ONTARIO SCIENCE STUDENTS SWEEP PRESTIGIOUS NATIONAL INNOVATION AWARDS

MONTREAL QC (May 19, 2016) Five Ontario high school students -- from Guelph, London, Ottawa, Grimsby and Markdale -- walked away with the majority of the prestigious Ernest C. Manning Awards for Canadian innovation at the 55th Canada Wide Science Festival this week at McGill University campus. Over 480 finalists competed with 420 projects for more than $1 million in prizes.

Four of the five are recognized as Manning Young Canadian Innovators, and each won $7500 in cash, a trip to Halifax, Nova Scotia in October for the Foundation's National Awards Gala, and membership in a network of nationally recognized innovators that spans 24 years of such achievement. The fifth Ontario student received a $500 Manning Innovation Achievement Award.

"The calibre and ingenuity of these projects prove age is no barrier to innovation," said Jennifer Diakiw, President of the Ernest C. Manning Awards Foundation. "For the past 24 years, the Foundation has encouraged and celebrated outstanding young Canadians competing at the Canada Wide Science Festival. The 2016 winners are passionate and creative visionaries and we and our sponsors believe supporting them is a privilege, as they are important contributors to Canada's reputation as an innovation nation."

The winner profiles and projects are:

GUELPH: Devanshi Shukla, an 18-year-old Grade 12 student at Centennial Collegiate & Vocational Institute in Guelph, who developed a biosensor for the detection of Microbial Contamination.

"Every year, millions of people get food poisoning -- causing complications and negative effects to their health. One of the main reasons for this is because fungal contamination is not always visible. So this year, I worked on developing a sensor to detect fungal growth in food and the environment before visible signs are present,"explained Shukla, a senior Gold Medallist.

"Even though microbial growth is not clearly visible it still has negative effects on human health," mentioned Shukla. She discovered that microbes growing on contaminated food release a unique chemical, known as p-cymene into the air. P-cymene is found to be produced by many forms of bacteria and yeast and more importantly, they are

detectable before any visible signs of microbial growth. Currently, methods of detecting p-cymene are expensive and time-consuming, making it difficult to identify contaminated food.

Shukla bioengineered a form of bacteria to be able to detect this chemical. Once the bacteria detects it, a reaction occurs inside of it, causing it to glow. When placed alongside a food item, the biosensor can indicate if there is microbial growth on the food. Shukla stated this bacteria can detect even trace levels of p-cymene. The high sensitivity of this biosensor means that contaminated food can be identified well in advance of it posing a health risk. Shukla has now developed the biosensor as a bead. When this bead is exposed to p-cymene, it begins to glow exactly like her initial work showed. This creates an effective and simple way to monitor the safety of food items.

Shukla mentions that the next step of her project is treatment. Through this, she plans on preventing microbial growth on food items. She plans on carrying this out by limiting the microbes' ability to communicate with one another therefore limiting growth of the microbe which significantly lowers the risk of food poisoning and spoilage.

“Science is about asking questions, finding unknown paths and creating change -- a notion that inspires me because the world’s biggest problems can be solved by its smallest things,” said Shukla, who, in addition to pursing her research interests, also volunteers at the hospital and pursues piano.

LONDON: Aoife Pucchio, Grade 11 student at A. B. Lucas Secondary School in London, developed a prototype process for municipalities to efficiently transport waste Styrofoam to a centralized facility for recycling into a highly reusable plastic.

“Ever since I was a child, I have had a passion for the environment, nature, and camping. The idea for my project was inspired by these passions and a desire to help solve the looming issue of climate change," said Gold Medallist Pucchio.

A large issue that Pucchio has focused on is the increasing size of landfills and need for more and more space to accommodate garbage. A large contributor to these landfill sizes is Styrofoam, which occupies approximately 30% of all landfills with less than one percent being recycled. In addition, Pucchio addressed the large environmental impact caused by inefficient transportation of Styrofoam to recycling facilities.

Pucchio discovered that d-Limonene, an oil extracted from the rinds of citrus fruit, was able to dissolve 46 litres of Styrofoam into one litre of this readily available, cheap and natural oil. Pucchio also developed a type of dumpster (small enough to fit into two parking spaces in a parkling lot) that would quickly and efficiently mix used Styrofoam into this citrus rind oil to be dissolved and store 8,000 litres of it until it is transported for recycling. Pucchio found that with her Styrofoam dissolving depot, she would be able to transport approximately 116,000 litres of Styrofoam, requiring only four transport trucks, compared to the current 131 trucks required, thus reducing CO_2 emissions from Styrofoam transport, from 32 tonnes to only one.

As an even further benefit, the dissolved Styrofoam can be removed from the d-Limonene in the form of a highly reusable, readily available plastic, and the separated d-Limonene would be able to be reused as well.

OTTAWA: Amit Scheer, 17, a Grade 12 student at Colonel By Secondary School in Ottawa, continued his pursuit in Gold-medal nanobiotechnology research through the development of a novel scaffold vaccination platform; in short, drastically improving the efficiency for how our immune system is recruited, activated and targeted towards not only traditional vaccine targets, such as a viral infection, but also extended to other diseases such as cancer.

Scheer developed a biodegradeable scaffold that will release a signal used to recruit the body's antigen presenting cells (APCs) or "immune system coordinator," used to alert and stimulate the body's immune system, and temporarily trapping these cells. The cells are trapped by specific interaction with a novel protein target identified through Scheer's extensive protein analyses.

While trapped, the scaffold will present molecules specific to the targeted health concern (cancer or viral infection for example), which will educate the immune cell on its target. This, however, is not sufficient to mount a defence by the immune system, as some disease-specific molecules aren't always perceived as a concern (even though cancer is usually a bad thing). Scheer addressed this by also subjecting the APCs to a danger signal (presented to the APCs by the scaffold) which will stimulate the APCs to immediately activate the rest of the immune system and mount a specific immune response against the disease. As a final innovative benefit, the scaffold will provide a sustained response to the disease, ensuring the immune response won't stop half way through its battle.

Scheer's innovation could advance the field of immunotherapy against various types of diseases through a targeted approach which will directly and effectively stimulate our body's most efficient and natural defence, which often just requires activation

Scheer is no stranger to science projects, having represented Canada on the International stage, and making his second appearance at the Canada Wide Science Festval this year. In addition to his record of science fairs, Scheer is actively involved as a Program Coordinator for the Foundation for Student Science and Technology, a foundation "dedicated to developing the career potential of gifted high school, college and university students for leadership roles in the science community".

“In the future, I plan to study immunology and chemistry to eventually become a scientist in the related disciplines. Pursuing research throughout high school was a profoundly influencing experience and I plan to continue developing my innovations, throughout my undergraduate degree and beyond,” said Scheer.

GRIMSBY: Lucas Penny, 17, Grade 11 student at Grimsby Secondary School, has been actively involved with science most of his life and this year focused on finding a successful, low-cost system for detecting breast cancer in its early stages.

This Gold-medal study used a profile of miRNA, which are pieces of specialized genetic material used in regulating gene expression, characteristic to breast cancer, for earlier detection of the onset of breast cancer. Penny found that these miRNAs could be found in saliva providing an easy, non-invasive way of obtaining the miRNAs and testing for the onset of breast cancer in different patients. To do this, Penny devised a way to make use of quantum dots (normally used in TVs to produce different colours), which are particles that are one-millionth of a centimeter big that produce light when activated. Penny combined these quantum dots with their own miRNAs. Furthermore, he developed a piece of genetic material that acts as an infrastructure for miRNAs to interact with, but on its own, will produce a certain coloured light that is able to be detected. However, only when a specific miRNA from the breast cancer profile is present, will the cancer-specific miRNA, as well as the quantum dot bind to the infrastructure and activate the quantum dot to produce a different coloured light that is able to be detected, indicating the presence of cancer.

In addition to creating the required miRNAs and specialized quantum dots, Penny created a device that will combine the saliva of the patient in question with the quantum dots and infrastructure genetic material, which will mix and produce either the light from the infrastructure indicating the absence of cancer, or will emit light from the quantum dot indicating the presence of cancer.

The method, in conjunction with the device Penny created, will be able to detect changes in the range of one quadrillionth of a gram to one billionth of a gram of miRNA, which will determine if a patient has early signs of cancer. This model that Penny developed, with its extreme sensitivity, will also be very cheap, being approximately five dollars per test. It can be very quick, taking less than 10 minutes to return results and with further miRNA profile characterization of other cancers or diseases, it may be possible to have a non-invasive, inexpensive quick and easy test for early onset of various diseases.

Penny is also on his school's rowing team. During his grade 9 year, he won gold with his crew in the Canadian National Secondary School Regatta. Aside from athletics, he is a member of the Education Minister's Student Advisory Council, and is playing level 8 Royal Conservatory of Music. At school, Penny is the President of DECA, the school's business case study club, a member of the Student Council, and on the committee for Relay for Life.

Penny hopes to pursue a career in medicine and believes Science Fair involvement is an incredible way to contribute to his learning and assist society at large.

MARKDALE: Katherine Teeter, 17, a grade 12 student at Grey Highlands Secondary School in nearby Flesherton, has been in six consecutive national competitions. A BBC article examining the extreme strength of Limpet teeth, a type of aquatic snail, inspired her Gold-medal investigation of this topic for medical applications. Teeter also won a $500 Manning Achievement Award, as well as being named the Senior Category Platinum Award winner.

Limpet teeth are believed to be so strong due to the unique composition and high mineral content, making it the strongest known biological compound, significantly outperforming spider silk. Her project examined ways to synthesize the constituents of Limpet teeth for the construction of prosthetic implants.

Teeter identified that current synthetic prosthetics are associated with a number of complications. "Out of the 109,639 knee and hip replacements in 2013/2014, 4,978 required revisions due to tissue damage, instability, device wear and failure" explained Teeter. These complications arise from the use of compounds such as polyethylene and certain metal alloys which over time release harmful compounds into the surrounding bone preventing proper development around the prosthetic implant. This increases the chances of requiring a revision after a hip or knee replacement. By using her knowledge of the strength of Limpet teeth, Teeter developed a safer alternative to conventional prosthetics material by synthetically producing the material of which Limpet teeth are composed.

Teeter set out to isolate the unique compounds composing Limpet teeth from several commonly found sources. These compounds included chitin, goethite, chlorophyll and vitamin B12. Teeter was able to synthetically develop a compound of chitin-goethite, similar to Limpet teeth, which she further strengthened by adding isopropanol. By performing several tests on the material which took into consideration daily forces a prosthetic implant endures, Teeter concluded that her compound performed far better than the conventional ceramic prosthetic material. Biological tests also showed that her compound was non-toxic. Teeter believes her compound can lower the risk of patients with prosthetic implants facing medical complications as a result of the use of conventional prosthetic materials.

“More than 580 physical, chemical, and biological stress tests concluded that synthetic Limpet teeth prosthetic implants were more resilient, and could reduce adverse health conditions associated with current prosthetics,” explained Teeter, whose balanced life also includes music, sports, mentoring and summers on the family farm. “Science fair has influenced, and will continue to positively change my life. My future endeavours may include doctoring or researching,” she said.

The Ernest C. Manning Awards Foundation is committed to advancing students’ success as innovators. The Foundation introduced its Young Canadian Program in 1992 to recognize outstanding high-school students at the Canada-Wide Science Festival. Each year, the CWSF and Manning judging teams select eight winning projects, to receive a $500 Manning Innovation Achievement Award. From the eight, four are honoured with the Manning Young Canadian Innovation Award, which includes a further $7,000 prize. More information about the Manning Awards is available at www.manningawards.ca, Twitter @ManningAwardsCA Facebook/ManningAwards.

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