10 CORE COMPETENCIES

TRAINED OVER **360** STUDENTS

OpenX Data

DHIS 2
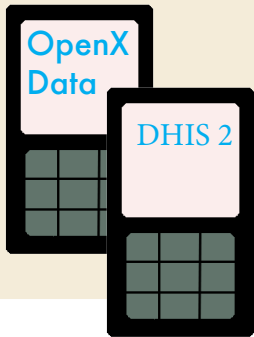
HOSTS MOBILE INTEROPERABILITY PLATFORM

SUPPORTS **10** PROJECTS WITH SOCIAL ENTERPRISES

FROM FRUGAL BEGINNINGS

The Frugal Innovation Lab (FIL) was founded in 2011 to allow SCU engineers to develop an expertise in using technology to benefit society, and to serve the engineering innovation needs of global social entrepreneurs. We started with one course, Engineering for the Developing World (EDW). Since then we've added three additional courses and have trained over 360 students. The FIL students have completed 19 projects using frugal innovation core competencies to address social problems; 10 of those projects were completed in partnership with the Global Social Benefit Incubator (GSBI) social entrepreneurs. FIL opened the Laboratory that currently hosts eight student projects. Frugal Innovation is now one of the 8 modules of Engineering 1, an introductory course taken by all freshman engineers. We've created activities exemplifying socially responsible engineering for numerous courses, such as Technology for Social Justice, as well as hosted a design-thinking workshop with Stanford's d.school.

Instruction

Mobile Appplications for the Developing World goes behind the scenes at Google.

More on Page 2

Innovation

Calling all Innovators! Laboratory open in School of Engineering.

More on Page 3

Immersion

GSBI social entrepreneurs share knowlege at FIL Mobile Workshop.

More on Page 5

Going inside Google

Frugal students get a sneak peak at the work and culture at Google

For the first time, Mobile Applications for the Developing World students stepped out of the classroom for a field trip to see the inner workings of Google. This unique experience provided students with insight into the work of Google engineers from programming to product line development. As students walked through hallways containing the original Google server, they asked questions about trends in mobile technologies, Google's plans for work in developing countries, and how mobile technologies are reshaping the way we do business.

Mobile Applications for the Developing World students at the Google campus in Mountain View. Photo by Katrina Jazayeri

Innovators Gather for Laboratory opening

In April, the Laboratory formally opened in the School of Engineering. During the Engineering Open House event, FIL hosted a panel discussion that explored the practical social justice work being done by SCU faculty and students, and social entrepreneurs from the Center for Science Technology and Society's GSBI. The Laboratory is a space in which student teams work collaboratively to research, design, and proto-type solutions to social justice and global develop-ment challenges. Located at the center of campus, the Laboratory is a working, dynamic showcase of the theories of frugal innovation and their application. In the Lab, visitors and students interact with and learn about senior design projects, GSBI entrepreneurs, and Tech Awards Laureates.

Professors Ashley Kim, Silvia Figueira, and Hohyun Lee share their frugal innovation experiences with guests at the opening of the Laboratory. Photos by Chuck Berry

Faculty Partners

Without the contribution and support from our dedicated faculty members, none of FIL's work would be possible.

Mark Aschheim
Silvia Figueira
Tim Healy
Ashley Kim
Shoba Krishnan
Hohyun Lee
Ed Maurer
Tonya Nilsson
Keith Warner
Sally Wood

Android for Development

Trial run of training program for young developers to use mobile technologies for social development.
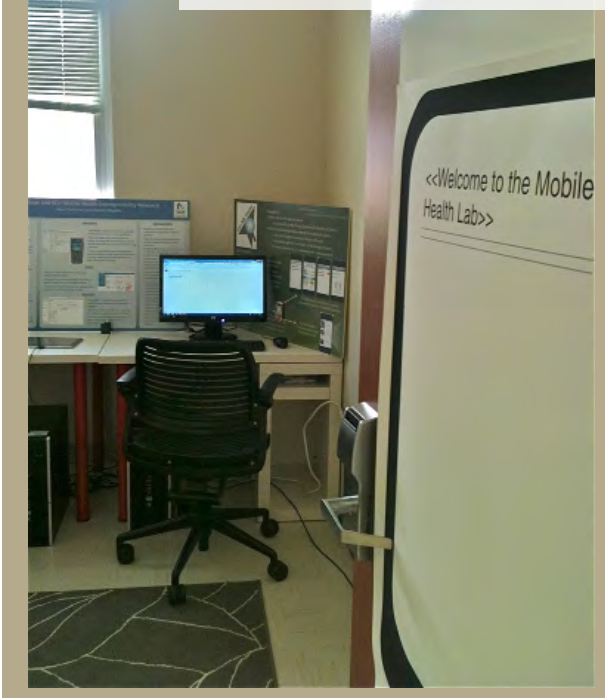
10 Engineers

6 Saturdays

Infinite Possibilities

Android is the preferred platform in many developing regions.

For six weeks, Professor Silvia Figueira spent her Saturdays with sophomores who want to be the next generation of mobile developers. As FIL's course offerings have increased and projects have become more intricate, Prof. Figueira saw the need to train young engineers in Android programming so that when they become juniors and seniors they are equipped with the necessary skills to build the next game-changing application for social change. Projects in the Mobile Lab require specialized technical skills. By introducing freshman and sophomore engineering students to developing technologies, Figueira ensures a pipeline of prepared students to continue the ongoing mobile development work.

Mobile solutions to social problems

<<Welcome to the Mobile Health Lab>>

FIL hosts a Mobile Lab that functions in collaboration with NetHope to test and disseminate mobile solutions that benefit NetHope member organizations and social enterprises. Under the supervision of computer engineering professor Silvia Figueira, students have created a platform where users can test the functions and interoperability of mobile enabled data collection and monitoring software before rolling them out in their organizations. The Frugal Mobile Lab currently hosts OpenXdata, DHIS 2, and Open Data Kit. The TAs who staff the lab not only ensure the functioning of the interoperabil-ity platform, but consult with other students, faculty, and entrepreneurs to determine the best solution for their project parameters, and assist with implementation. Find out more about the kinds of field-based projects the Frugal Mobile Lab supports in the Immersion section of the newsletter.

FRUGAL INNOVATORS WIN HP FUNDING

COEN, ELEN, and BIOE Team Designs
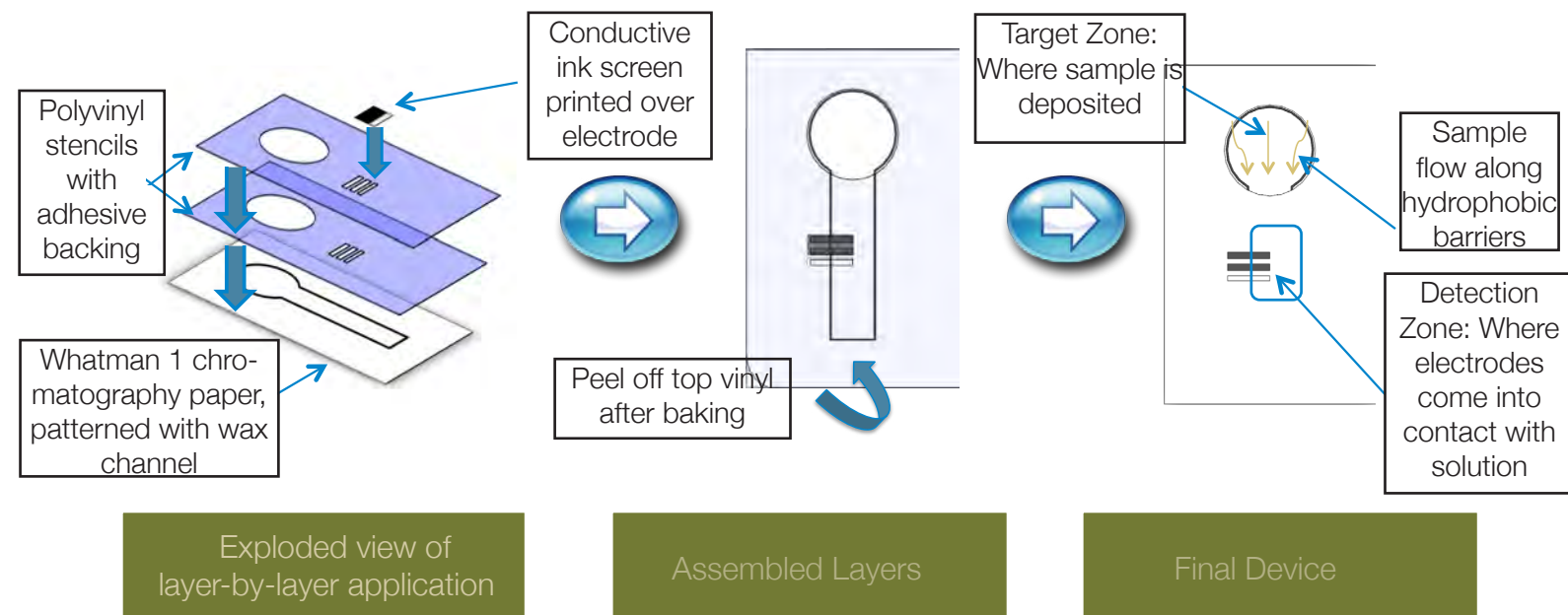## "Lab on a Chip" for Affordable Water Analysis

This is an excerpt from the BIOE portion of this collaborative project.

Title: Electrochemical Detection of Arsenic Using a Paper-Based Microfluidic Device towards Rapid, Sensitive, and Affordable Water Quality Monitoring

Team: Ben Demaree, Jessica VanderGiessen, Unyoung (Ashley) Kim

Abstract:

The determination of trivalent arsenic species in a water sample via electrochemical analysis on a paper-based microfluidic device was investigated. The ability to measure arsenic contamination on a parts per billion scale with a paper device will provide a cheap, disposable, and therefore more distributable method of testing water samples in remote areas. Screen printed electrodes made from conductive ink (carbon for the working/counter electrodes, silver/silver chloride for the reference electrode) were printed onto paper substrate and used for fabrication. To detect the arsenic species, the application of two chemical modifiers, cobalt oxide powder and gold nanoparticles, to the working electrode was explored.

Polyvinyl stencils with adhesive backing

Conductive ink screen printed over electrode

Target Zone: Where sample is deposited

Sample flow along hydrophobic barriers

Whatman 1 chromatography paper, patterned with wax channel

Peel off top vinyl after baking

Detection Zone: Where electrodes come into contact with solution

Exploded view of layer-by-layer application

Assembled Layers

Final Device

Dangers of Arsenic Exposure:

Elevated risk of heart disease, stroke, and diabetes.

Cancer of bladder, lungs, skin, and kidneys.

Stomach pain, nausea, vomitting, diarrhea, and liver disease.

Next Steps:

1) Develop an electrochemical detection device for arsenic using a recyclable plastic surface in place of paper with a LOD not exceeding 10 ppb.

2) Test device for competing metals to ensure selectivity.

GSBI MOBILE COHORT GATHERS FOR SECTOR WORKSHOP

In August, FIL hosted a Mobile Workshop for GSBI's first Mobile Cohort. The workshop featured guest speakers from Vodaphone, NetHope, Oxford, and Medic Mobile. The objectives of the workshop were to 1). Provide opportunities to share and collaborate with social enterprises in the mobile cluster, 2). Conduct deeper analysis of barriers to scaling and practical solutions, 3). Explore avenues for collaboration and replication of proven models, and 4). Develop a repository of sector specific knowledge.

In advance of the workshop, the entrepreneurs filled out FIL needs assessment surveys that were used to solicit students from the Mobile Applications for the Developing World course interested in working on the entrepreneurs' projects. At the workshop, the entrepreneurs were presented with the students' work, and also learned about the tools available to them through the Laboratory. The Lab TA, Ryan Davidson, walked attendees through demos of several data collection and analysis platforms hosted by SCU and discussed how best to tailor the tools to specific enterprise needs.

GSB Fellows in the Frugal Innovation Lab

Santa Clara's best and brightest join GSBI social entrepreneurs for a summer of field work, but not before a practice run in the Frugal Lab.
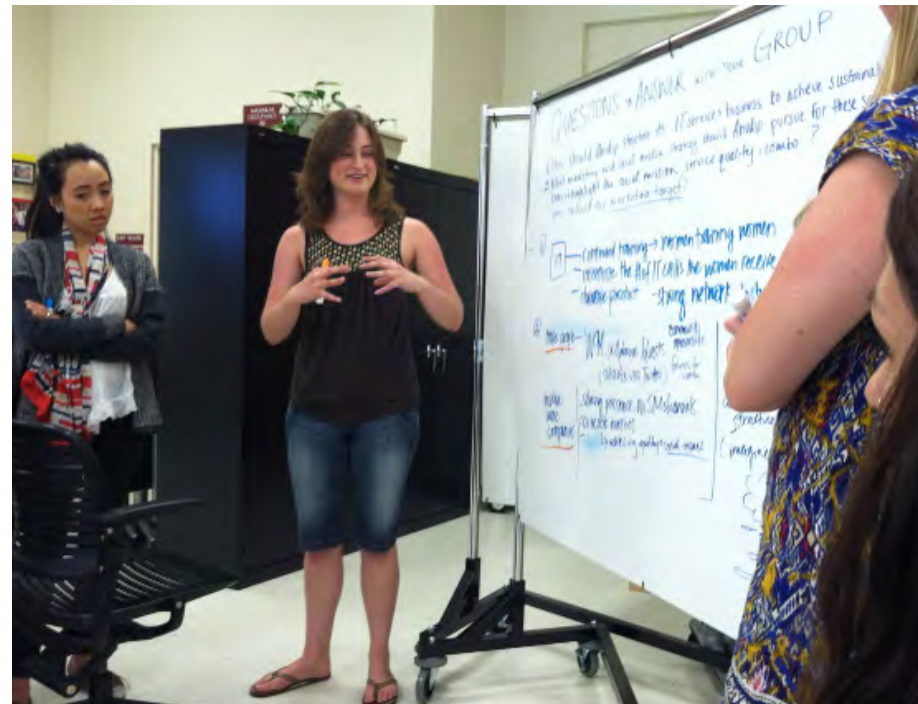
Before the Global Social Benefit Fellows departed to their field posts with social enterprises, they spent an afternoon in the Laboratory learning some trade secret from FIL's resident entrepreneur—Radha Basu, Director of the Frugal Innovation Lab. The fellows were presented with challenges faced by all growing enterprises such as marketing strategies, partnership building, and deciding on a funding model. Each team prepared a pitch to explain how they would proceed in each area, and received feedback about their plan from Radha, who shared her experiences making these decisions for her social enterprise, Anudip.

Cast Study:
Seed Bank Tracking to Prevent Seasonal Hunger

FIL Mobile Lab helped Assistant Professor Chris Bacon and his student Ian Dougherty from the Department of Environmental Studies to test a mobile tracking solution for seed banks in Nicaragua. The project aims to help seed banks collect, store, and analyze data from seed deposits and withdrawals to help combat seasonal hunger. Mobile Lab TA Ryan Davidson worked with Ian to install an OpenXData server in Nicaragua and create the electronic data collection forms to be completed and transmitted in via mobile phone. This initial implementation increased the efficiency of seed banks in the area by sharing pricing and quantities. Eventually the data collected at each seed bank will

be analyzed for trends, which can then be used to prevent seasonal hunger due to shortages of seed.

Acknowledgements
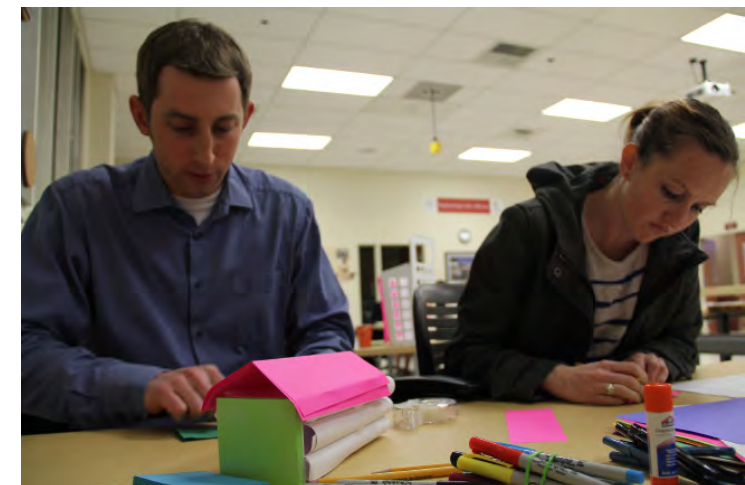
The Frugal Innovation Lab at Santa Clara University was featured in the Association for the Advancement of Sustainability in Higher Education's 2011 Higher Education Sustainability Review in the report's "Innovative campus-community sustainability partnerships" section.

Engagements

FIL Director Radha Basu was elected to the board of NetHope, a technology consortium of 37 world's largest NGOs, sponsored by tech companies including: Cisco, Intel, Accenture, Microsoft, Adobe and HP.

Radha was the keynote at the launch of Women's TechConnect, a joint initiative by Microsoft and NetHope to accelerate the advancement of women in technology.

FIL hosted guests from USAID, Vodafone, and HP.

Mobile Lab TA John Seubert presented at Microsoft to 300 global participants of the NetHope annual summit.

Radha assisted with the Tech Museum's identification and hosting of the Global Humanitarian Awardee, Narayana Murthy.

Radha taught a seminar on Frugal Innovation at Oxford's Said Business School, and is working with a DPhil Candidate from Oxford working on a dissertation on Frugal Innovation.

FIL is working with a Brandeis Professor on a book on frugal innovation.

Partners

A special thank you to all of our partners whose contributions helped create and support the Frugal Innovation Lab.

Jeff and Karen Miller: FIL Incubation Center for Science, Technology and Society
Hewlett Packard: Project Funding
Regis and Diane McKenna Endowment
School of Engineering

Please visit *www.scu.edu/engineering/frugal* for more information.