A one-of-a-kind department and a one-of-a-kind opportunity to advance evidence-based approaches to biology education
THE EXPERIMENT CONTINUES!

A new season of The Petri Dish launched this fall at Camp Bar in downtown St. Paul. Join us for lively, informal, curiosity-driven conversations about how biology affects our lives and what it means for our future.

Doors open at 6 p.m. Program starts at 7 p.m.

More information at z.umn.edu/fall2017petridish

OCTOBER 4
Setting the table for 10 billion
The world population could reach close to 10 billion in just over 30 years. That’s a lot of mouths to feed. How we do it has broad implications. Join us for a discussion about what it will take to feed the world as demand continues to grow.

NOVEMBER 8
The future of water in the land of 10,000 lakes
Nothing is more synonymous with Minnesota than water. Our lakes and rivers are integral to our identity as a state — and they are under threat. Explore possible solutions to pervasive problems from nitrogen runoff from agricultural land to invasive species.

DECEMBER 6
Resetting the conversation on science
From evolution to climate change, the gap between public discourse and scientific consensus is an ongoing concern. We’ll talk about what’s behind this mismatch and how we might establish a shared understanding of what we know and how we know it.
2 A message from the dean  
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Roadside attractions for pollinators, a new day for industrial hemp and peptides with potential

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ABOUT THE COVER: ASSISTANT PROFESSOR ABDI WARFA TALKS WITH UNDERGRADUATE STUDENTS SARA HENRY AND BETHANY ROWBAL IN AN ACTIVE-LEARNING CLASSROOM. PHOTO CREDIT: JACKSON EDDY/FAST FORWARD PHOTOGRAPHY

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A MESSAGE FROM THE DEAN

Making the case for science
Being part of the broader conversation starts with meeting people where they are.

When you think about what we do here at the College of Biological Sciences, teaching and research most likely come to mind. They are two of the three cornerstones of our mission and central to our identity. But as a land-grant institution, it’s not enough to advance knowledge. We must share that knowledge with the broader community and engage in dialogue about what we do and why it matters.

As alumni and friends of this College, it’s a safe bet that you care about the public discourse around science. From climate change to vaccines, debate over topics where scientific consensus is quite clear leaves many of us scratching our heads. Getting people to understand the validity of science begins with getting people to understand the world that sparks the questions we investigate.

Our students and faculty do this in many ways, from presentations in K-12 schools to online citizen science efforts such as Snapshot Serengeti, which gives members of the public the opportunity to participate in the process of science by categorizing animals captured on camera. Volunteers identify wildlife on the savanna and record observations about their behavior, which becomes data for researchers investigating a range of questions.

Recognizing the need for greater dialogue — between disciplines, between different parts of society, and between individuals from diverse backgrounds — we launched the Petri Dish series last year. The topics are serious, but the setting is not. These “curiosity-driven conversations” about subjects with social relevance and a biological bent happen off campus in an informal space that invites participation.

This summer, Market Science engaged thousands of visitors at farmers markets around the Twin Cities. The volunteer-run group whose members include scientists from CBS and other STEM colleges at the University also took their science “show” on the road to East Bethel, Bemidji, Park Rapids and other locations around the state. They brought the science happening here there with hands-on ways to learn about fungi, bioreactors, venom and many other topics.

Reaching beyond campus and the Twin Cities is critical. In this, our field stations have a vital role to play. In the past year, Cedar Creek Ecosystem Science Reserve greatly expanded opportunities for the community to experience that unique place. And finding new ways to connect to the communities surrounding Itasca Biological Station and Laboratories will be high on the to-do list for incoming director Jonathan Schilling.

It is incumbent on each of us to get outside of our comfort zone and start communicating the value of science. These are small steps toward a larger paradigm shift in how we do business. I welcome your ideas for how we can deepen our engagement with the community.

VALERY FORBES
Dean, College of Biological Sciences
William Faulkner famously wrote: “The past is never dead. It’s not even past.” *Past Is Present* offers hard evidence in support of his statement. In celebration of 50 years of field-shaping work across a wide range of disciplines, the Department of Ecology, Evolution and Behavior is hosting an evening of fast-paced “lightning talks” that explore the influence of classic research by Raymond Lindeman, Margaret Davis, Eville Gorham and other scientists connected to the department whose work had a profound and lasting impact. Current faculty members will trace lines between those earlier findings and exciting or unanticipated applications, policies and insights in the present day.

The event is free and open to the public, but space is limited! [Reserve your spot at z.umn.edu/pastispresent](z.umn.edu/pastispresent)

**DID YOU KNOW?**

The Department of Ecology, Evolution and Behavior is a research powerhouse with an international reputation. Here are a few reasons why.

- The department is home to five of the University of Minnesota’s 14 living National Academy of Sciences members.
- Current faculty published papers with co-authors from more than 900 institutions in 59 countries.
- Ranked fourth-most-productive department of its kind in the world in a study published by the Ecological Society of America.

**PUTTING THINGS INTO PERSPECTIVE**

Regents Professor Emeritus Eville Gorham, pictured above in 1984, made landmark discoveries relating to acid rain and nuclear fallout. His findings contributed to the Nuclear Test Ban Treaty and legislation that dramatically reduced levels of atmospheric sulfur dioxide, a pollutant linked to lung disease and acidification of lakes. Gorham’s work continues to inform efforts to understand the relationship between wetlands and the atmosphere. His legacy will be among those highlighted at *Past Is Present.*

**THE LINEUP**

- **Emilie Snell-Rood** on John Tester and Don Siniff’s work on radio-tracking at Cedar Creek Ecosystem Science Reserve.
- **Forest Isbell** on Raymond Lindeman’s foundational contributions to ecosystem ecology.
- **Jennifer Powers** on Dan Janzen’s work on biodiversity in the tropics, cryptic species and conservation.
- **Sehoya Cotner** on Mike Lynch’s work on mutational meltdown in species and implications for conservation.
- **Jim Cortner** on Eville Gorham’s work relating to radioactive fallout and acid rain.
- **Elizabeth Borer** on Margaret Davis’ work on paleoecology and its implications for our understanding of climate change.

**THE ECOLOGY BUILDING ON THE UNIVERSITY’S ST. PAUL CAMPUS**

**PAST IS PRESENT**

October 26 | 7 p.m. | Coffman Memorial Union Theater

The Ecology Building on the University’s St. Paul Campus
Roadside attractions

A new statewide study examines whether roadsides provide quality food for monarchs and native bees.
Paul Bunyan, the SPAM museum and a giant twine ball are just a few of Minnesota’s beloved roadside attractions. These don’t interest insects, but plants along the strips of pavement often do. For pollinators experiencing declines and habitat loss — including monarch butterflies and native bees — these corridors are particularly important.

Since roadsides also serve as corridors for automobiles, mounds of road salt linger for months. This struck Emilie Snell-Rood, an associate professor in the College of Biological Sciences, during her first winter in Minnesota. Knowing that sodium is a component of road salt and a micronutrient required by animals, Snell-Rood launched a study assessing how elevated levels affect butterflies, and found elevated sodium levels in roadside milkweed and impacts on developing monarchs.

Questions abounded and drafts for new research proposals began. Since monarchs and bees often use roadside plants, understanding how runoff impacts their development is important for conservation efforts. Roadsides accumulate heavy metals from car wear and tear, nitrogen from exhaust, and the effects on the health of pollinators remain largely unknown. “The questions are interesting at a basic level,” Snell-Rood says, “but they also have these really important and direct translations.”

The Environmental and Natural Resources Trust Fund awarded Snell-Rood and her collaborators on the project a multi-year grant to tackle some of these questions. Collaborators include CBS faculty members Elizabeth Borer and Clay Carter, and College of Food, Agricultural and Natural Resource Sciences faculty members Dan Cariveau, Karen Oberhauser and Marla Spivak, along with colleagues from the Minnesota Department of Natural Resources (DNR).

Surveys in the field kicked off this summer with technicians crisscrossing the state to collect data, covering 3,000 miles, or the distance from Brooklyn to the Golden Gate Bridge. For three years, Snell-Rood will split her time between the roadside, field plots and lab. As site selection began earlier this year, surveys completed by the Monarch Joint Venture — a project that aims to conserve monarchs — helped narrow down the possibilities to 50 roadside sites throughout Minnesota ranging from country roads to heavily-traveled thoroughfares.

Snell-Rood is thrilled that work is underway. “This project will help us answer some really interesting questions about how nutrients and heavy metals interact to affect plant and pollinator health,” she says.

DNR staff and others will use results to develop best management practices along roadsides. Many eyes are on the “Monarch Highway” initiative, which aims to improve habitat along Interstate 35 — a critical migration corridor for monarchs. Subtle changes in management could improve pollinator health in roadsides, whether it’s planting species that don’t accumulate certain nutrients in nectar or mowing areas with higher heavy metals. Roadside pull-offs to view thriving monarchs and native bees will hopefully join Minnesota’s list of roadside attractions in the coming years. —CLAIRE WILSON
Hemp on the horizon
Field trials allow researchers to determine what varieties of industrial hemp grow best in different parts of Minnesota.

If you had visited a farm field in Minnesota before World War II, you might have come across a crop you would not today: hemp. In fact, hemp was one of the state’s first industrial crops. It has surged in popularity in recent years as an ingredient in food, personal care products, clothing and even construction materials. Sales of hemp-based products make up a $600-million annual market in the United States alone, but nearly all of those products are imported.

Minnesota’s climate is well suited to growing hemp, but it hasn’t rejoined corn, soybeans and wheat as a commercial crop despite its economic potential because it is a variety of Cannabis sativa, the same species as marijuana. But the two are quite distinct. Industrial hemp contains very little tetrahydrocannabinol, or THC, the psychoactive ingredient in marijuana.

Although the distinction between marijuana and hemp may seem obvious, the Agricultural Act of 2014, commonly known as the Farm Bill, was the first time the difference was recognized under U.S. federal law.

George Weiblen, a Distinguished McKnight University Professor in the College of Biological Sciences, started to disentangle the genetics of cannabis more than a decade ago. In 2015, he published a study that pinpointed the genes that distinguish hemp from marijuana.

That same year, the Minnesota Department of Agriculture (MDA) launched the Industrial Hemp Pilot Program to assess growth, cultivation and marketing of the crop. Given the Weiblen lab’s expertise in cannabis genetics, a collaboration quickly formed with MDA and the Minnesota Crop Improvement Association.

Two members of the Weiblen lab — Jonathan Wenger and Clemon Dabney — work on the project.

“. . . I’m thrilled to be able to bring hemp into the light of day in Minnesota and into a field setting,” Weiblen notes.

Weiblen’s team planted a dozen varieties of hemp from Canada at five different sites across the state. The pilot study is focusing on hemp grain yield, mainly used for oil and food. To assess which varieties are most suitable for growing conditions, staff track growth, pests and yield. This will reveal which varieties from our northern neighbor thrive in Minnesota and which provide the highest yield come harvest time.

“Ten years ago I could not have imagined that we would come this far with hemp research,” Weiblen says. He is optimistic that industrial hemp is on the state’s horizon once more. —CLAIRE WILSON
Poisonous promise

A serendipitous discovery points to a biochemical pathway in the jack-o’-lantern mushroom with potential applications in drug design and agriculture.

They call it the jack o’ lantern mushroom. With an eerie greenish bioluminescence by night and a pleasant orange hue by day, *Omphalotus olearius* grows wild in the woods of Europe. Unfortunately for fungi foodies, it resembles the coveted chanterelle but contains nasty compounds that make humans ill. Fortunately for biochemists, however, it also produces a family of nematode-killing toxins called “omphalotins” through a biochemical pathway that defies nearly a century of scientific assumptions.

Before arriving at the University of Minnesota, Michael Freeman, an assistant professor in the College’s Department of Biochemistry, Molecular Biology and Biophysics, worked as a postdoctoral researcher in Switzerland. One day, a fellow researcher who studies fungal biology casually dropped by with an intriguing find. “When a colleague showed me this DNA sequence, my eyes widened and I couldn’t believe what he had stumbled across,” says Freeman. “I dropped everything I was doing and started working on it.” That work continued and is yielding insights.

Within the glowing fungus, Freeman and his Swiss colleague found the genomic sequence of a large, methylated, cyclic peptide. “Methylation” means attaching carbon and hydrogen atoms to the amine backbone of the peptide. Similar to DNA methylation (think: epigenetics), peptide methylation can substantially change the molecule’s properties.

Whereas typical peptides are confined within cells, the small family of compounds produced by this pathway can freely pass through biological membranes, specifically because they are cyclic and methylated. However, the molecule itself isn’t the main attraction. Instead, Freeman’s remarkable finding is how the molecule gets made.

For decades, scientists believed that these outlier compounds had to be made and methylated independently from the ribosome. However, this peculiar paradigm involves methylation of proteins and peptides made by the ribosome. What’s more, the enzyme that completes the methylation is autocatalytic, meaning that it modifies itself in the process of catalyzing the reaction.

In the wild, the omphalotins present in the jack-o’-lantern mushroom kill off root-munching nematodes, so it is possible that modified versions could be engineered for use in agriculture to deal with pests. Chemically, the family of compounds also resembles cyclosporine, a powerful immune-suppressing drug used in organ transplants, which means it might be possible to use their synthetic pathway to produce pharmaceuticals.

Freeman suspects this type of pathway is present elsewhere in nature and is excited to explore new avenues for its use in both basic and applied science. “We think we know a lot about biology, but nature is always showing us how little we know and how it has figured things out way ahead of us,” he says. “By doing this type of research, we are inspired to look at nature from a whole new perspective.”

—C. ESTELLE SMITH
Undergraduate education has been a priority for the College for decades. Now, a one-of-a-kind department is accelerating efforts to advance evidence-based approaches to teaching biology.
A decade ago, the College of Biological Sciences championed efforts to establish the first active-learning classrooms at the University of Minnesota.

The spaces were a radical departure from the theater-style lecture halls so familiar to generations of students. Round tables designed for collaboration replaced rows of seats facing in a single direction. It was part of a paradigm shift premised on the idea that students learn best when they put their biology knowledge to work to answer questions with real-world relevance instead of passively absorbing information.

The College’s introductory biology course sequence — Foundations of Biology — quickly became the standard bearer for this new approach, even earning accolades from the journal Science, which awarded the College its Prize for Inquiry-Based Instruction. But knowing something works and knowing why it works are two different things.

Several years ago, the College launched the Department of Biology Teaching and Learning (BTL) to dig deeper into the why. The first-of-its-kind department brings together a critical mass of faculty dedicated to discovering and sharing evidence-based approaches to teaching biology. “We use our classrooms as laboratories to try things we think work and gather data to make that case,” says Deena Wassenberg, a teaching associate professor in the department. “Being part of BTL makes it much easier to collaborate with people who share a common interest in advancing this work. It creates a kind of feedback loop between research and actual teaching.”

A HISTORIC OPPORTUNITY

The launch of BTL underscored the College’s deep commitment to biology education, but that commitment is hardly new. It goes back decades, in fact. Concerned with gaps in their students’ knowledge on topics like evolution, faculty launched the General Biology Program just after the College formed in the 1960s with the goal of developing curriculum designed to provide a solid grounding in basic biology concepts. More comprehensive introductory courses followed over the years. Then in the early 2000s, the College introduced Nature of Life, a four-day program at Itasca Biological Station and Laboratories for incoming students, which quickly became a model for other institutions. In 2006, the General Biology Program was renamed the Biology Program and a year later, the Foundations of Biology course sequence made
its debut. The launch of BTL in 2014 grew out of that sustained effort to evolve the curriculum and create the conditions for student success. The College’s focus on biology played a role, too.

“Part of the reason this is so unique is the rarity of colleges like the College of Biological Sciences that are focused on a single subject,” says Dean Valery Forbes. “Often, you’ll find researchers interested in biology education embedded within biology departments. In such situations, it can be difficult to build a critical mass of researchers with a passion for driving innovations in biology education. The College’s focus on biology makes a department like BTL possible.”

THE SCIENCE OF BIOLOGY EDUCATION

Sehoya Cotner, an associate professor in the department, echoes that sentiment: “There’s no place like BTL in the country,” she says. “We’re first and foremost trained as scientists and we’re coming at this as scientists, which is unique. We know active learning works, for example, but as scientists we want to understand why that is.” To that end, BTL researchers investigate a range of research questions that put various aspects of the student experience under the proverbial microscope.

Abdi Warfa wants to know how what an instructor says or does helps or hinders the learning process. Warfa, an assistant professor in BTL, tests whether the two-way exchanges enabled by the active-learning approach improve outcomes. This fall, he launched a project to test this idea. He plans to record classroom interactions, interview students and gather data on student outcomes in the Foundations of Biology courses. “Dialogue in lecture-based classrooms is almost impossible,” says Warfa. “Active-learning classrooms make it possible to ask students questions and use that as the starting point for guiding them to a conclusion. I want to be able to demonstrate that and get even more granular by identifying the best types of interactions.”

Fellow BTL faculty member Anita Schuchardt wants to integrate math- and computer-based thinking into biology to help students develop conceptual models for topics like population genetics. It’s a proven approach in the sciences broadly, but not in biology — until now. “Students do best when they think holistically and learn how ideas fit together to explain why something happens the way it does. If you talk to scientists it’s what they
do: They apply models, test them and refine them, but we don’t teach students that way. The idea is to teach them in the way science is done.”

AUTHENTIC RESEARCH EXPERIENCES FOR ALL
Anyone who has been through the lab section of a biology course is probably well-acquainted with the “cookbook approach” in which students follow a recipe to achieve a specific result. No original questions. No original results.

BTL is upending that outdated model. Just as active-learning classrooms replaced lecture halls, the department is “flipping” the research experience, renovating old teaching labs by replacing narrow rows of lab benches with flexible spaces that facilitate interaction among students and support independent experimentation. These “active-learning labs” are meant to mimic the environment in which faculty researchers work.

“It’s not just the space to do the work, it’s the space to think. Students need space to collaborate,” says BTL interim department head David Kirkpatrick. “The hard work is really done in the thinking space. Those spaces need to be contiguous and integrated so it’s easy to move between them.”

The goal, says Kirkpatrick, is for every student to have an authentic research experience in which they are empowered to ask and answer their own research questions. “Ultimately, we want every student we teach to have a real encounter with what science is and how to do it themselves.”

Active-learning labs are part of a larger push to provide all students with an opportunity to do authentic research, including the many students who take CBS courses but aren’t majoring in biology. Course-based research projects are one avenue for achieving that goal. BTL education program specialist Jess Blum manages a number of these projects. She’s developed opportunities for students to investigate questions relating to the movements of wildlife on the Serengeti and to help identify new varieties of a promising cold-hardy cover crop called pennycress, among other topics.

“Traditionally the way students have gotten research experiences is to seek them out in faculty labs, but not every student knows to seek those out and some may not have the chance to do research at all,” says Blum. “By integrating that experience into the courses students are taking, everybody gets the opportunity to do collaborative, independent research with real-world relevance. That is something we can offer because of BTL. We have people, funding, time, energy and the know-how to make that happen.”

LEVELING THE PLAYING FIELD
For Cotner, making sure every student has an authentic research experience is part of a larger drive to take down barriers to participation, especially for women and underrepresented minorities. She recently received an incubator grant from the National Science Foundation to launch a collaboration with colleges around the country — from Ivy League universities to community colleges — to develop baseline data to test ideas relating to barriers to participation.

One observation rooted in recent research comparing biology courses in active-learning...
classrooms and lecture hall-style classes: “In traditional classrooms, males are the dominant voices even in classes that are majority female. We’re not seeing those gaps in active-learning classrooms,” says Cotner. She plans to expand the scope of her inquiry with the new network. “If we see the same types of barriers and document interventions at other institutions, then I think we will have a real story for our colleagues looking to address these issues.”

The factors that influence whether a student succeeds are complex. Gender and other demographic factors are just part of the picture. Meaghan Stein, education success and retention coordinator in BTL, is developing a different set of metrics for identifying potential roadblocks based on less tangible factors like persistence and grit. “It’s more complex than who a student is,” says Stein. “It’s about what they think and how they behave.”

Case in point, a person’s ability to work through difficult tasks without giving up, or “persistence on task,” plays an outsized role in success. “One thing we found looking at student data so far is that lower scores on persistence on task are related to lower first semester GPA, which is related to likelihood of leaving CBS,” says Stein. “If a student feels confident they can work through difficult problems, there’s more likelihood they will stay the course.”

Kirkpatrick sees this approach as part and parcel of what BTL is about. “Our long-term goal is to achieve a more holistic view of the student experience and really pinpoint which factors play the greatest role.”

EXTENDING BTL’S REACH
The energy and enthusiasm around the department are palpable. Faculty talk about the potential for new collaborations and to make an impact on the field with the excitement of people involved in a hot new startup. The appetite for innovation is strong. So how does a department that’s taking things to the next level get to the next level? One way is by creating an endowed chair to attract a top scholar in the field.

“The Department of Biology Teaching and Learning is like no other place in the nation for scholarship and innovation in teaching STEM,” says Forbes. “As part of continuing on this trajectory, we need to attract an established faculty member with a national reputation who will make connections across institutions. An endowed chair will help us do that.” —STEPHANIE XENOS
GETTING DOWN TO BUSINESS

With biology-based solutions moving into the foreground, cross-sector collaborations between industry and academia present a unique opportunity to drive innovation and train students.

Fernando Bazan spent the better part of his career at Bay Area biotechnology companies. He trained at Stanford, Berkeley and the University of California, San Francisco, where cross-pollination between industry and academia are integral to the identity and vitality of the institutions. Four years ago, he moved to Twin Cities–based Bio-Techne, a leading life sciences company, and saw an opportunity.

“The pace of discovery in the biological sciences over the last 20 years or so has been incredible,” says Bazan. “Keeping up with the state of the science is essential to staying in the lead. So when I started at Bio-Techne as the chief technology officer, one of the first things I did was to bring in people from the University for seminars and the opportunity to engage our scientists. I focused on early-career professors who are full of energy, brimming with ideas, and up on new methods and tools. It’s been transformative in terms of new collaborations and the adoption of new processes.”

Bazan sees a real opportunity for the creativity, entrepreneurial spirit and ingenuity so pervasive in Silicon Valley to take root here.

“The College of Biological Sciences has been very forward-thinking in hiring terrific young faculty in areas such as systems and synthetic biology, chemical biology, protein design and bioinformatics,” says Bazan. “These labs have naturally gravitated to working with each other and interfacing with like-minded groups from other colleges. It’s one of the best clusters of this sort that I’ve seen anywhere. Not only that, the College has been proactive in creating new spaces for cross-disciplinary collaborations, which are key incubators for discovery.”

Bazan is part of a committee advocating for the College of Biological Sciences campaign to attract investment for critical initiatives, including a new integrative program to ramp up internships and collaborations that reach beyond campus and engage both startups and established biotechnology and biomedical companies. Graduate students and postdoctoral fellows are a key component since they bring fresh thinking to companies and, in return, learn about opportunities beyond academia.

Moving quickly to make the most of this moment has major implications for the University and the state, says Bazan. “This is the century of biology. We are in an unprecedented position to figure out the molecular basis of biological systems across organisms and how these mechanisms respond to external threats — or go awry in disease. There are pressing challenges right now to human health and our environment, and biology is the common thread. There’s not going to be a field of science not affected or inspired by biology. The College of Biological Sciences is square in the middle of this vital conversation, and it’s going to be a very exciting place to be for years to come.”
MAKING TIME FOR WHAT MATTERS MOST

Scholarships provide the financial support students need in order to spend their time pursuing their passions instead of focusing on making ends meet.

College of Biological Sciences undergraduates are among the brightest and most motivated students at the University of Minnesota. Meet a handful of students who received scholarship support this year.

Seeing the big in the small

JACK HEDBERG
Juliamarie Andreen Grilly Scholarship

Majors: Biochemistry and Physiology
Goal: To become a physician

Jack Hedberg looks to the miniscule inside us and sees the beyond. “We have this stunning complexity in which our bodies operate,” he says. “That’s the same chemistry and physics that applies to the rest of the universe, and it has evolved to produce our consciousness. That is really cool to me.” Hedberg wants to go to medical school and used his scholarship to gain undergraduate research experience.

Animal aficionado

KAITLYN KNUTSON
Monica Tsang and James Weatherbee Merit Scholarship

Major: Ecology, Evolution and Behavior
Goal: To become a zookeeper

Kaitlyn Knutson knows her love of animals is only one step toward career success. “Scholarships are helping me pursue valuable opportunities to gain experience and form great memories,” she says. “A lot of positions require experience going in. So every semester that I can work in zoos or in a lab is more I can use to say, ‘I know I can do this. I know that I love it.’” The aspiring zookeeper recently interned at Como Zoo in St. Paul. She also works in a research lab and volunteers at a local animal shelter.
The care behind the care

EMMANUEL OKEMATTI
Zoology Department Memorial Scholarship

Major: Biology
Goal: To become a physician

Emmanuel Okematti sees practicing medicine as more than helping people get better when they are sick. “I want to be a doctor who people can trust,” he says. “I want to be the kind of doctor who makes people understand — especially minority people — that I am here to care for them.” Scholarship support has allowed Okematti to be ambitious in achieving his goals. He spends time he might otherwise be working as a volunteer at Hennepin County Medical Center and doing research in a faculty lab.

A hardworking hurdler

LINDSEY SMITS
Richard S. Caldecott Award

Majors: Biology and Neuroscience
Goal: To become an occupational therapist

Lindsey Smits has had to overcome many hurdles as a CBS student, literally and figuratively. “School and track take up a lot of my time,” she says. “I’ve had to work for the past few years. This award will help me focus more on my academics and athletics, and allow me to use free time for volunteering.” The 400-meter hurdler on the University’s track team plans to pursue occupational therapy and is preparing for this career in part by using her time to volunteer at the U of M Masonic Children’s Hospital.

Returning to her roots

MELINDA HOLMSTADT
Claudia Neuhauser Scholarship in Biology

Major: Biology
Goal: To become a physical therapist

Melinda Holmstadt sees her future by looking to her past. “I grew up on a third-generation family farm,” she says. “I really see myself moving back and working in rural communities after I graduate.” Planning to eventually practice physical therapy in a rural area, Holmstadt will put her scholarship to use this fall. The financial support is making it possible for her to take on a sports medicine internship with the University’s Gophers football team.
Before Cedar Creek Ecosystem Science Reserve became a magnet for scientists from around the world for its long-term biodiversity experiments, it was a humble research outpost where a graduate student named Raymond Lindeman collected data at Cedar Bog Lake. Those long days of fieldwork in 1936 led to insights that would eventually upend conventional wisdom about how ecosystems work.

Up until then, ecologists focused on classification and characteristics of plant and animal species. Lindeman shifted the focus to ecosystems by showing how organisms depend on each other and their environment for survival. His thesis laid out a radical new theory about how energy and nutrients move through ecosystems, beginning with photosynthesis and traveling up the food chain.

Lindeman contracted a rare liver disease in 1937, but he continued his work with assistance from his wife, Eleanor Hall Lindeman, who eventually became his research partner. Lindeman went on to Yale where he submitted his paradigm-shifting paper to the journal *Ecology* in the fall of 1941. It was rejected. Lindeman’s illness returned and he was hospitalized for a period, but he still managed to revise the paper and resubmit it later that year. He died the next year at the age of 27.

“Lindeman’s work was fundamental in that he really was the first ecologist to quantify the movement of matter and energy through an ecosystem,” says Jim Cotner, a professor in the Department of Ecology, Evolution and Behavior. “Lindeman recognized that all of the organisms in an ecological setting were connected to each other energetically — all the way from microbes up to...

As Cedar Creek celebrates 75 years, a seminal discovery continues to inspire as does the place where it was made.
to the top predators. And he recognized that it is the movement of matter and energy that actually makes an ecosystem an ecosystem. His work in tiny Cedar Bog Lake set the stage for many of the ecosystem-scale studies that are done at Cedar Creek and all over the world today. It also laid the groundwork for understanding of the whole Earth as an ecosystem, what we now refer to as global ecology.”

Cotner recently received funding from the National Science Foundation to bring Lindeman’s work in Cedar Bog Lake into the 21st century by quantifying the exchange of carbon dioxide and methane, another important greenhouse gas, with the atmosphere. “Similar to combustion of fossil fuels, organisms in all ecosystems produce these gases as end products,” says Cotner. “The work we are doing will help us understand whether and when lakes are important as both a source and sink of these gases.”

Today, visitors to Cedar Creek are likely to spend time in the Raymond Lindeman Research and Discovery Center a short distance from Cedar Bog Lake. The lake remains a landmark and a source of inspiration for scientists all over the world, including College of Biological Sciences ecologist Jeannine Cavender-Bares, who launched one of the newer long-term experiments at Cedar Creek to investigate forests and biodiversity.

“The sheer beauty of Cedar Bog Lake makes it special,” says Cavender-Bares. “You pass through several different ecosystems to get to it. You go through an upland knoll, you go through a cedar wetland area, you go through alders that are fixing nitrogen. Then you get to the lake, and you can imagine Raymond Lindeman doing his experiments, really having this tremendous vision of the flow of energy and materials through that whole system. He thought very holistically in a way that people hadn’t done before at the system level. Visiting here is a very powerful and inspiring experience.”

CEDAR BOG LAKE AT CEDAR CREEK ECOSYSTEM SCIENCE RESERVE PHOTO BY CAITLIN BARALE POTTER

A MICROCOSM OF MINNESOTA

The Minnesota Ecology Walk will take visitors across prairie and oak savanna and through forests for a firsthand experience of the state’s major ecosystems.

Cedar Creek Ecosystem Science Reserve is a living laboratory just an hour north of the Twin Cities. No place as close to the metro area can match its biodiversity. Minnesota’s habitats all find a home here spread out across nearly nine square miles in East Bethel, Minnesota. This renowned long-term ecological research station has produced some of the most important insights about biodiversity and ecosystem ecology of our time. But experiencing the diverse landscape is a challenge for visitors, especially those with limited time or mobility. The Minnesota Ecology Walk could change that. The wheelchair-accessible path will take visitors through each of the environmental biomes present at Cedar Creek, with lessons about biodiversity, ecosystems and more along the way.

Learn more and support the project at z.umn.edu/ecologywalk
Great science at a grand scale
The College of Biological Sciences is ready to accelerate work that will ultimately benefit us all.

College of Biological Sciences researchers are doing truly amazing work. I’ll give you just one example. Mikael Elias, an assistant professor in the Department of Biochemistry, Molecular Biology and Biophysics, developed enzymes that can fight harmful, antibiotic-resistant bacteria. His technology “hijacks” bacterial communication mechanisms, preventing them from forming the structures that lead to disease and drug resistance. His research could contribute to the development of new approaches with the potential to help millions of people.

Biology-based strategies to address some of our most pressing problems, like those being developed in the Elias lab, are within reach. Few places are as well-positioned to advance this critical work as the College of Biological Sciences. With the right investments right now, we can lead the way.

With that in mind, the College launched a $21-million fundraising campaign this fall to support key initiatives that we believe will deliver the most return on that investment. We describe our aspirations for this campaign as doing “great science at a grand scale” in classrooms, in labs, on campus and off campus.

The Campaign for the College of Biological Sciences focuses on areas of opportunity that are unique to CBS. We have distilled our goals into four priority areas. We propose to:

• attract and support top students by increasing the number of four-year merit- and need-based scholarships available to them.
• build cross-disciplinary, cross-sector collaborations that provide graduate students with opportunities to gain experience outside academia.
• grow faculty diversity by providing a pathway for Ph.D.s from underrepresented groups to become professors.
• continue to build on our reputation for biology education innovation by extending active learning from the classroom to the lab and creating an endowed chair in biology teaching and learning.
• expand opportunities for the public to experience the region’s most diverse plant collection and explore Minnesota’s major ecosystems.

We have many of the pieces we need already. Our talented faculty and students advance knowledge in key areas. Our proven approach to undergraduate education produces graduates who excel. We are doing more than ever before to share our science with more people including thousands of K-12 students each year.

You can help turn the key that unlocks this potential. Please join us as we work to solve today’s most pressing problems and make the most of very real opportunities to lead.

To learn more about the campaign, please visit driven.cbs.umn.edu.

REEDE WEBSTER
Director of Advancement
College of Biological Sciences
The Campaign for the College of Biological Sciences

**CAMPAIGN GOALS**

- **$21M**
  - Attract the best students to our College through increased scholarship support
  - Support innovative science teaching and learning
  - Strengthen faculty diversity and cross-sector collaborations with innovative programs

- **$5.5M**
  - to create an endowed fund that will enable us to offer four-year scholarships to 100 incoming students

- **$2.2M**
  - to build a new Conservatory in St. Paul to house the region’s most diverse plant collection

- **$4.0M**
  - to create student-driven active-learning labs for undergraduates

- **$1.8M**
  - for an Ecology Walk at Cedar Creek Ecosystem Science Reserve to increase accessibility

- **$2.5M**
  - to fund an endowed chair in the Department of Biology Teaching and Learning

- **$2.0M**
  - to launch a postdoctoral program designed to build faculty diversity

- **$3.0M**
  - to endow a fund that supports a program for interdisciplinary research

**Support science teaching & learning**

- **$5.5M**
  - to create an endowed fund

**Strengthen Faculty**

- **$3.0M**
  - to launch a postdoctoral program

**Attract the Best Students**

- **$2.5M**
  - to fund an endowed chair

**Build New Facilities**

- **$2.2M**
  - to build a new facility

**Build a new Conservatory and a Minnesota Ecology Walk to connect with community**

- **$4.0M**
  - to create student-driven active-learning labs

**Support innovative science teaching and learning**

- **$1.8M**
  - for an Ecology Walk

**Strengthen Faculty**

- **$2.0M**
  - to launch a postdoctoral program

**Attract the best students to our College through increased scholarship support**

- **$5.5M**
  - to create an endowed fund

**Build New Facilities**

- **$2.5M**
  - to fund an endowed chair

**Support Science Teaching & Learning**

- **$1.8M**
  - for an Ecology Walk

**Strengthen Faculty**

- **$2.0M**
  - to launch a postdoctoral program

**Attract the Best Students**

- **$2.5M**
  - to fund an endowed chair
FY17 Fundraising Facts & Figures

Scholarships & fellowships
CBS awarded 142 scholarships and 35 fellowships in FY17. Awards totaled $1,007,197 — tripled from 2015.

$2.1M
TOTAL FUNDS RAISED FROM PRIVATE DONORS

609
DONORS

Nearly 80% were gifts from $5 to $500

Distribution of funds
- Student Support
- Research
- Academic Program Support
- Faculty Support
- Capital Improvements/Facilities
- Outreach/Community Engagement

How to make a gift »
Send a check in the enclosed envelope or donate online at give.umn.edu (click on “Give Now”). Whether you write a check or give online, be sure to note that your gift is for College of Biological Sciences and indicate a specific purpose for the funds.

Questions?
Contact Reede Webster at webst033@umn.edu or 612-624-9460.
The College gratefully acknowledges the following donors, who have generously provided support for Itasca, Cedar Creek, scholarships and fellowships, research and a variety of initiatives. Every gift makes a difference.

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