Integrative Physiology
University of Colorado Boulder

Department Newsletter

IPHY

Issue #11 May 2014

Special points of interest:

- One of the strengths of IPHY's curriculum is its flexibility
- Complete altitude adaptation may take up to one year
- Insufficient sleep leads to weight gain, reduced insulin sensitivity, and impaired cognitive and motor performance
- Teaching strategies continue to evolve in IPHY

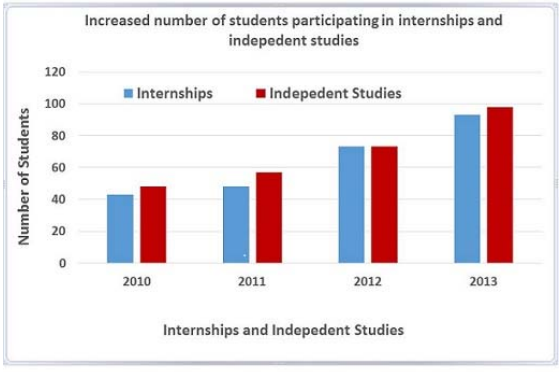
Inside this issue:

A Few Words from the Chair — Roger Enoka

CU-Boulder recently completed a Program Prioritization Initiative to provide a comprehensive review of the academic and administrative programs on our campus. The purpose of the Initiative was to obtain quantitative data to inform our decisions and help us better serve our students and the state of Colorado. The evaluating committee (Academic Affairs Budget Advisory Committee) examined ten program characteristics that were grouped into four clusters: resource efficiency, degree production, scholarly accomplishments, and undergraduate teaching effectiveness. The rating scale for each criterion was highly effective (black), very effective (yellow), effective (grey), moderately effective (white), and less than effective (red). These ratings were combined into an overall score. IPHY was one of six academic units that received an overall rating of highly effective. We were second behind Psychology and Neuroscience, and the other units in our group were Sociology, Education, Economics, and Geography. The complete results can be found at http://www.colorado.edu/prioritization/results. We are deservedly proud of this recognition.

One of the strengths of our curriculum is its flexibility. This is evident, for example, by the options our majors have in selecting core courses. As described by Dr. Jia Shi (one of our academic advisors), the flexibility is also being expressed by students completing the requirements for more than one major and various minors and certificates. The most popular second majors for IPHY students are Psychology and Spanish, with some interest also in Ecology and Evolutionary Biology (EBIO) and Molecular, Cellular, and Developmental Biology (MCDB). Other second majors include Chemistry, Studio Arts, and Philosophy. There is a growing interest among our students in the business minor and the most popular certificates are Neuroscience, Technology, and Arts and Media. We expect the new certificate in Public Health (http://www.colorado.edu/intphys/ugrad/public-health/) to be extremely popular once it begins in Fall 2014.

In addition to adding other majors, minors, and certificates to an IPHY major, our students are participating more often in internships and independent study to personalize their program of study (see figure below). The driving force behind this trend is the demand for real-life experiences by various career options, especially health-care professions. IPHY students tell us that these experiences often help distinguish them from other applicants and provide them with a distinct advantage. As our curriculum continues to evolve, we will continue to explore opportunities that provide unique experiences for our majors.



Applied Exercise Science Laboratory by Bill Byrnes

The Applied Exercise Science Laboratory (http://www.colorado.edu/intphys/research/exercise.html) examines the short- and long-term adjustments that the body makes to physical activity with the goal of determining how these adjustments influence an individual's health and/or athletic performance. The lab has its origins to a previous time when the Department of Integrative Physiology (IPHY) was known as the Department of Kinesiology. At that time, the 'Human Performance Laboratory' was a resource for multiple investigators with an expertise in exercise physiology. Over the years, this group included Art Dickinson, Emily Haymes, Art Weltman, Gary Klug, Bob Mazzeo, and myself. As the department transformed into its current structure, I inherited the lab and now direct its research activities.

The lab's focus on adaptations to physical activity has resulted in research protocols ranging from quantifying the energetics of load carrying by commercial porters in Nepal to determining the role of passive cycling as a tool to combat the adverse health consequences of 'too much sitting'. Because the lab is located at a moderate altitude, we have also maintained an emphasis on the influence of altitude on athletic/physical performance. Our work has demonstrated that acute exposure to a moderate altitude, such as Boulder, adversely affects endurance performance and complete adaptation may require up to one year of altitude residence.

The current personnel in the Applied Exercise Science Laboratory include four doctoral students, two master's students, and five IPHY undergraduate students actively pursuing questions related to the role of physical activity in improving health and performance. These individuals have been recognized for their research efforts at the university level (Beverly Sears Graduate Student Grant: Molly Welsh, Ben Ryan, James Peterman, & Lewis Kane; Undergraduate Research Opportunity Program: Eric Contini, Kailey Osbaugh, Lewis Kane, Matt Batliner, Joanna Shea, and Jessie Goodrich), the regional level (Rocky Mountain American College of Sports Medicine Graduate Student Award/Grant: Molly Madden, Ben Ryan, & James Peterman), and the national level (American College of Sports Medicine Research Award: Ben Ryan). They follow in a long tradition and I feel fortunate to be directing the activities of this lab and grateful to all of its alumni who have been contributed to our accomplishments.

Sleep and Chronobiology Laboratory by Christopher Depner

The overall goal of the Sleep and Chronobiology Laboratory, which is directed by Dr. Kenneth Wright, is to investigate health and safety consequences resulting from disruption of sleep and circadian rhythms. These disruptions are typically caused by too little sleep or being awake at the wrong biological time (i.e., being awake during the biological night). Both environmental (e.g., shift-work, night-time light exposure) and pathological (e.g., obstructive sleep apnea) factors can contribute to sleep disruptions. Sleep is a fundamental biological process and disruptions in either sleep or circadian rhythms can increase the risk of and contribute to such health problems as obesity, diabetes, cardiovascular disease, cancer, cognitive impairments, accidents, poor school and work productivity, mood disorders, and addiction. This wide array of physiological consequences derived from disrupted sleep facilitates diverse research projects within the laboratory ranging from neuroendocrine, metabolic, and immune function, to behavioral assessments including sleepiness, memory, learning, mood, and cognitive and motor performance all with application to public health and safety.

The two major ongoing projects in the laboratory are the Weekend Recovery and Eating at Night studies. Previous findings from the laboratory indicated that 5 days of insufficient sleep resulted in positive energy balance, weight gain, reduced insulin sensitivity, and impaired cognitive and motor performance. Weekend Recovery is designed to assess the ability of weekend recovery sleep to mitigate these known metabolic and cognitive consequences associated with a 5-day work week of insufficient sleep. Some of the key tools being utilized for the Weekend Recovery study are whole room calorimetry (energy balance, macronutrient utilization), hyperinsulinemic euglycemic clamps (hepatic, skeletal muscle, and adipose insulin sensitivity), and driving simulators. About half of the subjects have completed the study thus far. The Eating at Night study is designed to model shift-work schedules and assess the metabolic consequences of wakefulness combined with eating during the biological night, a common habit in shift-workers. To determine the influence of eating at night on the way our body metabolizes food and how this impacts energy balance and weight gain, minute by minute carbohydrate, fat, and protein utilization are being analyzed by whole room calorimetry and appetitive hormones are being quantified by hourly blood assessments. Data collection is finished and published results are expected soon.

New research projects underway include Morning Eating and a series of camping studies. Morning Eating is designed to investigate the metabolic consequences of early morning eating by shift-workers when their body clock is still in the biological night. Analyses will focus on insulin sensitivity, appetitive hormones, substrate utilization, and weight gain. The series of camping studies are designed to assess the impacts of artificial lighting on the timing of our internal body clock. Thus, backcountry camping is being used as a tool to completely prevent artificial light exposure and light pollution from the city. This means no use of cell phones, computers, headlamps, or any type of artificial light exposure during the trip. The subject's timing of their internal body clocks are measured in the lab before and after the camping trips using salivary melatonin radioimmunoassays. The most recent week-long camping trip took place near the winter solstice in December when natural sunlight exposure was at its minimum. This made for a chilly camping trip and early bedtimes with the sun setting at 4pm. The findings of this winter camping trip will be compared to a summer camping trip that took place during the summer solstice. The findings will be published soon. In line with its diverse research projects, the laboratory has a staff with diverse expertise including undergraduate volunteers, graduate students, post-docs, and professional research assistants. If you are interested in sleep and circadian research do not hesitate to contact the Sleep and Chronobiology Laboratory to pursue research opportunities or collaborate on research projects.

An Alternative Career Path by Tom LaRocca

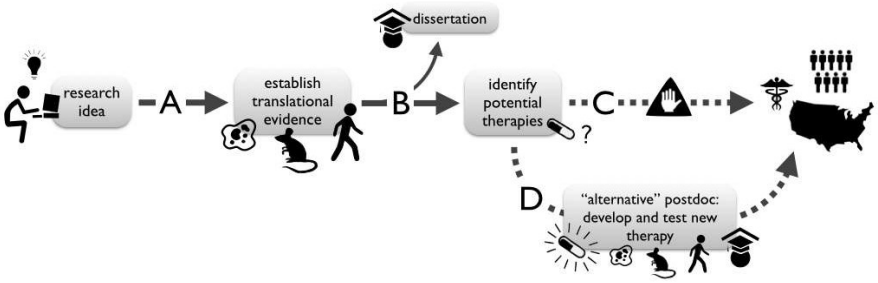
"The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them."
~William Lawrence Bragg

A string of simple questions changed the way I think about science. In 2005 I left a career as a high school chemistry teacher to study physiology because I wanted to learn more about the science of human health and apply it to important problems. In the Integrative Physiology of Aging Laboratory here in IPHY, I received hands-on experience in clinical research on aging (studies comparing young and older human volunteers). I learned that aging causes reduced physiological function and predisposes us to disease, and I helped conduct research aimed at improving function in arteries of older adults. I was fascinated by the underlying biochemistry. One early question I posed was: How do aging cells recycle old, damaged molecules? Many literature searches later, I understood that cells degrade damaged biomolecules through a process known as autophagy—or cellular "self-eating". This fascinated me, and no one knew much about how autophagy influenced aging and physiological function. Thus, I had a dissertation question: Does altered autophagy underlie changes in physiological function with aging?

To examine links between autophagy, physiological function, and aging, I turned to "pre-clinical" models (cell culture and mice). I found that autophagy becomes impaired with aging and causes reduced function in cultured arterial cells and arteries of old mice. We wanted to "translate" (apply) these findings to humans, so I revisited samples from our previous clinical studies, and found that impaired autophagy is also associated with reduced arterial function in older human volunteers. Thus, we had exciting "translational evidence" for autophagy's role in arterial aging. However, this led to another question: If impaired autophagy reduces function, can we improve function by enhancing autophagy? Briefly, the answer appears to be yes. Certain natural compounds are reported to boost autophagy, and we were able to show that some of these can improve function in cells and arteries of old mice. This series of studies was sufficient for my dissertation, but there was still a fairly major loose end: Could we translate this new knowledge to benefit human/public health?

As is the case with many pre-clinical discoveries, we encountered several obstacles to applying our findings on natural autophagy boosters directly to humans (dosing, safety and regulatory issues). At the time, I was in the process of deciding what to do for postdoctoral research training—the 3-5 year period of additional scientific training after completing a PhD. After some serious reflection, I realized I had a unique opportunity to do something different by tackling those obstacles and perhaps tying up that loose end. So instead of performing a traditional postdoctoral fellowship, I went back to the drawing board to develop a new autophagy-boosting treatment that might be easily translated to humans. To increase our chances of success, we have been designing a blend of natural compounds that middle-aged and older adults could take safely, and have been testing prototypes in cells and mice using a larger panel of physiological assessments (motor, cognitive, and liver function in addition to arterial health). So far, the results are promising; boosting autophagy really does improve multiple physiological functions in old mice.

We are optimistic that our innovative approach will ultimately make it possible to apply my research, perhaps in the form of a novel product or therapy, to benefit public/human health (see figure). Whatever the outcome, participating in this process has been fulfilling, and it has changed the way I think about translational science and my career. Deciding not to follow a traditional career track took some nerve, but I am increasingly confident that it's just one of many alternative routes toward our common goal as physiologists—to discover and promote knowledge of how humans and other animals function, especially for the purpose of improving health.



The figure illustrates an alternative approach to translating science and carving out a career: **(A)** Developing a research question and testing it using translational models (cells, mice and humans) leads to a dissertation **(B)** and new ideas for potential therapies. **(C)** Roadblocks to applying this work provide a basis for new ideas **(D)** and a platform for an alternative postdoctoral training experience aimed at translating the initial research idea to benefit public/human health.

National STEM Education Project by Teresa Foley

Last June the University of Colorado Boulder was chosen by the Association of American Universities (AAU) to participate in a national initiative that will transform undergraduate education in science, technology, engineering, and math (STEM) fields. CU-Boulder was one of eight campuses awarded $500,000 over the next three years by the AAU, and work on the initiative began in the fall.

The three-year project, which is managed through the university's newly formed Center for STEM Learning, focuses on working with faculty who teach undergraduate STEM courses. In particular the education initiative will help faculty objectively determine the success of their teaching practices by adopting and implementing validated, evidence-based assessment tools. These tools have been developed by members of the STEM community and include, but are not limited to, pre- post conceptual assessments, classroom observations, critical thinking assessments, or student surveys. These evaluations will complement the more subjective student course evaluations filled out at the end of a semester.

Along with Physics and Mechanical Engineering, the Department of Integrative Physiology (IPHY) was chosen as an inaugural department of participation. Dr. Teresa Foley was chosen as the department lead for the education initiative based on her experience with discipline-based education research and STEM education efforts on campus. Her primary role in the education initiative will be to support the project and the faculty members involved. Together with project staffer Dr. Joel Corbo, she will work with IPHY faculty on a voluntary basis to find the most appropriate evaluation tools to implement in their classrooms and to interpret newly collected evaluation data at the end of each semester.

The first two IPHY faculty members to participate in the education initiative include Drs. Rodger Kram and Leif Saul. Both faculty currently teach the 3000-level Human Anatomy course for the department, which serves ~300 undergraduates/semester. Dr. Kram was interested in finding a way to include drawing activities as a regular component of the anatomy course, and Dr. Saul wanted to better understand how his students' study techniques and habits correlated with their performance in that class. Discussions have occurred on both fronts, and work will continue over the summer to implement at least one of these ideas for the fall semester.

Another major objective of the education initiative is to influence the value of teaching at CU-Boulder at the administrative level. By collaborating with Provost Russell Moore and the Boulder Faculty Assembly, the education initiative will help faculty define an institutional reward system that values effective teaching practices. This administrative change should encourage CU STEM faculty and departments to use more effective measures of teaching than are currently being employed.

The other seven campuses participating in the AAU STEM education initiative include Brown University, Michigan State University, University of Arizona, University of California at Davis, University of North Carolina at Chapel Hill, University of Pennsylvania, and Washington University in St. Louis.

People Updates

After completing graduate studies in exercise physiology (MS 1989), **Mary L. Ulrich** initially worked with elite athletes during a one-year internship at the Olympic Training Center in Colorado Springs. After that experience, she managed the Sports Medicine Technology Department at Denver Technical College in Colorado Springs. One of her responsibilities in that position was to teach courses in exercise physiology. She moved to St. Louis, MO in 1993 (for love, but left some of her soul in Colorado). She is currently a clinical research specialist and has been involved in research at Washington University School of Medicine for 17 years. Her research experiences include the privilege of working with children with cerebral palsy, adults with trans-tibial amputations, seniors, and numerous patient populations, including adults with heart failure, severe scoliosis, orthopedic surgeries, and metabolic abnormalities related to obesity. Additionally, under the supervision of John O. Holloszy, M.D., she managed a multi-site randomized clinical trial that examined healthy aging and the impact of caloric restriction. She is currently working on a community research grant addressing nutrition and fitness needs of 4th and 5th graders in a large urban school district. Mary and her husband Mike have three children: Britni (24), Mitch (23), and Kyle (18). They also have a granddaughter, Evelyn (2) and a Border Collie named Shadow. Mary stays fit biking to work and taking their dog for a run while she bikes. She also enjoys watching their children succeed at sports (mainly baseball), and she is now an avid Cardinals fan. [Submitted by Bob Mazzeo]

Maricarmen Stout graduated from CU-Boulder in 2011 with a BA in integrative physiology and certificate in neuroscience. During her time at CU she assisted in Dr. Marissa Ehringer's lab at the Institute for Behavioral Genetics. After graduation she moved to El Paso, Texas to begin medical school at the Paul L. Foster School of Medicine where she has been involved with research investigating the protective effects of pregnancy in breast cancer development at the Center of Excellence in Cancer Research at Texas Tech University Health Sciences Center. She is currently in her 3rd year of medical school, and hopes to return to Colorado for a pediatric residency at the University of Colorado School of Medicine. In her free time she enjoys traveling and playing volleyball. Maricarmen is currently engaged to Landon Shields, also an integrative physiology graduate from CU! They are returning to Boulder this summer for their wedding! [Submitted by Marissa Ehringer]

As a senior, **Lisa Jung** (BA 2009, MS 2013) joined Dr. Tsai's Reproductive Neuroendocrinology Lab to study her favorite hormone (gonadotropin-releasing hormone) in mice, sea slugs, and lancelet. As a graduate student, she loved teaching anatomy, physiology, and endocrinology as well as serving as a National Science Foundation research fellow in Taipei, Taiwan. Upon graduation, she knew that she wanted a career in health care, and no matter which field she chose, it was going to be affected by Affordable Care Act. Several hours after realizing this dream, she booked a one-way flight to DC. She did not have any connections, a job, or a place to live, but she knew she would figure things out along the way. After spending the entire first week at the capitol, she decided to work for Congress where she could learn from the best health care experts from around the world. She currently interns for the U.S. Senate and specializes in health care policy. She hopes one day to play an indispensable role in shaping the future of U.S. health care system. [Submitted by Pei-San Tsai]

Justus Ortega completed an MS (2001) degree in kinesiology under the mentorship of Dr. Roger Enoka in the Neurophysiology of Movement Lab and a PhD (2006) in integrative physiology under the mentorship of Dr. Claire Farley and Dr. Rodger Kram in the Locomotion Lab. Upon graduating, Justus moved back to Northern California with his wife and two children where he took a lecturer position at his alma mater, Humboldt State University. During this time, Justus received an NIH post-doctoral training grant to work in the Department of Radiology at the University of Washington (Seattle, WA) where he spent his summers studying the effects of aging on muscle efficiency. In 2007, Justus received the American Society of Biomechanics "Journal of Biomechanics Award" for his work at CU-Boulder investigating the metabolic cost of stabilization among older adults. In 2008, Justus took a tenure-track biomechanics position in the Department of Kinesiology at Humboldt State and received the Promising Young Faculty Scholar Award. Justus is the director of the Biomechanics Lab at Humboldt State University where he continues to perform research on aging and locomotion. Justus is also the director of the North Coast Concussion Program where he provides clinical neurocognitive testing for concussion management and explores the effects of concussion on cognitive function, balance, and mobility. He returned to the Locomotion Lab last summer for a sabbatical where he worked collaboratively with Dr. Rodger Kram and Dr. Alena Grabowski, along with a team of IPHY and Humboldt State students, to investigate the effect of aging and regular exercise on the energetics and mechanics of walking and running. Most recently, Justus was awarded the 2013 Distinguished Excellence in Teaching Award at Humboldt State. In his free time, he enjoys trail running through giant redwood trees, sea kayaking with his wife, and fishing for salmon, Dungeness crab, and abalone along the Humboldt County coast with his son and daughter. According to Justus, "I'm livin' the dream. Thanks CU". [Submitted by Roger Enoka]

Hamza Pasha (BA 2011) majored in IPHY with a minor in biochemistry and worked in Dr. Seals' lab for four years (2008-2012) while at CU-Boulder. He worked on various projects in the laboratory learning about different aspects of research from clinical translations research to mechanistic studies. He found it to be an excellent learning experience and sparked an interest in continued involvement in research. He joined the research track as part of an elective curriculum at the University of Colorado School of Medicine where he is a third year student. He worked with Dr. Robert Eckel on a neuroendocrinology project looking into molecular mechanisms of obesity in 2013. He is grateful for the training he is receiving as a physician scientist in which he can combine the research that happens at the bench to improve the quality of care of patients at the bedside. Outside school, he has been involved with the Emergency Medicine interest group and enjoys snowboarding and everything else that Colorado has to offer. [Submitted by Doug Seals]

While completing her degree in integrative physiology, **Chelsea Brotherton** (BA 2012) had the opportunity to work for Dr. Suzanne Nelson as an undergraduate teaching assistant for Nutrition for Health and Performance. She also conducted an independent study, which was supervised by Dr. Nelson, on the links between nutrition and autism spectrum disorders. Her research inspired her to pursue work with children on the neurological disorders spectrum after graduation, and in 2013 she started working as a sensory-motor coach at Brain Balance—a supplemental learning center for children with various neurological, developmental, and behavioral disorders. She recently took on the role of assistant director at the center and loves being able to work with these children in the unique and innovative way that they do. Continuing to be inspired by this area of science, Chelsea hopes to begin a graduate degree program in occupational therapy or early childhood development in the near future. She also devotes time at Craig Rehabilitation Hospital volunteering in the research department on a study testing the efficacy of using virtual reality systems as therapy tool for people with traumatic brain injuries who suffer chronic balance deficits. In her free time, Chelsea enjoys long distance running, working in her vegetable gardens, and cooking creative new meals with the crops she harvests! [Submitted by Roger Enoka]

Sarah (Hanson) Giovagnoli (BS 1987, MS 1990) was the first undergraduate student to graduate with Honors in our department, and she went on to complete a MS degree in kinesiology in 1990 under the guidance of Dr. William Byrnes. Her work in the Human Performance Lab helped prepare her to be the first exercise physiologist hired at the new Heart Center of Sarasota. After moving back to Colorado, Sarah was hired in the Cardiac Rehab Department at Vail Valley Medical where she continued to work until three years ago when she was hired as the coordinator of the Fit for Survival program at the Shaw Regional Cancer Center. Currently, Sarah works with cancer patients in the hospital's rehab facility to develop individualized exercise programs. Her current position draws on her work at CU with exercise testing and prescription since each patient is offered fitness and body composition testing as they enter the program. Sarah works with a variety of cancer patients, post surgery, during chemotherapy and radiation, and often with survivors who are dealing with the challenges of androgen deprivation therapy. Sarah is also a key staff member with the Shaw Cancer Center's new Spirit of Survival program, designed to offer social support, nutrition seminars and fitness opportunities to all survivors in the Vail Valley. She recently was chosen by the Vail hospital to assist with their new in-house corporate wellness program. This summer Sarah will be extending her love of working with cancer patients and kids, as she volunteers with the pediatric cancer program at Round Up River Ranch. In her free time, Sarah continues to pursue her love of running, biking, and skiing with her family in Eagle, Colorado. [Submitted by Bill Byrnes]

Chris Cunningham (BA 2012) recently completed four months of elk horn coral research aboard the SSV Tabor Boy, a 92 ft. sailing schooner in the Virgin Islands. This was the most difficult job he have ever had, but also the most rewarding. He was able to visit beautiful places such as Bermuda, Culebra, and other small islands. He worked as a deckhand/engineer aboard the schooner, maintaining and sailing the boat around the Virgin Islands while high school students spent 8 days sailing and researching coral in various parts of St. John, USVI (http://ssvtaborboy.org). He found that living on a boat with 23 other people for an extended amount of time can be challenging. In addition, communication with the "real" world was limited. He grew up sailing on the ocean and living in Boulder for five years made him realize how much he loves the ocean! Prior to disembarking at Cape Cod, he had submitted applications to seven MS programs for prosthetics and orthotics. It was challenging dealing with school admissions and interviews from the schooner. However, he was able to work around this and the programs to which he applied were accommodating. So far he has been accepted into two programs and is still waiting to hear from three others. The IPHY program at CU provided him with an education that enabled him to be competitive in these prosthetic and orthotic programs. He is about to start another job in a few days teaching sailing to inner city children until the MS program begins in August. His ultimate goal is to mix his love of sailing and the ocean with a career in prosthetics! [Submitted by Roger Enoka]

Kudos to Faculty, Staff, and Students

Our research-active faculty (assistant professors, associate professors, and professors) spend much of their time conducting research and generating new knowledge. The following list represents selected key research highlights of our faculty during the last academic year:

- In contrast to running, there is little useful storage and recovery of elastic energy in cross-country skiing. [**Rodger Kram]**
- The combination of aging and an American diet (high fat and high sugar) causes severe vascular dysfunction, but this can be prevented by regular aerobic exercise. [**Doug Seals**]
- Identification of novel classes of proteins that are generated in the brain cells in response to drugs used to treat human patients. [**Charles Hoeffer**]
- Electrical lighting and reduced exposure to sunlight during our daily activities leads to later timing of the internal clock and sleep. [**Ken Wright]**
- Heating the body with an infrared lamp has antidepressant effects in patients with depression. [**Chris Lowry**]
- Training programs that focus on performing steady contractions can improve muscle strength and motor function in older adults. [**Roger Enoka**]
- Deficiency in a molecule called Fgf8 permanently increases anxiety level and leads to an abnormal response to stress. **[Pei-San Tsai]**
- Powered ankle-foot prostheses reduce the risks of knee osteoarthritis and falls relative to those for conventional ankle-foot prostheses. [**Alena Grabowski**]
- Alcohol is reduced in adolescent mice when they have access to a running wheel, and there are some differences in the influence of exercise intensity between males and females. [**Marissa Ehringer**]
- Motor skills are compromised when performers are asked about the body positions that were achieved during movement. [**Dave Sherwood**]
- The vascular dysfunction that develops as we age is mediated by oxidative stress caused by the excessive production of reactive oxygen species (free radicals) by dysfunctional mitochondria, the energy synthesizing component in cells. [**Doug Seals**]
- Brain connectivity as reflected in the sleep EEG changes across early childhood and across a night of sleep. [**Monique LeBourgeois**]
- The process of learning a new movement can be accelerated by providing rewarding feedback. [**Alaa Ahmed**]
- A gene important for initial sensitivity to nicotine also effects the development of tolerance to nicotine. However, it is the genetic effect on initial sensitivity rather than the development of tolerance that predicts nicotine consumption. [**Jerry Stitzel**]
- Runners over age 65 still run with the same efficiency as young runners; however, they have a lower maximal aerobic capacity. [**Rodger Kram**]
- Interventions that extend life in mutant C. elegans also prolong the duration of good health. [**Tom Johnson**]
- The contribution of ankle muscles to walking speed is modulated across a range of uphill and downhill slopes. [**Alena Grabowski**]
- Discovery of two rare DNA variants in a gene for nicotinic receptors are associated with risk for drug behavior. [**Marissa Ehringer**]
- Motor function in non-diabetic older adults is associated with insulin-glucose dynamics and the levels of vitamin D metabolites. [**Roger Enoka**]

Other noteworthy accomplishments by faculty and staff include:

- Approval of the Certificate in Public Health http://www.colorado.edu/intphys/ugrad/public- health/\
- Recognition for the efforts of Suzanne Nelson at reducing the use of paper on campus http://www.colorado.edu/content/iphy-department-exams-have-gone-green
- Popular press articles about the research of Chris Lowry on the likely interaction between bacteria and depression http://www.coloradanmagazine.org/2014/04/01/gut-feeling/
- Report by Doug Seals and colleagues on how a novel antioxidant can make arteries on old mice similar to those in young mice http://www.colorado.edu/news/releases/2014/05/05/novel-antioxidant-makes-old-arteries- seem-young-again-cu-boulder-study
- Alaa Ahmed received a prestigious Faculty Early Career Development Award from the National Science Foundation http://www.nsf.gov/awardsearch/showAward?AWD_ID=1352632&HistoricalAwards=false
- Teresa Foley received the Marinus Smith Award from the CU Parents Association, for the second time http://parents.colorado.edu/cupaprograms/marinus-smith/
- IPHY Manager of Operations Jennifer Law was named as a Chancellor's 2013 Employee of the Year http://www.colorado.edu/news/features/chancellor's-2013-employee-year-award- recognizes-staff-excellence#sthash.jwDdkb6h.dpuf
- Heidi Bustamante received a Faculty Recognition Award from the Boulder Faculty Assembly for reviving the IPHY Student Club

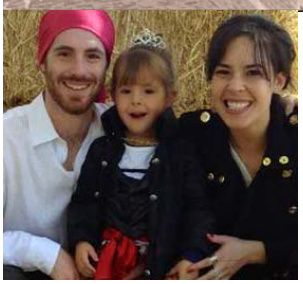
Carrie Mares Sadler joined the department in 2007 as an Administrative Assistant. Her responsibilities include helping students navigate the registration system, coordinating faculty course questionnaires, reminding instructors to comply with grading deadlines, issuing keys, assisting with graduation, and serving as building proctor. She has enjoyed working with everyone in Integrative Physiology, but this summer brings some big changes for Carrie. She has just completed an MS degree (2014) in Global Affairs from the University of Denver, and she will be moving to a new position of Student Services and Curriculum Coordinator with the Department of Computer Science at CU-Boulder.

Graduating Doctoral Students

At our graduation ceremonies on December 20, 2013 and May 9, 2014, six of our graduate students were recognized for completing the requirements for a doctorate in integrative physiology. These graduates, Lida Beninson, Evan Chinoy, Robert Thompson, Andrew McHill, Evan Paul, and Leah Brooks had a range of experiences during their 4-5 years of doctoral training in our department.

Born and raised in Montana, **Robert S. Thompson** (PhD 2013) moved to Boulder in 2000 to pursue an academic career in stress physiology. Robert has earned bachelors degrees in molecular biology and integrative physiology and a MS degree in integrative physiology. In addition, he has recently earned a dual PhD in Physiology and Neuroscience and will continue his career in stress physiology as a post-doctoral researcher under the direction of Dr. Monika Fleshner. Robert's graduate projects involved investigating how chronic stress, control over stressful experiences, and exercise prior to stress can differentially alter physiological responses and thus affect overall health. Robert's research has been published in peer- reviewed scientific journals including Behavioral Sciences, Physiology and Behavior, and Acta Physiologica. The Defense Advanced Research Projects Agency (DARPA) funded much of his research on chronic stress thus allowing many travel opportunities. For example, he visited the Navy Seals BUD/S training facility in San Diego, CA and the National Intrepid Center of Excellence (NICoE) in Washington D.C. for collaborations aimed at examining the role that combat-related stressful experiences can play in contributing to or exacerbating stress-related psychiatric disorders (e.g. PTSD). When not attending to graduate work, he is an active member of the Boulder community volunteering his time or skiing in the mountains.

After nearly 15 years at the University of Colorado Boulder as an undergraduate student, employee, and graduate student, **Evan Paul** (BA, 2005; PhD, 2014) has completed in a doctorate in integrative physiology and neuroscience. His dissertation research was conducted in the Behavioral Neuroendocrinology Laboratory (http://www.colorado.edu/intphys/research/behavneuroendo.html), which is directed by Dr. Christopher Lowry. His research focused on how traumatic early life events alter the functioning of brain serotonin systems. He plans to continue this line of research as a postdoctoral researcher at the Max Planck Institute of Psychiatry in Munich, Germany in the Neurobiology of Stress Laboratory of Dr. Alon Chen. His specific project will investigate the role of small non-coding microRNAs in fine-tuning neural responses to stress. When not in the lab, Evan enjoys traveling and spending time outdoors.



Lida Beninson (PhD 2013) is a scientist and educator with a lifelong passion for improving global health and access to science education. As a graduate student in Dr. Monika Fleshner's lab, Lida participated in cross-disciplinary collaborations to uncover the physiological consequences of stress. Additionally, Lida earned a graduate certificate with the Center for Science and Technology Policy Research, where she researched energy insecurity, research misconduct, and pharmaceutical regulation. Lida's awards include: the American Institute for Biological Science's Emerging Leaders in Public Policy Award, the Dean's Dissertation Completion Fellowship, and a fellowship from the National Science Foundation (NSF). Lida recently became Editor in Chief at the Journal of Science Policy and Governance and is an active member in CU's Forum on Scientific Ethics and Policy. Prior to joining Dr. Fleshner's lab, Lida held positions in education, industry, and government, including: an elementary science instructor for charter schools and collegiate outreach programs, an immunodiagnostic analyst at Monsanto where she generated reports for federal agencies concerning genetically modified crop safety, and an internship with the NSF where she verified the success of various undergraduate research programs at recruiting minority students. Lida received her BS from Princeton University in 2002 and currently lives with her husband Jonathan and daughter Eva in Colorado.

Evan Chinoy (MS 2011, PhD 2013) grew up in Scotch Plains, New Jersey and received a BA in psychology from Rutgers University in New Brunswick, New Jersey. After college, Evan's interest in sleep led him to Colorado to work as a professional research assistant in the Department of Integrative Physiology's Sleep and Chronobiology Lab before starting graduate training in the same laboratory under the mentorship of Dr. Ken Wright. Evan's doctoral dissertation examined brain electroencephalographic (EEG) activity during sleep comparing healthy young and older individuals and investigated how age-related changes in brain physiology could influence the processes of falling asleep, waking up from sleep, and how the most common sleep medication zolpidem (Ambien) modulates EEG brain activity during sleep. His research has implications for understanding how much aging reduces sleep drive and why the sleep of older adults is more disturbed by frequent awakenings during the night, compared with young adults. Also, his doctoral work showed that the same dose of zolpidem has different effects on sleep EEG activity in older versus young adults. Evan received funding to pursue aging and sleep research with an NIH aging training grant through the University of Colorado. Evan has presented his work at national research conferences and has collaborated on several other studies while in the Sleep and Chronobiology Laboratory, including studies on circadian rhythms and cognitive performance with insufficient sleep. When not in the lab, Evan can be found enjoying the outdoors: running, hiking, skiing, and playing ultimate Frisbee, as well as enjoying Colorado's many microbrew beers. In the spring, Evan will begin a post-doctoral research fellowship at the Division of Sleep Medicine at Harvard Medical School in Boston with Dr. Jeanne Duffy where he will continue to do research on the effects of aging on sleep and circadian rhythms.

Andrew McHill (MS 2012, PhD 2014) received a BS in exercise science at Gonzaga University in Spokane, Washington and worked at the Washington State Sleep and Performance Laboratory before moving to Colorado to undertake masters and doctoral research under Dr. Kenneth P. Wright Jr (http://www.colorado.edu/intphys/research/sleep.html). After completing his MS (2012), Andrew married Madeleine in Portland, Oregon on a beautiful Oregon summer day. Andrew's thesis project focused on identifying mechanisms by which working and eating at night, as occurs during nightshift work, leads to poor health outcomes and increased risk of accidents. Identifying these mechanisms is a critical step in developing research based treatment strategies. In addition to his research activities in the Sleep and Chronobiology Laboratory, Andrew had the opportunity to present talks and posters at numerous conferences and has funded additional research projects through the Dean's Graduate Research Grant. In his free time, Andrew enjoys training for marathons with his wife Madeleine and cheering on Gonzaga and Colorado basketball. After graduation, he is headed for a post-doctoral fellowship position at Harvard Medical School with Dr. Charles Czeisler and Dr. Elizabeth Klerman focusing on the role of social networks and their influence on sleep and circadian rhythms.

After completing a BA in biochemistry at CU-Boulder, **Leah Brooks** (MS 2009, PhD 2014) investigated methods of sequencing DNA using silicon nanopore technology in a small biotechnology company before joining Dr. Monika Fleshner's lab as a professional research assistant. In 2007, she transferred to the Reproductive Endocrinology Lab (http://www.colorado.edu/intphys/research/repr oductive.html) directed by Dr. Pei-San Tsai as an IPHY graduate student. She is driven by the question, "what makes people do what they do?" The general focus of her research thus far has been brain development and behavior. She was first interested in how disruption of neurons that control reproduction impact maternal behavior (MS 2009) and then shifted focus to developmental factors critical for the formation of neuronal networks that contribute to anxiety under the co-mentorship of Drs. Tsai and Christopher Lowry (PhD 2014). Leah is excited to teach neuroscience to kids this summer with Science Discovery and hopes to find a job where she can continue to learn as well as share her enthusiasm for research and the brain.

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Integrative Physiology
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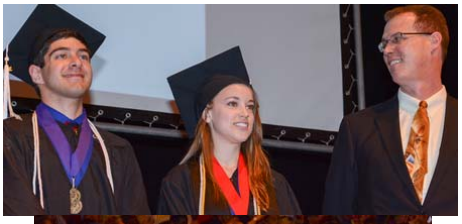

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