RICE INSTITUTE FOR GLOBAL HEALTH TECHNOLOGIES NOW

Newsletter for the Rice 360°: Institute for Global Health Technologies

Volume 1, Issue 1—Fall 2009

Inside this Issue...

The Way I See It

Beyond Traditional Borders opened my eyes to the world

BY SOPHIE KIM, *adapted from* Rice News

As I write this, I am sitting on the plane on my way to Lesotho, Africa. It is my third trip to the small mountain kingdom, which I had never heard of until I took a global health course at Rice two years ago and traveled there as a student intern with Rice's Beyond Traditional Borders (BTB). Now, as I sit listening to the familiar accents of the South African Airways crew, I'm filled with anticipation because Lesotho opened my eyes to world, and I have come to love the place and its people.

I was a member of the first class of seven BTB interns that traveled to sub-Saharan Africa. On my way to Lesotho the first time, I had no idea what lay ahead. For years, I had dreamed romantic visions of helping to rescue the world from illness and poverty. But with Africa looming, I was anxious about coming face to face with extreme poverty. I was afraid I would not be able to handle the harsh realities in a country that had experienced so much death and suffering. I hoped and prayed this would not be the case, and that my passion for this line of work would grow stronger from the experience.

During a previous trip with Beyond Traditional Borders, Sophie Kim, center, worked with students at the SOS Children's Village, an orphanage in Maseru, Lesotho. Kim used an after-school activities club to promote interest in science and health with a focus on HIV/AIDS.

Thankfully, it did. And as I look back at the past two years, I can see that BTB trip to Lesotho has changed the course of my life. I am grateful to Rice for all of the opportunities it offers to educate its students about the wider world. Through programs like BTB and the global health initiative Rice 360°, Rice allowed me to explore and expand interests I have fostered since childhood.

Growing up, I loved reading Eyewitness Books -- educational books for children covering topics ranging from airplanes to the planets. As I journeyed from page to page, it was the beautiful drawings of physiological systems that captivated me and made me consider medicine as a possible career. That decision was cemented when I watched a documentary on the global HIV crisis in high school. Absorbing the images, I felt frustrated that treatment was not being delivered and that millions were dying without it.

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Letter from the Institute

Since 2007, Rice 360°, Rice University's Institute for Global Health Technologies, has developed technologies and educational programs to address global disease and poverty. Rice 360° focuses its activities in three areas: appropriate technology design, sustainable technology dissemination, and global health education. The work I have done as part of this program has been some of the most challenging and rewarding of my career. It has been an honor to collaborate with my colleagues at Rice, the Texas Medical Center and across the developing world to design and deploy solutions to global health inequities. As educators, we have been inspired by our students, who are committed to improving lives half a world away. This year, Rice 360° is sharpening its focus on how to maximize the impact of our innovative technologies and programs through sustainable, widespread dissemination.

In July, John McDevitt joined the Rice faculty as Brown-Weiss Professor of Chemistry. Professor McDevitt is a leader in point-of-care diagnostic technology. He has developed a diagnostic "lab-on-a-chip", which has been commercialized by the Texas-based company, LabNow. The technology was originally developed to measure CD4 counts in HIV/AIDS patients in rural Africa. It provides results at the point of care, so HIV/AIDS patients can initiate or adjust anti-retroviral therapy immediately. This work holds great potential to improve diagnosis and care for the 22 million people in Africa infected with HIV.

Vicki Colvin, Kenneth S. Pitzer-Schlumberger Professor of Chemistry and Professor of Chemical and Biomolecular Engineering, working with Professor Mason Thomson of Civil and Environmental Engineering and Rice's Center for Biological and Environmental Nanotechnology, has developed "nanorust", small magnetite particles, to remove arsenic from drinking water. Unlike traditional water purification systems, the technology does not require electricity or infrastructure, so it can be used in homes in the most remote areas of the world. Her technology has the potential to help the estimated 130 million people worldwide whose water is contaminated by elevated levels of arsenic.

Through Rice 360°'s undergraduate education initiative, Beyond Traditional Borders, gives Rice students are engaging in solving some of the world's most challenging issues of health and poverty. Working with faculty, clinicians, and mentors in the developing world, students have designed technologies and educational programs that have reached more than 11,000 people. Through internships with our international network of partners, BTB undergraduates test and implement of their projects under the guidance of healthcare providers, gathering feedback to improve future designs. Last summer, we sent 21 interns to Haiti, Guatemala, Ecuador, Nicaragua, Swaziland, Lesotho, and Malawi. Interns offered courses of their own design in career guidance, microenterprise, and math and science, and field-tested backpacks designed to help provide dental, ophthalmologic, diagnostic, and gynecological care. Interns also built, tested, and delivered low-cost warming cribs and UV phototherapy lights to treat neonatal jaundice.

To ensure that more people benefit from the extraordinary work of our faculty and students, Rice 360° is strengthening its technology dissemination efforts. Last spring, in partnership with Professor Marc Epstein of the Jesse H. Jones Graduate School of Business, we offered our first graduate level course, called "Commercializing Technology in the Developing World." MBA students traveled to Rwanda and developed plans to commercialize student-designed technologies in the region. In the spring, we produced 24 diagnostic lab-in-a-backpacks for the government of Ecuador to use in mobile clinics throughout the country, representing the first country-wide scale up of a student-led intervention.

Through the hard work of our faculty, students, and international partners, Rice 360° is continuing to grow, bringing the strengths of Rice University to bear on the world's most difficult challenges of disease and poverty. We look forward to where our work will lead.

Rebecca Richards-Kortum, PhD
Founder, Rice 360° & Beyond Traditional Borders
Stanley C. Moore Professor, Bioengineering

How to Give

Rice 360° is a signature initiative of Rice's Centennial Campaign. For more information on how you can participate in Rice 360° in ways that are meaningful to you, please call Resource Development at 713-348-4600.

Contact Info

Rice 360°: Institute for Global Health Technologies
Rice University
6100 S. Main St.—MS636
Houston, TX 77005

Phone: 713-348-5840
Fax: 713-348-3160

Email:
Rice360@rice.edu
beyondtraditionalborders@rice.edu

Website:
www.rice360.rice.edu
www.btb.rice.edu

Rice 360° & Beyond Traditional Borders Collaboration Sites

Rice 360° works with communities to design and implement low-cost, high-performance technologies that prevent disease, improve health, and reduce poverty. These successful partnerships provide a model for larger and enduring efforts throughout the world.

Beyond Traditional Borders — the undergraduate initiative of Rice 360° — challenges students through multidisciplinary education programs to develop sustainable innovations in technology & education that address pressing global health challenges.

"BTB has provided me with an experience that I could have hardly ever dreamed of! … I've been able to experience first-hand how to efficiently run mobile medical clinics and to see my own project being used by medical professionals in remote regions." - intern Andrea Ulrich, Ecuador 2009

The Way I See It , Continued from page 1

This clear disconnect convinced me that I could help alleviate people's suffering if I became a doctor. But my idea of how to accomplish that was vague at best. It was my experience through BTB, during that first trip to Lesotho, that gave shape to my dream.

When I first arrived in the unfamiliar mountainous land, the culture shock was overwhelming. No matter how much I prepared beforehand, I did not know the people, their culture or their language. It was also unexpectedly frigid, with winter's bitterness impossible to escape from.

It was only after building relationships with my Basotho students from the SOS Children's Orphanage that I felt myself becoming alive in my work. I loved teaching and interacting with the youth. But as I grew closer to my students, I began to worry about their future. I dreaded the thought of what would await them in a country overwhelmed by HIV and poverty.

Every day I saw children afflicted by AIDS in the Baylor Pediatric HIV clinic where I worked. And all of my students had already been orphaned. The circumstances in the country were devastating. Yet the children's vibrancy, hope and compassion made me believe they could beat the odds — if only they were given the chance .

I wasn't just saddened and concerned by what I saw; I was also deeply angry at times. There seemed many cases of tragic misuse of funds, even in this country that has relatively little corruption compared with others in the region. For example, the government hospital in the capital city Maseru was in shambles, while the Ministry of Health building across the street was new and beautiful with nice furniture and central heat, a rare luxury in Lesotho.

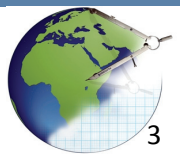
I discovered the lack of resources was only partly to blame. There was an equally devastating lack of good management and leadership. While leaders sometimes make poor choices in every country, the stakes seemed far too high here. I saw a child nearly die because the entire country had run out of oxygen tanks, and I constantly met children who did not attend school because they could not afford the fees. Meanwhile, government officials traveled in fleets of fancy luxury cars.

My BTB internship inspired me to gain a deeper understanding of the circumstances surrounding poverty and ill health – two issues that are inextricably connected. Since graduating from Rice, I've tried to keep learning about these problems and to find appropriate solutions for them, first as a Fulbright Fellow in Toronto and now as a Weidenfeld Scholar at Oxford.

I'm going back to Lesotho a third time, thanks to the Wagoner Fellowship, to develop a scholarship and social support program for orphaned students who do not have enough money to attend school (only primary education is compulsory in Lesotho). I largely credit my experience with the BTB program and Rice 360° for my desire to meet the world's problems head on and make a difference. These programs and Rebecca Richards-Kortum—the professor who founded them and who taught that first global health class I enrolled in two years ago—have helped bring me closer to fulfilling my childhood dream.

I hope I am fulfilling part of it now–and giving something back. I know that having the opportunity to return feels like a gift beyond price.

Sophie Kim '08 is one of five U.S. scholars chosen by the Weidenfeld Scholarship and Leadership Program this fall for a master's in global health at Oxford University. In 2009 she completed a Fulbright Fellowship, working at Toronto's Centre for Research on Inner City Health with HIV patients. She plans to enter medical school in 2011.



Seeing is believing

Tiny Global Focus Microscope to improve on Lab-in-a-Backpack

BY MIKE WILLIAMS, *adapted from* Rice News

BTB graduate ***Andy Miller*** is working with the NGO PATH to assess a low-cost, battery-powered microscope he designed at Rice to improve detection of malaria and TB. He plans an industrial career in medical device design.

The backbreaking work of delivering medical care to those in need will get a little less so as the next version of Rice's innovative Lab-in-a-Backpack incorporates Andy Miller's invention. The 2009 bioengineering graduate has designed a compact but powerful microscope that will nestle among the other supplies in the pack, a product of the Rice 360° and Beyond Traditional Borders initiatives that can be carried to otherwise inaccessible locations, like to the residents of remote villages who rarely see a doctor.

Packed up, the microscope is a white plastic obelisk a little larger than a brick, but weighing in at about a pound. The microscope Miller manufactured at the Oshman Engineering Design Kitchen this year would replace a standard instrument at least four times as heavy and much more fragile. The new scope is built into its protective case, eliminating the bulky and expensive packing material the current microscope requires to keep from breaking in the field.

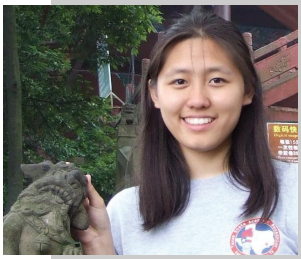
With the case becoming the base, the microscope is an elegant device that magnifies objects up to 1,000 times through the use of lenses and mirrors and matches the performance of stock instruments. Even better, it doesn't need to be plugged in. Light to power the system comes from any standard flashlight. "And it's multifunctional. You can take out the flashlight and do an eye exam, do an ear exam, whatever else you need," said Miller.

The microscope could have been half its size, but that would have meant using custom lenses. Using instead standard items that can be easily replaced if broken, the lenses and mirrors cost about $150. Miller hopes the final version will be less than $180 per microscope — the price of the instrument currently used in the backpack.

The plastic casing should also make for easier field repairs, he said, as a bit of solvent should be able to weld broken bits back together. He expects the cases — the only custom part in the device — will be manufactured in batches by injection molding.

Though still tweaking the focusing mechanism and working on ways to incorporate fluorescence microscopy, which would greatly increase its value as a field microscope, Miller expects the Global Focus Microscope will be part of the Lab-in-a-Backpacks sent out into the world this year. "I've probably got one or two minor changes before it's finalized, but an important part of designing something is getting feedback," he said. "I'm not looking for perfection -- I'm looking to get it out and get it used as soon as possible."

Malawi BTB Intern 2009 - ***Yiwen Cui*** -



"There were the bili-lights, propped on top of the wooden incubators. I felt honored that the lights I helped make were being used. It was surreal to actually see babies under the bili-lights I made last summer. I thought about it, dreamed about it, but I couldn't believe I was actually seeing it in a hospital setting rather than in a research lab."

www.owlsbeyondborders.rice.edu

Malawi BTB Intern 2009 - ***Elizabeth Nesbit*** -

Sophomore BTB student Elizabeth Nesbit and her team designed a backpack for community health nurses. The pack helps nurses care for and determine which patients to refer for advanced care. Elizabeth tested the pack with nurses from St. Gabriel's Hospital in Malawi; she is redesigning it to incorporate feedback and will produce 14 improved packs for the hospital this year.

Low-cost warming crib & UV phototherapy lights

BTB undergraduates designed a neonatal warming crib which can be built for less than $50 from materials available in most developing countries, e.g. wood, light bulbs, and Plexiglas. When coupled with BTB student designed bilirubin phototherapy lights — an innovative, yet simple, design using low-cost LEDs to deliver the appropriate light (30 uW/cm2/nm and a wavelength of 470 nm) for less than $30 — these devices can effectively and affordably treat babies with neonatal jaundice.

Implemented in: Swaziland, Malawi, Lesotho, Nicaragua

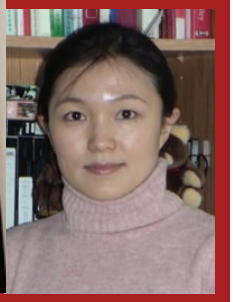
Nanotechnology Fuels Advances in Water Treatment

Technology for arsenic removal to be tested in Mexico

Image of Nanorust
used with permission from CBEN/Rice

Rice researchers in the Schools of Natural Sciences and Engineering are using nanotechnology to develop cutting-edge water treatment systems for communities and households in the developing world. According to United Nations Development Programme estimates, if waterborne diseases could be prevented, half of the world's hospital beds would be empty.

Vicki Colvin, Kenneth S. Pitzer-Schlumberger Professor of Chemistry, together with Professor Mason Thomson of Civil and Environmental Engineering and her colleagues at Rice's Center for Biological and Environmental Nanotechnology, has developed a low-cost technology called "nanorust" – small magnetite particles -- to remove arsenic from drinking water. The process, which uses a combination of olive oil, rust, and magnets , is efficient, inexpensive, and simple enough to be used in water-treatment plants, communities and homes in the developing world.



Dr. Vicki Colvin (left) and Dr. Qilin Li (below)

Building on this technology, Professor Tomson and ***Qilin Li***, Assistant Professor of Civil and Environmental Engineering, are exploring ways to coat sand, often used in water filtration, with magnetite to remove arsenic and viruses from water. Tomson and Li are preparing to test the technology in Guanajuato, Mexico, where it is estimated that 60% of the population is supplied by groundwater with a high arsenic concentration.

Together with Colvin, Li is also working on modified traditional titanium dioxide photocatalysts coated with silver nanoparticles, to inactivate viruses in water. When tested in suspension with UVA and visible light, the technology inactivates 99.9999% of viruses from water in 90 seconds. Traditional solar disinfection methods can take four to six hours.

Rice 360° Awards Global Health Research Grants

Grants funded new collaborations in cost-effective global health technologies

Rice Chemical and Biomolecular Engineering Assistant Professor ***Lisa Biswal*** and MD Anderson Cancer Center Molecular Pathology Professor Peter Gascoyne developed an acoustic nanoliter dispensing technique, which can eject a controlled droplet as small as one picoliter, from a pool of liquid. Acoustic dispensing ejects droplets without a nozzle, preventing clogging and allowing it to be used with many different kinds of fluids. Because acoustic dispensing can fire drops quickly, it creates opportunities for low-cost high throughput sample preparation.

The dispenser uses an interdigitated ring transducer to launch surface acoustic waves into the fluid, ejecting the droplet. A microfluidic channel sits on the tranducer to stabilize the height of the fluid. A wide opening at the top controls the directionality and size of the droplets.

One potential application of this technology is in determining the precise patterning of biomolecules on substrates. Biswal and Gascoyne have included this work as part of an NIH Challenge Grant and plan to use the results to apply for an NSF Emerging Frontiers Grant.

These grants were made possible by Molly and Jim Crownover.

Rice Bioengineering Assistant Professor ***Tomasz Tkaczyk*** and Dr. Clinton White of the University of Texas Medical Branch at Galveston worked on developing an array of fluorescent infinity-corrected microscopes for TB detection. This approach provides a larger screening area for more efficient detection and quantification of Mycobacterium tuberculosis organisms.

Their research focused on fabricating lenses with diamond micro-milling, a very fast and efficient technique which can provide a larger range of sag values than the slow slide servo process.

Lenses were made in PMMA (Acrylic) and Polystyrene materials, two different material types, enabling color correction of microscope arrays. The quality of fabricated lenses suggests that it will be possible to build high performance arrays of miniature microscope systems.

Commercializing Health Technologies in Rwanda

With a generous gift from Molly and Jim Crownover, Rice 360° offered its first graduate level class last spring in partnership with the Jesse H. Jones Graduate School of Business. The class furthers Rice 360°'s commitment to wide-scale dissemination of technologies developed by Rice students and faculty, and explores effective distribution systems for health technologies in the developing world.

Taught by Distinguished Research Professor Marc Epstein, a world-renowned expert in the use of microenterprise and other commerce models to promote economic development, "Commercializing Technologies in Developing Countries" gave students an understanding of successful models for distributing goods and services in the developing world. Students worked in teams to develop viable business plans for four global health technologies in the developing world, with the goal of promoting health and working with local entrepreneurs to generate economic growth. Three of the technologies on which the students focused were developed by Rice undergraduates in Beyond Traditional Borders, including a diagnostic-lab-in-a-backpack, a dosing syringe to accurately administer liquid medication, and a low-cost warming crib and UV phototherapy light to treat neonatal jaundice. In addition, one student team worked on a plan to distribute commercially available micronutrient supplements.

"All of these products are terrific designs, but you cannot solve pervasive health problems with one or two of each of these. You need them by the hundreds and thousands. Neither governments nor aid organizations have been effective at getting products to the people who really need them. But that's what business does best. Products get delivered and customers get served when there is a profit motive."

- Distinguished Research Professor Marc Epstein

Students in the course spent Spring Break in Rwanda, where they met with local entrepreneurs, leaders from non-governmental organizations, representatives from government and regulatory agencies, and potential consumers. The students made tremendous progress in identifying the challenges associated with producing and distributing health technologies in a developing country.

"In this class, we applied the skills we gained over the past two years in business school to devise a plan to disseminate a product in a challenging market," said student Dipesh Shroff, who graduated in May 2009. "We graduated already having put our knowledge to work to produce real results, and it was very rewarding to use our skills to improve lives."

The team charged with developing a plan for the low-cost warming crib worked with a local furniture cooperative to build a working prototype and demonstrated it to area hospitals. Together with the Ministry of Health, the team identified a potential market of 900 incubators in Rwanda and the region. The warming crib remains in the central testing laboratory, where it is being evaluated for local use .

Exploring the Benefits of Sustainable Energy Technology

For the second year, the Energy Forum of the James A. Baker III Institute for Public Policy and Rice 360° partnered to offered a class focused on promoting sustainable practices in the developing world. In "Integrated Approaches to Sustainable Development", taught by Amy Myers Jaffe, the Wallace S. Wilson Fellow in Energy Studies at the Baker Institute, students learned about the connection between energy, poverty, and health, and how sustainable energy technology can improve health and increase economic independence for families in the developing world. Students worked in teams to design fuel-efficient stoves that emit less smoke to prevent indoor air pollution—responsible for 2.5 million deaths annually, mostly of women and children.

"Access to energy and quality of health are intricately related. If you only have access to biomass for heating and cooking, it is likely you will spend time breathing in harmful smoke," said Jaffe. "Students in this program are uncovering the nature of this connection in communities in Lesotho, with the goal of returning to Rice to work on designing solutions. These solutions must incorporate both technology and policy to be successful, which is why this partnership between the Baker Institute Energy Forum and Rice 360° is so important."

Student interns spent six weeks in Lesotho, where they performed survey research with University of California-Davis researcher Kristen Matsumura on the connection between energy, income level, and health in three periurban villages around the capital city of Maseru. Students also led community projects focused on promoting environmental sustainability. Students built rainwater catchment systems in Ha Motloheloa and Masianokeng to help the communities address water shortages. In addition, students weatherized and refurbished an abandoned school building at Koalabata Primary School, and planted nutrient-rich gardens at needy households identified by the communities.

"It was great to return to Lesotho to build on our work from last year," said junior Mark Hoffman, who has been part of the program for two years. "We are building long-term relationships in communities and learning from people where the needs are and how we can contribute to sustainable practices in communities in Lesotho. This program has given me new perspective on how I am able to use what I am learning at Rice to make the world better."

Read more about the students' experiences in Lesotho at www.owlsbeyondborders.rice.edu.

BTB expands reach and impact of *Bioengineering & World Health* curriculum for HS teachers & students in the U.S. and abroad

BY SHAWN HUTCHINS

In 2006, HHMI provided generous funding to launch Beyond Traditional Borders (BTB) at Rice with an outreach program designed to prepare middle and high school teachers as well as university educators to teach *Bioengineering & World Health* at their respective institutions.

Students at the conclusion of the Rice-Monterrey Tec collaborative offering of *Bioengineering & World Health*, shown with course faculty, Yvette Mirabal and Jesus Ibarra (first and third on left back row), and BTB PI, Dr. Richards-Kortum (fourth on left back row).

The BTB outreach program promotes global health by giving educators innovative curriculum based on real issues involving perspectives from psychology, sociology, philosophy, public policy, religious studies, as well as science and engineering.

The course received approval from the Texas State Board of Education as a new course for state elective credit; and for the past four summers BTB has been working to expand the number of educators teaching *Bioengineering & World Health.* Since its inception, BTB has disseminated appropriately tailored teaching curriculum to 36 teachers from 24 schools and universities in the Houston-area and abroad—including Mexico, Lesotho, and Malawi—through an annual four-week Professional Development Workshop, impacting more than 1860 middle and secondary school students to date.

Malawi high school teacher participants of the Science, Math, and Technology Camp with their trainers—2009 PDW participant and KIPP teacher, Jada Hallengren (next to last on right), and BTB Director, Yvette Mirabal (far right).

In 2008, BTB and the School of Biotechnology and Health at Tecnológico de Monterrey offered the course to 20 Houston and Monterrey high school and university students. The students began the course in Mexico with two weeks of study at the Tecnológico de Monterrey and two weeks of study at Rice followed.

In 2009, BTB and the University of Malawi hosted a two-week Science, Math, and Technology Camp for 36 underprivileged, deserving female high school students in Malawi to promote enrollment in the sciences and engineering at the university level. The two-week program concurrently trained 18 teachers in the *Bioengineering & World Health* curriculum.

Also in 2009 BTB established a global health technologies design competition for high school students, working with instructors who participated in the *Bioengineering and World Health* Professional Development Workshop. Student teams were given a year-long design challenge of global health importance and were assessed on how well their prototype adhered to metrics that weighed suitability for intended use, as well as on the use of the engineering design process in the development of their prototype.

Winning HS design team in front of the incubator they designed. Shown also are their teacher, PDW participant Tim Johnson (far right) and BTB PI, Dr. Richards-Kortum (far left).

Rice 360°: Institute for Global Health Technologies NOW shares information about Rice 360° and Beyond Traditional Borders' programmatic work with global health colleagues around the world.

To subscribe, please send your contact information to Rice360@rice.edu. To learn more about Rice 360° & Beyond Traditional Borders, please visit www.rice360.rice.edu & www.btb.rice.edu. We invite students, academics, researchers, medical professionals and other persons with an interest in the intersection of global health and technology to subscribe to the BTB listserv, through the BTB website. BTB is made possible by a grant to Rice University from the Howard Hughes Medical Institute through the Undergraduate Science Education Program.

Editorial Team: Rebecca Richards-Kortum, PhD, Maria Oden, PhD, Lauren Vestewig, Yvette Mirabal

Contributing Writers: Sophie Kim, Lauren Vestewig, Mike Williams, Shawn Hutchins

Designer: Yvette Mirabal

RICE 360°

Rice 360°: Institute for Global Health Technologies
Rice University
6100 S. Main St.—MS636
Houston, TX 77005

UPCOMING EVENTS

November 6,2009

TRANSITIONING TECHNOLOGIES FROM LABS TO LEAST DEVELOPED COUNTRIES WORKSHOP

Rice University
Houston, TX

Join **RICE 360°: INSTITUTE FOR GLOBAL HEALTH TECHNOLOGIES** and leading experts in the field of appropriate, sustainable ***health technologies for use in least developed countries*** as they advance the discussion of how health technologies go ***from prototype to wide-scale dissemination in the developing world.***

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- *Student Poster Session* on global health technology research & design for undergraduate & graduate students

For free registration & information on abstract submission

VISIT WWW.RICE360.RICE.EDU

or contact Janet Wheeler 713-348-3071/jmw@rice.edu

The Beyond Traditional Borders Labs to LDCs Workshop is made possible by a generous grant to Rice University from the Howard Hughes Medical Institute

Nicholas D. Kristof

April 8, 2010

6pm, James A. Baker III Hall, Rice University

Event is free and open to the public

Nicholas D. Kristof, a columnist for The NY Times since 2001, is a two-time Pulitzer Prize winner who writes op-ed columns that appear twice a week. Mr. Kristof has lived on four continents, reported on six, & traveled to more than 140 countries. For more information on this speaker, please visit www.apbspeakers.com.

This event is hosted by the Rice 360°: Institute for Global Health Technologies & the James A. Baker III Institute for Public Policy