2010 Collegiate Inventors Competition Press Kit

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Graduate Finalists

Alice Chen
Harvard University / MIT
Humanized Mouse via Tissue-Engineered Liver Mimetics for Drug Development
Advisor: Sangeeta Bhatia
Download Chen image
Photo courtesy of Alice Chen

Although mice are widely used in medical research, they're often not helpful for pharmaceutical testing. The liver is where many drugs are broken down, or metabolized, and mouse livers and human livers metabolize substances differently.

Chen has developed a way to implant human liver cells in mice. Her approach is different than other existing techniques in that she implants a matrix that contains functioning human liver cells and the nutrients they need directly into a healthy mouse. The matrix, once implanted, performs functions much like a human liver, making it beneficial for drug testing and other therapeutic applications.

Chen, 29, grew up in San Jose, CA, graduating from Leland High School in 1999. As a youngster, she loved to study living things, and after receiving a simple microscope as a gift , found herself looking at anything she could find. Although she considered becoming a physician, she turned her attention instead to bioengineering since it offered a way to bring a practical approach to studying living things. Chen attended the University of California, Berkeley for her B.S. in bioengineering and is currently a doctoral candidate in Harvard-MIT's joint program in Health Sciences and Technology. After graduation, she looks forward to joining a biotechnology venture , helping her to understand how to realistically get innovations through regulations, to the market, and into the hands of those who use and need them.

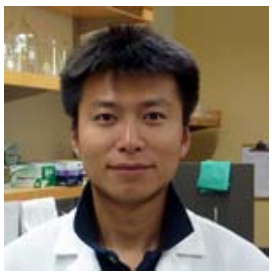
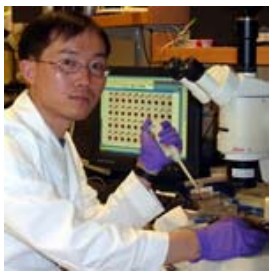

Erez Lieberman-Aiden and Nynke L. van Berkum
Harvard/MIT
University of Massachusetts Medical School
Hi-C: Method for Genome Sequencing in Three Dimensions
Advisors: Eric Lander, Job Dekker
Download Lieberman-Aiden image
Photo courtesy of Erez Lieberman-Aiden
Download van Berkum image
Photo courtesy of Nynke L. van Berkum

With their invention, which they call Hi-C, Lieberman-Aiden and van Berkum have found a new way of viewing the human genome in three dimensions, showcasing how the DNA is folded into the nucleus of a cell in an efficient and functional way.

Until this invention researchers have been unclear on how a genome folds six-feet of itself into a tiny nucleus. The pair's three dimensional genome sequencing allows them to focus on questions about genome folding and how the folds change. They speculate that aberrations in genome folding could relate to human disease, which would provide the potential to help prevent or treat devastating diseases such as cancer.

Lieberman-Aiden, 30, a native of New York City, graduated from high school at Yeshivah of Flatbush in 1997, and received his undergraduate degree in mathematics from Princeton in 2002. In addition, he holds master's degrees in history and applied physics from Yeshiva University and Harvard. He recently received his Ph.D. from Harvard-MIT's Division of Health Sciences and Technology and serves as a Fellow with the Harvard Society of Fellows. When he first entered graduate school, Lieberman-Aiden knew that he wanted to conduct research at the interface of science, technology, and medicine. For the future, his goal is to run a university research group that looks at basic science and medicine, and to teach an undergraduate course that will excite a new generation about science.

Van Berkum, 33, attended school in her native Holland, and at the University of Utrecht, received her M.S. degree in biomedical sciences and her Ph.D. in molecular biology. From the time she was young, she loved the idea of performing experiments in a lab and solving puzzles, and in her field today, she hopes to understand how the process of different cell types using different parts of DNA to carry out their individual jobs is regulated. Until earlier this year, she conducted postdoctoral research at the University of Massachusetts Medical School. Now, she is a scientist at the Dutch Research and Development Institute for Applied Science where she brings different fields of science together to find innovative solutions for industry and society in the areas of microbiology, food, and human health.

Feng Shen and Wenbin Du
University of Chicago
High Throughput Multiplex Nanoliter PCR on a SlipChip
Advisor: Rustem Ismagilov
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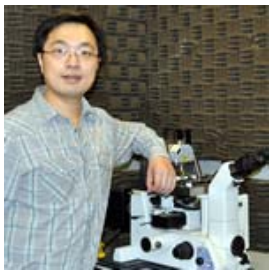
Photo courtesy of Feng Shen
Download Du image
Photo courtesy of Wenbin Du

The polymerase chain reaction, or PCR, allows for the amplification of a small amount of DNA, which in turn allows for widespread testing and research involving DNA. The widespread use of PCR has many lab uses, including identifying diseases, other diagnostics, and profiling in forensic science.

Feng Shen and Wenbin Du have found a way to implement PCR on a plastic or glass slide suitable for use in the field, providing a way to conduct inexpensive and portable PCR. Their SlipChip is a chip that uses two pieces of plastic or glass that are etched on the surface. The etched surfaces can create channels for fluids, and when the pieces are moved, the channels close off and become individual test beds. The pair note that there would be tremendous use in resource-limited settings, such as those found in poverty-stricken or third world areas.

After receiving his B.S. in chemistry from Tsinghua University in his native China, Shen, 28, came to the University of Chicago to study for his Ph.D., which he received in September of 2010. He selected the university because of its research program in microfluidics and his admiration for his advisor, Prof. Rustem Ismagilov, and is proud of his accomplishment since he is the first in his family to receive a Ph.D. During his time in graduate school, he asked himself about unmet needs and how a successful invention could change people's lives. In the future, he hopes to develop new microfluidic platforms to understand and treat diseases.

Du, 30, also is a native of China, attending Zhejiang University for his B.S. in chemistry and his Ph.D. in analytical chemistry. He was attracted to the University of Chicago for his current postdoctoral research because of its status as a leading intellectual community on sciences, law, and economics. Like Shen, he admired the work of Rustem Ismagilov in the field of microfluidic technologies. He hopes that their device will be able to lead to low cost and point-of-care diagnosis tools to fight diseases and benefit human health.



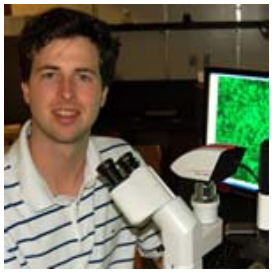

Bozhi Tian and Tzahi Cohen-Karni
Harvard University
Three Dimensional, Flexible Nanoscale Field Effect Transistors as Intracellular Probes
Advisor: Charles Lieber
Download Tian image
Photo courtesy of Bozhi Tian
Download Cohen-Karni image
Photo courtesy of Tzahi Cohen-Karni

Tian and Cohen-Karni have developed a tiny electronic cell probe that is capable of observing and monitoring the inner electrical workings of living cells. A technique for listening to cells' electrical activity has been around since the 1970s, but the technique is passive and difficult to amplify. This team's method allows them to use a V-shaped silicon nanowire as a field-effect transistor, which can be inserted into cells such as cardiomyocytes and neurons to monitor signals within. Their work has the potential to greatly enhance basic medical science investigations.

Tian, 30, grew up in China, where he received his B.S. and M.S. degrees in chemistry from Fudan University. Earlier this year, he received his Ph.D., also in chemistry from Harvard, and he is now conducting postdoctoral work at MIT. He is fascinated by the impact that nanoscience and nanotechnology have on many fields, ranging from medicine, electronics, biomaterials, and energy production. As a youngster, Tian spent a great deal of time drawing and painting macroscopic 3-D objects. Today, he continues to make 3-D objects, but with orders-of-magnitude smaller features using nanotechnology.

Cohen-Karni, 34, grew up in Holon, Israel, and received a B.S. in materials engineering and a B.A. in chemistry from the Technion Israel Institute of Technology. He also received his M.S. in chemistry from the Weizmann Institute of Science. It was during his time there that he attended a talk by Prof. Charles Lieber of Harvard, which led him to his current position, a Ph.D. candidate at Harvard in Lieber's group. Cohen-Karni finds nanoscience to be at the frontier of research in materials science, with many directions to explore and many

questions to investigate. He is excited to be a pioneer in the field and looks forward to leading a research group in materials science in the future.



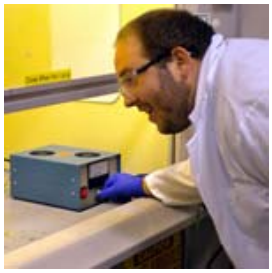
Thomas Vierbuchen
Stanford University
A Method for Reprogramming Skin Cells into Functional Neuron-Like Cells
Advisor: Marius Wernig
Download Vierbuchen image
Photo courtesy of Thomas Vierbuchen

Vierbuchen has devised a protocol that can turn fibroblasts, a type of cell found in connective tissue, into cells that act like neurons, the basis of the nerves and brain. His new technique is quick, efficient, and inexpensive and has positive implications for the study of disease, especially neurological diseases such as Parkinson's and Alzheimer's.

Although a technique has existed since 2006 that can culture fibroblasts into neurons, the process is long and takes much effort. Vierbuchen's protocol, a vast improvement over that technique, is all the more impressive because he made his discovery as an incoming grad student in the space of just a few weeks.

Originally from Charlottesville, VA, Vierbuchen, 25, graduated from St. Anne's-Belfield High School in 2003. He received undergraduate degrees in biology and anthropology from the University of Pennsylvania, and is currently pursing his doctorate in cancer biology at the Stanford University School of Medicine. He finds cellular reprogramming a fascinating field because it combines developmental biology with regenerative medicine, potentially making advances that could have important implications for human health. Vierbuchen also enjoys the fast pace of research in the field, which often presents exciting and new advances.

Undergraduate Finalists


Devon Anderson, Jonathan Guerrette, and Nathan Niparko
Dartmouth College
Absorbent, Bioresorbable Surgical Sponge
Advisor: Douglas Van Citter
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Photo courtesy of Devon Anderson
Download Guerrette image
Photo courtesy of Jonathan Guerrette
Download Niparko image
Photo courtesy of Nathan Niparko

Sometimes during surgeries, sponges that have been inserted to keep the surgical site clear of fluids are forgotten and left in the patient's body, leading to infections and other complications.

Anderson, Guerrette, and Niparko have designed a new kind of absorbent sponge using a novel combination of materials, including cellulose and alginate, and a novel fabrication method involving electrospinning. If accidentally left in a patient's body, the sponge can break down into harmless substances that can be absorbed by the body.

The three team members graduated in 2010 from Dartmouth with their undergraduate degrees, Anderson and Niparko in biomedical engineering and Guerrette in chemical engineering. Anderson, 23, is now a researcher at a Veteran's Administration hospital where he is able to devote his time to continued research on the bioresorbable sponge. A graduate of Carson High School in Carson City, NV in 2005, he has aspired to be a surgeon from the time he was young, and after spending a year on his current research, plans to enter an MD/PhD program. Through his study of biomedical engineering, Anderson has discovered that surgeons use many devices and techniques that would be inaccessible without engineering development and innovation.

Guerrette, 23, is in a graduate engineering program at Dartmouth while he continues to conduct part-time research on the project with Anderson. He grew up in Wells, Maine and was a 2005 graduate of Berwick Academy. Before attending Dartmouth, he spent three years at Colby College where he received a B.A. in chemistry and physics in 2009. With his work on the bioresorbable sponge, Guerrette is hoping to drastically reduce the amount of complications that arise for patients when a sponge is left behind.

After graduating from Dartmouth, Niparko went to work as an analyst for Audax Group Private Equity. He is a 2005 graduate of Gilman School in Baltimore.



Michael Harm, Gregory Capece, and Nicholas Rocha
Lehigh University
MPlug
Advisor: Pasquale Costa
Download Harm image
Photo courtesy of Michael Harm
Download Capece image
Photo courtesy of Gregory Capece
Download Rocha image
Photo courtesy of Nicholas Rocha

The elderly or those with a disability can often find it difficult to plug or unplug common household appliances. Harm, Capece, and Rocha wanted to make it easier for them. The result was the MPlug, an electrical plug and wall socket combination.

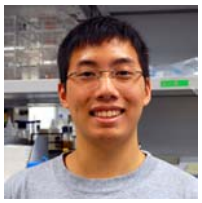
By using magnets, the two pieces can pull towards each other, allowing the plug to fall into place without any force. Electrical contacts within the device are in concentric rings, so no matter how the pieces connect, current can flow. Plugging an appliance is just a matter of letting the magnets do the work, and unplugging one is just a matter of a slight pull.

Harm and Capece, both originally from New Jersey, received their B.S. degrees from Lehigh's Integrated Business and Engineering program, and look forward to receiving B.S. degrees in Industrial Engineering next. Harm, 23, is a 2006 graduate of Christian Brothers Academy, and he is particularly proud of advancements his team has made with the MPlug, including filing for a patent, winning seed funding, and seeing the prototype they constructed actually work.

Capece attended North Hunterdon High School, graduating in 2006. He serves as the president of Plug Away, Inc., the company founded by the trio to develop the MPlug.

Rocha, 22, from Vero Beach, Fla., graduated from Vero Beach Senior High School in 2006, and received his B.S. in Integrated Business and Engineering in May 2010. He looks forward to receiving his M.S. in Analytical Finance in May. Rocha enjoys the information and systems engineering focus of his undergraduate degree, which taught him optimization and to consider how things can be done more efficiently.






Leyla Isik, Salina Khushal, Michael Shen, and Emilie Yeh
Johns Hopkins University
Intelligent Surgical Drill for Improved Orthopedic Surgery
Advisor: Robert Allen
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Photo courtesy of Leyla Isik
Download Khushal image
Photo courtesy of Salina Khushal
Download Shen image
Photo courtey of Michael Shen
Download Yeh image
Photo courtesy of Emilie Yeh

This team took what seemed like a simple challenge in their biomedical engineering design course: to find a way for surgical drills to provide guidance or warning when in use on a patient. In orthopedic surgeries, drilling in bone to place screws or plates is commonplace. Surgeons must mostly rely on practice, skill, and intuition when guiding and stopping a drill to keep from damaging surrounding tissue or bone.

Isik, Khushal, Shen, and Yeh determined that by using an accelerometer on a standard surgical drill, they could detect sudden changes in drilling speed, such as when a drill clears a bone. They also determined that they could detect changes in tilt and direction of the drill, vital for keeping a surgeon's drilling on a correct angle. They hope that their new drill guidance device will soon be used to train and guide orthopedic surgeons everywhere.

All four team members are May 2010 recipients of their B.S. degrees in biomedical engineering from Johns Hopkins. From Syracuse, NY and a 2006 graduate of Fayetteville-Manlius High School, Isik, 22, served as the team leader. She is currently a Ph.D. student in computational and systems biology at MIT, as she has great interest in the intersection of biology and computation and using this combination to address health and medical problems.

Khushal is pursuing an M.S. in physiology and biophysics at Georgetown, and also serves as a research assistant at Johns Hopkins in the Department of Materials Science and Engineering.

Shen, 21, originally from Houston, TX, is a 2006 graduate of Pikesville High School. Now completing a postbaccalaureate research fellowship at Johns Hopkins, Shen plans to enroll in an MD/PhD program. He enjoys biomedical engineering because it allows him to take a quantitative approach to understanding the complexities of the human body and then apply that knowledge to creating novel treatments for disease.

Yeh, 22, is employed with Accenture in Washington, DC. A native of Buffalo Grove, IL, a suburb of Chicago, she graduated from the Illinois Mathematics and Science Academy (IMSA) in 2006. She applied to IMSA because she knew she wanted to receive a rigorous education focused on math and science and also participate in their high school research program. Yeh hopes to return to school in a few years to pursue an MBA, and eventually, to be an executive of a medical technology or related healthcare company.

Mark Jensen
Brigham Young University
Continuous Fabrication of Composite Lattice Pole Structures
Advisor: David Jensen

Download Jensen image
Photo courtesy of Mark Jensen

When Jensen was young, his father invented IsoTruss struts—poles made of specially braided cords hardened with resin that were lightweight but structurally, very strong. The IsoTruss had never received widespread use, however, because of the difficulty in manufacturing the complex braiding patterns necessary to build it.

When Jensen got to college, he thought about the challenges that his father faced and invented a new machine to produce structures like the IsoTruss. The machine is programmable, fault-tolerant, and capable of intricate braiding patterns, far beyond the capabilities seen in other industrial braiding machines.

A 2010 graduate in chemical engineering from Brigham Young University, Jensen, 23, also previously received his associate's degree in science the same year he graduated from high school. He lives in Provo where he is the CEO of Altus Poles, the company he founded to manufacture composite poles and where he works on developing his machinery.

A 2004 graduate of Springville High School in Utah, Jensen sees his machinery as not just a tool to assist in the improvement of civil infrastructure, but also as being eco-friendly and efficient. He looks forward to continuing to grow Altus Poles, including through the selling of licenses for its intellectual property.




Jacob Murray, Paul Wettin, Carla Heathman,
and Jeffrey Sweeney
Washington State University
USB Data Transfer and Storage Device
Advisor: Denny Davis
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Photo courtesy of Jacob Murray
Download Wettin image
Photo courtesy of Paul Wettin
Download Heathman image
Photo courtesy of Carla Heathman
Download Sweeney image
Photo courtesy of Jeffrey Sweeney

USB flash drives have become standard tools in day-to-day life at work, school, and home. Faced with the need to copy material from one USB drive to another, but finding themselves without a computer, Murray, Wettin, Heathman, and Sweeney together worked to create their USB Data Transfer and Storage Device.

Their invention is designed to connect to any USB memory drive, and, through a readout and controls on the small device, will allow the user to select data to be copied to another drive. Once selected, it takes just seconds for transfer to occur, all without starting up a computer. The team continues to work on their device and hopefully take it to market soon.

All four team members are 2010 graduates of Washington State University, Murray and Wettin with B.S. degrees in computer engineering, Heathman with a B.S. in electrical engineering, and Sweeney with a B.A. in business administration, focusing on entrepreneurship. Murray, 22, has continued his studies at WSU and is working towards his Ph.D. in electrical and computer engineering. He grew up in Tri-Cities, WA and graduated from Pasco High School in 2006. During his time there, he always was drawn to math, the sciences, and computers, added to the fact that he had an interest in electrical engineering due to his electrician father. He finds computer engineering a fascinating field with great opportunities to provide positive influence to the world around him.

Wettin, 23, is a native of Anchorage, AK where he attended Dimond High School, graduating in 2006. He also continues his studies at WSU by working towards his Ph.D. in electrical and computer engineering. Although his childhood goals included becoming a hockey player, fireman, police officer, and astronaut, all at the same time, he went into computer engineering because of his affinity for math, science, and computer programming.

Originally from Renton, WA and a 2002 graduate of Hazen High School, Heathman, 26, is now employed as an engineer with Relay Application Innovation. She has always been interested in finding creative solutions to problems, and with engineering, she is able to do

that. She hopes to always be constantly learning new things, and in the future, to help others by mentoring those new to the field.

Sweeney, 27, works for the Department of Veterans Affairs, helping disabled veterans establish their entitled benefits. Sweeney grew up in Tumwater, WA, graduating from Tumwater High School in 2001. Sweeney spent five years in the U.S. Army where he was a sergeant and team leader and during which time he received numerous decorations. He has a passion for business and entrepreneurship and one day, plans to establish his own business relying in part on the skills learned from his entrepreneurship degree.