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Winners of Competition to Reimagine the Chemistry Set Announced

Microfluidics "Lab on a Chip" Takes First Prize and $50,000 Award in Prototype Category

April 8, 2014 (Palo Alto, Calif.) – The Gordon and Betty Moore Foundation and Society for Science & the Public (SSP) today announced winners of the Science, Play and Research Kit (SPARK) Competition, a challenge to reimagine the chemistry set for the 21st century. Winners were selected in two categories: prototypes – projects that are operational and demonstrable - and ideations – fleshed out project ideas that have not yet been developed into prototypes, but have a strong potential for development.

The SPARK Competition focused on science beyond chemistry, challenging the nation's most creative minds to develop projects and ideas that will encourage imagination and interest in science and technology, inspiring today's children – often through immersive play and learning through doing - much as the classic chemistry kit inspired earlier generations to learn, explore and discover. Many of today's scientific innovators – including Moore Foundation and Intel co-founder Gordon Moore – attribute their early fascination with science to their childhood chemistry sets. Yet, the chemicals in these classic sets are now illegal and replacement sets often lack elements of excitement and wonder. The competition sought to elicit new catalysts that could foster the persistent curiosity and creativity that lead to longer term engagement in science and engineering, as well as to put a spotlight on the importance of experiences that ensue from unscripted exploration and tinkering.

"As a whole, these winners conveyed an exciting variety of ways to get kids hooked on science and engineering," said Paul Gray, PhD, interim president of the Moore Foundation. "We need these different entry points to cultivate a long-term interest in exploring science and technology."

The Winners

Manu Prakash, PhD (Stanford, CA), an assistant professor of bioengineering at Stanford University, and his graduate student George Korir – who created what could literally be a 21st century chemistry set - won the first place award of $50,000. Prakash and Korir developed a prototype of an inexpensive "lab on a chip" using a technology known as "microfluidics." Microfluidics uses programmable microchips containing miniature pipes, valves, and pumps to carry out a wide variety of chemistry or biology experiments. Until now, the high cost of this leading edge technology has confined its use to major laboratories. Prakash has found a way to produce very inexpensive (about $1) yet fully functional versions of this technology that children can use to design and carry out their own experiments – much as they would with traditional chemistry sets, but now using a safer self-contained kit with nanoliters of chemicals, enzymes and other reagents.

Second prize ($25,000) in the prototype category was won by Robijanto Soetedjo, MD, PhD (Kenmore, WA), a neurophysiologist with the University of Washington. Dr. Soetedjo developed a toy set that children can experiment with to see the effects of the electrical signals produced by their muscles, their hearts, and even their brains. Electrodes are attached to a part of the body, such as the forearm, and to another device that shows them the effects of their electrical signals. For example, by tightening a hand grip, the child can turn on a light, spin a propeller, control a motor or (through an audio amplifier) emit a sound. The toy set can also interface with a range of computer devices and helps opens up the space of neuroscience and biofeedback as areas for children to explore in play.

Tying for third place ($10,000) were a team led by biologist and geologist Barnas G. Monteith (Tumblehome Learning, Inc.), of Brockton, MA, and including Pendred Noyce, MD (Weston, MA) and Peter Wong (Brighton, MA); and a group led by physicist Deren Guler (Brooklyn, NY), along with Michael Rule (Providence, RI) and Laura Miller (Brooklyn, NY).

The Tumblehome group, which also won second place in the ideation category for a related idea, developed what they call the "SenSay Sensor System." The system is a modular all-in-one sensor and exploration kit with online supports. The kit lets explorers experiment with physics, environmental energy, biology, chemistry and engineering design without having to solder parts together or use a pre-existing bulky microcontroller. The sensor allows users to gather data, provides output on a computer, and provides immediate feedback via sound, light, and graphs. The kit provides a novel way to get children interested in – and interacting with – data and its analysis.

The Invent-abling team created a number of gender-neutral kits that enable young inventors to create science and craft-based projects using such materials as color-changing fabric, switches, magnetic viewing film, conductive ink, and electronics. The kits provide opportunities to learn science concepts while children explore creative applications. The group has made an explicit commitment to engaging girls and under-represented young people in the fun, thrill and work of "making." The kits evolved from the group's realization that, although there are great kits for creating electronic gadgets and wearable devices for young designers, many are geared more toward boys.

Prototypes awarded honorable mention ($5,000 prize) included 4-D printing software and technology, an earth and space systems kit, a cardboard circuitry kit that requires building and soldering from scratch, data visualization and pattern recognition software for young children, and an expandable home science exploration kit.

Winning a first prize of $5,000 in the ideation category is David M. Gertler (San Francisco, CA), a manufacturing engineer with Google X/Makani Power, for his "Survival Shelter Science Project." The proposed project would use a narrative theme to engage young people, ages eight and up, to build and experiment with the goal of improving or creating a desert relief shelter. Scientific techniques and engineering solutions would be applied to real-world materials. The project, which could be done by an individual child or group of children, would require the young experimenters to expand on general instructions in order to build, and provide power and water to, a model shelter. Users would be provided with inexpensive instruments – such as thermometers and voltmeters - to enable them to take simple measurements of the mechanical functions of their "shelter."

Second prize ($2,500) in the ideation category was won by the Tumblehome Learning team, this time led by physician and science education advocate Pendred Noyce, MD (Weston, MA), along with Barnas Monteith and Peter Wong. Dr. Noyce and colleagues developed the concept of SenSay Sustainable Villages©. If developed, the project will allow young people to design and build model solutions to universal problems of human settlement, including shelter, heat and insulation, lighting, solar and wind power, pumping and purifying water, growing plants with irrigation or hydroponics, and managing a pond or aquarium. Users would experiment both virtually and in the real world, where they will use sensors and other components of the SenSay Sensor System to model solutions to challenges.

Winning third prize ($1,500) in the ideation category is Douglas Thornton (Columbus, OH), an electrical and computer engineer with Battelle Memorial Institute, for “The Physics Ball – A Microscope for Physics.” As envisioned, the “Microscope” provides students with an engaging, explorative learning tool through the embedding of sensors inside a small ball. These sensors would measure acceleration, angular rate, magnetic field, pressure and temperature. A wireless link would transfer measurements from the ball to a user interface (computer or tablet), which would provide data to the student. The user interface would define experiments, and could be used with free apps and open-source software.

Competition Entrants

Entrants came from all walks of life, including K-12 science teachers, undergraduate and graduate students, university professors, engineers, architects, toy designers, scientists and inventors, among other professions. Nearly all states were represented.

“With a remarkable range and quality of entries submitted, our judges were challenged to narrow down the top winners,” said Rick Bates, interim CEO and chief advancement officer, SSP. “The prototypes and ideas of our winners have an especially strong potential to be developed and to inspire kids to explore their world while developing a passion for science.”

One hundred twenty-five entries were received in the competition, which awarded a total of $136,000 in prize money. Sixteen projects were selected for recognition. (Complete list of winners provided below.) Entries went through several rounds of judging by groups of independent evaluators selected for their scientific, engineering or education expertise. Prototype and ideation entries were judged by two separate pools of evaluators, and top-ranked entries were reviewed by a select group of judges.

“These projects exemplify the qualities that we should encourage in science education: hands-on problem solving inspired by curiosity about how things work,” said UCSF Professor Emeritus Bruce Alberts, PhD, who recently retired as editor-in-chief of *Science*, served as president of the National Academy of Sciences, and has been a long-time, tireless advocate for science education. Dr. Alberts sits on the Moore Foundation’s board of trustees.

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	Prototype Category				
Place	**Winner(s)**	**Project**	**Hometown**	**Institutional Affiliation***	**Prize**
First	Manu Prakash, PhD, George Korir	“Punchcard Programmable Microfluidics”	Stanford, CA	Stanford University	$50,000
Second	Robijanto Soetedjo, MD, PhD	“Bioelectricity Toy Set”	Kenmore, WA	University of Washington	$25,000
Third	Barnas G. Monteith, Peter Wong, Pendred Noyce, MD	“SenSay Sensor System”	Brockton, Brighton, and Weston, MA	Tumblehome Learning, Inc.	$10,000
Third	Deren Guler, Michael Rule, Laura Miller	“Invent-abling”	Brooklyn, NY; Providence, RI; Brooklyn, NY		$10,000
Hon. Mention	Stephen H. Lewis	“Big Data for Little People”	New York, NY	New York Hall of Science	$ 5,000
Hon. Mention	Margaret Richards, Peter Friedman	“HEXPODS”	Pittsburgh, PA, Chicago, Il	Carnegie Mellon University, Argonne National Laboratory	$ 5,000
Hon. Mention	Joel Rosenberg	“Cardboard Circuits”	Washington, DC		$ 5,000
Hon. Mention	Robert B. Thompson	“EK01 Earth & Space Science Kit Prototype”	Winston-Salem, NC	The Home Scientist, LLC	$ 5,000
Hon. Mention	Skylar Tibbits, Jon Haines, Carlos Olguin, Shelly Linor	“4D Printing – Transforming Educational Models”	Boston, MA; Brookline, MA; San Francisco, CA; Rehovot, Israel	MIT Self-Assembly Lab, Stratasys Ltd., Autodesk Inc.	$ 5,000

Young Innovator	Nikhil Buduma	"Pulse6: Bringing Hands-on Chemistry Education to Life with the Sixth Sense"	Cambridge, MA	MIT	$ 2,500
Young Innovator	Mikhail Yakhnis, Paul Chang, Oliver Kliewe	"Codeco"	Ithaca, NY	Cornell University	$ 2,500
Ideation Category					
Place	**Winner(s)**	**Project**	**Hometown**	**Institutional Affiliation***	**Prize**
First	David M. Gertler	"Survival Shelter Science Project"	San Francisco, CA	Google X/Makani Power	$ 5,000
Second	Pendred Noyce, MD, Barnas Monteith, Peter Wong	"SenSay Sustainable Villages"	Weston, Brockton and Brighton, MA	Tumblehome Learning, Inc.	$ 2,500
Third	Douglas Thornton	"The Physics Ball: A Microscope for Physics"	Columbus, OH	Battelle Memorial Institute	$ 1,500
Hon. Mention	Bonnie Lei	"The Food Lab for Kids"	Cambridge, MA	Harvard University	$ 1,000
Hon. Mention	Peter Rillero, PhD	"Tub Science"	Anthem, AZ/Phoenix, AZ	Arizona State University	$ 1,000

*In most cases, entries were submitted on behalf of an individual or team, without the involvement of affiliated organizations. Winners' affiliated organizations may or may not have played a role.