SPECIAL ADVERTISING REPORT

Explore

SUMMER 2019

Research at the University of Florida

Aiming High

UF Researchers Pursue Grand Challenges

UF

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About the cover:
A full moon rising over Gainesville's DNA bridge illustrates the super-sized ambition behind UF's moonshot initiative.

UF

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Editor:
Joseph M. Kays
joekays@ufl.edu

Art Director:
Katherine Kinsley-Momberger

Design and Illustration:
Katherine Kinsley-Momberger
Ivan J. Ramos

Writer:
Cindy Spence

Web Editor:
Jewel Midelis

Copy Editor:
Bruce Mastron

Printing:
StorterChilds Printing, Gainesville

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Aiming High

By Provost Joe Glover and Vice President for Research David Norton

Joe Glover

Over the past decade the University of Florida has made extraordinary advances—being recognized as a top 10 public university, breaking records in research funding, hiring hundreds of new faculty with unprecedented support from the Florida Legislature, and welcoming the most accomplished students ever.

So at this moment in its history, UF is uniquely positioned to leverage these advances to tackle some of society's most daunting challenges.

Climate change, trust in the media, shorter life spans than our parents—these are the kinds of 21st century challenges that the advances of the industrial and information revolutions have brought us. But where better to address these challenges than at one of the nation's most comprehensive research institutions?

Indeed, President Kent Fuchs notes that only an institution as comprehensive as UF, with experts representing just about every field, can address such complex, interconnected challenges.

Last year, we invited the college deans to work together to identify broad societal issues they thought UF could marshal its vast interdisciplinary resources to address. Eight proposals were selected and provided with a combined $17 million in funding from a variety of sources, including private donors and technology royalties.

Those eight projects, referred to as "moonshots," are outlined in this edition of *Explore*. From health to education and the arts to the environment, these projects represent the University of Florida at its best, bringing together researchers with vastly different expertise to address grand challenges that know no traditional disciplinary boundaries.

The term "moonshot" originates from a famous speech delivered by President John Kennedy at Rice University in September 1962: "We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills…"

This initiative is really a collection of "moonshots"—really hard problems and grand challenges that rely on collaboration among colleagues from all areas of the university.

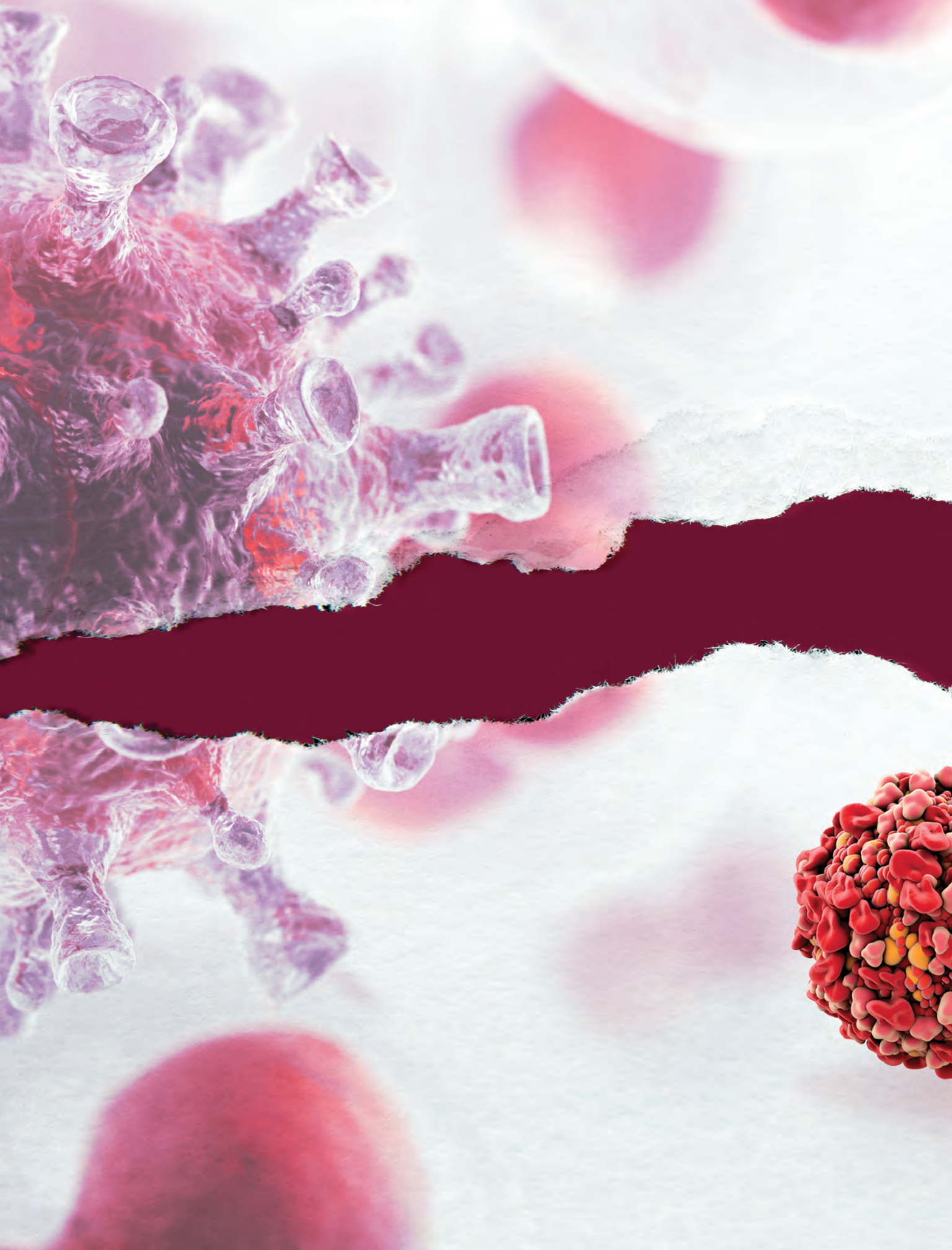
David Norton

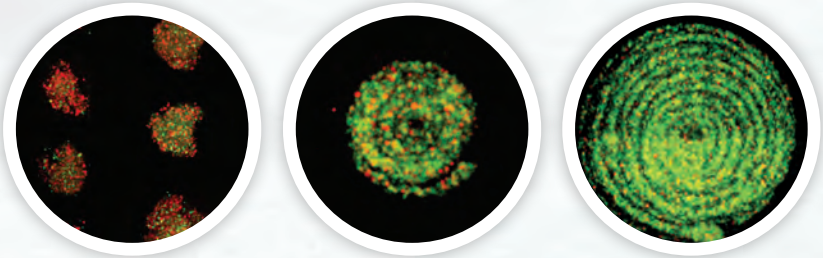
But President Kennedy made several other comments that day that are perhaps even more relevant to the challenges we face today and the University of Florida's ability to meet them.

"We meet at a college noted for knowledge, in a city noted for progress, in a state noted for strength, and we stand in need of all three, for we meet in an hour of change and challenge, in a decade of hope and fear, in an age of both knowledge and ignorance," he said. "The greater our knowledge increases, the greater our ignorance unfolds … the vast stretches of the unknown and the unanswered and the unfinished still far outstrip our collective comprehension."

This initiative is really a collection of "moonshots"—really hard problems and grand challenges that rely on collaboration among colleagues from all areas of the university.

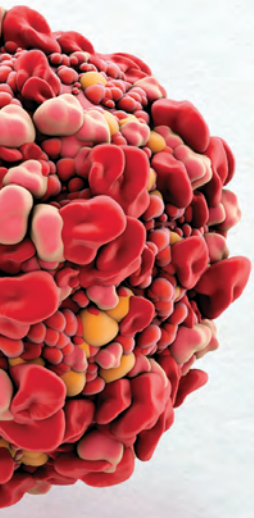
We probably won't solve these challenges during the four-year initial time frame for this initiative but the voyage and the discoveries along the way are perhaps even more important than the final goal.





Printing Cancer's End

New tools to illuminate the disease



By Cindy Spence

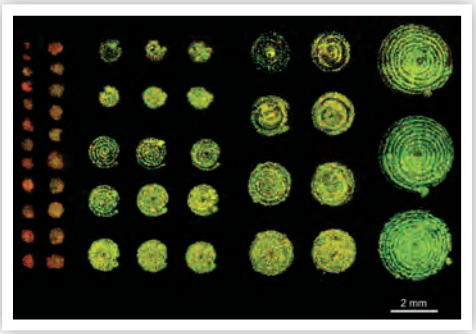
Greg Sawyer got a text as he was walking into a meeting of the University of Florida's new cancer engineering team, a group of doctors and engineers who collaborate, often side by side, to build tumors so that new cancer therapies can be tested. The text was from a colleague, a doctor, who said he wouldn't make the meeting. A treatment strategy for a patient had failed and he needed to break the news.

His message: "She really needs this."

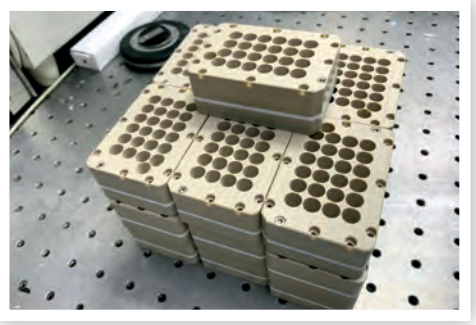
The engineers and doctors understand that urgency. They refer to cancer engineering as a "failure is not an option" project.

The phrase suits a moonshot. Its origin is the Apollo 13 mission. The aerospace engineers at NASA knew they were sending friends into danger and that bringing them home would require a very large team of scientists and engineers to do their jobs exactly right.

In traditional 3D printing the wispy tentacles at the base of the jellyfish would have crashed under the weight of the head, but the microgel held it in place. Angelini's soft matter printing method was quickly incorporated into the Cancer Engineering Lab.



3D spheres are printed with cancerous cells for use in developing personalized cancer therapies.



The trays to hold cells have to be machined by hand, a time-consuming process.

In the cancer engineering lab, there is a team, too, building an infrastructure that has never existed before to coax cancer cells into forming 3D tumors that can then be bombarded with therapies. If it works—or when—it could speed up investigations of drug therapies by orders of magnitude. But first, the lab has to be finished, the trays for the cells have to be hand-machined and the painstaking process of growing tumors must be refined. What's more, there's not a lot of funding for infrastructure and labs that no one quite understands yet.

"All these words you hear at conferences, that this is an exciting time, advances are being made…" says Sawyer, an engineer and a cancer patient. "This is not fun. It's not an exciting time. We all just want this to be over.

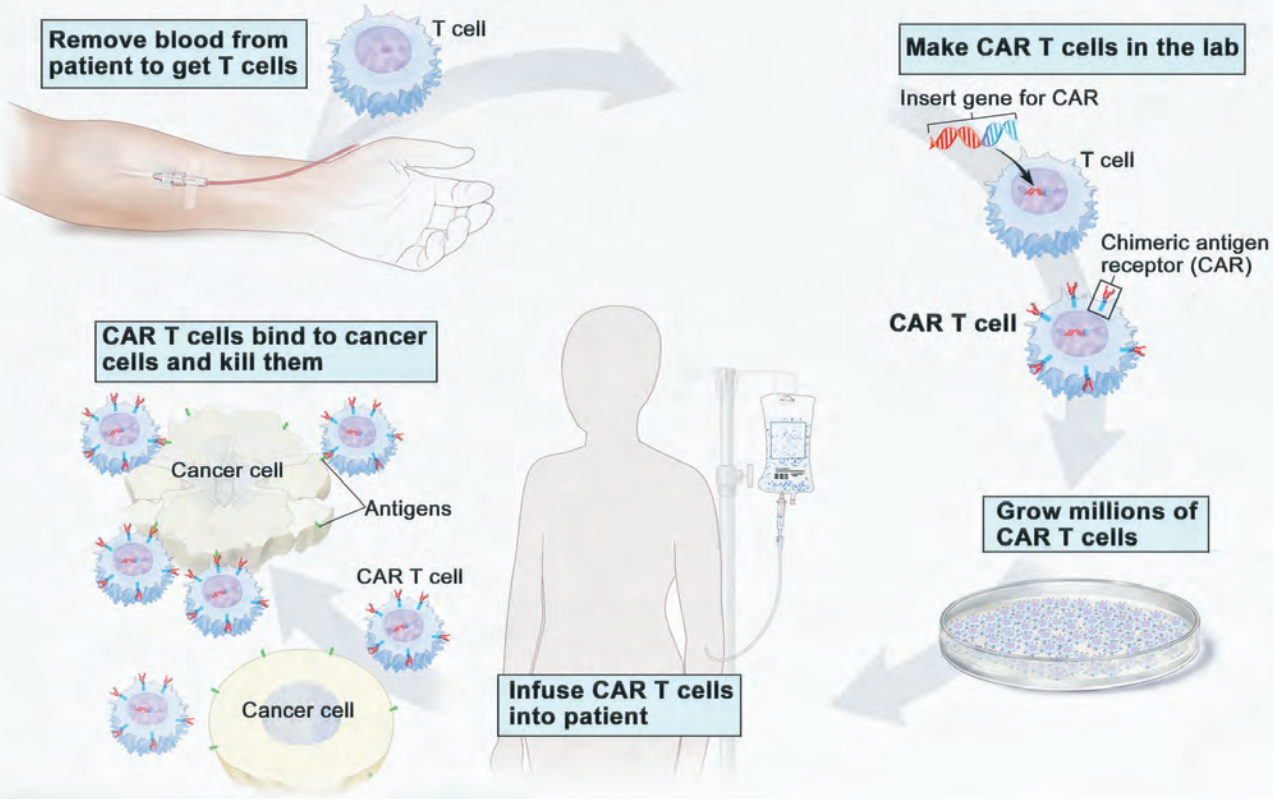
"Failure is not an option."

Seeing Tumors

For the moonshot on Cancer Engineering—3D Tumors for Cancer Research, the team asked for a microscope. At $500,000, it's not just any microscope, but a high-speed confocal microscope that can yield high-resolution studies of tumors, immune cells and drugs in 3D.

The ability to study tumors in 3D is a key to cancer engineering but required a new tool. That tool emerged from the lab of engineering researcher Tommy Angelini, who had been working on a method to create 3D structures out of cells when he began using a granular microgel, which has properties of both solids and liquids. Sawyer challenged him to print something he thought was impossible—a jellyfish. In traditional 3D printing the wispy tentacles at the base would have crashed under the weight of the head, but the microgel held the jellyfish in place. Angelini's soft matter printing method was quickly incorporated into the Cancer Engineering Lab.

Cancer cells in 3D are important to research because cancer itself is a 3D system. Studies of cells in petri dishes are 2D, so they fall short of mimicking cancer in the human body. Cells and tumors in mice are 3D, but not all cancers will grow in mice, and growing cancer in mice to test therapies is expensive



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CAR T-cell Therapy

and time-consuming. By the time a tumor grows in a mouse, and a therapy is tested only to fail, a patient may not have time to wait for the next mouse model.

Growing cells and tumors in microgel allows them to behave much the way they would behave in the human body, expanding naturally. And microgel is permeable, so immune cells and various drugs at various concentrations can be tested, all at the same time. Cancer is different person to person, so ideally, the lab could harvest a patient's own cancer cells, grow them in the lab and test as many therapies as a doctor wants to test.

That's where the microscope comes in. When the cancer cells and tumors are bombarded with drugs or immunotherapy, their reaction can be watched through the high-speed confocal microscope. The microscope can image cell and tumor sections roughly the thickness of a human hair, showing in minute detail how the tumor reacts when a therapy—immunotherapeutic T cells for example—are introduced.

Immunotherapy

Immunotherapy is the specialty of Dr. Duane Mitchell, the co-director of the Preston A. Wells Jr. Center for Brain Tumor Therapy.

Mitchell studies glioblastoma, the most common malignant brain tumor in the adult patient population. The majority of patients who are diagnosed with a malignant brain tumor present with stage four disease, or glioblastoma. Standard treatment is aggressive and includes surgery, radiation and chemotherapy. Still, the average survival is about 15 to 18 months after diagnosis.

Mitchell says immunotherapy can safely target malignant brain tumors, and it is less toxic and better tolerated.

"Immunotheraphy is really an attempt to engage the patient's own immune system in fighting the advancement of malignant disease," Mitchell says. "There are a number of experimental approaches that we and others are pursuing to try to engage the immune system to fight tumors."

The trick is to get immunotherapy to recognize the cancerous cells as

abnormal and attack them but leave the healthy cells around the tumor untouched.

Watching the interactions of activated T cells with cancer cells requires the high-speed, high-resolution imaging of the confocal microscope. With the microscope, the tumor microenvironment is enlarged and the migration of T cells toward cancer cells can be watched, then the invasion of cancer cells by T cells, and then the T cells killing cancer cells. By using time-lapse studies, the researchers hope to identify the critical steps and cellular activity at every step in this process.

In a subset of patients who received immunotherapy combined with standard therapies, such as chemotherapy and radiation, there has been some success.

In a phase one clinical trial, a New York woman treated with an immunotherapy vaccine has had no evidence of recurrence in 16 years, Mitchell says. Others in that cohort, about 30-40 percent of those treated, are five years post-treatment with no recurrence. Phase two of that clinical trial, funded by the National Cancer Institute, is being led by UF in collaboration with Duke University. The trial has a target of treating 120 patients with glioblastoma and has enrolled over 40 patients so far.

"Getting this to work effectively in all patients is a challenge," Mitchell says.

The process of getting T cells to recognize, invade and attack a tumor has several signals along the pathway, and in instances where immunotherapy does not work, it turns out that cancer cells are blocking the signals and the immunity cycle is not complete. So, watching T cells at work can show where T cells are blocked.

"One of the big efforts in our work is to try to understand why some patients have remarkable, durable responses and others do not," Mitchell says.

Engineering Cancer

Discovering why some patients are responders and others are not will require 3D tumor assays that can be studied and perhaps manipulated. Using the new microscope, the lab can perform time-lapse studies, which could reveal the mechanisms of immunotherapy.

The brand-new lab emerging on the ground floor of a mechanical engineering building is a hybrid of a medical lab and an engineering lab, doctors and engineers alike in white coats in a clean environment. The new microscope is up and running.

Lab director Padraic Levings, on loan from the Department of Orthopaedics and Rehabilitation, says working with engineers has been interesting. He points to a table made of stone, a stable surface to reduce vibration. He mentioned in an offhand way to one of the engineers his need for such a table, and when he came in the next day, there it was.

"In a molecular biology lab you might glue things together for certain purposes," Levings says. "We might think, 'man if we could just build a tool to do this.' For these guys, it's like 'how big do you want it to be, what do you want it to do, when do you want it?'"

That can-do spirit permeates the cancer engineering lab, where the team finds it unfathomable that the mortality rate for many cancers has remained largely unchanged for the past 50 years. Putting cancer through the paces engineers use to solve problems could yield new therapies, once they fine-tune the infrastructure for marrying mechanics and biology.

The engineers want people to understand what's possible when engineering and medicine collaborate. And they're hoping to recruit other engineers and doctors to help.

"We don't want to be alone. We have a different lab. Nobody else has this lab, and that's not making me happy," Sawyer says. "I don't want to be the only cancer engineering lab. I want one at every university."

W. Gregory Sawyer
Ebaugh Professor, Department of Mechanical and Aerospace Engineering
wgsawyer@ad.ufl.edu

Duane Mitchell
Phyllis Kottler Friedman Professor
Department of Neurosurgery
duane.mitchell@neurosurgery.ufl.edu

"Immunotheraphy is really an attempt to engage the patient's own immune system in fighting the advancement of malignant disease. There are a number of experimental approaches that we and others are pursuing to try to engage the immune system to fight tumors."
— Duane Mitchell

COLLABORATORS:
- *Herbert Wertheim College of Engineering*
- *College of Medicine*

Restoring Trust

Tackling a crisis of confidence

By Cindy Spence

When Diane McFarlin talks about the crisis of trust in society, she acknowledges the challenge but remains optimistic.

And why not? When University of Florida librarians searched for science on trust on the University of Florida campus, they found 139 research projects that touch on the topic.

As dean of the College of Journalism and Communications and the leader of UF's Consortium on Trust in Media and Technology, that critical mass of scholarship heartens her, as does a 2019 statistic from the Edelman Trust Barometer that shows academic experts are the second most trusted source of information.

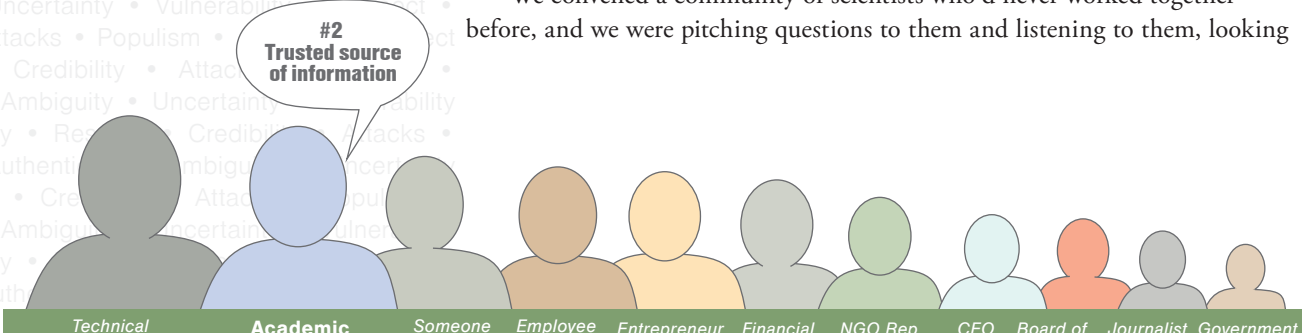
"We have a great platform here to do meaningful work," McFarlin says. "If we already have a reservoir of trust, we're positioned to make a greater difference than any other type of professional."

McFarlin was already working on the trust front, especially considering that the Edelman Trust Barometer puts the media on the lower end of the trust scale. The college convened a national summit last summer that brought together journalists and scholars in behavioral, cognitive and social sciences to discuss ways to help journalists reconnect with the communities they serve.

The discussions, McFarlin says, showed her that collaborations at the intersections of disciplines could yield important insights. Focusing on just the media, she thought, would amount to coming up short in solving the trust crisis.

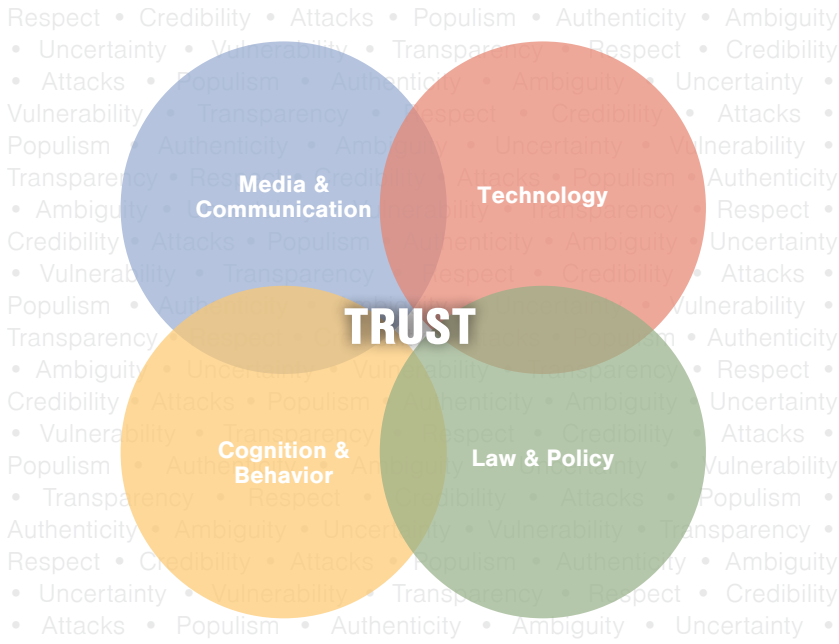
"We convened a community of scientists who'd never worked together before, and we were pitching questions to them and listening to them, looking

Diane McFarlin



Who do you Trust?

According to the Edelman Trust Barometer, academics are the second most trusted source of information.



Major Areas of Research on Trust at UF

at trust through their lens," McFarlin says. "It was eye opening. Multidisciplinary teams can take a problem and teach each other and build an approach that is brand new because of the mix of scholarship.

"Eventually, we hope every unit on campus will be involved."

A common denominator in the trust crisis is the impact of technology on the relationships people have with each other and with institutions. So McFarlin asked Juan Gilbert, chair of the Department of Computer & Information Science & Engineering in the Herbert Wertheim College of Engineering, to join forces. Technology has accelerated the decline in trust, so human-centered computing will be important to figuring out how trust and technology interact, McFarlin says. Social scientists, too, will be needed, to discover how people perceive truth in a world where truth seems to be a moving target.

"The potential is great when you think about technologists sitting down with social scientists and communications scientists and whatiffing," McFarlin says.

The college itself, already a training ground for generations of journalists, can function as a testbed for new research. WUFT, UF's public television station, for example, has the largest audience in a 21-county region. The college also is home to the STEM Translational Communication Center and the Center for Public Interest Communications. Science on trust also will be incorporated into the curriculum for the college's students, digital natives who are comfortable with technology but who need to be educated on how to become trustworthy practitioners in a media environment permeated by disinformation and fake news.

Technologies such as virtual reality and mixed virtual reality can be used for good, as in the college's Media Effects and Technology Laboratory, which uses VR to foster understanding of decline in the health of oceans and the consequences of climate change. Verification tools, which allow information consumers to judge the veracity of news, are another robust research arena.

"Technology has changed our lives for the better," McFarlin says. "But a strength can also be a weakness."

McFarlin is searching for a director for the consortium who already has a "seat at the table" for discussions on trust in society. The director will be charged with building one of the largest ecosystems in the country, perhaps the world, conducting research on trust.

"The word crisis is frequently used because it is, in fact, a crisis for modern society," McFarlin says.

Trust, once lost, is hard to restore, and McFarlin says the attempt is worthy of being called a moonshot.

"It's an ambitious project, but moonshots have ambitious, if not audacious, goals," McFarlin says. "We may not achieve the goals we're looking to achieve, but the journey will be revelatory.

"What we'll learn along the way will enable our institutions to do a better job of being trustworthy and enable the public to do a better job of determining what institutions are trustworthy."

Diane McFarlin
Dean, College of Journalism and Communications
dmcfarlin@ufl.edu

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- *College of Liberal Arts and Sciences*
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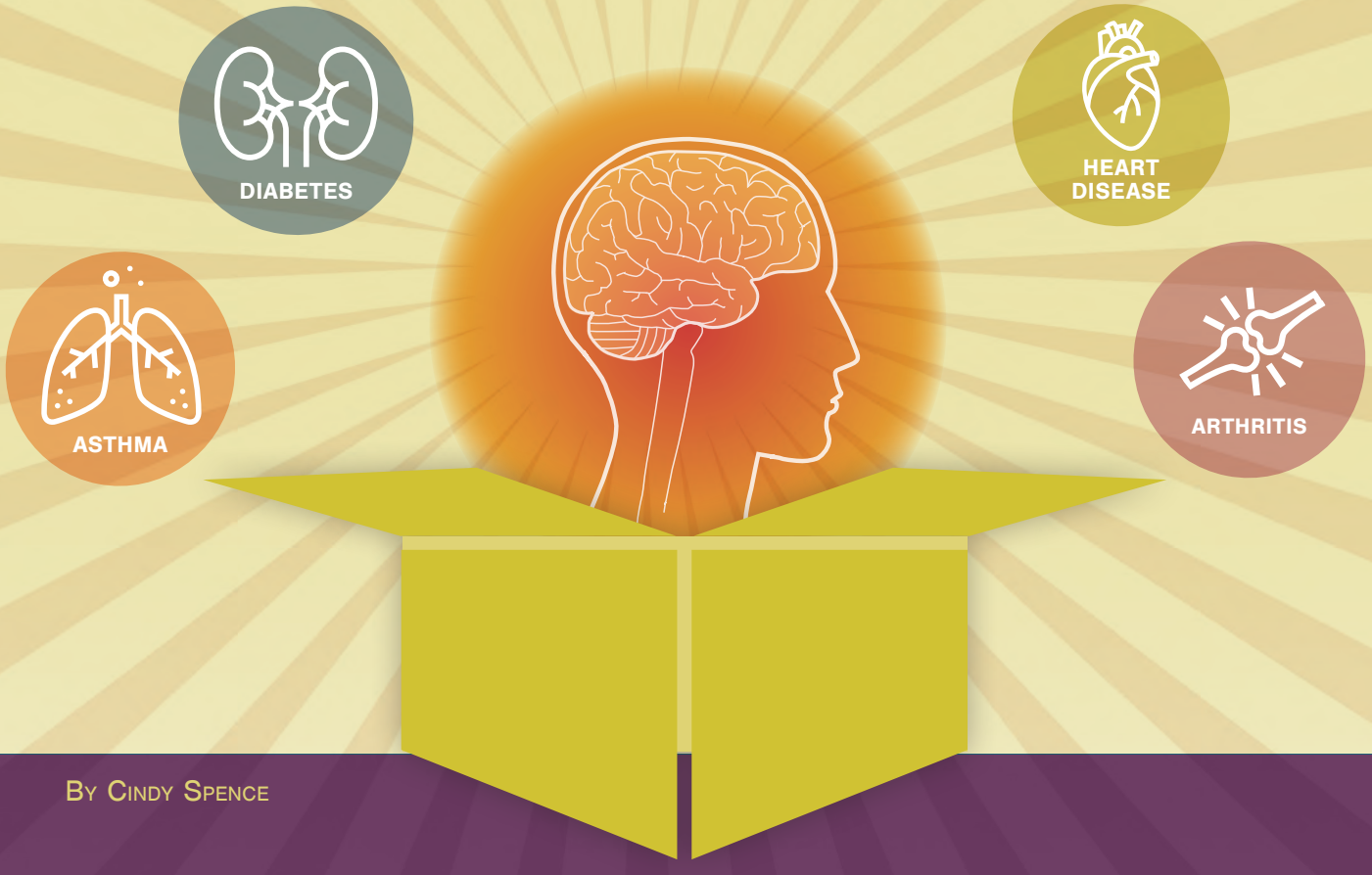

By Cindy Spence

Unpacking Inflammation

Many factors affect immune response

Inflammation plays a role in almost every disease, as well as the aging process, but quantifying various forms of inflammation and identifying their molecular effects in human disease is challenging.

Learning more about inflammation could lead to better health outcomes for a host of ailments, say Dr. Lyle Moldawer and Dr. Michael Clare-Salzler, who are the leaders of the UF Health initiative called Creating the Healthiest Generation.

It's a big challenge considering that inflammation is implicated in so many diseases, from systemic blood infections (sepsis), arthritis and heart disease, to Type 1 and 2 diabetes, obesity, cancer, and Alzheimer's disease, as well as pain and mental disorders.

It's estimated that inflammatory diseases cost the U.S. over a half trillion dollars annually and thus are of critical importance to patients, their families and the country.

These investigators say inflammation comes in many varieties, so addressing it requires a detailed understanding of contributing factors, including patients' genetic makeup, their environment and lifestyle, and the role of infections. Understanding the molecular mechanisms of inflammation in an individual patient provides opportunities for focused, effective personalized therapies, they say.

Dr. David R. Nelson, interim senior vice president for health affairs at the University of Florida and president of UF Health, says researchers will tackle multiple projects,

but it makes sense to start with disease-associated inflammation.

"Inflammation is one of multiple overarching challenges UF Health hopes to address through this Healthiest Generation initiative," Nelson says. "From nutrition to genetics, UF Health has the kind of comprehensive, interdisciplinary expertise to ensure that our children and grandchildren can live longer and healthier lives than we do."

Clare-Salzler, director of the Center for Immunology and Transplantation and the Stetson Professor in Experimental Pathology in the UF College of Medicine, says many medical teams already investigate inflammation, but the Healthiest Generation initiative will provide a coordinated approach to inflammation science. How is inflammation the same, or different, across multiple conditions and how can doctors best treat it?

To answer that question, the initiative will conduct a detailed and integrated assessment of inflammation, which could lead to the creation of precision medicine approaches to a range of diseases, according to Moldawer and Clare-Salzler.

UF already has foundational expertise in place to take its inflammation science to the next level. Many investigators in colleges throughout the university are involved in some aspect of inflammation research and human clinical studies. There are also key research resources, such as a Biorepository Core which banks human biologic samples that are critical for investigating inflammation. In addition, there is a substantial research infrastructure that provides such services as gene sequencing and analysis of large and complex data sets.

"The ultimate objective is to get a collective of investigators across UF campuses and bring them together to develop common programmatic approaches to inflammation science."
— Michael Clare-Salzler

One of the first projects will be to develop molecular diagnostic and prognostic tools to better understand the role of inflammation in two important human conditions: sepsis — the body's extreme response to infection — and trauma or massive tissue damage. Moldawer's team has been a national leader in this area and sees this project as an opportunity to "develop new tools to better manage these critically ill patients."

Another initial project will be to examine inflammation in pancreatic cancer and will be headed by Dr. Steven Hughes from the Department of Surgery. Hughes and his team will examine pancreatic cancer tissues for unique inflammatory signatures in the tumor microenvironment that are key to understanding the patient's diagnosis, prognosis and treatment, thus yielding a personalized medicine approach to this deadly form of cancer.

These and other projects will benefit from the purchase of a new tool, a GeoMX Digital Spatial Profiler™, which will enable characterization of proteins and messenger RNA at an ultra-fine scale in human tissues.

Moldawer and Clare-Salzler point out that investigating inflammatory responses in pancreatic cancer and sepsis is just the first step in the Healthiest Generation initiative. Eventually, the initiative will draw on all six colleges, the UF Health system, the UF Health libraries and 26 centers and institutes.

"The ultimate objective is to get a collective of investigators across UF campuses and bring them together to develop common programmatic approaches to inflammation science," Clare-Salzler says. "This will be a very deep analysis of inflammation over the long run and the beginning of what we think will be a much larger initiative."

Michael Clare-Salzler
Stetson Professor in Experimental Pathology
Director, Center for Immunology and Transplantation
salzler@pathology.ufl.edu

Lyle Moldawer
Robert H. and Kathleen M. Axline Basic Science Professor of Surgery
moldawer@surgery.ufl.edu

COLLABORATORS:
- *College of Medicine*
- *College of Pharmacy*
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- *College of Public Health and Health Professions*
- *College of Veterinary Medicine*

iCoastConnection

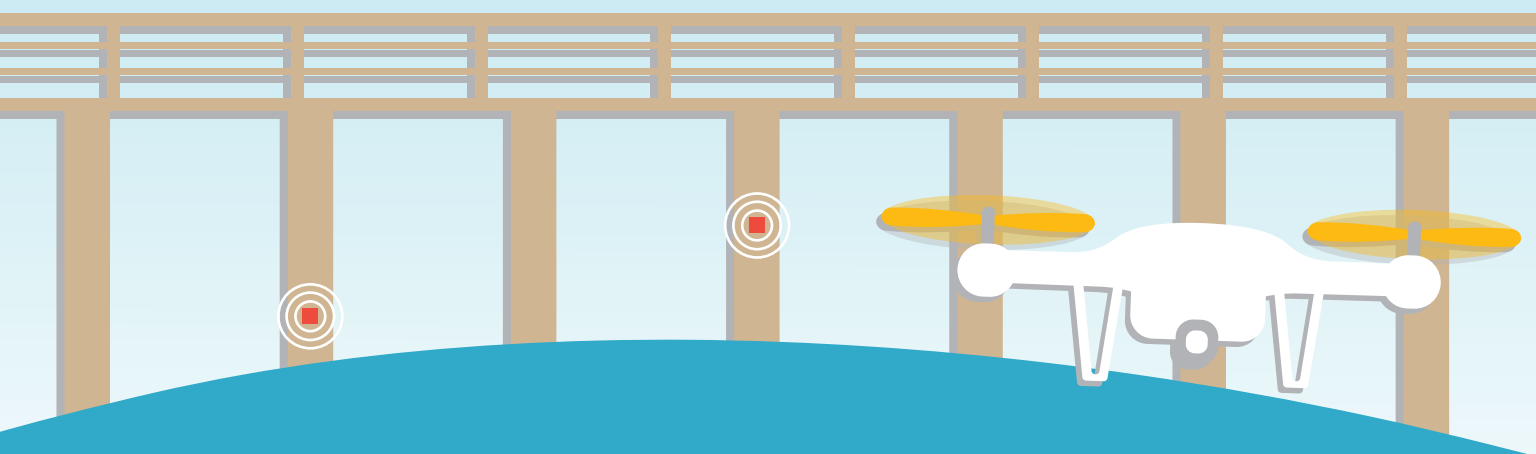
Quantifying Florida's coastline

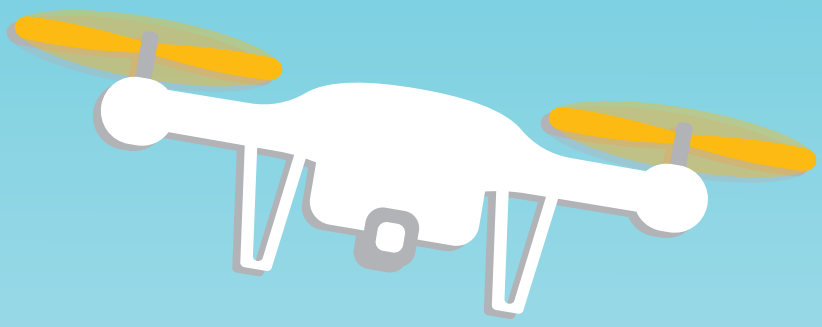
By Cindy Spence

Drones fan out across the waves of Crescent Beach, sipping sea water and ferrying samples back to shore. Sensors monitor the environmental DNA of sea life and the integrity of structures like bridges and piers. High-performance computers crunch all the data and make predictions about the health of Florida's 8,436 miles of coastline.

It's the iCoast, and it's only the beginning.

In a pilot program led by the University of Florida's Whitney Laboratory for Marine Biosciences and the Herbert Wertheim College of Engineering, scientists and engineers will deploy sensors, robotics and other technology to collect fine-grained data on the health of the coastline from San Sebastian to Pellicer Creek on Florida's east coast. Their goal is to use the data to react in real time to threats like red tide, which was especially severe in 2018, killing dolphins, manatees, sea turtles and fish by the tons, and damaging tourism so severely that the governor declared a state of emergency.





"We can shoot people to the moon, but we still can't predict red tide, a problem that is right in our face in Florida," says Todd Osborne, an assistant professor of biogeochemistry at the Whitney Lab, which is situated between the Atlantic Ocean and the Intracoastal Waterway. "So we thought we would use the best technology available and perhaps develop some of our own technology to sense the environment in a more rapid and novel way so we can model what is going on on the coastline."

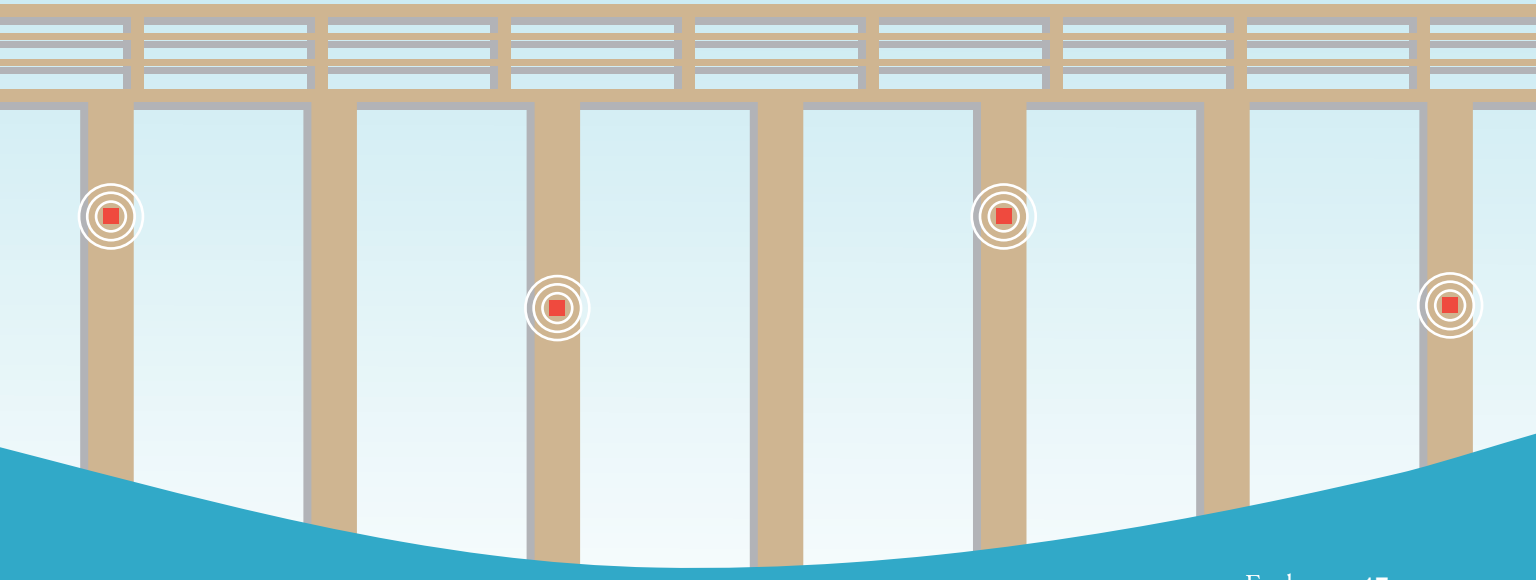
Osborne says a patchwork of monitoring goes on in the coastal zone today by environmental and public health agencies.

"What we're using now is sort of last century. Literally, someone is going out with a bottle and collecting water and bringing it back to a lab to analyze it," Osborne says. "You've got all these agencies—state, federal, private groups—measuring everything under the sun, and it's all over the place. So, centralizing the effort is really important."

Osborne and David Kaplan, an associate professor of environmental engineering and director of the H.T. Odum Center for Wetlands, say researchers plan to build the sensor devices and platforms and have them up and running this summer on Florida's east coast near the Whitney Laboratory, which will serve as the project's home base.

Kaplan says the three main components of iCoast are the sensors, the platforms to which the sensors are attached, and the system for integrating, modeling and using the data.

Some sensors, such as those that measure temperature and salinity, already exist, but others, such as a microfluidic sensor for detecting pathogens and algal blooms, are in development by UF engineers. Current water tests require on-site collection and analysis in a lab, a labor-intensive and time-consuming process. Kaplan says the eventual goal for the microfluidic devices is to measure pathogens directly in the water.



"We can shoot people to the moon, but we still can't predict red tide, a problem that is right in our face in Florida."

— Todd Osborne

The sensing platforms can be bridges, piers or buoys, but also biological structures like mangrove roots or even migrating fish. Some of the network would be autonomous or semi-autonomous, such as aerial and underwater drones, Kaplan says. When the network is operational, it will provide physical, biological and chemical data that will be integrated with a model to predict environmental responses, providing an early warning system for coastal health.

For example, microfluidic sensors that detect *E. coli* in the water will be coupled with a model that predicts the direction of water flow in real time, giving coastal communities information to protect beachgoers from exposure. In the case of an oil spill, a sensor network could provide enough warning to put up booms to protect coastal marshes.

With better and more timely information, Osborne says, scientists can give policymakers data on which to base decisions.

"If we know what's coming, we don't need to wait to respond. We can have proactive solutions to our coastal water quality issues," Osborne says. "We are looking for an opportunity to be proactive to things like red tide, not reactive."

Algal blooms are just one coastal issue. Others include storm surge and inundation, salt water intrusion, contaminants and pathogens, microplastics, invasive species and aging infrastructure.

The coast from the Whitney Lab up to the San Sebastian River is a prime location to test iCoast, Osborne says. Along that strip of coast are multiple ecosystems from beaches to salt marshes and lands that range from protected to industrial and natural to urban. The variety of environmental settings will provide a textured picture of coastal health and put the technology to the test under a range of conditions.

Issues that affect the coast impact not only the environment but the economy, Osborne says. Protecting the economy means protecting the coast, and protecting the coast requires data. Osborne envisions multiple sensors, some perhaps in 55-gallon drums attached to buoys or piers and others, such as drones or submersibles, remotely directed to locations. Still others, like sondes, are about as long as a pen and are clustered in groups of eight that are about three inches in diameter. They can measure tidal cycles. Another device is solar-powered and barrel-shaped and collects water samples at intervals and stores them until they can be retrieved.

The tsunami of data the sensors will unleash will be funneled through the Whitney Lab's connection to UF's high-performance computing platform, HiPerGator, for processing.

About 40 percent of the world's population lives within 100 kilometers of the coast, so making the iCoast model portable once it

"Our ecosystems are not just about the aesthetics of a beautiful beach. They're about the water we drink, the crops we produce, and the air we breathe."

—David Kaplan

has been field-tested is important, Osborne says.

"One of our design criteria is to be able to put this in a car and deliver it anywhere," Osborne says. "Our vision was a deployable sensory array that could go anywhere in the world."

Kaplan says the iCoast system could be used to warn of the danger of a cholera outbreak, like the one in Mozambique, or detect contaminated water after a nuclear disaster like Fukushima. In Florida, he says, both human and environmental health are at stake.

"With 1,000 people moving to Florida every day, the need for this project is critical, but it can't work on its own," Kaplan says. "It's like the canary in the coal mine. It's great until you run out of canaries.

"Our ecosystems are not just about the aesthetics of a beautiful beach. They're about the water we drink, the crops we produce, and the air we breathe," Kaplan says. "If we only invest on the tech side, we'll do a really good job of measuring what we're degrading."

COLLABORATORS:

- *Whitney Laboratory for Marine Biosciences*
- *Engineering School of Sustainable Infrastructure & Environment*
- *Mechanical and Aerospace Engineering*
- *Geological Sciences*
- *Soil and Water Science*
- *Anthropology*
- *Physiological Sciences*

Todd Z. Osborne
Assistant Professor of Biogeochemistry
The Whitney Laboratory for Marine Biosciences
osbornet@ufl.edu

David Kaplan
Associate Professor of Environmental Engineering and Director, H.T. Odum Center for Wetlands
dkaplan@ufl.edu

DIGITAL LITERACY

Educating future generations

By Cindy Spence

Hans van Oostrom has two photographs he shows to make a point about educating University of Florida students.

In the first, students are lined up in rows in an auditorium, facing a lecturer. In the other, students are lined up in rows in an auditorium, facing a lecturer. The first, in black and white, is from the 1970s. The second, in color, is from today.

In the midst of what has been called the fourth industrial revolution, marked by the connections of the physical and cyber worlds, we can do better, says van Oostrom, who conducts research on educational methods and directs the Institute for Excellence in Engineering Education.

Cammy Abernathy, dean of UF's Herbert Wertheim College of Engineering, says educational opportunities are limitless in an age that offers virtual reality, artificial intelligence, facts-at-your-fingertips, machine learning and big data analytics, along with the next new thing, whatever that might be.

"The way we deliver education must change," Abernathy says. "Our goal is to make UF the most digitally literate, digitally responsible public university in the nation."

On campus, a short walk from the lecture hall where van Oostrom's photos were taken, is one example of what progress looks like.

At the Digital Worlds Institute, in the Polymodal Immersive Classroom Theater, or PICT, class is in session.

"I envision a classroom that integrates the physical and virtual worlds, where students have goggles on, and they have their own individual instructor, a virtual instructor, who will teach them some of the basics."

—Hans van Oostrom

The professor stands at a podium, operating touch controls like a starship commander. An immersive, multi-channel projection system creates a panorama that unfolds on multiple screens, some showing lessons, others showing students. Cameras seamlessly zoom in on a student asking a question, which can be answered synchronously by another student anywhere in the world. Behind the scenes is a control room.

Today, it's state of the art and the only classroom of its kind at UF, says James Oliverio, director of the Digital Worlds Institute and a collaborator with engineering and education researchers on the digital literacy initiative. But in a more digitally literate world, PICTs, or something better, could be everywhere.

Van Oostrom will draw on Oliverio's expertise with environments like the PICT in designing a new space for the digital literacy initiative called the iClassroom. For now, it will be based in engineering's Larsen Hall and will function as a testbed for the use of new technologies in education. The iClassroom will be a place where vendors and tech developers can test the real world educational applications of their inventions. Teaching will occur as students use the devices, improving upon some, identifying flaws in others. In addition to building a physical space, UF will build a curriculum for digital literacy, open to all students.

Technology moves fast, and UF will have to move fast, too, to stay current.

"As a large, traditional institution, we don't often move fast, that's part of what we want to change," van Oostrom says.

The iClassroom will move to the Data Science and Information Technology building, once the planned $70 million, 150,000-square-foot structure goes up next to Larsen Hall.

"Version 1.0 of the iClassroom will help us design that space," van Oostrom says. "It's a research approach, to try out new technologies for education and see what works."

"The way we deliver education must change. Our goal is to make UF the most digitally literate, digitally responsible public university in the nation."

—Cammy Abernathy

"We're focused on re-envisioning how learning is occurring in the online and hybrid space now so we can figure out what learning is going to look like 15 years from now."

—Glenn Good

The resources of the Warren B. Nelms Institute for the Connected World also will come into play, and when the program is fully developed, it will offer certificates in digital literacy and data analytics.

New technologies will offer more opportunities for precision learning, van Oostrom says. Students who need more help, would get more help. Students who have grasped a concept could move on.

"I envision a classroom that integrates the physical and virtual worlds, where students have goggles on, and they have their own individual instructor, a virtual instructor, who will teach them some of the basics," van Oostrom says. "Then afterward, perhaps the students work together on a project.

"That technology is not too far away—bits and pieces exist—and we can integrate them for education."

Another vital component of the initiative is the College of Education's Institute for Advanced Learning Technologies, which is hiring several top researchers to crunch data on how current online students learn with the aim of designing online and "hybrid" residential/online educational experiences for tomorrow's students.

"We're focused on re-envisioning how learning is occurring in the online and hybrid space now," says College of Education Dean Glenn Good, "so we can figure out what learning is going to look like 15 years from now."

While tools like social media and video chat might dominate today's online experience, the researchers anticipate virtual and augmented reality being the platform of the future. Laboratories featuring state-of-the-art tools are key components of a $30 million renovation currently underway at the College of Education's Norman Hall, which houses the PICT.

Oliverio says one of the things the Digital Worlds Institute brings to the conversation about digital literacy is a focus on how people interact with a technological space. Lecture halls, he says, are "so 20th century."

Designing virtual educational environments requires thinking about how people experience an event or narrative, Oliverio says. That design approach will push classrooms into the multiple realities of 21st century technology.

Oliverio says "pesky human factors" must be taken into account since classrooms blend generations

UF Digital Worlds Institute

of humans as both teachers and students. No matter how dazzling the technology under the hood, digital classrooms need to feel natural and intuitive to avoid the kind of frustration that causes people to tune out.

"Once an interface makes you mad or frustrated, you're not going to use it. You will stay in your comfort zone," Oliverio says. "Just because the code underneath is brilliant, doesn't mean the interface is usable."

Oliverio says post-millenial generations expect to use technology. If classrooms are not in that space as well, "then we're not preparing them to live and work in the middle of the 21st century."

"Virtual and augmented realities, eventually other realities, are going to be a daily thing like television and iPhones. That's the next internet, in ways we don't yet fully appreciate," Oliverio says.

Van Oostrom says social sciences will play a role in the digital literacy initiative in preparing students to be responsible in a more digital world. The virtual world can't become the only world. Exploring social interactions that maintain a real-world connection is important, he says.

"The days are gone when we would build a technology and not worry about its effect," van Oostrom says.

Positioning the digital literacy initiative in engineering, he says, is appropriate because of engineering's approach to learning.

"When I studied electrical engineering, I was building things with transistors," van Oostrom says. "Today, students buy a whole board with integrated chips. Engineering is not as stable as British literature from the 18th century. In four years in engineering, we need to teach students how to be lifelong learners.

"Because things will change."

Hans van Oostrom
Director, Institute for Excellence in Engineering Education.
oostrom@ufl.edu

James Oliverio
Director, Digital Worlds Institute
james@digitalworlds.ufl.edu

"Virtual and augmented realities, eventually other realities, are going to be a daily thing like television and iPhones. That's the next internet, in ways we don't yet fully appreciate."

—James Oliverio

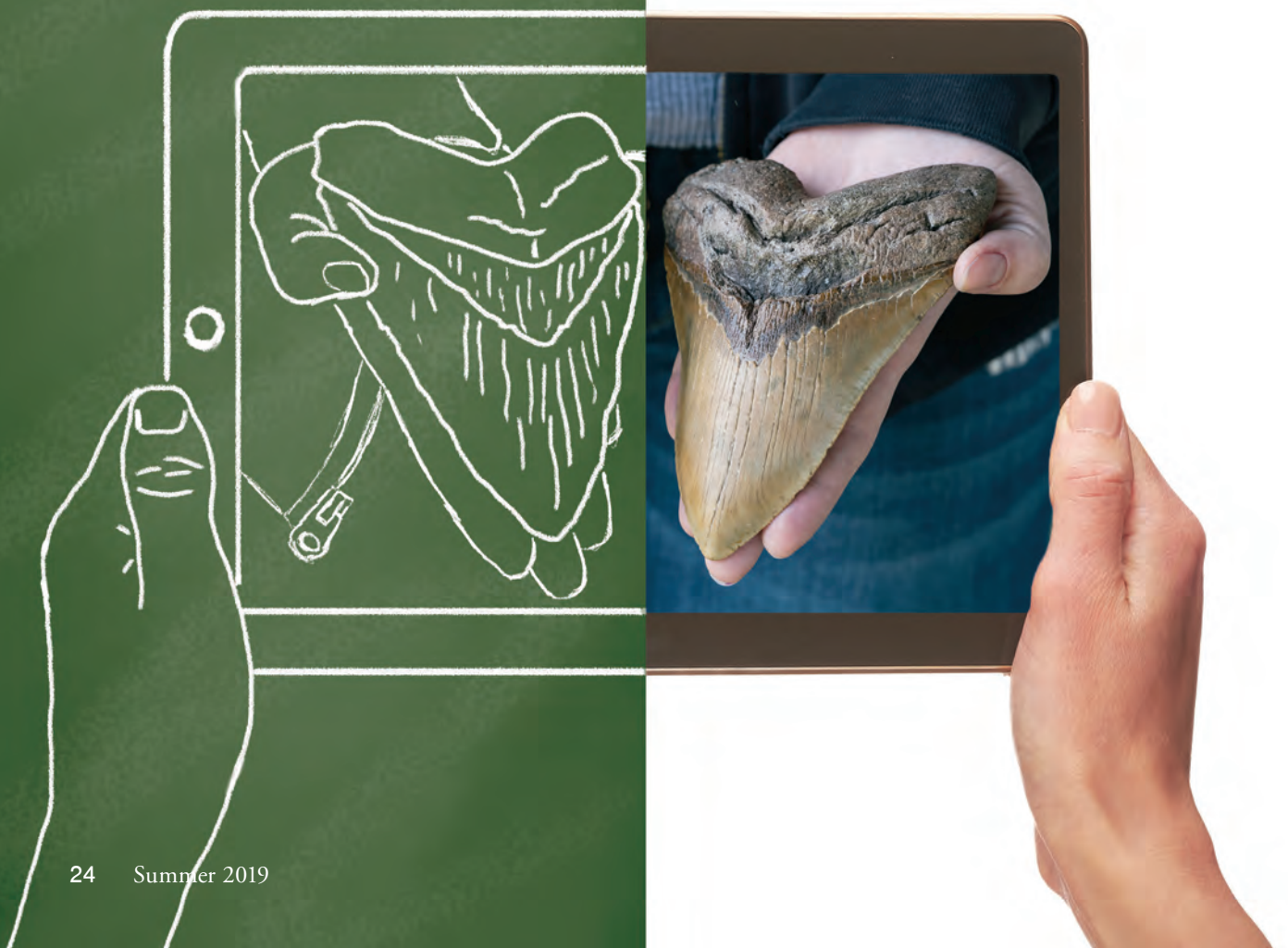
COLLABORATORS:

- *Herbert Wertheim College of Engineering*
- *College of Education*
- *College of the Arts*
- *Institute for Excellence in Engineering Education*
- *Nelms Institute for the Connected World*
- *Digital Worlds Institute*
- *Institute for Advanced Learning Technologies*

SCIENCE CLASS

Connecting scientists with teachers and students

By Cindy Spence



Bruce MacFadden has accumulated a list of professional accomplishments a mile long over his 42 years as a paleontologist and museum curator. But perhaps this moment in his distinguished career is best summed up by a science teacher:

"Bruce MacFadden is the guru of science in the classroom."

That assessment comes from Scott Flamand, a retired teacher from Gainesville's Buchholz High School who has been a longtime collaborator with MacFadden on bringing the University of Florida's foundational expertise in science into K-12 classrooms.

When Flamand heard that MacFadden and Associate Professor Pasha Antonenko would be leading a new initiative — Scientist in Every Florida Classroom — the recently retired educator jumped at the chance to volunteer.

"This will allow teachers all over the state to experience the incredible resources of UF the way I experienced them," Flamand says.

MacFadden and Antonenko are quick to point out that UF won't be emptying labs to send scientists to classrooms. Instead, new technologies make it possible for teachers and students to tap into the expertise of UF scientists.

"It's not feasible to physically put a scientist in every classroom, but we can do the next best thing," says Antonenko, an expert on educational technology in UF's College of Education. "Modern technology gives us a host of different tools to bring science to classrooms."

The focus of the initiative will be on Earth sciences — air, water, land and life — and MacFadden plans to leverage the resources of the brand-new UF Thompson Earth Systems Institute, which he directs. One goal of the institute is to communicate research discoveries by UF scientists, and one of the institute's target audiences is Florida K-12 students, all 2.6 million of them.

"It's hard for science teachers to keep abreast of the most recent research discoveries and advances in knowledge. Scientists can help by communicating directly with teachers and students."

— Bruce MacFadden

MacFadden and Antonenko envision trying blends of in-person and digital interaction in five possible pilot locations: Alachua, Escambia, Lee, Palm Beach and Seminole counties. Escambia, Lee and Palm Beach counties are coastal so have a particular connection to issues like sea level change, salt water intrusion, red tide and algae blooms.

As MacFadden focuses on the content, Antonenko will focus on delivery.

"When people talk about educational technology, the educational part of that is really important," Antonenko says. "It's not just about tools. How does this use of technology in this particular classroom with these particular students foster engagement?"

Some digital tools are familiar, such as video conferencing, but Antonenko also is considering how to use holograms or other virtual and mixed reality tools. The goal is to create an online community of practice that allows teachers to more easily network with UF scientists. The pilot kicks off July 1, and as the team experiments over the next four years, it will keep what works and discard what doesn't. And in a summer institute with UF's Center for Precollegiate Education and Training, science teachers can weigh in on how they want to incorporate UF science in their lesson plans.

MacFadden and Antonenko note that they are not starting from scratch. Assistant Professor Jamie Liozzo in the Institute of Food and Agricultural Sciences does a video series called Streaming Science and Associate Professor Andrew Zimmerman in the Department of Geological Sciences has been taking a program called GeoGators to local schools for almost a decade.

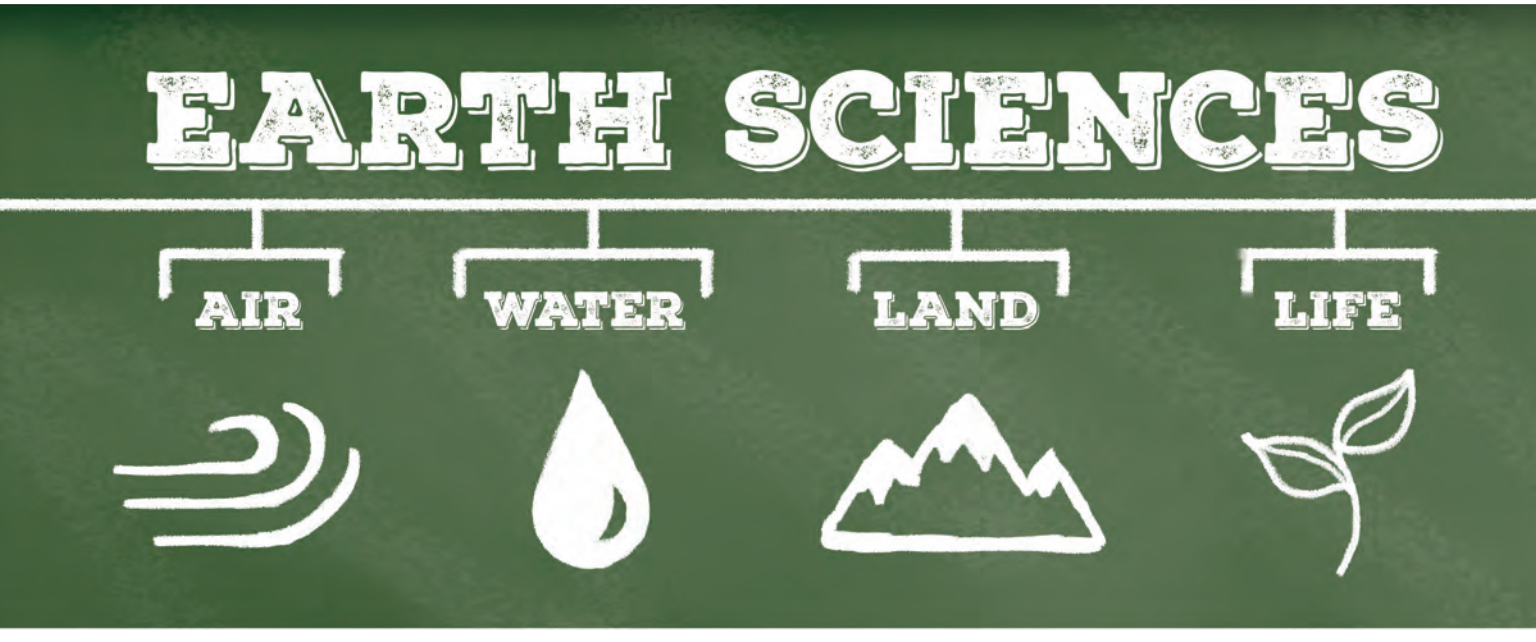
"When people talk about educational technology, the educational part of that is really important… How does this use of technology in this particular classroom with these particular students foster engagement?"

—Pasha Antonenko

Antonenko says the initiative will act like a matchmaker, connecting the right scientists with the right teachers and classrooms. MacFadden says teachers have a hunger for the latest in science.

"It's hard for science teachers to keep abreast of the most recent research discoveries and advances in knowledge," MacFadden says. "Scientists can help by communicating directly with teachers and students."

MacFadden saw the impact of collaboration between a university and a K-12 district in an unusual 2015 sabbatical, which he spent not in the field but as a visiting scientist in schools in Santa Cruz, California. He has also brought dozens of middle and high school science teachers to the Panama Canal over the last decade to participate in paleontological digs supported by the National Science Foundation.



Jeff Gage

MacFadden has provided hands-on learning opportunities for teachers at digs along the Panama Canal and at UF's Montbrook fossil site and Powell Hall.

Getting science into elementary schools, where the focus is often on reading and math, is particularly important, he says.

"I have no problem teaching my fossils to third-graders. At that grade level, they have innate curiosity," MacFadden says. "If I go into a classroom of third-graders and bring a box of fossils and say, 'Who wants to study fossils today?' Every kid in that class raises their hand."

Antonenko says the initiative's ability to provide role models is as important as its science content.

"Research shows engagement is so much better when there is a gender- and race-matched role model in the classroom," Antonenko says. "For girls in STEM, a young woman scientist can be a true trigger experience. One hour with someone like that can do so much."

MacFadden says he plans to ask for graduate student volunteers to visit classrooms to talk not only about their science but about their journey and the careers ahead of them.

Flamand says there is yet another benefit—boosting science literacy.

"These students will grow up to become citizens and voters and will help make decisions about climate change and vaccines and other issues," Flamand says. "Science literacy is about more than someone becoming a scientist."

MacFadden says changing attitudes toward science starts by working with K-12 students and their teachers.

"This is a generation that's going to be affected by a lot of the science issues of our day," MacFadden says. "Making them predisposed to like science or want more science can't be a bad thing."

Bruce MacFadden
Director, Thompson Earth Systems Institute
bmacfadd@flmnh.ufl.edu

Pasha Antonenko
Associate Professor of Teaching and Learning
p.antonenko@coe.ufl.edu

COLLABORATORS:

- *Florida Museum of Natural History*
- *College of Education*
- *Thompson Institute*
- *Multiple Florida School Districts*

Childhood: A to Z

A hub for early childhood science

By Cindy Spence

Surrounded by national scholars in early childhood studies at a summit in 2017, Patricia Snyder and her University of Florida colleagues got drafted. Their charge: create a trusted database to which both scholars and parents could turn for the science on early childhood studies.

The summit—Starting Ahead, Staying Ahead—was hosted by UF and its Anita Zucker Center for Excellence in Early Childhood Studies, which Snyder directs.

As the group of 120 scholars discussed opportunities and challenges in the interdisciplinary field of early childhood, they identified a gap that impacts all their fields. There was no central location to find science-based resources on early childhood issues from law to pediatrics, from education to public policy. They also highlighted a need to make the resources relatable for families and caregivers of very young children.

So, the Anita Zucker Center took on a new initiative—the A to Z's of Early Childhood: Communicating the Science of Early Childhood Development and Learning to Those Who Need It Most from a Trusted Source. Using the alphabet as its organizing principle, the online communications and resource hub will work its way from A to Z.

For example, starting with A for Access, the site will give key points about how to access high-quality early care and education. B, for Behavior, will offer simple strategies caregivers can use to promote children's positive behavior. The B section also points out how nimble the resources in A to Z can be, given that the strategies align with a recently released American Academy of Pediatrics policy brief on disciplining young children.

"The policy brief was timely, so we chose to feature positive behavior as the first B," says Snyder, the David Lawrence Jr. Endowed Chair in Early Childhood Studies.

The site, A to Z's of Early Childhood: The Science of Child Development and Learning, launched in April.

Making the science of early childhood development and learning accessible to practitioners, families and caregivers is important, Snyder says. The landing pages include videos, links to additional resources, and materials that can be downloaded. Anyone, parent or scholar, who wants a deeper dive can find links to policy briefs or research studies that elaborate on the A to Z content from UF scholars or their global partners.

Acknowledging the importance of working across disciplines, collaboration is the first C, and it's something the Anita Zucker Center knows how to do well, both on campus and in the community.

"We have scientific reasons why we do our work, but we also have moral reasons. It's the right thing to do, not only for children and families, but for society."
—Patricia Snyder

Community collaborations helped pass the Children's Trust of Alachua County, a special taxing district for children's services in 2018, and supported the recently opened CHILD (Children's Health, Imagination, Learning, and Discovery) Center for Early Learning in Gainesville. UF early childhood researchers are partnering with the center and others to transform early childhood education and care services.

Snyder says the community and a major research university can do more for children by working together.

"Our colleagues around the country have asked us how we've accomplished so much," Snyder says. "So 'C' will include tips for collaboration that results in meaningful community-level impact."

Following the 2017 summit, Snyder and co-director Maureen Conroy ramped up their collaborations to help support the convening of a mini-summit on child and family law by UF's Levin College of Law. One outcome from the summit was a special issue of the *Florida Law Review* in which Snyder, Conroy and faculty from the colleges of Medicine and Public Health and Health Professions published alongside legal colleagues, an unusual venue for scholarship by educators and doctors.

Such work across disciplines is critically important, Snyder says, because the disciplines that touch early childhood issues overlap and need to work in the same space.

"We are committed to building these interdisciplinary connections, to integrating science, policy and practice in early childhood studies," Snyder says.

A second national summit is being discussed, possibly in 2021. Snyder says she is heartened by the vote of confidence of her colleagues in asking UF to take the lead on the A to Z's of Early Childhood.

"Many of our colleagues commented about the fact that the president, the provost, the deans of four colleges, and faculty of those colleges were all present at the summit," Snyder says. "That really demonstrated UF's interdisciplinary commitment to this area of study at the highest levels."

As more disciplines collaborate, having a go-to resource for science and scholarship becomes even more important.

"We want to be sure that the research can be put into practice," Snyder says.

"We have scientific reasons why we do our work, but we also have moral reasons," Snyder says. "It's the right thing to do, not only for children and families, but for society."

Patricia Snyder
David Lawrence Jr. Endowed Chair and Director, Anita Zucker Center for Excellence in Early Childhood Studies
patriciasnyder@coe.ufl.edu

Related Wedsite:
ufearlychildhood.org

COLLABORATORS:
- *Colleges of Education, Journalism and Communications, Law, Liberal Arts and Sciences, Medicine, Public Health and Health Professions, Nursing*
- *Harn Museum of Art*
- *Baby Gator Child Development and Research Center*

Artistic Impact

Economic benefits from a world of creativity

By Cindy Spence

One in five Florida residents were born elsewhere and brought their music, dance, art, ideas, traditions and innovations with them.

How much is this cultural gestalt worth? For Florida, a state at the crossroads of arts and migration, quite a lot.

"The creative production of people who arrive from afar can have profoundly stimulating effects on the economic ecosystem," says Anthony Kolenic, assistant dean for research in the University of Florida's College of the Arts.

Researching the role of migrants in the state's creative economy is the goal of an initiative called Migration Redefined: Arts, Diaspora and Entrepreneurship in the 21st Century, which will draw on the college's foundational expertise in global arts, particularly those with a Latin American or African focus.

The arts already add $33.4 billion to the state's economy and with Florida's migrant populations poised for growth, Kolenic says the arts sector of the economy can grow.

"We can engage this moment and its possibilities," Kolenic says. "Florida is exactly the right place to do this kind of work because it's a network of global networks, as a state and as a population."

A center for arts, diaspora and entrepreneurship would counter the narrative in some quarters that immigrants are a social danger or a drain on the economy.

"Just the opposite is true," Kolenic says.

Over 20 percent of Florida residents are immigrants, but immigrants make up 26 percent of the employed population. Immigrants are disproportionately likely to be entrepreneurs, with 381,117 immigrant business owners accounting for 30.7 percent of all self-employed Floridians and generating $5.6 billion in business income.

In Miami/Fort Lauderdale/Miami Beach, immigrants account for 61.6 percent of business owners. A full 66.8 percent of Miami's creative class identifies as nonwhite.

Kolenic says there has been a paradigm shift in what it means to be an artist in the 21st century.

"The guiding thought here is to look at the ways culture is produced along the historical and contemporary tributaries of human movement," Kolenic says. "Art includes the page, the stage and the frame, but it goes way beyond that. Artists can be a community asset, an expert collaborator, an excellent problem finder as opposed to just the problem solver. Artists, from a methodological perspective, are willing to stay with a problem longer than most disciplines have a tolerance for.

"The thing that makes the arts the arts is that we build meaningful experiences for people, and that has a

"The thing that makes the arts the arts is that we build meaningful experiences for people, and that has a variety of applications that can make the arts a wonderful resource."
—Anthony Kolenic

variety of applications that can make the arts a wonderful resource."

Kolenic points to the role of landscape architecture in a civil engineering project like Gainesville's Sweetwater Wetlands Park. The artistic view of the landscape architect "threw a Z axis" into the project, turning a straightforward watershed management project into a tourism and recreation project and a revenue generator.

Among the new center's goals is advocacy for communities that generate creative works. Often, Kolenic says, the rewards of cultural creativity have not accrued to the creators.

Many of the music, dance and storytelling narratives we think of as American have significant threads borrowed from migrant cultures, but the creators have not benefitted from the appropriation into the mainstream. A question the center would like to explore is how to ensure that cultures and artists that create art benefit from that creation.

Kolenic says the center will be college-level, much like the college's pioneering Center for Arts in Medicine, the first of its kind and the one that other universities emulate.

Eventually, the center might seek a downtown location in a nod to Gainesville's historical connection to "strands of people that have inhabited this space, including those who were kicked out of this space 200 years ago." But the space is less important than the work. Says Kolenic: "In 2019, you can be a migrant in place. You can stay in one space, and the world will flow around you. It's a much broader approach to migration."

Kolenic came to UF from the University of Michigan after getting to know UF faculty through the Alliance for the Arts in Research Universities, of which UF is a founding member.

"The University of Florida has the wonderful opportunity as a public land-grant institution to serve all the people of Florida. As one of the most comprehensive research universities in the United States, UF has the capacity to serve the arts just as well as anything else. We have a unique opportunity to develop the arts in this context where we are also engaged in research."

Anthony Kolenic
Assistant Dean for Research, Technology and Administrative Affairs, College of the Arts
akolenic@arts.ufl.edu

COLLABORATORS:
- *Center for African Studies*
- *Center for Latin American Studies*
- *Herbert Wertheim College of Engineering*
- *Center for Entrepreneurship*
- *IFAS Extension*

UF Research

Discoveries WITH IMPACT

- UF faculty had a record $865 million in research expenditures in 2018, exploring new solutions in fields ranging from medicine to agriculture and engineering to art
- Over the last decade, UF technology transfer efforts have resulted in 137 startup companies, nearly 1,000 patents and $378 million in royalty revenue
- Companies licensing UF technologies have total sales revenue of $1 billion annually and are responsible for more than 10,000 jobs

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UF spinoff AGTC is partnering with ophthalmology Associate Professor Shannon Boye and her colleagues to develop treatments for blinding diseases

Photo by Mindy Miller