Scaling Up For Impact: Year One of the Global STEM Alliance

HIGHLIGHTS FROM THE Global STEM Summit

ROSS PRIZE WINNER Charles Serhan

REMEMBERING THE OLD Junior Academy
President's Council

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Hamid, Germany

Awards

In 1946, the Academy established the New York City Chapter, which became the New York Academy of Sciences in 1950. In 1987, the Academy established the New York Academy of Sciences Education and Development Foundation, Inc. (NYSEDF), a 501(c)(3) nonprofit organization, to support the Academy’s educational programs. In 1997, the Academy established the New York Academy of Sciences Foundation, Inc. (NYSF), a 501(c)(3) nonprofit organization, to support its scientific programs.

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Scientists don't have to read the colorful first person accounts by the Sydney Brenners, Frank Wilczeks or Svante Pääbos of our community to know that most—perhaps all—of scientific progress starts with an idea hatched by someone else. Whether novel insights are triggered by reading a scientific paper, attending a conference, or simply exchanging ideas on a social level, networking is the key to progress.

For 199 years, the New York Academy of Sciences has embodied this notion. The doctors who founded the Academy in 1817 opened Membership not merely to New Yorkers but to Europeans, and not merely to already renowned academic scientists but to industry and government leaders, and even to young innovators. The result was a community that just Bell, Edison and nearly all the renowned American scientists you would expect, but Presidents Jefferson and Monroe; John Jacob Astor and John Roebling, and also Darwin, Pasteur, Von Humboldt, Lord Kelvin, James Joule and over 100 Nobel Laureates worldwide.

But the dream wasn't about gathering names on paper; it was about encouraging the exchange of ideas through cutting-edge conferences and workshops and by disseminating insights through Annuals (and today our ebriefings and webcasts) to millions of scientists worldwide.

What if we could build on these traditional methods, and increase by orders of magnitude the opportunities for inspiration? And what if we could expand those opportunities to populations Educations of the gifted that too often have been left on the margins?

We come to the special subject of this issue: the Academy's Global STEM Alliance. This landmark initiative invites you to imagine what might arise from an advanced social network that exploits the power of 24/7 online interaction to connect places, institutions, and even age groups at unprecedented scale. Imagine the world's most promising young scientists and engineers mentoring the world's most gifted children.

And imagine tens of thousands of women scientists and engineers providing advice and inspiration to hundreds of thousands of STEM-loving girls who might otherwise lack the confidence and resources to pursue their dreams.

"Imagine tens of thousands of women scientists and engineers providing advice and inspiration to hundreds of thousands of STEM-loving girls who might otherwise lack the confidence and resources to pursue their dreams.”

Ellis Rubinstein
President & CEO

Building the World’s Smartest Network

On May 25, 1961, President Kennedy pledged that before the decade was out, the United States would land a man on the moon. It was a monumental undertaking, something we all dreamed of for thousands of years, and the nation answered his call. Hundreds of thousands of passionate individuals from the fields of science, technology, engineering, and math, or what we now call STEM, combined their efforts, and on July 20, 1969, Apollo 11 became the first spacecraft to bring human beings to the surface of the moon. Today, our goals for STEM initiatives are less focused on transcending cosmic boundaries and more focused on solving fundamental problems here on earth. From food shortages to pandemics, conquering these challenges will require armies of innovators who have not only developed their talents in STEM, but have the opportunities to deploy them.

As the new CEO of the Global STEM Alliance (GSA) at the New York Academy of Science, my team and I are focused on solving global problems by enhancing STEM reach across the globe. The GSA is a collaboration of students, scientists, and mentors—a supercharged network within the world’s smartest network. We believe STEM is the backbone of innovation and that innovation solves problems. Across the globe, few can deny the need for STEM-enhanced education. And in regions where students receive adequate STEM training, the career opportunities in STEM may be lacking. We intend to solve these problems by enhancing STEM education where needed and creating opportunities for those with STEM backgrounds. Our goal is to construct a global community of STEM-prepared individuals capable of tackling global challenges.

In only two years, the GSA has grown to an organization of 250 partners, including corporations, government agencies, NGOs, and educational institutions. We have more than 15,000 students in the GSA and currently work with scientists and industry leaders from fifty countries, each of whom offers time and resources to further our efforts. Our initiatives are truly global and are facilitated in a manner that connects students and mentors alike through our own proprietary, tech-based collaboration platform. To date, we have delivered more than 200,000 hours of STEM programming. And what comes next is even more exciting!

Over the next few months, we plan to launch an ambitious STEM certification program which has the potential to become the global standard for STEM curricula across education verticals. We are currently expanding our program offerings through our successful Junior Academy with a new, ten-week intensive STEM training program. We are working on expanding our content reach to other parts of the world through joint ventures with respected NGOs and education-focused companies. Lastly, we are developing ways to enhance and expand the reach of our digital content.

As someone who founded and built an education company, I can apply similar principles from my business experiences to help the GSA reach its goals.
First Global Stem Alliance Summit Brings Together Students From Around the World

At the end of July the New York Academy of Sciences hosted the first annual Global STEM Alliance Summit, which brought together more than 120 students from thirteen countries to gain skills, network, and interact with STEM leaders. Students from three Global STEM Alliance education programs—The Junior Academy, 1000 Girls, 1000 Futures, and Scientist-in-Residence, came together across continents and cultures to exchange ideas, discuss research, and investigate STEM careers.

At the Summit, the GSA also announced the winners of The Junior Academy’s innovation challenges. Two teams of students were named winners for their outstanding work creating novel solutions addressing major challenges in low-resource locations.

The innovation challenges took place over sixty days, during which students in The Junior Academy, a virtual program that gives exceptional students from around the world the opportunity to enhance and apply their STEM skills, formed teams and worked with STEM professionals serving as expert mentors. Students worked together—across time zones and cultures—to develop innovative solutions to two specific challenges.

1. A GSA team visits the studio at iHeartRadio.
2. Academy President Ellis Rubinstein addresses the students of the GSA.
3. Joy as two of the GSA students celebrate after a team building game.
4. At the GSA summit welcome reception, two students bond over chocolate-covered strawberries.
5. A panel discussion: “Collaboration: The Key to Unlocking Innovation.”
6. A 1000 Girls team works together to develop a product roadmap.
7. During the summit, a team of students compares notes.
8. A roadmap to innovation in Puebla, Mexico.
The Hippocampus in Mental Construction and Temporal Organization

The hippocampus, a critical portion of the cerebral cortex of humans and other vertebrates, is a lateral structure (shaded yellow in figure) that extends into the temporal horn of the lateral ventricles of the brain. First described in the 16th century, the hippocampus has a temporal element—albeit one determined by contextual changes and computational models of human and rat hippocampi with the anatomy of the hippocampus to map out a network involved in encoding sequences within memory. Through this elaborated hippocampal system, the hippocampus associates conceptually distinct memories that occur within the same sequential episodes and segregates conceptually similar events that occur in distinct temporal contexts. The authors note many future questions to explore and caveats of the current studies, including the difficulties in moving from studies examining arbitrary sequences of unrelated events and the narratively and contextually complex relationships among contingent events in real remembered experience.

Mobile Health: The Power of Wearables, Sensors, and Apps to Transform Clinical Trials

The development of sophisticated mobile technologies—including smartphone healthcare apps, wireless biosensors, wearable gadgets, and implantable medical devices—has allowed many people to take a more active role in monitoring measures of their own health. For example, patients with chronic diseases can monitor daily changes in the severity of their clinical symptoms and adverse drug events, while presymptomatic individuals can track various biological parameters related to vital signs, sleep, fitness, and mental acuity. The capacity of mobile health technologies to collect large amounts of fine-grained data about sick and healthy individuals has led many to predict the rapid integration of these technologies into everyday healthcare delivery and to address a key bottleneck of traditional clinical research, namely, the enormous costs of collecting patient data. A recent Annals issue presents a report entitled, “Mobile health: The power of wearables, sensors, and apps to transform clinical trials,” authored by researchers and professionals from the fields of science and engineering, analytics, healthcare, business, and government. The report stems from a conference jointly sponsored by Medidata and the New York Academy of Sciences that fostered an important dialogue on the promise and challenges of mobile technologies in revamping healthcare and clinical research.

Several major advantages of adding mobile technology to the design of clinical trials were discussed throughout this report, including easier patient recruitment. Using remote monitoring technologies to collect data facilitates patient recruitment and retention because of more convenient at-home trial participation, easier access to patients for whom mobility is limited, reduced travel costs, and reduced losses to follow-up. Small wearable biosensors that can unobtrusively and continuously measure quantifiable physiological endpoints in real-life settings may also provide a more complete understanding of the effects of new drugs, drug dosing, and pharmacodynamics than was previously possible. And, the gathering of data on presymptomatic individuals, mobile technologies can help uncover the etiology of disease before clinical symptoms manifest and can provide insights on diseases on numerous diseases on which researchers currently have none. In addition to easing patient recruitment and collection of patient data, mobile health technologies can also make biomedi- cal tools more accessible, through the use of smartphones. Mobile technologies lend themselves to field-portable and cost-effec- tive designs that easily integrate with smartphones to perform pathology and microscopy techniques, even in resource-poor settings where traditional techniques are difficult to implement. The use of smartphone-based biomedical tools, such as bacteria/pathogen sensors, allergen detectors, imaging flow cytometers, immunochromatographic diagnostic test readers, and blood count analyzers, could open the door to affordable high-quality mobile health applications in diagnostics, imaging, and pathology for researchers in developing countries.

Although mobile technologies clearly have the potential to improve clinical research processes, this Annals report also discusses several important issues that must be addressed, including patient privacy and data ownership. Although evidence shows that most users of mobile health technologies are open to sharing their personal health data with researchers, their participation may depend on whether the research process will uphold certain values, such as transparency, free open access, anonymity, and control over who has access to the data. Other critical issues discussed in the Annals report are those related to the rapid evolution of data gathered by these biosensors and the validation of devices, potential incorrect use of mobile de- vices, which could impair data quality; data encryption; and the performance of the technology, including battery life. Although the use of mobile health technology in clinical trials is still in the early stages, continued support from regulatory agencies and life sciences companies may pave the way for mobile health and wearable sensors in clinical research to eventually become part of the standard practice of clinical trials.

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Around a very-nearby star, there orbits an Earth-like planet that could one day be visited by mankind. Deep inside an ordinary plant, there lies a natural treatment for skin cancer. And within the cells of the human body, there is a complex language of signals that could change the face of oncology and immunology. These were the breakthroughs honored by the 2016 Blavatnik National Awards for Young Scientists.

The Awards, given annually by the Blavatnik Family Foundation and administered by the New York Academy of Sciences, honor the nation’s most exceptional young scientists and engineers, celebrating their extraordinary achievements and recognizing their outstanding promise. Each of the three National Laureates receives $250,000—the largest unrestricted cash award given to early-career scientists. This year’s Blavatnik National Laureates are:

**David Charbonneau**, Professor of Astronomy, Harvard University. Dr. Charbonneau is honored for his numerous pioneering discoveries of exoplanets. Dr. Charbonneau’s recent results include a landmark discovery of an Earth-like planet orbiting a very nearby star, dubbed “arguably the most important planet ever found outside the solar system.”

**Phil Baran**, Professor of Chemistry, The Scripps Research Institute. Dr. Baran is being recognized for his transformative research in the field of natural product synthesis. One of the recent successes in the Baran laboratory is the synthesis of the plant-derived ingenol, derivatives of which have been approved by the U.S. Food and Drug Administration to treat skin cancer.

**Michael Rape**, Professor of Cell and Developmental Biology, University of California, Berkeley. Dr. Rape is honored for his discoveries related to ubiquitination, a complex cellular language essential for information transfer and communication in nearly all organisms. By deciphering the ubiquitin code, Dr. Rape has opened the door for next-generation therapies in oncology, immunology, and inflammation.

“The Blavatnik Family Foundation is pleased to recognize and promote the extraordinary work of our Laureates and to provide resources that support and encourage further exploration,” said Len Blavatnik, Founder and Chairman of Access Industries, head of the Blavatnik Family Foundation, and an Academy Board Governor. “I am encouraged about the future of scientific thought and look forward to how the Laureates and National Finalists will inspire the next generation of scientists.”

The three National Laureates were selected from a pool of nominations submitted by 148 of the nation’s leading universities and research institutions. Each institution was invited to nominate one physical scientist or engineer, one chemist, and one life scientist. The names of highly qualified nominees were also submitted by members of the Blavatnik Awards Scientific Advisory Council.

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**Ahmed Zewail**, sole recipient of the 1999 Nobel Prize in Chemistry, Academy Member, and a member of the New York Academy of Sciences President’s Council, passed away on August 2. The Linus Pauling Professor of Chemistry, professor of physics, and director of the Physical Biology Center for Ultrafast Science and Technology at the California Institute of Technology, Dr. Zewail was 70 years old. The first Egyptian to win a Nobel in science, Dr. Zewail was a pioneer in the field of femtochemistry—the study of chemical reactions taking place at extremely short timescales. He built his first chemistry set out of the oil burner his mother used to make coffee, and pursued science with that same passion for innovation for the rest of his life.

Using lasers, Dr. Zewail was able to track chemical reactions and transformations at the atomic level occurring within almost infinitesimal moments of time. When he was awarded his Nobel, the Royal Swedish Academy of Sciences announced that his work had “brought about a revolution in chemistry.”

In Memoriam: Ahmed Zewail

At age thirteen, Richard Rifkind was beginning to worry about his future. Following the party celebrating his Bar Mitzvah, he convinced his family physician to take him along on his evening round of house calls. Before morning, the inquisitive boy was set on becoming a doctor. The practice of medicine eventually led him to basic biological research at the lab bench, a distinguished career at several of New York’s most respected research institutions, and, finally, in his retirement years, to the cutting edge of documentary film.

After time in the army, and with degrees from Yale and, in 1955, from the Columbia University College of Physicians and Surgeons, Rifkind taught at Columbia, where he led an overhaul of the curriculum designed to provide medical students with a stronger and more relevant grounding in the scientific and research elements that supported their clinical experiences.

“We are now in an era of enormous growth in scientific knowledge,” Rifkind told his medical students. “The practice of medicine must keep up with it!”

In 1984, Rifkind was appointed Chairman and director of the legendary Sloan-Kettering Institute for Cancer Research, where he presided over a complete overhaul and diversification of the Institute’s research faculty towards making the organization “more advanced and entrepreneurial.” His own laboratory work now focused on control of malignant cell growth, leading to a new class of chemotherapy, as the affiliated Memorial Hospital set strategic goals of applying developmental biology to the treatment of cancer.

In the 1990s, as a participant in high level discussions among New York’s leading scientific institutions, Rifkind was able to convince his colleagues that “to make this city able to compete for the finest research talents, we must collaborate in providing the most advanced scientific technology.” This led to the formation of the New York Structural Biology Center, a trend-setting consortium of ten biomedical institutions and the creation of a world-class, cost-efficient cooperative core facility, ultimately representing public investment of close to $100,000,000.

That talent for large-scale management challenges caught the eye of the New York Academy of Sciences, who in 1993 recruited Rifkind to serve on their Board of Governors. “We are very grateful to Dick for his years of service on our Board of Governors,” says Academy President Ellis Rubinstein. “The Academy is incredibly fortunate to have been able to draw upon someone of his stature, who could bring to the role not only a profound understanding of the scientific process, but also the accumulated wisdom of years of experience in leading complex global organizations.” Promoting a strong interest in the public understanding of science, Rifkind also served on the boards of the New York Academy of Medicine and the New York Hall of Science.

Further afield, Rifkind took an adventuous leap into film making, seeing the documentary as a way of awakening public concern for the terrible impact of mass tourism on a dearly loved city, Venice, where he had a second home. Working with his wife, Carole, an author and architectural historian, he produced and directed The Venetian Dilemma, a film about a city that the New York Times’ review of the film noted as “being admired to death” that was shown on public television and film festivals in the U.S. and abroad.

“It amazed me to learn that making a film is very like doing science,” Rifkind says. “It’s a continuous process of asking questions and solving problems. You can’t let yourself give up.”

Upon retiring from Sloan Kettering in 2003, he set out to make a film that encourages youth to enter the world of science. Together with Carole and his camera crew, he spent several years in repeatedly showing the experiences of three young scientists in training in a laboratory at Columbia University, not knowing if the students would fail or succeed in their projects. With a good deal of dramatic tension, one of the students achieves a remarkable success. The film received a top award from the National Academy of Science, was broadcast around the world, and is used as a teaching tool in dozens of universities. One message of the film is that “Failure is an essential step in the pathway to success.”

“As the Academy launches programs like the Junior Academy, which will impact children all over the world, Dick remains an inspiration,” says Rubinstein. “His combined success in science and filmmaking remind us that creativity is an essential ingredient in STEM.”

Rifkind is impressed by the GSA and the Junior Academy, a project he called “beautiful,” saying that if you want science to continue, “you have to invest in the young.”

Above: Richard Rifkind takes a walk through Manhattan’s Fort Tryon Park.
In 2014, the New York Academy of Science’s Education Department reached the limits of time and space. Thanks to a $2.95 million National Science Foundation grant, the department’s STEM mentoring program was working with 3,000 children annually across the New York region, from the farthest reaches of the outer boroughs to the classrooms of Newark, New Jersey. The governor of Connecticut had asked the department to bring that mentoring program to New Haven, while the mayor of Barcelona and the prime minister of Malaysia had extended invitations to take the program overseas. But Connecticut, Barcelona and Malaysia were only the beginning.
"Corporate and government heads of state became really interested in the work we were incubating here in New York," says Senior Vice President of Education Dr. Meghan Groome, "and kept asking us over and over again, 'How do we bring this to our kids?'"

When Academy President Ellis Rubenstein mentioned Dr. Groome's after-school mentoring programs during a speech at a United Nations event, the ambassadors from a dozen countries surrounded him, asking for the Academy to come their way. The Academy's mentoring program had changed thousands of lives across the New York area. Now it had a chance to change the world.

But how could the Academy scale up its unique mentoring program, which is built around close contact between STEM-trained mentors and their bright young mentees? And, at the same time, how could it use that program to patch the leaks in the global STEM pipeline, helping women, members of ethnic minorities and people from low-income or rural backgrounds get a leg up in the field?

Enter the Global STEM Alliance. Its mission: to eventually reach one million students in one hundred countries.

"We needed to be able to expand our programs in a way that anybody in the world could join," says Groome. "In order to do that, we needed to invest in technology and people who knew a lot about tech."

Achieving the GSA's mission would mean blazing new trails in online engagement, harnessing social media and groundbreaking new technology in order to replicate the face-to-face mentoring that has made the Academy's programs such a success. In a single year, the GSA went from nothing but an ambitious idea to a truly global initiative, as the Academy launched two pilot programs designed to use those partnerships for real change: The Junior Academy and 1000 Girls, 1000 Futures.

"In their first year, these programs have reached students for whom a career at the forefront of STEM was only a dream, and shown them that anything is possible."

Nineteen-year-old Olayemi Toba majors in industrial chemistry at the University of Lagos in Nigeria, and plans to pursue a career in medicine. He believes that his high school science classes spent too much time teaching him how to take tests, and not enough time giving him the practical instruction that a STEM career requires. To acquire the knowledge and proficiency to succeed in science as a vocation, not just a subject, he joined The Junior Academy.

"The Junior Academy is a roadmap to success," says Toba. "It goes beyond even science, and makes you able to create work that conforms to the standards of the scientific community."

Following Research 101, the students worked together to design a cost-effective, eco-friendly water bottle under the supervision of a Nigerian-based mentor. The Junior Academy special.

"The 101 course was just excellent," says Toba. "It goes beyond even science, and makes you able to create work that will conform to the standards of the scientific community."

The winners of the Food Loss and Waste Challenge, for instance, featured teammates from Tanzania, Morocco, the United States and China, who worked together to design a cost-effective, eco-friendly water bottle under the supervision of a Nigerian-based mentor. That's what the Academy calls making The Junior Academy special.

"It's very good to have different cultures involved," he says, "because we bring different experiences and different knowledge."

The program serves students often overlooked by their schools, whom Senior Vice President of Digital Learning Solutions Celina Morgan-Standard describes as "passionate, driven, [and who] have demonstrated aptitude and grit in STEM. They represent the STEM innovators and leaders of the future," she says, "and are crucial to helping society at large address some of the world's greatest challenges."
Eighteen-year-old Kehinde Lawal is one of the first generation in her family to be allowed to attend college in the U.S. But girls in particular are less likely to receive the encouragement and opportunity necessary to pursue STEM.

Scholars, 1000 Girls supports female students at a pivotal time in their academic careers. Many students, regardless of gender, drop out of the STEM pipeline in high school. But girls in particular are less likely to receive the encouragement and opportunity necessary to pursue STEM. Come high school, says Groome, “there’s not a lot of room for a girl to be super-cool and popular and also to be a nerdy STEM kid.”

1000 Girls aims to change that conversation, and Lawal—who enters the City College of New York biochemistry program this fall—represents a first step. The 1000 Girls curriculum helped her master the college application process and the one-on-one mentorship gave Lawal invaluable personal attention. Her mentor coached her on how to make her applications stand out and critiqued all six of Lawal’s college essays. The program also afforded once-in-a-lifetime opportunities, such as an event with Bill and Melinda Gates, where students discussed what superpowers they would want a power that could manage fossil fuels.”

The conversation generated “a lot of weird, smart ideas,” and that’s what 1000 Girls is all about, she added. Like Lawal, 1000 Girls mentor Zaleyma Peralta was the first in her family to attend college. Now a PhD candidate at the Icahn School of Medicine at Mount Sinai in New York City, Peralta says she was not just on her own while trying to make sense of the undergraduate college application process: she was also getting the runaround. As an undocumented immigrant who emigrated from Mexico when she was six years old, she says, “it’s nice to introduce those faces and that background, and change that picture.”

Although they are sometimes in the background, the GSA would not be possible without its extensive network of partners, who are drawn from different fields across the globe. “If there’s one thing I’ve learned over the past year, it’s that we as an organization are really good at managing complex partnerships,” says Groome. “The GSA represents an investment in technology, but also an investment in partnership management and all the different pieces that go into it.”

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THE POWER OF PARTNERS

In addition to developing employees’ analytic, communication, and leadership skills by engaging them as mentors, partnerships connects companies with new ideas and a large pool of young, ambitious mentees and mentors. By investing financial support and talent in these programs, Morgan-Standard says, partners strengthen their current workforce, develop a STEM pipeline, and “identify the future talent that will be leaders in their companies.”

No surprise then that over fifty companies have joined the Global STEM Alliance doing amazing things. Motorola sponsors girls in Saudi Arabia and Oman, Goldman Sachs’ women will mentor girls in Warsaw, 183 employees will mentor children in Rwanda and South Africa, and the list goes on.

NEW SOLUTIONS TO GLOBAL CHALLENGES

Creating a global mentoring program from the ground up in a world that was bound to come with some growing pains, as mentors and students dealt with—and overcame—surprising obstacles. Communication was sometimes a problem, although Toba says his team was able to break through the language barrier by speaking in English. Scheduling meetings across time zones was tricky, and students sometimes had trouble with the GSA’s technology.

“The students use very different technology than we make available to them,” says Groome. “So when we rolled out the platform, which looks a lot like Facebook, they were like, ‘Can we use Snapchat?’ To them it felt old-timey.”

The challenge most cited by program participants, however, was internet access. “[Some students] may have a computer,” Groome says, “but they may not have Internet access. They may have a phone, and it may be a smartphone, but it may not have a data plan. There are pockets of students who don’t have the phone or the computer plus the Internet access.”

Even a smartphone with data doesn’t guarantee success: Groome cites a student in the South Bronx who must squeeze her homework into a limited data plan or wait in line at the local library for a computer—an unsafe option in her neighborhood after dark.

The Academy customizes the programs as much as possible so students with limited technology can still benefit. But making do requires creativity of program, participants, and partners alike.

“We’ve seen all sorts of interesting adaptations to try to make it work,” says Groome. “In Puebla, Mexico, the girls every Saturday get on a bus and go to the local state-run education hub to get on the computers all day.”

In South Africa, where Internet connectivity can be unreliable, the South African Young Academy of Sciences, a GSA partner, allows mentees and mentors to use the organization’s computer terminals on Saturdays. The students’ willingness to adapt is testament to their drive, determination, and commitment to their futures in STEM.
A RESOUNDING SUCCESS—AND MORE TO COME

By every metric, The Junior Academy and 1000 Girls have been a fabulous success. 55% of Junior Academy students had completed Research 101 by the year’s halfway point—a number that makes Morgan-Standard very happy. “If you think about Research 101 as a massive open online course [MOOC], which is what it is,” she says, “a 55% completion rate is really high. The average MOOC completion rate is 7%.”

Of those students, 100% showed improvements in research skills, with assessment scores increasing 32% on average. All students showed improvements in communication, critical thinking, and creativity. By the end of the innovation challenges, 85% of challenge participants reported an increase in leadership skills.

1000 Girls’ retention numbers suggest similar high success. Of the more than 500 mentees and mentors enrolled in the program, more than 90% remained active participants halfway through the program year.

Morgan-Standard credits the social component as key to the program’s success. Especially for girls and students who might feel socially isolated otherwise, these virtual dialogues provide a safe space to both “feel comfortable and confident in shining their STEM skills,” says Morgan-Standard, and “seek out advice from researchers in the STEM community.”

With a Backpack

Teen AquaVita took home the prize in the Wearables challenge after proposing a remarkably portable water filtration system housed in a backpack. The proposed wearable includes a stainless steel sink filter, an activated carbon pack, and a canvas cotton cloth. The cloth is outfitted with silver nano particles which allow it to conduct a fifty nano ampere current to rid of common pathogens.

Team members Edita Bytyqi, Swadhin Nalubola, Smiti Shah and Vasdehi Shah included a TDS (Total Dissolved Solids) meter to inform the user of the purity of the filtered water. The backpack also features a GPS unit capable of data logging and mapping the water quality.

Project judges noted the submission included “great examples of the team collaborating and prototyping the ideas.” They also lauded the thorough attention to market research, as well as the team’s summary of rejected ideas, which clarified the team’s process.

The winners of the Food Loss and Waste Challenge were Asha Abbas, Oussama Amri, Ryan Bose-Roy and Yuan Yuan Wei, who designed a water bottle made from both collapsible and reusable, reducing food spoilage and waste. Made from a combination of natural rubber and polylactic acid, which is derived from starch in corn, wheat and potatoes, the bottle also incorporates a commercially-available smart labeling system that monitors temperatures and notifies the customer whether the product is safe or spoiled. The team worked with mentor Gbonjubola Amuda of Access Bank Plc., who is based in Nigeria.

This is a very innovative idea and I think there is a great market for this,” said one project judge. Another judge was impressed by the combination of an innovative material and the smart label, while a third noted the team’s focused method for addressing a major challenge.

Each student received a cash prize, as well as reimbursement for their travel to the summit. This sort of international collaboration is precisely what the Global Stem Alliance was designed to foster. An international initiative of the Academy with more than 230 partners in fifty countries and regions, the GSA was created to increase the number and diversity of students in the STEM pipeline, with a goal of reaching one million students in 100 countries by 2020. By providing hands-on research projects, mentoring opportunities with leading STEM experts, and a comprehensive, tech-based learning platform, the GSA arms students with the skills they need for successful careers. This water bottle and filtra- tion backpack show that they are well on their way.
A n environmental economist, Joy Hecht, PhD, has studied the economic impact of environmental damage everywhere from Lebanon to Malawi. But in 1974, she spent most of her free time somewhere less exciting: the Xerox room of the New York Academy of Sciences. As president of the Junior Academy, Hecht oversaw an entirely student-run opera- tion with members all over New York. We spoke to her recently to ask about her memories of the Junior Academy, and the special bond she and the other students formed.

HOW DID YOU GET INVOLVED WITH THE JUNIOR ACADEMY?
JH: I went to Hunter High School, which at that time was an all girls school. My mother told me, “You should get involved with the Junior Academy of Sciences. You can meet boys that way.” I got involved with it, initially as a way to meet boys, and it became a part of my life. I think a great deal of what made the Junior Academy awesome is that it was run by high school kids. We did all the work. No one else was telling us what to do.

WHAT WAS THE JUNIOR ACADEMY LIKE THEN?
JH: It was a place to hang out. The Junior Academy had its files in the Xerox room, so we all hung out at the Xerox machine. We were organizing events, we were doing mailings, we would get kids in after school to stuff envelopes. We always had a group of kids who were hanging around. It was very social. We were often there after five o’clock, and we had free run of the place. I distinctly remember wandering in and out of the president’s conference room after everyone went home. These were really nerdy kids—a lot of big Trekkies—so we weren’t the cool kids in after school to stuff envelopes. We always had a group of kids who were hanging around. It was very social.

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I was madder than hell, but I got over it.

We started calling up the Academy members who had labs, and asked if they were willing to take on high school kids during the summer. We put together what we called the summer opportunities booklet—we published it and distributed it. I assume there were kids who ended up working in labs because of it. That was the most important thing, to actually get kids doing stuff in science, instead of just going to lectures.

AND DID YOU MEET BOYS?
JH: Oh, yes. Paul Sullivan ended up being my first boyfriend. Mind you, I hated Paul at the beginning. He was the president the year before me, and I couldn’t wait for him to leave so I could take over, but then the summer before my senior year of high school, he called to tell me the Academy had hired him as the Junior Academy advisor. I was madder than hell, but I got over it.

Every June, one of the field trips would be a trip up to Mohonk. There was a trail there we always hiked, and it’s something my cohort at the academy kept doing every summer for four or five years after high school. When Paul died in 1999, we all found each other again, and we went on the same trail at Mohonk, and we planted a tree in his memory. We didn’t stay boyfriend and girlfriend very long, but we stayed good friends throughout his life.

WHEN YOU BECAME PRESIDENT, HOW DID YOU CHANGE THINGS?
JH: I started out doing the same stuff the Academy had been doing all along. That fall, my mother took me and my sister out to San Francisco to look up the California Academy of Sciences, and I spent a bunch of time talking to the guy who ran their Junior Academy.

He asked me, “When you look back on this experience, what do you want to have accomplished? Do you want to feel like you did something new, or do you want to have just kept the Junior Academy what it was?”

“WHEN YOU LOOK BACK ON THIS EXPERIENCE, WHAT DO YOU WANT TO HAVE ACCOMPLISHED? DO YOU WANT TO FEEL LIKE YOU DID SOMETHING NEW, OR DO YOU WANT TO HAVE JUST KEPT THE JUNIOR ACADEMY WHAT IT WAS?”

So I went home, and I told the group: “We organize lectures, and we do field trips, but it doesn’t really make any difference. What we need to do is get these kids working in science, to see if they like it.”

I started calling up the Academy members who had labs, and asked if they were willing to take on high school kids during the summer. We put together what we called the summer opportunities booklet—we published it and distributed it. I assume there were kids who ended up working in labs because of it. That was the most important thing, to actually get kids doing stuff in science, instead of just going to lectures.

Innovating Molecular Medicine through the Resolution of Inflammation

Charles Serhan’s groundbreaking research is changing the way we view inflammation and the strategies for its therapeutic resolution.

Daniel Radloff, PhD, NYAS

T he 2016 Ross Prize in Molecular Medicine was awarded to Charles N. Serhan, PhD, DSc, who serves as the Simon Gellman Professor of Anesthesiology, Perioperative and Pain Medicine at Harvard Medical School and Professor of Oral Medicine, Infection and Immunology at Harvard School of Dental Medicine. A pioneer in the field of inflammation resolution research, Dr. Serhan was the first researcher to identify anti-inflammatory cellular mediators, including resolvins and lipoxins, which are critical in regulating the pro-inflammatory pathway. These discoveries have paved the way for increased understanding of how the resolution of inflammation can be translated into therapies for a variety of human diseases. We sat down with Dr. Serhan to discuss the award, the scope and impact of his research, and the importance of mentorship in developing the next generation of scientists.

WHAT IS THE CURRENT RESEARCH FOCUS OF YOUR LABORATORY?
CS: The main research focus of the lab is the elucidation of the mechanisms involved in the resolution of inflammation and structural elucidation of the mediators in order to understand organ protection and collateral tissue damage, as this is the basis of many diseases and the collateral stress and damage for surgical interventions.

HOW DID YOU CHOOSE MEDIATORS OF THE INFLAMMATORY RESPONSE AS THE BASIS OF YOUR WORK?
CS: I have always been interested in chemistry and biochemistry. The notion of chemical mediators orchestrating the immune response intrigued me from learning about things like histamines and the early prostaglandin research. You could say I have stuck with this research through my entire career, as there were enough questions to ask to go deeper and deeper which led to resolution, which no one had really studied before in a mechanistic fashion.

WHAT WAS THE “EUREKA” MOMENT, WHEN YOU REALIZED THAT YOUR RESEARCH ON THESE PATHWAYS COULD BE USED FOR THERAPEUTIC PURPOSES?
CS: It has been a steady progression. I have to say that at one point I did have an epiphany about the whole system—that it was a straight line that has yet to be fully realized, and we could use each one of the mediators we have identified to serve as a backbone for therapeutics. I would say another moment was rewriting the errors in the biochemistry textbooks on how essential fatty acids were actually regulating inflammatory responses. Overall, it has been an incremental process and a lot of slow, hard work—more than one moment.

WHAT WILL BE THE NEXT INJURY WHOSE TREATMENT WILL BE INFLUENCED BY YOUR AND OTHERS’ RESEARCH IN THE INFLAMMATION FIELD?
CS: The stress of surgery is well recognized among surgeons as an acute inflammatory response, as is reflow injury, when blood reflows to tissue. These are two areas we can have a big impact on. Demonstrations are currently underway at a clinical trial level focused on ocular dry eye inflammation using a resolvin E1 mimetic. This work is based on a company I was involved in starting in 2000, but I am no longer actively involved in this venture.

Additionally, an orphan disease of great public health importance focused on by my lab is periodontal disease, which is inflammation-induced bone loss around the periodontium. We were able to go from a mouse model to a rabbit model thanks to NIH funding and have been able to develop a GMP-syn- thesis and pro-resolving molecule. A trial is on, with more than sixty people enrolled at the Forsyth Institute, to see if we can stimulate resolution of inflammation in the early stages of periodontal disease. This is being done in collaboration with Tom Van Dyke and his colleagues at the Forsyth Institute, with support from NIH/NIDCR. So I have a focus in my lab on periodontal disease, thinking that if we control local inflam- mation, what would be the impact on systemic inflammation. There is evidence in a lot of papers showing links to all sorts of systemic diseases resulting from periodontal disease.

WHAT DO YOU HOPE WILL BE THE LONG-TERM IMPACT OF YOUR RESEARCH FROM A GLOBAL PERSPECTIVE?
CS: One aspect we haven’t really touched on, but which is re- ally important, is having a better education about the role of nutrition in an appropriate innate immune response. Some of our work underscores how important fatty acid nutrition is—a different side of our work that is still very important.
Interview

Ross Prize

DO YOU ALWAYS ENVISION YOURSELF AS A SCIENTIST, OR DID YOU DREAM OF BEING SOMETHING ELSE AS A YOUTH?

CS: As you know, no one really sees themselves as a geek growing up. I really enjoyed chemistry when I was younger, tinkering around with chemistry sets and microscopes, but as I got older really wanted to be a musician. I even spent time on the road touring with bands, but I had a very swift change of heart and went back to my roots, deciding to study science. As you know, no one really sees themselves as a scientist but rather a biomedical investigator. I always have seen scientists as people who work on rocket ships.

DO YOU THINK YOUR MUSICAL TRAINING HAS HAD ANY INFLUENCE ON HOW YOU APPROACH SCIENTIFIC RESEARCH?

CS: Absolutely, most definitely, it does play a role in science. The way I organize the laboratory projects is analogous to orchestration of music. Also, I would compare developing patience, skill and rigor in the scientific process to developing musical skills through continual practice. The more proficient you become mastering scales and rudiments in music, the more confident you become in your skills, and I see scientific research the same way.

WERE THERE ANY INDIVIDUALS IN YOUR LIFE THAT STEERED YOU TOWARDS SCIENCE OR PLAYED AN IMPORTANT ROLE IN YOU BECOMING A SCIENTIST?

CS: Yes, I had great science teachers in elementary school and absolute graduate school. When I was at graduate school at NYU I frequently visited high school science classes and told them how exciting scientific research was.

WERE THERE ANY MAJOR CHALLENGES YOU HAD TO OVERCOME IN YOUR CAREER TO BECOMING A SUCCESSFUL SCIENTIST?

CS: Oh yeah, trying to remain continually funded is a real challenge. Other than that, overall, I have been very lucky, having great mentors and a supportive family. I’ve also had great trainees over the years, with about 90% of them successfully moving on to the next steps in their career.

SPEAKING OF MENTORS, WHAT IS THE MOST VALUABLE LESSON THAT YOU HAVE LEARNED FROM YOUR MENTORS OVER THE COURSE OF YOUR CAREER?

CS: Anyone that does reasonably well in science has to not only one. Science drives tech and technology drives science. Lately, I have been working on tissue regeneration, and am interested in nanotechnology and local drug delivery systems, and I believe these approaches will revolutionize medical treatment and improve life. Also, from my perspective, I would say personal metabolomics is another emerging field, which may help us to understand collective health and behavior as well as personalized medicine.

WHAT DO YOU HOPE THAT YOUR MENTEES WILL PASS ALONG TO THEIR OWN MENTEES ONE DAY?

CS: Of course, almost everyone would say the passion for experiments, but I would say steadfastness, commitment, and rigor are the key, because there are many things that can lead you astray these days.

WHAT DOES WINNING THE 2016 ROSS PRIZE IN MOLECULAR MEDICINE MEAN TO YOU?

CS: I can’t even find the words to express it. I am so humbled and makes me very proud. On a personal level it’s nice for the people in my lab as they can see something to aspire to.

AS THE ACADEMY APPROACHES ITS BICENTENNIAL, WE’RE REACHING OUT TO TOP MINDS IN EMERGING FIELDS TO GET THEIR OPINIONS ON THE FUTURE OF THE SCIENCES. WHAT EMERGING FIELDS DO YOU THINK ARE THE MOST EXCITING?

CS: That’s a hard one. There are a lot of emerging areas of science that I’ve been interested in for a long time. One of the key areas is microbial science and gut microbiota. Gut microbiota have been implicated in weight gain and other side effects of antidepressants and other medications. Because such medications can change the microbiome so dramatically, it was suggested that defining those effects may soon be a condition for drug approval.

In the final presentation, Emeran Mayer of the University of California, Los Angeles, began with arguments against simple translation from animal models to humans. The brain biochemistry and behavioral responses that can be measured in rodents are only approximations of human brain imaging signatures and the subjective emotional, cognitive, and pain responses found in human report.

Mice exhibit “evoked reflexive behaviors,” he said, while humans have “spontaneous complex emotional feelings, thoughts, and behaviors.” Furthermore, many of the brain regions important in psychiatric disease are small or not present in mice. The brains are so different that Mayer likened the comparison to that of a linear processing computer with a supercomputer capable of early artificial intelligence. Although the increasing prevalence of autism is an intriguing spike in a disorder linked to the gut microbiome, Mayer cautioned that this may be an anomaly. Other disorders linked to the gut, such as autoimmune and metabolic diseases, are not becoming more prevalent, and neither are psychiatric disorders. “The heterogeneity of human populations resulting from genetic variability, differences in stress reactivity, trait anxiety, and depression,” Mayer said, “greatly differ from homogenous inbred mouse populations.”

Nonetheless, Mayer’s lab has found evidence in humans of changes in specific brain regions after probiotic treatment, although the researchers did not detect changes in mood or gut function. Early data also suggest an association of IBS gut microbiota with grey matter signatures and the structure of some brain regions, although causation has not been established. Such evidence, when combined with the other research presented at the symposium, suggests powerful connections between gut and brain. 

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Advances in Human Microbiome Science: Gut-Brain Interaction

On March 15, 2016, the Academy’s Microbiome Science Discussion Group convened researchers for the second of three symposia on the causal relationships between microbiota and disease—this one focused on the link between the gut and the brain. Commensal human colon microbiota are integral to numerous functions that maintain health, and there is growing interest in their connection to the central nervous system. The interconnectedness of the gut and brain raises the possibility of targeting the microbiome to treat neurological diseases. Speakers discussed ways that the relationship between gut and brain can affect psychiatric disorders ranging from depression to schizophrenia, the regulation of neural function, and the development of autism spectrum disorders.

Much of the research was based on the study of the microbiota of mice, particularly those mice who have been separated from their mothers, who develop a distinct microbiome and exhibit increased anxiety-like and depression-like behaviors. That early-life stress may affect the hypothalamic-pituitary-adrenal (HPA) axis, changing gut function and the metabolome, with metabolites then triggering brain changes and anxiety.

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Sohn Conference: Pediatric Cancer in a Post-genomic World

Cancer is the leading cause of death among children past infancy in the United States and much of the world. But the tools available to treat pediatric cancer today are much improved compared to those of two decades ago. On the basis of the declining rates of death related to pediatric cancer, from 2.5 per 100,000 in 1975 to 1.5 per 100,000 for solid tumors and 0.75 per 100,000 for hematological tumors such as leukemia and lymphoma in 2010, pediatric cancer could be considered a success story in the long-running war against cancer.

With 91,000 children worldwide diagnosed with cancer each year, however, there is much to be achieved before victory can be declared. Cancer continues to challenge researchers and clinicians, and as more pediatric cancer patients survive to adulthood, late effects including cancer recurrence and secondary cancers have become more common. The underlying etiology of pediatric cancers may also be far different from that of adult cancers.

On March 30 to April 1, 2016, the Academy convened researchers, clinicians, pediatric cancer advocates, and industry and government stakeholders for the Sohn Conference: Pediatric Cancer in a Post-genomic World. In his keynote address, Richard Gilbertson identified four pillars on which the pediatric oncology community is working toward success and four challenges to be overcome to significantly improve treatment outcomes. Subsequent speakers discussed epigenetics, mechanisms of metastasis and disease recurrence, disease risk factors, and diagnostics in pediatric oncology.

Regenerative Medicine: Transitioning Therapeutics from Cells to the Clinic

The field of regenerative medicine is burgeoning with cell-based therapies that aim to enhance or correct cell function. Preclinical and early-stage clinical trials have demonstrated that these therapies can provide local and systemic benefits by driving the production and secretion of biologically active mediators such as cytokines and growth factors to reverse disease progression and promote healing.

Cell-based therapies are commercially available for cartilage and severe burn injuries, and clinical trials have shown promising results in diabetes, kidney disease, heart disease, stroke, cancer, spinal cord injury, neurodegeneration, graft-versus-host disease, and other areas.

On February 22, 2016, representatives from academia and industry met at the Academy for a symposium titled Regenerative Medicine: Transitioning Therapeutics from Cells to the Clinic. The symposium focused on efforts to make these new therapies routinely available in the clinic—requiring scaled manufacturing and formulation to meet distribution demands and regulatory guidelines, as well as adaptive clinical trial strategies, including novel outcome endpoints.

John D. Sinden of ReNeuron spoke on his efforts to use neural cell-based therapies to enhance or correct cell function and to improve clinical outcomes. Early testing has been promising. Other speakers discussed repairing neurodegenerative diseases through stem cell therapies, encouraging cell regeneration with local applications of placenta-derived products, and replacing depleted pancreatic cells in patients with Type 1 diabetes by using human embryonic stem cells.

Developing Scientists Through Outreach

Research scientists who employ their subject expertise and enthusiasm to mentor school children in science and related topics often find the experience personally meaningful and professionally valuable. Children who receive mentorship, particularly those in underprivileged communities, benefit from opportunities to explore their own potential, to identify rewarding careers, and to build the skills and confidence needed to succeed. But research institutions often do not prioritize science outreach and sometimes actively stigmatize it. Nonetheless, research careers can no longer be built on the basis of solitary work at the bench or telescope. Science is increasingly collaborative, and researchers need communication and teaching skills. Meanwhile, growing numbers of science trainees will not pursue long-term academic careers and must gain transferable skills during their studies. Participation in science, technology, engineering, and math (STEM) mentoring programs is a way for them to help struggling communities while also gaining valuable experience.

On February 18–19, 2016, the State University of New York and the New York Academy of Sciences convened a two-part conference on Developing Scientists Through Outreach. A series of presentations, panel discussions, and interactive workshops explored programs that place STEM students and postdocs in K–12 learning environments to mentor and teach. The group sought to determine best practices to grow and benefit from STEM education programs, including how to participate in these and other forms of outreach.
Emerging Paradigms in Drug Discovery & Chemical Biology

Chemical Biology is changing the face of drug discovery. This symposium will highlight recent developments in the field, featuring examples from neurobiology and cancer, the ubiquitin proteasome system, GPCRs, and protein lipidation.

Wednesday, October 26, 2016 | 7:00 PM - 8:30 PM

Delving Within: The New Science of the Unconscious

What is the relationship between conscious awareness and the unconscious mind? Psychologist Efrat Ginot and psychiatrist George Makari will shed light on the latest research investigating the benefits of achieving macral healing in the treatment of intestinal disorders.

Thursday, November 10, 2016 | 8:00 AM - 6:00 PM

Microbial Influences in Cardio-Metabolic Diseases

The microbiome is emerging as an important regulator of health, and disease well beyond the digestive tract. This symposium will highlight recent research innovations and therapeutic applications from the microbiome with a focus on metabolic disease.

November 7, 2016 - February 9, 2017

From Scientist to CSO: Experiencing the Scientific Method as your Guide to Career Success

This 35 hour course introduces the key competencies that are valued by hiring organizations for entry-level positions and essential for career success.

Wednesday, November 2, 2016 | 6:00 PM - 8:30 PM

Grantmanship for Students and Postdocs: F30, F31, F32

Join Science Alliance for “Grantmanship for Graduate Students and Postdocs” to learn the skills for concise and persuasive writing that is not only vital in academia, but essential for any career path.

Tuesday, November 29, 2016 | 9:00 AM - 5:00 PM

Epigenetics in Cancer: Translational Medicine Approaches

This conference will explore novel target validation strategies, translational approaches to assess predictive and response biomarkers, resistance mechanisms, and combination strategies for targeting epigenetic susceptibilities in cancer.

Saturday, November 12, 2016 | 1:30 PM - 4:30 PM

Genome Integrity Discussion Group

As we start the yearlong celebration of our 200th anniversary, we invite you to join us for our second annual Women in Science Wikipedia Editathon. At this event you can learn how to edit Wikipedia articles and also participate in our effort to add and improve Wikipedia entries on female scientists and their many accomplishments.

Wednesday, December 15, 2016 | 9:00 AM - 5:00 PM

Alzheimer’s Disease as a Neurovascular Inflammatory Disorder

This symposium will highlight basic research and clinical science elucidating the mechanisms underlying vascular contributions to cognitive impairment and dementia (VCIID).

Tuesday, December 6, 2016 | 9:00 AM - 5:00 PM

Targeting Tau in Alzheimer's Disease and Related Disorders

This event will cover the translational potential of immunotherapy for tauopathies, reviewing the pre-clinical and clinical development of several tau immunotherapy programs that exemplify this emerging therapeutic approach.
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Presented By
The New York Academy of Sciences
NYS School of Medicine

Location
The New York Academy of Sciences
10 World Trade Center
250 Greenwich Street
40th Floor
New York, NY 10007

FREE EVENT

When he set sail on the Beagle in 1831, Charles Darwin could have never imagined that nearly two centuries later, the future of science would be a collaborative global project. It’s fitting, then, that Charles was invited to join the party.

As the inaugural Global Stem Alliance summit wrapped up, students were invited to pose for a #DarwinSelfie, tying together the past and future of scientific endeavor with silly glasses and a fake moustache.

Save the Date

The Need to Accelerate Therapeutic Development: Must Randomized Controlled Trials Give Way?

Join prominent representatives from academia, industry, patient groups, regulatory, open source, and government for 2 days of panel discussions on the current role and future of randomized controlled trials.

For more information, go to www.nyas.org/events

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WHO IS ELIGIBLE?
NEXUS-NY program participants come from NY research universities and the general community and share several common traits:

1. They are passionate about their research and want to start a great company.
2. They want to solve big problems for real customers.
3. They recognize the need to demonstrate their technology and business model through meaningful proof-of-concept prototypes and customer interaction.

WHY DOES THE PROGRAM EXIST?
To catalyze and accelerate clean energy startups. To help move research derived innovations from research labs into the marketplace.

HOW CAN I GET INVOLVED?
Apply at NEXUS-NY.org between October 18th - November 11th.

NEXUS-NY IS A CLEAN ENERGY SEED ACCELERATOR.
We provide financial, business and educational support to entrepreneurial teams selected through a competitive application process. Program participants are eligible to receive more than $50,000 of equity-free financial support plus additional business and educational assistance.