



May 2016

Message from Dean Breneman



Commencement Week is here! Finals are over, grades are in, the residence halls have (mostly) cleared out, and many warm student memories are going home with members of the Classes of 2017, 2018, and 2019 for the summer. On the other hand, members of the Class of 2016 have been doing a lot of celebrating – and for good reason! My wife, Mimsy, and I joined President Jackson and others in the Rensselaer leadership for some recent Commencement-related festivities,

including the Senior Banquet at the Albany Marriott. (Yes, as promised, President Jackson did lead a rousing Electric Slide line dance on the packed dance floor! There wasn't any dance floor at the National Medal of Science Gala in Washington, D.C., after she received her medal from President Obama recently, but we all had fun there anyway. I should have realized that learning that dance would be part of my job description...oh well.) On Friday, even more celebrations took place, including the School of Science Commencement Brunch at the Hilton Garden Inn where we gathered to recognize the achievements of our graduates and the support of their parents during their college years!

There are some great student news items to highlight this month. Our Data Science-oriented IDEA group hosted a DATATHON recently, during which students immersed themselves in data analytics – you can read more about this in the story called “MITRE Corp helps RPI Student Data Scientists Code Their Way to Riches.” (I like the sound of that!)

Other undergraduate achievements include Class of 2016 Biology major Alice Huang winning first place at the Rensselaer Undergraduate Research Symposium! Congratulations to Alice on some wonderful work and a great presentation. Speaking of presentations, thanks all around to our fantastic Science Ambassadors – undergraduate students who travel to local schools to show young students how amazing science can be. The Science Ambassadors recently hosted a group of students from the Amsterdam, N.Y., school system on campus for a day of demonstrations, tours, and a panel discussion. Well done, Ambassadors!

In graduate news, congratulations to Bryan Eskew, who won a coveted 2016 NASA Earth & Space Graduate Fellowship to fund his research in the area of “Biosignatures and Microbial Assemblages in a Mars Analog Volcanic Ecosystem.” I’m going to have to ask Bryan whether he plans to do his future field work on the Red Planet – that would run up the budget a bit. Congratulations are also due to Marek Durniak, who won an AMS International Chapter Scholarship for his work in solid-state physics. Way to go, Marek!

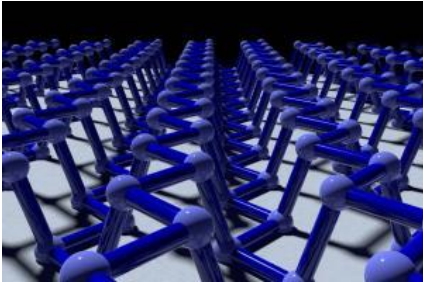
There is a lot of exciting news in research and faculty achievements as well. Congratulations to Computer Science Associate Professor Heng Ji – she was just nominated as “Young Scientist for the World,” and Earth & Environmental Science Professor Mimi Katz was just elected a fellow of the Geological Society of America. In other news, Tetherless World Constellation Professor Deborah McGuinness has been selected as Keynote Speaker at a major conference – the Open Travel Alliance Annual meeting. Congratulations to all!

So many great things are happening in the Rensselaer School of Science! Stay tuned - and there’s so much more to say!

Come to Rensselaer and Change the World!

Curt Breneman, Dean of Science

Exploring Phosphorene, A Promising New Material



Two-dimensional phosphane, a material known as phosphorene, has potential application as a material for semiconducting transistors in ever faster and more powerful computers. But there's a hitch. Many of the useful properties of this material, like its ability to conduct electrons, are anisotropic, meaning they vary depending on the orientation of the crystal. Now, a team including researchers at Rensselaer has developed a new method to quickly and accurately determine that orientation using the

interactions between light and electrons within phosphorene and other atoms-thick crystals of black phosphorus.

Phosphorene—a single layer of phosphorous atoms—was isolated for the first time in 2014, allowing physicists to begin exploring its properties experimentally and theoretically. [Vincent Meunier](#), head of the Rensselaer Department of Physics, Applied Physics, and Astronomy and a leader of the team that developed the new method, published his first paper on the material—confirming the structure of phosphorene—in that same year.

“This is a really interesting material because, depending on which direction you do things, you have completely different properties,” said Meunier, a member of the Rensselaer Center for Materials, Devices, and Integrated Systems (cMDIS). “But because it's such a new material, it's essential that we begin to understand and predict its intrinsic properties.”

[See more](#)

Discovery of Rules for CRISPR Advanced Metabolic Engineering

Discovery of rules that govern a variation of the CRISPR/Cas9 gene-editing method makes it possible to use living cells to manufacture valuable metabolic compounds like pharmaceuticals and nutraceuticals. Researchers at Rensselaer have developed new tools for controlling the signaling pathways in cells to manufacture compounds, dialing down production of unwanted compounds, and increasing production of valuable compounds.



The research, published in *Nucleic Acids Research*, describes an aspect of the CRISPR/Cas9 gene-editing method, which makes use of dCas9, a disabled protein. Specifically, the researchers describe how to vary a snippet of RNA to create multiple tools that use dCas9, each with the ability to block activity at a single site along complex multi-step signaling pathways, with no crosstalk.

“CRISPR is one of the most powerful gene editing techniques available, but until now, we’ve only seen it used in healthcare. This is the first real metabolic engineering application to make high-value products using this gene editing approach,” said [Mattheos Koffas](#), who led the research. “If you look 10 years into the future, people might be controlling thousands of genes in an organism, producing quite valuable products.”

The CRISPR/Cas9 system is derived from a natural defense bacteria employ against familiar viruses. “Clustered regularly interspaced short palindromic repeats,” or CRISPR, is bacterial DNA that contains segments of viral DNA from previous exposures. When known viral DNA invades the cell, bacteria use CRISPR to produce a snippet of “guide RNA” that will match with, or complement, the viral DNA. The guide RNA is coupled with the Cas9 protein complex, which can cut DNA. Thus equipped, the Cas9 is able to unzip, latch on, and cut the complementary viral DNA, thereby disabling it. CRISPR/Cas9 has been used in health applications, such as disabling specific genes to produce transgenic animals for research.

CRISPR/Cas9 also holds enormous potential as a means of controlling signaling pathways, the complex chemical communications by which cells perform most functions and make necessary substances. The instructions for the numerous steps in each signaling pathway are contained in DNA. If the process can be controlled at each step – by blocking or allowing transcription of DNA at the site of a genetic switch called a “promoter” – the output of the cell can also be controlled, redirecting its energy to producing desired compounds. One variation of this method, CRISPR/dCas9, blocks transcription by using a disabled Cas9 protein to latch on to the target DNA and remain in place, thwarting further attempts to transcribe the instructions in that particular DNA sequence.

“The cell is a factory, and we can take over production and make the things we want,” said Brady Cress, first author on the research, which was conducted in the labs of Koffas and [Robert Linhardt](#) in the Rensselaer Center for Biotechnology and Interdisciplinary Studies (CBIS). “With CRISPR/dCas9, what we can do is make critical compounds – those required to build up the big high-value compounds – more prevalent by shutting off competing pathways.”

[See more](#)

President Shirley Ann Jackson Receives National Medal of Science

The Honorable Shirley Ann Jackson, Ph.D., has been presented with the 2014 National Medal of Science, the highest honor for scientific achievement bestowed by the United States government. It was presented on May 19 by President Barack Obama in a White House ceremony. The award honors individuals deserving of special recognition for their outstanding cumulative contributions to



knowledge in the physical, biological, mathematical, engineering, or behavioral or social sciences, in service to the nation.

“These scientific laureates exemplify the American spirit and ingenuity that have enriched our society and the global community in profound and lasting ways,” President Barack Obama said. “Their ambition and accomplishments are an inspiration to the next generation pursuing careers in the essential fields of science, technology, engineering, and math.”

The National Medal of Science was established by the 86th Congress in 1959. A committee of 12 scientists and engineers appointed by the President evaluates the nominees for the award. Since its establishment, the National Medal of Science has been awarded to 487 distinguished scientists and engineers whose careers spanned decades of research and development.

“This is a proud day for everyone at Rensselaer Polytechnic Institute,” said the Honorable Arthur J. Gajarsa '62, Chairman of the Rensselaer Board of Trustees. “Dr. Jackson is a deserving recipient of the nation’s pre-eminent award for research and leadership in science. She has been the driving force behind establishing a new model for scientific and technological education at Rensselaer. Due to her leadership, we continue to be counted among the top universities in the world, while breaking new ground in terms of our research linked to global challenges, leading-edge pedagogical innovations, and an integrated transformative student experience.”

[See more](#)

Faculty News and Notes

- **Chris Bystroff**, professor of biological sciences, taught a new interdisciplinary course this spring, Human Population (BIOL 4961), covering human ecology, growth models, systems dynamics and, yes, contraception. Chris's op-ed column describing his experience with the new course was published in the Times Union on May 8. The course is synergistic with the Bystroff lab research thrust in contraceptive vaccine development.
- **Heng Ji**, associate professor of computer science, received a nomination as a Young Scientist for the World.
- **Mimi Katz**, associate professor of earth and environmental sciences was elected a fellow of the Geological Society of America.
- **Deborah McGuinness**, Tetherless World Senior Constellation Chair and professor of computer science, gave a keynote address for the Open Travel Alliance annual meeting.
- **Carlos Varela**,
 - General Chair for the ACM/IEEE International Symposium on Cloud, Cluster, and Grid Computing (CCGrid 2016) to be held in Cartagena, Colombia, May 15-19, 2016.

Student News and Notes

MITRE Corp Helps RPI Student Data Scientists Code Their Way to Riches



On Saturday, April 30 and Sunday, May 1, over 50 undergraduate and graduate students comprising 17 teams competed in the spring 2016 RPI DataThon. The event was sponsored by The MITRE Corporation, a not-for-profit company that operates multiple federally funded research and development centers providing innovative, practical solutions for some of our nation's most critical challenges in defense and intelligence, aviation, civil systems, homeland security, the judiciary, health care, and cybersecurity. MITRE is one of the founding corporate affiliates of the Rensselaer

Institute for Data Exploration and Applications (IDEA), which ran the event.

World Development Indicators datasets from the World Bank served as the primary input for the analytics challenge. The data included subjective governance measures in six categories such as rule of law and political stability, as well as objective development statistics in areas like health, finance and labor. The challenge to the teams was to formulate a hypothesis about some aspect of national development and governance, then conceive and execute a data analytics project that combined elements of the subjective governance data with objective statistical development data to evaluate their proposition. They were also free to incorporate any other external data to augment their efforts.



The teams spent Saturday exploring data sets, conceptualizing data driven applications, and building and testing solutions. On Sunday they returned to finalize and present their findings to a panel of judges from Rensselaer and MITRE.

The projects were evaluated on originality and clarity of proposed objective, use of data and analytics methods, level of success in solution implementation and quality of presentation. The following awards were made:



1st Place: \$2,000 – Team #10 – “Refugee Tracker”

- **Y. Machado, C. Paradis, M. Powathil, and R. Russo**

2nd Place: \$1,000 – Team #15 – “Evaluating Countries and Products in the International Trade, An Evolutionary Bipartite Graph Approach”

- **Y. Chen and X. Niu**

3rd Place: \$500 – Team #2 – “Towards a Better Economy, Using data to understand working of economics”

- **C. Li, N. Rastogi, and P. Zhang**

Honorable Mentions: \$100 –

- Team #8 – “The Effect of National Anomalies on the World”, **S. Ibarluzea**
- Team #12 – “Democratic vs. Republican Analysis Based on a Historical Scale, Reference, Comparison and Analysis in both Economic and Social Aspects”, **Z. Huang, Y. Lu, and J. Ren**
- Team #14 – “Does being rich imply a good governance?” **M. Al Iqbal, A. New, and A. Vargas**
- Team #16 – “An Analysis of Gender Diversity in National Legislatures,” **A. Batbouta, M. Blanco, and M. Poegel**

The Rensselaer IDEA is a key component exemplifying The New Polytechnic at Rensselaer with a goal to maximize the capabilities of new tools and technologies for the purpose of expediting scientific discovery and innovation, developing the next generation of digital enablers, and preparing students to succeed and lead in a data-driven world. IDEA serves as a hub for Rensselaer faculty, staff, and students engaged in data-driven discovery and innovation, empowering researchers with new tools and technologies to access, aggregate, and analyze data from multiple sources and in multiple formats. The New Polytechnic enables collaborations between talented people across disciplines, sectors, and global regions, in order to address the complex problems the world.

RPI Science Ambassadors Host Amsterdam Smart Scholar High School Students



The [science ambassadors](#) ended the semester with two “hybrid” visits by Amsterdam Smart Scholar High School Students. The hybrid visit consisted of two presentations by our science ambassadors, a tour of EMPAC, Nason Hall Aquaponics, and the School of Engineering’s centrifuge.



The visit culminated with lunch and a panel discussion with our ambassadors.

Student Briefs

- Graduate student **Mark Durniak**, won an AMS International Chapter Scholarship, awarded by their Eastern NY Chapter during its annual banquet on May 2nd, 2016 (<http://www.asmeasternny.org/index.html>). The scholarship carries a \$1,000 and has been awarded to Mark now a second time. Mark is graduate student of Materials Science & Engineering and advised by Professor **Christian Wetzel**. ASM was formerly known as the American Society for Metals.

- **Bryan Eskew**, graduate student in the Biological Sciences Department was awarded a 2016 NASA Earth & Space Science Graduate Fellowship! This is a highly prestigious and competitive graduate fellowship: there were a total of 767 applicants to the program, and within the Planetary Science division, there were 180 applications and 28 awards made. That's a funding rate of 15 percent and quite the achievement! Bryan's proposal was titled: "Biosignatures and Microbial Assemblages in a Mars Analog Volcanic Ecosystem [1]" and is directly related to ongoing work in the New York Center for Astrobiology to understand the limits of habitability in Mars analog environments.
- Biological Sciences (Accelerated Physicians-Scientist Program) student **Alice Huang** was awarded 1st place on her oral presentation at the Undergraduate Research Symposium Awards Ceremony.
- Computer Science Ph.D. student **Shigeru Imai** received a Best Student Paper award at the ACM/IEEE International Symposium on Cloud, Cluster, and Grid Computing (CCGrid 2016) for his paper: "Cost-Efficient Elastic Stream Processing using Application-Agnostic Performance Prediction," co-authored with Professors **Stacy Patterson** and **Carlos Varela**.

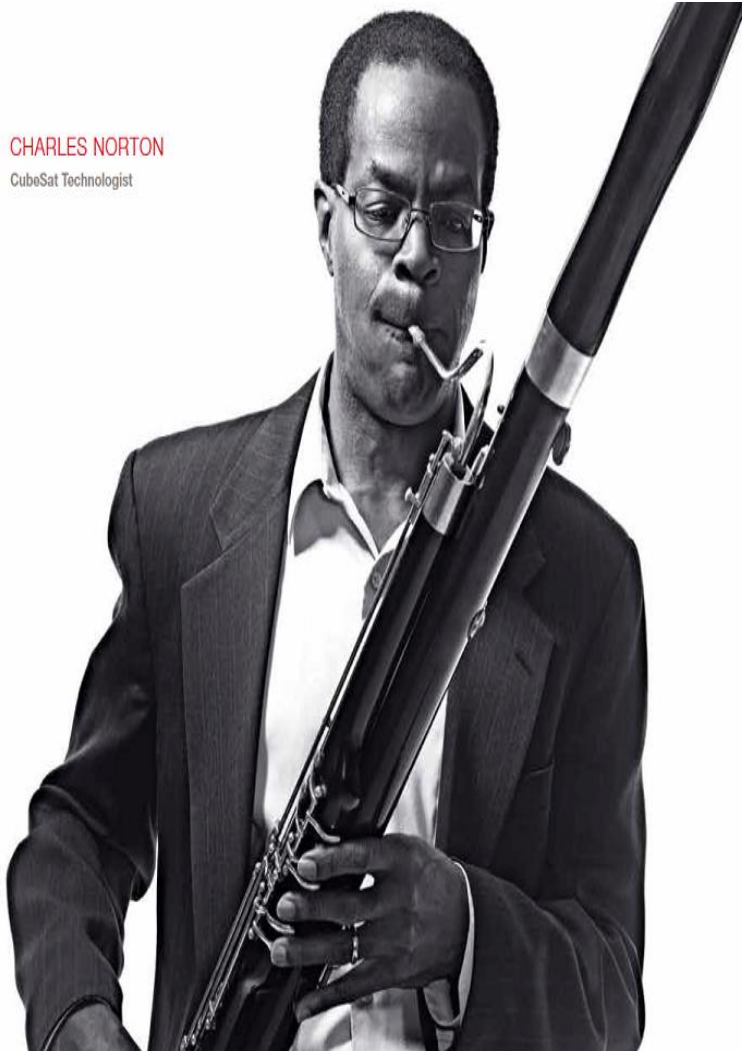
Staff News

- Members of the School of Science Staff participated as part of the RPI team in the CDPHP Workforce Team Challenge, a 3.5 mile race that began at the Empire State Plaza in Albany.



Alumni News and Notes

CHARLES NORTON
CubeSat Technologist



[Reproduced from the 2015 JPL Annual Report, pp 38-39]

Why do so many people with advanced math and science skills have a special affinity for music? That may be a question for neuroscience, but nowhere is it more true than at JPL, where sheet music and guitar picks are as likely to be found as calculators in many briefcases and backpacks. And at the Lab there is no better exemplar of this skill mix than Charles Norton.

After getting a taste of the bassoon as a sixth grader in Long Island, Norton went on to tour with a regional youth orchestra, performing in 35 countries over six summers. By the time he was leaving high school, he had to decide whether to accept an audition invitation as a principal with the New York Philharmonic. "It was the kind of opportunity that only comes along once every 40 years," Norton remembers now. "But it was also a challenging time to be a musician."

Instead, Norton headed to Princeton for a bachelor's in electrical engineering, followed by a master's and Ph.D. in computer science at Rensselaer. That led him

to JPL as a postdoc working on high-performance computing in Earth science.

He was offered a role managing technology tasks around the same time colleagues were getting involved in CubeSats, and the two threads intertwined. Today he has a hand in managing nearly all of the Lab's nearly two dozen CubeSat projects.

Norton — whose love of music is shared by his daughters, one an oboist and the other active in ballet — says it provides an inspiration that carries over into his technical work. "It's hard to put into words," he reflects, "but both the technical work and the music are very satisfying." And speaking of carrying over in your work, Norton arranged for the Los Angeles Youth Orchestra — one of its members is his oboe-playing daughter — to perform at JPL in July. Among the compositions was one called "Cosmic Dust," a new work inspired by the Hubble Space Telescope and its JPL-built camera.

- **Charles Norton**- CubeSat Technologist at JPL, former Bolek Szymanski student.

Catch more School of Science updates on social media!

