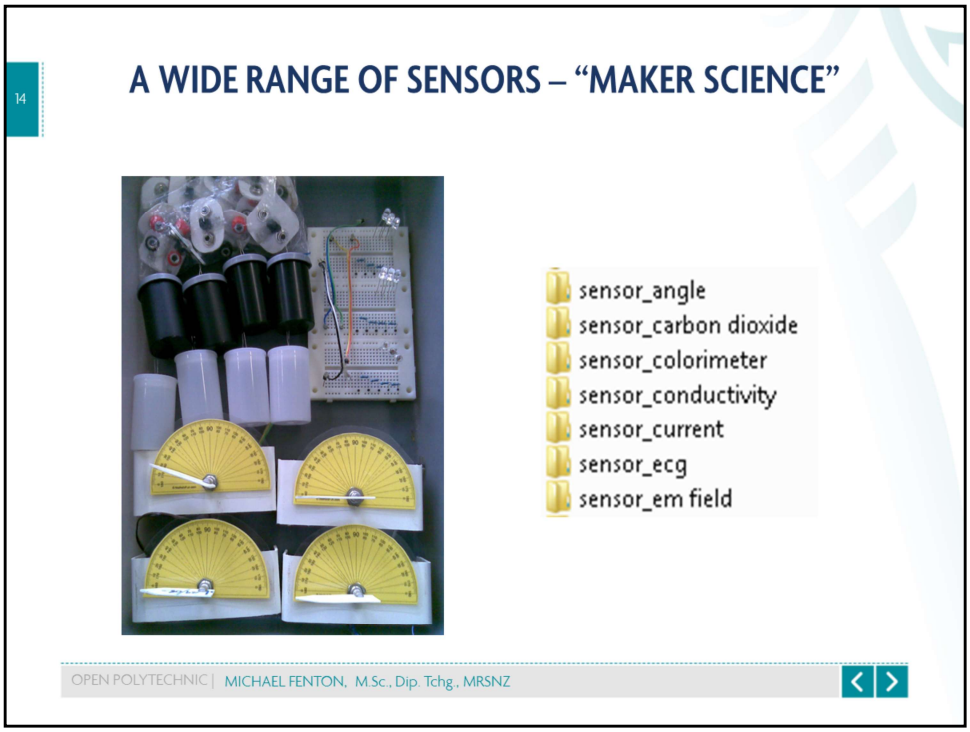
Traditional silos of knowledge such as biology, chemistry and physics as taught in schools no longer match the way science is done now.

The Secondary / High School system is too tied to NCEA; so if you want to revamp science, it is at the Primary level where the greatest impact can be made.

Teachers guide students through 3 steps as they make their own sensor system kits;

- BUILD IT
- TEST IT
- USE IT

Testing may include calibrating sensors to give real-world values, eg, temperature in degrees Celsius

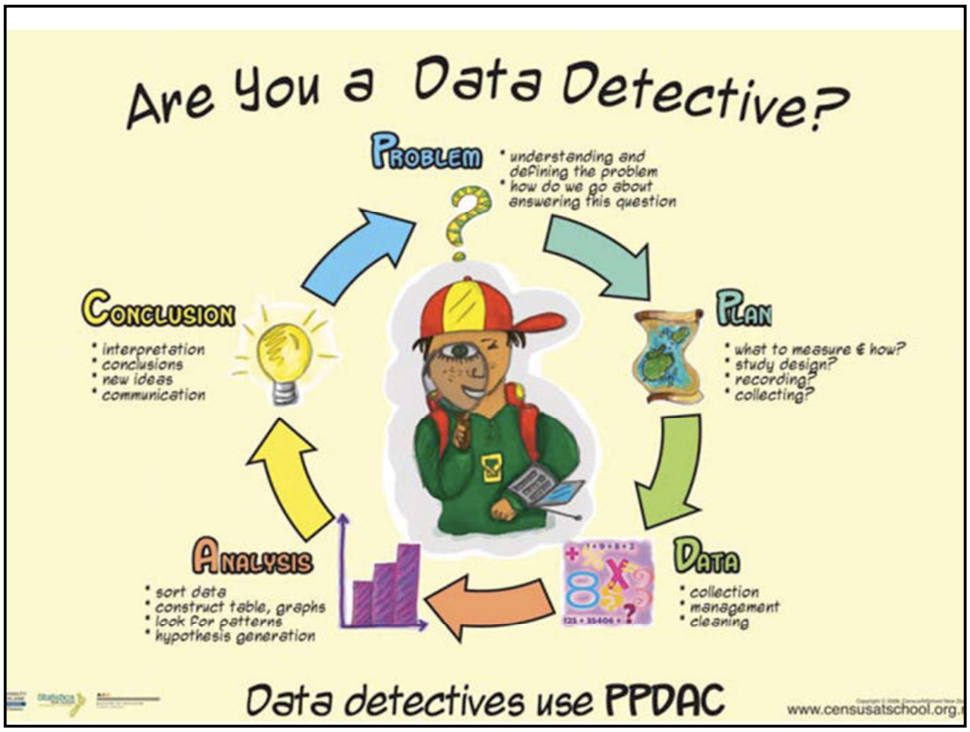


Kits can be developed with the help of students and stored easily.

Many sensors cost $1 or less (bought in bulk), so students could purchase their own multimeter, but the school supply consumables such as the sensors.

Time to go through the BUILD IT and TEST IT phases yourselves!

Handouts are for you to take away.



Mathematics and science, as a process in schools, follow a similar cycle; looks a lot like the traditional “scientific method”

Primary teachers often report they don’t have time for science; why not use science activities to develop authentic numeracy skills?

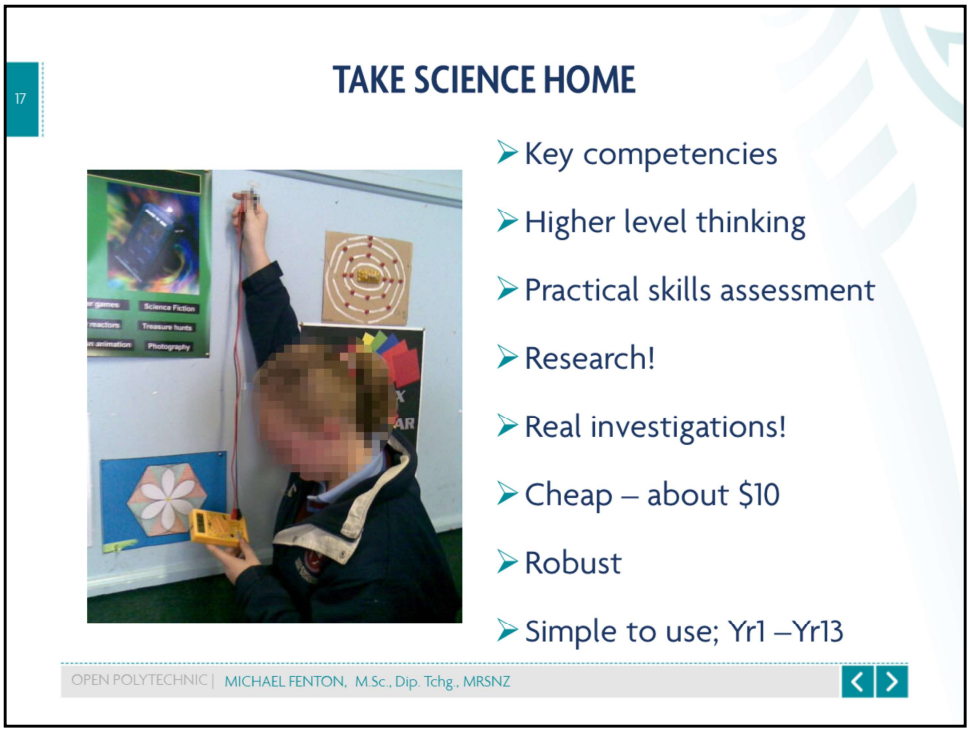
Using the multimeters permits students to pursue their own investigations after they have completed the introductory activities with the teacher.

This is a form of authentic learning that permits students to develop and improve their key competencies, explore concepts in science topics first-hand, and develop their mathematical skills.

Assembling a sensor and using mathematics to describe how it functions.

Here a maths class goes through the BUILD IT, TEST IT phases.

This activity reminds students that mathematics is based in the real world and has real world consequences if calculations are incorrect…



http://nexusresearchgroup.com/technical-data/multimeter-sensors.htm

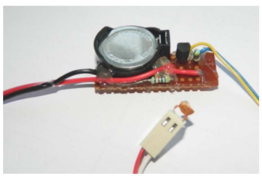
For more about authentic science, using inexpensive equipment students can take home, to embed numeracy skills.

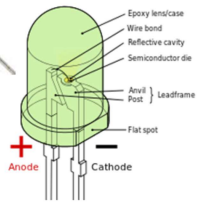
Here a student enters the third phase, USE IT.

She has decided to investigate the air temperature at various locations and distances above the floor.

She could then investigate temperature at home, perhaps exploring convection currents, the effect of curtains on windows, etc.

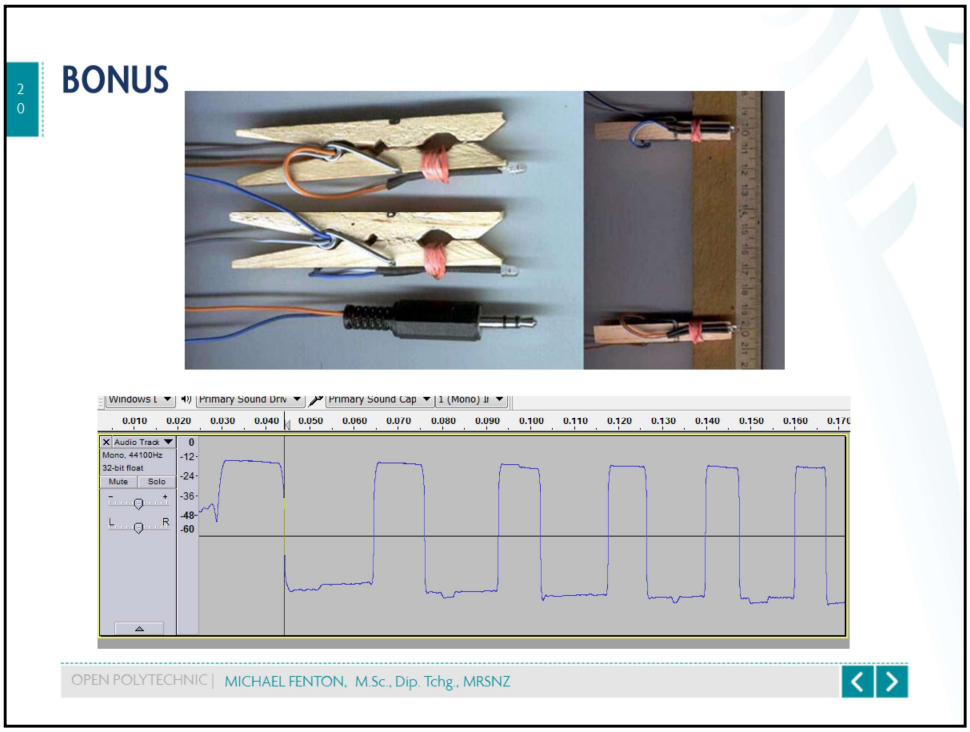
MAKER SCIENCE - TIPS





- Any device, any material
- Responds to environment
- Change in
  - resistance
  - voltage
  - current
- Passive - simplest
- Active - powered

BONUS – MIC INPUT SENSORS



An alternative low cost system to capture data is to cut the plug from an old pair of headphones (or purchase a 3.5mm stereo plug as in the photo) and connect a light dependant resistor or photodiode.

If plugged into the mic socket, changes in light levels can be seen using sound recording software.

This system can be used for time of flight investigations, acceleration due to gravity, motion of a pendulum, and impact sensing.

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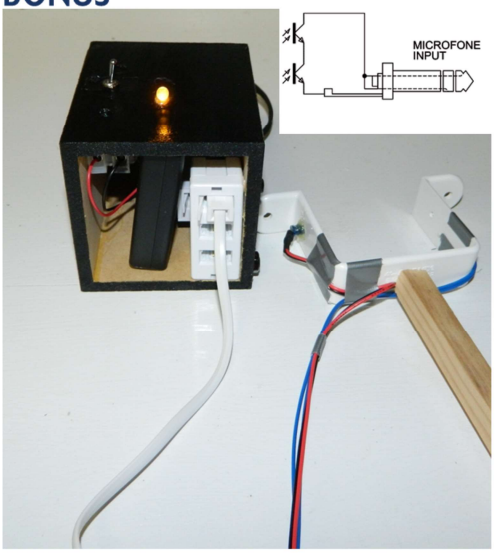
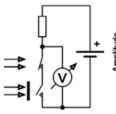
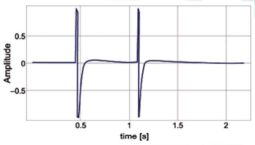
BONUS







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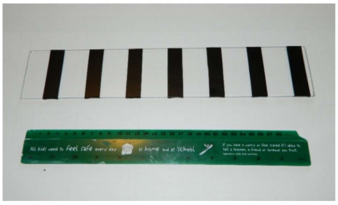
BONUS


0.010 0.020 0.030 0.040 0.050 0.060 0.070 0.080 0.090 0.100 0.110 0.120 0.130 0.140 0.150 0.160
Audio Track
Mono, 44100Hz
32-bit float
Mute
Solo
L
R
0
-12
-24
-36
-48
-60

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MEETING A NATIONAL NEED
SUPPORTING COMMUNITIES OF PRACTICE

Fascinating stuff so far. I really like the way this material is presented ..."

THANK YOU

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Michael Fenton

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Mathematics Teaching

Digital Technology