Brandeis INNOVATION SHOWCASE

INNOVATIONS WITH IMPACT

Social Entrepreneurship | Emerging Technologies | Scientific Discovery | Startups | Inventions

Event Guide

Welcome to Brandeis University's 2nd Annual Innovation Showcase!

Throughout the event we encourage you to view the poster presentations, learn more about the startups and products launched by Brandeis faculty, visit our exhibitors, enter the raffle and vote for your favorite innovation.

Thank you to the following exhibitors for sharing their resources:

Asper Center for Global Entrepreneurship

Brandeis International Business School (IBS) 3 Day Startup Challenge

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Brandeis Professional Science Master's Program in Biotechnology

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Project Summaries

Brandeis University

Innovation Showcase

November 17, 2016

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2015 Fan Favorite: Efficacy of a Novel Carrot Fiber as an Antidiabetic Agent in Nile rats and Humans
Team Lead - Michelle Landstrom, MPhil, MS, RDN (PI - KC Hayes), SPROUT 2015

Project Summary: Dietary modulation is a primary consideration in the prevention and management of Metabolic Syndrome and Type 2 diabetes mellitus (T2DM). The Nile rat is a novel model for both T2DM and Metabolic Syndrome that, like humans, responds favorably to increased fiber consumption and low glycemic load diets. Within the rapidly growing dietary fiber industry, a relatively novel source of fiber, from carrot pomace powder (CPP), was found to be even more effective at preventing T2DM than inulin (chicory root), the gold-standard soluble fiber used in health food products used for its antidiabetic attributes. CPP, the material left after the extraction of carrot juice, is 50% fiber (a unique blend of soluble and insoluble types) that also contains beneficial plant polyphenols and phytosterols. SPROUT funding and UMASS Innovation Awards (2015-2016) were applied to help test CPP against nine other dietary fibers, and seven different forms of CPP were compared to determine the best sources, processing, and amount required to afford the most effective protection against T2DM in the rodent model. Here, five Nile rat studies (n=275 weanling males) were conducted to better understand the efficacy of CPP in preventing, delaying, or reducing T2DM.

Finally, two methods for testing the CPP modulation of the oral blood glucose response in humans (OGTT) were applied with equal success in a small sampling of normal subjects: 1) after three days of CPP consumption at 13 g fiber per day, designed to allow the large bowel flora enough time to be altered by fiber ingestion; and 2) after a single 15 g dose of fiber 12 hours prior to the standard OGTT the following morning. They both worked in responder subjects. Collectively these studies suggest that a natural, unadulterated fiber derived from carrots can act as a superior, low-cost alternative to other leading fibers in the marketplace.

Poster # 1: Carrot pomace powder [CPP] induces favorable changes in gut flora during prevention of Type 2 Diabetes in the Nile rat
Team Lead – Alice Luu (PI – KC Hayes), Featured Technology

Project Summary: The increased availability of 16s ribosomal RNA gene sequencing has allowed for the comparisons of many different gut microbiomes between individuals and species under a variety of environmental circumstances. The Nile rat (NR) (Arvicanthis niloticus) is a novel model for Type 2 Diabetes Mellitus (T2DM) and Metabolic Syndrome. It is prone to T2DM when fed standard lab chow or high carbohydrate(hiCHO) diets, whereas low-glycemic index foods such as lentils or certain dietary fibers prevent diabetes. Therefore, we hypothesized that low glycemic load (GLoad) diets would favorably impact the gut flora. 16s rRNA sequencing was conducted on the cecal flora from 60 NRs fed seven different diets: 1) chow (diabetic, low GLoad), 2) a green lentil diet (nondiabetic, low GLoad), 3) a hiCHO semi-purified diet(diabetic, high GLoad), the same hiCHO semi-purified diet supplemented with 4) cellulose (diabetic, high GLoad), 5) inulin (nondiabetic, lower GLoad), 6) carrot pomace powder (CPP) (nondiabetic, lower GLoad),and 7) palm fruit juice (PFJ), a plant extract rich in phytochemicals. The results showed that the effect of diet composition dominated over diabetes status on the phyla level; when the microbiota of hiCHO nondiabetic (n=7) with hiCHO diabetic (n=7) NRs were compared, no significant differences were observed in the alpha-diversity or relative abundances. However, Nile rats fed the two plant-based diets, chow (n=5) and green lentils (n=5), had at least a ten-fold increase in Bacteroidetes compared to the five semi-purified diets.

Supplementation of CPP in the hiCHO diet (n=10) decreased the incidence of diabetes and 117 OTUs were identified to be significantly enriched in the microbiome of CPP compared to the hiCHO diabetic controls. Of those enriched was Prevotella, and the Prevotella/Bacteroides ratio of CPP was higher compared to the diabetic hiCHO. This keeps in accord with the recent publication of enriched Prevotella associated with improved glucose metabolism. Overall, dietary components distinctively impact the gut flora and have the potential to modulate the development of T2DM in the Nile rat.

Poster # 2: Palm Fruit Juice (PFJ) Demonstrates Unique Protection Against Drug-Induced and Dietary-Induced mtDNA Mutations and Diabetes *in vitro* and *in vivo*
Team Lead – Adam E. Osborne (PI – KC Hayes), Featured Technology

Project Summary:
Drug-Induced Damage. Many drugs have toxic side effects, including AZT, an anti-retroviral drug against HIV, and Isoniazid (INH), used to treat tuberculosis. We investigated AZT- and INH-dependent mtDNA damage in cultured human liver cells, and tested whether PFJ rich in polyphenols mitigates such damage. AZT caused a 9-fold increase, and INH an 11.5-fold increase, in DNA mutations. PFJ reduced random mutations 60% and also decreased cell death, indicating the protective effect of PFJ against AZT and INH induced mtDNA mutations in human cell cultures.

Type 2 Diabetes. Nile rat diet-induced diabetes was subsequently investigated with or without PFJ, known to reduce the diabetes incidence. mtDNA mutations were reduced in genetically *'resistant'* (nondiabetic) rats vs *'susceptible'* (diabetic) rats fed the same diet, but mutations increased with diabetes *severity*. Interestingly, the 30'OGTT was the best indicator of mitoDNA damage, but PFJ lost its protective power if diabetes was already ongoing when PFJ began, together implying early protection of mtDNA by PFJ is key, ie. BEFORE the diabetes has been established, as detected by high FBG or RBG. The data further suggest that the inherent genetic *susceptibility* (or *resistance*) of the Nile rat to T2DM lies in the sensitivity of its mitochondria to be damaged (or not) by elevated glucose metabolism.

The protective effect of PFJ against drug toxicity and type 2 diabetes highlight a potential means of deterring a common side effect of drugs and chronic disease. Our LATE-PCR assays for mtDNA mutations without sequencing is broadly applicable and can be used for early drug development as well as the monitoring of disease progression and drug side effects.

Poster # 3: Palm Fruit Juice deters the onset and progression of Type 2 Diabetes in Nile rats
Team Lead – Avinaash Subramaniam , Michelle Landstrom (PI – KC Hayes), Featured Technology

Project Summary: The Nile rat, aka the African Grass rat, is a small desert rodent from North Africa weighing 100-120 g when mature. In captivity it develops 'spontaneous' Type 2 Diabetes (T2DM) in a matter of weeks, even when fed rat lab chow, or more reliably when fed high-carbohydrate semipurified diets similar to Western diet compositions. The diabetes can be accelerated or blocked by manipulation of the semipurified diets, including specific supplements. As with humans the Nile rat develops Metabolic Syndrome and T2DM characterized by hyperinsulemia, hypertension, high serum triglycerides with low HDL, and fat accumulation in the visceral perirenal pad and interscapular brown fat, associated with fatty liver enlargement similar to nonalcoholic fatty liver disease (NAFLD) in humans, progressive kidney failure, and altered cecum size linked to modified gut flora activity. Whereas early diabetes is linked to expanding selective fat pads, in advanced disease ketosis develops, which consumes all fat reserves leading to emaciation and death if left unattended. Three glucose parameters are used to describe the hyperglycemia that develops: the oral glucose tolerance (OGTT) excursion, random blood glucose (RBG) and fasting blood glucose (FBG), with RBG being the most reliable predictor of the diabetes found at necropsy after the 10wk diet induction period used in our studies.

Among the various supplements found to deter the diabetes is a water-soluble extract from the fruit of the oil palm, a tea-like waste product produced during the extraction of palm oil from the fruit. PFJ is a rich source of polyphenols, generally recognized among plant bioactives as useful in the control of blood glucose. As seen in the accompanying data, PFJ greatly deters the development of T2DM in Nile rats when implemented from a young age. In the process, it stabilizes fat and glucose metabolism, abolishing the MetS on the way to preventing diabetes in most cases.

Poster # 4: New therapy for the diseases of aging
Team Lead – Anne Lawson, (PI - Lizbeth Hedstrom), SPROUT 2016

Project Summary: Cancer and neurodegeneration are the most prevalent and devastating diseases associated with aging. An epidemic of these diseases is looming as the baby boomer generation reaches its twilight years. Dysregulation of the mammalian Target of Rapamycin (mTOR) signaling pathways is common feature of diseases such as cancer, neurodegeneration, and diabetes and inhibition of mTOR holds great promise for the development of treatments to target these diseases. Dysregulation of mTOR signaling occurs, and mTOR inhibition is a promising strategy for the development. We have discovered a novel inhibitor of mTOR signaling (CB3A). CB3A has different effects than previously described mTOR inhibitors, which may provide a therapeutic benefit for some diseases. Thus CB3A based therapy could have a major impact on human health with a total potential market of hundreds of billion dollars. Currently available mTOR targeted drugs have toxicity issues that may limit their use in some applications (e.g., diabetes) and modest efficacy in others (e.g., cancer). CB3A has a novel mechanism of action that may be therapeutically advantageous in these situations. We are currently using SPROUT funding to understand the mechanism of CB3A action and identify the diseases that are most likely to respond to CB3A-based treatment.

Poster # 5: Selectively Inhibiting Ovarian Cancer Cells by Derivatized Dipeptides
Team Lead – Jie Li (PI - Bing Xu), SPROUT 2016

Project Summary: To address the problem that tight ligand-receptor binding, paradoxically, is a major root of drug resistance in cancer chemotherapy, we focus on the development of a novel process—enzyme-instructed assembly (EIA)—to kill cancer cells selectively. We design and synthesize the small peptide precursors as the substrates of carboxylesterase (CES). CES cleaves the ester bond pre-installed on the precursors to form the peptides that self-assemble in water to form molecular nanofibers. As the process that turns the non-self-assembling precursors into the self-assembling peptides upon the catalysis of CES, EIA occurs intracellularly to selectively inhibit a range of cancer cells including drug resistant cancer cells that exhibit relatively high CES activities. While it is innocuous to normal cells which have lower level of CES. In addition, in vivo toxicity evaluation confirms that EIA is innocuous to mice, agreeing with the exceptional selectivity of EIA in cell assays. This work illustrates a new approach to amplify the enzymatic difference between cancer and normal cells and to expand the pool of drug candidates for potentially overcoming drug resistance in cancer therapy.

Poster # 6: Enzymatic synthesis of novel cyclic dinucleotides regulating V. cholera infectivity
Team Lead – Ben Pomerantz (PI – Maria Eirini Pandelia), SPROUT 2016

Project Summary: Nucleotides are not only indispensable constituents of DNA and RNA, but also crucial signaling molecules in all domains of life. Cyclic dinucleotides (CDNs) represent an important and growing family of second messengers, which have been previously recognized as key modulators in many bacterial and mammalian processes. In 2012, an enzyme from Vibrio cholerae (Vc), DncV, could produce from ATP and GTP a new hybrid CDN, the 3'3'-cGAMP. DncV was demonstrated to promote Vc intestinal colonization by downregulating chemotaxis, previously associated with hyperinfectivity, highlighting the importance of the novel 3'3'-cGAMP. DncV homologs are present only in other bacterial species (several of which are pathogenic), indicating that 3'3'-cGAMP regulates cellular functions associated with infection and general metabolism. The importance of hybrid CDNs in regulating the immune response in humans was also exemplified by the discovery of the non-canonical 2'3'-cGAMP, which acts to detect cytosolic DNA and induce an immune response. To date these novel CDNs are only commercially available in small quantities and high costs, due to a cumbersome chemical synthesis that has low yields. We propose to circumvent the present limitations, by producing these CDNs enzymatically employing DncV (synthesizing the canonical 3'3'-cGAMP and c-diGMP) and the human cGAS (synthesizing the non-canonical 2'3'-cGAMP). In this manner, we can obtain high amounts of pure CDNs that are often required for biochemical experiments necessary to characterize the function of enzymes involved in their metabolism. In addition, these CDNs are promising candidates for development of vaccines, and establishment of pure and inexpensive source is a significant step towards those efforts. We have expressed and isolated the Vc DncV and human cGAs in high yields and purity. We will present initial results of our activity assays with these two proteins, which consist the initial step for the enzymatic overproduction of the hybrid CDNs, which can potentially be used in studies of therapeutic value.

Poster # 7: Development of New and Powerful Organocatalysts for Synthesizing Important Medical Intermediates
Team Lead - Xiao Zhou (PI – Li Deng), SPROUT 2016

Project Summary: The uniquely druggable properties of trifluoromethylated amines render them attractive compounds for drug discovery and development. Consequently, there is a high demand in pharmaceutical industry for general and economic synthetic methods that provide rapid and versatile access toward a great range of trifluoromethylated amines in optically active form. Organocatalytic asymmetric isomerizations reported by us and metal catalyzed hydrogenation of trifluoromethyl imines by others represent the most promising strategy. The hydrogenation suffers from the use of expensive transition metals and metal contaminations of pharmaceutics. Meanwhile, the existing organocatalysts afford low turnover number rate, which leads to high catalyst loading and long reaction time. Based on mimicking how enzyme catalyzes a reaction, we designed the enzyme-like organocatalyst which could bind to a substrate in the active site, and then promote a fast reaction. The invention of the enzyme-like organocatalyst will solve current problems completely and enable the organocatalytic method to be the most general, economical and environmentally friendly technology for preparation of trifluromethylated amines. Moreover, our catalyst could potentially catalyze other proton transfer reactions such as the isomerizations of butenolides, □-amino acids, allenes and cyclohexenones which could also generate important medical intermediates, thereby impacting drug discovery, development and manufacturing.

Poster # 8: Circadian Rhythm Incubating Device (C.R.I.D.)
Team Lead: Jae Jung (PI – Michael Rosbash), SPROUT 2016

Project Summary: More than 50 million people in the United States alone suffer from chronic long-term sleep disorders each year. In order to study sleep and our biological clock, researchers use the fruit fly as their model organism. Fruit flies are very advantageous to use since fruit flies have a similar molecular feedback system as mammals and also they are very cheap to maintain and genetically modify. In flies, sleep is recorded by their activity levels. If flies are moving, they are considered awake and if they are not moving, they are considered asleep. Traditionally, this paradigm is recorded by a system called Drosophila Activity Monitor (DAM). This system uses a single infrared beam mechanism to detect the activity of the flies. However, this system has proven to be insensitive due to its narrow detecting field. Consequently, many researchers have experienced its flaws and have complained about the weaknesses of the system. Thus, my team and I have engineered a new paradigm that can solve DAM system's weaknesses. We utilized a video recording system to track the locomotor activity and behavior of the flies holistically. By doing so, researchers can now get more accurate data since flies cannot be active and avoid detection unlike DAM system. Additionally, DAM system takes two days to prepare the flies for the experiment. However, our system, CRID, only requires two hours for preparation, dramatically decreasing the prep time. Our product will be released in a small niche of sleep and circadian field for research purposes. However, we want to expand our market by introducing an education version that private high schools and teaching labs in universities can use to teach introductory genetic courses. With the SPROUT funding, my team and I have successful finished two prototypes. And we further plan to finalize our designs for manufacture soon.

Poster # 9: Targeted delivery of therapies in *any* type of cells by *easy* design
Team Lead – Yasu Shima (PI – Sacha Nelson), SPROUT 2016

Project Summary: Many neurologic diseases are caused by malfunctions of specific types of neurons; dopamine-producing neurons in Parkinson's disease and medium spiny neurons in Huntington's disease, for example. Gene therapy and stem cell-derived cellular therapies are expected to be promising treatments for those diseases, however, the effectiveness of those therapies is limited because there is no method to select for a specific neuronal cell type. Conventional methods for cell selection require specific antibodies, but this is not feasible as laborious screening is needed for obtaining good antibodies. Currently the best existing technology can only separate neuronal cells in general from all other cell types. Therefore there is a need for technologies that can distinguish between specific neural cell types.

Here we present our developing platform technology for targeting *any specific cell type in any species* based on its unique pattern of gene expression. We initially aim to develop cell type specific selection kits capable of targeting a wide range of molecules. We have been pioneering gene expression profiling in different neuronal cell types and found that different cell types can be easily discriminated by what gene products – RNA molecules – they have. Our strategy combines designable RNA binding proteins with powerful gene activators to express any gene of interest. Although the individual molecular components already exist, their combined use in such a system is unprecedented. We have tested each molecular components and now are seeking best composition of the components. This technology could further extend to distinguishing between non-neural specific cell types as well.

Poster # 10: Quasi-chemical Modeling for Food Safety – Inactivating Listeria monocytogenes and Bacterial Spores by High Pressure Processing and Other Nonthermal Technologies
Team Lead - Christopher J. Doona, Featured Technology

Project Summary: High Pressure Processing (HPP) is increasing in use worldwide for the commercial production of pasteurized sliced meats, seafood products, cold-pressed fruit juices, and chilled ready-to-serve soups by inactivating spoilage organisms and vegetative pathogens such as Listeria monocytogenes. Foods pasteurized with HPP are more fresh-like, feature increased quality and improved organoleptic attributes, avoid the use of chemical preservatives (i.e., clean label), and have the potential to increase consumer acceptance, stimulate the consumption of healthier foods, and increase market share. Inactivating bacterial spores (particularly Clostridium botulinum spores in low-acid foods) requires HPP treatments with elevated pressures and temperatures to achieve food sterilization. Despite the advantages of HPP, food products sterilized with HPP are not currently available in the commercial marketplace.

Here, we present the Enhanced Quasi-chemical kinetics (EQCK) model to characterize continuous growth-death-tailing dynamics of the pathogens Staphylococcus aureus, Listeria monocytogenes, or Escherichia coli in various sandwich foods. We developed novel secondary models (Equivalence Chart, dimensionless Transition State Theory models) to estimate processing and kinetics parameters that offer new insights into the inactivation mechanisms of microorganisms by HPP. We also develop a 3-step "quasi-chemical" germination model (QCGM) to evaluate the germination of spores of B. subtilis, B. amyloliquefaciens, and the notorious opportunistic pathogen Clostridium difficile by HPP, recognizing the crucial role of spore germination prior to inactivation by HPP. The Quasi-chemical modeling approach helps improve the understanding of mechanisms of microbial inactivation and will provide the knowledge base to support the commercial implementation of HPP for food sterilization, bio-decontamination, and myriad other applications.

Poster # 11: Closed-Tube DNA Barcoding of Edible Fish: Fighting Fraud and Preserving Stocks for the U.S. and Global Markets
Team Lead – Larry Wangh, Featured Technology

Project Summary: Introduction: The facts are sobering: 1) The market for edible fish in the U.S. is $20.2 billion; 2) 91% of the fish consumed in the U.S. is imported and beyond the control of US regulators; 3) On the average, 1/3 of the fish consumed in the U.S. market is mislabeled (it is not the species it is purported to be); 4) Stocks of edible fish today are only 39% of what they were in 1950; 5) The U.S. government has mandated the FDA and other federal agencies to combat fish-fraud by use of DNA Barcoding of species (a method involving DNA amplification and sequencing); 6) The FDA currently only analyzes 0.02% of fish by DNA Barcoding. The problem is that DNA Barcoding is labor intensive, costly, slow and requires a laboratory.

Our Approach: We propose to replace DNA Barcoding with Closed-Tube DNA Barcoding, an easy to use, inexpensive, rapid method for species identification using laboratory equipment or a handheld device. We will also replace standard methods of sample preparation with a simple method of lysis and dilution. Each species of fish will generate its own species-specific "fluorescent signature" and we will build an ever expanding library of fluorescent signatures for all fish species. Closed-Tube DNA Barcoding will therefore make it possible to efficiently distinguish correctly labeled and mislabeled fish-species at the key locations where fish is bought and sold in the world market place. We further anticipate being able to distinguish geographically distinct populations of fish within each species. Population monitoring will enhance efforts to manage and conserve fish stocks.

Progress to Date: 1) We have identified the 88 species of edible fish that need to be monitored for the U.S. market; 2) The FDA has given us a set of fish comprised of 75 samples of 5 species of fish (15 replicates each) to use as a proof-of-principle test of Closed-Tube DNA Barcoding of fish; 3) Primers and probes for the assay are currently being designed and will be purchased using Sprout Grant funds; 4) Experimental work on the assay will commence in November; 5) Additional funds ($50,000) for support of assay development work have been applied for from the National Fisheries Institute (NFI)*; 6) A start-up company, ThermaGenix Inc., has been identified for commercialization of the assay for Closed-Tube DNA Barcoding of fish; 7) A potential investor with an interest in supporting the R&D effort at ThermaGenix, Inc. has been identified; 8) A business plan for marketing the assay for Closed-Tube DNA Barcoding of fish is being developed.

*The National Fisheries Institute (NFI) is the United States industry trade group representing the seafood industry. It is a member of the International Coalition of Fisheries Associations (ICFA).[1] Its member companies consist of all levels of business involved in seafood, from fishing vessel operators to seafood restaurants. (Wikipedia)

Poster # 12: Rapid Detection of the "Brain Eating" Amoeba Naegleria fowleri in Ponds and in People using Closed-Tube DNA Barcoding
Team Lead – Larry Wangh (PI – Larry Wangh), SPROUT 2016

Project Summary: Each summer a few children in the U.S. and around the world die because they swim in warm fresh water that is contaminated with N. fowleri, a particular species of soil amoebae within the genus Naegleria. In these cases N. fowleri are inhaled. Once in the nasal passages they migrate into the brain where they wreak havoc and almost always rapid death. N. fowleri is found in ponds throughout the southern U.S., but also as far north as Minnesota and the CDC is concerned that N. fowleri is being spread by global warming. There is currently no highly specific assay available for N. fowleri that can be used for on-site environmental testing, as well as for rapid diagnosis of suspect cases of amoebic meningitis.

We are currently working on our Closed-Tube DNA Barcoding technology for identification of N. floweri, the notorious "brain eating" amoeba. This advanced Closed-Tube DNA Barcoding assay will use highly specific Super-Selective primers to amplify just N. fowleri, regardless of other species of animals, plants and microbes in the sample. Sample preparation by lysis and dilution is quick and easy. The Closed-Tube DNA Barcoding assay will be carried out in a portable device suitable for use in the field or in the hospital. Analysis will take under one hour. Our basic research over the last several years (paid for in part using SPROUT Grant funds) demonstrates that Closed-Tube DNA Barcoding is an innovative method for rapid, accurate, and inexpensive identification of many species. The basic technology being developed for detection of N. fowleri is also applicable for environmental detection of virtually any water borne pathogen.

Poster # 13: Discover Deis: Navigation and location finding application for Brandeis and beyond
Team Lead - Ziyu Qiu, SPARK 2016

Project Summary: Incoming visitors often face the challenge of navigating an unfamiliar campus with difficult to interpret maps and signs. Although paper maps and other means are available to assist navigating, more often than not the directions are ambiguous and non-descriptive. Applications like Google or Apple Maps however, use top-down strategy (from satellite data), which lacks fine granularity, customizability and accuracy. The platform our team aims to build would enable all kinds of institutions with an actual base to create a customized map of their campus, providing a better solution for finding, exploring, and learning about the campus. Our platform will also serve analytics on route usage and user interactions to the institution. It is a tool that will eliminate the uncertainty of how to reach a destination and provide the institution with data they can use to improve student and visitor satisfaction. Discover Deis was the recipient of a SPARK award and has used the funds to purchase required software and hardware to develop a web application accessible to all people, and ongoing development for native mobile applications. In addition, we plan to use the funds for testing and promotion of our application. Our team has also explored business opportunities like MassChallenge and the Brandeis IBS 3 Day Startup Challenge.

Poster # 14: Preparing for the unfamiliar: An app for individuals with autism to prepare for doctor's office visits
Team Lead - Michelle Techler, SPARK 2016

Project Summary: There is a need for a product that can help prepare individuals with autism for clinical encounters while reducing clinicians' workload in communicating with these underserved, challenging and time-intensive patients. The existing problem with current market offerings is the fact that caregivers and individuals with autism have to generate the content for their social stories themselves, rather than having content designed by medical professionals. This project seeks to prepare people with autism and their caregivers for doctor's visits through the use of a specially-catered mobile application.

Our application uses a social story to prepare the individual for their appointment, including information about what will happen during the appointment, hints about what to expect, and how to interact successfully with the health care team. Our product fills an important need identified by individuals with autism and their health care providers. This app is essentially needed for individuals with autism, as well as the larger healthcare community. After we have finished the application, we will be piloting the program with Massachusetts General Hospital's Lurie Center for Autism. After we receive feedback from that phase, we will work to adapt our application for larger-scale use.

Poster # 15: Going upstream: Addressing the social causes of disease to improve health and reduce costs
Team Lead - Rajan Sonik, SPARK 2016

Project Summary: Health disparities, preventable differences in health outcomes between people based on characteristics such as race, gender, and education, cost the United States hundreds of billions of dollars per year. The primary cause of these health disparities are social disparities, which arise in areas such as education, income, safe housing, and hunger. As the Affordable Care Act and other measures increase access to health care for lower-income Americans, the cost of health disparities will only rise if we fail to address their roots—generally referred to as the "social determinants of health." This fact is becoming increasingly problematic for health care systems across the country, which are beginning to be held accountable for ever rising costs in health care but which lack the structures to deal with the social determinants of health.

Our project is piloting the development of such a structure. Through the support of a SPARK grant and by leveraging partnerships with Vermont Legal Aid, University of Vermont Medical Center, and Vermont Medicaid, we are designing a system to (i) preventively detect and meet health-affecting social needs, and (ii) track the health and healthcare cost impact of this system through a randomized controlled trial. The results of our work will greatly inform the development of programs within health systems to proactively reduce health disparities, reduce health inequities, and save healthcare dollars.

Poster # 16: Mapping the Human Eye with Sclervey
Team Lead - Hermann Wellenstein, SPARK 2016

Project Summary: Many people suffer from complex corneal diseases that cause severely impaired vision or even blindness. Extreme dryness of the eyes can lead to these problems as well. These vision of these patients cannot be corrected with typical glasses or contact lenses, as the shape of the cornea is no longer a smooth surface. The Boston Foundation for Sight (BFS) has successfully developed a method to restore vision to such patients. PROSE (Prosthetic Replacement of the Ocular Surface) requires custom fitted lenses that form a seal on the sclera, allowing a saline solution to be held between the prosthetic lens and the damaged tissue. This creates a "new cornea" and thus restores vision, but there is a significant flaw in the fitting process which causes patient discomfort as well as increasing the time and cost of the process.

Our proposed device will survey the sclera (hence the name Sclervey) without making contact and will generate a high-precision map of the sclera non-invasively in a matter of minutes, providing medical professionals with the necessary data to efficiently design custom fitted lenses. The 2015 SPARK funds we received have allowed us to run our experiments with high quality image sensors for our cameras and the custom-made LED arrays necessary for our mapping method. This has given us a much clearer picture of error sources and our limitations allowing us to file a provisional patent for our current design.

Poster # 17: Reduction of Dengue through Non-Pesticide Screening of Private and Public Places
Team Lead: Dr. Laurence Simon, SPARK 2015

Project Summary: Dengue is a mosquito borne viral infection, which spreads by female mosquito vector called Aedes aegypti. Each year 390 million cases are reported worldwide in more than a hundred countries. An expensive dengue vaccine with limited efficacy has resulted in reliance on other options ranging from vector control in the community to reduced vector borne viral spread and an effective case management of infected person to prevent early death due to severe hemorrhage. Realizing dengue as a major public health problem, the GDS project was launched by seed money from SPARK in a phasic manner. The project aimed to develop a study design, test the efficacy, effectiveness of school and house window and door screening as an intervention to prevent Dengue Fever (DF) in resource limited, high prevalent areas of the world.

During first phase, the project has developed a rigorous methodology of a nested research model with three tiered interventions and control groups which includes school screening, a subgroup of home screening, and a subgroup of natural plant-based mosquito repellents for skin application. An initial visit of schools and homes in proposed urban centers of Colombo, Sri Lanka and Dhaka, Bangladesh to better understand the challenges of infrastructure, environment, culture, and cost has already been accomplished. This is being followed by a baseline data, which involves a count of mosquito densities in school classrooms, homes, and a record of incidence of dengue among the trial population and control group. At present, the bi-national project is being implemented in large urban centers under the direction of the research directors of BRAC School of Public Health, in Bangladesh and the Sarvodaya Movement of Sri Lanka and with the backing of the Health Ministries of their respective governments. In view of the public health impact of the present project, the mission of World Health Organization (WHO) in Bangladesh has pledged financial support for the pilot program.

In the future, the project aims to enrich its scope by going up to other regional countries and by pursuing funds from international agencies and funders.

Poster # 18: Biotech Elements
Team Lead – Tomer Goldstein, SPARK 2016

Project Summary: Biogas is a product of microbial activity through decomposition of organic waste in an oxygen-free environment. It is generally composed of 60% Methane (CH_4) and 40% Carbon dioxide (CO_2). After biogas is collected, it can be used directly to generate electricity, however, because of the CO_2 portion, it is considered to be a low quality fuel source. Biogas upgrading is a combination of chemical and physical methods that improve gas quality to a 98% CH_4 level by removing other gas fractions. BioTech Elements' innovative technology uses a biological method to convert the CO_2 portion to CH_4, increasing usable gas quality and quantity. As an alternative energy source, our system reduces the exploitation of fossil fuels and greenhouse gas emission, which is highly associated with climate change. We have built a two stages small scale prototype, in which hydrogen gas is being extracted from a low quality water source (effluent) in the first stage. Then, the hydrogen transfers to a new chamber and being mixed with the collected biogas. In this second stage chamber, special microorganisms convert the gas (hydrogen and 40% CO_2) into CH_4 in their metabolic pathways. We tested the prototype capabilities under series of laboratory experiments, which provided promising results energetically and economically. Thanks to SPARK we were able to hire engineers, scale up our technology and build a medium size prototype in an existing Waste Water Treatment Plant in Israel. Currently, BioTech Elements is cooperating with a leading wastewater company (EPT) by using their facilities while our R&D team is constantly improving our technology.

Poster # 19: Cleanfield Capital
Team Lead – Debarshi Nandy, SPARK 2016

Project Summary: Data from the Environmental Protection Agency (EPA) shows that millions of acres of contaminated land or "brownfields" lie neglected across the United States. These brownfields have an impact on the health of local residents and on their community's economy. Their neglect contributes to downward pressures on neighboring property prices and poor local economic opportunities. Addressing the brownfield problem requires remediation and redevelopment but the level of contamination is difficult to predict, and further returns from repurposing the land may not be sufficient to cover clean-up costs, resulting in financial losses. The risk is substantial enough to dissuade most private sector investors for engaging in cleanup and redevelopment efforts. Cleanfield Capital's solution is based on the principles of risk diversification and portfolio theory. Risk is the currently constraining factor for private sector participation in redevelopment of brownfields. If, however, the investment is not just one property at a time, but a portfolio of properties packaged together in a real estate investment trust (REIT), the risk-adjusted financial return can be made sufficient to attract private impact investors to participate alongside public sector funding from the EPA. Using a propriety algorithm, we will construct diversified portfolios of brownfields with high risk adjusted returns that we will then clean and redevelop with a focus on environmental sustainability. Resulting projects will include commercial and housing complexes using renewable energy sources and smart home automation technology alongside solar fields.

Poster # 20: A coffee flour food ingredient rich in antioxidants and caffeine; and a new method to optimize extraction of coffee during K-cup or similar brewing
Team Lead - Dan Perlman, Featured Technology

Project Summary: The green coffee beans are a rich source of chlorogenic acid (CGA) antioxidants that have been clinically proven to beneficially modulate sugar metabolism and insulin response. Traditional roasting of green coffee beans to improve its flavor for consumption, aroma, and color degrades CGA, necessitating the packaging of unroasted green coffee extract as capsules. Brandeis University researchers have developed a new, cost-effective method for partially baking the green coffee beans into a mild-colored coffee flour that not only preserves the CGA levels, but retains the caffeine. This natural product with its pleasant nutty flavor can be used as an ingredient directly in food and beverages including baked goods, chewing gums, mints, etc. as an excellent source of CGA and caffeine.

Brandeis University researchers have also discovered a novel method to increase the efficiency of extraction of coffee during K-cup or similar brewing. By optimizing the particle size of the coffee included in these single pods, researchers were able to increase the coffee extractables from 15-40% during the low-pressure, quick brewing conditions typical to single pod brewing machines.

Poster #21: CLASPER: Cas9-Linked And SNAP-tag Primed Enhancement of Recombination
Team Lead - Nelson Lau, SPROUT 2016

Project Summary: In a 2014 SPROUT-supported effort, we solved the first step of creating and showing that the Cas9 protein fused to the SNAP module can cut human cell genomic DNA and generate mutations twice as effectively as the original Cas9. We also discovered an unexpected resistance for 5'-modifieid linear DNA repair templates towards general DNA repair and integration into human cell genomes. To overcome this problem, we are now creating a new BG-labeled circular plasmid repair templates that will allow tethering of the BG to Cas9-SNAP, and the plasmid will be a much more conducive repair template at the targeted gene location. We have now devised a scalable methodology to generate plasmids with Internally labeled BG groups, so that we can then move onto the human cell culture editing experiments. It is our hope to be the first to demonstrate the proof-of-principle of the CLASPER system (Cas9 Linked And SNAP-tagPrimed Enhancement of Recombination).


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