Pacific Union College

MATHEMATICS, PHYSICS & ENGINEERING
NEWSLETTER

FALL | 2018
ISSUE #2

CONTENTS

WELCOME!

We are thrilled to be bringing you the second issue of the Mathematics and Physics & Engineering Departments annual newsletter! Please enjoy some of the highlights from the 2017-2018 academic year, including the amazing achievements of our students, generous contributions by our alumni, and some of the work your major departments do to make PUC a wonderful learning experience for all who attend here. We hope our report of how you've made your mark on PUC and what we've been up to since our last newsletter finds you and your families well. Don't forget that we look forward to sharing updates from our alumni every fall; be sure to respond to our survey and let us know what you are up to!

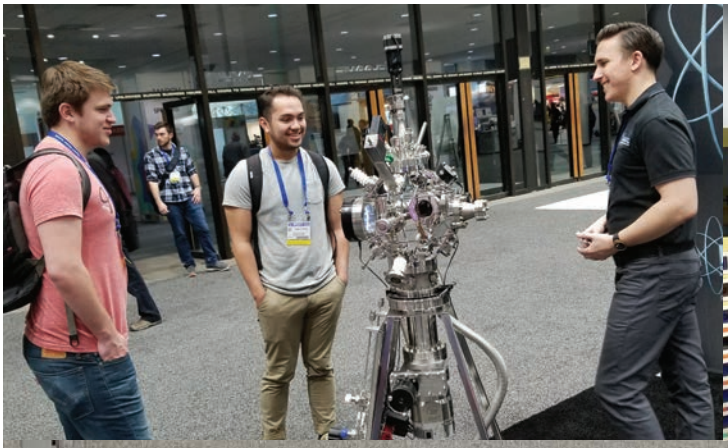
Chair's Remarks

While every year has its own form of uniqueness, this past year had some features that really set it apart from others. As with most things, we have the opportunity to choose whether to focus on the bad or the good in those features.

The month of October saw the unprecedented shutting down of campus for a week as a precaution against the wildfires in our area. While nearby Redwood Academy was destroyed entirely, PUC was fortunate to avoid any damage and was able to find creative ways to fit ten weeks of course material into only nine. In response to an increased need for information on Angwin air quality, we were able to get a PurpleAir monitor installed on campus, so now you can check on the college air from the comfort of your home.

On a personal note, shortly after the fires, my older sister had to begin chemotherapy sessions to treat cancer. In support, I shaved my head every morning for six months, which initially shocked many people who could only picture me with the long or medium length hair that I've had for years. My poor calculus class had barely returned from the week off, facing class meetings five times per week instead of four, and now with a hairless teacher! These events, combined with a two-quarter experiment with arguably the worst online homework system ever devised, drew the students together to become one of the most close-knit classes I've had. I'm happy to report that my sister is now cancer-free, and my hair is back to a normal length.

Finally, as the summer was winding down, I received the news that Sidney Shields had accepted a research opportunity with Sandia Laboratories in New Mexico and would not be able to teach for us this year. As an example of Divine Providence, however, Professor Emeritus Lloyd Best had decided just a few days earlier to return to Calistoga after a year of blissful retirement in the Washington, DC area. When I contacted him about our need, he quickly agreed to fill in for this year, changing a potential panic-inducing situation to one of faith restoration. We are happy for Sidney and his wife as they start their new careers, and look forward to a great academic year with Lloyd as part of our departmental family again.



DEPARTMENTAL UPDATES

Physics Student Research

There is so much we wouldn't be able to do without funding from grants and our generous alumni. We invite you to read about our research activities over the last year and how our alumni have supported their PUC MPE departments in these efforts.

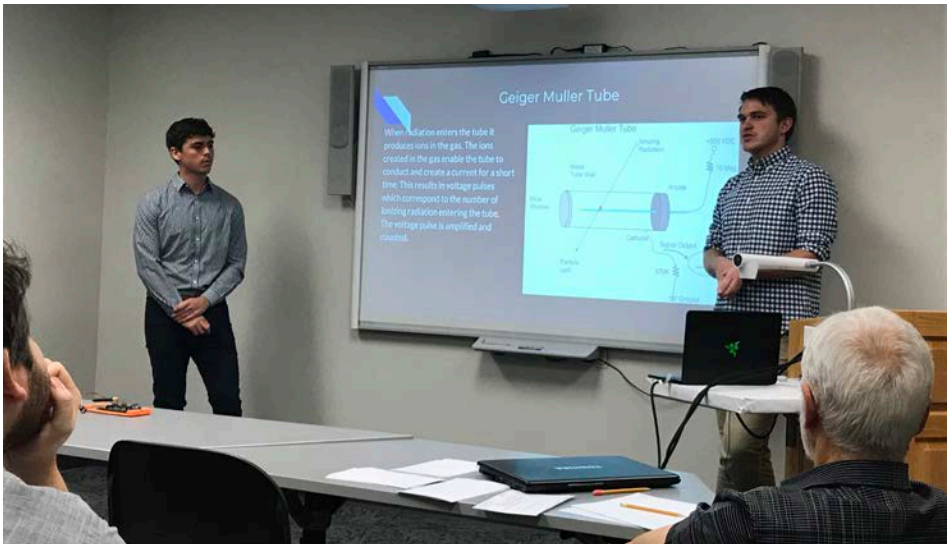
Collaboration with Oak Ridge National Laboratory (ORNL):
The Division of Physics of the National Science Foundation accepted our request this Fall for a fourth-year extension on the Major Research Instrumentation (MRI) grant awarded in Fall of 2015 and granted an additional $20,000.00 in funding, increasing the total award to $209,922.00. Vola Andrianarijaona, physics faculty member and principal investigator for the grant, has been working to develop a portable three-dimensional imaging device that will allow vibrationally resolved measurements of cross sections of charge transfer in collisions between molecular ions and neutral particles. The new beamline was finished in late April 2018, and we conducted a very promising first test in Summer 2018. The next step will be to implement the alkali oven and the position sensitive detectors. We estimate that the project will be accomplished by September 30, 2019. Big thanks to our graduating physics majors Aaron Watson, Jared Taylor, Kitae Kim, and Elijah Nuss; we will really miss these students who contributed so much to this research project during their time here at PUC.

Collaboration with Lawrence Livermore National Laboratory (LLNL):
Our NASA subcontract with Lawrence Livermore National Security (LLNS) continues this year with approximately $10,000.00 in grant funding. Our goal and the main job will be to build a hydrogen source for the Electron Beam Ion Trap (EBIT) at LLNL. We are excited that our go-to contact person in this collaboration will be PUC alum, Dmytro Panchenko ('17), who has been working at LLNL since 2017.

Mathematics, Physics & Engineering Fund
While grants support a great deal of our research, monetary contributions and equipment donations from our alumni are a significant part of providing opportunities for students to participate in research activities. Below we share some of the ways this fund has been used over the last academic year and hope you will consider sponsoring more of this type of activity for our students in the future by contributing.

A significant portion of donations made to the Mathematics, Physics & Engineering Fund is used to subsidize conference fees, travel expenses, and lodging for students conducting research and attending professional conferences. Notable activities over the last year include:

- Independent research at PUC by Josue Tobar ('16) on the Inductive Coupled Plasma (ICP) ion source. This study/ research is being done with the help of Dr. Robert Wilson from the Chemistry department.
- Chemistry, Mathematics, and Physics major, Aaron Watson, went to Albuquerque University in February 2018 to work on and learn about the cryogenic pump technique that we will be implementing in our own physics research facility at PUC.
- Students Dayton Brown, Elijah Nuss,



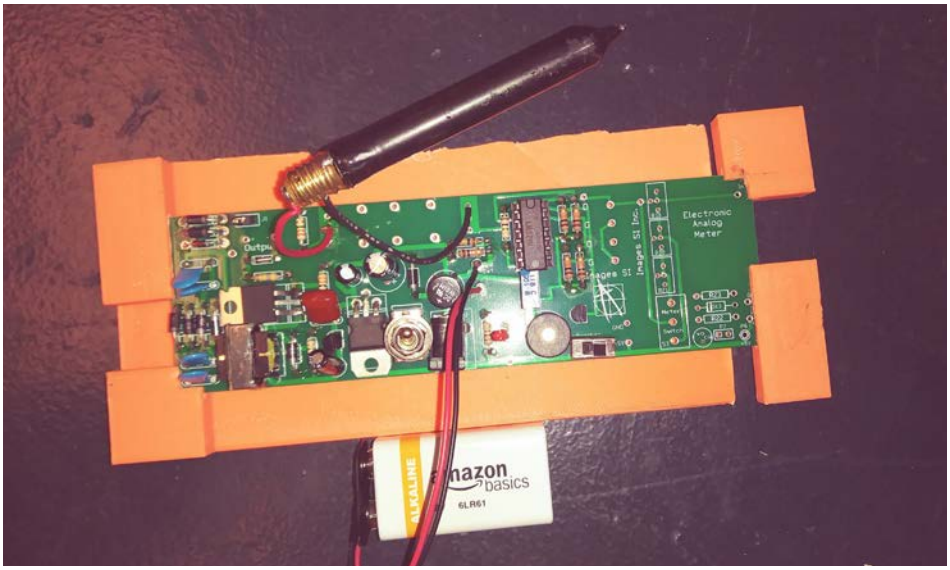
Jared and Eli present their project to students and faculty at the Mathematics Senior Seminar

Jared Taylor, Kitae Kim, and Josue Tobar ('16) attended the March 2018 meeting of the American Physical Society in Los Angeles and participated to the "Density Functional Theory" (or DFT) workshop. The DFT is one of the approximations we use in our theoretical calculations for the Independent Research class. Our students' calculations provide new data sets on the ionization potential of macromolecules of biological interest.

- Students Cliff Deguzman, Monarc Manlongat, Edwin Schultz, Kelsey Garfield, Volana Andrianarijaona, and Joseph Yang attended the October 2018 Annual Meeting of the Far West Section of the American Physical Society at California State University Fullerton.

If you are interested in supporting our ability to enrich our majors' education with opportunities for research and attending professional conferences, please consider giving to the Mathematics, Physics & Engineering Fund.

In addition to financial contributions, John Brenneise ('90) generously donated a TCL Roku TV monitor and several computers along with new graphics processing units to be installed to increase their processing speed. Biophysics major, Dayton Brown, started his calculations for the ionization energies of DNA and other smaller molecules in Spring 2018 using the homemade computers. We are planning to use the TCL Roku TV to rehearse talks and posters before going to conferences. Also, the large display will be useful when we visualize the ionization energies in three dimensions once the students' calculations are done.



The completed Geiger counter with 3D printed casing

Mathematics Student Research

During the Winter 2018 quarter, senior physics and mathematics major, Kitae Kim, joined Sidney Shields in his research on using numerical methods to approximate solutions to time-dependent partial differential equations. Numerical methods often introduce undesirable, non-physical, numerical oscillations that need to be "smoothed" to give more accurate results. The ultimate goal of the research is to measure and compare the performance of three different methods for smoothing out the undesired oscillations in numerical solutions when applied to the shallow-water equations. As a first step towards this goal, they used these three methods to a simpler, yet very similar set of equations known as the 2D inviscid Burgers' equations.

To fully understand and compare the performance of the three smoothing methods, they chose a Crank-Nicholson temporal discretization and a continuous Galerkin finite element method spatial discretization to simulate and solve the 2D inviscid Burgers' equations. These numerical methods were chosen specifically because significant non-physical oscillations appear in the corresponding solutions. Kitae then compared the three smoothing methods with the original numerical results using FEniCS, a computing platform for solving partial differential equations. The initial results for the 2D inviscid Burgers' equations were somewhat inconclusive, but they are continuing their investigations into how these smoothing methods perform with the shallow-water equations while Kitae studies abroad in Germany and Sidney settles into his new position at Sandia National Laboratory in Albuquerque, New Mexico.

Students Build Geiger Counter

For their Advanced Experimental Physics class, seniors Elijah Nuss (physics major) and Jared Taylor (engineering and physics major) worked on a project to build a Geiger-Müller counter using an electronic circuit board from Images Scientific Instruments. The completed device could be used to send data directly to an electronic device such as cell phone, serving as a possible substitute for our usual Geiger counter during general physics labs (e.g., radioactivity lab). Assembling the Geiger counter gave these students engineering experience they would not have experienced otherwise and also involved calculations, welding, and calibration of the custom-made Geiger counter with different methods: comparing the background measurement with a calibrated counter, using a

known radiation source, and using two known active samples (silver and indium). While this project fulfilled the capstone class requirement and completed Jared and Eli's physics curriculum, the project can be easily modified into a new lab for courses like Applied Physics. We are hoping that other students will resume this project and refine its transfer to labs. If you are interested in supporting the expanded use of these custom-made devices in our physics courses, please consider giving to the Mathematics, Physics & Engineering Fund to help!

The Spring 2018 Maker Faire

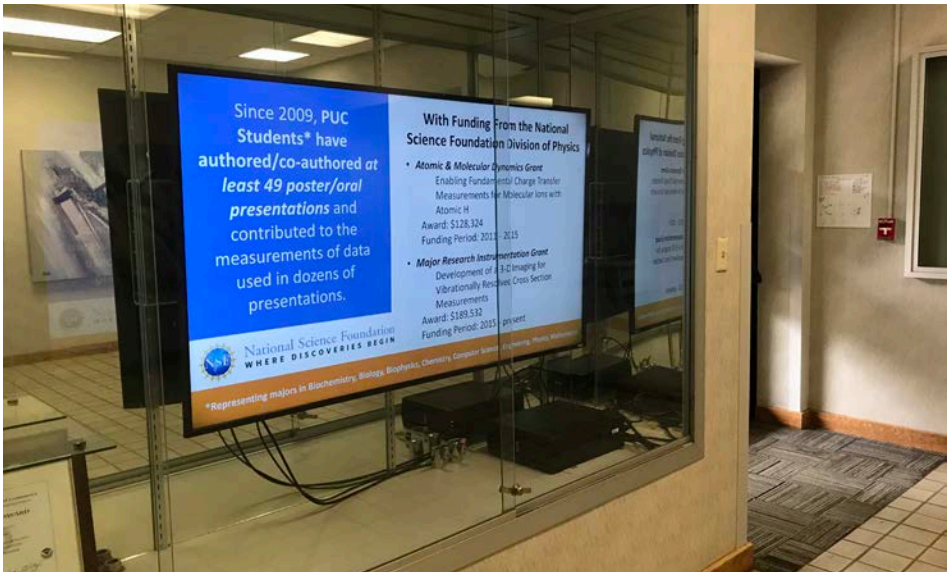
At the end of the Spring 2018 quarter, a Maker Faire was hosted by the Loma Linda Academy on their campus in Loma Linda. Maker Faire is a community show-and-tell event that celebrates arts, craft, science, and engineering. A typical event gives exposure to enterprising groups or individuals eager to engage the public with their ideas, projects or products by providing booth space for these individuals or groups for hundreds of community members to visit. Faculty from PUC's fine arts, biology, and MPE departments used this opportunity to display the ingenuity of its staff, faculty, and students.

Our own Raulton Haye, Assistant Professor of Physics and Engineering, hosted a popular booth featuring Thermo-bots. The Thermo-bot gadget promoted at the Maker Faire was a thermo-electric generator designed and built by the Fall 2017 Introduction to Engineering class. The thermo-electric generator exploits the Seebeck effect, a phenomenon where a voltage difference is created as a result of a temperature difference, allowing thermal energy to be converted into electrical energy. The generator built by the students used ice and fire to create the temperature gradient and produced an output exceeding 5 Volts and was sufficient to charge a smartphone partially.

Flame and ice create a difference in temperature

There was a constant stream of visitors at PUC's "Thermo-bots" booth making it impossible for Raulton to take a break as he was mobbed by eager patrons from 9 am until about 3:15 pm. Visitors were fascinated when they were able to charge their phones with the "Thermo-bot." They were also intrigued by other scenarios where this gadget could be useful to them.

"I really enjoyed my time at the Maker Faire," Raulton reflected, "it was a meaningful outreach, and the people seemed to appreciate our gesture of sharing our projects, our thoughts and our time with them." The MPE departments appreciate that Raulton was able to represent PUC and our work by our own majors at the 2018 Loma Linda Academy Maker Faire.



Weather Monitoring Update: PurpleAir Air Quality Sensor

For almost 70 years, the Physics Department has recorded and reported daily weather data for the National Weather Service. This data has been used to establish the mean rainfall for Angwin, as well as to show the lack of any rainfall trends through the years. Although rainfall continues to be a concern for most Californians, air quality has quickly become a significant topic of discussion. During the fires last Fall, it came to the attention of the community that there were no air quality monitors near PUC. The college also received many questions regarding the air quality on campus from concerned parents, so a method to measure air quality was sought out.

In response to this local need and to help add to the data being collected in the Napa Valley and throughout the world, the MPE departments installed a PurpleAir PA-II air quality sensor in November 2017. The sensors on the air quality monitor work by analyzing the reflections of a laser off particles in the air, drawn into the unit by a fan, to count six sizes of particulate between 0.3 µm and 10 µm diameter. The data from our sensor is reported directly to the PurpleAir servers and is available to government agencies and popular sites, such as Weather Underground, on the Pacific Union College Station (ID: KCAANGWI11).

Digital Bulletin Board: Sharing with Students

Last year, PUC alum John Brenneise ('90), provided the Mathematics and Physics & Engineering Departments with a new 65-inch flat screen TV monitor and a computer. The PUC

Facilities team worked to hang it in the lobby on the main level of Chan Shun Hall where we have used it to provide announcements and educational information for our majors and other students at PUC. At the beginning of every school year when we meet our new majors, we have been sharing advice from our graduating seniors on how to be successful in mathematics, physics, and engineering fields of study. Now we can share advice in the lobby such as research and opportunities to pursue in the department, useful study and sleep habits, and how to choose elective courses. For π Day in March, we had a special slideshow with fun facts and videos about the transcendental number. We have also enjoyed the opportunity to use this resource for students to view live SpaceX rocket launches!

Updating the Kilburg Geochron

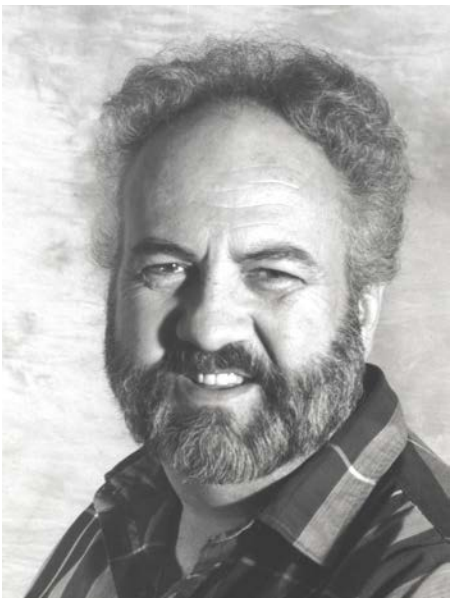
The Geochron, a mechanical world clock featuring the sun's location on a moving map, has graced the Physics department at PUC for decades. Constructed of 300 moving parts, the department Geochron has faithfully displayed the time and kept track of the seasons since its purchase in 1976 while receiving map updates and mechanical adjustments from the manufacturer every ten years. When the Geochron came due for its fourth regular maintenance in 2016, we were met with two surprises. First, the cost of refurbishment had doubled. Second, an announcement was made that a digital version of the Geochron would be produced and would display even more information in 4K digital quality.

After some production delays, the MPE departments received our new Geochron Digital 4K UHD this year. It is a simple small box, housing an Intel Atom processor and running Android 5.1 OS. The 4k geospatial computer can be mounted to the back of a monitor and connects to the internet for free lifetime updates for five mapsets. A large 4K television was purchased and quickly installed so that today, visitors to Chan Shun Hall are greeted with the new, bright and colorful display. The digital Geochron model also boasts features that enrich the educational experience of our students, such as the live tracking of the International Space Station and the seasonal changes of the sun's path, which intrigue students taking our Astronomy course. We are grateful that this digital option will allow us to continue offering students a chance to see the world in a different light; hopefully, for decades more to come!

THE YOUNG OBSERVATORY

The College has a long history of teaching astronomy and maintaining an observatory on campus. While the Young Observatory continues to be a prized jewel in the Physics department, it was not the first observatory at PUC. According to Walter C. Utt in his book, A Mountain, a Pickax, a College, the first two observatories on campus were built in the 1930's by Professor Newton. They contained a 6-inch telescope made from parts transferred from an observatory in Healdsburg and a 14-inch reflector telescope that utilized a rear car axle salvaged from Professor Newton's 1910 Mitchell as a mount. Students and visitors may remember seeing an older observatory near the airport; that was the Newton Observatory. Long left abandoned, it was dismantled about ten years ago.

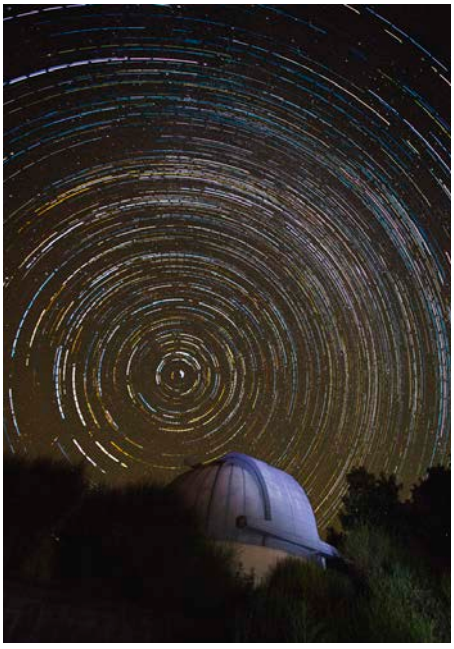
In 1970, the construction of the Young Observatory was completed. A small distance from the airport, the new observatory was far from sky-dimming light pollution. Initially, the new observatory contained a home-made



Gary Shearer, 1994

telescope that was later replaced by a computer-controlled Celestron 14-inch Schmidt telescope. As optical coatings and computer technology advanced, a newer Celestron (CGE1400 14-inch Schmidt with a 3910mm focal length) replaced the older model in 2009. While the new telescope was installed, the observatory underwent additional renovations, receiving a fresh coat of paint, inside and out, and a new floor.

Today, the Young Observatory is used for laboratories twice a week during the Fall and Winter quarters by the Astronomy classes. It is also used for public viewings two or three Friday nights per quarter as well as select private viewings for special summer programs. The Friday night schedule represents a change



from when it was recently available to the public every Friday night. By opening the observatory every weekend, it seemed to lose some urgency in the minds of students to visit over time. Now, by restricting the number of evenings it is available, we have more interest from visitors and can adjust the schedule based on when the moon's phase is most conducive to good viewing.

Over the years, faculty such as Bill Mundy, Bruce Ivey, David Bell, James Robertson, and Raulton Haye have kept the tradition of opening the Young Observatory to the public for Friday night observations. Each faculty member, often joined by some of our physics majors, would take a Friday night to split up the weekly commitment. In addition to science faculty, Gary Schearer, PUC Reference Librarian from 1983 to 2006, loved to share his incredible love for astronomy by helping every Friday night for years. Though he never wanted to operate the telescope, he wanted to interact with the public and share his knowledge about the objects being observed; his passion for astronomy was inspiring and infectious. In 2008 Gary retired and moved to Missouri, where he passed away in 2016. "I always looked forward to starting the Sabbath under the stars at the observatory with Gary," James reflects, "I miss him terribly."

The most frequent reaction from first-time visitors to the Young Observatory is amazement at seeing the Milky Way for the first time. The college is blessed to have the Young Observatory and its unspoiled location and the opportunity to widen visitors' perspective of God's creation.

STUDENT & ALUMNI UPDATES

Welcoming Our New Majors

It is a special time each year when we have the opportunity to welcome new students into our departmental family. This year we are happy to introduce four new majors:

Samantha Rodriguez (Freshman)
Major/Program: Engineering
High School: Monterey Bay Academy

Brian Pham (Freshman)
Major/Program: Engineering
High School: Milipitas High School

Kelsey Hadfield (Transfer)
Major/Program: Biophysics
College: Napa Valley Community College

Angela Shin (Newly Declared at PUC)
Major/Program: Biophysics
Year: Sophomore

2017–2018 Academic Year Departmental Scholarships, Commendations, Honors, and Awards

The MPE Departmental Commendation for a four-year student demonstrating scholarly excellence, outstanding academic achievement, non-curricular leadership, character, service, and/or community involvement was awarded to Jared Taylor.

The MPE Departmental Student Worker Award for students with strong work performance and excellence, demonstrating initiative, integrity, and dependability in their on-campus jobs were awarded to Taylor Bothwell (MPE Head Secretary)and Kitae Kim (Head Physics Lab Teaching Assistant).

The Math Scholarship for a deserving Mathematics Major was awarded to Noelle Madrio.

Current Student Spotlight

For the 2018–2019 year, we were sad to say goodbye to our MPE Department Head Secretary, Junior Biomathematics major, Taylor Bothwell. Normally we would be completely devastated to lose such an excellent student, model employee, and major whose extracurricular activities included organizing the collegiate church service, The Twelve, but we know this loss is only temporary. For the 2018–2019 Academic Year, Taylor has traveled to Pohnpei, one of four states in the Federated States of Micronesia, as a student missionary where she is teaching high school mathematics. We look forward to her return to campus but

Samantha Rodriguez

Angela Shin

Brian Pham

Kelsey Hadfield

know this will be a life-changing experience. She is keeping a blog of her adventures, which she has kindly given permission for us to share. We hope you will enjoy reading what Taylor is up to in her Tales of Teacher Tay: Stories of my days on a tiny island in the Pacific.

Recent Graduates

We celebrated the graduation of our majors this June with an annual gathering at Steve Waters' home in Angwin. It is hard to let them go, but we can't wait to see where life takes these impressive and talented 2018 graduates. Here is a snapshot of their plans:

Kitae Kim
Mathematics BS, Physics BS: anticipated 2019
Adventist Colleges Abroad in Germany for a year followed by pursuing Ph.D. in mathematics

Elijah Nuss
Physics BS: anticipated 2019
Adventist Colleges Abroad in Italy for a year followed by pursuing a graduate degree in economics or finance

Rischel Tabiolo
Biomathematics BS
Optometry program at Western University of Health Sciences

Jared Taylor
Engineering AS, Physics BS
Graduate school for Ph.D. in Medical Physics at Louisiana State University

Aaron Watson
Chemistry BS, Mathematics BS, Physics BS
Graduate school in physics at the University of California, Santa Barbara

Updates from Alumni

We were thrilled to hear back from some of our alumni in response to our last newsletter. Here are some of the updates our alums wanted to share with all of you.

Julie (Vieau) Dickerson (Mathematics 2007)
I've worked as a math teacher and/or vice principal for the past 10.5 years since graduating from PUC. I will now take time off to raise my 1-year-old and second baby due later this year.

Larry Hoffman (Computer Science 1984)
Larry lives in Colorado Springs, Colorado where he is the Director of Global Computing Services Operations for Agilent Technologies. Agilent is

(Left to Right) Sidney Shields, Chantel Blackburn, Vola Andrianarijaona, Jared Taylor, Aaron Watson, James Robertson, Rischel Tabiolo, Steve Waters

(Not Pictured) Elijah Nuss, Roy Benton, Raulton Haye

a leader in life sciences, diagnostics and applied chemical markets. The company provides laboratories worldwide with instruments,

services, consumables, applications, and expertise, enabling customers to gain the insights they seek. Larry's team manages the data centers, servers, database, storage & associated compliance and security at about 30 sites around the world, hosting applications and services for R&D, Manufacturing, Finance & Global Infrastructure Operations and Logistics. After attending Union College, Larry's daughter Cynthia completed a degree in Veterinary Technology from Front Range Community College and now works at a Vet Clinic in Cheyenne, Wyoming. Lawrence Jr completed a BS in Aviation Technology from Walla Walla University, is married to Victoria Buell. They have recently moved to Anchorage, Alaska where Lawrence will be a pilot for ACE Air Cargo. Victoria is pursuing an MBA at the University of Alaska.

Richard Strom (Mathematics, Physics 2015)
Received Masters in Atomic & Molecular Physics from Auburn University, December 2016. Entered Ph.D. candidacy January 2017, working on double photoionization of molecules at the Advanced Light Source at Berkeley Labs. Expected Doctoral Defense in December of 2018

We would love to hear what you have been doing. Please take a moment to give us an update for our next newsletter! Not getting our newsletter? You can update your email as well.

FACULTY UPDATE

Faculty Fur Friends

As we conclude this year's newsletter, we thought you might like to hear about the pets in the department. Our fur friends provide us with companionship and antics that enrich our lives when we are not teaching in classrooms or working in our offices. We hope you enjoy hearing about them as much as we enjoy sharing them with you!

Steve Waters
Our wonderful 13-year-old "gray boy," Chebychev, is a long-haired ball of fur, who is wonderfully cuddly but only with my wife and me and a couple of friends who were required to have regular visits for several years before

Chebychev

being accepted entirely. Cheby serves as a backup to my alarm clock every morning. He doesn't actually wake me up but is usually staring me in the face when I do wake up, and then makes sure that I don't go back to sleep.

Our six-year-old girl, Sabrina, is the kind of short-haired black cat that is often associated with Halloween. This sleek athletic cat loves to interact with me, playing games of fetch and "talking" incessantly. While she doesn't yet fully appreciate the concept of sitting in laps, she does follow me around the house and insists on being picked up for a few minutes every morning.

Sabrina

James Robertson

In 2009 my daughter, Catie, adopted a Pekinese-toy poodle (aka peekapoo) dog while I was out of town. She named her Lexi. My family knew I would never approve of a dog in the house while we had a cat. Since the cat was bigger than the dog, the two tolerated each other and so did I. She is a crazy little dog. Always barking heroically at the UPS delivery man from behind the door. Oh, and she likes to eat apples.

Lexi

Chantel Blackburn

I picked η (Eta) out from his litter when I was accepted to graduate school in April of 2006 and named him after what I consider to be the prettiest Greek letter. He liked to play fetch with a fuzzy toy, chew on sticky sheets from lint rollers, deposit various treasures in his water or food dishes, and open kitchen cabinet doors. He lived with me in 3 apartments and 3 houses across 3 states. He passed away from complications of kidney disease in August 2018.

η *(Eta)*

Cracker Jack (Jackie), a buff-colored Maine coon, is constantly demanding attention. He learned to jump up into my arms from the floor upon invitation (and was discouraged from doing so at all when he started to do it without invitation),

Cracker Jack (Jackie)

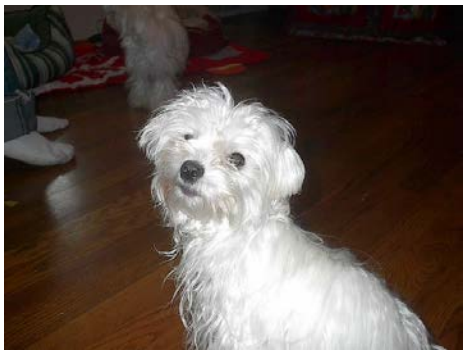
can catch treats thrown in the air, and begs to lick off the lid of any plastic food container whether he likes it (e.g., sour cream or yogurt) or not (e.g. peanut butter or salsa).

Alistar, a short-haired tortoiseshell, is both fiercely independent and extremely affectionate with huge orange eyes and a giant purr. She loves to sleep on top of the upper kitchen cabinets, dunks her head under running water when she gets a drink, chews on the flaps of cardboard boxes like a gerbil, and seems to enjoy delivering a variety of objects (including empty food cans and flip-flops) to me in my bedroom at night.

Alistar

Vola Andrianarijaona

Our Maltese pets, Ci-Ci and Toe-Toe, are both 8 years old and around seven pounds. They may have Cotton de Tulear in their bloodline, which is a Bichon-type breed from Madagascar, my



Ci-Ci

Toe-Toe

original country. They are quite loud for small dogs and bark at any moving object they see from afar. They like playing hide and seek together, but definitely hate long walks.

Ci-Ci is a few days older than Toe-Toe and is an alpha female dog. She likes to play with a small ball during our evening prayer to get our attention. She would throw the ball with her mouth and try to catch it with her front legs. Very impressive!

Toe-Toe also has his own character. He lays down near kids who are playing monopoly game and stays still. As soon as some of the kids decide to go to the bathroom, Toe-Toe would step into the game field, grab one of the game pawns, go back to where he was, and lay down again on top of the pawn as if he did nothing at all. They are just fun to watch.

In November 2017, we adopted a gray cat, which our kids named Winter. He was very sweet but clearly was looking lonely. When we heard a clinic in Lakeport was trying to place some feral kittens, we took the risk of trapping them and got all the three kittens. It was challenging to tame them, they were feral, after all, but Winter helped a lot. Now they are very friendly and let our kids pet them. I am allergic to cats, so they all live outdoors.

The names of the three feral kittens have a funny story. The veterinarian asked the names of the kittens when I made an appointment for them. I did not know what to say because the three were not named yet. I started with Winter because that was easy. Then, I just continued with the different seasons: Spring, Summer, and Fall. The colors did not match though, but that is OK because they are taking good care of our yard. We do not know their exact ages, but they are all a year old now.

From left to right: Spring, Summer, Fall, and Winter

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NEWSLETTER

NEWSLETTER CREDITS

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