Application Details

Manage Application: Faculty Award for Academic Outreach - 2018

Award Cycle:	2018
Internal Submission Deadline:	Friday, February 2, 2018

Application Title:	Lieberman
Application ID:	002205
Nominator's First Name:	M. G.
Nominator's Last Name:	Finn
Nominator's Title:	Proffessor and Chair
Nominator's Primary Organization:	Georgia Instiute of Technology, School of Chemstry and Biochemistry
Nominator's Email Address:	mgfinn@gatech.edu
Nominator's Phone Number:	404-894-8222
Nominee's First Name:	Raquel
Nominee's Last Name:	Lieberman
Nominee's Title:	Associate Proffessor
Primary Organization(s):	Chemistry and Biochemistry
Nominee's Email Address:	raquel.lieberman@chemistry.gatech.edu

Faculty Award for Academic Outreach Nomination

Raquel Lieberman

Table of Contents

Georgia Institute of Technology

M.G. Finn, Ph.D.
Professor and Chair, School of Chemistry & Biochemistry
Professor, School of Biology
Chief Scientific Officer, Georgia Tech Pediatric Technology Center
Editor-in-Chief, ACS *Combinatorial Science*

January 26, 2017

Dear Selection Committee,

It is my pleasure to nominate Associate Professor Raquel Lieberman for the 2018 GT CETL Faculty Award for Academic Outreach. For the past seven summers, Dr. Lieberman has hosted Mr. Casey Bethel, a high school science teacher from Douglas County, in her lab. This fantastic partnership was initially supported by her NSF CAREER award and continues via support from GIFT.

As detailed in the applicant's description, Lieberman and Bethel have developed innovative K-12 classroom materials, some of which were published in the *Journal of Chemical Education* in 2014, and were further disseminated at local and national conferences. In addition, Lieberman has repeatedly hosted Mr. Bethel and students from his school and others in the Atlanta area in the laboratory, some of whom contributed to high impact scientific publications and participated in high school science competitions. The impact of this partnership is quantified by an exponential growth in the number of Mr. Bethel's students who now pursue undergraduate STEM majors, including some who matriculate at Georgia Tech.

Mr. Bethel has been recognized multiple times for work done with Dr. Lieberman, culminating in his selection as 2017 Georgia Teacher of the Year and thus catapulting him to the national spotlight. Mr. Bethel routinely cites his experience in the Lieberman lab as transformative for his teaching.

Other evidence of Prof. Lieberman's commitment to K-12 outreach includes her service as a judge for the prestigious national Siemens High School Science Competition each year since her arrival to Georgia Tech in 2008 and participation in CEISMC camps for middle school girls.

The selection of Dr. Lieberman for this academic outreach award would recognize her outstanding contributions in creating, nurturing, and sustaining a unique and extraordinary partnership with a local STEM educator, making a real difference in the lives of students from socioeconomically disadvantaged backgrounds. Our School's fundamental justification for outreach education is captured in a quote from the actor Idris Elba: "talent is everywhere; opportunity is not." No one does more than Prof. Lieberman to address the inequity captured in the second half of that statement, to the Institution's, and the State's, great benefit.

Sincerely,

M.G. Finn, Ph.D.
James A. Carlos Family Chair in Pediatric Technology

Statement of Excellence in and Impact of K-12 Outreach Activities

Raquel L. Lieberman, PhD
Associate Professor
School of Chemistry & Biochemistry

1. Lasting Partnership with Mr. Casey Bethel, 2017 Georgia Teacher of the Year

Since 2011, I have hosted in the summers Mr. Casey Bethel, a dynamic, caring, intelligent, charismatic and dedicated science teacher from Douglas County, GA (**Fig. 1**). I supported him through NSF Research Experiences for Teachers (RET) supplements from my CAREER award for four years, and subsequently he has been sponsored by GIFT (Georgia Intern Fellowship for Teachers). At this point in time, Casey is the "most senior" member of my research group, having returned to the lab for 7 summers in a row.

r. b bench in 2011. Right, picture of Bethel and Lieberman taken for highlight in Research Horizons http://www.rh.gatech.edu/features/next-generation-genius-0.

The first two summers, Mr. Bethel and I developed and implemented two discovery-based educational modules for high school students. The nuggets of ideas for these modules were part of my CAREER proposal. Shortly after joining his first summer, Casey confirmed my suspicion that the status quo taught in high school biology was not enough preparation for college level bio-related science courses. Our two modules introduce concepts like protein three-dimensional structure and its relationship to protein function, as well as what happens when things go awry, namely, genetics, heredity, and disease. They incorporate different learning media and methods.

The first module, "The Art and Science of Hemoglobin" starts out with students watching "Extraordinary Measures," a Hollywood movie about an inherited metabolic disorder. A questionnaire guides the students in what to pay attention to during the movie (inherited characteristics, bioethics, treatments). Students then explore their own medical history, and discuss DNA as genetic material and information carriers. This is followed by an introduction to proteins, leading ultimately to computer-based visualization. The second module, "Not Your Grandfather's Hemoglobin," engages students in discussions about evolution, mechanisms of evolution, evidence for evolution, and ends with sequence alignments. Over the 2012 summer, Mr. Bethel brought several of his students (**Fig. 2**) to the lab to implement and refine the activities and introduce students to the lab. Together with my lab members, we made a video about the modules (http://www.youtube.com/watch?v=iEySsDlSfQc).

Mr. Bethel and I published the materials and classroom implementation (Bethel, C. M. & Lieberman, R. L. *Journal of Chemical Education*, **2014**, *91* (1), pp 52–55, http://pubs.acs.org/doi/abs/10.1021/ed300677t), and it has already been cited 9 times. Our manuscript includes quantitative demonstration of improvements in Mr. Bethel's student's comprehension of the material as a result of implementing the activities. Periodically I receive emails from interested high school teachers requesting more information about the materials (copyrighted images within the PowerPoint presentations included as supplementary material had to be redacted) and implementation, supporting the notion that our materials have reached a wide audience. Mr. Bethel has shared his physical materials (including un-redacted presentations, assessments, standards, homework, lecture notes) to science teachers in his

district, has presented at Teaching in the Urban South meetings, at DeKalb County School System Science Teachers' Conferences, and at GTRI's Educator's showcase (https://www.youtube.com/watch?v=1vveRLALzIc (0:25-0:42)). In recognition of these modules, Mr. Bethel was awarded first place in the 2012 Paul A Duke GIFT Program Action Plan Achievement Award and I received the corresponding Mentor Award.

visiting the lab in 2012.

In subsequent summers, Mr. Bethel's work in the lab has involved modern biochemistry laboratory techniques, both for his own interest and ultimately to add a laboratory module at his school. In the summers of 2013 and 2014, Casey collaborated with a technician, undergraduate, and graduate student in my lab to clone, express, purify, and crystallize a new enzyme. In 2015, Mr. Bethel again returned with two high school students to study the biochemical effects of different metal ions and pH on enzyme activity. The high school students presented their poster at the end of the summer (https://youtu.be/l3ohxt3F7wU) and submitted their group project for the national high school Siemens Competition (but did not advance). One of the two students subsequently received a Gates Millennium Scholarship for undergraduate studies in forensic anthropology at Emory. Mr. Bethel's many different, and critical, contributions to the success of this vertically-integrated research project landed him a spot on the coauthor list of the corresponding manuscript published (Kalyoncu, S. et al. *Nature Chemical Biology*, **2016**, 12(12), pp. 1031-1036). The publication was highlighted in Research Horizons (http://www.rh.gatech.edu/news/582003/unique-bacterial-chemist-war-potatoes) and was mirrored at Argonne National Labs (https://www1.aps.anl.gov/APS-Science-Highlight/2016/unique-bacterial-chemist-war-potatoes), where critical data for the paper was collected

Mr. Bethel's integration of his authentic research experience in my lab to his classroom have been recognized with awards including New Manchester High School Teacher of the Year, Douglas County Teacher of the Year, and culminating in Bethel's selection as the state-wide 2017 Georgia Teacher of the Year, which catapulted him and his summer experiences in my lab at Georgia Tech to the national spotlight (including a visit to the White House). To our knowledge, it is unprecedented in Georgia for this award to go to a STEM teacher at the high school level. This is a tremendous honor for me as well as Georgia Tech, in recognizing the impact of long lasting collaborations between K-12 teachers and universities. The award and our partnership were highlighted in Research Horizons (http://www.rh.gatech.edu/features/next-generation-genius-0), College of Sciences webpage (https://www.cos.gatech.edu/hg/item/539531), and NSF (https://mcbblog.nsfbio.com/2016/06/20/mr-casey-bethel-recipient-of-georgias-2017-teacher-of-the-year-award-following-a-nsf-research-experience-for-teachers-ret/). This past summer, Mr. Bethel was back in the lab (in between speaking engagements across the US), working toward characterizing another metal-dependent enzyme.

Mr. Bethel credits his sustained research experience in my lab as being transformative for his teaching. He recently gave a TEDx talk entitled "The Power of Meaningful School-Industry Partnerships" about the importance of partnerships like ours in helping to emphasize real-life applications of academic STEM topics (https://www.youtube.com/watch?v=LS2KCFo5FOM&t=472s, specific discussion the impact of our collaboration appears 7:20-9:46). The talk was mentioned on the AJC's GetSchooled blog (http://getschooled.blog.myajc.com/2017/09/14/2017-georgia-teacher-of-the-year-we-need-to-

show-students-what-scientists-engineers-do/). We have data to support the impact of our collaboration: prior to joining my research group, Mr. Bethel knew of just one student who went on to pursue a STEM major in college; this number has steadily increased through this year (2017), when almost 40 students (~1/3) that have passed through Mr. Bethel's science classes his high school are majoring or pursuing careers in STEM fields (**Fig. 3**). Collaborating with Mr. Bethel and seeing our partnership grow and propagate from our lab to across the nation is truly one of the most rewarding aspects of my career to date, and one that I hope continues far into the future.

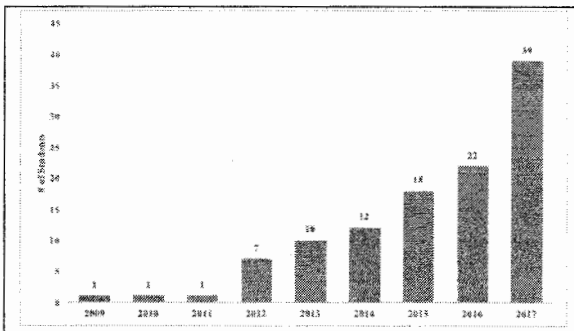

Fig. 3. Number of Mr. Bethel's students pursuing STEM majors/careers since his joining Lieberman lab (2011).

2. Other: Siemens Competition Region 6 Semifinalist Judge and G.I.R.L.S. Middle School Camp Involvement

One of the motivations for welcoming high school students into my lab (usually in the summer with Mr. Bethel) is that I got my first start in biochemical research in high school, when I was 16 years old. The experience I had working in a lab for a sustained period in high school gave me the "research bug" and led me on the path I am today. In fact, the work in my own lab has many similarities with the research project I conducted in high school. This past summer I had the opportunity to reflect on my journey as the keynote speaker at the final lunch for the CEISMC middle school camp Girls Interested in Rapidly Learning STEAM (G.I.R.L.S.). I have committed to returning to participate in the camp this summer.

Finally, based on my own high school research experience, I didn't hesitate to accept Prof. Joseph Montoya's (School of Biological Sciences) invitation to join the judging team of the Siemens (now Discovery) Competition regional finals (hosted annually at Tech) in 2008, and I continue to serve on the judge's panel. The judging of these high school research projects has a lot at stake- the national winner takes home a $100K college scholarship. I enjoy meeting high achieving high school students bound to be our future STEM leaders, and pushing them to the boundaries of what they know in the intense question and answer period after their presentation. Some years, the judging process has been particularly rewarding, e.g. selecting a regional winner who we learn later came from a disadvantaged background and for whom the experience and college scholarship will really open doors for their future.

Georgia Tech
Center for Education
Integrating Science,
Mathematics & Computing

January 23, 2018

To the Members of the Georgia Tech CETL Awards Selection Committee:

I am pleased to offer support the nomination of Dr. Raquel Lieberman to receive the 2018 Faculty Award for Academic Outreach.

Dr. Lieberman was one of the first faculty members to contact me when I assumed the role of Executive Director of CEISMC. She was extremely enthusiastic about K-12 Outreach and had excellent ideas for how Georgia Tech might increase its impact in this area. Since that meeting, I have been continually impressed by Dr. Lieberman's deep commitment to using her academic expertise to further the learning of K-12 teachers and students. She most certainly is an excellent candidate for this most prestigious award.

For the past ten years, Dr. Lieberman has hosted a diverse array of K-12 teachers and students in her lab as part of the GIFT program, exposing them to hands-on, authentic research experiences in STEM and helping them write new curricula for their classrooms. She has worked with her graduate students to prepare them to communicate science to broad audiences, thus producing the next generation of researchers with this valuable skill.

In addition, K-12 educators and students nationwide benefit from Dr. Lieberman's co-authored publications with GIFT teachers that describe how to translate innovative research into K-12 classroom lessons. Dr. Lieberman and her teacher intern's research findings are published in *Nature* and *The Journal of Chemical Education*. Also indicative of her long-term impact, the majority of high school students who have interned in her lab go on to major in STEM here at Georgia Tech and elsewhere.

Dr. Lieberman also volunteers annually as a judge for the *Siemens Competition in Math, Science and Technology*. This prestigious competition of high school student researchers provides yet another opportunity for top high school students to be introduced to Georgia Tech, resulting in many of them applying to Georgia Tech as their postsecondary institution of choice. She is an excellent representative for this institution.

Dr. Lieberman is most deserving of this award. She routinely goes out of her way to engage and enrich K-12 teachers and students and increase their interest and STEM content knowledge. I offer my unqualified recommendation.

Regards,
Sincerely

Lizanne DeStefano
Executive Director, CEISMC
Professor of Psychology

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Georgia Intern-Fellowships for Teachers Program

Georgia Universities and Corporations Collaborating to
Impact Science and Mathematics Education

January 22, 2018

Georgia Tech CETL Awards Selection Committee:

It is with honor that I support the nomination of Dr. Raquel Lieberman to receive the 2018 Faculty Award for Academic Outreach.

Having spent the past ten years responsible for facilitating science, technology, engineering and mathematics (STEM) internship opportunities at Georgia Tech for K-12 teachers and students, I can attest to Dr. Lieberman's commitment to using her academic expertise to further the learning of K-12 teachers and students. Not only does her body of work epitomize the award's selection criteria, in many ways it exceeds the requirements and expectations for the award.

Each summer, for at least the past ten years, Dr. Lieberman has opened her labs to K-12 teachers and students of varying ethnicities and genders, exposing them to hands-on experiences in STEM. She has hosted both teachers individually as well as teacher/high school student teams, always advancing discovery and understanding while promoting teaching and learning. In addition to her on site efforts, she significantly impacts the lives of teachers and students not directly in her lab. Through working with her teacher intern to jointly publish research findings and to develop plans for transferring findings into classroom lessons, K-12 educators and students nationwide benefit from Dr. Lieberman's making her work available to interested parties. Dr. Lieberman and her teacher intern's research findings are published in the prestigious *Nature* magazine, and *The Journal of Chemical Education*. Indicative of her long-term impact, the majority of high school students who have interned in her lab go on to pursue fields in STEM here at Georgia Tech and other institutions of higher learning.

Additionally, Dr. Lieberman volunteers annually as a judge for this region of the country *Siemens Competition in Math, Science and Technology*. This prestigious competition of high school student researchers provides yet another opportunity for top high school students to be introduced to Georgia Tech, resulting in many of them applying to Georgia Tech as their postsecondary institution of choice. Without the volunteer service of professors like Dr. Lieberman, this competition would not be able to take place.

It is a privilege to know and work with Dr. Lieberman. She represents all that is good about postsecondary academic outreach, willingly going beyond her normal duties to enrich K-12 teachers and students with her subject matter knowledge. I can think of no one more deserving of this award than Dr. Lieberman.

Regards,

Bonnie F. Harris

Bonnie F. Harris
Program Director, GIFT

Georgia Institute of Technology

Biological Oceanography
School of Biological Sciences
Atlanta, GA 30332

22 January 2018

Selection Committee
Academic Outreach Award
Georgia Tech CETL

Dear Members of the Selection Committee:

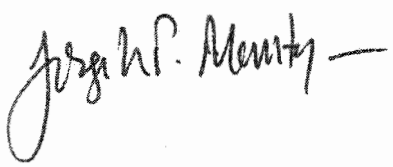
I am pleased to write in support of Dr. Raquel Lieberman's nomination for the Faculty Award for Academic Outreach. I know Raquel well through our interactions on various university committees and through extended interactions involving the Siemens Competition in Math, Science and Technology. Georgia Tech hosts one of the regional final competitions and Raquel has been a member of the panel of judges since at least 2008, when I took over as Lead Judge of our regional final.

Dr. Lieberman has played a key role in making our regional final a success and a model for other universities. I meet regularly with the sponsors (the Siemens Foundation) and organizers (The College Board through 2015 and Discovery Education since then) of the Siemes Competition and it's clear that they deeply appreciate our panel of judges and recognize the contribution that they've made to improve the integrity of the competition. Specifically, Raquel has played a central role in helping identify a number of for-profit "mentoring" shops that specialize in placing high school students in regional finals of prestigious science competitions.

On a personal level, Raquel is an engaging colleague with broad interests in the life sciences and biological chemistry. She has been an invaluable fellow judge and is very adept at interacting with high-school students presenting their work. Although the students are often working at an advanced level scientifically, their age and inexperience create a real challenge for the judges charged with questioning them and exploring their command of the materials. Raquel excels at interacting with high school students as well as other judges. She is a great team player with the independence and confidence to challenge and direct conversations with both competitors and colleagues from diverse academic backgrounds.

Although I have not interacted with Raquel in other outreach settings, I can confidently say that she is exceptionally engaged in K-12 outreach and has a real talent for reaching out to and inspiring young scientists.

Sincerely yours,



Joseph P. Montoya
Professor, School of Biological Sciences
phone: 404-385-0479; email: montoya@gatech.edu

RAQUEL L. LIEBERMAN, PHD
Associate Professor
School of Chemistry & Biochemistry
Georgia Institute of Technology

I. EARNED DEGREES

B.Sc.	Chemistry, Music	1994-1998	Massachusetts Institute of Technology
M.S.	Chemistry	1998-1999	Northwestern University
Ph.D.	Chemistry	1999-2005	Northwestern University (advisor: A. Rosenzweig)

II. EMPLOYMENT HISTORY

2005-2007	NIH NRSA Postdoctoral Research Fellow (joint) Center for Neurologic Diseases, Brigham & Women's Hospital/Harvard Medical School (advisor: M. Wolfe) & Chemistry Department/Rosenstiel Center, Brandeis University (advisors: G. Petsko, and D. Ringe)
2008-2013	Assistant Professor, School of Chemistry & Biochemistry, Georgia Tech
2013-present	Associate Professor, School of Chemistry & Biochemistry, Georgia Tech

III. HONORS AND AWARDS

2017	Sigma Xi Best Faculty Paper Award (Georgia Tech) College of Science Faculty Mentor Award (Georgia Tech)
2014	Cullen Peck Fellow (College of Sciences Georgia Tech)
2013	Junior Faculty Outstanding Undergraduate Research Mentor Award (Georgia Tech)
2012	Sigma Xi Young Faculty Award (Georgia Tech) Paul A. Duke GIFT Action Plan Achievement Mentor Award For K-12 outreach (Mr. Casey Bethel, teacher), first place
2010	Blanchard assistant professorship (Georgia Tech) Pew Scholar in Biomedical Sciences Fellow
2009	NSF CAREER award American Federation for Aging Research Rosalinde and Arthur Gilbert New Investigator Award
2008	Glaucoma Research Foundation Schaffer award
2006	American Chemical Society Nobel Laureate Signature Award for Graduate Education in Chemistry American Crystallographic Association Travel Grant
2005	Ruth L. Kirschstein NIH Postdoctoral Research Fellowship
2001	L. Carroll King teaching award, NU Department of Chemistry NU Office of the Vice President for Research Travel Grant Society for Biological Inorganic Chemistry student grant
2000	NIH Molecular Biophysics Grant Trainee (2000-2002) National Science Foundation (NSF) Preparing Future Faculty Program Fellow (2000-2001) American Crystallographic Association Pauling Poster Prize
1998	Phi Beta Kappa, MIT Merck Index Award for Excellence in Chemistry, MIT

IV. RESEARCH, SCHOLARSHIP, AND CREATIVE ACTIVITIES

** indicates work done at Georgia Tech*
@ indicates corresponding author or co-corresponding author
 # indicates current or former lab members for manuscripts with collaborators
Underline indicates undergraduate student
See also https://scholar.google.com/citations?user=qmtLr9kAAAAJ&hl=en&authuser=1

A. PUBLISHED BOOKS, BOOK CHAPTERS, AND EDITED VOLUMES

A1. Books

No data

A2. Refereed Book Chapters

1.* Johnson, J. L. Kalyoncu, S., **Lieberman, R. L.@** Lessons from an α-helical membrane enzyme: work flow to optimize expression, purification, and detergent for biophysical and structural characterization. Methods in Molecular Biology, 1432:281-301, 2016. (DOI: 10.1007/978-1-4939-3637-3_18)

2.* **Lieberman, R. L.@**, Peek, M. E, Watkins, J. D.# "Macromolecular X-ray crystallography" in Electron Crystallography of Soluble and Membrane Proteins, Methods in Molecular Biology 955, 475-93, 2013. (Humana Press). (DOI: 10.1007/978-1-62703-176-9_25)

3. **Lieberman, R. L.**, Rosenzweig, A. C.@ Metal ion homeostasis. In Comprehensive Coordination Chemistry II: From Biology to Nanotechnology (J. McCleverty, T. J. Meyers, eds.), Oxford:Pergamon, New York, **8**, 195-211, 2003.

A3. Edited Volumes

No data

B. REFEREED PUBLICATIONS AND SUBMITTED ARTICLES

B1. Published and Accepted Journal Articles

4.* Hill, S. E.#, Nguyen, E.#, Donegan, R. K.#, Patterson-Orazem, A., Hazel, A., Gumbart, J. C., **Lieberman, R. L.@** Structure and misfolding of the flexible tripartite coiled coil domain of glaucoma-associated myocilin., Structure 25(11), 1697-1707, 2017.

- Highlighted in: http://www.news.gatech.edu/2017/10/19/y-protein-unicorn-might-matter-glaucoma
- Featured on journal cover

5.* Joe, M.K., **Lieberman, R. L.**, Nakaya, N. and Tomarev, S. I.* Myocilin regulates metalloproteasae 2 activity through interaction with TIMP3, Invest. Ophthalmol. Vis. Sci., 58(12):5308-5318, 2017.

- Lieberman designed & conducted experiments, analyzed results, edited manuscript. Remaining authors designed, conducted experiments, analyzed results, and wrote paper.

6.* Crowley, V.C., Huard, D. J. E., **Lieberman, R. L.**, Blagg, S. J., Second Generation Grp94-selective Inhibitors Provide Opportunities for the Inhibition of Metastatic Cancer. Chem. Eur. J., 23(62):15775-15782, 2017.

- Huard, Lieberman designed & conducted experiments, analyzed results, edited manuscript. Remaining authors designed, conducted experiments, analyzed results, and wrote paper.

7.* Entzminger, K. C., Hyun, J., Patterson-Orazem, A.C.#, Pantazes, R. J., Frye, Z., Hughes, R. A., **Lieberman, R. L.**, Ellington, A. D., Maranas, C. D., Maynard, J. A.@, *De novo* design of antibody complementarity determining regions binding a conformational FLAG epitope, Sci. Rep, **7**, Article number: 10295, 2017.

- Patterson-Orazem, Lieberman designed & conducted experiments, analyzed results, edited manuscript. Remaining authors designed, conducted experiments, analyzed results, and wrote paper.

8.* Hill, S. E.#, Nguyen, E.#, Ukachukwu, C. U.#, Freeman, D. M.#, Quirk, S., **Lieberman, R. L.@** A tetranuclear metal ion cluster in the *E. coli* Nudix hydrolase dihydroneopterin triphosphate pyrophosphatase informs its catalytic mechanism. PLoS ONE, 12(7): e0180241, 2017.

9.* Kalyoncu, S.#, Heaner, D. P.#, Kurt, Z., Bethel, C. M.#, Ukachukwu, C.#, Spain, J., **Lieberman, R. L.@** Enzymatic hydrolysis by transition metal-dependent nucleophilic aromatic substitution. Nat. Chem. Biol. 12(12), 1031-1036, 2016. (DOI: 10.1038/nchembio.2191)

- Highlighted in: http://www.rh.gatech.edu/news/582003/unique-bacterial-chemist-war-potatoes
- Highlighted in: http://www.rh.gatech.edu/features/next-generation-genius-0
- Highlighted in: https://www1.aps.anl.gov/APS-Science-Highlight/2016/unique-bacterial-chemist-war-potatoes
- Highlighted in: http://www.cos.gatech.edu/content/meet-casey-bethel-georgias-2017-teacher-year
- Highlighted in: https://mcbblog.nsfbio.com/2016/06/20/mr-casey-bethel-recipient-of-georgias-2017-teacher-of-the-year-award-following-a-nsf-research-experience-for-teachers-ret/

10.* Goldenzweig, A., Goldsmith, M. Hill, S. E.#, Gertman, O., Laurino, P., Ashani, Y., Dym, O., Albeck, S., Prilusky, J., **Lieberman, R. L.**, Aharoni, A., Silman, I., Sussman, J. L., Tawfik, D. S., Fleishman, S. J.@ Fully automated computational design of poorly behaved human enzymes for higher bacterial expression and stability. Mol. Cell, 63(2), 337-346, 2016.

- Hill, Lieberman designed & conducted experiments, analyzed results. Hill, Lieberman wrote and edited paper. Remaining authors designed, conducted experiments, analyzed results, and wrote paper.

11.* Crowley, V., Khandelwal, A., Mishra, S., Stothert, A., Huard, D.J.E.#, Zhao, J., Muth, A., Duerfeldt, A., Kizziah, J.#, **Lieberman, R. L.,** Dickey, C. A., Blagg, B. J.@ Development of Grp94-Selective Inhibitors based on the BnIm and Radamide Scaffold. J. Med. Chem., 59(7):3471-88, 2106. (DOI: 10.1021/acs.jmedchem.6b00085)

- Huard, Kizziah, Lieberman designed & conducted experiments, analyzed results. Huard, Lieberman wrote and edited paper. Remaining authors designed, conducted experiments, analyzed results, and wrote paper.

12.* Entzminger, K., Johnson, J. L.#, Hyun, J., **Lieberman, R. L.**, Maynard, J. A.@ Increased Fab thermoresistance via V_H-targeted directed evolution. Prot. Engin. Des. Sel. 28(10), 365-77, 2015. (DOI:10.1093/protein/gzv037)

- Johnson, Lieberman designed & conducted experiments, analyzed results, and edited paper. Remaining authors designed, conducted experiments, analyzed results, and wrote paper.

13.* Naing, S.-H.#, Vukoti, K. M., Drury, J. E.#, Johnson, J. L.#, Kalyoncu, S.#, Hill, S. E.#, Torres, M., **Lieberman, R. L.@** Catalytic properties of intramembrane aspartyl protease substrate hydrolysis evaluated using a FRET peptide cleavage assay. ACS Chem. Biol. 10(9), 2166-74, 2015. (DOI:10.1021/acschembio.5b00305)

- Naing, Drury, Johnson, Kalyoncu, Hill, Lieberman designed, conducted experiments and analyzed results. Vukoti, Torres conducted mass spectrometry experiments and analyzed results. Naing, Torres, Lieberman wrote paper.

14.* Hill, S. E., Donegan, R. K., Nguyen, E., Desai, T. M., **Lieberman, R. L.@** Molecular details of olfactomedin domains provide pathway to structure-function studies. PLoS ONE, 10(6), e0130888, 2015. (DOI:10.1371/journal.pone.0130888)

11.* Johnson, J. L.#, Entzminger, K., Hyun, J., Kalyoncu, S.#, Heaner, D.#, Morales, I.#, Sheppard, A.#, Gumbart, J. C., Maynard, J. A., **Lieberman, R. L.@** Structural and biophysical characterization of epitope-specific engineered Fab fragment and complexation with membrane proteins: implications for co-

crystallization. Acta Crystallographica Section D, 71(part 4), 896-906, 2015. (DOI:10.1107/S1399004715001856

- Johnson, Kalyoncu, Heaner, Morales, Sheppard, Lieberman designed, conducted, and analyzed experiments. Johnson and Lieberman write the paper. Remaining authors designed and conducted experiments, analyzed results, edited paper.

15.* Donegan, R. K., Hill, S. E., Freeman, D. M., Nguyen, E., Orwig, S. D., Turnage, K. C., **Lieberman, R. L.@** Structural basis for misfolding in myocilin-associated glaucoma. Hum. Mol. Genet., 24(8), 2111-2124, 2015. (DOI: 10.1093/hmg/ddu730)

- Featured on cover of journal
- Highlighted in http://www.news.gatech.edu/2015/04/21/3d-structure-solved-vulnerable-region-glaucoma-causing-protein

16.* Stothert, A. R., Suntharalingam, A., Huard, D. J. E.#, Fontaine, S., Crowley, V., Mishra, S., Blagg, B., **Lieberman, R. L.**, Dickey, C. A.@ Exploiting the interaction between Grp94 and aggregated myocilin to treat glaucoma. Hum. Mol. Genet., 23(24), 6470-80, 2014. (DOI: 10.1093/hmg/ddu367)

- Huard, Lieberman designed, conducted, analyzed in vitro experiments, wrote and edited paper with other coauthors.

17.* Yu Y., Mena-Barragán T., Higaki K.*, Johnson J. L. #, Drury J. E.#, **Lieberman R. L.**, Nakasone N., Ninomiya H., Tsukimura T., Sakuraba H., Suzuki Y., Nanba E., Mellet C. O.*, García Fernández J. M., Ohno K. Molecular Basis of 1-Deoxygalactonojirimycin Arylthiourea Binding to Human α-Galactosidase A: Pharmacological Chaperoning Efficacy on Fabry Disease Mutants. ACS Chem. Biol., 9(7), 1460-9, 2014. (DOI: 10.1021/cb500143h)

- Johnson, Drury and Lieberman cocrystallized and solved structures. Remaining authors synthesized and tested molecules. Yu, Higaki, Garcia-Fernandez, Mellet, Lieberman wrote paper.

18.* Kalyoncu, S.#, Hyun, J., Pai, J. C., Johnson, J. L.#, Etzminger, J., Jain, A., Heaner, D.#, Morales, I. A.#, Truskett, T. M., Maynard, J. A., **Lieberman, R. L.@** Effects of protein engineering and rational mutagenesis on crystal lattice of single chain antibody fragments: implications for membrane protein crystallization chaperones. Proteins, 82(9), 1884-95, 2014. (DOI:10.1002/prot.24542)

- Kalyoncu, Johnson, Heaner and Morales designed, analyzed and conducted experiments. Kalyoncu and Lieberman wrote paper. Remaining authors designed and conducted experiments, analyzed results, and edited paper.

19.* Orwig, S. D.#, Chi, P. V.#, Du, Y., Hill, S. E.#, Cavitt, M. A., Suntharalingam, A., Turnage, K. C.#, Dickey, C. A., France, S., Fu, H., **Lieberman, R. L.@** Ligands for glaucoma-associated myocilin discovered by a generic binding assay, ACS Chem. Biol., 9(2), 517-25, 2014. (DOI:10.1021/cb4007776)

- Orwig, Chi, Hill, Turnage (Lieberman lab) designed, analyzed, and conducted experiments. Orwig and Lieberman wrote paper. Remaining authors conducted experiments.
- Highlighted in: http://www.news.gatech.edu/2014/01/23/researchers-discover-potential-drug-targets-early-onset-glaucoma
- Feature in EuroTimes (June 2014), EyeWorld (July 2014)

20.* Hill, S. E., Donegan, R. K., **Lieberman, R. L.@** The glaucoma-associated olfactomedin domain of myocilin forms polymorphic fibrils that are constrained by partial unfolding and peptide sequence. J. Mol. Biol., 426(4), 921-35, 2014. (DOI:10.1016/j.jmb.2013.12.002).

- Highlighted in: http://www.news.gatech.edu/2014/01/23/researchers-discover-potential-drug-targets-early-onset-glaucoma
- Feature in EuroTimes (June 2014), EyeWorld (July 2014)

21.* Bethel, C. M., **Lieberman, R. L.@** Protein structure and function: A multimedia-based guided-inquiry education module for the high school science classroom. J. Chem. Educ., 91(1), 52-55, 2014.

- This work is the outcome from two summers of GIFT program participation by Mr. Casey Bethel
- Video implementation: http://www.youtube.com/watch?v=iEySsDlSfQc&feature=results_video

22.* Donegan, R. K., Hill, S. E., Turnage, K. C., Orwig, S. D., **Lieberman, R. L.@** The glaucoma-associated olfactomedin domain of myocilin is a novel calcium-binding protein. J. Biol. Chem., 287(52), 43370-43377, 2012. (DOI:10.1074/jbc.M112.384800)

20.* Suntharalingam, A., O'Leary, J. C. III, Koren, J. III, Blair, L. J., Hill, S. E.#, Abisambra, J. F., Jinwal, U. K., Tomarev, S. I., **Lieberman, R. L.**, Dickey, C. A.@ Grp94 triage of mutant myocilin through ERAD subverts a more efficient a more efficient clearance mechanism. J. Biol. Chem., 287(48), 40661-40669, 2012. (DOI:10.1074/jbc.M112.408906)

- Hill and Lieberman designed experiments, analyzed results, and wrote manuscript.

23.* Orwig, S. D.#, Perry, C. W.#, Kim, L. Y, Turnage, K. C.#, Zhang, R., Vollrath, D., Schmidt-Krey, I., **Lieberman, R. L.@** Amyloid fibril formation by the glaucoma-associated olfactomedin domain of myocilin. J. Mol. Biol., 421, 242-255, 2012. (DOI:10.1016/j.jmb.2011.12.016)

- Orwig, Perry, and Turnage designed, conducted, and analyzed experiments. Kim (Schmidt-Krey lab) and Zhang (Vollrath lab) conducted experiments. Orwig and Lieberman wrote the paper.
- Highlighted in: http://www.gatech.edu/newsroom/release.html?nid=78611

24.* Orwig, S. D.#, Tan, Y. L., Grimster, N. P., Yu, Z., Powers, E., Kelly, J. W., **Lieberman, R. L.@** Binding of 3,4,5,6-tetrahydroxyazepanes to the acid β glucosidase active site: Implications for pharmacological chaperone design for Gaucher disease, Biochemistry, 50(49), 10647-10657, 2011 (DOI:10.1021/bi201619z)

- Orwig (Lieberman lab) and Lieberman designed and conducted crystallographic experiments. Tan, Grimster, and Yu (Kelly lab) conducted other characterization experiments. Orwig, Powers, and Lieberman wrote the manuscript.

25.* Burns, J. N., Turnage, K. C. Walker, C. A., **Lieberman, R. L.@** Stability of myocilin olfactomedin domain variants provides new insight into glaucoma as a protein misfolding disorder. Biochemistry, 50(26), 5824-5833, 2011. (DOI:10.1021/bi200231x)

26.* Orwig, S. D.# and **Lieberman, R. L.@** Biophysical characterization of the olfactomedin domain of myocilin, an extracellular matrix implicated in the inherited form of glaucoma. PLoS ONE, 6(1), e16347, 2011. (DOI:10.1371/journal.pone.0016347)

27.* Pai, J. C.; Culver, J. A.#; Drury, J. E.#; **Lieberman, R. L.@**; Maynard, J. A@. Peptide specific antibody scFv chaperones for cocrystallization chaperone development. Prot. Engin. Des. Sel., 24, 419-428, 2011. (DOI: 10.1093/protein/gzq120)

- Culver, Drury conducted experiments, analyzed results, and wrote initial manuscript drafts; Lieberman and Maynard planned and analyzed experiments, and revised manuscript.

28.* Burns, J. N.#, Orwig, S. D.#, Harris, J. A.#, Watkins, J. D.#, Vollrath, D., **Lieberman, R. L.@** Rescue of mutant myocilin thermal stability by chemical chaperones: Implications for glaucoma. ACS Chem. Biol., 5(5), 477-497, 2010. (DOI: 10.1021/cb900282e)

- Burns, Orwig, Harris, Watkins and Lieberman planned, conducted, and analyzed experiments. Vollrath assisted in critical reading of the manuscript. Burns, Orwig and Lieberman wrote the paper.

29.* Landon, M. R., **Lieberman, R. L.**, Hoang, Q. Q., Orwig, S. D.#, Kosakov, D., Ju, S., Brenke, R., Chuang, G. Y., Vajda, S., Petsko, G. A., and Ringe, D.@ Detection of ligand binding hot spots on protein surfaces using fragment-based methods: application to DJ-1 and glucocerebrosidase. J. Comp. Aid. Des., 23, 491-500, 2009. (DOI: 10.1007/s10822-009-9283-2)

- Orwig analyzed data collected by Lieberman prior to GT arrival. Orwig and Lieberman contributed to figures and manuscript writing.

30.* **Lieberman, R. L.@**, D'aquino, J. A., Ringe, D.@, Petsko, G. A.@ Effects of iminosugar pharmacological chaperones on lysosomal glycosidase structure and stability. Biochemistry, 48, 4816-4827, 2009. (DOI: 10.1021/bi9002265)

- Lieberman collected data prior to GT arrival. Data analyzed and paper written by Lieberman at GT.

31. **Lieberman, R. L.** Wustman, B. A., Huertas, P., Powe, A. C., Jr., Pine, C. W., Khana, R., Schlossmacher, M. G., Ringe, D., Petsko, G. A.@ Structure of acid-β-glucosidase with pharmacological chaperone provides insight into Gaucher disease. Nat. Chem. Biol., 3, 101-107, 2007.

- Lieberman postdoctoral work with Petsko/Ringe

32. **Lieberman, R. L.**, Kondapalli K., Shrestha, D. B., Hakemian, A. S., Smith, S. M., Telser, J., Kuzelka, J., Gupta, R., Borovik, A. S., Lippard, S. J., Rosenzweig, A. C.@, Stemmler, T. L.@ Characterization of the particulate methane monooxygenase metal centers in multiple redox states by X-ray absorption spectroscopy. Inorg. Chem., 45, 8372-8381, 2006.

- Lieberman thesis work with Rosenzweig

33. **Lieberman, R. L.**, Rosenzweig, A. C.@ Crystal structure of a membrane-bound metalloenzyme that catalyses the biological oxidation of methane. Nature, 434, 177-182, 2005.

- Lieberman thesis work with Rosenzweig

34. **Lieberman, R. L.**, Shrestha, D. B., Doan, P. E., Hoffman, B. M., Stemmler, T. L., Rosenzweig, A. C.@ Purified particulate methane monooxygenase from *Methylococcus capsulatus* (Bath) is a dimer with both mononuclear copper and a copper-containing cluster. Proc. Natl. Acad. Sci. USA, 100, 3820-3825, 2003.

- Lieberman thesis work with Rosenzweig

35. **Lieberman, R. L.**, Arciero, D. M., Hooper, A. B., Rosenzweig, A. C.@ Crystal structure of a novel red copper protein from *Nitrosomonas europaea*. Biochemistry, 40, 5674-5681, 2001.

- Lieberman thesis work with Rosenzweig

36. **Lieberman, R. L.**, Bino, A., Mirsky N., Summers, D. A., Thompson, R. C.@ Synthesis, structure and magnetic properties of a chromium(III)-nicotinamide complex, $[Cr_3O(O_2CCH_3)_6(\text{nicotinamide})_3]^+$. Inorg. Chim. Acta, 297, 1-2, 2000.

- Lieberman undergraduate semester-abroad research with Bino

B2. Conference Presentation with Proceedings (Refereed)

No data

B3. Other refereed material

37.* Donegan, R. K. and **Lieberman, R. L.@** Discovery of molecular therapeutics for glaucoma: challenges, successes, and promising directions. J. Med. Chem., 59(3), 788-809, 2016. (DOI: 10.1021/acs.jmedchem.5b00828)

- Invited review.

38.* Donegan, R. K., **Lieberman, R. L.@** A new direction for glaucoma therapeutics: Focus on the olfactomedin domain of myocilin, Future Med. Chem., 4(17), 2012. DOI:10.4155/FMC.11.34)

- Invited review.

39.* **Lieberman, R. L.@** Sneak peak at galactocerebrosidase, Krabbe disease's lysosomal hydrolase. Proc. Natl. Acad. Sci USA, 108(37), 15017-8, 2011. (DOI: 10.1073/pnas.1112653108)

40.* **Lieberman, R. L.@**, Culver, J. A.#, Entzminger, K. C., Pai, J. C.; Maynard, J. A. Crystallization chaperone strategies for membrane proteins. Methods, 55(4), 293-302, 2011. (DOI:10.1016/j.ymeth.1011.08.004).

- Invited review based on collaborative work between Lieberman and Maynard labs

41.* **Lieberman, R. L.@** A guided tour of the structural biology of Gaucher disease: acid-beta-glucosidase and saposin c. Enzyme Research, 2011, ArticleID 973231, (DOI:10.4061/2011/973231)

- Invited review.

42. **Lieberman, R. L.**, Wolfe, M. S.@ From rhomboid function to structure and back again. Proc. Natl. Acad. Sci. USA, 104, 8119-8120, 2007.

- Invited review with postdoctoral mentor Wolfe

43. **Lieberman, R. L.**, Wolfe, M. S.@ Intramembrane protease poses for photoshoot. Proc. Natl. Acad. Sci. USA, 104, 401-402, 2007.

- Invited review with postdoctoral mentor Wolfe

44. **Lieberman, R. L.**, Rosenzweig, A. C.@ The quest for the particulate methane monooxygenase active site. Dalton Transactions, 21, 3990-3996, 2005.

- Invited review with graduate mentor Rosenzweig

45. Sommerhalter, M., **Lieberman, R. L.**, Rosenzweig, A. C.@ X-ray crystallography and biological metal centers: is seeing believing? Inorg. Chem., 44, 770-778, 2005.

- Invited review with graduate mentor Rosenzweig

46. **Lieberman, R. L.**, Rosenzweig, A. C.@ Crystallographic trapping of a precatalytic enzyme complex provides new insight into the mechanism of dioxygen activation at a mononuclear copper center. Chemtracts, 17, 562-268, 2004.

- Invited review with graduate mentor Rosenzweig

47. **Lieberman, R. L.**, Rosenzweig, A. C.@ Biological methane oxidation: regulation, biochemistry, and active site structure of particulate methane monooxygenase. Crit. Rev. Biochem. Mol. Biol., 39, 147-164, 2004.

- Invited review with graduate mentor Rosenzweig

B4. Journal Articles Submitted and in Preparation

48.* Stothert, A. R., Tang, X., Suntharalingam, A., Crowley, V. M., Mishra, S., Sabbagh, J., Nordhues, B., Huard, D.J.E.#, **Lieberman, R. L.**, Passaglia, C., Blagg, S. J., Dickey, C. A., Blair, L.@ Isoform-selective Hsp90 inhibition rescues models of hereditary and acquired vision loss. Provisional acceptance, Sci Rep., accepted 12/2017.

49.* Naing, S.H.#, Oliver, R.C., Weiss, K.L., Urban, V.S., **Lieberman, R. L.@** Solution structure of the *Methanoculleus marisnigri JR1* intramembrane aspartyl protease. Provisional acceptance, Biophys. J., accepted 12/2017.

50.* Huard, D.J.E. #, Qi, M., Crowley, V., Suntharalingam, A., Tomlin, M. #, Du, Y., Dickey, C. A., Blair, L., Fu, H., Blagg, B.S.J., **Lieberman R.L.@** Development of a high throughput kinetics assay for the detection of compounds that ameliorate glaucoma-associated aggregation and enable its cellular degradation -- proof of concept with Grp94 inhibitors. Provisional acceptance, ACS Chem. Biol, revision submitted 12/2017.

51.* Naing, S.H.#, Kalyoncu, S.#, Smalley, D. M., Tao, X#., George, J. B. #, Jonke, A., Kim, H., Oliver, R.C., Urban, V.S., Torres, M. P., **Lieberman, R. L.@** Quantitative in vitro proteolytic cleavage preferences of a presenilin ortholog. Submitted, 122017.

C. Other Publications and Creative Products

Lieberman, R.L. Structural and biophysical characterization of particulate methane monooxygenase from Methylococcus capsulatus (Bath). PhD dissertation, Northwestern University.

D. Presentations

Meetings:

2018 **Invited** speaker, ARVO annual meeting symposium "Proteostasis networks: challenges and therapeutic opportunities for ocular disease" (5/2018, Honolulu, HI)
Invited participant, NSF sponsored strategic planning workshop, Progress and Prospects for Neutron Scattering in the Biological Sciences (2/2018, Arlington VA)

2017 **Invited** participant, Trabecular meshwork study group, Portland, OR (Nov 2017)
Invited speaker, PEGS Boston, Boston, MA
Invited speaker, International Society for Eye Research/Brightfocus 2017 Glaucoma Symopsium (Atlanta, GA)
Invited speaker (2 talks), SERMACS annual meeting (Charlotte, NC)
Contributed poster, ARVO annual meeting, Baltimore, MD
Contributed poster, 30th annual AFAR meeting, Santa Barbara, CA

Invited speaker, 10th annual AFAR New Investigator Meeting, Santa Barbara, CA

2016 **Invited** speaker, 8th Ocular Disorders Drug Discovery, San Diego, CA (3/2016)
Invited speaker, Annual ARVO meeting, Seattle, WA (5/2016)

2015 **Contributed** poster, Annual ARVO meeting, Denver, CO [canceled attendance for personal reasons]

2014 **Invited** speaker, Society for Laboratory Animation and Screening (SLAS) annual meeting
Invited speaker, Pew Foundation Annual Meeting
Invited speaker, Annual ARVO meeting, Orlando, FL
Invited speaker, Discovery on Target: Antibodies against membrane proteins, Boston, MA

2013 **Contributed** poster, Pew Foundation Annual Meeting
Invited speaker, Annual ARVO meeting, Seattle, WA
Invited speaker, 2013 ISER Sarasota Symposium

2012 **Invited** speaker, Keystone symposium "Structural Biology of the Cell", Keystone, CO
Invited speaker, Suddath Symposium on protein misfolding (IBB/GIT)
Invited speaker, Keystone Symposium "Chemical Biology and Novel Tools in Pharmacology" (3/2012)
Contributed poster, Pew Foundation Annual Meeting
Invited speaker, 243rd ACS National Meeting in San Diego BIOL division
Invited speaker, Annual ARVO meeting, Fort Lauderdale, FL
Invited speaker, The Glaucoma Foundation Nineteenth Annual Optic Nerve Rescue and Restoration Think Tank (9/2012)
Invited speaker, Bio Industry Symposium @ Georgia Tech
Invited speaker, Sigma Xi Monie A. Ferst Award Symposium (in honor of K. E. Van Holde) (11/2012)

2011 **Contributed** poster, Annual ARVO meeting, Fort Lauderdale, FL
Invited speaker, Proteins Gordon Research Conference, Holderness, NH

2010 **Contributed** poster, 3rd Annual NIH Roadmap Membrane Protein Structural Biology, San Diego, CA
Invited speaker, Pew Charitable Trusts Davis Family Symposium, New York, NY
Contributed poster, American Chemical Society spring meeting, San Francisco, CA
Contributed poster, Cold Spring Harbor Meeting on Stress and Chaperones, Huntington, NY
Contributed poster, American Federation for Aging Research annual mtg, Santa Barbara, CA
Invited poster, National Science Foundation MCB meeting on integration of teaching and research, Arlington, VA
Invited speaker, NanoMAD annual retreat (Georgia Tech)
Invited speaker, Industrial Partners Symposium (Georgia Tech)

2009 **Contributed** poster, Proteins Gordon Research Conference, Holderness, NH

2008 **Contributed** poster, Lysosomal Diseases and the Brain Conference, Sacramento, CA

Colloquia:

2017 **Invited** speaker, University of South Carolina, School of Chemistry & Biochemistry (Host: Caryn Outten)
Invited speaker, Southern Mississippi School of Chemistry & Biochemistry (Host: Vijay Rangachari)

2016 **Invited** speaker, University of Delaware Center for Biomanufacturing Science and Technology (Host: Christopher Roberts)
Invited speaker, Loyola University of Chicago (Host: Dali Liu)

2015 **Invited** speaker, Sunnybrook Research Institute, Toronto ON (Host: David Andrews)
Invited speaker, Northwestern University Department of Molecular Biosciences (host: Biophysics training grant)
Invited speaker, Purdue University Department of Chemistry (host: Chittaranjan Das)

Invited speaker, Kennesaw State University, Department of Biology, Kennesaw GA (Susan M. E. Smith)
Invited speaker, NANOfans forum "Current Trends in Ophthalmology", Atlanta, GA

2014 **Invited** speaker, University of Colorado Boulder, Department of Molecular, Cellular, Developmental Biology (host: Jingshi Shen)
Invited speaker, University of Minnesota Chemical Biology seminar series (host: Erin Carlson)

2013 **Invited** speaker, University of South Florida Department of Molecular Medicine (host: C. Dickey)
Invited speaker, Clemson University Department of Biochemistry (host: M. Sehorn)

2012 **Invited** speaker, UT Austin Department of Chemistry & Biochemistry, Austin TX (host: J. Maynard)
Invited speaker, Vanderbilt Chemical Biology Seminar Series (host: Charles Sanders)
Invited speaker, University of Michigan School of Medicine (host: Julia Richards)
Invited speaker, University of Pennsylvania, Philadelphia, PA (host: So Jung Park)
Invited speaker, Emory University Department of Chemistry (host: Khalid Saalita)
Invited speaker, Ohio State University, Columbus, OH (host: Tom Magliery)
Invited speaker, University of Missouri, Columbia, MS (host: Krishna Sharma)
Invited speaker, Emory University Eye Center (host: Michael Iuvone)

2011 **Invited** speaker, Wayne State University Department of Chemistry, Detroit, MI (host: Christy Chow)
Invited speaker, University of Michigan Department of Chemistry, Ann Arbor, MI (host: Mi Hee Lim)
Invited speaker, Michigan State University Department of Biochemistry, East Lansing, MI (host: Shelagh Ferguson-Miller)
Invited speaker, University of Pittsburgh Chemistry Department (host: Lillian Chong)
Invited speaker, North Carolina State University, Raleigh, NC (host: Carla Mattos)
Invited speaker, Duke Department of Chemistry, Durham, NC (host: Kathy Franz)
Invited speaker, Emory University Dept of Biochemistry, Atlanta, GA (host: Anita Corbett)
Invited speaker, Auburn University Department of Chemistry & Biochemistry, Montgomery, AL (host: Susanne Stiegler)

2010 **Invited** speaker, Georgia State University Department of Biology, Atlanta, GA (host: Irene Weber)

2009 **Invited** speaker, University of Georgia Department of Biochemistry, Athens, GA (host: Jeff Urbauer)
Invited speaker, Pomona College (host: Matthew Sazinsky)
Invited speaker, College of Charleston (host: Pamela Riggs-Gelasco)
Invited speaker, Furman University (host: Eli Hestermann)

2008 **Invited** speaker, University of Puerto Rico, Rio Piedras Department of Chemistry, San Juan, PR (host: Zarixia Zavala-Ruiz)
Invited speaker, CDC Newborn Screening Group, Atlanta, GA (host: Victor de Jesus)
Invited speaker, Emory University Department of Human Genetics Grand Rounds (host: Paul Fernhoff [deceased])

E. GRANTS AND CONTRACTS

E1. As Principal Investigator

Current:

Characterization of purified myocilin: glaucoma as a protein misfolding disease (competitive renewal of R01EY021205)
Agency: NIH
Total Dollar Amount: (2017-2021) $1,484,586

Role: PI
Collaborators: Matthew P. Torres (BIOL)
Period of Contract: 3/2017-3/2021
Candidate's Share: $200K direct/yr

Purification and structure of folate biosynthetic proteins
Company: Kimberly Clark Corp
Total Dollar Amount: $85,000
Role: PI
Period of Contract: 7/2012-7/2018

Identification of myocilin post-translational modifications and binding partners under static and glaucoma-relevant mechanical stretch
Agency: BrightFocus Foundation
Total Dollar Amount: $75,000
Role: PI
Collaborators: Matthew P. Torres (BIOL)
Period of Contract: 7/1/2017-NCE
Candidate's Share: $75K direct

GT-FIRE: Characterization of glaucoma as an amyloid disease
Agency: Georgia Tech
Total Dollar Amount: $40,000
Role: PI
Collaborators: Anant Paravastu (CHBE)
Period of Contract: 7/1/2017-6/30/2018
Candidate's Share: $20K/yr

Completed:

Development of pharmacological chaperone therapy for inherited primary and juvenile open angle glaucoma
Agency: Glaucoma Research Foundation
Total Dollar Amount: $40,000
Role: PI
Period of Contract: 1/2008-1/2009

Crystal structure of an intramembrane aspartyl protease
Agency: American Federation for Aging Research
Total Dollar Amount: $75,000
Role: PI
Period of Contract: 6/2009-6/2011

Development of pharmacological chaperone therapy for inherited primary and juvenile open angle glaucoma
Agency: American Health Assistance Foundation (now BrightFocus Foundation)
Total Dollar Amount: $100,000
Role: PI
Period of Contract: 6/2008-3/2011

Blanchard Assistant Professor
Agency: Georgia Tech School of Chemistry & Biochemistry

Total Dollar Amount: $70,000
Role: PI
Period of Contract: 7/2010-7/2012

CAREER: Research and education in the structure and function of intramembrane aspartyl proteases MCB 0845445
Agency: NSF
Total Dollar Amount: $867,346
Role: PI
Period of Contract: 4/2009-3/2015

Cullen-Peck Fellow
Agency: Georgia Tech College of Sciences
Total Dollar Amount: $10,000
Period of Contract: 1/2014-12/2014

2010 Pew Scholar in the Biomedical Sciences
Agency: Pew Charitable Trusts
Total Dollar Amount: $240,000
Role: PI
Period of Contract: 6/2010-6/2015

Characterization of purified myocilin: glaucoma as a protein misfolding disease (R01EY021205)
Agency: NIH
Total Dollar Amount: (2011-2016) $1,520,312
Role: PI
Period of Contract: 3/2011-3/2016
Candidate's Share: $250K direct/yr

E2. AS CO-PRINCIPAL INVESTIGATOR

Completed:

Structure of signal peptide peptidase by cryo electron crystallography
Agency: Integrative BioSystems Institute (Georgia Tech)
Total Dollar Amount: $30,000
Role: Co-PI
Co-PI: Ingeborg Schmidt-Krey
Period of Contract: 7/2010-7/2011
Candidate's Share: $15K/yr

Crystal structure of signal peptide peptidase with engineered antibody fragment (R21DK091357)
Agency: NIH
Total Dollar Amount: $405,728
Role: PI
Co-I: Jennifer A. Maynard (UT Austin)
Period of Contract: 7/2010-7/2012
Candidate's Share: $100K/yr

Engineered single chain antibody fragments for cocrystallization with signal peptide peptidase R01GM095638
Agency: NIH
Total Dollar Amount: $1,092,964

Role: Co-I
PI: Jennifer A. Maynard (UT Austin)
Period of Contract: 6/2010-6/2015
Candidate's Share: $125K/yr

Miniaturization and pilot high throughput screening assay for new glaucoma therapeutic targeting the interaction between Grp94 and mutant myocilin
Agency: Atlanta Clinical & Translational Science Institute
Total Dollar Amount: $50,000 direct
Role: Co-PI
Co-PI: Haian Fu (Emory)
Period of Contract: 9/2015-8/2016
Candidate's Share: $25K/yr

Identification of glaucoma-associated myocilin amyloid and pathway to treatment
Agency: Petit Institute for Bioscience and Bioengineering (Georgia Tech)
Total Dollar Amount: $100,000
Period of Contract: 9/2013-12/2016
Role: Co-PI
Co-PI: C. Ross Ethier (BME)
Candidate's Share: $50,000

E3. AS SENIOR PERSONNEL OR CONTRIBUTOR

No data

E4. PENDING PROPOSALS

Investigator Competition
Agency: Howard Hughes Medical Institute
Role: PI

R01 Chemical probe discovery for the olfactomedin domain of myocilin: pathway to new glaucoma therapy
Agency: NIH
Total Dollar Amount: $1,305,885
Role: PI
Collaborators: Emory Chemical Biology Discovery Center, Stefan France (GT)
Period of Contract proposed 4/1/2018-3/31/21

Decoding Elusive Signal Transduction Pathways with Antibody Mimics
Agency: Keck Foundation
Total Dollar Amount: $750,000
Role: Co-PI
Collaborators: Erin E. Carlson (U. Minnesota)
Period of Contract Proposed 5/1/2018-4/30/2021

Decoding Elusive Signal Transduction Pathways with Antibody Mimics
Agency: Pew Charitable Trust
Total Dollar Amount: $50,000
Role: Co-PI
Collaborator: Erin E. Carlson (U. Minnesota)
Period of Contract Proposed: 7/1/2018-6/30/2020

Decoding intramembrane aspartyl protease substrate preferences and activity
Agency: NSF
Total Dollar Amount: $757,000
Role: PI
Collaborators: Matthew Torres (Biology), James Gumbart (Physics)
Period of Contract Proposed 7/1/2018-7/21/2021

E5. PROPOSALS SUBMITTED BUT NOT FUNDED (last two years)

2016

Biochemistry of intramembrane aspartyl proteases
Agency: NSF
Total Dollar Amount: $661,250
Role: PI
Collaborators: Matthew P. Torres (BIOL)

Mirror-Image Antibody Toolkit for Pharmaceutical Discovery
Agency: Pew
Total Dollar Amount: $100,000
Role: Co-PI
Collaborators: Erin E. Carlson (U. Minnesota)

R01 Chemical probe discovery for the olfactomedin domain of myocilin and pathway to new glaucoma therapy
Agency: NIH
Total Dollar Amount: $2,676,634
Role: PI
Collaborators: C. Ross Ethier (BME), Emory Chemical Biology Discovery Center

2015

Faculty Scholar Award
Agency/Company: Howard Hughes Medical Institute
Total Dollar Amount: $400,000
Role: PI

R01 Chemical probe discovery for the olfactomedin domain of myocilin and pathway to new glaucoma therapy
Agency/Company: NIH
Total Dollar Amount: $1,133,435.00
Role: PI

Biochemistry of intramembrane aspartyl proteases
Agency: NSF
Total Dollar Amount: $ 650,860
Role: PI
Collaborators: Matthew P. Torres (BIOL)

Identification of myocilin posttranslational modifications and binding partners under static and glaucoma-relevant mechanical stretch
Agency: NIH
Total Dollar Amount: $ 419,561

Role: Co-PI
Other PIs: Ross Ethier (BME), Matthew Torres (BIOL)

F. Other Scholarly and Creative Accomplishments

No data

G. Societal And Policy Impacts

- Panelist at congressional luncheon on early-stage investigators (Research!America, ACS, 2010)
- http://www.usnews.com/science/articles/2012/07/09/connecting-enzymes-and-diseases
- *Lab research*: article in Technique 2011, the Georgia Tech Yearbook
- *http://www.gatech.edu/newsroom/release.html?nid=78611*
- *Pew Scholar in Biomedical Sciences (2010): http://www.youtube.com/watch?v=cD5hy_6X9k8&feature=player_embedded&noredirect=1*
- *Congressional luncheon*: Research!America Annual Report 2010
- http://www.news.gatech.edu/2014/01/23/researchers-discover-potential-drug-targets-early-onset-glaucoma
- Feature in EuroTimes (June 2014)
- Feature in EyeWorld (July 2014)
- http://www.news.gatech.edu/2015/04/21/3d-structure-solved-vulnerable-region-glaucoma-causing-protein
- http://www.rh.gatech.edu/news/582003/unique-bacterial-chemist-war-potatoes
- http://www.rh.gatech.edu/features/next-generation-genius-0
- https://www1.aps.anl.gov/APS-Science-Highlight/2016/unique-bacterial-chemist-war-potatoes
- http://www.cos.gatech.edu/content/meet-casey-bethel-georgias-2017-teacher-year
- https://mcbblog.nsfbio.com/2016/06/20/mr-casey-bethel-recipient-of-georgias-2017-teacher-of-the-year-award-following-a-nsf-research-experience-for-teachers-ret/
- Feature in IBB Impact Report 2015, 2016
- http://www.news.gatech.edu/2017/10/19/y-protein-unicorn-might-matter-glaucoma

H. Other Professional Activities

- Keynote speaker, GIRLS camp lunch banquet, Georgia Tech

V. Teaching

A. Courses Taught

Semester, Year	Course Number	Course Title	Number of Students
Fall, 2017	4521	Biophysical Chemistry	12
Spring, 2017	4511/6501	Biochemistry I	74/4
Fall, 2016	4521	Biophysical Chemistry	11
Spring, 2016	4511/6501	Biochemistry I	83/7
Spring, 2014	4521	Biophysical Chemistry	17
Fall, 2012	4521	Biophysical Chemistry	50
Fall, 2011	4521/6582	Biophysical Chemistry	40/10
Spring, 2011	3511	Survey of Biochemistry	135

B. INDIVIDUAL STUDENT GUIDANCE

B1. Ph.D. Students

Current:

Swe-Htet Naing — 6th year (1/2013-)
"Solution Structure and Biochemistry of an Intramembrane Aspartyl Protease"
William H. Emerson Fellowship – *Georgia Institute of Technology*
Best Poster Presentation Award at Annual Departmental Retreat 2015
College of Science Poster Presentation Award at CRIDC 2016
Third Prize for Best Poster Presentation at 14th Annual Georgia Tech Graduate Technical Symposium 2017
Dean's Travel Fund to visit and perform experiments at Oak Ridge National Lab (ORNL) – Aug, Sept 2016, Feb 2017
Safety Award, Spring 2017 Chem/Biochem
Oral Presentation at Protein Processing, Trafficking and Secretion 2016 *(Gordon Research Seminar)*
Poster Presentation at Protein Processing, Trafficking and Secretion 2016 *(Gordon Research Conference)*

Athena Patterson-Orazem — 4rd year (3/2015-)

Xingjian (Jay) Tao — 2nd year (10/2016-)

Iramofu M. Dominic — 2nd year (1/2017-)

Federico Urbano-Munoz — 2nd year (3/2017-)

Previous (Ph. D. recipients):

Sibel Kalyoncu — 9/2011-6/2016
"Structural and functional characterization of an intramembrane peptidase and a non-peptidase homolog"
Current position: Postdoctoral fellow, Peter Tessier RPI
Fulbright opportunity grant, 2011
Poster presentation, Membrane Technologies Roadmap Meeting, Nov 2012
Poster presentation at 42nd Annual MidAtlantic Crystallography meeting, University of Virginia, May 2012
Poster presentation, SER-CAT 2012 symposium, 2012, University of Kentucky, March 2012
Poster presentation, 20th Annual Suddath Symposium, Georgia Institute of Technology, February 2012
Poster presentation at Biophysical Society Meeting, 2014
Senior Molecular Biophysics Trainee 2013-2014

Rebecca K. Donegan — 11/2010-4/2015
"Structural and biophysical characterization of the myocilin olfactomedin domain"
Current position: Postdoctoral fellow, Amit Reddi (GT)
Poster presentation, 20th Annual Suddath Symposium, Georgia Institute of Technology, February 2012
Poster award, International PEM6 meeting, 2012
Senior Molecular Biophysics Trainee 2012-14

	Oral presentation, 2nd place winner, graduate research symposium, 2013
Jennifer L. Johnson	11/2010-5/2015 *"The quest for a general co-crystallization strategy for macromolecules: Lessons on the use of chaperones for membrane protein crystallization"* Current position: Capricor Therapeutics Senior Molecular Biophysics Trainee 2012-2013 Oral presentation, Keystone Meeting: Frontiers of Structural Biology, 2014 Poster presentation, Membrane Technologies Roadmap Meeting, Nov 2012 Chemistry GAANN Fellowship 2010-2011; 2011-2012 William Emerson Fellowship, 2011-2012 Oral presentation at 42nd Annual Mid-Atlantic Crystallography meeting, University of Virginia, May 2012 Poster presentation, 9th Annual SER-CAT Symposium, University of Kentucky, March 2012 Poster presentation, 20th Annual Suddath Symposium, Georgia Institute of Technology, February 2012 Oral presentation, Molecular Biophysics Research Review, Georgia Institute of Technology, September 2011
Susan D. Orwig	PhD student 1/2008-8/2011, postdoctoral fellow 8/2011-12/2011 *"Biophysical and structural characterization of proteins implicated in glaucoma and Gaucher disease"* Current Position: GE Healthcare Center for Drug Discovery, Development and Delivery GAANN fellowship (2008-9, 2010-11) Poster presentation, 2011 Proteins Gordon Research Conference Poster presentation, 2010 NanoMAD conference, Georgia Institute of Technology Poster Presentation, 2009 American Crystallographic Association meeting, Toronto, Canada Oral presentation at 2009 Pittsburgh diffraction meeting, University of Georgia Poster Presentation, ACA meeting

B2. M.S. Students (Indicate thesis option for each student)

Joyce Nicole Burns	2/2009-12/2010 (thesis option) Current Position: AP Chemistry/Biology Teacher at Woodland High School (Bartow County) Coauthor of two manuscripts
Jeffrey A. Culver	6/2009-12/2011 Current Position: Research associate at Sanford Burnham Institute, Orlando, FL Coauthor of two manuscripts
Natalie D. John	11/2008-5/2009 Current Position: Pharmacy School Molecular Biophysics trainee (2008-9)
Melissa A. McDonald	11/2008-12/2009

Current Position: CDC ORISE fellow

Lindsay Porter 6/2011-6/2012
Current Position: Biology Teacher at Woodward Academy (Atlanta)

Michelle Womack 1/2013-6/2014
Current Position: Unknown
Molecular Biophysics Trainee 2012-2013
Southern Regional Educational Board doctoral scholar

B3. Undergraduate Students

Current:

Hayeon Cho 9/2016-present
CoS Dean's Scholar 2016-2017

Zachary D'Zio 1/2018-

Yemo Ku 9/2017-present
CoS Dean's Scholar 2017-2018

Yinglin Li 1/2018-

Moya Tomlin 6/2016-present
Petit Scholar 2017-8

Previous:

Naomi Benveniste 6/2011-5/2012
Current position: industry employment

Pamela Chi 6/2010-5/2013
Coauthor of publication
Awarded PURA fellowship, Spring 2011
Awarded UNCF/Merck Summer Fellowship, Summer 2011
Best Oral Presentation, College of Sciences Spring UROP symposium 2011
Current position: Physician's Assistant school

Kevin Crowley 5/2011-7/2011
REU from Coastal Carolina University Class of 2012
Current Position: unknown

Jessica Dougherty 6/2008-12/2008
Current position: unknown
'2009, Chemistry major

Quincy Faber 1/2016-1/2017

Dana Freeman 9/2011-5/2013
Current position: PhD program in Public Health, Johns Hopkins
Spring 2013 PURA awardee
Coauthor on publications

Jenna Gallops 6/2008-5/2009
Current position: Pharmacist

Josh George 9/2015-8/2017

James Going 6/2014-5/2017
Current position: Medical school (GRU)

Jacqueline Harris 8/2013-8/2014
Current position: Medical School (Vanderbilt)

Julia Harris 5/2009-7/2009 REU from Capital University Class of 2010
Current Position: Associate Director & Research Integrity Officer OSU
Coauthor on publication in 2010
Poster presentation at ASBMB meeting 2011

	NSF Graduate Fellowship at OSU
David Heaner	1/2012-12/2015
	Current position: Medical School (University of Central Florida)
	Petit Scholar 2013-2104
	Coauthor on publications
	Poster presentation, SERMACS 2013, 2014
	Oral presentation, ACC Meeting of the Minds
	Sigma Xi Best Undergraduate Thesis Award
Steve A. Hsieh	1/2008-5/2010
	Current position: Associate at Sullivan & Cromwell
	Fall 2012, Law School, NYU
	Research Undergraduate Thesis (Fall 2010)
	Awarded PURA fellowship 2009, 2010
	Oral presentation, ACC Meeting of the Minds, NC State
	Oral presentation, ACC Meeting of the Minds, Georgia Tech
	Oral presentation, Center for Undergraduate Research Opportunities at UGA
	Poster presentation, Herty Medalist Undergraduate Research Symposium, Mercer University
	Poster presentation, Southeast Enzyme Conference at GSU
James Kizziah	5/2014-7/2014 REU from Spring Hill College Class of 2015
	Poster presentation, SERMACS 2014
	Coauthor on publication
	Current position: PhD program at University of Alabama
Michelle Kwon	5/2014-5/2017
	Petit Scholar 2015-6
	Research Option Biochemistry major
	CoS Best Undergraduate Thesis award
	Coauthor on publication forthcoming
Jaya Janadhyala	5/2013-12/2014
	Current position: Unknown
Ivan Morales	6/2012-12/2013
	Current position: Medical School (GRU)
	Petit Scholar 2013-2014
	Coauthor on publication
Elaine Nguyen	5/2013-5/2014
	Current position: PhD program at U. Pitt.
	Technician in Lieberman lab
	Coauthor on publications
Sasha Patel	1/2014-4/2014
	Current position: Unknown
Christopher W. Perry	6/2009-12/2011
	Current Position: Medical School
	Awarded PURA fellowship, Spring '11
	Beckman Scholar Fellowship (2010-2011)
	Poster presentation, Beckman Scholar Annual Symposium (2011)
	Coauthor of publication in 2012
James Rives	1/2010-5/2013
	Current position: PhD program in Chemical Biology at Johns Hopkins University

	Awarded PURA Fellowship, Summer 2011, 2012 Best Oral Presentation, College of Sciences Spring UROP symposium 2012
Aly Sheppard	1/2009-5/2012 Current position: Grant writer Oral presentation at Spring UROP symposium 2012 Coauthor on publication
Kenneth Sidoryk	10/2016-10/2017
Leigh Stafford	5/2012-7/2012 Current position: unknown REU from Rowan University Class of 2013
Chandler Walker	5/2010-7/2010 REU from NC State University Class of 2011 Current Position: Postdoctoral fellow at AstraZeneca Poster presentation at ACS meeting 2011 Coauthor on publication Honorable Mention for the NSF Graduate Research Fellowship in 2012 Completed PhD in neurology, Columbia University
Rachel Wills	5/2013-7/2013 Current position: unknown REU from Spring Hill University Class of 2014

B4. Service on thesis or dissertation committees

School of Chemistry & Biochemistry

Jesse Ashworth (Reddi, MS completed 2016)
Jeremy Allegood (Merrill, PhD completed 2008)
Lauren Austin (El Sayed, PhD completed 2014)
Pritha Bagchi (Fahrni, PhD completed 2012)
Daisy Bourassa (Fahrni, PhD completed 2016)
Zhanjun Guo (Barry)
James Keough (Barry, PhD completed 2011)
Nathanael Levenson (Oyelere, MS completed 2017)
Kerry McGill (Schmidt-Krey)
Lisa Pan (Kelly, MS completed 2010)
Brandon Pollander (Barry, PhD completed 2012)
Poorna Roy (Williams, MS completed 2012)
Stephen Sarria (Peralta-Yahya)
Vonda Sheppard (Kroger, PhD completed 2010)
Fangxu Sun (Wu)
Russell Vegh (Bommarius, PhD completed 2012)
Feifei Zhang (Kelly, PhD completed 2014)
Jessie Ashworth (Reddi)

School of Biology

Pavithra Chandramowlishwaran (student of Yury Chernoff)
Matthew Johnson (student of Inga Schmidt-Krey, PhD completed 2013)
Patrick Ruff (student of Francesca Storici, PhD completed 2012)
Kasahun Neselu (student of Schmidt-Krey)

School of Applied Physiology

Angela Kampfer (student of Ed Balog, PhD completed 2011)

School of Biomolecular Engineering
Matthew Mistilis (student of Mark Prausnitz, PhD completed 2015)
Benjamin Hudson (student of Anant Paravastu)
University of South Florida Molecular Medicine
Andrew Stothert (PhD completed 2016)

B5. Mentorship of postdoctoral fellows or visiting scholars

Current:

Dr. Shannon E. Hill 10/2011-present (Res. Sci)
PhD: U. South Florida with Martin Muschol
Poster presentation, 20th Annual Suddath Symposium, Georgia Institute of Technology, February 2012
Biophysical Society 2013 annual meeting
Oral presentation, Atlanta Vision Research Seminar

Dr. Dustin J. E. Huard 10/2013-present (Postdoc)
PhD: UCSD with Akif Tezcan
Oral presentation, Atlanta Vision Research Seminar

Previous:

Dr. Jason E. Drury 10/2009-4/2013
PhD: U. Penn Pharmacology with Trevor Penning
Current position: Postdoc at St. Jude's Children's Research Hospital
Oral presentation, IBB, Graduate and Postdoc (GaP) Seminar Series, October 2011
Poster presentation, 20th Annual Suddath Symposium, Georgia Institute of Technology, February 2012

Dr. J. Derrick Watkins 9/2008-9/2010
Current Position: NuBAD CSO
PhD: Georgia Tech with Loren Williams
Oral presentation, IBB, Graduate and Postdoc (GaP) Seminar Series, July 2011
Oral presentation, Molecular Biophysics, November 2010

Dr. Tanay Desai 9/2010-6/2011
Current Position: Zeiss
PhD: U Maryland Chemistry with Victor Munoz
Oral presentation, IBB, Graduate and Postdoc (GaP) Seminar Series, Oct. 2011

Dr. Carl Robert Rankin 5/2014-12/2014 (Joint position with C.R. Ethier, BME)
Current Position: Unknown
PhD: Emory University with Charles Parkos and Asma Nusrat

C. OTHER TEACHING ACTIVITIES

Technicians Supervised:

Previous:

Christopher Cantrell 5/2010-4/2011
Current position: Master's student at Keck Graduate Institute
B.S.: Georgia Institute of Technology, Biochemistry major

Elaine Nguyen 7/2014-5/2015
B.S.: Georgia Institute of Technology, Biochemistry major

Katherine C. Turnage 6/2010-3/2013
Current position: Veterinary Technician, Seattle WA
B.S.: Carleton College, Chemistry major

Chiamaka Ukachukwu 6/2013-6/2015
Current position: Fulbright Scholar (Belgium)
B.S.: Georgia Institute of Technology, Biochemistry major
M.S.: University of Michigan (Chapman lab, 2017)

High School Teachers and Students Supervised:

Mr. Casey Bethel (2011-2017)
With Jose Amador, Endiya Dumas (high school students 2015)
Ms. Tanya Bailey (2010)
Ms. Ayesha Johnson (2009 [deceased])
With Hope Turner (high school student)
Monae Fennel (high school student)

VI. SERVICE

A. PROFESSIONAL CONTRIBUTIONS

- 2018 SER-CAT annual meeting organizer
- PLoS Biology Academic Editor (3 year term)
- Proc. Nat. Acad. Sci USA Guest Editor
- NIH Study Section ZEY10 (July 2011, April 2012)
- Ad hoc reviewer for NSF grants (MCB division)
- Ad hoc reviewer for Argonne National Labs and Oak Ridge National Labs user proposals
- Consultant for Calladus Biopharma
- Judge for Siemens High School Science Competition Regional Semifinals (2008-2017)
- Ad-hoc journal referee: (~ 1/month total) *ACS Chemical Biology, J. Med. Chem., J. Am. Chem. Soc., J. Phys. Chem. B, Nature Chemistry, Nature Chemical Biology, Nature Communications, Molecular Genetics and Metabolism, Glycobiology, Proc. Natl. Acad. Sci USA, PLoS ONE, Exp. Eye Res., Biochemistry*
- Reviewer for Portuguese Foundation for Science and Technology grants (2012), American Heart Association graduate fellowships (2010), Prentice Hall textbook (2009), Velux Stiftung Foundation (2017)
- Panelist at congressional luncheon on early-stage investigators (Research!America, ACS, 2010)

B. PUBLIC AND COMMUNITY SERVICE

- Visitor, Westlake High School (2008)
- Home Park Day Care Board (2017)

C. INSTITUTE CONTRIBUTIONS

Georgia Tech School of Chemistry & Biochemistry Committees

- Biochemistry Division Chair (2014-2017)
- Executive Committee (2011-2017)
- Graduate Admissions (2008-9, 2015-)
- Physical Chemistry Curriculum Task Force (2015)
- Curriculum Review Committee (2014)
- Communications committee (2013- 2014, 2015-)
- Development committee (2012-2013)

- Strategic Planning Committee (2012)
- Undergraduate Curriculum Committee (2010-11)
- Safety Committee (2009-10)
- Awards Committee (2009-12)
- Cryo-EM faculty search committee (2009-10)

Other Institute service

- IBB Steering Committee (2010-)
- Petit Scholars Program Faculty advisor (2016-)
- Faculty Benefits Committee (elected 4-year term, 2015-, Chair, 2016-)
- Suddath Symposium Committee (2012-)
- Grand Challenges Living Learning Community (2012-2013)
- Organized two multidisciplinary journal clubs (membrane protein structure/function and protein misfolding) that meet biweekly throughout the year
- Reviewed Seed Grants for GIT/St. Josephs Translational Research Institute (2010)
- Reviewed IBB seed grants (2011, 2012, 2014, 2015-2017)
- Participated in NSF-CAREER panel discussion through OSP (2010, 2011)
- Met with Alpha Chi Sigma about undergraduate research opportunities (2010)
- Involved in hosting speakers from Systems Biology (2008-)
- Co-organized 1-day symposium on structural biology at GT (with Inga Schmidt-Krey, 2008)

JOURNAL OF CHEMICAL EDUCATION

Article

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Protein Structure and Function: An Interdisciplinary Multimedia-Based Guided-Inquiry Education Module for the High School Science Classroom

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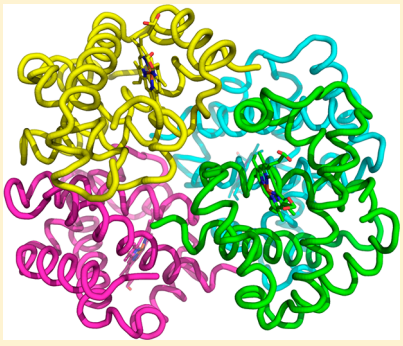
Supporting Information

ABSTRACT: Here we present a multidisciplinary educational unit intended for general, advanced placement, or international baccalaureate-level high school science, focused on the three-dimensional structure of proteins and their connection to function and disease. The lessons are designed within the framework of the Next Generation Science Standards to make learning more relevant to daily life, and to help high school students engage in and understand advanced topics beyond the typical high school chemistry or biology curriculum. The unit involves lectures, videos, a hands-on activity, a research paper, a laboratory experiment, and a culminating project. Students are introduced to protein crystallography, the protein data bank, and the computer program PyMOL (free download for educational use) to visualize protein structure in three dimensions. Clear improvements in student comprehension of protein structure and function have been documented after implementation of the unit.



KEYWORDS: *High School/Introductory Chemistry, Biochemistry, Computer-Based Learning, Hands-On Learning/Manipulatives, Inquiry-Based/Discovery Learning, Amino Acids, X-ray Crystallography, Proteins/Peptides, Enzymes, Molecular Modeling*

INTRODUCTION

In secondary school science education, two important goals are for students to achieve mastery of fundamental scientific concepts, and, of equal importance, to ignite students' curiosity and inspire the next generation of scientists.[1] In biochemistry, one challenge to achieving these goals is the abstract concepts related to the cellular and then molecular level, which involve molecules that cannot be seen with the naked eye. As a result, students have difficulty synthesizing the material, and are sometimes left with the impression that science is a simply a body of isolated facts.[2] Students struggle to see how major science concepts are related to their daily lives, or how major science concepts are related to each other, even in biochemistry where such connections are abundant. The best teachers point students toward these connections, yet additional educational materials are needed, especially in light of the fast progress of interdisciplinary biomedical science research.

The Next Generation Science Standards (NGSS) for K−12 education are intended to assist in achieving the goal of connecting scientific concepts to daily lives by encouraging the use of crosscutting concepts, and increasing the emphasis on science practices.[3] Crosscutting concepts are overarching themes that persist throughout science; specific reference to these ideas aids students in developing a broader, cumulative understanding of science.[4] The term "science practices" refers to the actual methods by which scientific knowledge is developed, including reasoning, inquiry, and experimental design, as well as the execution of common lab techniques; the practices learned by students should reflect those of professional scientists. When successfully implemented, NGSS will allow students to move from building a base of current knowledge to the ability to ask and answer questions pertinent to how this information came about.

One area at the interface of chemistry and biology that is ripe for lessons within the NGSS is protein science. Proteins are key biological macromolecules, performing myriad vital, often interconnected tasks within every organism that form the basis of life. Proteins can be structural, such as dystrophin, a major component in muscle tissue,[5] or antibodies, made by the immune system to recognize and defend against foreign pathogens. Others are involved in transport of metabolites across cell membranes, such as porins,[6] or involved in cell signaling, such as integrins.[7] Some proteins are enzymes, which facilitate difficult chemical reactions. One such example is acid-β-glucosidase, which helps to break down glucosylceramide, a membrane-embedded signaling molecule, within the lysosome compartment of the cell.[8] Proteins provide an important link between life and physical sciences because changes in their chemical or structural properties lead to serious human disorders. In the case of acid-β-glucosidase, defects in the breakdown of glucosylceramide lead to Gaucher disease,[8] but many other diseases, from muscular dystrophy to Alzheimer's disease to sickle cell anemia to cancer, have origins in a dysfunctional protein. In many cases, hope for the design of drugs to treat these ailments relies in part on understanding the normal, or native, structure of these proteins and what goes awry under disease conditions.

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Proteins are large three-dimensional molecules with four distinct levels of structure.[9] Primary structure depends on the unique, linear arrangement of amino acids connected in a polypeptide chain. Their common chemical basis structure leads to hydrogen bonding patterns that create α-helices and β-sheets, which are the major secondary structural features of proteins. Tertiary structure refers to the spatial arrangement of the helices and sheets because of interactions between the distinctive chemical moieties of the 20 different amino acids, called R-groups or side chains. In quaternary structure, separate polypeptide chains come together to form the larger, more complex protein entities. The final shape of the protein is exquisitely set up to carry out its function.

In the high school science curriculum, protein structure focuses narrowly on primary sequence, omitting the higher levels of organization that result in the final functional unit. This is unfortunate because a protein's ability to carry out its task is significantly influenced by these features. Neglecting higher-order protein structure passes up the valuable opportunity to demonstrate the relationship between structure and function, a major crosscutting concept in science. Moreover, because loss of function leads to human ailments, high school students are missing out on a clear real-world connection.

Here, we present an interdisciplinary-themed educational unit for secondary school science based on the three-dimensional structure of proteins. Whereas education materials in the area of protein structure–function have been implemented for the undergraduate level,[10] our lessons are tailored for a grade 9–12 audience. The materials discussed here work within the framework of the NGSS to make learning more relevant to daily life, and to help students comprehend advanced topics and methods they will encounter in further depth in college. The activities were developed for biology or chemistry courses and implemented in general chemistry, advanced placement (AP) chemistry, and international baccalaureate (IB) biology. We incorporate lectures, videos, a hands-on activity, a research paper, a laboratory experiment, and a culminating project. Students are introduced to protein crystallography, the protein data bank (PDB) and to PyMOL as a tool for visualizing protein three-dimensional structure. PyMOL, a computer program available as a free download for educational use,[11] is now used routinely by protein scientists worldwide to generate many of the representations of proteins in textbooks and other science publications.

PROCEDURE

The activities are described in the order they have been implemented in the classroom. (See the list in Box 1.) The time allotted for implementation of the full complement of activities is eight, 90-min classes. However, the material is flexible; it is possible to rearrange the activities and still reach the desired outcome. Detailed instructions, sample lectures, rubrics for grading, and links to resources, are provided in Supporting Information accompanying this article.

Box 1. Unit Plan in the Proposed Order of Activities

1. Lecture 1 (interdisciplinary)
2. Family medical history (inquiry education)
3. Lecture 2 (interdisciplinary)
4. Research paper (multimedia-based)
5. Hands-on activity (inquiry education)
6. Lecture 3 (interdisciplinary)
7. Video 1 (multimedia-based)
8. Lab experiment (inquiry education)
9. Video 2 (multimedia-based)
10. Culminating project

Lecture 1

This short lecture reviews the central dogma of molecular biology. Concepts addressed include DNA as the genetic material, proteins as the "working" chemicals in living beings, and RNA-mediated protein synthesis.

Family Medical History Intake Form

In this activity, students are asked to complete a family medical history questionnaire. This is an engaging activity used to get students to learn about their family medical background and to think about the possibility of their own inheritance of genetic disorders. If there are concerns about discussing this sensitive material in the classroom, it can be modified or omitted.

Lecture 2

This follow-up lecture explains the introduction and effects of genetic mutations. A few representative disorders, sickle cell anemia and Gaucher disease, are used as examples.

Research Paper

Students choose a genetic disorder and write a research paper that explains the cause of the disorder, including the gene and protein product involved, describe the common symptoms and outline any treatments, therapies, or current research. This is an effective way for students to extend their understanding from the lecture. A variation on this assignment involves watching one of several Hollywood movies on genetic disorders, for example, *Extraordinary Measures*[12] (2010, CBS Films) or *Lorenzo's Oil*[13] (1992, Universal Studios).

Hands-On Activity

In this activity, students are provided with common ball-and-stick molecular modeling kits and assigned to build different amino acids. As the process unfolds, students visualize how the R-group is unique for each amino acid. Once this process is completed, the students come together in groups to connect their individual amino acids to form a polypeptide chain. At this stage, students recreate the chemical process of dehydration that is involved in forming the peptide bond. In addition, as more amino acids are added to the chain, students may have to twist and adjust the chain to account for the steric bulk from the R-groups of neighboring amino acids. This experience is vital for students' later understanding of the role that interactions between R-groups play in higher orders of protein structure. If possible, it is suggested that instructors have on hand preconstructed ball-and-stick models of an α-helix and a β-sheet to show students the most common secondary structure outcomes of such amino acid interactions.

Lecture 3

A final lecture formally explains the hierarchy of protein structures; primary, secondary, tertiary, and quaternary levels are addressed. Special emphasis is placed on the overarching concept in all areas of science that structure is related to function. Students are also introduced to protein crystallography and X-ray diffraction as the classical[14] and major experimental method to determine the three-dimensional structure of a protein.[15] Students also gain insight into how understanding protein structure helps researchers design new drugs. In this way, students can see the practical application of this information in real-world scenarios.

dx.doi.org/10.1021/ed300677t | J. Chem. Educ. 2014, 91, 52–55

Video 1

The higher levels of protein structure may prove difficult for high school students to grasp. There are several short videos that are effective at clarifying this otherwise complicated subject. We used one particular video available online;[16] teachers are encouraged to search for others available in the public domain.

Laboratory Experiment

During the second lecture, students were introduced to protein purification and crystallography as initial steps in studying protein structure, and in this experiment, they put these concepts into practice. Students crystallize a protein called lysozyme, for which a suitable kit for the experiment is commercially available (Hampton Research HR7-108). Students manipulate the buffer components to grow lysozyme crystals using procedures that mirror those conducted in current biochemistry laboratory research. The kit, which is readily set up and disposed of, includes teacher instructions, student protocols, and all of the materials needed to implement in any science classroom. Crystals grow within several hours or overnight, and can be visualized under a stereomicroscope. It is possible to expand the scope of this laboratory experiment, for example, by including purification, enzymology,[17] and carbohydrate binding[18] modules that were developed for higher education classrooms.

Video 2

In preparation for the culminating project (see below), students need to be introduced to the PDB, and to the PyMOL molecular visualization tool. This is accomplished by viewing the PyMOL tutorial video.

Culminating Project

In this assignment, students access the PDB[19] online,[20] search for and download the file (file extension .pdb) corresponding to the structure of human deoxy-hemoglobin (PDB code 4HHB), which contains the spatial 3D location of every amino acid. Hemoglobin is a homotetrameric oxygen carrier protein in red blood cells and the research behind the 1962 Nobel Prize for Chemistry. The real-world motivation is the relationship of hemoglobin to sickle cell anemia[21]—genetic mutations in hemoglobin change the protein shape, leading to disease. Studying sickle cell anemia reinforces the overarching theme that structure is related to function. This example also allows students to connect their experience with PyMOL and protein structure on a computer screen with their understanding of genetic disorders from previous lessons. Next, students load the protein file into PyMOL and manipulate the three-dimensional structure of hemoglobin. They begin by executing the basic commands covered in the introductory video, but they may also expand their practice to different and more complicated commands, which are also well documented online[22] and simple to execute. By changing the view of the protein structure, students can zoom in on different aspects of the hemoglobin, such as its tetrameric quaternary structure, oxygen-binding heme moiety, as well as the site of the most common sickle-cell-anemia-causing mutation. By assigning all students the same protein, emphasis is placed on the commands and manipulations, but lead to unique representations of the same protein. Another variation would be to assign a different protein to each student, or to let students choose their own protein after background study.

Students submit images from different steps in their practice that illustrate their individual interpretation of the three-dimensional structure of the protein, using the rendering function within PyMOL. The images and their descriptions, assembled as a portfolio demonstrate the students' familiarity with the PDB, their competency in performing simplified manipulations in PyMOL, their understanding of protein structure, their appreciation of the uniqueness of individual proteins, and their grasp of how protein structure is related to function. A side benefit is that some of the images may be strikingly artistic, depending on selection of colors, lighting, and other options available in PyMOL, which can be used to adorn the classroom, if desired.

CONCLUSION

The study of proteins provides an important link between the life sciences and physical sciences, and is an excellent illustration of the relationship between structure and function. Through the combination of learning about one's family history, formal lectures, videos, an experiment in protein crystallography, and interpreting protein structure in silico using PyMOL, students gain a window into the current research in biochemistry and drug design that centers around the study of proteins. This module has been taught to over 80 students, twice in high school general chemistry, once in AP chemistry, and once in IB biology. It is important to note that module materials presented in the Supporting Information were adapted each time, upon considering student level and time constraints. Thus, while all students were administered the same pre- and posttests, not all classes received identical or all of the coursework included in Supporting Information. Nevertheless, as indicated by the cumulative comparison of pre- and posttests, students showed marked improvement in their understanding of protein structure, the molecular basis of disease, and their science habits of mind (Figure 1). The impact of the module is further illustrated in student interviews in the video we produced.[23]

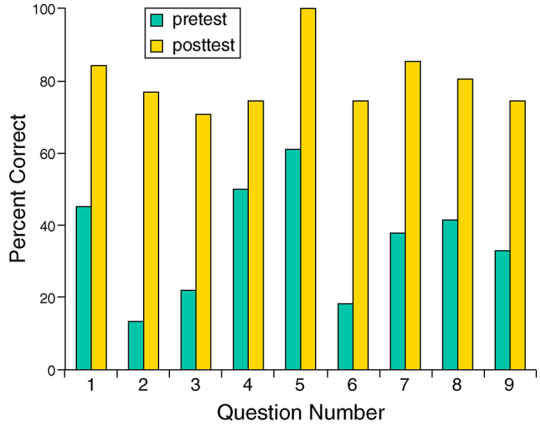

Figure 1. Comparison of correct responses for matched pretest and posttest questions compiled for 82 students in general chemistry, AP chemistry, and IB biology. Overall average pretest score was 36 ± 15%; the average posttest score was 80 ± 11%.

ASSOCIATED CONTENT

Supporting Information

Detailed instructions; sample lectures; rubrics for grading, resource materials; sample images. This material is available via the Internet at http://pubs.acs.org.

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Notes

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Get Schooled (http://getschooled.blog.myajc.com/)

Your source to discuss and learn about education in Georgia and the nation and share opinions and news with Maureen Downey.

2017 Georgia Teacher of the Year: We need to show

September 14, 2017

Casey Bethel, a science teacher at New Manchester High School, in Douglas County, is 2017 Georgia Teacher of the Year.

Georgia 2017 Teacher of the Year Casey Bethe (http://www.gadoe.org/External-Affairs-and-Policy/communications/Pages/PressReleaseDetails.aspx?PressView=default&pid=439)l delivered a lively speech at a Tedx event in March that became accessible online this week. You ought to watch it.

A Douglas County high school science teacher (http://www.douglas.k12.ga.us/Common/News2/HomePagePopUps/Default.asp?ItemID=85586&ISrc=District&Itype=News), Bethel discussed how few students go on to major in science in college. As a teacher, he realized we can't make kids believe they can become engineers or scientists without exposing them to what engineers or scientists actually do.

His talk, "The Power of Meaningful School-Industry Partnerships," targets schools and industry.

Bethel earned a master's degree in plant genetics and conducted experimental research at the Center for Applied Genetic Technologies at the University of Georgia. Bethel worked with biochemist Raquel L. Lieberman (http://www.chemistry.gatech.edu/faculty/lieberman/) in her lab at Georgia Tech as part of the Georgia Internship for Teachers program and now takes his students into the lab.

Bethel recently ended his stint with DOE advocating for public education. In June, John R. Tibbetts (http://getschooled.blog.myajc.com/2017/06/12/worth-county-economics-teacher-named-georgia-teacher-of-the-year/), an economics teacher from Worth County High School in Sylvester, was named the 2018 Georgia Teacher of the Year

The Power of Meaningful School Partnerships | Casey Bethel | TEDxDouglasville

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Mr. Casey Bethel: Recipient of Georgia's 2017 Teacher of the Year Award Following a NSF Research Experience for Teachers (RET)

Dr. Raquel Lieberman (Left) and Mr. Casey Bethel, Georgia's 2017 Teacher of the Year (Right)

Mr. Casey Bethel was recently honored as Georgia's 2017 Teacher of the Year (http://www.ajc.com/news/news/local-education/georgas-next-teacher-of-the-year-chose-teaching-ov/nrQLm/). He teaches advanced placement (AP) Biology, AP Physics, Biology, and

Physical Sciences at New Manchester High School (http://www.newmanchesterhigh.ga.dch.schoolinsites.com/?PageName=TeacherPage&Page=1&StaffID=242250&iSection=Teachers&CorrespondingID=242250) in Douglasville, Georgia. Recipients of this prestigious award are outstanding local and state public school teachers in Georgia who serve as shining examples of excellence in education, and Mr. Bethel is the first STEM teacher in over a decade to receive this award. He notes, "This award is a huge honor, and in many ways it serves as validation of the hard work and sacrifices I have put into growing in this career. I hope that it further inspires my students to work hard and pursue their dreams."

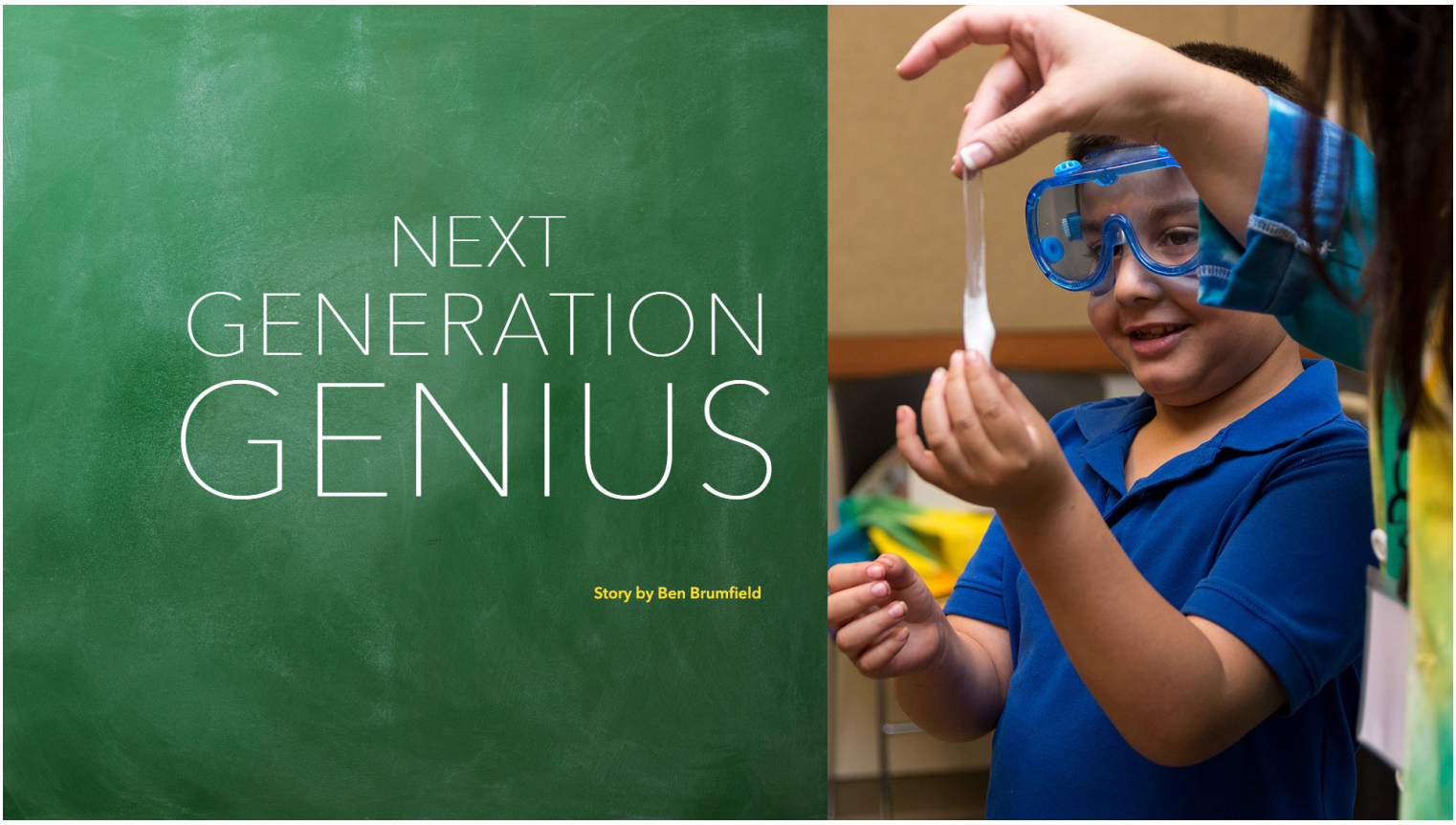
Mr. Bethel credits his accomplishment and growth as an educator to the many summers he spent working in Dr. Raquel Lieberman's lab supported in part by a Division of Molecular and Cellular Biosciences (MCB)-funded Research Experience for Teachers (RET) supplement. As described in the Dear Colleague Letter (NSF 12-075) (http://www.nsf.gov/pubs/2012/nsf12075/nsf12075.jsp), RET supplements enable K-12 science educators to participate in NSF-funded scientific research projects with the goal of enhancing their professional development through the experience of conducting research at the emerging frontiers of science in order to bring new knowledge to the classroom. Dr. Lieberman (http://www.chemistry.gatech.edu/people/lieberman/raquel) actively recruited Mr. Bethel and requested a RET supplement when designing the broader impacts of her MCB-funded 2009 CAREER award (http://www.nsf.gov/awardsearch/showAward?AWD_ID=0845445&HistoricalAwards=false). You can find out more about the Faculty Early Career Development Program (CAREER) award here (https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503214).

The Lieberman lab (http://ww2.chemistry.gatech.edu/lieberman/) uses techniques, such as protein crystallography and computer modeling, to determine structure–function relationships of proteins associated with Alzheimer's disease and glaucoma. Mr. Bethel notes, "Dr. Lieberman welcomed me and made me a contributing member of her team. Every year since, my wealth of knowledge has grown and my teaching practices have improved. My students are better prepared for college science courses now, and more than 50 of them are excelling in STEM majors and careers." Additional outcomes of the RET experience for Mr. Bethel and Dr. Lieberman include co-authorship of a scientific research paper undergoing peer review, and the publication of a teaching unit describing multimedia-guided inquiry for high school science classrooms in the Journal of Chemical Education (http://pubs.acs.org/doi/abs/10.1021/ed300677t).

Join us in congratulating Mr. Casey Bethel as Georgia's 2017 Teacher of the Year and acknowledging the commitment of Dr. Raquel Lieberman to expanding the broader impacts of her research as MCB celebrates this outstanding recognition.

This work is partially funded by the Division of Molecular and Cellular Biosciences, Award #MCB-0845445 (http://www.nsf.gov/awardsearch/showAward?AWD_ID=0845445&HistoricalAwards=false).

Posted in Blog, Broader Impacts and tagged award, Dr. Raquel Lieberman, Georgia's 2017 Teacher of the Year, MCB, Mr. Casey Bethel, NSF, RET on June 20, 2016 by nsfmcb. Leave a comment



Next Generation Genius

Georgia Tech cultivates science and technology education for K-12 students and teachers

A countertop catapult flicks a scratchy Velcro ball onto a fuzzy mat stretching down a 10-foot table. It plunks snugly into place, instantly motionless, and children standing on the sidelines measure how far it flew.

“Write down the distance,” their teacher, Antoinette Richter, reminds them. She teaches engineering at Carver Road Middle School in Griffin, Georgia, using materials provided by the Georgia Institute of Technology.

Sixth-grader Chyna grabs a bicycle pump attached to the catapult, which is made of erector set parts, and puts her might and weight into the plunger.

“Always pump the air up to the same pressure every time,” Richter tells her. The compressed-air science gadget needs a consistent amount of force behind each launch.

Passion and test scores

Chyna is one of thousands of students benefiting every year from a palette of Georgia Tech K-12 outreaches so numerous they are hard to keep track of.

"I want to be a pediatrician. They do scientific things, and I like science, actually a lot."

Some researchers dazzle young eyes at weekend sci-tech fests with laser experiments or underwater rescue robots. Others give schoolrooms vistas on nebulas thousands of light years away.

They stir wonder for science and awe for technology and push kids to reach for them. But the main focus is a bit less glamorous and a lot more committed to guiding classes through years of learning to raise grades and standardized test scores.

"We want long-term partnerships with schools so we make sure our efforts will actually facilitate change in the classrooms," said **Lizanne DeStefano**, who runs a core Georgia Tech K-12 education and outreach unit called **CEISMC**. "That takes prolonged engagement over time."

Earth-shaking STEM

CEISMC, pronounced seismic, like in an earthquake, stands for Center for Education Integrating Science, Mathematics, and Computing. Its mission is to raise exposure to STEM education — another acronym — which stands for science, technology, engineering, and math.

With the heft of 50 employees, including Ph.D. scientists, designers, engineers, and teachers, and with $9.4 million in annual funding, CEISMC supports several Georgia school districts, the Boy Scouts, the Girl Scouts, and much more.

Its major funders are the National Science Foundation, the Goizueta Foundation, the Blank Foundation, and the Georgia Department of Education.

Its broader purpose is to take cutting-edge Georgia Tech research to the people. "We're a knowledge transfer bridge," DeStefano said. "We help the public to better understand the importance of science and technology in daily life."

But children are the focal point. CEISMC alone helps educate 11,000 children per year. "Our staff don't sit in their offices much," DeStefano said. "They're out in the community."

On the road again

CEISMC's Will Jimerson has driven 50 miles south from Atlanta to help out at Carver Road. He's instructing some of Richter's students using a catapult at the table next to hers. "You want to have a list of distances when you're done, so you can average them later," he tells them.

At Richter's table, Chyna groans. "This is so hard!" She means the physical strain of the pump, not the mental strain. She's a STEM success story, engaging with and responding to CEISMC's teaching methods as hoped.

"I want to be a pediatrician," she said. "They do scientific things, and I like science, actually a lot."

Children learn how to make a simple electric motor in CEISMC's Horizons program at Drew Charter School Elementary Academy. Photo: Fitrah Hamid

Breaking the fall

Chyna and her engineering classmates exemplify the mission of most of Georgia Tech's K-12 outreach, which casts a particular eye on underserved students likely to lose interest in STEM or fall behind, then drop out of it.

The main outreach targets are public schools in areas where parent incomes are especially tight, and children often don't have opportunities to learn like students elsewhere. These schools also might not be able to afford some nicer equipment and instructional aids on their own.

Jimerson gestures to a device in the classroom corner. "That's a 3-D printer. Our grant funded 3-D printers for all middle schools and high schools in the county school system." CEISMC also created and donated the teaching texts, which are all over Carver Road's science classrooms. In fact, Richter has only ever taught engineering from CEISMC books.

Most likely (not) to succeed

A few halls away, in a seventh-grade science lab, students thumb through a CEISMC workbook on oil spills while they form teams for an experiment using tap water and cooking oil.

While she works over an aluminum tray with the oil-water mixture, Tiffany says she already knows she wants to be a scientist. "I got interested in sciences in the fifth grade."

Though many of the students in the science lab are white and male, it also has a good number of minority students and females, reflecting Carver Road's overall student body makeup.

To CEISMC, that's progress. One of its aims is to keep minority students and girls going in science, as both are very likely to turn away.

"We still see fewer girls interested in science than boys and far fewer African-American and Latino students in science careers," DeStefano said.

Chyna happens to be both female and African-American. She's also in her middle school years, a phase notorious for shedding math and science students.

The middle school wall

"Middle school is when we lose them," said Leigh McCook, who coordinates STEM outreach for the **Georgia Tech Research Institute (GTRI)**.

GTRI is Georgia Tech's applied research organization, and it has access to lots of technology that makes kids say "cool!" — like lasers, underwater robots, and nanotechnology.

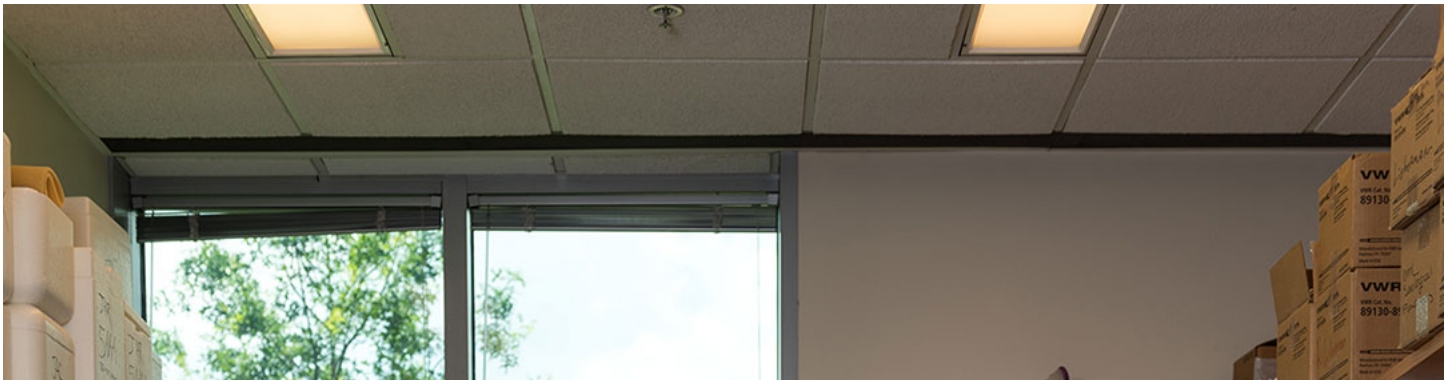
One GTRI program, called Direct-to-Discovery, uses a high-bandwidth teleconferencing system to connect students to megatelescopes halfway around the globe as well as cutting-edge Georgia Tech labs in their own state.

Like CEISMC, GTRI meets kids at science festivals and takes GTRI Road Kits to their schools to teach them about math, physics, and engineering.

Its K-12 outreach goal matches CEISMC's: Get children into STEM and point them toward college and a science or technology career. But GTRI also integrates business partners interested in helping with education.

GTRI has a dedicated year-long internship program called Project ENGAGES in four Atlanta public high schools, including one predominantly African-American boys school and one predominantly African-American girls school.

It brings underserved students into Georgia Tech labs to conduct research throughout the year and apply what they've been learning in science and engineering.



High school science teacher Casey Bethel is a bona fide Georgia Tech researcher in Professor Raquel Lieberman's lab. He's also Georgia's Teacher of the Year for 2017. Photo: Rob Felt

Puberty peer pressure

When kids hit middle school, science classes become more challenging, and many students hit a wall and turn away, said Mindy DiSalvo, a former principal who is an educational guide for GTRI.

It's more like three or four walls, for girls in particular. As a principal, DiSalvo watched them turn away from sciences in droves.

"First of all, they're just middle school kids, and they're more interested in social things. There's peer pressure." At one STEM event, only boys turned up, she recalled. "They told me that the girls were not there because they all went to cheerleading practice."

Also, middle schoolers aren't in one classroom all day with the same teacher, who knows their weaknesses along with their strengths to try to balance them out. Instead, pupils move from subject class to subject class, and the teachers don't get a full picture of what's going on with them.

"If we can hold onto them through middle school and engage with the teacher, we can see more of them sticking with sciences," McCook said.

That often means teaching the teacher. Richter, for example, teaches engineering but holds a degree in business management. Georgia Tech has helped her develop her subject-matter skills.

"They not only did a great job of explaining the goals of the curriculum, but they gave me the tools I need to teach my students," Richter said. "Things like 3-D modeling software and how to use a 3-D printer."

Meet Superteacher

In the past five years, CEISMC has trained around 2,000 schoolteachers.

Many have become classroom heroes, but high school science teacher **Casey Bethel** could rightly wear a Superman cape. He was selected Georgia's Teacher of the Year for 2017.

He's also a bona fide biochemistry lab researcher at Georgia Tech thanks to a CEISMC program called GIFT, short for Georgia Intern-Fellowship for Teachers.

He's now an expert on 3-D protein crystallography and has co-authored a research paper submitted to the prestigious research journal *Nature*.

That astounds him.

"Who would have thought this high school teacher might be published in *Nature*?" Bethel said. It makes him dream about going for his Ph.D. and researching full time, but for now he's dedicated to his students.

About half the children at New Manchester High School in the Atlanta suburb of Douglasville come from low-income families, he said. "It's not a Title 1 school, but it's also not far from it." About three quarters of the students are African-American.

At GoSTEM, parents hear in Spanish about the possibilities a science education can offer their children. Photo: Atlanta Science Festival

Science sidekicks

As with the students they serve, many Georgia Tech programs target educators at underserved schools, and when they come into labs for a summer to work, work they do.

"Teachers are paid a living wage. It's not charity," DeStefano said.

When the school year starts back, Bethel will stride into class a real-life scientist. "The first few years, I had no idea what I was doing as a science teacher. It takes a lot of honesty to say that," he said.

How things have changed for him. At Georgia Tech he co-authored a paper on engaging students in science that was published in the *Journal of Chemical Education*.

Georgia School Superintendent Richard Woods walked into Bethel's classroom unannounced in May to declare him teacher of the year. Bethel nearly hit the floor, but his students went through the roof. "They were jumping up and down clapping and whooping," he said.

In the fall, when Bethel returns to his classroom, he'll have new STEM sidekicks. "I get to bring some students each summer to the labs for five weeks," he said. "When they get back to school, they become advocates for science careers."

People just like me

As another component of its STEM education outreach, Georgia Tech brings children from historically underrepresented minorities and ethnicities onto campus to get them accustomed to the idea that a university is a place for them.

These visits get Bethel's students out of their typical surroundings, he said. "They come out of that and see that scientists are people just like them."

With Hispanic students, the language barrier with parents can play a role, so CEISMC offers a Latino STEM day all in Spanish.

"What was really powerful was the parents," DeStefano said. "The parents could easily participate, and the kids didn't have to translate for them. The parents were so engaged. They asked questions like crazy."

That's rare. Usually, they are quiet because of language.

"Now, the children and their parents have experienced campus as a place that they belong," DeStefano said.

These outreach programs are not just about recruiting future students for Georgia Tech. "We take a bus of students from Gwinnett County around to colleges in Georgia and outside of Georgia," DeStefano said.

CEISMC's Sirocus Barnes gives instruction in an extracurricular science and technology class at Drew Charter School. Photo: Fitrah Hamid

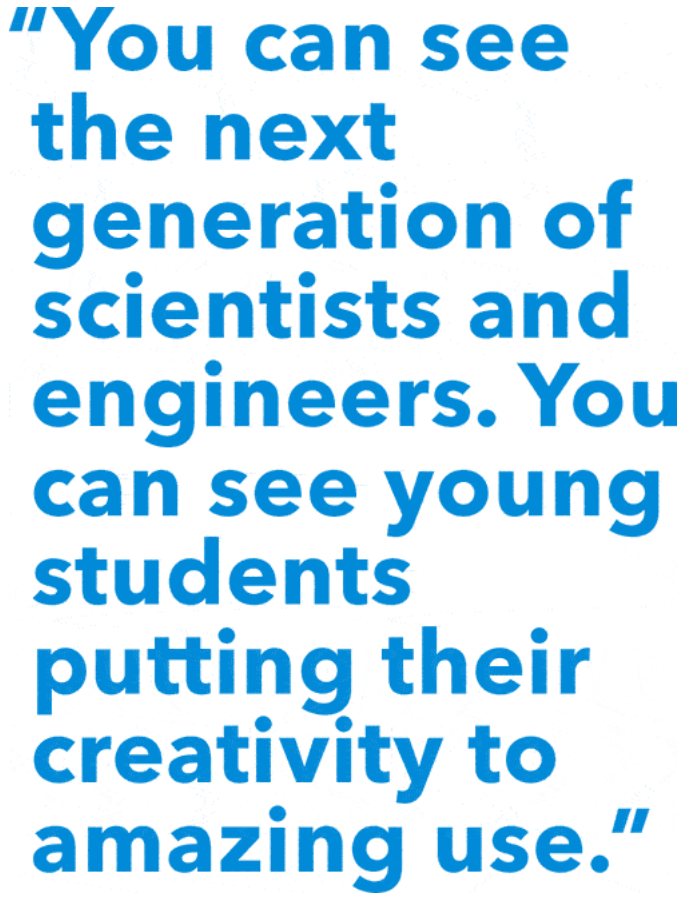
When things go right

There is little doubt about Nick going to college, maybe only whether it will be Georgia Tech, MIT, or an Ivy League school. He's visiting Georgia Tech to boost his already stellar robotics skills at one of the many outreach opportunities open to all students.

Many who attend such publicly available seminars are high achievers.

Nick is captain of his school's robotics team, and with a competition coming up in three weeks, they're at Georgia Tech's Institute for Robotics and Intelligent Machines to sharpen their competitive edge.

"In the competition, there's an autonomous vehicle and also a driver challenge," Nick said. The winner gets a cash prize.



Nick's classmate Colette already has her takeaway from Georgia Tech's programmers.

"They give their robots tiny little commands, and then the robots decided how to use them," she said. "That's what we're kind of trying to do with ours."

Hot car alarm

Georgia Tech also gives budding engineering geniuses a chance to show off their inventions in the K-12 InVenture Challenge.

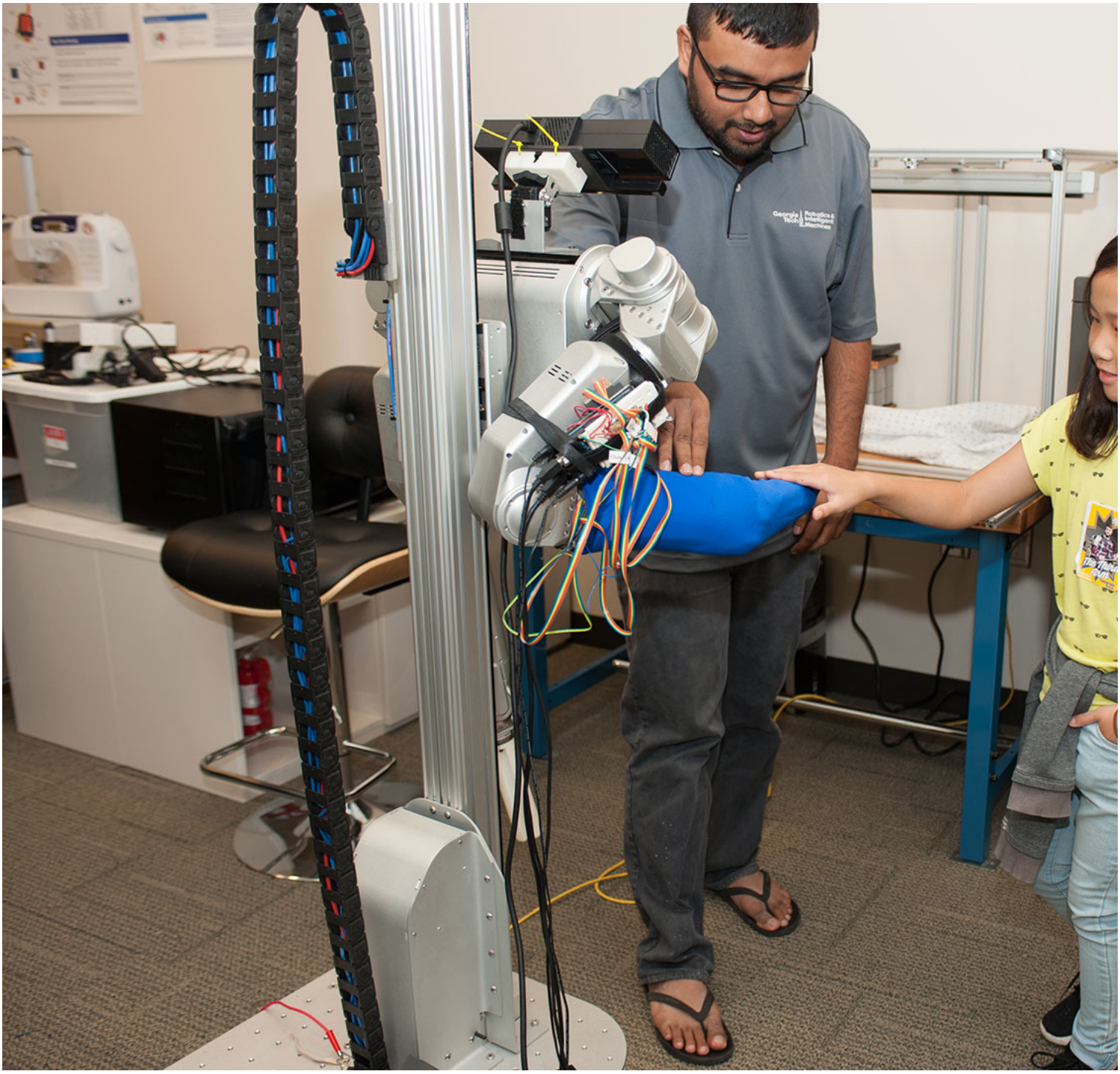
Some innovations are what one would expect from the research and development wing of a major corporation, like the car seat invented by a high school student who saw news reports about children dying in cars parked in the sun. Her seat sets off an alarm and dials 911 as the temperature in the car rises.

"You can see the next generation of scientists and engineers," DeStefano said. "You can see young students putting their creativity to amazing use and getting excited about their ability to create things and solve problems."

In another CEISMC public outreach, the Kids' Club, elementary and middle school students are learning about energy-producing technologies in a Saturday on-campus seminar. Most every question the teachers ask is met with a lightning-fast answer.

"The challenge is that they know more than you're expecting," said one of the teachers. "So, you try to get this line of inquiry going. But they already know everything."

These students are benefiting from a great education, and it shows. They're clearing the middle school wall like it's a runner's hurdle.



A student gets hands-on experience in robotics with the help of a Georgia Tech engineer. Photo: Fitrah Hamid

The early birds

The bricks to that wall are laid in elementary school, DiSalvo said.

“A generation of elementary school teachers say, ‘I don’t do science and math. I really don’t do that,’” DiSalvo said. “Teachers will say, ‘I have never been a biologist; I only teach a little biology.’”

Many of their students are then ill prepared for middle school science.

At two public elementary schools in Atlanta, CEISMC is planting the STEM seed early with dedicated programs called Horizons. One of the schools is Drew Charter School Elementary Academy.

Lea is not quite 3 feet tall and looks about 6 years old, but at Drew, she’s trying hard to be the boss. She heaves herself into the teacher’s chair and pretends to

commandeer her schoolmates as they file into a classroom for some extracurricular afterschool STEM.

Her squeaky voice is no match for the whooping of two dozen kids fueled by the knowledge that school will let out for summer in just a few days.

‘Clap three times’

A man bellows warmly, “If you hear my voice, clap once; if you hear my voice, clap twice.” The noise dies down, and after “clap three times,” the room is silent. Little faces gaze up at CEISMC’s Sirocus Barnes as he readies them for this week’s lesson.

Three Georgia Tech undergraduate students have come with him to help the children learn about electromagnetism by building a simple electric motor.

They bend wires into heart shapes and spirals and balance them atop AA batteries perched on magnets. Then Barnes asks the class, “What’s going to happen with the wire when I let it go?”

“It’s going to heat up,” a boy answered. True, but that’s not what Barnes is looking for. Most of the little faces are stumped. Then eyes widen when Barnes lets go of the wire to show them how it rotates around the battery. “What’s it doing?” he asks.

No answer, at first.

“I’m so confused right now!” moans Gania, one of the smallest girls in the room. She puts on a frolicsome grin, then muses, “I get confused a lot.”

Horizons is working to change that for her and two-thirds of the students in the classroom, who make below-average grades. The extra instruction is designed to boost the performance of the bulk of the students.

Georgia Tech is committed to staying with them from first grade to early ninth grade, and plans to extend the program through high school are in the works.

During summer, the students come to Georgia Tech for booster courses. They also work in labs and learn how to swim.

The Horizons program is working. “Their achievement gaps are reduced,” DeStefano said. The kids are doing better in school and scoring higher on state-wide standardized tests.

Ignoring pizza

In the classroom at Drew, a few hands shoot up. “The forces are moving the copper coil around and around,” a girl answers.

“The electromagnet has forces that combine together to make the wire spin around, and the energy that flows through it is making it spin,” a boy calls out.

Now, the kids are getting it, but brows are still furrowed. The new challenge lies not in the dexterity of mind but of hand. The wires are a bit thick for them to bend.

But they’re so determined to finish making the motors that they ignore the aroma of pizza that has flooded the classroom for the past 10 minutes. The teachers end the lesson and serve up dinner.

Their parents will pick them up soon. On the ride home, the children can tell them all about electric motors. Parents who learned and remember the right-hand rule of electromagnetism in grade school might be able to follow along.

If they can’t, they can take satisfaction in seeing their child get a better shot than they may have had at doing well in school — and in life.

Ben Brumfield is a senior science writer with Georgia Tech’s Institute Communications. He is a former CNN.com editor.

BEN BRUMFIELD

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Meet Casey Bethel, Georgia's 2017 Teacher of the Year

May 24, 2016 | ***Atlanta, GA***

College of Sciences basks in the reflected glow of a GIFTed science teacher

Casey M. Bethel, Georgia's 2017 Teacher of the Year, has spent the past five summers doing research in the College of Sciences through the Georgia Intern Fellowships for Teachers (GIFT). This summer, he will return again to the lab of Raquel L. Lieberman, an associate professor in the School of Chemistry and Biochemistry.

An extraordinary science teacher and mentor at New Manchester High School, in Douglasville, Bethel personifies the power of university-school partnerships enabled by programs like GIFT to transform teaching and learning of science, technology, engineering, and mathematics (STEM), says Lizanne DeStefano. She is the executive director of the Center for Education Integrating Science, Mathematics, and Computing (CEISMC), the College of Sciences unit that administers the GIFT program.

"For 25 years, Georgia Tech's GIFT program has been providing K-12 teachers with opportunities to participate in real-world applications in STEM fields, so that they can then pass along learnings and applications to students," says Georgia Tech President G.P. "Bud" Peterson. "We are grateful for teachers like Casey Bethel whose commitment to STEM education is helping to prepare and inspire the next generation," he says. President Peterson himself was a high school mathematics and science teacher early in his career.

The Lieberman group studies, among others, proteins associated with human diseases, such as glaucoma and Alzheimer's disease. Protein crystallography, biochemical/physical characterization, and computer modeling are some of the methods the group uses to elucidate the structure and functions of disease-related proteins.

On the basis of Bethel's education, professional experience, and interests, Lieberman thought Bethel would be a good match for her lab and actively recruited him to work with her. She adds that three years of Bethel's participation in GIFT were supported by her National Science Foundation Faculty Early Career Development Program (CAREER) award.

Bethel says working in the Lieberman lab vastly improved his teaching and knowledge. The experience enabled him to better prepare his students for college-level courses. More than 50 of his former students have gone into STEM majors and careers, he says; some of them are students at Georgia Tech.

GIFT provides K-12 science and math teachers paid summer internships in research laboratories,

where they participate in designing and conducting experiments, interpreting data, and communicating findings. Internships may also take place in industry, where teachers gain workplace experience and learn the skills needed for STEM careers. By working daily with researchers or in industry, teachers increase their content knowledge and find ways to enrich their teaching practices.

At New Manchester High School, Bethel teaches Advanced Placement (AP) Physics, AP Biology, Biology, and Physical Science. As a result of his research experience at Georgia Tech, Bethel, with Lieberman, designed a teaching unit comprising lessons centered on protein structures and their relation to function and disease.

Bethel and Lieberman describe the unit in The Journal of Chemical Education. "The lessons are designed … to make learning more relevant to daily life, and to help high school students engage in and understand advanced topics beyond the typical high school chemistry or biology curriculum," they write.

Separately, Bethel is helping the advance of basic scientific knowledge. According to Lieberman, he is a coauthor of a scientific research paper that is undergoing peer review.

After having worked with Bethel for five consecutive summers, Lieberman is elated, but not too surprised, that he is now Georgia's 2017 Teacher of the Year. "He is focused, committed, and passionate," says Lieberman. "He loves to learn and has a no-nonsense attitude. He follows through on commitments and is highly professional."

While Bethel was gaining knowledge and research experience from his GIFT internship at Georgia Tech, the Lieberman lab also was learning from him.

"Casey is a natural teacher," says Lieberman. "He is able to explain complex issues to a broad audience," a skill that many students struggle with, she notes.

"Casey is inspirational," Lieberman adds. "Students pick up on his infectious enthusiasm and love of learning."

As Georgia's 2017 Teacher of the Year, Bethel will serve as ambassador for all Georgia public school teachers, school systems, and students; speak to various groups throughout the state; conduct staff development activities for other teachers; and represent Georgia in the 2017 National Teacher of the Year competition.

"Couldn't be more proud of Casey," Lieberman tweeted when the news broke on May 20.

"We are utterly delighted at Casey's selection as Georgia's Teacher of the Year," says College of Sciences Dean Paul M. Goldbart. "Casey is an extraordinary representative of the K-12 community, inspiring Georgia Tech staff to learn more about high-school teaching and learning strategies as they work with him to support his innovative approaches to teaching."

Casey Bethel, Georgia's 2017 Teacher of the Year, Reflects on His Teaching Journey

What got you started in teaching science and the GIFT program?

I grew up in the Bahamas, in a family of teachers. I was told at an early age that because I performed well in science, I had to be a doctor or a scientist. I pursued those careers all the way to graduate school, earning a master's degree in plant genetics from the University of Georgia. However, the work never brought enough fulfillment.

On the other hand, I thoroughly enjoyed my experiences as a teaching assistant, instructing undergrads. In 2005, I tried teaching, in the DeKalb County School System, at first as a one-year experiment. I found my calling and never looked back.

After a few years of teaching, I hit a wall. I was unsatisfied with my students' progress. A mentor of mine advertised the GIFT program as a means of broadening my background. I tried it, and I saw immediate results.

Dr. Lieberman welcomed me and made me a contributing member of her team. Every year since 2011, my wealth of knowledge has grown and my teaching practices have improved.

What does the Teacher of the Year award mean to you?

This award is a huge honor. It serves as validation of the hard work and sacrifices I have put into growing in this career. I hope that it further inspires my students to work hard and pursue their dreams.

What will you do with this award?

I hope to bring attention to some of the ways we can solve education's greatest challenges.

It is becoming harder to recruit and retain talented teachers, especially in science and math. I am on a recruitment tour to attract some of the brightest science and math students to join the teaching profession. The challenge of educating the next generation of problem solvers and world leaders is just as important as the race to cure cancer. Teaching is the best way to make a difference.

At the same time, I hope to be an example of how collaboration between universities, industries, and K-12 educators can radically improve the way we teach and prepare students. My own teaching practices sky-rocketed since I formed a partnership with Dr. Lieberman and her research team. Working with them in the summers, I get to see how the concepts I teach in my high school classes are applied to authentic research. Such exposure provides the real-world connections that help me make science more relevant for my students. We need more of these collaborations in every content area.

What is the secret to your success as a teacher?

The secret is passion. When teachers are passionate about what they do, it translates to their students. Effective teachers are excited to share what they know in a way that draws students in, making them see the value of knowledge. My students and I have a saying, "Information is currency."

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  Casey Bethel, Georgia's 2017 Teacher of the Year. Photo courtesy of Casey Bethel.

- 

  GIFT in the lab: (from left) Jose Amador, Dustin Huard, Elaine Nguyen, Casey Bethel, Swe-Htet Naing, Sibel Kalyoncu, Rebecca Donegan, Shannon Hill, Michelle Kwon, Athena Patterson-Orazem, and Raquel Lieberman.

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College of Sciences

Resources

Unique Bacterial Chemist in the War on Potatoes

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MORE PHOTOS

‘Wacko’ enzymatic breakdown of natural toxin unprecedented, furthers path toward protecting crops and degrading pollutants

Posted October 3, 2016 • Atlanta, GA

In fertile farm soils where potatoes grow, *Streptomyces scabies* bacteria wage war using chemicals related to explosives and pesticides.

But a microbial spoiler defuses one of *S. scabies*’ poisons. Researchers at the Georgia Institute of Technology have gained new insights into a one-of-a-kind mechanism it employs, which could someday contribute to the development of new agents to degrade tough pollutants and help rescue

crops.

When *S. scabies* infects potatoes, it spews poisons called thaxtomins, which riddle potatoes with familiar dark scabs. Perhaps a trifle to the potato connoisseur excising them with a paring knife, on a global scale, the blemishes add up to a slash in agricultural production.

Unprecedented moves

Scientists investigating potato soil found that bacteria of the species *Bradyrhizobium sp. JS329* run interference. Though their tough enzymes don't break down thaxtomins, they do render innocuous another *S. scabies* toxic secretion called 5-nitroanthranilic acid (5-NAA).

Still, understanding how it is broken down could prove useful to agriculture. "The 5NAA molecule is similar enough to thaxtomin that studying its degradation might inspire future work to engineer an enzyme or bacterium, or even the plant itself, to detoxify thaxtomin," Lieberman said.

One enzyme in particular uses seemingly unprecedented and spectacular chemical tricks to tear apart 5-NAA's otherwise ironclad chemical structure.

Researchers uncovered them and published the results in the journal Nature Chemical Biology on Monday, October 3, 2016. The research was funded by the National Science Foundation, Pew Charitable Trusts, Georgia Internship for Teachers, and the U.S. Department of Energy.

Chemical warfare

S. scabies bacteria are masters of chemical warfare, and not just against potatoes.

"This family of bacteria is known for the ability to synthesize lots of different molecules, including ones that humans use as antibiotics," said senior researcher Raquel Lieberman, an associate professor at Georgia Tech's School of Chemistry and Biochemistry.

"They're good at killing other organisms," she said. Though the thaxtomins they secrete are well-known for marring potatoes, little is known about toxin 5NAA.

Enzymatic kung fu

5NAA has met its match in bacterium Bradyrhizobium sp. JS329, which we'll call "Brady" for short.

"Brady" produces enzymes that can combat 5NAA, the first of which is called 5NAA-A. The added "A" after the dash stands for "aminohydrolase," a term that means it uses water to alter part of toxin 5NAA.

The "substitution reaction" that enzyme 5NAA-A carries out is common in organic synthesis, but extremely rare in living things. "There's only one other known enzyme confirmed to utilize this particular chemical mechanism," Lieberman said.

Lieberman's team, which specializes in making protein crystals of enzymes like 5NAA-A, observed the moment of the ensuing reaction. "We were able to capture the critical step (hydrolysis) in the crystal for this paper," she said.

"It does this wacko chemical reaction," Lieberman said. 5NAA-A helps destroy toxin 5NAA in two ways that are like outlandish kung fu moves.

Breaking the wrong arm

Toxin 5NAA enters the "Brady" bacterium with a deadly weapon. A nitro group, or NO2, is part of its structure, which makes 5NAA a nitroaromatic compound.

"Basically, all these nitroaromatics are either explosive or toxic," Lieberman said. "TNT is not that different from this compound."

Plenty of bacteria have evolved enzymes to tackle synthetic nitroaromatics -- pollutants like dyes, pesticides or explosives that have been dumped in our environment. The enzymes tend to use the same strategy. "The nitro groups are typically the first target of any degrading enzyme, because they are so toxic," Lieberman said.

Not so for enzyme 5NAA-A.

It goes after another group on the toxic molecule, the amine, which is innocuous. It's like a kung fu master breaking the arm opposite of the one with the weapon. But it works.

By hydrolyzing the amine, enzyme 5NAA-A sets up toxin 5NAA for destruction by other enzymes. "The fact that it does it without removing the nitro is the weird part. It's an unexpected move," Lieberman said.

Kryptonite suicide

Then there's the weirdness around metal.

5NAA-A is a metalloprotease, an enzyme that needs a metal ion to do its work. But unlike other metalloproteases, it doesn't have one embedded in it. It can operate with one of four different metals, but 5NAA-A can't seem to find the metal on its own.

"It relies on 5NAA to bring it to the party," Lieberman said.

In other words, poison 5NAA seems to tow a metal ion up to enzyme 5NAA-A, which then takes it away and uses it to destroy the poison. It's like Superman handing off kryptonite to an arch enemy.

"At least that's very much what we think is happening," Lieberman said. "We're going to investigate the details further."

Solitary master

The sum of 5NAA-A's weird ways led Lieberman's team to check an enormous genome database for matches of the gene sequence that can produce an enzyme like 5NAA-A. They found only one single known other example on Earth.

"That enzyme gene sequence comes from sediment in Yellowstone National Park," Lieberman said. It is not yet confirmed that bacteria housing it actually detoxify 5NAA, though it's likely.

Even if it does, enzyme 5NAA-A remains uncommonly rare, given the myriad microbes on Earth producing an even higher number of enzymes. "The fact that there may just be one other is mind-boggling," Lieberman said.

High school researchers

In another rarity, a high school science teacher is one of the authors on the research paper. Casey Bethel, who was named Georgia Teacher of the Year for 2017, helped the other researchers break through a barrier that was holding up progress.

"We use so-called tags to identify the enzyme we're interested in when we go to harvest it. We suspected the tags were interfering in the crystallization process," Bethel said. So, he cloned the proteins with removable tags, which significantly helped the project move forward.

Bethel participates in Georgia Tech's main K-12 outreach, CEISMC, which, among other things, boosts STEM education among underserved populations in Georgia public schools. And for three years, CEISMC has helped him improve his teaching skills.

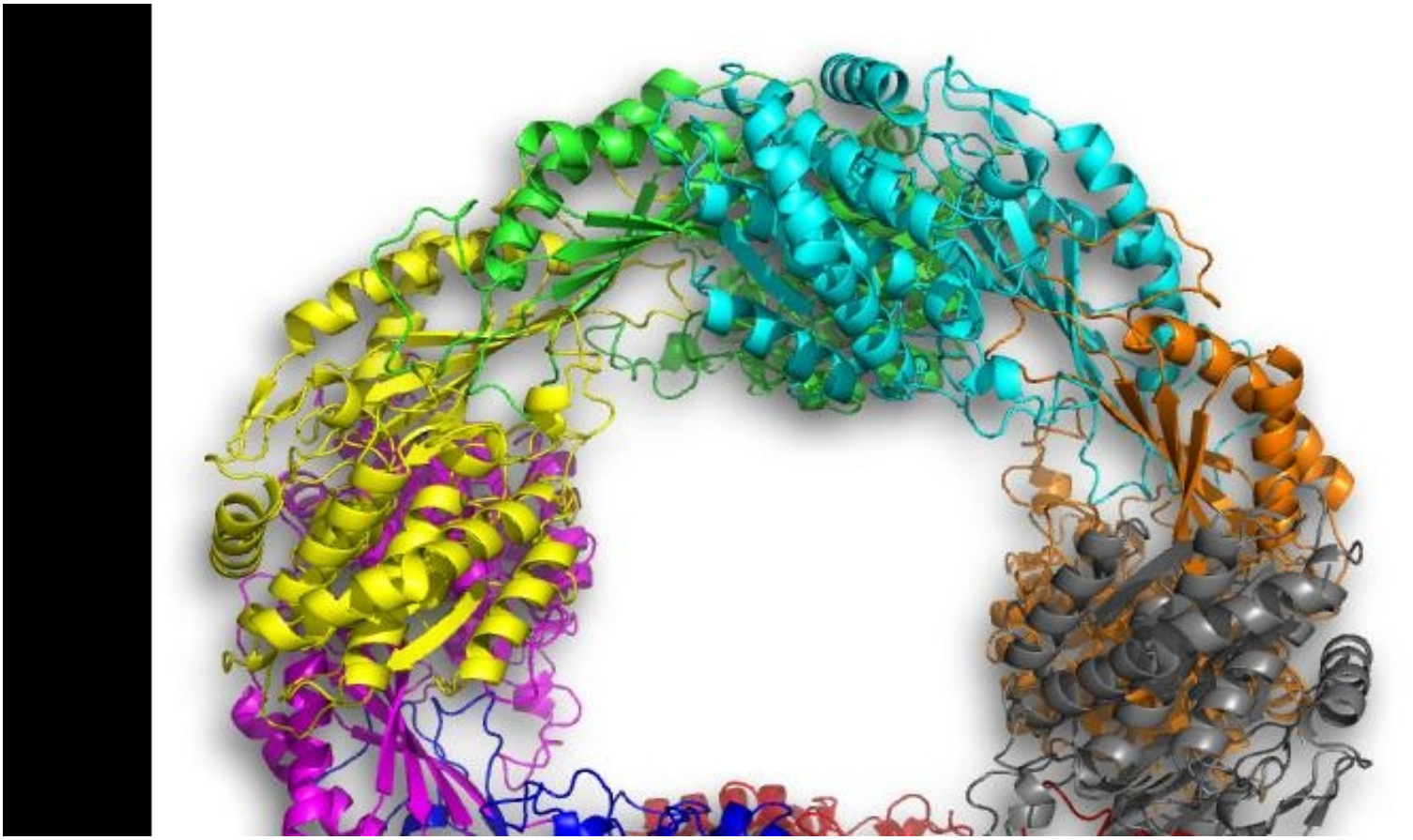
Bethel has also brought high school students to work in Lieberman's lab with him. He's thrilled that he -- and they -- could be a part of the study. "Fantastical! Unimaginable! Who'd think that a high school teacher would be published in a Nature journal?" Bethel said.

Since starting with Georgia Tech's outreach, Bethel has seen at least 60 of his former students choose STEM studies and careers. "Whereas before, the number was close to zero," he said. "It's indescribable. It's momentous, magnificent and impactful. I'll never be able to measure the impact."

READ: Georgia Tech's major outreach to K12 students

READ: Hairy nanorods and the fight against cancer

Former Georgia Tech researchers Sibel Kalyoncu and David P. Heaner Jr. were the paper's main authors; Zohre Kurt, Casey M. Bethel, Chiamaka Ukachukwu, Srinivas Chakravarthy and Jim C. Spain, all from Georgia Tech coauthored the paper. The research was funded by the National Science Foundation (CAREER award 0845445), and the U. S. Department of Energy, Office of Science, Office of Basic Energy Sciences (contract W-31-109-Eng-38).



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CATEGORIES:

Douglas County Sentinel 10/14/15

PA1

County's Teacher of the Year brings positive energy and his heart into the classroom

BY LIZ MARINO
STAFF WRITER

Positive energy, humility, sincerity, humor and integrity and a whole lot of heart are just a few words to describe that Casey Bethel brings into the classroom at New Manchester High School each day.

And it shows.

Casey Bethel, science teacher at new Manchester High School, was named Douglas County's Teacher of the Year on Oct. 1.

Bethel is originally from Nassau, Bahamas, where he lived until he finished high school. In 1996, he came to Georgia where he attended Fort Valley State University as an undergraduate and earned a masters degree in genetics from the University of Georgia.

It is hard to keep the natural-born teacher out of the classroom. Instead of taking advantage of his planning period, Bethel can often be seen poking his head in other classrooms and winding up teaching other subjects such as math, reading with students or engaging in a classroom discussion.

Bethel said he was in school originally to become a scientist — and did so while he worked at UGA.

But something was tugging at his heartstrings during that time. And that was teaching.

"I always liked working with youth," he said, "although I was good at science."

As a scientist, he decided to "experiment" by trying his hand at teaching for one year but "one year has turned into 11 and a half years," said Bethel.

Bethel taught in Dekalb County for nine years before coming to New Manchester, where has taught two and a half years.

At New Manchester High School, he currently teaches AP Biology, AP Physics and ninth grade biology. In the past he has taught physical science and chemistry.

It is hard to keep the natural-born teacher out of the classroom. Instead of taking advantage of his planning period, Bethel can often be seen poking his head in other classrooms and winding up teaching other subjects such as math, reading with students or engaging in a classroom discussion.

Bethel said, "At the end of the day, it is about planting seeds and motivating. Students think that teachers only know one thing. I've had students ask me, 'how do you know math?' I try to let them know that teachers

SEE TEACHER/PAGE A2

Above: Science teacher and Douglas County's Teacher of the Year Casey Bethel of New Manchester High School, assists student Joseph Russev with a math formula. Bethel often goes room to room during his planning period and teaches other subjects in other classrooms. He thinks that students should know that their teachers know other subjects and are well-rounded, as the students should aspire to be. **Right:** Bethel and his principal, Connie Craft, stand in New Manchester High School's grand hallway, graced by the school's mascot, a panther.

Photos by Liz Marino/ Douglas County Sentinel

TEACHER

FROM THE **FRONT PAGE**

Liz Marino/Douglas County Sentinel

Teacher of the Year Casey Bethel, weighs in during a math class during his planning period. Bethel, who earned a Master's degree in genetics from UGA, teaches AP biology, AP physics and ninth-grade biology at New Manchester High School. He chose the high school level because he feels that high school students need the extra help and he can make a greater impact.

well-rounded — just as students should be well-rounded."

He added, "Sometimes kids see how what they learn in different classes are connecting."

He, his wife Elise and twins Jaxon and Harper have made Douglas County their home. Elise is an after school program coordinator at North Douglas Elementary School. The twins go to Douglasville First United Methodist Church preschool.

"I think Douglas County is a great place to raise kids," said Bethel. "It is a strong, positive community."

In addition to playing with his son and daughter, Bethel enjoys watching soccer matches and catching up with the classics — literature, that is.

The science teacher said that he enjoys reading, and cited such works as "Pride and Prejudice" and "1984" among his "must-reads."

"When I was in high school, I read Bahamian classics," Bethel said. "Now I am trying to read English and American classics."

He thinks it is important for teachers to live in the community where they work. He said that some teachers live and teach in two different areas for fear that they might run into students at the movies or grocery store.

Contrarily, he feels that is important for students to see their teachers out in the community living their daily lives.

"I really appreciate the teacher who lives in the community where they work. I've come to realize that teachers are setting an example for students," Bethel said. "I love it when I see students at the movies or at the Chick-Fil-A drive-thru where they work. Teachers are building the community. This has changed for me the past few years."

When he is not teaching during the day, Bethel may be teaching adult students at the Douglasville campus of Strayer University, something he has done for the past five and one-half years. There, he teaches college-level biology and physics classes, sometimes to two familial generations.

"I teach the child during the day and the parent at night," said Bethel. "I have taught parents of children that I teach at the high school."

Bethel said that he teaches on the high school level because he can make the most impact there.

"This is from my own personal experience. My own high school years were when I became who I am," he said, "and those are the years when you can have the biggest impact. I think those are the years where students need the most help."

As a product of a Bahamian education, he found a few differences in education here in the United States. For one thing, how the importance of education was stressed in the Bahamas.

"It is not separated by culture," said Bethel, "as much as a difference chronologically. In the Bahamas, you could not miss the message that education is important. We live in a society now where the message isn't loud enough.

"I see kids now who think that they can be successful without an education."

Bethel, by nature, is an unassuming, humble person. Yet, he said that he is proud of being named Douglas County's Teacher of the Year. He seemed somewhat baffled by the amount of SWAG the community lavishes on the Teacher of the Year.

"I'm proud of the being named. Inside, it is fulfilling to realize that hard work is recognized and that maybe I'm making a difference at the school and in the community," he said.

New Manchester Principal Connie Craft certainly agrees that Bethel is making a tremendous difference both as a teacher and r model at the high scho

In addition to teachi science classes, he is th boys' soccer coach at N Manchester and deeply involved with a progran called Project Manhooc Craft said.

Bethel and several other teachers hold wee meetings with students Project Manhood. Craft said that the group talk about the role of men in society and how to be better people. The grou also engages in a numb of community service projects.

The principal said th Bethel was a real find a a tremendous asset to N Manchester.

"He sees the positive in everything," she said "and exposes students t so much more than wha inside the classroom. H helps students understa that living is learning. He truly has a heart for teaching."

Bethel noted, "When you do what you love, it not work. I love coming school everyday."

The next step for Douglas County's Teach of the Year is to submit application for Georgia's Teacher of the Year to the state the first week in December. The state judges the applications a announces the semi-fina in early April.

of those bottles and found that they tested positive for methamphetamine

PUBLIX MYSTERY COUPON

Douglas County Sentinel 10/14/15 P A2

fuels attack
Page 1B

recalls visit with troops
PAGE 4A

Douglas Neighbor

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STAFF REPORT ▮ TEACHER OF THE YEAR

New Manchester's Bethel wins honor

New Manchester High School science teacher Casey Bethel was named the 2015-2016 Douglas County Teacher of the Year at the school system's annual recognition program last week.

Bethel beat out finalists Nick Epstein, a physical education teacher at Dorsett Shoals Elementary School, and Adrienne Griffin, a physical education teacher at Fairplay Middle School, for the honor during a ceremony at Central Baptist Church in Douglasville.

He will represent the county in the competition for the Georgia Teacher of the Year award, which will be given in May 2016.

The newly-named Douglas County teacher of the year received his undergraduate degree in biology from Fort Valley State University and master's degree in agronomy from the University of Georgia. He began his career as an educator in 2005 in DeKalb County before moving to New Manchester High in 2013.

Bethel said he wanted to be a cardiovascular surgeon after high school but later discovered that teaching was his calling, the release stated.

He also said on his teacher website that he spent five years conducting experimental research in The Center for Applied Genetic Technologies in Athens where he published original papers in peer-reviewed science journals.

"Conducting experiments was my life," he said. "Ten years ago, I decided to lay down that pursuit and give back through teaching young people, and I love it."

Bethel said sharing his knowledge with students is the best way to make a difference in the present and to influence the future. He said his students are products of his teaching and he wants to produce students who are well-rounded and lifelong learners who are prepared for both colleges and careers, the release stated.

Each of the 33 county schools and the Performance Learning Center selected a teacher to represent them in the program. They then completed a detailed application form and submitted it to the school system's Community Relations Office.

An 18-member selection committee read the applications and chose eight teachers as semifinalists. They included Bethel, Epstein, Griffin and Matthew Nauman of Bill Arp Elementary; Kimberley Haile of Burnett Elementary; Meghan Rathel of Holly Springs Elementary; Thomas Thorne of Yeager Middle; and Grant Fossum of Douglas County High.

The committee members did a 30-minute observation of each semifinalist teaching in their classroom before choosing the three finalists and the winner. Bethel was the county's high school teacher of the year, while Epstein was elementary teacher of the year, and Griffin was middle school teacher of the Year.

TEACHER, 2A

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Douglas County Sentinel Aug 31, 2014

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MANCHESTER HIGH SCHOOL

n studies Wolof with Mr. Sidi Guay, his language instructor at the West African Research Center in Dakar, Senegal.

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Casey Bethel anchester High iology teacher

After having investigated new areas within their disciplines, two teachers from New Manchester High School eagerly began the school year ready to share their experiences with their students. John Green, teacher of French, studied in Senegal, a francophone country in West Africa, and Casey Bethel, teacher of biology, researched protein structure at Georgia Tech.

Mr. Green received a Fulbright Scholarship to study the Wolof language and the Senegalese culture at the West African Research Center in Dakar, Senegal. He and 12 other language teachers from the Atlanta area spent the month of June learning a new language, living with host families, and touring the country. Mr. Green returned to his classroom this fall with accounts from his travels and fresh insights from that part of the French-speaking world.

"The Georgia Performance Standards for modern languages stress not only language skills, but cultural competences from all parts of the world where the target language is spoken," explains Mr. Green. In the area of French, that includes much of Africa, a continent that has more French speakers than France. "Before traveling to Senegal last summer, I had very limited knowledge of and no experience in Sub-Saharan Africa. My scholarship opportunity helped me to broaden my knowledge and is allowing me to add some African studies to my French curriculum."

Mr. Green's classroom is decorated with posters and artifacts he brought back from Senegal. What a casual observer would not notice is his instructional repertoire that now includes legends, biographies, and historical accounts from Senegal

SEE **RESEARCH/PAGE B3**

Mr. Casey Bethel helps Anika Carter begin an experiment similar to those he performed last summer on the campus of Georgia Tech.

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teacher Mrs. Aletheia Leavitt.

s: A glance into y's Sneak-a-Peek

e to gain par- personal con- nd establish mmunication l year. When mentary were ool's sneak-a- familiar with planning, and sure parents k in advance, out the real planning the ull use of the a chance not assroom and to ask ques-

We made sure parents knew about all of our activities and clubs, such as: Chess Club, Science Olympiad, Road Runners, Patriot Performers, Patriot Ambassadors, Art Club ... just to name a few. We also informed parents about our free movie nights and After School Program. There was a consensus that Bill Arp has a lot of great things to offer ... along with excellence in education.

Bill Arp's Sneak-a-Peek was a successful event with over 500 parents and students in attendance. Our preparation for a good first impression paid off and our goal is to keep this momentum going throughout the school year.

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RESEARCH

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and surrounding countries. Mr. Green has designed an entire unit on Senegal that he will present to his upper level students of French.

Casey Bethel did not travel across the globe to perform his research. He had only to drive to Georgia Tech's laboratories where he investigated the structure of five-nitroanthranilic acid deaminase. Studies of protein structure like this one could lead to cures for diseases like Alzheimer's and glaucoma.

"After having conducted this research," states Mr. Bethel, "I feel better equipped to demonstrate to my students the type of critical thinking and problem solving skills involved in real world, hands-on research."

Both Mr. Green and Mr. Bethel were fellows of Georgia Tech's Georgia Intern Fellowships for Teachers (GIFT) program. GIFT connects university researchers with local schools to provide classroom teachers practical experiences in their disciplines. Early in the program, scholarship recipients are assigned university mentors who guided their research. After the summer experience, the fellows develop lesson plans on what they learned and attend round table discussions where they share their findings with other researchers. One such event was the GIFT luncheon on Georgia Tech's campus on July 22.

Mr. Green will tell what he learned in Senegal by talking to other French teachers in Douglas County at their monthly meetings and by presenting at the 2016 conference of the Foreign Language Association of Georgia. He hopes that other instructors use some or all of his Senegal unit in their instruction. Mr. Bethel plans on speaking at the Georgia Science Teachers' Association annual conference this February in Macon, Georgia.

This is Mr. Bethel's fourth GIFT scholarship. In 2012, he won the GIFT Action Plan Award. That year's research experience led to a group of lesson plans centered around effectively teaching biochemistry concepts in high school science classrooms. The bulk of that work was published in The Journal of Chemical Education. Mr. Bethel's success would not have been possible without the wise guidance of Dr. Raquel Lieberman, his mentor in Georgia Tech's Department of Chemistry.

Mr. Green would like to thank the Foreign Language Association of Georgia and the sisters of Alpha Delta Kappa, an educators' sorority, for awarding him scholarships that paid for instructional materials and incidental expenses not covered by the Fulbright scholarship.

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