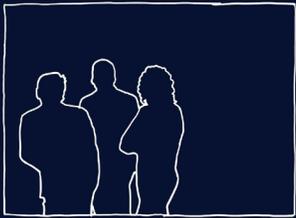


2015 IMPACT REPORT

20 YEARS OF INTERDISCIPLINARY
RESEARCH AND EDUCATION



Executive Director



The integrated work of engineers, scientists, and clinicians is embodied in this trio of Petit Institute researchers (L-R): Wilbur Lam (a physician-scientist-engineer who is an assistant professor in the Wallace H. Coulter Department of Biomedical Engineering, a joint department of Georgia Tech and Emory), Andrés García (an engineer who is a Regents' professor in the Woodruff School of Mechanical Engineering and the director of the Bioengineering graduate program), and Raquel Lieberman (a scientist who is an associate professor in the School of Chemistry and Biochemistry).

In 2015, the Petit Institute celebrated 20 years of interdisciplinary research and education. Twenty years of bringing together engineers, scientists, and clinicians like Andrés, Raquel, and Wilbur who are featured on our cover and represent the collaboration between different disciplines to solve some of the world's most complex health challenges.

Over the past 20 years, Georgia Tech has invested significantly in biotechnology infrastructure and facilities. The early fragmented research activities have been transformed into an internationally recognized nexus of interdisciplinary research and education programs in bioengineering and bioscience. I think it's safe to say that the Petit Institute's original goal when it was launched in 1995 to accelerate Georgia Tech's move into bio-related research has been achieved. But, we're not resting. In fact, I think we are just beginning to hit on all cylinders and scratching the surface of the impact we can have as a truly integrated collaborative bio-community.

As the calendar year 2015 closed, faculty membership had grown to 172 faculty from six universities and more than 15 disciplines. Our core facilities expanded with the new Engineered Biosystems Building (EBB) in addition to our continual support of 18 research centers. We hosted over 100 events bringing together more than 7,000 people (that's a 30 percent increase compared to last year). And in fiscal year 2015, research funding totaled \$53.8 million. A few of the exciting research stories from this year are highlighted here, but represent just a fraction of those disseminated via the Petit Institute website and our Catalyst e-newsletter, which goes out to more than 10,000 readers every month.

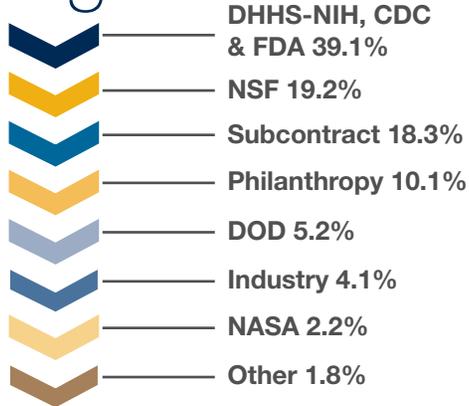
All of this would not be possible without you, our bio-community, our faculty, students, and staff, and our endowment from Parker H. (Pete) Petit. We are very thankful for Pete and his wife Janet's incredible support of Georgia Tech and our interdisciplinary research institute. And I can honestly say we would not be where we are today, if it were not for their generosity.

So here's to another 20 years! I'm very excited about what the future has in store for us as we collaborate across disciplines to solve complex problems together. When I consider how far we've come since 1995, I cannot wait to see what we've been able to collectively achieve in 2035!

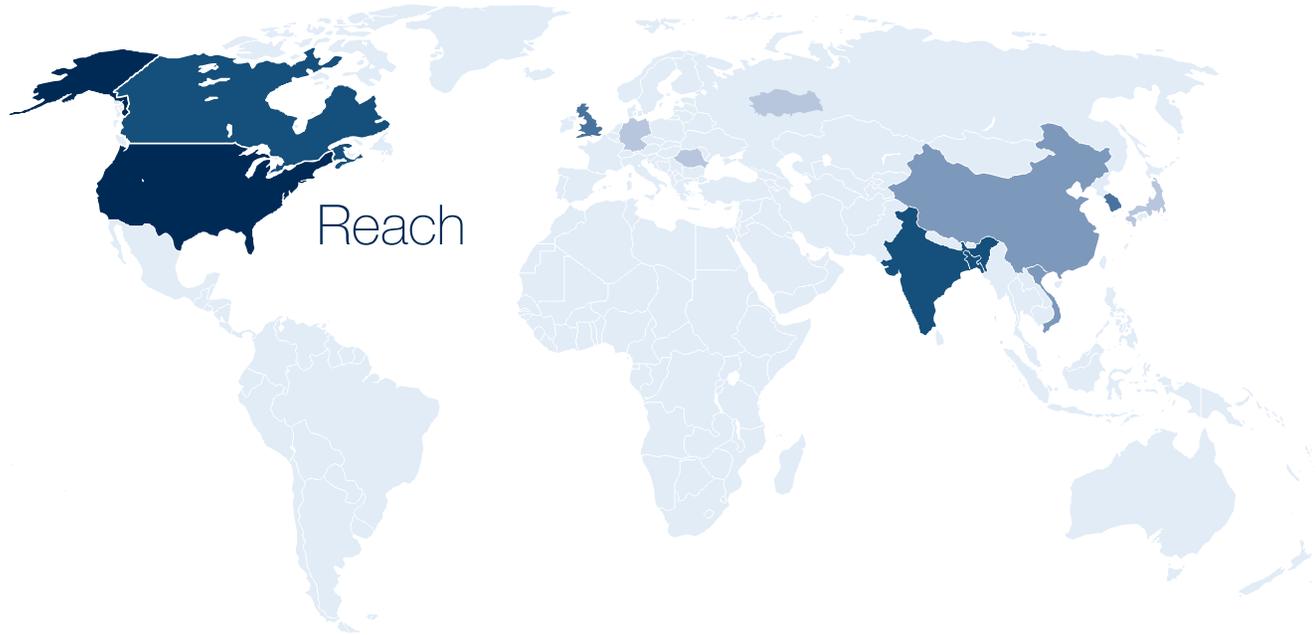
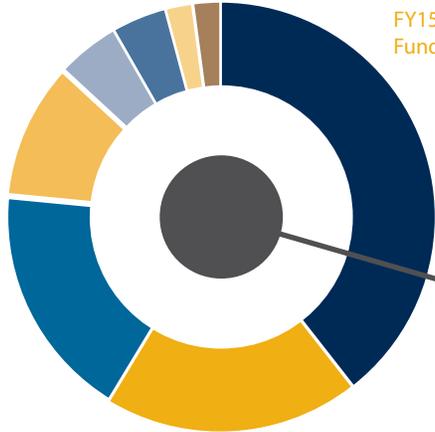
ROBERT E. GULDBERG, PH.D.
EXECUTIVE DIRECTOR
PARKER H. PETIT INSTITUTE FOR BIOENGINEERING AND BIOSCIENCE



Research Funding

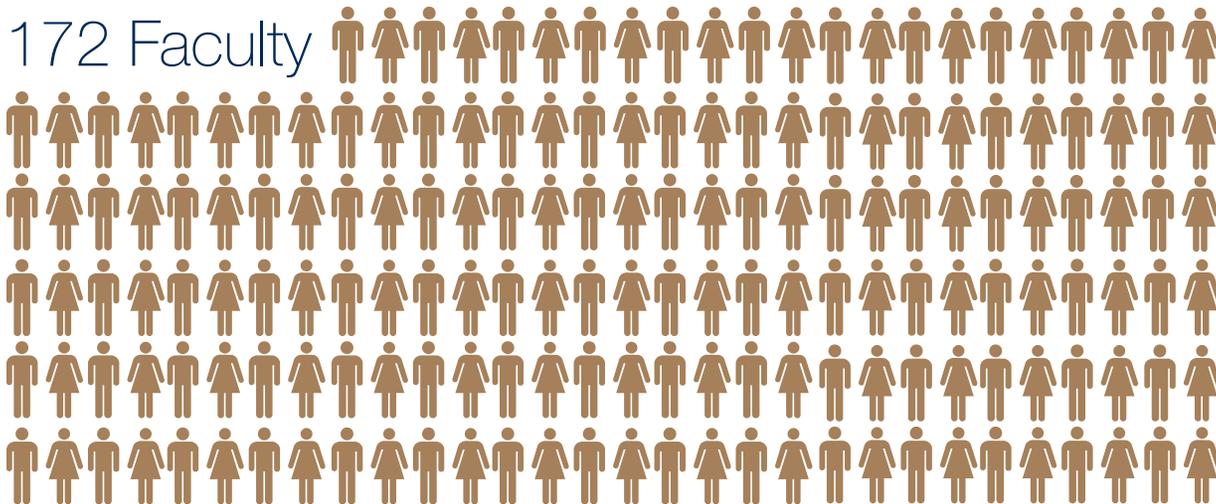


FY15 Petit Institute Funding Sources



\$53.8 million

172 Faculty



- 9 Focus Areas
- 18 Research Centers
- 15 Core Facilities
- Over 100 pieces of equipment

A person in silhouette is looking at a screen that displays the text "Celebrating 20 years of Innovation". The screen has a yellow background with the text in a white, cursive font. The person's head and shoulders are visible in the foreground, looking towards the screen. The overall scene is dimly lit, with the screen being the primary light source.

Celebrating 20 years of
Innovation

2015...A Year in Milestones

Petit Institute Turns 20

The Petit Institute celebrated its 20th anniversary with a gala event that drew more than 300 people. The who's who guest list included President Bud Peterson, President Emeritus Wayne Clough, Vice President of Research Steve Cross, Deans Gary May (College of Engineering) and Paul Goldbart (College of Sciences), founding faculty and leaders, staff, spouses, children, board members, and the person whose generosity sparked it all, Parker H. "Pete" Petit.

They came to celebrate two decades of game-changing, interdisciplinary research; to see how far the institute has come, from its early grassroots to one of the world leaders in bioengineering and bioscience, encompassing 18 research centers that helped attract nearly \$55 million in research funding last year.

"We can go on and on about the numbers," said Petit Institute Executive Director Bob Guldberg. "But clearly, more important than the numbers are the people that make up this collaborative community."

Engineered Biosystems Building Opens

The Engineered Biosystems Building (EBB) opened in May, with a dedication ceremony in September, beginning a new era of multidisciplinary research in the largest building investment in Georgia Institute of Technology history.

The building houses Petit Institute faculty members and core facilities. The \$113 million, 219,000 square-foot building – made possible through a partnership between Georgia Tech, the Georgia Tech Foundation, and the State of Georgia – is designed to enhance collaborative research in chemical biology, cell and developmental biology, and systems biology.

"EBB puts Georgia Tech at the forefront of biosciences and bioengineering research," said M.G. Finn, professor and chair of the School of Chemistry and Biochemistry. "Ultimately we are all working to fight disease and save lives," he said. "EBB is designed to foster the research to do just that."

“We can go on and on about the numbers,” said Petit Institute Executive Director Bob Guldberg. “But clearly, more important than the numbers are the people that make up this collaborative community.”

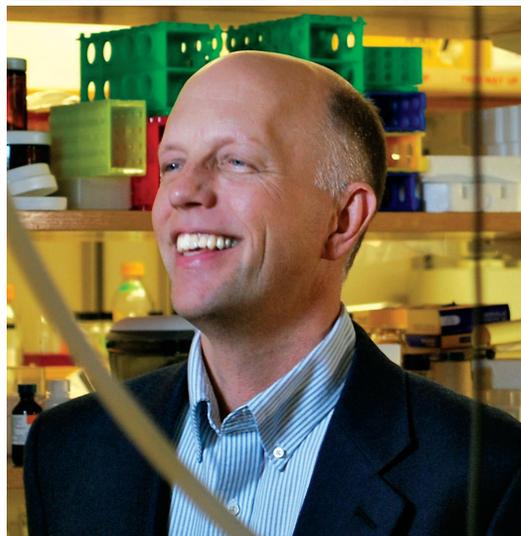


CCE Continues Search for Life's Origins

The Center for Chemical Evolution (CCE) got a big boost in its quest to answer our species' most fundamental question: How did life begin? The CCE's research mission was renewed for another five years as the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA) provided \$20 million in funding.

CCE is a multi-institutional team led by Georgia Tech and including labs from the University of Florida, Furman University, Jackson State University, Kennesaw State University, the Scripps Institution of Oceanography, the Scripps Research Institute, the SETI Institute, and Spelman College.

CCE is one of eight Centers for Chemical Innovation (CCI) funded by NSF, but it is the only one jointly funded with another federal agency, NASA, which is, “keenly interested in what we’re doing because it fits in very well with their mission to determine if there is life on other planets,” according to Nick Hud, director of the CCE, professor in the School of Chemistry and Biochemistry, and associate director of the Petit Institute.



QBioS: New Grad Program Introduced

In September, a new doctoral program in Quantitative Biosciences (QBioS) started accepting applications from students who want to enter a rapidly emerging field working at the leading edge of research that spans biological scales from molecules to organisms to ecosystems.

QBioS brings the physical, mathematical, and biological sciences together in one Ph.D. program, with the overriding mission to educate students and advance research in quantitative biosciences, enabling the discovery of scientific principles underlying the dynamics, structure, and function of living systems.

“This combination is what is needed from the next generation of scientists if we are to understand principles of living systems and, in turn, tackle global-scale challenges,” said QBioS Director Joshua Weitz, associate professor in the School of Biology and courtesy associate professor in the School of Physics.

QBioS is supported by the Petit Institute, along with the Bioengineering and Bioinformatics graduate programs.

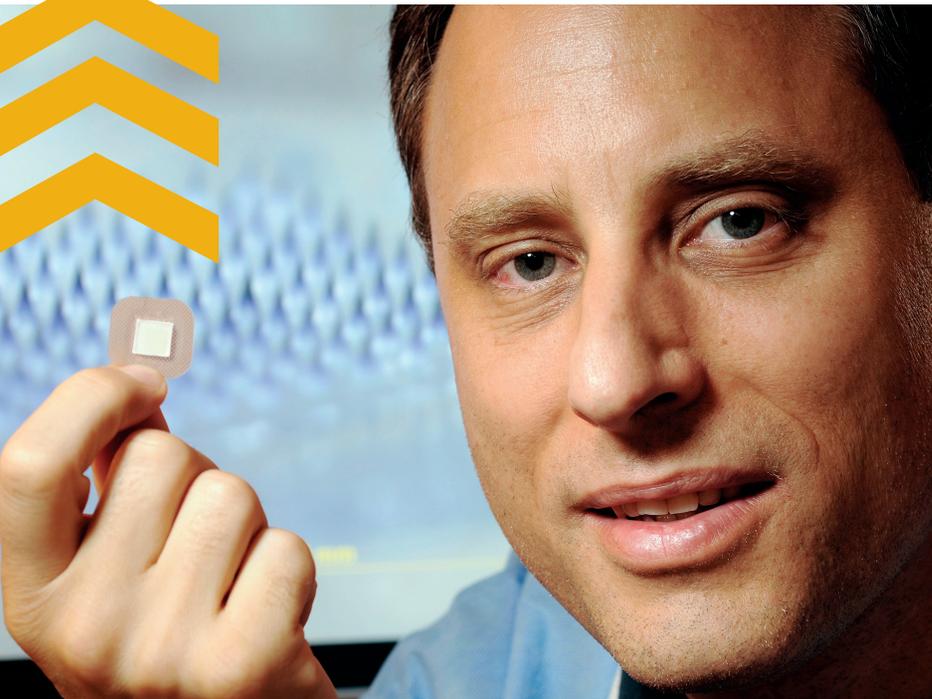
Translating Scientific Discoveries into Game-changing Solutions

Vaccine Patch Could Eliminate Needles

Researchers at Georgia Tech, led by Mark Prausnitz, developed microneedle patches that could change the way we receive vaccinations and treatments for ailments such as polio and influenza.

“We would like to remove the health care professional from the administration of the vaccine and instead let people go to the corner store and pick up vaccine patches from the shelf and bring them home for themselves and their family and self-administer them,” said Prausnitz.

A new clinical study at Emory University is underway, testing the effectiveness of the painless patches.



Finding the Roots of the Tree of Life

Loren Williams led a team of NASA-funded researchers who are using information found in cells to trace life's evolution, looking at biological processes from almost 4 billion years ago.

By examining variations in the ribosomal RNA of modern cells, scientists can visualize the timeline of life, elucidating molecular structures, reactions and events near the biochemical origins of life. The Georgia Tech study was reported in November in the journal *Proceedings of the National Academy of Sciences*.

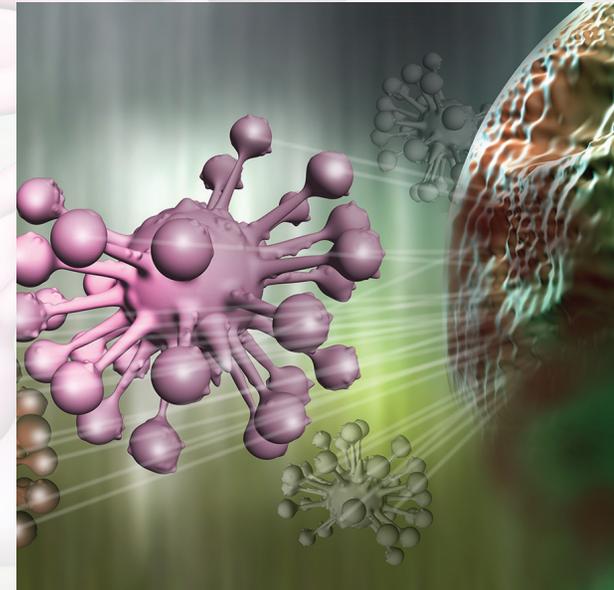
“We are figuring out how to read some of the oldest records in biology to understand pre-biological processes, the origin of life, and the evolution of life on Earth,” said Williams.

Hope for Ovarian Cancer Patients

A research team led by John McDonald and Facundo Fernández identified 16 biomarkers that may enable development of a highly accurate screening test for early-stage ovarian cancer.

Ovarian cancer is difficult to treat because it typically is not diagnosed until after it has metastasized to other areas of the body. Researchers have been seeking a routine screening test that could diagnose the disease when the cancer is confined to the ovaries.

“We think our results show great promise, and we plan to further validate our findings across much larger samples,” said McDonald.



Breast Cancer Breakthroughs

The labs of two Petit Institute researchers, Manu Platt and Susan Thomas, made important breakthroughs in the battle against breast cancer in 2015.

Platt's team demonstrated a proof-of-principle technique that could give women and their oncologists more personalized information to help them choose options for treating breast cancer. Their technique could also have an impact for men with prostate cancer, where treatment also requires making difficult choices about the risk of metastasis.

Meanwhile, Thomas' team developed new nanotechnology designed to carry medicine directly to tumors, work that was supported by a grant from the Komen Foundation.



Researchers Discover How to Regrow Teeth

Studying the cichlid fishes of Lake Malawi in Africa, a team of researchers from Georgia Tech and King's College in London made discoveries that could lead to tooth regeneration in humans.

The researchers examined how teeth and taste buds grew in cichlid fish embryos. By watching the hybrid fish grow up while tracking their genome, they labeled which genes were responsible for the development of taste buds and which ones spurred the growth of teeth.

"The potential applications to humans make this interesting to everybody who has dealt with dental issues at one time or another in their lives," said Petit Institute researcher Todd Strelman, co-author of the study, which appeared in October in the *Proceedings of the National Academy of Sciences*.

BRAIN Taps Two Petit Institute Researchers

Two researchers from the Georgia Institute of Technology received grants from the National Institutes of Health (NIH) to support the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative.

Christine Payne and Garrett Stanley, both faculty members of the Petit Institute, are among the 131 investigators at 125 institutions in the U.S. and eight other countries that secured 67 new awards, totaling more than \$38 million.

Stanley and Emory researcher Dieter Jaeger are principal investigators of a project titled, "Multiscale Analysis of Sensory-Motor Cortical Gating in Behaving Mice." Payne is principal investigator for a project titled, "Conducting polymer nanowires for neural modulation."

Our Growing Institute

Military-minded Symposium Makes Debut

The Petit Institute hosted the Military and Veterans Healthcare Technology Symposium in January.

The first-time event brought together 90 scientists, engineers, students, and representatives from the Department of Defense to share the latest research addressing the health challenges facing military personnel, in key areas of research, including regenerative medicine, neuro-engineering, and prosthetics and orthotics.

The Center for Regenerative Engineering and Medicine (REM) took the lead in sponsoring the symposium, solidifying a spirit of collaboration – REM is a partnership between Emory University, the Georgia Institute of Technology, and the University of Georgia.

REM co-directors: Steven Stice - University of Georgia, Johnna Temenoff - Georgia Tech, and Edmund Waller - Emory University



Suddath Symposium Hits Full Speed

Some of the world's top researchers gathered at the Petit Institute to present their work in February at the 23rd annual Suddath Symposium.

The 2015 focus was on, "Immunology and ImmunoEngineering," an emerging field evolving on traditional immunology, utilizing the latest innovative approaches of biochemistry, molecular biology, biophysics, and bioinformatics.

"There has been a real revolution in the past decade concerning our molecular-level understanding of immunity, and Atlanta is fortunate to be the home of many outstanding research and clinical immunologists," said M.G. Finn, chair of the School of Chemistry and Biochemistry, who co-chaired the symposium with fellow Petit Institute researcher Krishnendu Roy.

Sharing Knowledge, Building Community

Scientists, engineers, physicians, students, and industry representatives gathered on Hilton Head Island, South Carolina, as they have every spring since 1997, for the annual Regenerative Medicine Workshop.

The 2015 event drew an international crowd – an eclectic group of 170 people from more than 30 different institutions – where the theme of the workshop was titled, "Discovery, Technologies and Translation."

"I think a big reason the workshop seems to get better and better is how quickly changes are happening in the regenerative medicine field right now," said Petit Institute Executive Director Bob Guldberg, who has expanded sponsorship of the event to include the University of Pittsburgh and the University of Wisconsin, along with the Center for Regenerative Medicine (REM).

Pharmaceutical Companies C-Suite Meets at Tech

It isn't every day that the C-Suite of a major multinational biopharmaceutical company comes to visit, all at once. But that's what happened in March when the UCB Executive Committee Meeting came to the Petit Institute.

UCB's senior executives from corporate headquarters in Brussels, Belgium, and U.S. headquarters in Smyrna, Georgia met with leadership from the Georgia Institute of Technology's bio community, further solidifying the partnership between the pharmaceutical company and one of the nation's leading research institutions.

"To have the whole executive team come in so that we can show what we do here at Georgia Tech – well, opportunities like this don't happen frequently enough," said Steve Cross, executive vice president of research for Georgia Tech. "My hope is that companies like UCB will think about Georgia Tech as sort of the Bell Labs for an industry sector. There's a lot we can do to support companies like this."

Shedding Light on the Business Side

The Business of Regenerative Medicine (BRM): Cells at Work course brought an international crowd to the Engineered Biosystems Building at Georgia Tech for a three-day workshop in July that offered a wide-angled view of a growing field.

An eclectic array of speakers from across the spectrum – research, industry, Wall Street, etc. – covered elements that are critical to business success in five evolving technology market areas: mesenchymal stem cells (MSCs), cord blood and neural stem cell therapies, immunotherapies, tissue engineering and cell-based devices, organ-on-a-chip, and induced pluripotent stem cell (iPSC) technologies.

"We understand already what's driving the science," said Frank Barry, professor at the National University of Ireland-Galway and one of the world's leading stem cell scientists, who spoke at the event. "But it's very good for us as scientists to understand what drives the business side of all this."



Education Hub for Diverse Student Body

Programs

Petit Scholars Simplify Complex Procedure

It would be difficult to find two students who embody the tone of the Petit Undergraduate Research Scholars program more than Robert Mannino and Yichen Wang, who created a way to investigate biophysical cellular interactions in the circulation system using common, off-the-shelf lab materials, reducing the time and cost it typically takes for such a procedure.

Mannino (a former Petit Scholar) mentored 2015 Petit Scholar Wang, who said, “This process effectively enables us to observe the process by which the blood cells and endothelial cells function together in the human body.”

Engaging the Next Generation

In 2015, Project ENGAGES continued addressing a national priority to increase the number of students proficient in science, technology, engineering, and math – or, STEM disciplines.

Last year, ENGAGES added more students and schools to the program (which brings inner city high school students



into the Petit Institute labs to work on year-round research). Meanwhile, former ENGAGES students went on to study at some of the nation’s top colleges and universities (Dartmouth College and Stanford University, for example). And one student, Katrina Burch (now a Georgia Tech freshman), was invited to the White House to be part of a panel focused on STEM education.

Biggest Buzz Brings Hundreds to Campus

The 2015 Buzz on Biotechnology brought more than 350 guests (high school and middle school students and families) to the Petit Institute for this annual open house of science and technology.

It was the largest Buzz yet as people from nearly 40 schools and 20 home school groups were treated to 18 different demonstrations/experiments and tours of six different Petit Institute research labs.

“This has evolved into one of Georgia Tech’s most effective outreach programs,” said Loren Williams, longtime Petit Institute faculty member. “It presents the best of Tech to the outside world.”

Awards and Honors

Bob Guldberg won a Georgia Bio Community Award

Ajit Yoganathan elected to the National Academy of Engineers

Bob Nerem won the Stem Cell Action Award for Leadership at the World Stem Cell Summit

Mostafa El-Sayed won the Priestly Medal from American Chemical Society

Five faculty members inducted into AIMBE College of Fellows: **Hanjoong Jo, Hang Lu, Garrett**

Stanley, Johnna Temenoff, and May Wang

Mark Borodovsky and Francesca Storici selected as Sigma Xi award winners

Andreas Bommarius and Mark Prausnitz won Innovation in Co-Curricular Education Awards

Julie Champion won the Junior Faculty Outstanding Undergraduate Research Mentor Award

Eva Lee named to the National Preparedness and Response Science Board

Yury Chernoff and Christoph Fahrni named fellows of the American Association for the Advancement of Science

Petit Institute “Above & Beyond” Awards went to **Alfred Merrill, Krishnendu Roy and Fred Van-berg** (faculty); **Karen Ethier and Floyd Wood** (staff); **Kyle Blum, Josh Hooks, and Claire Segar** (students)

Jordan Ciciliano named the Suddath Memorial Award winner

Jóse García won a Society for Biomaterials Student Award for Outstanding Research

Thank you to the Petit Institute staff for all their hard work making the year a success.



Matt Mistilis took first in the Anthony Shuker Scientific Poster Session at Georgia Bio Innovation Summit

Intellimedix, a company built around technology from **Jeffrey Skolnick**, won an Intel Innovation Award

Marian Hettiaratchi took second in Georgia Tech's Three Minute Thesis (3MT) competition

Brennan Torstrick and **Nathan Evans** took first place in a business plan competition at the

Tissue Engineering and Regenerative Medicine International Society World Congress

Bradford Taylor won the Nerem International Travel Award

Giuliana Salazar-Noratto won a National Science Foundation GROW Award, allowing her to study in Ireland

Ashley Allen won the Chris Ruffin Student Leadership Award, **Brandon Dixon** won the Faculty Advisor Award at BioE Day

Timothy Kassis won the Chih Foundation Research Award

Former Petit Scholar **Mohamad Ali Najjia** helped lead OculoStaple (a medical device company that previously won the Capstone Design competition) to second in both the Georgia Tech InVenture Prize competition and the National Institute of Biomedical Imaging and Bioengineering DEBUT Challenge

Former Petit Scholar mentor **Yogi Patel** developed the technology for Team Bioletics, which took first place in the 2015 Georgia Institute of Technology Startup Competition



Georgia Tech  **Parker H. Petit Institute for Bioengineering and Bioscience**

315 Ferst Drive NW
Atlanta, GA 30332-0363
petitinstitute.gatech.edu