



Integrative Physiology

University of Colorado
Boulder

Department
Newsletter

IPHY

Issue #17

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Special points of interest:

- David Sherwood will lead IPHY in the coming academic year
- IPHY gets its own building, the Ramaley Addition
- Inquiry-based approach instituted to enhance students' research skills in Physiology Labs
- Innovative curriculum implemented in IPHY Statistics
- Clinical case studies are included through the multi-year IPHY curriculum

Inside this issue:

Introduction to Statistics	2
Physiology Lab Student Projects	3
Anatomy and Physiology Case Studies	5
A Journey to Med School	6
From Mexico to Military to Medical School	7
Kudos	9
Cartoon	10
List of Graduates	11
Many Thanks to Donors	12

A Few Words from the Chair By Pei-San Tsai

The Spring semester of 2017 has brought forth several new developments for IPHY.

First, with 289 IPHY graduates walking in the May 2017 commencement, we have officially set the record for the largest graduating class in the history of IPHY. Congratulations to the Class of 2017! Second, after years of anticipation, IPHY will finally have a new building of its own. This building, currently named the Ramaley Addition, will have ~14,400 assignable square feet to house three existing IPHY research laboratories, two new laboratories for IPHY's future faculty hires, and offices and seating areas for faculty, staff and trainees. Additional features to support research infrastructure, such as a freezer farm, conference area, and shared research space, are also included. The building is slated to become fully operational in early 2020 and is estimated to cost \$21 million. We look forward to this building and the support it will provide. Third, our faculty have been extremely successfully in obtaining federally funded research dollars between 2016-2017. Some examples include new multi-million dollar awards from the National Institutes of Health to Drs. Alaa Ahmed, Chris DeSouza, Monique LeBourgeois, Doug Seals, and Ken Wright, as well as many additional external awards to the IPHY faculty. These highly competitive awards support our research endeavors, graduate and post-graduate training, and important day-to-day operations. We thank our talented faculty for their effort in obtaining the extramural grant support.

Of course, IPHY would not be functional without our dedicated staff. They play an important role in IPHY's mission and have been the unsung heroes year after year. Marsha Cook, Jennifer Law, Rachel Salaz, Brandon Geer, Trisha Ward, and Eric Heltne have each assumed responsibilities related to undergraduate and graduate programs, faculty support, course assignment, budget management, hiring, building maintenance, and performed many other strange and seemingly impossible tasks. IPHY owes much of its success to these superheroes.

Lastly, it is with my great pleasure to introduce Dr. David Sherwood, our current undergraduate associate chair, as the next IPHY Chair (starting July 1, 2017). It has been a privilege and honor for me to serve IPHY for the last three years, and we look forward to Dr. Sherwood's upcoming leadership!!





***Introduction to Statistics:
The “Why”, How and Does it Matter?” of Biomedical Research***
By Marissa Ehringer, Steve Hobbs and John Harsh

All IPHY students are required to take IPHY 2800, an introductory course where they learn important elements of study design, analysis, and interpretation as it applies to biomedical research. It is fair to say that most students enter the course with a less than favorable view of statistics and a low level of interest in the topic. For this reason, instructors for the course have spent the last 5 years developing material and examples specifically tailored toward application in health sciences, and trying to avoid lectures about how many purple marbles are pulled out of a bag.

However, as future health professionals and/or researchers, it is imperative our students learn three important aspects of statistics. First, students learn to critically evaluate the overall study design, and whether methods used are appropriate to address the question being asked. Second, students develop skills to perform standard statistical analysis, appropriate for the type of data and distribution of variable item scores. Finally, these ideas are integrated so students learn how to interpret results from a study in terms of “the big picture” and whether meaningful and practical guidance about future treatments and/or other studies can be formulated.

There are challenges to learning statistics because many concepts are not intuitive. As mentioned above, many students begin the course with a low level of interest and sometimes a high level of fear. Furthermore, it is essential that students have many opportunities to practice and apply the content and analyses using real datasets. Attending lectures and reviewing notes will not necessarily provide the depth of knowledge to critically evaluate research reports or media articles about scientific advances.

Our IPHY statistics course utilizes a couple of novel methods to enhance learning and competency. First, the traditional textbook is not used. Instead, students purchase access to an online statistics resource called OLI (Online Learning Initiative) produced by Carnegie Mellon University. OLI is organized around modules (like chapters) that explain the theory and practice of statistics, but in addition contain activities and problems for students to practice, and which provides customized feedback to each student. Graded quiz-like “checkpoints” are interspersed in the readings and are mostly unique to every student. Students can collaborate on checkpoints, but won’t benefit from copying answers, and they can make multiple efforts with a small penalty while receiving helpful feedback after each submission. In this way, students can learn from each other and from their own mistakes, while still earning high marks and acquiring proficiency.





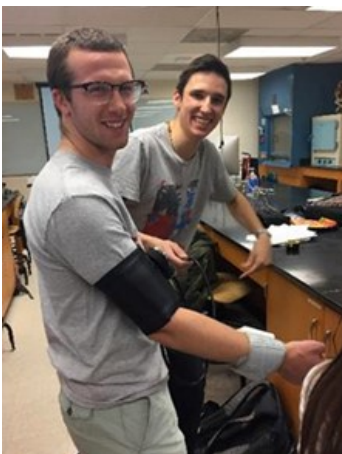
A second innovation in IPHY statistics is the use of R Studio for performing statistics. R Studio is a platform for performing statistics that employs the powerful, free, and open source language called R. R is arguably the most commonly used approach for performing statistics in the professional world. Thus, IPHY students not only learn how statistics is used in medicine and human research, but they also learn a very practical and sought after skill applicable to a wide variety of futures in science.

Finally, instructors recruit undergraduates who have successfully completed the course and show enthusiasm for sharing their knowledge as Undergraduate Teaching Assistants (UGTAs). This provides peer-peer learning throughout the semester. The UGTAs assist during clicker questions or other group activities by walking around the lecture rooms and providing assistance. Furthermore, they serve as an additional resource during the weekly computer laboratory sessions where students use Excel, R, and other tools to analyze the data (led by graduate TAs). Finally, the UGTAs provide office hours, which gives more flexibility for students to obtain individualized help.

Importantly, the team of instructors who teach Introduction to Statistics has worked closely with faculty who teach upper level laboratory courses (such as physiology) to incorporate the use of statistics and R Studio analyses into their projects. This has benefitted everyone, because an instructor can refer to how a particular skill will be applied in future courses (giving them a bit more “buy-in” to the importance of learning it!). It also allows the students to review and practice their statistical tools in later semesters. In summary, changes in pedagogy have led to a current curriculum that integrates multiple features to generate an interesting and sometimes even fun experience for students while ensuring a high level of rigor and challenge.

Introduction of Student Projects in Physiology Lab Encourages Students to Act More Like Scientists

By Janet Casagrand, Teresa Foley, and Jia Shi



How does the scent of lavender versus peppermint affect heart rate and blood pressure? How does the sight, smell, or taste of pizza influence blood glucose levels? Does consumption of a spicy drink before exercise reduce the likelihood of muscle cramps? These are some of the questions that students in the revised physiology labs have been asking and testing for themselves.





The ability for students to test their own ideas has resulted from a revision to the physiology labs over the past six years. These laboratories serve about 400 integrative physiology (IPHY) majors and non-majors each year, and explore basic human physiological principles. Five IPHY faculty members revised the labs from a “cookbook” style of instruction, in which students are told exactly what to do and what to expect, into a more inquiry-based approach, in which the process and outcome are not narrowly defined. A number of studies have shown this style of lab instruction improves student learning and understanding of lecture concepts and the scientific method, and also overall attitudes and motivation toward learning and science. Furthermore, the inquiry-based lab activities more closely model how scientists actually engage in research and help students develop independent, critical and analytical thinking, and scientific reasoning abilities.

“[The projects] give students the opportunity to take what they learned in the lab section and essentially play in a sandbox to create their own path.”

-Physiology Lab student

As part of the revision process, end-of-semester student projects were added to the curriculum. Working in groups of three or four, students spend three weeks designing and performing an experiment from start to finish using the skills they learned throughout the semester. This process requires students to: (1) formulate a hypothesis and research question, (2) design an experiment that answers that question including proper controls and possible limitations, (3) use statistics to analyze whether the given data support or refute the hypothesis, (4) propose a future experiment that would correct for any unforeseen limitations they had, or would be a logical next step, and (5) formally present their experiment and results to their peers.

“Not only did we get to practice the scientific method independently, we also got to explore what physiologically interests us. I loved collecting data for the project!”

-Physiology Lab Student

Overall, student reaction to the projects has been very positive with 96% of students reporting on end-of-semester surveys that they enjoy the projects. Students take the assignment very seriously and assume full ownership of their projects. They become very enthusiastic and engaged in the process, and often spend a lot of time outside of the lab on their projects. Some students even recruit family and friends to participate in their studies, and take on the role of research scientist when interacting with their subjects and performing their experiments. Students also learn how to collaborate with their peers, delegate tasks, meet deadlines, be accountable to one another, and present scientific information to an audience. Students often comment that they do not appreciate how much work goes into designing a good experiment, until they have to do it themselves.

“Our project just made us realize how hard it is to design and [implement] a good experiment.”

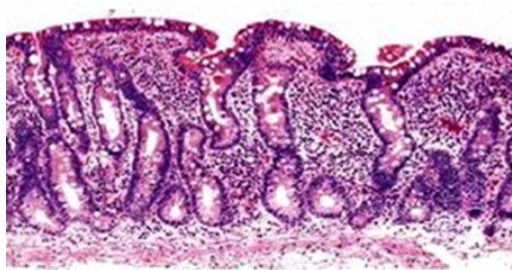
-Physiology Lab Student

We hope that these projects help students appreciate the process and complexity of scientific research, and be better able to apply these skills when they read/hear about science in the real world.



Introducing Case Studies into Anatomy and Physiology

By Janet Casagrand, Teresa Foley and Ruth Heisler



Over the past few months, Eliana has been suffering from intermittent abdominal discomfort, low appetite, lethargy, and diarrhea. Eliana goes to her physician who orders a series of tests that indicate that Eliana has celiac disease. Eliana learns that celiac disease is an autoimmune disorder in which gluten in foods causes destruction of cells in her small intestine. How does damage to the small intestine in celiac disease affect absorption of nutrients and lead to the symptoms displayed by Eliana?

This is the introduction to a case study recently added to our anatomy and physiology course sequence. Research has shown that students learn better by applying key anatomical and physiological concepts in the context of real-world scenarios. Case studies are a type of problem-based learning in which carefully designed problems challenge students to apply and synthesize what they have learned to a real-world situation. In anatomy and physiology, these often take the form of a medical/clinical scenario. Good case studies reinforce learning goals, are student-centered, engaging, and have real-world relevance.

Why use case studies in IPHY?

Integrative Physiology (IPHY) majors are required to take a foundational, 3-course introductory sequence (Human Anatomy, Physiology 1, Physiology 2) before they can take specialized upper division courses (e.g., immunology or endocrinology). One challenge is that students often see these as isolated course experiences, and can fail to recognize how concepts fit together within the courses, and across the courses. Students can also have difficulty appreciating the real-world relevance of the course material. To address these challenges, we proposed to incorporate a single case study following a celiac disease patient into the 3-course sequence with the goal of illustrating the integrative nature of concepts within each course throughout the semester, and across the 3-course sequence. Throughout these three courses, faculty discussed different anatomical and physiological concepts that all related to the same case study.

Coordinating the integration of case studies across the three courses

IPHY recently created three Curriculum Coordinator positions to support the educational goals of the department. These positions are currently filled by three senior instructors (Ruth Heisler, Teresa Foley and Janet Casagrand) who have extensive experience in science education. To support this effort, we applied for and received a one-year TRESTLE (*Transforming Education, Supporting Teaching and Learning Excellence*) award that would allow us to develop case studies and work with the faculty teaching these courses to help integrate and troubleshoot these new learning activities. TRESTLE is a seven-institution, National Science Foundation (NSF)-funded project to support improvements in undergraduate STEM education through (1) supporting course design projects, (2) enhancing educational expertise in departments, and (3) building communities within and across campuses to enhance the impact of local experts.

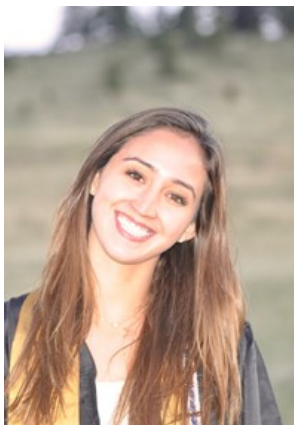


With this funding, we spent the summer creating a case study with integrated in-class activities that emphasizes key concepts in the courses, and met with faculty teaching these courses to get their input and to help them implement these activities successfully into their courses.

So far, feedback from students has been very positive, and we have observed gains in student learning of key concepts targeted by the case studies. We will continue to look for ways to expand the use of case studies in these courses and to further improve students' critical thinking skills for their future careers.



A Journey to Medical School By Daniella Escobar (IPHY Major, Class of '17)



Like many other integrative physiology students, I knew that I desired to pursue a medical career at a young age. I first verbalized this ambition at the age of eleven, after my stepmother had undergone chemotherapy treatment. My childhood thereafter embodied the cliché of a pre-medical student: my Valentine's Day cards were modeled around anatomically-correct hearts, the CNN health tab was my computer's home page, and I read Dr. Paul Farmer's books "for fun".

As an undergraduate student in the Integrative Physiology department, I learned that I have a passion and ability for health-related coursework. Immersing myself in health-related courses such as Immunology, Endocrinology, and Pathophysiology confirmed my long held goal to become a physician. This ambition also drove me to assist in research within the Integrative Physiology department devoted to studying $\alpha 4\beta 2$ nicotinic acetylcholinergic receptors.

My desire to pursue medicine naturally led me to applying for the Medical Scholars Program. Although it is unfortunately no longer available, the program served as a pipeline for the University of Colorado School of Medicine.



If I have any advice from my personal experience in preparing to apply to medical school, it would be to learn how to utilize the resources provided by the University of Colorado and the Integrative Physiology Department. Most of the IPHY professors generously allow undergraduate students to assist in research or even conduct their own experiments. The University also provides students an email list-serve with a plethora of clinical and volunteer opportunities. Finally, various clubs on campus provide free tutoring for challenging classes, interesting speakers, and various other events geared toward students inclined toward pursuing health-related careers. Participating in these activities fruitfully supplemented my undergraduate education and further confirmed my desire to pursue medical degree.

If anything, my journey to medical school has been an expedited one. I am very lucky to have found a career path so early in life about which I am passionate, and have had the resources and support to pursue. I am extremely thankful to my family, the Medical Scholars Program Directors, and the Integrative Physiology Department for their continued support. My commitment to medicine is one of the things in my life that I feel absolutely certain about, and I look forward to exploring it further at the University of Colorado School of Medicine.

From Mexico to the U.S. Military Service to Medical School

By Uriel Villalobos (IPHY Major, Class of '17)

I grew up in a small rural town in Mexico where the nearest medical facility was an hour away. Getting very sick or needing immediate care was less than ideal for anyone, and I wanted to change that situation. Since a young age I had the dream of becoming a doctor and constructing a small clinic in my town. At the age of fifteen I moved to the city with one of my uncles to attend high school. After working hard in high school and achieving a good GPA, I was in route to start college, when something unexpected happened. My parents moved to the United States.

There I was, a seventeen-year old knowing no English, in a place called Colorado. The cold weather and snow were things I had never experienced before, coming from a seaside town in Mexico—I was totally lost! I only had the chance to attend one year of high school while working at a fast food restaurant. I put all of my effort into learning English as fast as I could and even took some AP science classes to accelerate my learning. At times, my strong accent made me feel ashamed to talk to my teachers or other students. After getting my high school diploma, I realized that paying for college from a part-time restaurant job was not very realistic. I abandoned my dream of going to medical school, at least temporarily.

Eager for medical knowledge and a desire to interact with patients during my Navy career, I specialized as a surgical technician. The idea of working directly with surgeons in the operating room captivated me. In my mind, I played an important role in patient care, since I was going to assist doctors as they saved lives.

Balboa Naval Hospital in San Diego was the first place that I labored as a surgical technician. For two years I rotated through different surgical specialties such as ophthalmology, orthopedics, otorhinolaryngology, general surgery, and OBGYN. Two days of the week I worked with pre-operative patients in the clinic, and four days I worked in surgery. In the clinic, I was in charge of starting IVs, taking vital signs, eye pressure, and in some cases, administering some pre-operative medications as indicated by the surgeons. My interactions with patients made my days feel short, as every encounter was an opportunity for me to learn something new about medicine. In addition, following their progress after surgery was amazing, since every time they came for their post-operative appointments they were in better shape than before.





The Navy also gave me the opportunity to live and work as a surgical technician in Sicily, Italy for two years. As a seasoned surgical assistant, I was in charge of advising other junior sailors in their job and their military career. Overall, the Navy brought discipline, purpose, and determination to my life. Working in hospitals around the world made me sensitive to other cultures and backgrounds and redirected me to the path I lost track of before: medicine.

June of 2013 was the end of my Navy contract. As happy as I was in the operating room as a surgical assistant, it was time to challenge myself by going back to school. I did not want to stay as a surgical tech; I was determined to become the surgeon. The transition from the military to civilian was not easy. After being out of school for some time, my study habits were not the same as before. Yet, it was just a matter of habituation, since I had the most important tool: motivation.

As an IPHY student at the University of Colorado Boulder, my enthusiasm towards medicine grew even more through classes such as human anatomy lab and human physiology. Moreover, as a cadaver specialist, dissecting under the guidance of Dr. Leif Saul, I developed an appreciation for the human body more than I had as a surgical tech. I was able to use my own hands and skills to dissect and expose structures for the benefit of other students.

After graduating this May, I will start medical school in August at the University of Colorado School of Medicine and retake the path that I abandoned years ago. Though challenging times are ahead of me, I will make the best of them and make sure I enjoy life as a student of medicine. One day I will return to my hometown in Mexico during the summer and provide my medical services, which is the least I can do for the place that inspired me to pursue medicine first.

Kudos

Dr. **Janet Casagrand** and **Ruth Heisler** each received a CU Boulder Arts and Sciences Fund for Excellence award to present a workshop on *Developing and incorporating interrupted case studies into Anatomy and Physiology courses* at the annual Human Anatomy and Physiology conference.

Drs. **Janet Casagrand** and Kate Semsar recently published a paper in *Advances in Physiology Education* describing the development and evaluation of a new Bloom's taxonomy training tool which helps address the challenge of mastering Bloom's taxonomy (a widely-used educational tool for differentiating levels of learning and understanding), and facilitates its use in conducting scholarly assessment of course reforms.

Drs. **Janet Casagrand** and Kate Semsar recently published a paper in *Advances in Physiology Education* describing the effectiveness of incorporating student-centered, evidence-based learning activities into the upper-division IPHY neurophysiology course to help students improve higher-order thinking skills, and the utility of using Bloom's taxonomy level as a metric to assess course reform.

Dr. **Marissa Ehringer** will be installed in May as the elected President of the International Behavioural and Neural Genetics Society (IBANGS) at the annual meeting in Madrid, Spain.

Dr. **Alena Grabowski** has recently published two papers in the *Journal of Applied Physiology* describing how different running-specific leg prostheses affect performance in athletes with bilateral amputations and unilateral amputations.



Dr. **Charles Hoeffler** has recently published a paper in *Experimental Neurology* reviewing the impact of maternal interleukin-17 in the expression of autism.

Dr. **Charles Hoeffler** has recently interviewed with *Outdoor Magazine* to discuss the impact of stress on the brain during aging for the publication on the Masters Athlete website.

Dr. **Monique LeBourgeois** received a 5-year grant from the National Institute of Child Health and Human Development to study the sensitivity of the circadian clock to light in preschool-age children.

Dr. **Chris Link** was a co-author on a paper published in *Science* ("Spt4 selectively regulates the expression of C9orf72 sense and antisense mutant transcripts") that investigated an approach to counteract the most common mutation that causes familial ALS.

Dr. **Chris Lowry** recently delivered the Mary Murphy Endowed Lecture in Biology at the Department of Biology, Clarke University, Dubuque, IA, to discuss the links between the microbiome and mental health.

Dr. **Chris Lowry** has recently interviewed for an article in *The Atlantic* exploring links between springtime allergies and suicide (<https://www.theatlantic.com/health/archive/2017/04/the-troubling-link-between-allergies-and-suicide/523608/>).

Dr. **Matt McQueen** presented results on sleep, biomarkers, stress and cognition of CU Boulder student-athletes at the Pac-12 Student-Athlete Health Conference.

Jessica Santos-Parker and co-investigators in Dr. **Doug Seals'** laboratory recently published a paper in the journal *Aging* showing that 12 weeks of supplementing the diet with curcumin, the active ingredient in the curry spice, turmeric, improved vascular function in healthy men and women 45 years of age and older.

Dr. **David Sherwood** published a paper in the *Journal of Motor Learning and Development* on how the mental focus of attention affects throwing accuracy.

Dr. **David Sherwood** recorded a podcast on how the mental focus of attention can be used to improve motor performance.

Dr. **Jia Shi** has recently published a paper in *JMBE* describing ways to change student understanding of molecular movements (*JMBE* V.18, Issue 1, April 2017).

Dr. **Jerry Stitzel** was a co-author on a study published in *Nature Medicine* that used a model developed in his lab to study how nicotine reverse the effect of a genetic variant on brain function and behavior related to schizophrenia.

Dr. **Pei-San Tsai** recently organized a symposium on hormone evolution and presented an invited symposium talk at the 18th International Congress of Comparative Endocrinology in Banff, Canada.

Dr. **Ken Wright** has received three grants from the NIH, one to identify biomarkers of insufficient sleep and sleepiness, one in collaboration with Dr. Desouza as co-principal investigators to determine if sleep interventions can improve cardiovascular health, and one in collaboration with Dr. LeBourgeois as a co-investigator to test the sensitivity of circadian clock to morning and evening light exposure in preschoolers.

Dr. **Ken Wright** has recently published a paper in *Current Biology* describing the influence of natural light exposure on the human circadian clock across seasons and a weekend camping trip.



A cartoon representation of Dr. Chris Link's research

by Leif Saul

WHAT CAUSES ALZHEIMER'S DISEASE?

ALZHEIMER'S DISEASE - IN WHICH NEURONS SHRINK AND DIE - IS A GROWING PUBLIC HEALTH PROBLEM.

I'M SHRINKING, SHRINKING!

I'M GROWING, GROWING!

MILLIONS OF CASES (USA)

2017 2040

(PREDICTED)

THE TWO KEY FEATURES ARE PLAQUES OF BETA-AMYLOID (A-BETA) PROTEIN OUTSIDE THE CELLS...

AND INSIDE THE CELLS, TANGLES OF THE CELL'S DISORDERED SKELETON...

IN WHICH TAU PROTEIN PLAYS A KEY ROLE.

MOST LIKELY, AGGREGATION OF A-BETA IS THE PRIMARY CAUSE, BUT TAU IS WHAT MORE DIRECTLY HARMS THE CELL.

THE STEPS IN BETWEEN ARE A POORLY UNDERSTOOD "BLACK BOX"

CHRISTOPHER LINK* IS FOCUSED ON THE FIRST PART OF THAT "BLACK BOX" --

WHAT IS THE IMMEDIATE EFFECT OF A-BETA?

WE THINK THAT A-BETA MAY ASSEMBLE INTO PORES WHICH DAMAGE THE CELL'S MEMBRANE.

A-BETA SUBUNITS

PORE ASSEMBLY

DR. LINK

HOW DO WE KNOW THIS?

IT'S JUST 'A-BETA' THEORY THAN ALL THE OTHERS

PATHOLOGICAL TAU

NEURAL BREAK-DOWN

***MOLECULAR NEURODEGENERATION LABORATORY, DEPT. OF INTEGRATIVE PHYSIOLOGY AND INSTITUTE FOR BEHAVIORAL GENETICS, UNIVERSITY OF COLORADO BOULDER**

SUPPORTING THIS IDEA, A-BETA HAS A STRUCTURE CALLED THE GLYCINE ZIPPER

HELP ME WITH MY ZIPPER - ?

OF COURSE!

-- WHICH IS A COMMON FEATURE ALLOWING TOXIC PROTEINS TO LINK UP AND FORM PORES.

SUCH 'PORE' WORKMANSHIP!

AND WHEN WE "BROKE" THE GLYCINE ZIPPER, THE NEURON NO LONGER PRODUCED PATHOLOGICAL TAU

...SUGGESTING THIS IS A REQUIRED STEP IN THE "BLACK BOX"

RAT NEURON

TO FOLLOW THE EFFECTS OF A-BETA, WE FED IT TO LABORATORY WORMS WHERE THE STEPS ARE EASIER TO OBSERVE.

OOH LOOKY, LOCALLY SOURCED FARM-RAISED A-BETA!

NOW, DEAR, REMEMBER THE LAST TIME YOU ORDERED THAT

THE CELLS ATTEMPTED TO REPAIR THEMSELVES BY INTERNALIZING THE A-BETA -- ADDING SUPPORT TO THE MEMBRANE DAMAGE HYPOTHESIS

PORE

MEMBRANE REPAIRED

WHY DON'T I EVER LISTEN TO HER!

...AND SUGGESTING ANOTHER STEP IN THE PROGRESSION OF ALZHEIMER'S DISEASE.

SO IT LOOKS LIKE THE GLYCINE ZIPPER MAY ALLOW US TO UNZIP THE BLACK BOX LINKING A-BETA TO TAU MISBEHAVIOR.

-- JUST ONE MORE STEP IN THE RACE TO SOLVE THIS COMPLICATED DISEASE!

HURRY UP ALREADY!

TIC TOC

leif saul



May and August 2017 Bachelor of Arts Graduates

Gauri Adettiwar	Tyler Dresser	Helen Hosse	Kelly Mohr	Amanda Salvatore
Kristin Allen	Madison Duvall	Darby Houck	Melissa Molaro	Maryana Sawaged
Chase Andersen	Kaylee Dykstal	Elsa Huber	Kai Mongan	Jacob Scheinman
Debra Anderson	Matthew Edwards	Andrew Hudson	Jakob Morawiec	Madison Schelble
Erin Anderson	Hannah Ehrlich	Mackenzie Hunt	Alecia Morgan	Garrett Schultheis
Charles Appleton	Ahmed Elsayed	Brooke Intermill	Michael Morikawa	Joseph Schultz
Chelsea Arent	Timothy Elsberry	Meaghan James	Kalee Morris	Laura Schulze
Diego Archuleta	Kira Enloe	Estefania Jaramillo	Madeline Mulvahill	Zachary Secunda
Chelsea Arent	Daniela Escobar	Laurin Jennings	Nicole Myers	Ryan Segervall
Zachary Arnold	Jason Evans	Nicolas Johnson	Jaclyn Nakamura	Charles Seglem
Morgan Avis	Katrina Fair	Magdaline Johnson	Hwanhee Nam	Thomas Shomaker
Akene Aku	Ryan Fay	Christopher Kaczmar	Robert Nelson	Lauren Shurnas
Eric Azua	Andrew Feemster	Madison Karakash	Anthony Nesius	Ryan Skidmore
Christina Baek	Alyssa Ferguson	Jeremy Kemp	Lucy Newman	Mariah Slack
Chris Barron-Graham	Audrey Filson	Katherine Key	Lan Nguyen	Attison Smith
Meghna Basnet	Whitney Fitzgibbons	Abigail Kilgore	My-Phuong Nguyen	Dylan Smith
Ashley Bassett	Danielle Flashner	Eun Kim	Hayden Noel	Chaison Snyder
Leah Bauder	Sarah Flood	MacKenzie King	Nicole O'Connor	Asni Solomon
Kendra Baughn	Victoria Flores	Jack Kirschner	Yoo Oh	Alexander Spoor
Garrett Baylis	Kelly Foster	Sigrid Kite	John Olson	Emma Spratt
Nora Benner	Robert Foster	Joseph Klotz	Kaylee Ortega	Rachel Stahl
Sophia Benosman	Delaney Ganz	Laurel Kornblau	Amanda Ortiz	Jenee Steffens
Kiera Benson	Nathaniel Garrison	Michelle Koszalka	Caroline O'Shea	Kaitlyn Steffy
Eleanor Beverly	Kirsten Gateley	Rebecca Kubiak	Blake Ozier	Baleigh Sterling
Elizabeth Binggeli	Nicholas Gault	Taylor Kuehn	Brooke Palay	Morgan Stone
Eryn Blakely	Brandon Gessert	Michael Kussin	Edward Pantzar, III	Carolyn Stroud
Austin Blanchard	Kiet Giang	Justin Lamb	Katie Parker	Bisrat Tadesse
Brian Blanchard	Rachel Goldstein	Magnolia Landa-Posas	Monica Patten	Jessica Takasugi
Oscar Blanco	Jordan Green	Ethan Larson	Michael Persinger	Rashi Taneja
Claire Blanken	Leah Greenfield	Bryn Lasley	Taylor Peter-Bibb	Zoe Tartz
Meghan Blough	Jordyn Grewal	Nathan Lay	Logan Pfister	Scott Theulen
Lacy Bogart	Bonnie Griesan	Jenny Lee	Melanie Phares	Zofia Tillman
Simone Botts	Tara Grieshaber	Andrius Lelis	Sophia Phillips	Sarah Toil
Alexandra Brown	Greg Guthrie	Joshua Levine	Sophia Phillips	Claire Touslee
Connor Brown	Robin Hacker-Cary	Andrew Lombardi	Justin Phu	Thuy Trang Trang
Kirby Brown	Ariela Halzel	Connor Long	Julia Pierce	Thomas Trinh
Jessica Burger	Shane Hanna	Anne Lubert	Kevin Pierce	Valentine Truong
Cameron Carter	Cameron Hardison	Luna Ly	Sofia Pinamonti	Jacqueline Turner
Lorena Castro	Taylor Harp	Hailey Lynch	Erica Pollack	Zachary Twardowski
Connor Cathey	Kailey Hassan-wolff	Thomas Maentz	Kyra Porter	Julia Vaiser
Alyssa Cavalier	Uma Hatangadi	Madeline Margulies	Samantha Posner	Nicholas VanDongen
Emily Chambers	Katherine Hawkins	Taylor Marshall	Matthew Poulsen	Kendall VanHee
Henry Charoen	Daniel Hayoun	Elizabeth Martin	Jasmine Prosch	Michelle Vigil
Kelsey Coker	Rosemary Helvey-Byers	Wesley Martin	Tate Pumphrey	Uriel Villalobos
Julie Compton	Heather Hentze	Kelsey Massoglia	Alexa Ramos	Emily Walderman
Kelsey Connolly	Bijan Heydari	Alyson Mat	Jazzmyn Randleman	Nathan Warrick
Kristin Cover	Jackson Hill	Kevin McGunigal	Nicholas Ranelli	Olivia Wells
Shawn Crespi	Sasha Hill	Meredith McKanna	Katelyn Rankins	Mackenzie Whitcomb
Jonathan Cunningham	Katarina Hine	Keely McKelligott	Shaylena Redin	Kaylyn White
Jacob Curtis	Mackenzie Hirsch	Adelle McKenerick	Lindsey Reinmuth	David Wilkins
Safiya Dawlatzai	Tala Hishmeh	Paul McSparin	Sophie Reskin	Jesse Williams
Aubrey Dedin	Dakota Hitchcock	Hannah Meharg	Kimberly Rivera	Caroline Wilson
Arrianna Diaz	Cassandra Ho	Christina Mickle	Marissa Robles	Sean Woods
Valerie Diaz	Kristin Hoagland	Claire Miles	Gerardo Rodriguez	Eric Yamaguchi
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