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Lost Tides
What historical records can tell us about the future of the Columbia River Estuary

Lemelson Foundation Award
Lemelson Awards PSU Foundation $706K to support Oregon MESA invention education activities statewide.

Modernizing Stats Education
Dr. Jennifer Noll studies new methods of teaching statistics to non-mathematics majors.

StoneStable, Inc.
A startup company with close ties to PSU has plans to revolutionize how vaccines are delivered by breaking the cold chain.
The Next Generation of PSU

From the Urban Growth Boundary to the Transit Mall, EcoDistrict to Tilikum Crossing, Portland is a city that loves to plan.

Now Portland State University is also getting into the act, with a strategic planning process and the design of a comprehensive fund-raising campaign coming on the heels of the successful “ReThink PSU” educational innovation program.

From the perspective of Research and Strategic Partnerships (RSP), we have been reshaping the way grants and contracts are administered, technology transfer is carried out, compliance is maintained, and our major partnerships are organized and advanced. As you can see in the later sections of this Report, those initiatives are bearing fruit, as most of our research metrics are climbing.

In the five years I’ve been at PSU, our priority research themes have not changed dramatically: sustainability initiatives that explore Portland’s unique natural and urban environment; health and life sciences that build on our strong relationships with the Oregon Health and Science University and various social service organizations; educational innovation that reflects longstanding partnerships with Portland Public Schools and our local community colleges; and entrepreneurial programs that take advantage of our region’s tech-fueled startup culture.

What HAS changed in this period, and what holds the most promise for the future of PSU, has been the arrival of an outstanding cadre of research-active junior faculty members. Several of these emerging research leaders are profiled in this edition of RSP’s Quarterly Review.

On the sustainability front, environmental engineer Stephen Talke applies a historian’s perspective to extract climate-related information from tide gauge records along the Columbia River dating back over 100 years.

Environmental biogeochemist Jennifer Morse is looking at the hidden carbon costs of “green” practices, like installation of urban bioswales and the establishment of an urban growth boundary, which may have higher ecological costs than previously thought.

Meanwhile, the strategic partnership between PSU and Portland General Electric is bearing both educational and research fruit, particularly in the area of power engineering.

In the health arena, you can read about Gerasimos Fergadiotis’s latest work to help diagnose and care aphasia, the debilitating loss of language that accompanies stroke and other brain injuries.

Electrical engineer Eric Wan uses signal processing to develop tools that can help older people remain in their homes rather than go to assisted living facilities.

The one veteran in our line-up, Biology Professor Ken Stedman, is working with a local startup company to commercialize some of his discoveries that can make vaccines more effective in rural parts of developing countries.

In the educational research sphere, Jennifer Noll of the Mathematics and Statistics Department is developing innovative ways to get students excited about learning statistics.

Curriculum and Instruction faculty member Jean Aguilar-Valdez is exploring how closer dialogue with students from diverse backgrounds can increase their success in STEM (Science Technology Engineering and Math) courses.

Similarly, the Lemelson Foundation has given a large award to support Oregon MESA programs that work to get kids from underserved communities targeted toward STEM careers.

Finally, keeping with the theme of transitions, we note that two of PSU’s leading administrative leaders, Jennifer Allen and Mark Sytsma, will be returning to their faculty roles after serving for several years as Director of the Institute for Sustainable Solutions and Associate VP for Research (AVPR), respectively. A search is currently underway for a new Director for ISS. RSP is happy to welcome Dr. Lisa Zurk from the Electrical and Computer Engineering Department as our new AVPR.

Lisa Zurk
Incoming Associate Vice President, Research Research & Strategic Partnerships

Jonathan Fink
Vice President, Research & Strategic Partnerships

Mark Sytsma
Associate Vice President, Research

Erin Flynn
Associate Vice President, Strategic Partnerships

Alan Kolibaba
Assitant Vice President, Research

Joe Janda
Director, Innovation & Intellectual Property

Dawn Boatman
Director, Sponsored Projects Administration

Lorraine McConnell
Director, Office of Research Integrity

Angela Jackson
Director, Center for Entrepreneurship

Portland State Business Accelerator

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No natural feature so dominates the geography, economy, and quality of life of residents of the Northwest US as the Columbia River. Draining a watershed of over 250,000 square miles in seven states and two Canadian provinces, the river provides irrigation, hydroelectricity, access to foreign and domestic markets, and recreation to millions of citizens on both sides of the 49th Parallel.

The “Lower Columbia”—the 145 miles stretching from Bonneville Dam through metro Portland to the Pacific Ocean—is the section best known to those living in Northwest Oregon and Southwest Washington. Here, before its turbulent entry into the sea, the river is broad, calm, and easily navigable, as well as navigable by barge, with access to foreign and domestic markets. Throughout the Columbia River Basin over 470 dams store water for hydroelectricity, drinking, and irrigation. Sediment is trapped behind dams and is no longer deposited at the mouth as it once was, affecting the depth of the estuary. In summer, the interplay changes between the river’s warmer fresh water and the ocean’s colder salt water, causing salinity to increase further upstream than ever before. The spring fresher, the yearly rise in stream level due to snow melt, occurs a month earlier on average, and at a 40% reduced magnitude compared to 100 years ago. The deep dredged shipping lanes affect how tides roll upstream as the river moves downstream. All of these factors place stress on the estuary, its marine and riparian environments, fish and wildlife habitats, and other characteristics.

The archives contain records that date back as far as about 1850 in Oregon. For example, tides, water temperature, and climate were measured continuously in Astoria from 1853 to 1876, while Portland was still a village.

There was a lot of detective work involved in finding those records,” Dr. Talke said. “But when I uncovered them, it was like coming upon a treasure trove of data that could expand by decades the horizon of time in which we can study the estuary.

Assistant Professor Stefan Talke and his colleagues in the Department of Civil and Environmental Engineering have long studied how man’s influence has shifted the Lower Columbia and other river systems from their natural state. Human- and naturally-induced changes are subtly reflected in wave behavior (e.g., the height of storm surges), tidal flows, bathymetry, water temperature and salinity. To figure out the past, present, and future functioning of these waterways, Dr. Talke has become an expert in the hydrodynamic processes and sediment transport in estuaries, rivers, and oceans. He combines historical research, field data collection, data analysis and computer modeling to unravel the stories implicit in past and modern records and reconcile how natural and man-made factors affect the environment.

“I began working with Professor David Jay on a project looking into why tides off the West Coast of the Americas had increased in magnitude over the last 100 years. The data we had showed that the height of tides had generally gone up everywhere. But in some places, like Astoria, the historical record showed an increase on the order of ten percent. It was a big change, and the reason for it was a mystery.”

Dr. Talke’s work with Professor Jay put him on a trail that eventually led to a prestigious National Science Foundation Faculty Early Career Development “CAREER” award. Dr. Talke received the honor for his proposal “Modeling 19th Century Estuaries to Address 21st Century Problems.” Funding from the award is financing the study of historical trends in sea level, tides, water temperature, and salinity in the Lower Columbia. Moreover, by embedding local high school teachers and underrepresented students in his research team, Dr. Talke’s project will develop curricular materials that will introduce a diverse set of secondary school students to the exciting applications of science and engineering in their own backyards.

During the five-year project, the team will take historical records discovered by Dr. Talke in places like the US National Archives and modify existing computer models to learn more about changes in the Lower Columbia. Using multi-decade time series of 19th century tidal and water temperature measurements in combination with 20th and 21st century data, the team will determine the natural variability in the river and establish historical baselines to better understand subsequent changes. Their work will also explore hydrodynamic processes, assess trends in water temperature, and predict the estuary’s future.

Understanding how climate change and sea-level rise may further stress the system is critical to coming up with solutions to problems such as declining salmon population. By deciphering the past of the Columbia River system, Dr. Talke, his colleagues and students hope to preview its future.
Modernizing Statistics Education

"Lake Wobegon, where... all the children are above average."

If any of those "Prairie Home" children eventually come to Portland State University, Assistant Professor Jennifer Noll wants to make sure they learn enough statistics to understand how nonsensical that famous quote is.

Data collection and statistical analysis are critical parts of all science. They are also essential components of everyday decision-making. Recent advances in visualization and modeling software now make it easier to perform those kinds of tasks without being a statistical expert. Given the deluge of data we now generate and consume on a daily basis, the arrival of such technologies could not be timelier.

"In the last 30 years the field of statistics has made huge leaps forward in terms of technologies, techniques and even the types of data statisticians work with," Dr. Noll said. "Meanwhile, the materials we teach within entry-level stats classes for non-majors have not kept up."

According to Dr. Noll there is a generation of students entering the classroom already familiar with technologies that capture data—such as smart phones, tablets, and wearable devices. Many of these students actively share information about themselves through a variety of social media outlets.

"We need as data consumers. Responding to this gap, community colleges and universities are greatly expanding their statistical course offerings. Dr. Noll's work will improve the value of such courses designed to help learners build and retain essential statistical reasoning and thinking skills. Dr. Noll will refine the CATALST coursework using data visualization and modeling software and conduct a comprehensive study of how students develop and later retain skills essential to statistical thinking and reasoning.

"When I first heard about the CATALST project, I was excited to try it in one of my classes," Dr. Noll said. "The software we used to make models really gave the students the chance to explore ideas of statistical inference in ways that were so much more engaging than memorizing and performing procedures in textbooks. The level of engagement was apparent when we saw that six months after the course a majority of the students still understood the lessons they had learned and many had even used the software in other classes."

Dr. Noll was impressed with how students responded to the CATALST program but thought the original materials were too structured. Curious, she let the students create their own models to figure out what the data meant without the aid of lesson plans.

"I'm really interested in looking at what can be done with those materials when we remove all the directions and let the students engage with the modeling software. There is a lot we can learn about teaching statistics, about the student learning experience, and about how students develop an understanding of modeling statistical problems, visualizing, and representing data in meaningful ways," Dr. Noll said.

"Facts are stubborn things," Mark Twain wrote, "but statistics are pliable." Over the next five years, Dr. Noll's project will address the stubborn fact that current methods and materials used to teach college statistics to non-mathematics majors need to be modernized. During that time she expects some 400 students will take one of the statistics courses she or her graduate students will offer.

Statistical literacy is an important skill set for students in a large number of disciplines, from sociology and psychology to engineering and chemistry. More broadly, it is a skill that all of us need as data consumers. Responding to this gap, community colleges and universities are greatly expanding their statistical course offerings. Dr. Noll's work will improve the value of such courses, increasing the odds that the students will have "above average" statistical skills.

"As an educator, I can see that we've reached a point where there is this great opportunity to teach students the power, use, and function of statistics," Dr. Noll said. "The problem is many students lose interest when we teach them with textbooks and performing procedures in textbooks. The level of engagement was apparent when we saw that six months after the course a majority of the students still understood the lessons they had learned and many had even used the software in other classes."

Dr. Noll is one of three recent CAREER winners at PSU. CAREER grants, the most prestigious awards offered to junior faculty members, are given to those who "epitomize the integration of teaching and scholarship through research activities." Dr. Noll's work will improve the value of such courses.
AGING IN PLACE

In PSU’s Biomedical Signal Processing Lab, Professor Eric Wan uses the latest machine learning methods to address the fundamental goal of letting people “age in place” in their homes.

“Help! I’ve fallen and I can’t get up!”

This famous advertising phrase for a personal alarm system highlights the concern that lead millions of Americans to enter assisted living facilities, but medical experts, social workers, and economists also recognize the benefits of remaining in one’s own home. A PSU electrical engineering professor and his students are using the latest advances in signal processing to give seniors of the future the option of safely “aging in place.”

Undergraduate Shaman Samin appears less like a gerontologist than a master tinkerer. In a basement lab lit by flickering fluorescent lights, Samin tests a small, rectangular sensor with an electric probe. Glancing around the room, one sees the raw materials of high-tech hardware: switches and circuit boards, oscilloscopes and spectrum analyzers, multimeters, function generators, computers and flat-panel, high-resolution monitors. It is a “makespace”—a venue where ideas become tangible and are then tested to prove their functionality. The sensor Samin is working with may eventually become a critical component of a wireless device tasked with monitoring an individual’s activity, how frequently they move from place to place, their breathing, or even their heartbeat.

Samin works in the Biomedical Signal Processing Lab in PSU’s Department of Electrical and Computer Engineering. The Lab’s director, Research Associate Professor Eric Wan, is an electrical engineer with expertise in statistical signal processing and machine learning. He is also an Adjunct Associate Professor in the Biomedical Engineering Department at Oregon Health and Sciences University (OHSU). He is well known for developing algorithms used in guidance and navigation systems. Google has applied his work to its driverless cars, while NASA has used it to direct Mars rovers.

Recently, Dr. Wan’s research has shifted to biomedical applications. He and a former Ph.D. student who now works at MotioSens have formed a startup company, MotioSens, which is developing remote sensing technologies that track and measure the movement of older adults who live alone or in assisted living facilities.

Biomedical signal processing uses software to analyze electronically-recorded health information that our bodies regularly broadcast in order to gather vital clues about an individual’s overall well being. It is a powerful tool for early detection, diagnosis, and management of diseases, as well as critical care. With MotioSens’ technology an array of sensors can easily be installed throughout an older adult’s home to collect data on that person’s movements: which room they’re visiting and when, how long they stay in each place, sleeping patterns, and more. Software capable of learning patterns and recognize anomalies can then process these data—like if a person fails to exit a room they usually spend little time in; or someone who normally wakes at six a.m. doesn’t get out of bed one morning. The smart machine would catch the change in behavior and send a notification to a physician, caregiver, friend, or family member. The receiver of the message could proceed from there.

“I think this is a great technology to lend peace of mind to older adults living alone and their families,” Dr. Wan said. “The sensors, which attach to walls and floor boards, gather information on general trends: the number of trips someone has made to their bedroom; the time and duration of visits to the kitchen. If the software recognizes something out of the ordinary, a call will go out directly to the family or caregivers.”

According to Dr. Wan, the MotioSens monitoring system is unlike anything else on the market. There are wearable technologies that track mobility, but they only work if users wear them regularly and keep the batteries charged. Video cameras are another option, but they raise privacy issues, particularly when a third party records and stores the data. Infrared remote sensing has been around for over 30 years, but is inaccurate and produces data at too low a resolution to be useful. Other technologies like Bluetooth beacons are useful for monitoring activities like opening a pillbox or refrigerator, but do not communicate information about mobility. MotioSens, on the other hand, uses low-power RF sensors that plug into outlets throughout the house. The sensors signal to each other, creating an invisible sensing network. Disruptions and changes in the RF patterns are then used to determine a person’s location, walking speed, and other information. MotioSens’ suite is the only unobtrusive, high-resolution monitoring system that tracks an individual’s movement through space and time and employs machine learning to determine if there is a need of assistance.

Dr. Wan said the next step is to improve the system’s ability to identify when there is more than one person in a room. By recognizing and tracking individuals within a group, the system could also provide important information about social interactions and other influences on an older adult’s mental as well as physical health. In the Lab, students like Samin are evaluating hardware and software that may soon make it possible to extract additional information about people in a room, such as their body stature and gender.

Dr. Wan’s work in the Biomedical Signal Processing Lab is just one example of how researchers at PSU are leveraging university assets like its high-tech engineering facilities, close partnership with OHSU, and throngs of eager and inquisitive students, to enter into health and health-related fields usually associated with medical schools. With the number of older adults in Oregon and across the nation increasing rapidly, remote sensing techniques will become increasingly important to how individuals, their families, and healthcare providers monitor and maintain their health and lifestyle. MotioSens’ and Dr. Wan’s technologies are designed to provide comfort and peace of mind to older adults who want to live independently.
In the award-winning film *The Theory of Everything*, neurodegenerative disease robs cosmologist Stephen Hawking of his ability to speak, just as he is discovering some of the deepest workings of the Universe. The cruel irony of this is that his ability to communicate is one of his deepest workings. His enforced silence, and Hawking's ability to overcome it with a prosthetic device, provides much of the story's dramatic power.

Outside of Hollywood's limelight, hundreds of thousands of people in the U.S. lose their access to speech each year due to the communications disorder known as aphasia. According to the National Aphasia Association, the condition "impairs a person's ability to process language, but does not affect intelligence." It is brought on when the brain's language center is damaged, most often as the result of stroke, although it can be triggered by any kind of traumatic brain injury. It is brought on when the brain's language center is damaged, most often as the result of stroke, although it can be triggered by any kind of traumatic brain injury.

One of the scientists working to help these victims is Assistant Professor Gerasimos Fergadiotis of the Department of Speech and Hearing Sciences at Portland State University. Dr. Fergadiotis' hypothesis is that there are mediating circumstances involved in how older adults process language. To learn more he's questioning the role psychosocial factors play in our ability to communicate coherently. Do social ties and activities—like talking regularly with friends or family, or going places and doing things with others—mitigate the effects of aging on language processing? If so, is there a way to qualitatively and quantitatively show what they do in reproducible studies? Answering such questions is a critical step along the path to extending the ability to communicate coherently well into later life.

For individuals who have had a stroke or other traumatic brain injury, regaining the ability to effectively communicate may be less certain. However, the earlier and more precisely a diagnosis is made, the better the chances that a speech-language pathologist can prescribe appropriate treatments that may lead to a partial or full recovery.

As Dr. Fergadiotis explained, there are many disadvantages to the diagnostic tools now available, which commonly involve very long tests, in some cases up to 175 questions. Imagine being in a hospital after a stroke, unable to speak, and being subjected to such a tedious evaluative procedure. Dr. Fergadiotis' innovative alternative, which he is working on in collaboration with researchers at the Veteran's Affairs hospital in Pittsburgh, Pennsylvania, is to apply computer adaptive testing as a tool to diagnose aphasia.

"Computer adaptive testing is the operating principle behind the Graduate Records Examinations and similar tests," Dr. Fergadiotis explained. "When someone takes the GRE, the software is adjusting the line of questioning based on the answers provided. We are creating algorithms that apply the same principles to diagnosing cases of aphasia. The test responds to the patient's ability level, which saves time, aggravation, and improves patient outcomes."

According to Dr. Fergadiotis, their software can cut the number of questions in an assessment from 175 to 30. Thus far their success rate is 99 percent as effective as the longer test. These promising results prompted them to submit a grant proposal to the National Institutes of Health to move the project into the next phase of testing and development.

Now in his third year at PSU, Dr. Fergadiotis is part of a growing cluster of faculty from departments including Speech and Hearing Sciences, Applied Linguistics, Electrical and Computer Engineering, the Graduate School of Education, and the School of Social Work, all addressing issues related to interpersonal communication. Whether developing methods to diagnose aphasia, measuring the efficacy of interventions and treatments, or creating innovative technologies to augment how communication is carried out, these researchers are laying groundwork for a more integrated approach to how we connect with one another through language.

**Oregon K-12 Geography Education gets $200K Boost**

**By John Kirkland**

Photo credit: Gerasimos Fergadiotis, Assistant Professor, Speech & Hearing Sciences

Gerasimos Fergadiotis, Assistant Professor, Speech & Hearing Sciences

Dr. Fergadiotis is a Speech-Language Pathologist who investigates how aging affects the ways people process language.

At Portland State University’s Center for Geography Education in Oregon (C-GEO) has received a $200,000 grant from the John and Betty Gray Geography Fund of the Oregon Community Foundation to improve geography education in Oregon’s K-12 schools.

The funds will be used for teacher professional development, instructional materials, community outreach and advocacy for geographic education.

C-GEO is a member of National Geographic’s Network of Alliances for Geographic Education. Its membership reaches into all grade levels and all regions of Oregon. Since 1986 the program has offered professional development opportunities for teachers, and has developed standards-based geography materials with strong Oregon content for classroom use. This work includes the Student Atlas of Oregon (in English and Spanish), which won the 2012 Geographic Excellence in Media award from the National Council for Geographic Education.

“We are grateful for the continuing support of the Gray Family Foundation and the Oregon Community Foundation,” said Teresa Bulman, professor of geography at PSU and co-director of C-GEO. Bulman said funding from the John and Betty Gray Geography Fund enables C-GEO to provide educational travel as well as classroom professional development.
By Christina Williams

Mr. Kumar, company CEO, noted that StoneStable’s goal of in the patient’s bloodstream and the vaccine would “reanimate.” production their proprietary technology would be used to processes. The company’s vision is that at a certain stage of cold chain, reducing costs, and saving lives.

In a 2013 New York Times article about his discovery that certain viruses could be “frozen” in silicon dioxide (silica) and later reanimated unharmed, Professor Stedman quipped, “It’s hard to put a fridge on the back of a donkey.” Dr. Stedman reasoned that if you could suspend a virus in a coating of silica and later return it to its original state, you could do the same with vaccines, no refrigerator needed. That is what StoneStable set out to do: change the way vaccines, one of the fastest growing sectors of the pharmaceutical industry, are shipped to clinics and health facilities around the world, eliminating the cold chain, reducing costs, and saving lives. The StoneStable team includes Rod Pitman and Anant Kumar, along with Dr. Stedman. According to Mr. Pitman, an entrepreneur, filmmaker and PSU alum, the goal is to create a product that could be integrated into existing manufacturing processes. The company’s vision is that at a certain stage of production their proprietary technology would be used to encapsulate vaccines in silica, rendering them inert until after being administered, when the silica would dissolve harmlessly in the patient’s bloodstream and the vaccine would “reanimate.” Mr. Kumar, company CEO, noted that StoneStable’s goal of developing viable methodologies and disruptive technologies to revolutionize the transport and delivery of vaccines is in line with the WHO’s Global Vaccine Action Plan, which aspires to deliver vaccinations to all who need them. “In this first phase, we’re really focusing on applying our techniques to the influenza vaccine,” Dr. Stedman said. “Here is a vaccine that is highly unstable and really important to public health anywhere you go in the world. The flu kills hundreds of thousands every year. With better ways of getting vaccines to people we could really lower that number.”

StoneStable is still in the early phase of testing and developing the technology, but according to Dr. Stedman, the lab tests have been promising. In the long run, he and the rest of the team would like to apply their methods to other biologics–proteins and other molecules known for being notoriously difficult to transport.

If the World Health Organization is going to reach its global vaccination targets, it will need new ways to make it easier and cheaper to get these fragile compounds to the populations that need them. The obvious way to achieve that aim is to break the cold chain. By moving innovations developed at PSU by Dr. Stedman from lab to market, StoneStable, Inc. seeks to make those advancements a reality.

PSU among Princeton Review’s Top Green Colleges

Portland State University was ranked among the top environmentally responsible colleges and universities, coming in at No. 11 among 355 institutions studied by Princeton Review. Portland State was lauded for its civic engagement and commitment to sustainability. Student quotes in the profile, which listed Portland State with a true potential to make a difference,” with a real prototype or product that the judges selected from nearly 300 semi-final teams to develop prototypes at the 2015 Oregon BEST Fest cleantech conference in September where the judges will select the winner.

Learn more about the Cleantech Challenge at pdx.edu/clean-challenge.

THE 2015 CLEANTECH CHALLENGE

By Christina Williams

After two successful years, the Portland State University (PSU) Cleantech Challenge has extended its call for environmental innovations throughout Portland, thanks to additional support from Wells Fargo.

The PSU Cleantech Challenge presented by Wells Fargo recently accepted applications for student teams from colleges and universities throughout the Portland metropolitan region who have ideas for products, services, and technologies that address the world’s most pressing environmental problems. Student teams will compete for summer development grants and a grand prize package worth more than $40,000.

The expansion is made possible by a three-year, $300,000 grant from Wells Fargo that builds on the company’s past support of the competition. The support also paves the way for the challenge to expand statewide.

“Wells Fargo is proud to have supported innovation and entrepreneurs since the inception of the PSU Cleantech Challenge,” said Tracy Curtis of Portland, Wells Fargo’s Oregon Region president. “We saw tremendous opportunity and success from this program in its first years at PSU, which is why we wanted to help expand this program to other universities in Portland and eventually throughout the state. It is in alignment with Wells Fargo’s goals to help foster innovation and increase job opportunities in a global clean energy economy, all leading to stronger, more sustainable communities.”

Here’s how the Challenge works: Student teams submitted their ideas and environmental ideas in an application due to challenge organizers by May 8. First round Challenge competitions were selected from the application pool and pitched to their concepts to a panel of judges on May 28.

From that group, the judges selected semi-final teams to develop prototypes over the summer with ongoing mentorship and feedback. The teams will make their final pitches and display their prototypes at the 2015 Oregon BEST Fest cleantech conference in September where the judges will select the winner.

Teams come into the Cleantech Challenge often with nothing more than an idea. And they come out of it with a real prototype or product that has true potential to make a difference,” said Angela Jackson, Director of the PSU Center for Entrepreneurship. “We’re cultivating a new generation of entrepreneurs and inventors and we’re thrilled to open up what we’ve created here to students at other Portland colleges and universities.”
In two forthcoming studies, biogeochemist Jennifer Morse and her students will examine sources of greenhouse gas emissions that are less well-known than tailpipes and coal-burning power-plants. Environmental leaders of the 1960s and ‘70s had a relatively easy task—find pollution and eliminate it. The sustainability movement of the past two decades, which tries to balance ecological, economic, and equity goals, faces much tougher challenges. Many seemingly “green” solutions turn out to have unanticipated financial, social or environmental costs.

Consider Oregon’s landmark urban growth boundaries established in the 1970s to protect agricultural lands from suburban sprawl. While proximity allows farmers to deliver their produce to Portland and Eugene with relatively modest fuel costs and carbon emissions, scientists now recognize that when fertilizer applied to those nearby fields reacts with groundwater, it can lead to serious greenhouse gas emissions. That’s where projects I’m currently developing are focused.

Now in her second year at PSU, Dr. Morse is developing two projects related to “unconventional” sources of greenhouse gases. Normally, when we think about emissions that contribute to global warming, carbon dioxide is what first comes to mind. While CO₂ accounts for the bulk of greenhouse gases entering the atmosphere, others including methane and nitrous oxide also have significant effects. The principal source for both these gases turns out to be agriculture.

In 2004, a large portion of the southern Willamette Valley was found to have groundwater nitrate concentrations above what is considered safe for drinking. Dr. Morse is currently planning to join Oregon’s Department of Environmental Quality and the Environmental Protection Agency in an effort to reverse both terrestrial and atmospheric nitrate contamination, while also providing carbon credits for farmers.

“As a part of the plan to reduce nitrate contamination, the EPA and DEQ have been studying how the ways farmers fertilize their fields influence nitrate pollution,” Dr. Morse said. “But not all of the fertilizer that gets sprayed onto the fields ends up in the same place. Some finds its way into ground water, some is absorbed by the plants, and some remains in the soil where interactions with the microbial biome turn it into nitrous oxide, a greenhouse gas. So my role in the project will start with looking at how farmers use fertilizer—the quantity they’re applying, when they’re applying it, and the methods of distribution.”

With that information, Dr. Morse and her students will be able to run lab experiments to investigate the biogeochemical processes that occur when nitrogen fertilizer comes in contact with soil microbes to produce nitrous oxide (N₂O). The project could show a correlation between how, when, and by what method farmers fertilize their fields and the subsequent amount of N₂O released into the atmosphere. By changing practices to reduce those N₂O levels farmers may qualify for carbon credits.

According to Dr. Morse, if the program is successful, it will benefit both the environment and farmers. Furthermore, if carbon credits become available, they might incentivize farmers elsewhere to fertilize their crops in ways that reduce the amount of greenhouse gases entering the atmosphere due to agricultural practices. In the long run, the program might serve as a model for other regions of the US where the overuse of nitrogen fertilizers is affecting air and water quality.

Back in Portland, Dr. Morse and her graduate students are thinking about another possible source of greenhouse gas emissions—bioswales. Bioswales are landscaped areas along roads, in parking lots, and sidewalks that are engineered to perform like wetlands: natural filters that remove harmful substances from runoff before it flows into rivers, creeks, and aquifers. In cities like Portland, bioswales are transforming the appearance of the cityscape, creating streets bordered by garden-like greenspaces. But as Dr. Morse notes, when viewed biogeochemically, bioswales may not be so benign.

“My students are really excited to take a close look at bioswales to see if there’s any relationship to greenhouse gas emissions,” Dr. Morse said. “We want to learn exactly what kinds of microbes live in the soils and what they’re doing. It could mean using molecular techniques to figure out the microbial community composition and how it responds to events like rain, spikes in pollutants, and other disturbances. I think it’s an exciting opportunity to look into something we don’t yet know that much about.”

Many members of the Portland State community come here because of the opportunity to live in one of the greenest cities in the country. Sustainability scientists like Professor Morse and her graduate students get the added bonus of being able to closely examine their unique urban environment and figure out how it can be made even healthier in the future.

External resources:
- "A lot of my work examines places like wetlands and forests. These ecosystems are important for a number of reasons," Dr. Morse said. "They play a role in stabilizing the climate. They accumulate and store carbon. They retain or remove nutrients from water. And when you look more closely, you see all these different chemistries and microbial processes going on. It’s a kind of special interplay that only happens in low-oxygen environments where aquatic and terrestrial ecosystems meet. I’ve also done a lot of similar work in urban and rural environments. That’s where projects I’m currently developing are focused."

- "As a part of the plan to reduce nitrate contamination, the EPA and DEQ have been studying how the ways farmers fertilize their fields influence nitrate pollution," Dr. Morse said. "But not all of the fertilizer that gets sprayed onto the fields ends up in the same place. Some finds its way into ground water, some is absorbed by the plants, and some remains in the soil where interactions with the microbial biome turn it into nitrous oxide, a greenhouse gas. So my role in the project will start with looking at how farmers use fertilizer—the quantity they’re applying, when they’re applying it, and the methods of distribution."

- "With that information, Dr. Morse and her students will be able to run lab experiments to investigate the biogeochemical processes that occur when nitrogen fertilizer comes in contact with soil microbes to produce nitrous oxide (N₂O). The project could show a correlation between how, when, and by what method farmers fertilize their fields and the subsequent amount of N₂O released into the atmosphere. By changing practices to reduce those N₂O levels farmers may qualify for carbon credits."

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The Hidden Cost of Going Green

The Lemelson Foundation has awarded a grant totaling $706,000 to the Portland State University Foundation to support Oregon MESA’s (Math Engineering Science Achievement) statewide invention education activities that build on science, technology, engineering and mathematics (STEM) skills. The new grant expands the work of the MESA program to help underserved youth pursue math-based higher education and STEM-related careers by providing a proven mix of pre-college academic, hands-on experience, and mentoring opportunities for K-12 students. This work is vital to the continued growth of Oregon’s innovation-led economy and efforts to ensure that all Oregonians can share in the state’s growing prosperity.

“The Lemelson Foundation’s expanding partnership with Oregon MESA represents our deep commitment to invention in our home state,” said Carol Dahl, executive director of The Lemelson Foundation. “MESA’s work is critical to advancing invention education. It gives young people more creative confidence, unleashes their thinking about ways to advance positive change, and maximizes their personal potential. That leads to a smarter, stronger Oregon.”

The Lemelson Foundation grant gives a significant boost to Oregon MESA’s mission of increasing the number of members of underserved populations in STEM-based employment, a cornerstone for invention and innovation. Both The Lemelson Foundation and Oregon MESA understand that the key to preparing a 21st Century workforce is a strong basis in STEM, combined with the ability to identify real-world problems and turn ideas into meaningful solutions.

The Need for Invention Education and STEM Skills Oregon

Students from underserved communities in Oregon lag behind in their exposure to invention education and STEM, making them less likely to pursue related university degrees and careers. The gap is even more pronounced for girls and underrepresented minorities.

In 2013-14, only 50% of economically disadvantaged high school students met or exceeded benchmarks compared to 62% of all Oregon students.

• African Americans, Hispanics, Native Indians and Alaska Natives earned only 6% of science, engineering, math and technology degrees in 2013 in Oregon, though they comprise 10% of all graduates and about 15% of the population.

• Women comprised 60% of all 2013 Oregon college graduates, but only make up 39% of graduates in science, engineering, math and technology programs.

These populations are missing important opportunities to share in the excitement and prosperity of Oregon’s burgeoning technology sector. According to the Technology Association of Oregon, the state’s technology industry has been the most productive in the US in terms of GDP for the past decade, and wages for workers in the technology industry are double the state’s average. The economic vibrancy of Silicon Forest and similar industry clusters was built by the kind of innovative talent and skills that Oregon MESA helps foster.

“The impact of The Lemelson Foundation’s grant in fostering invention through greater access to science, technology, engineering and mathematics is tremendous,” said David Coronado, executive director of Oregon MESA. “Thanks to the generosity and vision of the Foundation, Oregon MESA’s mission of creating education and career success for underserved students is more powerful than ever.”

Solution

The new grant will allow Oregon MESA to expand its reach to different parts of the state and build opportunities for students to participate in invention and STEM-based activities during the school day. The Lemelson Foundation, a long-time partner of Oregon MESA, has awarded the grant in recognition of MESA’s strong track record of success.

“Oregon MESA’s curriculum gives these students hands-on experience to create the inventions of tomorrow and the creative confidence to identify and tackle the world’s most challenging problems,” said Rachel Jagoda Brunette, Oregon regional program officer for The Lemelson Foundation.

Portland State University (PSU) launched the local MESA chapter in 1985 for the purpose of encouraging greater levels of STEM education, college graduation, and career participation from underserved students. Since that time, Oregon MESA has helped thousands of underserved youth, particularly minority and female students, achieve academic excellence, attend college, and progress on to STEM-related careers.

Based in PSU’s Maseeh College of Engineering and Computer Science, Oregon MESA now serves thirteen middle and high schools throughout the Portland Metro area, and has recently expanded to four schools in the Salem-Keizer School District. Oregon MESA delivers a 25-year track record of 98% high school graduation and 92% college continuation rates for participants.

PSU also hosts MESA Day, an annual highlight of the program. MESA Day is a statewide competition designed to foster engineering, math, and science innovation by having students tackle a complex but concrete social problem. For last year’s challenge, students had to build a prosthetic arm design. This year’s event took place May 15, and finalists will proceed to the national competition to be held in Utah this summer.

“PSU is the most diverse university in Oregon, but we need to encourage more students of color to pursue careers in the science and technology sectors,” said Portland State University President Wim Wiewel. “The Lemelson Foundation recognizes that need and I’m glad to see them support our partners at Oregon MESA.”

About Oregon MESA

Established in 1989, Oregon MESA’s mission is to provide students underrepresented in the fields of mathematics, engineering, science and technology with the skills, knowledge and opportunities to develop their talents, explore technology-based careers, enter college and compete successfully in the workforce. Oregon MESA is supported by Portland State University, school districts, industry, and community organizations, foundations and individual donors. For more information, visit oregonmesa.org.

About The Lemelson Foundation

Based in Portland, OR, The Lemelson Foundation uses the power of invention to improve lives. Inspired by the belief that invention can solve many of the biggest economic and social challenges of our time, the Foundation helps the next generation of inventors and invention-based businesses to flourish. The Lemelson Foundation was established in the early 1990s by prolific inventor Jerome Lemelson and his wife Dorothy, and is celebrating its 20th Anniversary throughout 2015. To date the Foundation has made grants and other investments totaling more than $185 million to hundreds of organizations around the world. For more information, visit lemelson.org.
Two of Portland State's most influential leaders, Jennifer Allen and Angela Jackson, have been honored with 2015 Women of Influence Orchid Awards from the Portland Business Journal.

The Orchid Award recognizes the region's most influential women professionals with strong records of innovation, outstanding performance in their fields, and meaningful contributions to their communities. Nominations for the award were judged on three criteria: professional accomplishments, community leadership, and awards and milestones.

More than 300 influential women were nominated this year, but only 25 were selected to receive the prestigious award. The awards ceremony was held on April 16 at the Hilton Hotel in downtown Portland.

Jennifer Allen, director of PSU’s Institute for Sustainable Solutions and associate professor of Public Administration, was recognized for her many years of leadership and service in sustainability research and education. Over the past seven years, the Institute for Sustainable Solutions and partners throughout the campus and in the community. Any influence I may have had is largely due to the great people I have the opportunity to work with,” Allen said.

Angela Jackson, director of PSU’s Business Accelerator and co-director of the Portland Seed Fund, was selected as the Orchid Award Entrepreneur of the Year for her contributions to a vibrant entrepreneurial scene in Portland. With Jim Huston, Jackson co-founded the Portland Seed Fund, which invests in early-stage companies. The fund was an early backer of Globe Sherpa, a mobile technology company that grew out of a project by PSU MBA students and now enables smart phone TriMet ticket purchases for thousands of Portlanders. Jackson also oversees the PSU Cleantech Challenge, a contest to support the development of earth-friendly innovations that is expanding its reach Portland-wide this year, and the PSU Business Accelerator, which was recently selected as the Business Accelerator of the Year by the National Business Incubation Association.

Jackson spoke on a panel after the awards ceremony with the three other women executives of the year selected in their respective business categories: nonprofit, small/medium company, and large company. She talked about her years working as a sailor on tall ships, where she learned the true meaning of leadership. “When you can do what you do yourself through others without even touching the wheel—that is leadership, that is success,” she said.

And she offered some final words of advice for finding career success: “Say yes. Then figure out how to do it later.”

The Partnership

PSU’s Jennifer Allen and Angela Jackson Among the City’s Most Influential Women

By Laura Gleim

Above: Angela Jackson and Jennifer Allen.

In total, PGE has provided $720,000 to support sponsored research projects at PSU since 2010. In addition to the overall benefit PGE, its customers and the region's economy can expect to gain from PSU's research, the university has delivered expertise and capstone projects of considerable value to PGE. Over the course of the five-year partnership, the rate of engagement and funding has increased dramatically. “It’s important in today’s climate that PGE, as a national research university, just makes sense for us to combine our resources in the fields of energy and sustainability.”

For more information about the PSU - PGE Partnership Contact: Erin Flynn Vice President Strategic Partnerships eflynn@pdx.edu 503-725-8490 pdx.edu/partnerships

Portland State University’s leadership in science, technology, engineering, and mathematics (STEM) education derives from at least four ingredients: strong community connections, commitment to university access for a diverse student body, partnership with our region’s public schools, and a robust pipeline of graduates to Oregon’s high-tech industry.

The value of these efforts at PSU has recently been affirmed by large research and training grants from the National Institutes of Health and the Howard Hughes Medical Institute, both of which seek to expand the number of minority students entering STEM disciplines and going on to careers in health care and the sciences.

Many STEM programs assume that the main limit on minority success is access and affordability. The implication is that if bright students from diverse backgrounds could simply get admitted to existing programs and given assistance through financial aid and academic coaching, their paths forward would be clear. But what if the barriers to matriculation include the ways minority communities are perceived by STEM instructors, and how STEM programs are being designed?

These are among the complex questions Dr. Jean Aguilar-Valdez, a recent addition to the PSU faculty, is exploring. Her scholarship complements the university’s long-standing commitment to university access for a diverse student body, the majority of whom were Latino, had a lot to teach me. Their experiences with issues like documentation and immigrants’ rights opened my eyes to a wider world. That humbled me and I realized that I needed to become involved with the social justice movement in education.

After several years of teaching middle school science in California and North Carolina, Dr. Aguilar-Valdez entered a Ph.D. program at the University of North Carolina at Greensboro. Her dissertation, “DREAMing of Science: Undocumented Latin@’s Testimonios Across the Borderlands of High School,” focused on high-achieving undocumented students with dreams of entering science.

Dr. Aguilar-Valdez is constantly asking how her research benefits the students and communities she works with. She acknowledges that she walks between worlds in her many roles as a Latina, an academic, an educator, scientist, feminist, and advocate for the young people who share so much with her and make the research possible. She leverages the strengths of each of those roles to push back against injustice and inequality in the education system and in society at large.

“One way I am able to achieve that push back in the research I do is to help the young people I work with elevate their voices,” said Dr. Aguilar-Valdez. “In their own words they relate the injustices they’ve experienced and highlight things so often overlooked because of the narrow view of science and education so many educators have: their culture, history, and traditions; the incredible knowledge they possess, and the beauty of who they are.”

As one of the newest members of the large community of STEM researchers at PSU, Dr. Aguilar-Valdez is trying to use her students’ perspectives to shed light on the underlying cultural assumptions that may serve as barriers to diversifying the scientific and health care workforce.

As her “co-participants,” as she records their thoughts, actions, and achievements.

“I see my scholarship as activism,” said Dr. Aguilar-Valdez. “When I began teaching, I thought that because I was a Latina who had gone to college and earned a Master’s degree in physics, I had something to impart to students about science and success. But teaching science at a bilingual, Title I middle school in East Los Angeles, I quickly learned that the students, the majority of whom were Latino, had a lot to teach me. Their experiences with issues like documentation and immigrants’ rights opened my eyes to a wider world. That humbled me and I realized that I needed to become involved with the social justice movement in education.”
Daim, Tugrul. NW Energy Efficiency Technology Roadmap Bonneville Power Administration; $650,011. MCECS; Amendment
DeRivers, Catherine; Ruiz, Greg. BAPID: A Rare Opportunity to Examine the Hydro Effect Resulting from Intensive Harvest of an Introduced Predator, National Science Foundation; $71,416. CLAS; New
Elliot; Debra. Oregon Gambling Persuasion Study Phone Survey; Administration for Children and Families; $600,000; SSW; New
Elliot; Debra; Cellarius, Karen. Miracles/Family Recovery Support Regional Partnership Grant - Program Evaluation; Administration for Children and Families; $600,000; SSW; New
Gaines, Eleanor. Watersheds Object Management and Nest Protection for 2015; US Fish & Wildlife Service; $253,914. CLAS; New
Gopalakrishnan, Jay. Novel DPG Method for Wave Propagation; US Air Force; $86,051. CLAS; Amendment
Keller, Tom. Evaluation of Monitoring Enhancements Demonstration Projects; US Department of Justice; $93,044. SSW; Amendment
Lafrenz, Martin; Bliss Ketchum, Leslie; DeRivers, Catherine. Biodiversity Corridors (Phase 3); Metro; $25,000. CLAS; New
Larsen, Sean. Progressing through Calculus; National Science Foundation; $523,086. CLAS; New
Liberty, Robert; Walton, Judy. Accelerating Local Implementation of the Sacramento Region Metropolitan Transportation Plan/Sustainable Communities Strategy (MTP/SCS); Sacramento Area Council of Governments; $352,000. CUPA; New
Moradkhani, Hamid. Portland State Climate Change Streamflow Dataset, Bonneville Power Administration; $577,550. MCECS; Amendment
Noll, Jennifer. CAREER: Transforming College Students’ Statistical Thinking: Data, Technology & Modeling, National Science Foundation; $193,021. CLAS; New
Orellana, E. Roberto; Cellarius, Karen. Oregon Caring Connections Initiative, Substance Abuse and Mental Health Services Administration; $312,800; SSW; New
Pallerosi, Sergio. Sacramento Neighborhoods Project; Sacramento Area Council of Governments; $100,000. COTA; New
Pasko, James. Water-Quality Research for the National Water-Quality Assessment Program - A Multi-Year Investigation; US Geological Survey; $209,960. MCECS; Amendment
Podralsky, Jason. Graduate Fellowship Program: Fellow - Claire Riggs; National Science Foundation; $69,500. CLAS; Student Award
Rockhill, Anna. Safer Futures; Department of Health and Human Services; $61,479. SSW; New
Rosenstiel, Todd. Proposal for Preliminary Quantification of Total VOC Emissions; Greenwood Resources; $63,837. CLAS; Amendment
Roussos, Daniel; Zurk, Lisa. Mid-Frequency Propagation Modeling Using the Wavelength Invariant; Office of Naval Research; $279,999. MCECS; Amendment
Strongin, Robert. Building on Success: Pacific Northwest Lewis Stake Alliance for Minority Participation (Phase 2); National Science Foundation; $217,350. OAA; New
Sysma, Mark. Joint Program for Collaboration and Cooperation in Research, Education, and Outreach; US Geological Survey; $1,564,000; SSW; Amendment
Sysma, Mark. Zebra and Quagga Mussel Monitoring in the Columbia River Basin; Bonneville Power Administration; $149,369. CLAS; Amendment
Takle, Stefan. Improving Exposure Transport Models Using Satellite Measurements (1); Office of Naval Research; $311,346. MCECS; Amendment
Takle, Stefan. Improving Exposure Transport Models Using Satellite Measurements (2); Office of Naval Research; $345,503. MCECS; Amendment
Takle, Stefan. CAREER: Modelling 19th-century Estuaries to Address 21st-century Problems; National Science Foundation; $105,301. MCECS; New
Teuscher, Christof. A Stochastic Influence Model based on Probabilistic Bit-Streams; Defense Advanced Research Projects Agency; $334,748. MCECS; Amendment
Tolmach, Andrew. SOUND - SAFE on Untrusted Network Devices; Defense Advanced Research Projects Agency; $551,181. MCECS; Amendment
Walker, Janet. Technical Assistance Network for Children’s Behavioral Health (TA Network) Task 2; Substance Abuse and Mental Health Services Administration; $239,506. SSW; Amendment
Walker, Janet. Technical Assistance Network for Children’s Behavioral Health (TA Network) Task 8; Substance Abuse and Mental Health Services Administration; $58,402. SSW; Amendment
White, Diana. Person-centered Care Measure in Adult Foster Care; Oregon Department of Human Services; $72,719. CUPA; New
Zaron, Edward. Improving Coastal Marine Governors; National Geospatial-Intelligence Agency, $219,753. MCECS; Amendment
Zarou, Lina. Analysis of Egoengagement Dynamics with Application to Office Role: Army Medical Research; Office of Naval Research; $341,598. MCECS; Amendment

Selected Proposals, Q3

View the complete list of proposals at: pdx.edu/research/university-research

Ancit, Tina. The Clinical Rehabilitation Counseling Education Program (CRCEP); US Department of Education; $998,650. GSE
Anderson, Timothy; Bass, Robert; Garrick, Will; Jetter, Antonie; Tiffee, Kristin. Open Source Framework for Accelerating Synopsizer Analysis; Bonneville Power Administration; $339,993. MCECS
Baney, William. Washington State Systems of Care Expansion Consultation; Substance Abuse and Mental Health Services Administration; $443,471. SSW
Bliss-Ketchum, Leslie; DeRivers, Catherine. Monitoring Effectiveness of the Lava Butte Wildlife Crossing Measures; Oregon Department of Transportation; $261,764. CLAS
Brettell, Scott; Delambre, Lois. III. Small: Weaving Quick Draw Semantics into the Web; National Science Foundation; $515,827. SSW
Buckley, Brad. Cellular Life and Death in the Cold: Apoptosis and DNA Damage in Antarctic Fish; National Science Foundation; $767,246. CLAS
Cal Santiago, Raul E. Collaborative Research - Advantages and Impacts of a Multi-scale Wind Farm; National Science Foundation; $284,807. MCECS
Campbell, Chris. Investigating Idiosyncratic Defense: Client Rights, Client Satisfaction, and (Mis)perceptions of the ‘Public Defender’; Department of Justice; $472,310. CUPA
Chen, Zhiqiang; Jiao, Jun; Hiro, Richard; Johansson, Erik; Koeneckamp, Ralph. NNCl: Enabling Nanotechnology Education and Research Nationwide via Portland State University’s Self-Sustaining Center for Electron Microscopy and Nanofabrication; National Science Foundation; $8,679,583. CLAS
Chang, Heejun; Podralsky, Jason; Rosenstiel, Todd; Fink, Jonathan; Kelly, Kirk. CC-DNI Networking Infrastructure: Research and Innovation Network for SU; National Science Foundation; $500,000. CLAS
Comer, William. Russian Flagship Center Renewal; US Department of Defense; $239,000. CLAS
Daim, Tugrul. NW Energy Efficiency Technology Roadmap, Bonneville Power Administration; $1,593,192. MCECS
DeRivers, Pam. Professional Development Systems, Standards, Support; Department of Health and Human Services; $878,558. GSE

Proposals by Quarter

FY 2015

Q1 | Q2 | Q3 | Q4

Pdx.edu/research/...
Selected Proposals Q3 View the complete list of proposals at: pdx.edu/research/university-research

Research Expenditures Q3, 2015

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Q3 Publications

View the complete list of publications at: pdx.edu/research/university-research

This partial list of publications contains articles by PSU faculty published between Jan. 1, 2015 and March 31, 2015. The list was generated by Web of Science, citations were provided by Google Scholar. The list is alphabetized by lead author listed on individual publications. PSU authors are listed in boldface. You can view the full list of faculty publications here. If you published a paper between January and March that does not appear in the Quarterly Review, email publication information in APA format to rpscom@pdx.edu.

Murphy, M. T.; Chatter, C. M.; Redmond, L. J. (2015). Quantification of avian parental behavior: What are the minimum necessary sample times? Journal Of Field Ornithology, 86(1), 41-50. CLAS
Yang, L. Q. (2015). Sometimes less is more: Directed coping with interpersonal stressors at work. Journal Of Organizational Behavior. CLAS

Research Snapshot

Q3 Publications

View the complete list of publications at: pdx.edu/research/university-research

Research Snapshot

Doctoral Degrees Conferred, Winter 2015

Gregory Alan Bostrom, Ph.D. Dissertation Chair: Andrew Rice Dissertation title: Modifications to a Cavity Ringdown Spectrometer to Improve Data Acquisition Rates
Carl William Foreman, Ph.D. Dissertation Chair: Neal Wallace Dissertation title: Impact of a State Evidence-Based Practice Legislative Mandate on County Practice Implementation Patterns and Inpatient Behavioral Health Discharge
Matthew Robert Holdgate, Ph.D. Dissertation Chair: Deborah Duffield Dissertation title: Applying GPS and Accelerometers to the Study of African Savannah (Loxodonta africana) and Asian Elephant (Elephas maximus) Welfare in Zoo
James R. Laidler, Ph.D. Dissertation Chair: Kenneth Stedman Dissertation title: Palaeological and Ecological Impacts of Virus Silicification
Dong-Joon Lim, Ph.D. Dissertation Chair: Tim Andersson Dissertation title: Technological Forecasting Based on Segmented Rate of Change
Dora Madeline Raymakan, Ph.D. Dissertation Chair: Wayne Wakeland Dissertation title: Intersections of Critical Systems Thinking and Community Based Participatory Research in Developing a Web Site for Autistic Adults
Jennifer Rae Rineker, Ph.D. Dissertation Chair: Donald Truxillo Dissertation title: Supporting the Aging Workforce: The Impact of Psychosocial Workplace Characteristics on Employees' Work Ability

Dissertation title: Structural and Metabolite Changes in the African Elephant (Loxodonta africana) and Asian Elephant (Elephas maximus) Welfare in Zoo


Dissertation title: Mindfulness and compassion in human development: Introduction to the special section.

Dissertation title: Structural and Metabolite Changes in the African Elephant (Loxodonta africana) and Asian Elephant (Elephas maximus) Welfare in Zoo
