



Four years of solar energy outreach in Manitoba, Canada: Our take on the SHARK program in an urban secondary school

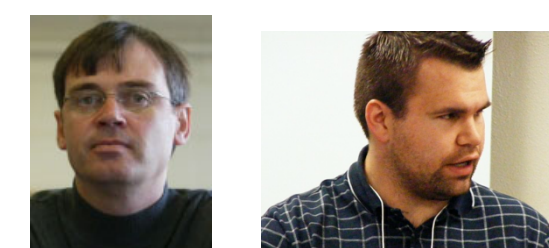
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Hi there! Back in 2010 our chemistry research group at the University of Manitoba in Winnipeg, Canada (point to the middle of North America on a map and you'll find it ;) began to partake in the SHARK/SEAL/SMD outreach program at two secondary schools: Kelvin High School and Daniel McIntyre Collegiate Institute. Last year we had a total of 25 students! We are proud to currently still be running our program at DMCI now in 2014 (with Kelvin hopefully be rejoining us in the near future!)

We have learned that circumstances (demographics, logistics) are unique to each institution involved, and so here we present how our program has evolved to meet our needs, and offer some new ideas for other institutions to strengthen their solar outreach program.

People

Leaders



Prof. Michael Freund
Principle Investigator

Mike McDonald
Program Coordinator

Mentors

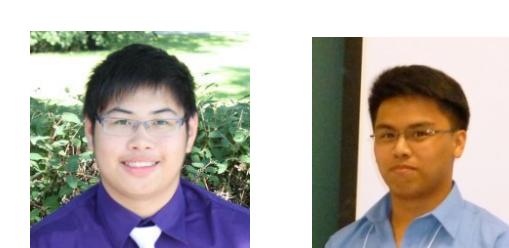


Jared Bruce

Megan McClarty

Shaun Ryman

Alumni mentors



Kevin Leung

Aaron Dela Pena

Academic affiliates



Prof. Derek Oliver
Electrical Engineering

Prof. Mario Bieringer
Chemistry

Dr. Kevin McElenny
Materials Institute

Teachers



(Left to right) Donna Labun, Liz Kozoriz, Bruce Johnson. (Not shown) Victoria Green, Sarah Wowchuk

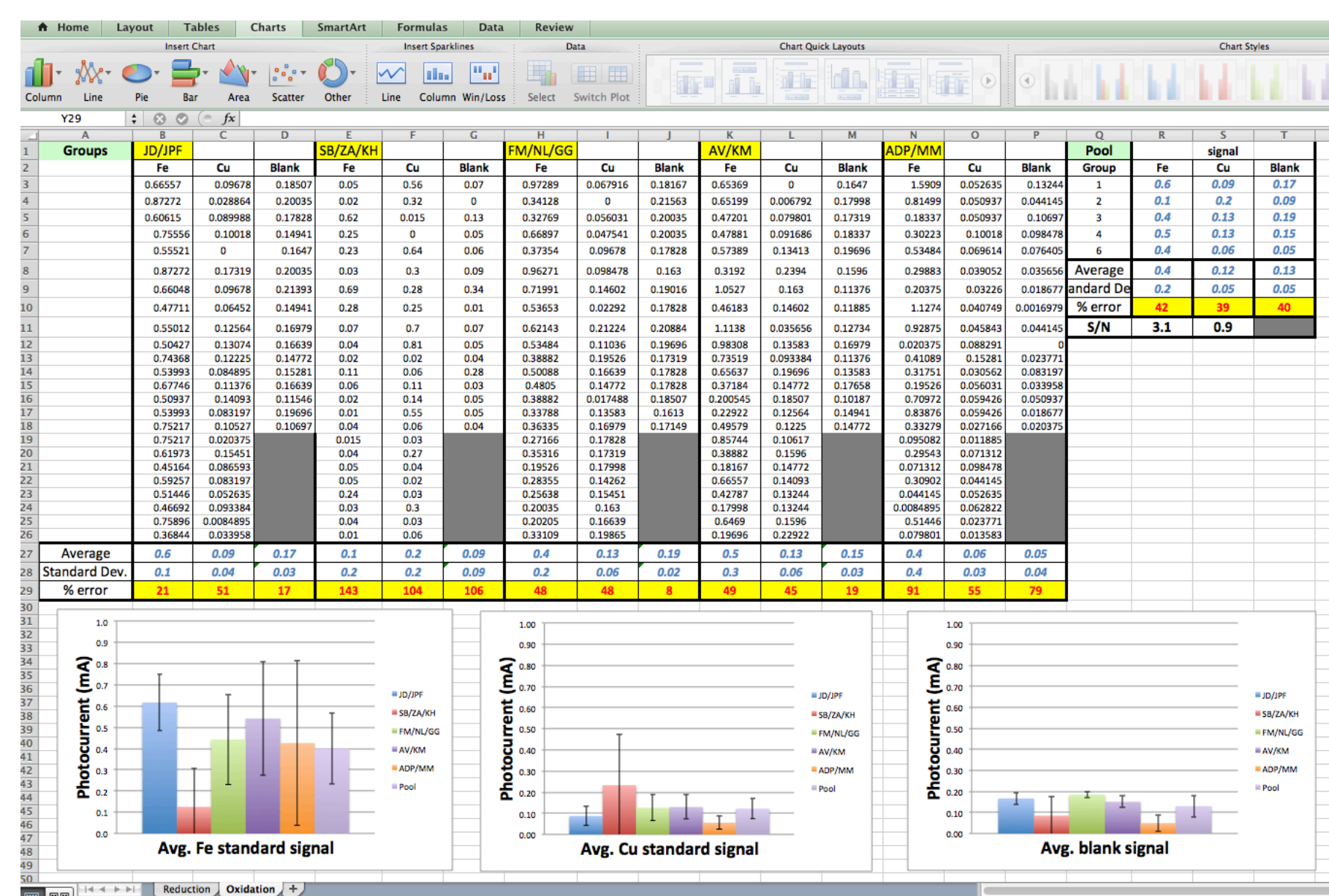
Schedule

Date	People	Objective	Notes
13/09/26	MSF	Recruitment	Admin: bench, office, office, internet, equipment, release
13/10/03	MBM, JB, MMM, SR	Introduction	People project, context, apparatus, release
13/10/10	MBM, JB	Making solutions	Stock solutions for the year. Have to calculate the final weight, dilute, etc.
13/10/17	MBM, JB, MMM, SR	Spotting standards-only	Lecture on importance of error. Investigate the systematic error of the spotting. Practice spotting. Attach lead wire. Fire corrected data.
13/10/24	MBM, JB, MMM, SR	Scan standards plate	Everyone gets a turn to learn the instrument. Others use enter data into spreadsheet with master computer.
13/10/31	MBM, JB/MMM/SR	Analyze data	Finish scanning. Calculate error in instrument of spreadsheet program. Discuss implications.
13/11/07	MSF, JB/MMM/SR	Tutorial 1	Approaches, outlines, materials of laboratory. Discuss error. Review of basic first-year chemistry.
13/11/14	MBM, JB/MMM/SR	Spot plates	First original work.
13/11/21	MBM, JB/MMM/SR	Scan plates	Discuss in detail errors on previous plate. Discuss error. Review of basic first-year chemistry.
13/11/28	MB, JB/MMM/SR	Tutorial 2	Review of basic first-year chemistry.
13/12/05	MBM, MMM	Spot plates	Review of basic first-year chemistry.
13/12/12	JB, SR	Scan plates	Review of basic first-year chemistry.
13/12/19	MSF, MB, DO, KM, DC, all	U of M facilities tour	Visit: XPS, XRD, WAXD, SEM, AFM, XRD, SPIN

Recruitment

"SHARK is a discovery research program. SHARK is an educational program. SHARK is an awareness program. We attract students with the first identity, retain them with the second, and graduate them with the third."

Exercise in Errors



It is important to study the precision of the values collected with the SHARK apparatus (LED array set-up). To practice materials preparation, students randomly spot 24x iron standard, 24x copper standard and 16x blanks. The standards plates are scanned under oxidation and reduction conditions and photocurrent values are collected from the resulting spreadsheet files and entered into the above spreadsheet, which calculates the expected signal magnitudes for a standard and how they vary sample-to-sample, and how they compare to a blank signal. Results can then be reported +/- error.

Materials & methods

- Custom student lab manual (right)
- Group or individual work, casual environment (music and sometimes treats!)
- 0.03 M metal salt stock solutions made in 2 vol% HNO₃
- "Core element" selected by each student/group for year-long investigation
- 90 µL pre-mix of 3 metal solutions in 8x8 well plate
- 8x8 laminated paper spot templates, FTO plate spotted with ~5 µL aliquots
- Dried overnight, fired (500°C, 2 hr) –teacher
- Wired attached with silver epoxy day before meeting -one student per week for entire group
- Scanned in 0.1 M H₂SO₄, +0.5 V, 3 scans per plate as a group, monitor projected for all to see results in real time

Hard at work



Supplementary education

- Four tutorials are given throughout the year to better understand core concepts.
 - Energy & combinatorial chemistry- Freund
 - Solids & characterization by X-ray diffraction- Bieringer
 - Semiconductors & light absorption- Oliver
 - Materials characterization: microscopy vs. spectroscopy- McElenny

Students also attend a tour of the U of M's materials science facilities on the last meeting before Christmas break- followed by pizza!



Dr. Freund explains how our lab's X-ray photoelectron spectrometer (XPS) works



Dr. Bieringer demos his diffractometer for students

Present & celebrate

