



the Fralin
Explorer
Spring 2016

WELCOME TO FRALIN



Dennis R. Dean

Director, Fralin Life Science Institute

Dear Colleagues and Friends of the Fralin Life Science Institute:

We have recently passed the twentieth anniversary of the establishment of the Fralin Biotechnology Center and we are also approaching the 10th anniversary of its transition into a major institute at Virginia Tech – the Fralin Life Science Institute. We are planning to have a variety of celebrations to recognize the remarkable accomplishments of the students, faculty, and visitors that have been associated with

the institute over the past two decades, such as those found in this edition of the Fralin Explorer. As we proceed, we would be delighted to hear from you to find out more about your career and your work, so please contact us and bring us up to date.

The past several years have been marked with incredible changes throughout the university. Among those changes are the retirement of President Steger, Provost McNamee, and Vice President for Research Walters. Indeed, President Steger, together with our founding director, Tracy Wilkins, challenged us with a bold and innovative mission - to help grow the life science research enterprise while remaining true to the ideal of *Ut Prosim* and continuing to embrace the teaching and outreach missions that underpin the land grant mission of the university. The successes of our affiliated faculty and their students in meeting these challenges, so far, have depended greatly on the guidance, abiding interest, and support provided by the offices of the Provost and the Vice President for Research. We are so grateful to have had the benefit of working with effective leaders that steadfastly provided the tools we needed to help advance the research community.

At this point in the evolution of the university, and in the Fralin Life Science Institute, I am reminded of Janus, the two-headed Roman god of beginnings, gates, transitions, time, doorways, and endings. Like Janus, we look back to our beginnings with an appreciation for the many opportunities we have been given, as well as satisfaction for the many accomplishments of the Virginia Tech faculty and students. Also, like Janus, we now look forward with great anticipation to the new vision and challenges articulated by President Sands, Provost Rikakis, and Vice President of Research Mayer. Here, I refer to the implementation of the Destination Areas and Beyond Boundaries.

The coming years will require transitions in our approaches, gates to overcome, doorways to burst through, and time to realize the creation of the model land grant university of the 21st century. However, unlike Janus, we do not see an ending; instead, we see ever expanding opportunities without boundaries. Please stay tuned as we look to the past in celebration of our achievements and look forward as we ‘invent the future’.



ABOUT US



Horace Fralin

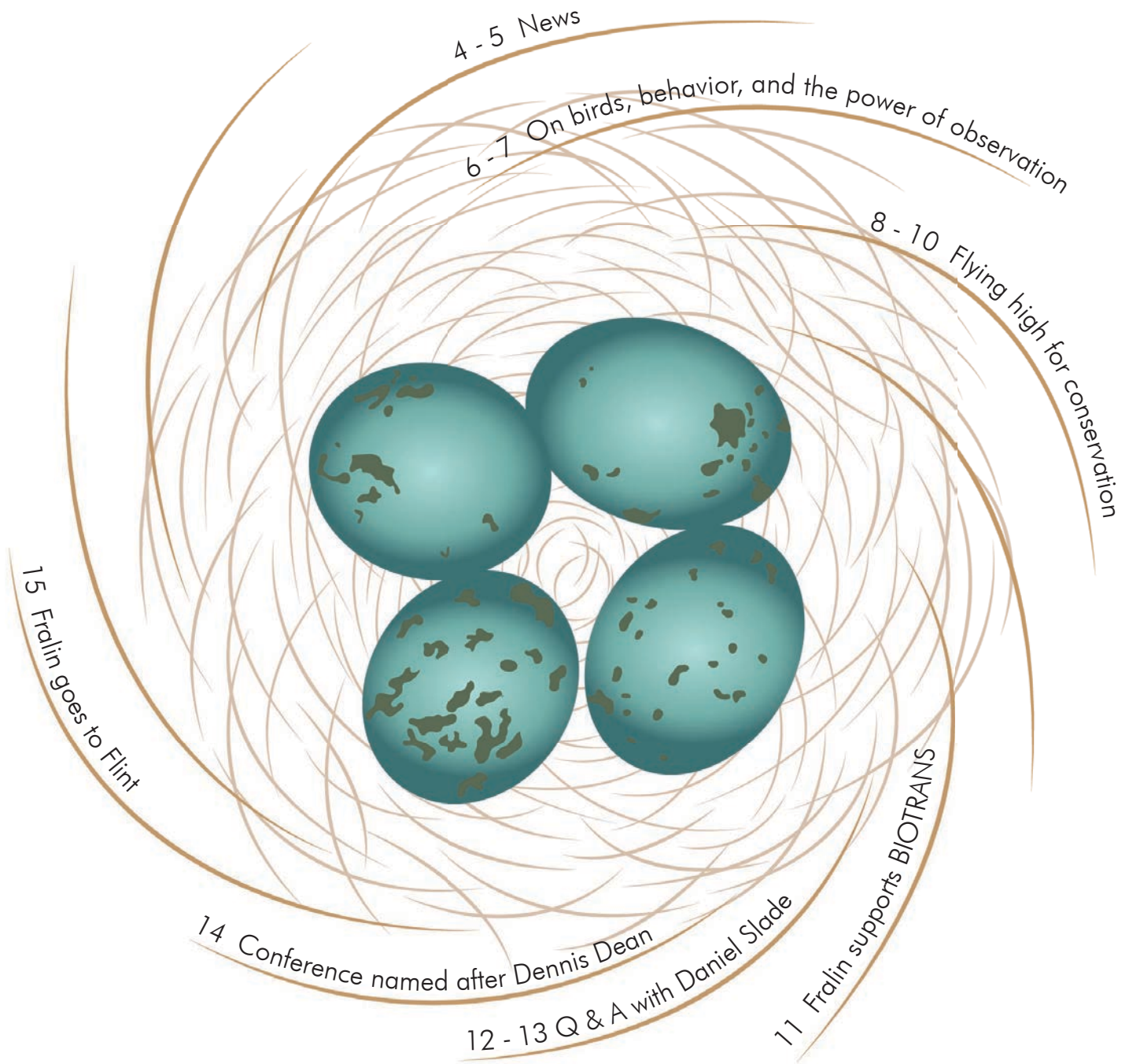
The Fralin Life Science Institute is an investment institute committed to supporting **research, education, and outreach** in Virginia Tech’s life sciences community. Residents of the institute’s four flagship buildings are automatically considered affiliated faculty members and all other life science researchers on campus are invited to become affiliated faculty members.

Affiliated faculty members are given resources necessary to explore new, innovative science that benefits people in the New River Valley, the Commonwealth of Virginia, and the world.

Through seminars, conferences, and research group support, the institute serves as a meeting point for progressive ideas involving multidisciplinary research. It is

closely aligned with Virginia Tech’s other six research institutes, which include the Virginia Tech Carilion Research Institute, Virginia Tech Transportation Institute, the Institute for Critical Technology and Applied Sciences, the Biocomplexity Institute, the Institute for Society, Culture and Environment, and the Institute for Creativity, Arts and Technology.

Research initiatives within the life sciences receiving the highest priority for support include vector-borne disease, infectious disease, plant sciences, ecology and organismal biology, obesity, and cancer biology. The Fralin Life Science Institute is also actively engaged in cooperative partnerships with colleges, departments, and other institutes that support the life science community.



LIFE SCIENCE RESEARCHERS SUGGEST GENE DRIVE STRATEGY TO COMBAT HARMFUL VIRUS SPREAD

With the outbreak of viruses like Zika, chikungunya, and dengue on the rise, public health officials are desperate to stop transmission.

Virginia Tech experts explore one way — through the genetic engineering of mosquitoes to maleness — in the Feb. 17 issue of the journal *Trends in Parasitology*.

In the paper, the researchers discuss how recent breakthroughs in CRISPR-Cas9 gene editing technology coupled with their discovery last year of a male sex determining gene, Nix, could be a winning combination for tipping the male-female mosquito ratio in the wild.

Male mosquitoes are harmless because they feed only on nectar; female mosquitoes need to feed on blood in order to produce eggs, and are solely responsible for disease transmission.

In the lab, Virginia Tech researchers have proven that adding Nix into female mosquito embryos could initiate male development.

“We are testing the hypothesis that insertion of key male determining genes such as Nix into the genome of female mosquitoes could produce fertile or sterile males or simply female lethality, all of which will result in less females,” said Zhijian “Jake” Tu, a professor of biochemistry in the

College of Agriculture and Life Sciences, co-author of the study and a Fralin Life Science Institute affiliate.

The next step, researchers said, is to understand how this technology might be useful in the wild.

“Combining Nix with CRISPR-Cas9 technology could really help us complete goals set and not reached by previous campaigns to eradicate *Aedes aegypti* mosquitoes, by driving maleness into wild populations,” said Zach Adelman, an associate professor of entomology in the College of Agriculture and Life Sciences and co-author of the paper.

Both researchers are affiliated with the Fralin Life Science Institute’s Vector-borne Disease Research Group. This work was supported by the National Institute of Allergy and Infectious Diseases.

-Lindsay Key

VIRGINIA TECH RESEARCHERS CALL FOR PUBLIC WATER QUALITY REPORTS TO DIRECTLY ADDRESS WATER SAFETY

Is your water safe to drink?

A Virginia Tech research team suggests that annual water quality reports should answer this question more directly to build people’s

confidence in and education about their drinking water.

This suggestion comes from its recent study published in the *Journal of Water and Health*.

In it, the team found that a national sample of Consumer Confidence Reports fails to communicate important information because the reports use complicated language and sophisticated data tables.

As a result, people are left to determine on their own if their water is safe to drink according to state and federal safety regulations.

“We are concerned about whether people are drinking enough water if they don’t understand these reports,” said Brenda Davy, a professor of human nutrition, foods and exercise in the College of Agriculture and Life Sciences, a core faculty member in the Virginia Tech Water INTERface Interdisciplinary Graduate Education Program, and a Fralin Life Science Institute affiliated researcher in the Fralin Translational Obesity Research Center.

Each year by July 1, people purchasing water from U.S. public water systems should receive a report by mail or online. The goal of the reports is to communicate where water comes from, what’s in it, and whether it meets state and federal safety regulations.

Davy’s concern originally grew from not understanding her report when she received it in the mail in 2014.

She and her team, including corresponding author Andrea Dietrich, a professor of civil and environmental engineering in the College of Engineering, analyzed the samples based on the Centers for Disease Control and Prevention’s Clear Communication Index. This index is designed for writers to ensure public health materials are written with plain everyday language for broad public audiences.

One component of the index suggests that materials contain a main message, which is meant to inform people of an overall health message. According to the researchers, these reports should begin by directly stating



Life scientists identified a male-determining genetic switch called Nix in a dangerous type of mosquitoes. The discovery could help protect human health. *Photo by Alexander Wild.*



Virginia Tech researchers called attention to the technical language used in annually issued Consumer Confidence Reports. Residents using public water systems should receive a report online or in the mail by July of each year.

whether water is safe to drink according to state and federal regulations. This message should then be followed by possible actions to take, such as calling water providers to learn more about testing, regulatory requirements, and potential risk.

“The goal is to inform people about their drinking water and whether water is safe to drink,” said Katherine Phetxumphou of Woodbridge, Virginia, a Ph.D. student in civil and environmental engineering and lead author on the paper. “This is the clearest way to do it.”

Phetxumphou began working with Davy through Virginia Tech’s Water INTERface Interdisciplinary Graduate Education Program; so did co-author Siddhartha Roy of Palanpur, India, a doctoral student in civil and environmental engineering.

“Please read your annual report,” Roy said. “Take a few minutes and make an effort. If you don’t understand it, call your water utility and have them explain. Ask straight, pointed questions about information that seems hard to understand.”

Roy speaks from recent personal experience, having spent months as the communications director for FlintWaterStudy.org – a site that, under the direction of Marc Edwards, the Charles P. Lunsford Professor of civil and environmental engineering, sought to inform Flint, Michigan, residents about the city’s lead contamination after switching its water source.

Currently, water quality reports are not required to have a single main message. However, they are intended to increase

public understanding of water quality so that people can make informed decisions about their water, according to the U.S. Environmental Protection Agency’s report rule. Including a main message about whether water meets regulations could work better to achieve this outcome and improve public health.

“This study highlights the need for more social science research in this area,” said Alan Roberson, director of regulatory affairs at the American Water Works Association, who served as a reviewer of the paper.

“Even though regulations require specific language, water utilities can frame information in terms that people can understand,” Roberson said. “Doing so can go a long way in ensuring people have access to the information they need to make informed decisions regarding their water.”

The EPA requires that reports contain specific language for consistency in communication; water providers then use EPA-maintained software called CCR-iWriter when preparing these reports. In response, the team recommends that the required language be revised to more effectively benefit service providers in their communications with consumers nationwide.

-Cassandra Hockman

FRALIN LIFE SCIENCE INSTITUTE RANKS AMONG 50 BEST GRADUATE RESEARCH INSTITUTES

Virginia Tech’s Fralin Life Science Institute is ranked 24th among the 50 best graduate research institutes by Grad School Hub, an online resource that offers information on high-quality graduate degree programs at U.S. universities.

The initial pool of research universities was drawn from an elite group of about 100 universities noted for the highest research activity by the Carnegie Classification of Institutions of Higher Education. The following metrics were considered by Grad School Hub: University research and development expenditures, awards and

recognition related to research, leadership in energy & environmental design (LEED) certified facilities, interdisciplinary approach, majority graduate/professional enrollment, very high research activity, “wow” factor.

The Fralin Life Science Institute provides resources to Virginia Tech’s life sciences community to support innovative research, education, and outreach. Established in 2008, the institute studies key issues in the life sciences such as ecology and organismal biology, vector-borne disease, infectious disease, plant sciences, obesity, and cancer biology.

“We are extremely proud to be named among the 50 best graduate research institutes in the country,” said Dennis Dean, Fralin Life Science Institute director, University Distinguished Professor, and the Stroobants Professor of Biotechnology. “The motto of our staff at the Fralin Institute is ‘Living Science,’ which embodies the scientific opportunities and the wonderful place to live and work that Virginia Tech provides.”

As a testament to ongoing growth and progress, three new laboratories at the institute have recently been renovated. These labs house a new insectary to support the work of the Vector-borne Disease Research Group. In 2015, a new Global Change Center was added to the institute. Its focus includes five emerging global threats: habitat loss, pollution, invasive species, disease, and climate change.

-Lindsay Key



Fralin Life Science Institute supports innovative research, education, and outreach in the life sciences.
Photo by John McCormick.

ON BIRDS, BEHAVIOR, AND THE POWER OF OBSERVATION



Virginia Tech graduate student Sydney Hope studies the biology and behavior of wood ducklings.
Photo by Gloria Schoenboltz.

Along the western coasts of Central and South America lives a bird with bright baby blue feet. Compared to the rest of its body, the bird's feet are big and floppy, and stand in stark contrast to its coffee brown wings and white-gray plumage.

The male, aptly named, blue-footed booby uses its webbed beauties to attract females. Once he approaches, he displays each foot, one at a time. As he displays, he rocks back and forth, performing a slow, ritualistic dance. Every few steps, he extends his wings in full, while still rocking back and forth, showing off his feet. If the female is interested, she will join him by displaying her feet, one at a time, back and forth, until both birds are in synchrony.

Sydney Hope witnessed this courtship sway while visiting the Galápagos Islands in 2011 after her freshman year in college. Crouched on a nearby rock, she watched the birds' movements, one foot at a time, back and forth. She was fascinated and wondered how this unique mating behavior evolved. As an undergraduate studying biology at the College of New Jersey, Sydney was attuned to observing wildlife. Ever since she could

remember, she loved watching and playing with animals. Now, she was bearing witness to life in the wild, and making connections between her coursework and her interest in animal behavior. Her thinking grew from an innate, personal curiosity to an observation-driven exploration.

Since then, she has applied the same fascination with the blue-footed boobies to other species of birds, including the Carolina chickadee, the Oregon junco, and most recently the wood duck – all the while asking questions about her observations. Why do these animals behave this way? How do they benefit from such behaviors?

With this deep sense of curiosity and questioning, Sydney began graduate school at Virginia Tech in the fall of 2014. As a Hokie, she studies wood duck behavior and physiology under the mentorship of Bill Hopkins, professor of fish and wildlife conservation in the College of Natural Resources and Environment, a Fralin Life Science Institute affiliate, and director of the Global Change Center at Virginia Tech.

For her master's research, funded by a National Science Foundation Graduate Research Fellowship, Sydney investigates how the wood duck's early developmental environment affects its ability to perform certain important behaviors for survival. One of the most important feats is leaving the nest shortly after hatching.

At a South Carolina fieldwork site, nestled inside a tree trunk about a foot below an opening, a baby wood duckling hatches. Its feathers are soft, light yellow and brown. Soon after, outside the nest, the mother wood duck whistles out something like a high-pitched *bre-eh-eh-eh* on repeat. Like a little dart, the baby wood duck uses the claws on its webbed feet to build a hopping momentum – until up, up, and out!

"This is my favorite wood duck behavior," Sydney said, having observed the ducklings during her field season last spring at the U.S. Department of Energy's Savannah River Site.

"Most of the time the nest is over water, so they jump into the water. But I've heard stories that they can nest in cities over concrete. When they jump, the ducklings fall to the ground, bounce up to three feet in the air, and then are perfectly fine!"

The ducklings' jump is usually motivated by their mother, who whistles for them to join the rest of the family as they leave for food or new shelter. Sydney measures these and other important social behaviors, such as how much and when a duckling vocalizes or 'calls.' She also measures how they interact with the world around them, including their movement patterns and their responses to stimuli, like calls from other wood ducklings.

"It's very important that the study of animals also involves observing their behavior," Sydney said. "If you only look at an animal's structure and physiology, you overlook many things about how that animal lives and interacts with its environment and other animals." Knowing how animals tend to behave in certain conditions informs how populations might adapt over time when these conditions change. So, how might the early



A wood duckling peaks out from a nest box at Virginia Tech's new research aviary. *Photo by Gloria Schoenboltz.*



A male blue-footed booby shows off his webbed feet and spreads his wings to woo a female. *Photo by Sydney Hope.*



nest environment of wood ducklings affect their behavior?

Environmental conditions may cause changes to the environment of a wood duck's nest and, in turn, influence the temperature of the eggs in that nest. Sydney's research focuses specifically on how small changes in incubation temperature impact how a duckling interacts with its environment once it hatches and grows.

"Anything that disrupts maternal wood duck behavior during incubation can affect the incubation temperature," said Sydney. Changes in incubation temperature may be due to a number of factors, she continued. This includes the amount of time the mother sits on the eggs, and whether other wood ducks have laid eggs in the same nest, increasing the nest size.

Human disturbances, such as walking or making noises near nests, for example, can scare an incubating wood duck mother off

her nest. At the same time, climate change may result in more extreme weather and variance in available food. If a mother has to leave her nest to get food, she could spend more time foraging and less time incubating. Both scenarios would cause a decrease in incubation temperature, which could affect wood duck development – and, ultimately, survival.

On the other hand, as Sydney is finding, a certain decrease in temperature may instead make wood ducklings more active. More movements and exploration may mean ducklings can get additional resources in order to survive in certain environments.

In the coming months, Sydney will compare behavior and incubation temperature to blood levels of certain hormones and the brain receptors for those hormones. Doing so will help reveal the biological mechanisms underlying these behavioral patterns, providing important answers to Sydney's tough but essential questions. We have the blue-footed boobies to thank.

- Cassandra Hockman

SYDNEY TALKS ABOUT SCIENCE

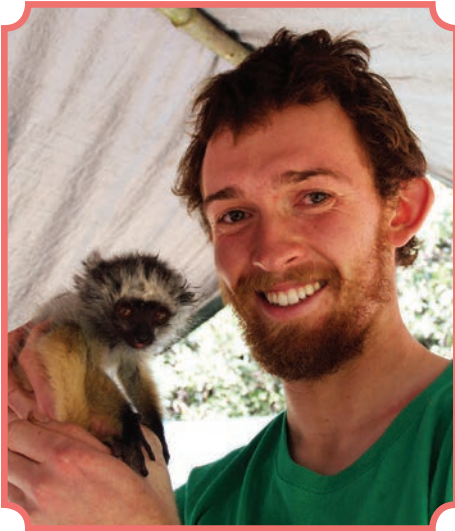
What would you like the public to know about conservation, climate change, or the value of basic science in general?

I think the public needs to trust in science, and agree that climate change and increased extinction rates are real issues so that efforts can be made to reverse these trends.

You have expressed passion for sharing science with others. Why is this important to you?

Science doesn't mean anything unless it is shared. The only way that scientific discoveries can make a change is through widely sharing them with the public.

FLYING HIGH FOR CONSERVATION: AN INTERFACES OF GLOBAL CHANGE FELLOW WILL USE DRONES TO HELP SAVE LEMURS



Brandon Semel with an infant diademed sifaka.

Brandon Semel's doctoral research can be traced back to a picture book.

Within the book are images of bushy tailed lemurs, hand drawn by an eight-year-old Brandon growing up in the Midwestern United States. He'd first seen the big-eyed primates on a wildlife documentary show on television and was hooked.

When Brandon presented his dad with the book, Brad Semel knew he had to encourage his son's passion. He called the Duke Lemur Center and arranged a guided tour. They graciously obliged.

Little did Brandon know that the person who led the tour would one day be the advisor for his undergraduate research into the wild world of lemurs.

"I was told that a family with a third grader who knew a lot about primates, and lemurs in particular, had scheduled a visit," said Dr. Ken Glander, a professor in the Evolutionary Anthropology Department at Duke University, and former director of the Lemur Center. "I was intrigued and told my staff that I was willing to be their guide on their visit. Brandon was unusual in that he was already much better informed than most young students; he was already at the level of many Duke undergraduates."

Back home in Illinois, Brandon volunteered with the state's department of natural resources, where he participated in wetland bird surveys, habitat restoration, and prescribed burns to maintain native prairies. While his knowledge and interest in all wildlife grew, he still had a favorite.

A love for lemurs

Rustling about in the slowly dwindling forests of Madagascar are all of the world's lemur species—the blue-eyed black, aye-aye, fat-tailed dwarf, red-bellied, eastern woolly, white-footed sportive, greater bamboo, ring-tailed, and golden-crowned sifaka, to name just a few.

Madagascar, the fourth largest island in the world, broke off from the Indian sub-continent around 88 million years ago, leaving species to evolve in isolation. It is the only place in the world where lemurs, and many other unique plant and animal species, can be found in the wild.

Scientists think that lemurs were washed towards Madagascar from mainland Africa 55 million years ago by ocean currents, carried on mats made of vegetation. Some lemurs can hibernate—an ability that likely helped their ancestors survive the long journey. Other lemurs, like their ancestors, are nocturnal tree-dwellers; perhaps their shadowy nighttime presence is what earned them the name "lemur," which comes from the word "lemures"—a ghost or spirit in Roman mythology.

These tree-dwellers come in a variety of shapes and sizes, ranging from the one-ounce mouse lemur to the 20-pound sifaka. Species today are just a fraction of the size of the earliest lemurs that lived in Madagascar prior to human settlement. All known extinct lemurs were larger than their modern relatives, with one the size of a female gorilla. Larger species had a hard time adapting to Madagascar's changing climate a few thousand years ago, and were easy prey for Madagascar's first human inhabitants.

Lemurs may be solitary, live in pairs, or be part of a group up to 20 members strong. Each group is ruled by a dominant female who has first choice of mates and food, which is usually plants or insects. Lemurs have long life spans for their size. Some live 16-20 years in the wild but can live for more than 30 years in captivity. Lemur reproduction is slow; females only ovulate for a few days during the year, usually between January and June. If impregnated, they typically give birth to one lemur at a time, or, on rare occasions, twins.

Of the 107 currently recognized lemur species, 24 were listed as critically endangered in 2013 by the International Union for Conservation of Nature (IUCN). This number is steadily growing due to human encroachment, deforestation, subsistence hunting, and climate change. In fact, the IUCN has named lemurs as the world's most endangered mammals.

"Humans are the biggest threat to lemurs, and the human population in Madagascar is growing fast," said Brandon.

The first time Brandon visited Madagascar was in high school on a family vacation. Staying in relatively nice tourist lodges near main parks and forests, the Semel family visited prime lemur and bird watching sites, learning about the wildlife from professional guides or translators who had a good deal of experience interacting with foreigners.

While the Semels got a bird's eye view of the country, when Brandon would return a few years later as an undergraduate researcher, he'd see a whole different Madagascar

A budding anthropologist

Come college time, Brandon knew exactly where he wanted to go. He chose to enroll as an evolutionary anthropology major at Duke University in order to gain the knowledge he needed to help conserve his beloved lemurs.

WILDLIFE CONSERVATION

At first glance, anthropology seems like an odd choice, as the field is often centered on the study of humans. However, the close genetic tie between humans and other primates, such as lemurs, makes it the major of choice for primate researchers.

“Studying the wide diversity of social behavior, nutrition, culture, habitat use, and evolutionary history of primates, our closest living ancestors, can teach us a lot about early human evolution,” said Brandon. “Thus, primatology is often included under physical anthropology. Most people who study primates in the United States—whether they’re studying behavior, conservation, evolution, morphology, etc.—work out of anthropology departments.”

As an undergraduate researcher in the evolutionary anthropology department at Duke, Brandon began working as a research assistant to Dr. Luke Dollar, associate professor of biology, who had strong ties to the Duke Lemur Center.

With Dollar, Semel traveled back to Madagascar to investigate the effects of human encroachment on the fossa, the most significant predator to lemurs besides humans. Fossas—which made a Disney debut in the film *Madagascar*—resemble miniature mountain lions, though they are more closely related to mongooses.

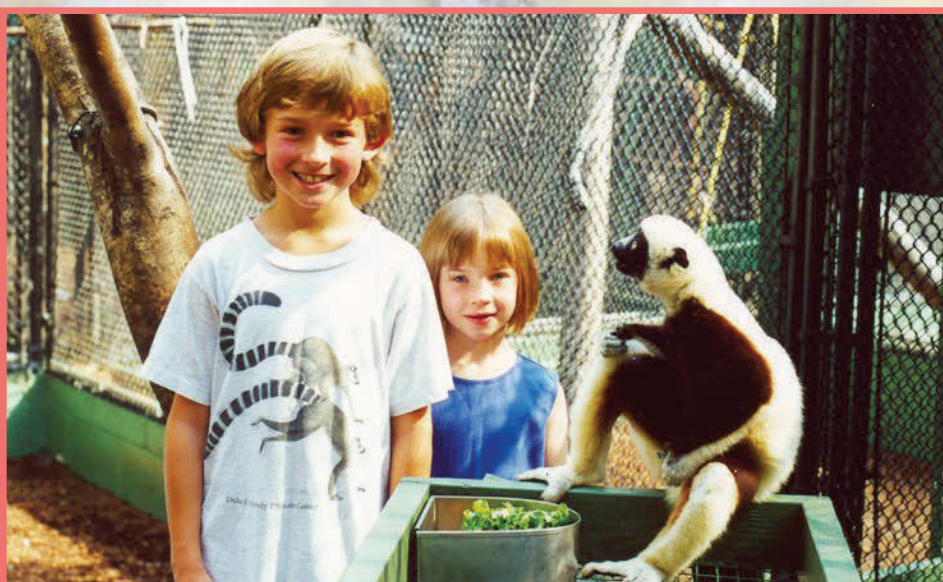
By conducting extensive vertebrate surveys and trappings, the team that Semel worked

with found that increasing feral dog populations were reducing populations of birds, reptiles, and mammals across the landscape. They also found that feral dogs were able to out-compete fossas for food. Therefore, the fossas were driven away from forest edges and deeper into the shrinking interior.

Living amongst native people while on research projects, Brandon saw a whole new Madagascar.

“Once I started to get a handle on the language, things really changed because I was no longer hearing second hand accounts of the challenges that people were facing,” Semel said. “They suddenly became real. People had individual hopes and dreams that I could understand and relate to, but the lengths to which people had to go to achieve them was mind-boggling and the obstacles seemed insurmountable. Everyone always talks about the Malagasy (the ethnic group that makes up the population of Madagascar) being tied to their homelands and families, so I was shocked to hear what lengths people would travel to find jobs or work, not knowing when or if they would be able to return home.”

Brandon learned about the specific environmental and economic challenges faced by the Malagasy. For example, he learned that poor tropical soils make a lot of the country’s land unsuitable for agriculture.



Brandon Semel and his sister, Sierra Semel, during their first trip to the Duke Lemur Center.



Verreaux's Sifaka.
Photo by Brandon Semel.

“When people need farm land, really all they can do is cut down the trees and burn them, to release those nutrients back into the soil,” Brandon said. “If you do that on a small scale, every few years, it can be sustainable. But Madagascar has one of the fastest growing human populations in Africa, in the world really, and so it has just become unsustainable.”

He also learned that in the rainforest areas, where it’s hard to keep domesticated animals, lemurs are the only real source of meat that the Malagasy have access to, and, therefore, hunting is a major threat for many lemur species.

While an undergraduate researcher in Madagascar, Brandon connected with Dr. Sarah Karpanty, an associate professor of wildlife in the College of Natural Resources and Environment at Virginia Tech. Brandon chose to continue his studies at Northern Illinois University where he got a master’s degree in anthropology; however, he stayed in touch with Karpanty, and this connection would prove important down the road.

A commitment to conservation

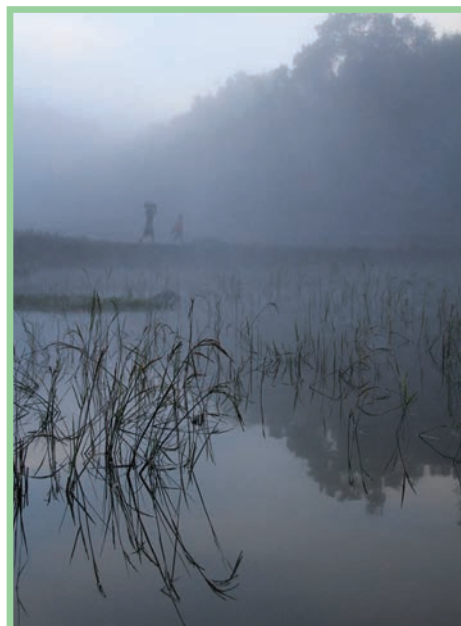
For his master’s thesis back in his home state, Brandon chose to study why two lemur species that live in Madagascar’s eastern rainforests eat soil. He investigated

several potential reasons: parasite removal from the gut, acid neutralization, diarrhea prevention, that the soil packed enough minerals to serve as a daily vitamin, and that the dirt flushed out toxins in the system.

The toxins, Brandon found, come from the lemur’s diet, which consists of leaves and seeds packed full of toxins created by the plants for defense. In the end, he found that this was the most likely reason for soil consumption.

Brandon enjoyed his master’s research, but when he decided to go for a doctorate, he knew that he wanted it to be in a field in which his research would go beyond behavioral studies of lemurs to applied conservation research.

That’s what brought him to Virginia Tech to work with Karpanty. After applying for and receiving a National Science Foundation graduate research fellowship to fund his studies, Brandon came to Virginia Tech in August 2015. Now, he is a Ph.D. student in the Department of Fish and Wildlife Conservation in the College of Natural Resources and Environment, and a fellow in the Interfaces of Global Change interdisciplinary graduate education program.



Malagasy people walking through rice paddy.
Photo by Brandon Semel.

At Virginia Tech, he hopes to expand his lemur research by studying how climate change has and will continue to shape the distributions of critically endangered golden-crowned sifakas in northern Madagascar.

“Their habitats are highly fragmented,” Brandon said. “The entire species is found in an area half the size of Montgomery County. There are fewer lemurs than there are students at Virginia Tech.”

This summer, with the help of a \$3,000 grant from the Cleveland Metro Parks Zoo, Brandon plans to use drone surveys to get the best data on population estimates of the golden-crowned sifaka in the forests of northern Madagascar. Drones are ideal for monitoring places that are hard-to-reach by foot, places where lemurs typically like to hang out.

The drone footage involves both still and moving photography, and geo-reference technology allows researchers to know the exact GPS coordinates where a lemur is photographed.

The use of drones for conservation research has become popular in the last few years. Ecologist Lian Pin Koh of Yale University founded ConservationDrones.org in 2012—an organization that seeks to raise public awareness about the use of drones for conservation purposes and to provide materials for researchers wanting to explore the technology, according to the group’s website.

While there are many regulations surrounding the use of drones to protect both people and wildlife, if successful, the technology has a lot of data to offer researchers.

“At the very least, drones can provide updated land cover data that’s often hard to come by and very expensive for conservation work,” said Semel. “But with the rate that drone technology is advancing, the sky really is the limit!”

- Lindsay Key

FRALIN SUPPORTS BIOTRANS PROGRAM

Tracking the movement of a hazardous agent through the atmosphere before it gets to a city or crop field. Investigating how small insects use a magnetic compass to get around. Modeling the dynamics of diving birds and flying snakes. These are just a few of the areas that BIOTRANS researchers work in.

BIOTRANS is an interdisciplinary graduate education program that trains students to solve problems at the intersection of engineering and biological sciences. Currently, there are 26 graduate trainees in the program, and each trainee is co-advised by a biologist and an engineer among the 18 affiliated faculty members.

Participating departments include biological sciences; biomedical engineering and mechanics; civil and environmental engineering; plant pathology, physiology and weed science; human nutrition, foods and exercise; and biological systems engineering, but the program collaborates beyond the boundaries of these departments.

Formerly known as MULTI-STEPS, the program changed its name in 2015 in an effort to better describe its members' interest in transport and to position the program for another large competitive award from the National Science Foundation.

BIOTRANS also has transitioned to a new, more nimble executive committee: Director and Recruiting Coordinator David Schmale, Co-Director and Rotation Coordinator Shane Ross, and Budget Manager Mark Stremler. Sally Shrader is the program administrator and Amy Pruden is the Graduate School Liaison.

"BIOTRANS is working on some of the biggest challenges in the world today at the nexus of disease, food, energy, and water," said Schmale, an associate professor of plant pathology, physiology and weed science in the College of Agriculture and Life Sciences and a Fralin Life Science Institute affiliate. "We are training the next generation of interdisciplinary biologists and engineers, and these students are the future."

First-year students in the BIOTRANS program participate in a series of fully funded 7-week laboratory rotations in order to get to know faculty members and their distinctive research. The BIOTRANS leadership team participates in 'match-making' to place Ph.D. students in laboratories that leverage the talents of the student and co-advisors for a productive partnership.

"The first year research rotations were an incredible experience," said BIOTRANS graduate student Gary Nave. "Not only did I get the opportunity to work with fantastic people and gain new perspectives on research, I got to see how different advisors go about advising. Some professors lean heavily on student collaboration while others prefer more one-on-one interaction. As I think about going into academia and having a research group of my own someday, I have gotten so many insights into how to go about doing research. Being a part of the BIOTRANS community has helped me grow as a researcher in such a unique way."

In addition to research, students also present at national and international conferences, participate in recruiting activities on campus and at collaborating institutions, organize annual retreats, and host renowned scientists and engineers from around the world for seminars.

For the next year, the program is supported by an NSF IGERT Award, an interdisciplinary graduate education program from the Graduate School at Virginia Tech, and the university's Fralin Life Science Institute.

"BIOTRANS is an exemplar of the vision and mission of the Fralin Life Science Institute and we are delighted to support the program," said Dennis Dean, director of the Fralin Life Science Institute. "Incubating collaborative research is what we do best and this combination of existing strength and emerging technologies by our research scientists in engineering and the life sciences is particularly exciting."

-Lindsay Key



FACULTY

David Schmale

Plant Pathology, Physiology, and Weed Science

Daniela Cimini

Biological Sciences

Rafael Davalos

Biomedical Engineering Mechanics

Raffaella De Vita

Biomedical Engineering Mechanics

Iuliana Lazar

Biological Sciences

Linsey Marr

Civil and Environmental Engineering

John Phillips

Biological Sciences

Shane Ross

Biomedical Engineering Mechanics

Eva Schmelz

Human Nutrition, Foods and Exercise

Jake Socha

Biomedical Engineering Mechanics

Mark Stremler

Biomedical Engineering Mechanics

Theresa Thompson

Biological Systems Engineering

Mary Leigh Wolfe

Biological Systems Engineering

Zhaomin Yang

Biological Sciences

COFFEE BREAK WITH A SCIENTIST



Daniel J. Slade
Assistant Professor, Biochemistry

What is the focus of your current research?

My laboratory studies how outer membrane and secreted proteins from the Gram-negative bacterium *Fusobacterium nucleatum* contribute to multiple human infections (i.e. mouth, brain, liver) through the induction of inflammation, and, ultimately, how this contributes to the onset and progression of colorectal cancer. *F. nucleatum* is highly overrepresented within the cancerous tissue of a significant percentage of patients with colorectal cancer, and transferring isolated bacterium from human tumors to a mouse model of cancer leads to both the acceleration of tumor formation and an overall increase in tumor number. Despite a connection between this bacterium and cancer, there is currently a lack of understanding as to which proteins and genes from the bacterium or the human host contribute to disease. This bacterium is unique in that it lacks several protein secretion systems that are commonly used by pathogenic bacteria to induce infection and disease. Despite this lack of previously characterized virulence genes, strains of *F. nucleatum* are able to invade epithelial and endothelial cells, and these invasive bacteria are more frequently isolated from patients with Inflammatory Bowel Disease (IBD) and colorectal cancer. To determine how this bacterium enters cells and if it is

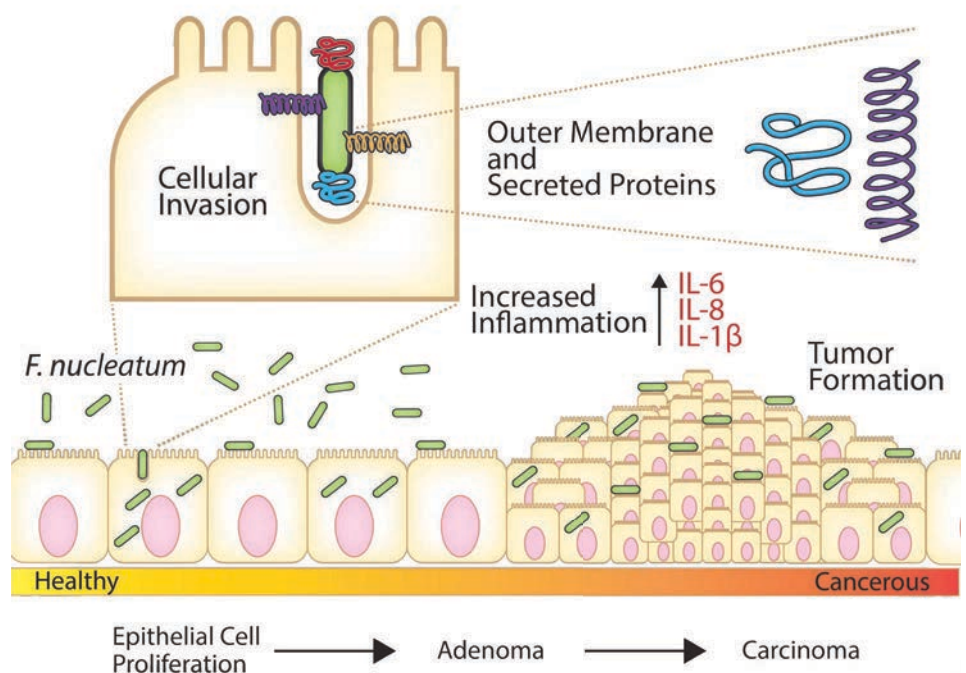
important for colorectal cancer modulation, we are characterizing how a group of large outer membrane proteins and secreted toxins known as autotransporters contribute to cellular binding, invasion, pro-inflammatory signaling, and the onset and progression of cancer. These studies will contribute to our understanding of how bacteria with the human microbiome are contributing to intestinal disorders including cancer.

A major focus of our research is to create gene deletions of the autotransporter family in *F. nucleatum*, followed by infection of human cells and mice to determine if specific outer membrane and secreted proteins are necessary for colonization, inflammation, and disease. As genetic manipulation of the *F. nucleatum* chromosome has been a severe bottleneck in the analysis of this bacterium, we are developing bacterial genetic tools with the goal of being able to delete multiple genes in the same bacterial strain. After we have identified autotransporter proteins that are critical for infection, we will use a combination of biochemical techniques to determine the structure and function of each gene with the goal of determining if these proteins can be targeted with inhibitors or even targets for vaccine

development. Since very little is known about this protein family in *F. nucleatum*, we are constantly surprised and intrigued by our results. This has made for very exciting discoveries that we are anxious to further develop and present to the scientific community to enable additional researchers and collaborators in the fight against bacterially induced cancer.

How did you become interested in your line of research?

My doctoral research focused on how the human innate immune system uses proteins circulating in the blood as a front-line defense against bacterial infections. I was fascinated by how our bodies are able to fight off invading pathogens, but even more intrigued as to how only a few select bacteria are able to evade this onslaught to infect and survive within the human body. To study the latter, I was awarded a postdoctoral fellowship to dissect how protein localization within the Gram-negative bacterium *Shigella flexneri* is essential for infecting and invading epithelial cells within the colon, which leads to severe dysentery. I then accepted a second postdoctoral position because I wanted to expand my training and knowledge of cancer by using structural



biology to study a group of enzymes that are upregulated in inflammatory diseases including breast cancer and rheumatoid arthritis. Through this work, I gained an understanding of how epigenetic changes in chromatin structure induce inflammation and modulate cell signaling pathways during disease, which is an important part of our current studies. After working in all of these diverse areas, I knew that I wanted to shape my laboratory by combining my love for immunology, microbiology, and cancer. Serendipitously, as I was forming my ideas for this, two major studies were published in parallel that showed that the Gram-negative bacterium *Fusobacterium nucleatum* was far more frequently found within colorectal cancer tumors when compared to healthy controls. After analyzing the interesting genome and protein repertoire of this bacterium, I knew that we could carve out a niche by using bioinformatics, molecular biology, and biochemical studies to discover proteins that allow colonization of the host and subsequent tumor formation.

How would you describe the dynamics and work environment of your laboratory?

I describe the laboratory as ‘ordered chaos,’ as we like to move at a fast pace because we are truly interested in finding the answers to our questions that could lead to a better understanding of bacteria in inflammation and cancer. At the moment, my team consists of one Research Scientist, two graduate students, and two undergraduate students. I am very proud to have recently trained two outstanding high school students from Virginia who are moving on to pursue degrees in the life sciences at prestigious universities. I like to think that I run my lab like Google, where scientists are encouraged to be creative and can pursue projects they are truly passionate about. While I can’t provide them with unlimited free food like Google, I do provide coffee, wireless speakers in the lab, a Frisbee to throw when we get exciting results, and group meetings and outings at a local watering hole! I have learned that when people are excited about their work, they are more likely to push projects to achieve outstanding results. My team is fantastic, and I always make sure to let them know

they are doing amazing work that has the potential to increase human quality of life.

Why did you choose to continue your career at Virginia Tech?

Virginia Tech fits my needs and wants perfectly as a scientist because this university excels in many areas, especially in the life sciences, bioinformatics, and engineering. Because of this, I have been able to expand the tools and techniques our lab uses to study bacterial infections by fostering interactions and collaborations with vibrant researchers at the university. After working at several universities and institutes, I am always impressed by the quality of work being performed by Virginia Tech scientists. There is a contagious energy that encompasses the campus, and new leadership and initiatives make this an exciting university to be a part of both now and in the future. When you combine the outstanding scientific vision at Virginia Tech with all that the Blacksburg community has to offer, there was no better choice for my family and me.

Which aspect of your research are you most excited about right now?

I feel that we are pushing boundaries for how to study difficult bacterial membrane proteins and how secretion systems are driving host-pathogen interactions. We are beginning to lean heavily on bioinformatics and cell biology to answer our questions, which will allow us to dissect the mechanisms of how bacteria contribute to diseases such as cancer. I am constantly pushing myself and my students to learn new techniques, with the goal of never having to limit the scientific questions that we ask to the skills that we currently have. It is exciting to give my students and scientists the freedom and encouragement to learn new techniques to facilitate their growth. We are also forming collaborations outside of our field, to study these bacteria using biomedical engineering and animal models. Virginia Tech is a great place to achieve this because the world-class science being performed here means that achieving scientific goals is only a phone call away to an experienced and outstanding colleague.

Hometown:

Bellingham, MA

Educational Background:

B.S. in Chemistry at Wofford College
Ph.D. in Biochemistry at the University of South Carolina
Postdoctoral Fellow in Microbiology at Harvard Medical School and Massachusetts General Hospital
Postdoctoral Associate in Chemistry at The Scripps Research Institute

Hobbies:

Drawing in either pencil or black pen, brewing beer, and hiking with my wife and daughters.

Favorite things to do around Blacksburg:

Lab group meetings outdoors at The Cellar, attending Hokie baseball games, and biking to work through the beautiful countryside.

A favorite book or two:

The Dragons of Eden: Speculations on the Evolution of Human Intelligence by Carl Sagan.
Oh the Places You'll Go! by Dr Seuss

A favorite quote:

“Science is not only a disciple of reason, but, also, one of romance and passion.”
– *Stephen Hawking*

Favorite type of music or artist:

I have a pretty substantial vinyl record collection, and I am enamored with the grace of Ella Fitzgerald, the raw energy of Louis Armstrong, the storytelling of Frank Sinatra, and the soul of Sam Cooke.

UNDERGRADUATE RESEARCH AND CREATIVE SCHOLARSHIP CONFERENCE TO BE NAMED AFTER DENNIS R. DEAN

A surprised look crossed Dr. Dennis Dean's face when a huge check was paraded out onto the stage after his keynote address at the 2016 Undergraduate Research and Creative Scholarship Conference held on Thursday, February 24 in Squires Haymarket Theater.

Behind the check was Dr. Jill Sible, Assistant Vice President for Undergraduate Education and a professor of biological sciences in the College of Science, who revealed that, in the future, the Spring conference will be named for Dr. Dennis R. Dean, and that an endowed fund had been set up in his honor to support the symposium. Colleagues and friends around campus had contributed to the fund to venerate Dean's extraordinary contributions to undergraduate research.

"Working in the Office of Undergraduate Research, I have the advantage of interacting with those who most support the undergraduate research mission. In that role, Dennis is unparalleled. Not only has he opened his own lab to dozens of students, but he has also been a role model for faculty in the mentoring of undergraduates," said Sible. "As an administrator, he has been a tireless champion in garnering the necessary resources for undergraduate research. When I floated the idea of building a lasting legacy to honor Dennis, my colleagues jumped at the chance."

Dean has provided advocacy, financial support, and research mentoring to numerous students and has personally mentored over 46 undergraduate researchers over his 30-year career at Virginia Tech.

Not only does Dean have experience mentoring undergraduates, he also had experience doing undergraduate research when he was a biochemistry student at Wabash College in the 1970's, which he spoke about in his address. Noting the hard work, long hours, and sacrifices that each of the students presenting at the conference had undergone, Dean told an amusing story about being the very last speaker at the first conference he ever presented at. Dean said

that by the time it was his turn to speak, only he and another student (who was scheduled to talk before him) were left in the audience. The other student suggested that they might as well skip their talks since nobody was there, but Dean wouldn't listen—he hadn't put in that much "sweat and tears" or traveled that far to not give his talk. So, the two gave each other their talks and continue to be friends to this day.

Dean is currently a professor in the department of biochemistry, a University Distinguished Professor, the Stroobants Professor of Biotechnology, and a Fellow of the American Association for the Advancement of Science (AAAS). He has served the university as the Director of the Fralin Life Science Institute, Director of the Virginia Bioinformatics Institute, and Interim Vice President for Research.

Dr. Dean's research on the mechanism of nitrogen fixation and the assembly of metalloclusters is recognized worldwide and he has published more than 160 peer-reviewed articles. He has received continuous extramural funding to support his research since 1975, including awards from the U.S. Department of Agriculture, National Science Foundation, National Institutes of Health, and Office of Naval

Research. Dean was a pre-doctoral National Institutes Trainee at Purdue University where he earned a Ph.D. in molecular biology and a National Institutes of Health postdoctoral Fellow at the University of Wisconsin. He began his independent scientific career at the Kettering laboratory.

Glenda Gillaspay, the head of the department of biochemistry in the College of Agriculture and Life Sciences, said of Dean: "Dennis Dean has been an enthusiastic supporter of undergraduate research during his career as a professor of biochemistry at Virginia Tech, and so it is fitting that the Undergraduate Research symposium should be named in his honor. During his career at Virginia Tech, he has advocated for the life sciences in many different ways. One of those ways is to ensure that undergraduates have a chance to do summer research on campus, through the Fralin SURF program. Within the biochemistry department, he is known for his excellent mentorship of both graduate and undergraduate students, who get unique training on one of the world's most important enzymes, nitrogenase."

- Janet Webster

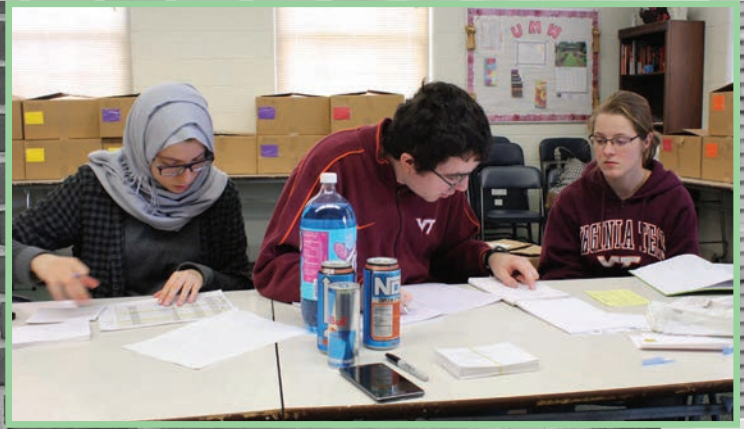


"Almost \$12,000 raised for the creation of the Dennis Dean Undergraduate Research Symposium

FRALIN GOES TO FLINT

The importance of building community. This is something Virginia Tech professor Marc Edwards and his Flint Water Study team know well. This is because several Flint, Michigan, citizens fought to get to the bottom of the lead contamination in their city's drinking water. As a result, they have worked alongside Edwards, the Charles P. Lunsford professor of civil and environmental engineering in the College of Engineering, and his team to collect water samples from homes well distributed throughout Flint.

This past spring break, Fralin communicator Cassandra Hockman joined a team of Virginia Tech students, researchers, and citizens who volunteered their time in Flint to collect a second round of water samples for lead testing. Each day they spent hours calling and visiting with residents in order to get as many samples as possible so Edwards and his team could see how the city's lead levels had changed.




Sara Chergaoui

Matt Dowdle

Maddie Brouse



The spring break team on the last day of kit distribution at Woodside Church in Flint. They are pictured with former Flint resident and concerned mother Lee-Anne Walters (middle), who currently leads the citizen-based initiative on the ground in Flint.

A close-up photograph of a blue-footed booby's feet. The feet are a vibrant, iridescent blue color and are webbed. They are positioned on a light-colored, textured rock surface. The bird's white feathers and black wing are visible at the top of the frame.

For some animals, mating happens feet first. Native to Central and South America, male blue-footed boobies show off their webbed beauties to attract females. If females are interested, they will do the same until both birds of the pair are engaged in a mating dance.

This mating ritual fascinates graduate student Sydney Hope, which led her to study wood duck behavior and biology in the College of Natural Resources and Environment at Virginia Tech.

www.fralin.vt.edu

Fralin Life Science Institute
Fralin Hall
West Campus Drive
Room 101
Virginia Tech 0346
Blacksburg, VA 24061

540-231-6933 (v)
540-231-7126 (f)

