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Our science superheroes: The xy-Men

TONY BOCK/TORONTO STAR

Derek van der Kooy, Department of Medical Biophysics, U of T

MORE HEROES

JOHN DICK

Senior Scientist, Toronto General Research Institute, University Health Network

Known for his work on blood cancers, and first to identify cancer stem cells. Leads the Cancer Stem Cells program at the Ontario Institute for Cancer Research.

ANDRAS NAGY

Senior Investigator, Mount Sinai Hospital's Samuel Lunenfeld Research Institute

Known for his work with embryonic stem cells. Made headlines this week for coming first in worldwide race to find a safer way to make human skin cells act like embryonic stem cells.

BENJAMIN NEEL

Director, Ontario Cancer Institute, University Health Network

Known for his work on cell signalling, in both normal and tumour cells. Recruited from Harvard University, Neel came to Toronto in 2007 to lead the renowned Ontario Cancer Institute.

TAK MAK

Director, Campbell Family Institute for Breast Cancer Research, Princess Margaret Hospital

Known for his groundbreaking work on the human immune system. Currently mapping genetic mutations in breast cancers to identify better, more targeted cancer drugs.

ALED EDWARDS

Professor, Banting and Best Department of Medical Research, University of Toronto
Known for being a leader in the field of structural genomics, an area critical for discovering new drugs to treat disease. Heads up the international Structural Genomics Consortium.
RODERICK MCINNES
Anne and Max Tannenbaum Chair in Molecular Medicine, The Hospital for Sick Children
Known for his work in retinal and eye development, and for identifying the genes related to inherited retinal degenerative diseases. He and Toronto scientist Derek van der. Kooy co-discovered retinal stem cells. Also scientific director of the Institute of Genetics at the Canadian Institutes of Health Research.
TONY PAWSON
Distinguished Investigator, Mount Sinai Hospital's Samuel Lunenfeld Research Institute
Known for being the first to discover how cells communicate with one another, a breakthrough that could lead to a Nobel Prize in Medicine.
STEPHEN SCHERER
Director, The Centre for Applied Genomics, The Hospital for Sick Children
Known for co-discovering copy number variation (CNVs) of DNA, the most common form of genetic variation in the human genome, and for pioneering the technology to detect it. Made headlines for pinpointing the genetic roots of autism spectrum disorder.
PETER ST. GEORGE-HYSLOP
Director, Centre for Research in Neurodegenerative Diseases, University of Toronto
Known for being a world authority on the genetics of Alzheimer's disease. One of the most-cited researchers in the field, including a 2000 discovery of a key protein that causes nerve cell degeneration.
(and women) in Toronto working to save the world one medical breakthrough at a time
March 07, 2009
Joseph Hall
Megan Ogilvie
HEALTH REPORTERS

Toronto is a hothouse of scientific study.
Some of the world's best researchers in genetics, cancer and stem cell science are lined up in labs along University Ave., producing groundbreaking work unmatched in all but a handful of locations around the world.
Some are homegrown talent, others have come to Toronto from afar to be part of the scene. All have been drawn by the city's culture of collaboration and collegiality. The Star checks in with some of the top names, profiling eight of the best.

DEREK VAN DER KOOY
DEPARTMENT OF MEDICAL BIOPHYSICS, U OF T
Education: Born in Toronto, the 56-year-old attended the University of Toronto, before doing graduate work in the Netherlands and at U of T in anatomy. He did postgraduate training at Cambridge University and the Salk Institute for Biological Studies in California.
Greatest Achievements: In seminal papers released in 2001 and 2006, van der Kooy's team showed that brain stem cells spring from embryonic stem cells in one fell swoop. Embryonic stem cells typically require many steps to transform into stem cells specific to heart, liver or skin tissue. Van der Kooy says the ease and immediacy of this transformation likely reflects evolutionary history and the importance of the brain to form quickly in animal development.
What Next: In a paper published last week, van der Kooy shows he can take this test-tube work into live animal models. A grasp of the stem cell process, he hopes, could lead to therapeutic methods to repair brain tissues damaged by trauma or degenerative diseases.
Why Toronto: Strangely, for someone with an obvious Dutch background, it is the pizzas. The closeness that has grown up around the city's stem cell community brings members together often for pizza, libations and idea exchanges.
"The people working on skin stem cells, and blood stem cells and brain stem cells, we've actually formed a pretty good group now," says van der Kooy, who helped organize the Toronto Stem Cell Initiative. "It's actually a very vibrant community right now."

TOM HUDSON, SCIENTIFIC DIRECTOR
ONTARIO INSTITUTE FOR CANCER RESEARCH
Education: MD, University of Montreal, post-doctoral work at McGill University and M.I.T.
Greatest Achievements: Hudson has many in the world of genetics. Among the highlights:
In 2000, at the Massachusetts Institute of Technology, he helped develop the first maps of the mouse and human genome.
In 2005, at McGill University in Montreal, he led the creation of the haplotype map, or HapMap, of the human genome – a tool that helps scientists identify the genes responsible for many common diseases.
In 2007, as scientific director of the Ontario Institute for Cancer Research, he co-led an international team that found the first genetic predictor for colorectal cancer, a discovery that will bring in a new era of screening for the second deadliest form of cancer in the country.
Many of Hudson's colleagues say his spirit of collaboration should be listed as one of his greatest achievements.
What Next: In his role as a geneticist, Hudson will continue to look for more regions on the human genome associated with colorectal cancer. As

head of OICR, Hudson also expects a lot of progress in 2009. The institute is on track to recruit 50 full-time lead scientists by 2012.
Why Toronto: "We have international scientists come here all the time to look at our programs, or come to see what OICR is doing to see if our model can be exported elsewhere."

JANET ROSSANT, CHIEF OF RESEARCH
THE RESEARCH INSTITUTE, HOSPITAL FOR SICK CHILDREN
Education: Master's degree from the University of Oxford and PhD from University of Cambridge in England.
Greatest Achievements: Rossant was a pioneer in research into embryonic development and did some of the most important initial work on embryonic stem cells – the great-great-grandmothers of all tissue types. A 1998 paper, showing the existence of stem cells in the incipient stages of the placenta, and another in 2005 that identified the gene that was switched off to make embryonic stem cells in the earliest stages of life, helped cement her global reputation.
What Next: Rossant will soon come out with work that shows how the microscopic blastocyst, the earliest embryonic stage, decides which of its cells will become the baby and which will form the placenta that will nurture it in the womb.
Why Toronto: Lured here from England by her Canadian husband, Rossant sees the Toronto research scene as one where a built-up vibrancy and cross-pollination of ideas pushes stem cell science to the highest levels in the world.

PETER ZANDSTRA
INSTITUTE OF BIOMATERIALS AND BIOMEDICAL ENGINEERING, U OF T
Education: Graduate work at University of British Columbia and post-doctoral fellowship at Massachusetts Institute of Technology.
Greatest Achievements: Zandstra's work focuses on conceiving and building the machinery that will guide stem cells in their transformation into adult body tissues. In particular, he looks at producing blood and heart cells from stem cells. His devices – some of which could fit on the tip of a pen – mimic the cellular environments in which stem cells would naturally, and over many steps, produce such tissues.
In a paper published in 2008, Zandstra, 40, showed he could guide stem cell production by using a micro-polymer surface to introduce growth factors.
What Next: Zandstra is writing a paper that will show he can mimic and control a cell's molecular communication networks to produce new tissues, using mathematical models and bioreactor devices.
Why Toronto: "I was attracted to Toronto really by the density of stem cell science here," he says. "This is, in Canada certainly, if not in North America, a hotbed of stem-cell research."

GORDON KELLER, DIRECTOR
MCKEOWN CENTRE FOR REGENERATIVE MEDICINE, UHN
Education: PhD, University of Calgary and postgraduate work at the University of Toronto.
Greatest Achievements: A world expert in human embryonic stem cell research, Keller is best known for his groundbreaking descriptions of how those powerful cells can turn into other cell types in the body. Last spring, Keller and his team reported they had grown the earliest form of human heart cells, which could one day be used to grow new heart tissue or repair damaged heart muscle.
What Next: Keller is learning how to direct human embryonic stem cells and induced pluripotent stem cells (embryonic-like cells that have been reprogrammed from adult skin cells) into heart, blood, liver and pancreas cells.
He is also using the lab-grown human heart cells to develop and test for new drugs – the most immediate use of engineered stem cells.
Why Toronto: Considered a coup for the city, Keller was lured here from New York City's Mount Sinai School of Medicine in 2007. He said it was the world-class science that drew him back.
"What's unique here ... is the close proximity of the major institutions to each other and that allows us to interact with scientists from different institutions very easily."

JEFF WRANA
SAMUEL LUNENFELD RESEARCH INSTITUTE, MOUNT SINAI HOSPITAL
Education: The Scarborough native received his PhD in biochemistry from the University of Toronto and held a post-doctoral fellowship at the Memorial Sloan-Kettering Cancer Center in New York.
Greatest Achievements: Wrana looks at how biological pathways that control normal human growth become "messed up" in cancer progression. Specifically, he looks at how the protein products of key genes interact to promote development and what goes wrong in the case of cancers. A watershed 1994 paper, written during his post-doctoral research, showed how one signalling molecule that has turned rogue in cancers actually communicates with cells.
What Next: An upcoming paper will describe how a pathway that controls a cell's spatial reference – left, right, up and down – can cause such ailments as spina bifida if it doesn't work properly.
Why Toronto: "Toronto in the last 20 years has seen a dramatic enhancement in the science that's going on here, the people that are here, the collegiality between scientists is very critical," Wrana says. "It's been a meteoric rise in the quality of the science and the excitement level."

BILL STANFORD
INSTITUTE OF BIOMATERIALS AND BIOMEDICAL ENGINEERING, U OF T
Education: PhD at University of North Carolina at Chapel Hill.
Greatest Achievements: The Stanford lab is trying to understand the complex molecular mechanisms that control how stem cells differentiate into various cells of the body. This is crucial in understanding what goes wrong in development to cause a wide range of diseases. Recently, Stanford and his team identified an important gene that controls whether or not a stem cell will differentiate into other cell types. They found that this gene is mis-expressed in a number of cancers, suggesting it could be linked to cancer development.
What Next: Stanford is working with induced pluripotent stem cells, or iPS cells, now considered one of biology's hottest fields. These embryonic-like stem cells have been reprogrammed from adult human skin, allowing scientists to generate stem cells from individual patients, a key component in personalized medicine.
As co-director of the Ontario iPS Cell Facility, he and his team have generated 10 disease-specific cell lines, including one for cystic fibrosis, and hope to bank many more in 2009.
Why Toronto: "Toronto was so famous for stem cell research and its collegiality, we (he and his wife) chose to come to Toronto over Boston for our training. We loved it so much that we never left."

FREDA MILLER
DEPARTMENT OF MOLECULAR GENETICS, U OF T
Education: PhD at University of Calgary, postgraduate work at California's The Scripps Research Institute.
Greatest Achievements: Miller is internationally recognized for her work on neural stem cells, responsible for generating the body's nervous system. Her team has made critical advances in understanding how these cells develop and establish connections, and are using that knowledge to investigate ways to repair spinal cord injuries and find possible cures for neurodegenerative diseases.
In 2001, in Montreal, Miller made headlines for showing that stem cells could be harvested from adult human skin. In 2007, in Toronto, she reported that skin-generated stem cells could help repair spinal cord injuries in rats. Last year, the Miller team identified a new gene that may raise a person's risk for neurodegenerative diseases, such as Alzheimer's.
What Next: Miller and her team will focus more on stem cells that form the brain – and what goes wrong during the formation that can lead to cognitive dysfunction, from learning disabilities to fragile X syndrome to autism.
Why Toronto: "When you are surrounded by really great scientists who are also wonderful colleagues and friends, then things happen in new ways. Because you trust that the science will be excellent and you trust

that the personal interactions will be excellent ... We really have a unique "we-can-do-it" kind of attitude."