Florida Trend's

RESEARCH Florida

The arrival of Nobel Prize-winning scientist Stefen Hell and his Abberior Instruments company highlights the role Max Planck Florida plays in global science and Florida.

Plus: Research News ...

Emerging Pathogens Institute; autistic students; fossil discovery; analysis breakthrough; neuroscience; science of instruments; virtual reality as therapy; studying ruins; brain disease; colors and investing.

By Mike Vogel

MAX PLANCK FLORIDA INSTITUTE

Finely Focus

Hell's microscope allows researchers to see down to 20 nanometers, a 10-fold advancement beyond what previous microscopes could see. A human hair is about 75,000 nanometers wide.

photos: Max Planck Institute

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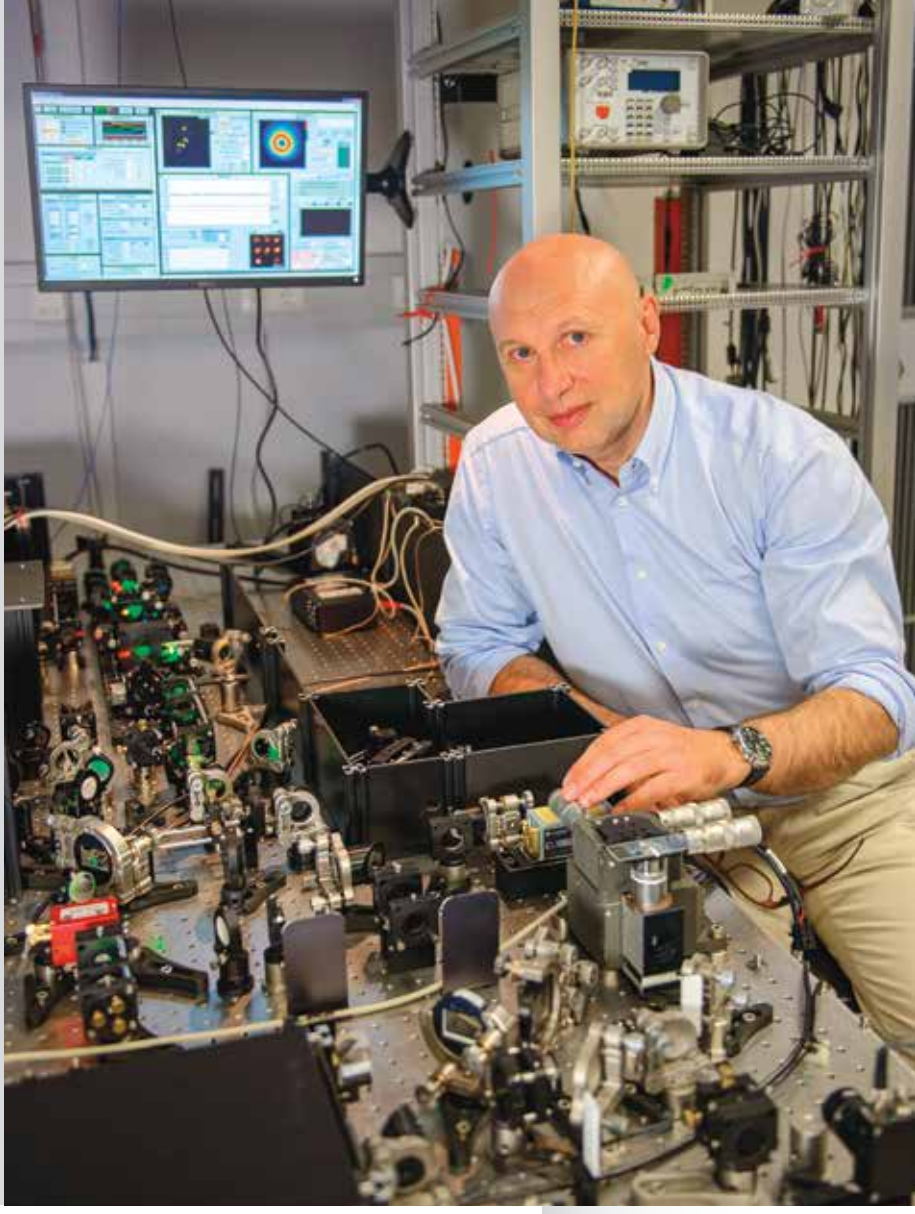
A Nobel Prize-winning German physicist brings his work — and the microscope he invented — to Florida. It's the only such microscope in the U.S.



Stefan Hell — in his optics laboratory at the Max Planck Institute in Germany — is taking a sabbatical to work at the Florida branch of the research institute.

In 1873, German physicist and optical pioneer Ernst Abbe discovered the limits of "microscope resolution" — how precisely an optical instrument can focus light, and thus how small an item can be seen clearly. Abbe found that the laws of physics make it impossible to get resolution on objects smaller than half the wavelength of light — about 200 nanometers. That's really small, a fifth of a thousandth of a millimeter, or about a hundredth the width of a human hair.

Abbe's discovery of the "diffraction barrier" was a breakthrough, but it was also bad news for researchers. Microbiology had been born thanks to microscopes, and much of scientists' understanding of biology had come from being able to see microbiology at work.

For scientists, it was akin to learning that they'd be able see details on the facade of a building without being able to observe how the people inside lived. Post-Abbe, researchers knew they'd be able to see larger parts of cells but never examine a cell in molecular detail — unable, for example, to observe molecules forming synapses between nerve cells. Or see how proteins aggregate in disease.

That was the state of affairs until 2000, when another German physicist, Stefan Hell, proved he could do an end-around past the resolution barrier by using lasers and fluorescence. His microscope sees down to 20 nanometers, a 10-fold step beyond the diffraction barrier.

For that solution, he and two other researchers — who came

photo: Irene Böttcher-Gajewski / Max Planck Institute

Abberior, the company that markets Stefan Hell's microscope, is based at the institute in Jupiter. From left: Hell, FLORIDA TREND South Florida Editor Mike Vogel, Abberior Instruments America CEO Christian Wurm and Max Planck CEO David Fitzpatrick observe a demonstration of the $1-million device.

up separately with their own end-around — were awarded the Nobel Prize in chemistry in 2014. "Due to their achievements, the optical microscope can now peer into the nanoworld," the Royal Swedish Academy of Sciences said in announcing the award. "Today, nanoscopy is used worldwide, and new knowledge of the greatest benefit to mankind is produced on a daily basis."

Perhaps some of that new knowledge will be discovered soon in Jupiter, Florida, home of the Max Planck Florida Institute for Neuroscience. Hell, 54, arrives there in January for a sabbatical from his job at the Max Planck Institute in Germany. The Florida institute also has become the U.S. base for Abberior Instruments America (a play on Abbe's name and "superior"), Hell's small firm that makes and sells his microscopes to research universities and organizations.

Max Planck Florida purchased one earlier this year — an "unprecedented level of imaging," institute scientific director and CEO David Fitzpatrick says. And Abberior has based a second there so it can show scientists around the nation its potential. "It was a very easy choice to come here because there's been such a good reputation that has been built up here," Hell says.

"This is science of the highest quality," says Max Planck Florida CEO David Fitzpatrick.

Increased stature

The arrival of Hell and his company highlights the role Max Planck Florida plays in global science and Florida. The Florida location is the first and only offshoot of the 83-institute Max Planck Society outside Europe, birthed in 2009 thanks to $94 million in state dollars and another $94 million in local support from Palm Beach County, the town of Jupiter and Boca Raton-based Florida Atlantic University. The local support funded a custom 100,000-sq.-ft. facility on FAU's Jupiter campus.

The state recruited Max Planck near the end of Florida's incentive-laden campaign to build a life-science industry here, a binge that began in 2003 with the $510 million that state and local governments put out to create Scripps Florida in Jupiter. That was followed by hundreds of millions more on other life-science ventures, most of which haven't prospered. One, VGTI in Port St. Lucie, failed, and others have struggled, including Sanford Burnham Prebys in Orlando, which wants to leave.

Max Planck Florida appears to be on firmer financial ground than some of its recruited peers. By 2015, the institute said it had grown to 144 employees, who made an average of $66,806 (its promise to the state for the incentives was to pay at least $64,770 on average). It's overseen by a powerhouse board of top executives from its German parent, high-profile local entrepreneurs and philanthropists George Elmore and Alex Dreyfoos, former FBI Director Louis J. Freeh and multimillionaires and former CEOs of GlaxoSmithKline, Pace Communications, General Dynamics and Wyeth. The non-profit Max Planck Florida managed a $55,511 gain after expenses on $25.4 million in revenue in 2015, according to its tax filing for that year.

Florida, however, expects more than mere survival from its life-science investment. And so far no spinoff companies — let alone firms employing large numbers — have come out of Max Planck Florida.

Fitzpatrick says that while spinoffs haven't materialized, the promised science has. Each Max Planck institute has its own spe-

photos: Max Planck Institute

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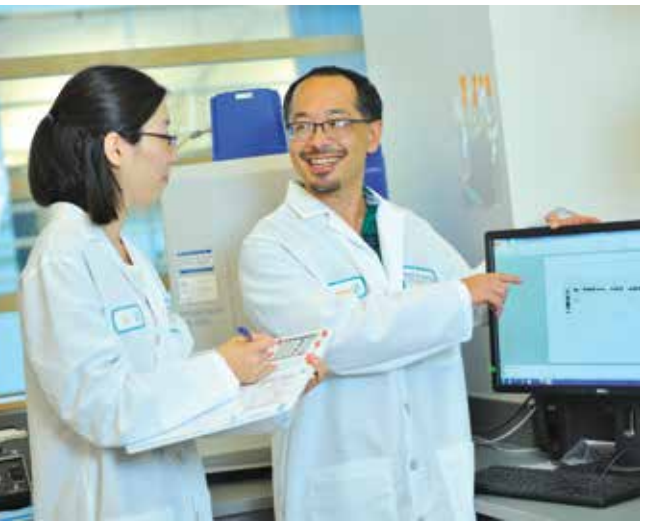


Ryohei Yasuda, right, won a $4.8-million Pioneer award from NIH to study dementia, autism and other disorders.

cialty. In Jupiter, that specialty is using and developing new imaging technology to study the brain at its most foundational, trying to understand how it works in order to understand why it sometimes doesn't.

In the last two years, the top-flight scientists that Max Planck has recruited to Florida have had 40 research papers published, including 25 in prestigious publications such as *Nature*, *Science* and *Cell*.

"This is science of the highest quality," says Fitzpatrick, who arrived in 2011 from Duke University's med school, where he was the James B. Duke professor of neurobiology and director of the Duke Institute for Brain Sciences. "I remember telling people 'just give us five years and you'll see what we will be able to produce.' And, of course, at the time I didn't really know what we would be able to produce, but we've done exceedingly well." As an endorsement of its success, the parent society now provides financial support for the Florida institute.

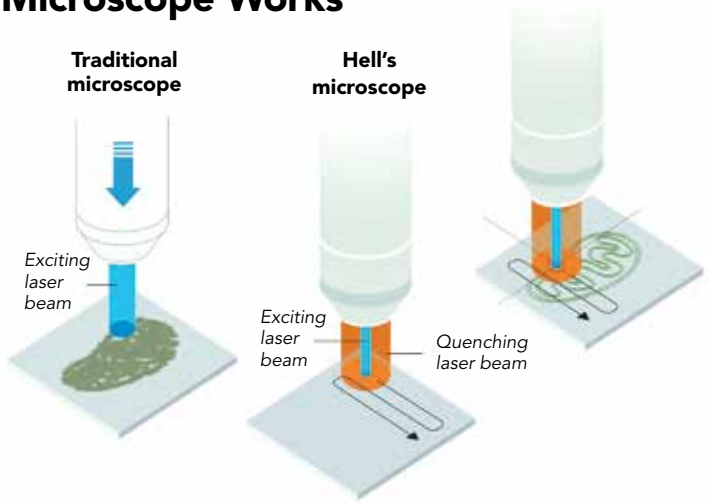
In 2015, the institute's other scientific director, Ryohei Yasuda, won a five-year, $4.8-million Pioneer award from the National Institutes of Health to fund research on the brain to gain insights into dementia, autism and other disorders. Only 13 Pioneer awards are given nationally to recognize groundbreaking approaches. (Next door at Scripps Florida, scientist Matthew Disney also won a Pioneer award in 2015.)

The Florida location is the only offshoot of the Max Planck Society outside of Europe.

In his lab earlier this year, Yasuda demonstrated how he works, standing in a darkened room filled by a baby grand piano-sized array of lasers and devices aligned to let him observe how neurons' dendritic spines function to exchange signals. "To look at a tiny thing, we need a big setup," he says.

Hell's Abberior microscope, conversely, is more compact — roughly the footprint of an upright piano. One system, says

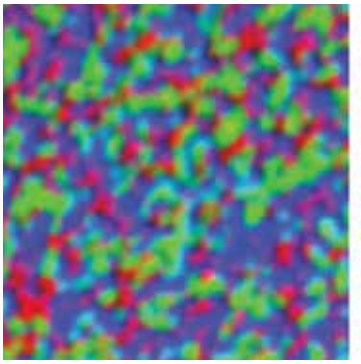
How Hell's Microscope Works



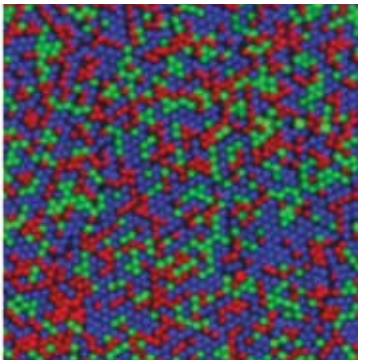
Traditional microscopes allowed resolution no better than half the wavelength of light, meaning a scientist could see a cell, but not the individual molecules inside the cell. Stefan Hell came up with a way to bypass that limitation.

Hell's approach uses two laser beams. The first scans across what the researcher wishes to view and "excites" the molecules inside the cell that fluoresce. A second laser then "quenches" — turns off — the fluorescing molecules aside from those within a certain desired volume. The researchers know exactly where the beam hits the sample and use that information to process the image.

The image on the left at the bottom shows the resolution that's possible with a traditional microscope; the image on the right shows the molecular-level detail that can be seen using Hell's microscope.



Traditional microscope



Hell's microscope

photos: Max Planck Institute

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Max Planck Florida occupies a 100,000-sq.-ft. building on the campus of FAU in Jupiter.

U.S. CEO Christian Wurm, can be transported in a suitcase. Abberior microscopes generally start at $200,000. A piano-size version with additional features can cost up to $1 million. That's expensive but "not outrageously more expensive" than existing tech, Hell says. He estimates there are 20,000 to 30,000 last-generation microscopes in use in U.S. university research and pharma companies, about 30% of the world market, that could be retrofitted with Abberior's compact system.

Max Planck, Scripps Florida and Florida Atlantic University share facilities and equipment in Jupiter.

Fitzpatrick says the presence of Abberior and the only such microscope in the nation enhances the reputation of the county and state for "best-in-class" research tools. After showing off the microscope in April, south Florida scientists held a sort of reception for Abberior. Scripps and FAU researchers already had put the new microscope through its paces — Max Planck, Scripps, which is across the street from Max Planck, and FAU have agreed to share Jupiter facilities and equipment. (Scripps last year bought a world-class microscope of its own with a $500,000 donation from the Iris and Junming Le Foundation.)

The Jupiter "neuroscience community" is coming together, Fitzpatrick observed. "FAU is a fantastic partner. The scientists at Scripps, we have a fantastic relationship. We all recognize our individual successes really build the whole entity."

FAU President John Kelly, at the reception, says FAU grad students working with Max Planck already have been credited as researchers in an article in *Nature*, "one of those impossible scientific journals to get into." Fitzpatrick helped FAU in its recruitment of Vanderbilt University scientist Randy Blakely ["Neuroscience Pillar," page 82] to head its brain institute. Fitzpatrick and Kelly traveled to Germany together last year for an FAU-Max Planck collaboration and to Tallahassee to promote the area's agenda. The institutions are sharing equipment and knowledge and, says Kelly, "our students get access to a Nobel Prize winner. Here, in Palm Beach. I love it."

Hell, the Nobel laureate, hopes his sabbatical year in Jupiter allows him to improve microscope capabilities further. "There is still more to be done," he says. "This is a fantastic place to do that."

photos: Max Planck Institute




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SWIMMING IN PLASTIC

Many Floridians know about plastic pollution in the ocean. What they may not know is that it's also a problem in most of Florida's streams, rivers and coastal waters.

Just how big a problem is hard to tell. Since large-scale production of petroleum-based plastics began in the early 1950s, researchers have learned that less than 10% of plastic ever gets recycled. Most ends up in landfills, as litter, or worse, broken down into ever smaller and smaller fragments called microplastics, that drift, blow and otherwise disperse into bodies of water.

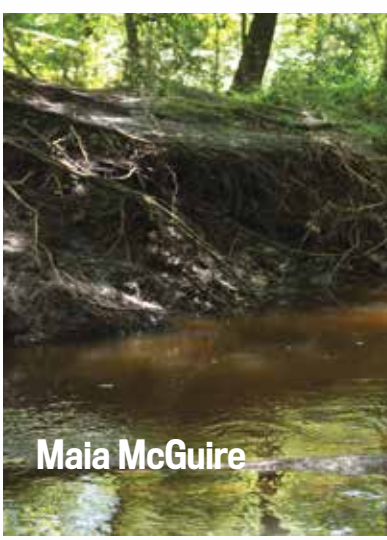
Some microplastics are deliberately manufactured in the form of tiny plastic beads that give scrub and gleam to some toothpastes, facial soaps, body washes and other personal care products. There are even microplastic fibers in the new generation of synthetic sportswear fabrics, and they shed from garments, especially in the wash.

All these microscopic bits make their way down sinks and around wastewater treatment plant filters then are discharged into rivers, lakes and oceans along with the rest of the treated effluent. In turn they are eaten by fish, birds, oysters, sea turtles and even tiny creatures low in the food chain, like plankton. What's more, toxins that adhere to these bits of plastics get eaten, too.

So each time Floridians brush their teeth or wash their workout clothes, they are inadvertently sending bits of plastic into the aquatic environment. Scientists now know that microplastics are everywhere in coastal and marine waters – many decades' worth – but they don't yet fully understand how the plastic bits got there, their overall impact or the potential for remedies. The connections between human health and environmental microplastics are also unknown.

Think Globally, Act Locally

Maia McGuire, a Florida Sea Grant agent with UF/IFAS Extension in Flagler and St. Johns counties, has launched a microplastics education initiative that is recruiting volunteers from around the state to sample for microplastics in coastal waters. Volunteers learn how to properly collect water samples, isolate microplastics from them and then enter their data into an online Google map that displays sampling results.


Maia McGuire

Project volunteers are

Plastic endures

but you can reduce your plastic footprint by:

- **Using a washable coffee cup** instead of a disposable cup.
- **Using washable containers** for packing lunches or leftovers.
- **Saying no to the straw.** Drinking straws are one of the top 10 items found in coastal cleanups. Paper or washable straws can reduce this.
- **Reading labels** on personal care products like facial scrubs and toothpaste, and avoiding products that contain polyethylene microbeads.
- **Choosing clothes made from natural fabrics** like cotton and hemp, and cleaning products like natural sponges and chamois cloths, rather than synthetic textiles that shed microfibers into rivers and the ocean.
- **Using paper and cloth bags** instead of single-use plastic bags when shopping.
- **Using a refillable water bottle** instead of disposable, single-use plastic bottles.

YOU CAN PLEDGE TO TAKE ONE OR MORE OF THESE ACTIONS BY VISITING PLASTICAWARE.ORG.

producing the first data set of microplastics distribution in Florida waters statewide. Thus far, more than 200 volunteers have collected and analyzed more than 1,000 water samples at 352 locations around the state, McGuire says. Nearly 90% of the samples contained at least one item identified as plastic. Microfibers are far and away the most common type of plastic found.

"The goal of the analysis is not to quantify the total amount of microplastics in the water," she says. "The analysis is primarily to show people that microplastics are present in local waters, and that this is not just a problem in the 'Great Pacific Garbage Patch,' or in the Great Lakes, as people might think from media coverage.

"I wanted to find a way to help people understand that there are things we can do as Floridians to help," McGuire says.

In addition to educating people about the prevalence of microplastics, McGuire also hopes to teach Floridians ways to reduce their personal contribution to microplastics pollution. As she points out, the popularity and convenience of disposable, single-use plastic packaging means that most of it becomes waste in just a few days.

"No one is calling for the removal of plastic from our lives, but we are hoping people will think more carefully about how they use plastic, and how they can use less.

"With a problem like this — a global problem — it's easy to get discouraged and wonder, what can I do about that?" McGuire says. "My answer is, making small changes means that at least one piece of plastic didn't end as waste. The more people making small changes, the more plastic is kept out of the ocean."

Want to become a volunteer who samples for microplastics in water?
There are multiple ways to get involved. The Florida Microplastic Awareness Project has a network of coordinators around the state who are seeking volunteers. You can also establish a sampling location in a new area. Visit www.plasticaware.org for more information.

Providing support for programs like this microplastics awareness initiative is part of the core mission of Florida Sea Grant. With your help, we can expand our research effort. Make a gift today at www.flseagrant.org/donate/.

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National Science Foundation

The NSF is a federal agency that supports research and education involving science and engineering in non-medical fields. The numbers below reflect grants received since January 2017.

40 — Number of Florida institutions receiving NSF grants in 2017

$128 million — Total amount of NSF funding to Florida institutions in 2017

The grants cover a range of areas, including $941,000 to Broward College for a five-year program that selects 30 high-ability, low-income students for a bachelor's degree program in biosecurity. A grant to Florida Gulf Coast University funds a program that recruits undergraduate majors in science, math and engineering to become math or science teachers in grades 6-12. Valencia Community College got a grant to develop an associate degree program in energy management and controls.

2017 Top NSF Grants in Florida

Institution, City	Grants	Amount (millions)
University of Florida, *Gainesville*	100	$41.57
Florida State University, *Tallahassee*	53	18.47
University of South Florida, *Tampa*	41	14.38
University of Central Florida, *Orlando*	36	13.36
Florida International University, *Miami*	23	9.91
University of Miami, *Coral Gables*	10	3.61
University of Miami, Rosenstiel School of Marine and Atmospheric Science, *Miami*	9	3.38
Florida Atlantic University, *Boca Raton*	13	3.11
Indian River State College, *Fort Pierce*	1	3.02
Florida Institute of Technology, *Melbourne*	10	2.28
Florida A&M, *Tallahassee*	4	2.07
Broward County School Board, *Fort Lauderdale*	1	1.24
Florida Gulf Coast University, *Fort Myers*	4	1.06
University of West Florida, *Pensacola*	2	.94
Broward College, *Fort Lauderdale*	1	.94
Valencia Community College, *Orlando*	1	.90
Florida Keys Community College, *Key West*	1	.89
Nova Southeastern, *Davie*	3	.84

Source: National Science Foundation

The Emerging Pathogens Institute now has its own 88,000-sq.-ft. building with 200 affiliated faculty.

UF

Danger, Danger, Danger

Good news for expecting parents everywhere on Zika. "Basically, the epidemic is over," says Dr. J. Glenn Morris Jr., director of the University of Florida's Emerging Pathogens Institute.

The virus, however, provides an example of what Morris sees as the problem with pathogen research. The public's attention span — and government funding — is too short. What's needed is a standing emergency fund to address novel outbreaks and also more continuing funding into known ones. He cites the unexplained mysteries of Zika, including why an obscure African monkey virus broke out with previously undocumented side effects in Brazil in 2015. "There is a huge amount of science that still needs to be done on Zika," Morris says.

The Legislature appropriated $55 million in 2006 to create the Emerging Pathogens Institute to focus on human, animal and plant pathogens — an unusual trio. Morris became its first director the following year. "When I got there, I had a small office in a little shed," he says. The institute now has its own 88,000-sq.-ft. building and 200 affiliated faculty from 11 UF colleges. Its research is funded by grants, about half from the National Institutes of Health and the other half from a mix of federal departments and, for one Zika research project, the European Union.

Morris can reel off dangers from pathogens spread by bugs, people and food. Viruses evolve constantly, and modern travel allows them to spread fast. "You can have a problem in Korea or Afghanistan, and in 24 hours it's a problem in Orlando," Morris says.

"If you ask me what my major worry was, it's probably influenza," he says. "All it takes is a couple viruses getting together in a pig in Iowa, and we could lose millions of people."

"There is a huge amount of science that still needs to be done on Zika," says J. Glenn Morris Jr., director of the UF's Emerging Pathogens Institute.

Research on the mosquito-transmitted Zika virus was funded in part by the European Union.

right photos: UF

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UF Research is ... Changing Florida and the world

Engineering doctoral student Chris O'Bryan prepares to 3-D print a silicone stucture in Associate Professor Thomas Angelini's lab.

Research spending at the **University of Florida** reached a record $791 million in 2016, placing UF among the nation's leading public research universities. From engineering to medicine and agriculture to education, UF researchers are addressing challenges to Florida, the nation and the world.

- Researchers in the Wertheim College of Engineering are 3-D printing stronger, less expensive and more comfortable silicone medical devices.
- College of Medicine researchers are prolonging the lives of adult and pediatric brain cancer patients by using vaccines to mobilize their own immune systems against tumors.
- Researchers in UF's Institute of Food and Agricultural Sciences are developing faster tests for the Zika virus and formulating new repellants and traps for its mosquito carriers.
- College of Education researchers are mining massive sets of testing data to personalize virtual instruction for future math students.

research.ufl.edu

FSU

Autistic Students: Unlocking Potential

Every year, about 16,000 people diagnosed with autism head off to higher education. Roughly one in three pursues a degree in science, technology, engineering or math. Unfortunately, people on the autistic spectrum often don't do well in college or in employment. Florida State University College of Education associate professor Brad Cox last year received a nearly $300,000, three-year grant from the National Science Foundation to figure out the prevalence of autism-related characteristics among STEM students, see how it affects their performance in "gateway" STEM classes such as calculus and chemistry and investigate how formal disability accommodations play out. Cox's grant says "the very traits that can cause students with autism-related characteristics to struggle in college classrooms may also serve as a springboard from which this population can make distinctive contributions to STEM fields and workplaces." Cox founded the non-profit College Autism Network to facilitate the translation of research into real-world improvements for students. Says Cox, "We're hoping our study will begin to show schools how to unlock these students' potential for college success."

Associate professor Brad Cox received $300,000 to study how best to get students with autism to excel in STEM-related fields.

National Institutes of Health

The NIH, part of the U.S. Department of Health and Human Services, is the largest biomedical research agency in the world. It funds a range of medical research at both public and private institutions.

39 — Number of institutions in Florida receiving NIH grants in 2017

$338.75 million — Total amount of NIH funding to Florida institutions in 2017

Examples: Among grants received by UF, the leading recipient of NIH funding in Florida, was money for research to address low-grade chronic inflammation and movement disabilities in the elderly, along with funds for research on type 1 diabetes and money to establish an Alzheimer's Disease Research Center. ArchieMD, a physician-led company in Boca Raton, received a grant for research in how to use opioids safely in children at home after surgery. The Jaeb Center for Health Research in Tampa got a grant to coordinate research focused on developing an artificial pancreas system.

Congress ignored President Donald Trump's request to cut NIH funding by $1 billion in 2017 and instead increased the agency's budget by $2 billion. Trump has requested an 18% cut to the NIH budget in 2018.

2017 Top NIH Grants in Florida

Institution, City	Grants	Amount (millions)
University of Florida, *Gainesville*	268	$102.77
University of Miami School of Medicine, *Miami*	162	65.58
Scripps Florida, *Jupiter*	80	34.06
University of South Florida, *Tampa*	60	22.98
Florida International University, *Miami*	44	17.40
Mayo Clinic, *Jacksonville*	30	17.05
Florida State University, *Tallahassee*	47	16.03
H. Lee Moffitt Cancer Center, *Tampa*	35	15.72
Mount Sinai Medical Center, *Miami Beach*	2	6.58
Jaeb Center for Health Research, *Tampa*	3	6.49
University of Central Florida, *Orlando*	21	5.89
Nemours Children's Clinic, *Jacksonville*	2	4.43
Florida Atlantic University, *Boca Raton*	11	3.56
Florida A&M, *Tallahassee*	4	2.80
University of Miami, *Coral Gables*	8	2.37
Max Planck Florida, *Jupiter*	5	2.16
Specific Technologies, *West Palm Beach*	2	1.99
Torrey Pines Institute, *Port St. Lucie*	3	1.52
ArchieMD, *Boca Raton*	2	.96
Emmune, *Jupiter*	1	.93

Source: National Institutes of Health

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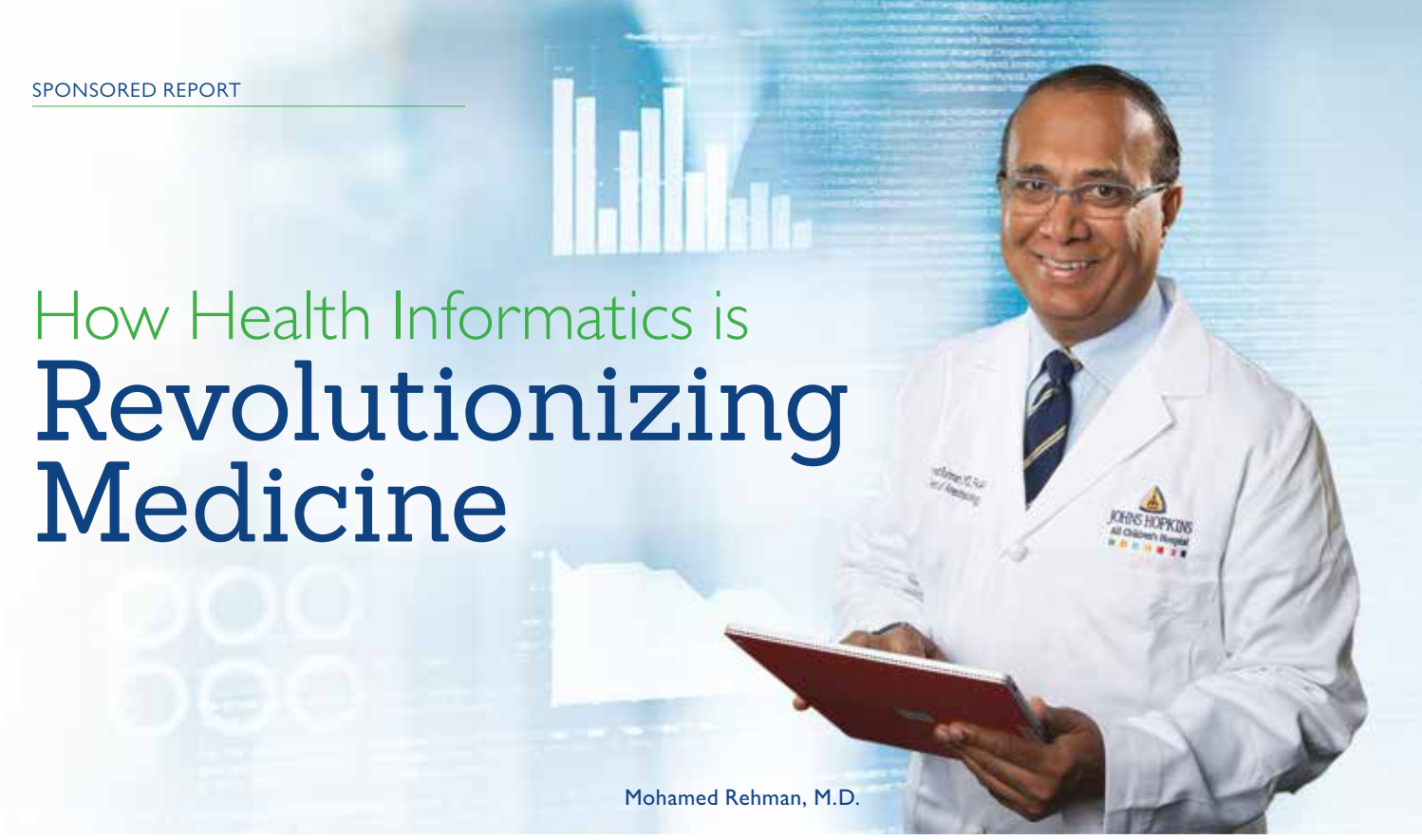
How Health Informatics is Revolutionizing Medicine



Mohamed Rehman, M.D.

THE LATEST EVOLUTION OF MEDICINE STARTED WITH AN EFFORT TO MOVE FROM PAPER TO DIGITAL.

Mohamed Rehman, M.D., was an early adopter about 20 years ago of electronic medical records. He set up a system to organize the information, eliminate the paper and make it more efficient. Before long, he realized he wasn't just getting rid of paper. He was compiling a wealth of data that could be organized and analyzed.

But what to do with it?

"We didn't think data at first. We just wanted to go from paper to electronic documentation and then capture all available data including laboratory data and vital signs," says Rehman, who in April 2017 became chairman of the Department of Anesthesia and director of perioperative informatics at Johns Hopkins All Children's Hospital. "Once I got the electronic medical record up and running, I said, 'It's not the record that is important. It's the data in the data warehouse.'"

Rehman has been a pioneer and advocate for the emerging field of health informatics ever since. The medical subspecialty uses data to improve quality of care, safety and cost containment.

"'Big data' is the big buzzword now," Rehman says. "My group was doing this even before big data became the buzzword."

Big Data Comes to Medicine

Businesses have been crunching data and information for years. Rehman points to Walmart, which tracks sales and inventory through radio-frequency identification (RFID) and automatically orders products to restock the shelves before the supply runs out.

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But the medical field was stuck on paper records for many years. Rehman was ahead of the curve, but it wasn't until 2009 that Congress created enough incentives to push the health care industry toward widespread use of electronic medical records.

That creates a wealth of information from vital signs, lab results and other notes about patients. The information can be overwhelming, which is where the areas of computer science known as machine learning, visual analytics and natural language processing come into play to identify trends and patterns.

"Over 24 hours, you're going to have about 800 megabits of data," Rehman says. "If I tell you to look at the data, that's a lot of data. But if I show you the very small segment of the data that is important to you based on the machine-learning algorithm and data visualization it may point out a medical problem in a timely fashion that may be lifesaving."

In health informatics, computers can analyze past data aggregated into large databases or real-time data during a patient's care. The computer algorithms process and sort the data more quickly and efficiently than the human medical team.

Think of how computers at your credit card company might flag an inconsistent purchase and call to confirm you didn't buy gas in Ocala or a boat in New York. Similarly, algorithms can flag a small but potentially dangerous trend before the medical team is likely to pick up on it.

"The holy grail of development that's going to happen in the future is to spot patients who are trending toward critical conditions before it is apparent," says Rehman, who previously started the first biomedical informatics group in anesthesia and the critical care unit at The Children's Hospital of Philadelphia.

"The data warehouse and the algorithms running on the data warehouse in real time will make this a reality in the future."

Informatics can do something as simple as creating an alert to remind the medical team to redose a child with antibiotics during a 12-hour surgery or as complex as shaping guidelines that eliminate costly blood typing and matching for patients who don't need it, Rehman says.

Using health informatics can alert a medical team to potentially dangerous problems in a timely fashion.

> "VISUAL ANALYTICS AND MACHINE LEARNING ARE GOING TO BE THE FUTURE OF MEDICINE."

Even with computers crunching the numbers, big data still can be hard to comprehend. But health informatics has evolved beyond spreadsheets into visual analytics, the science of displaying information from large data sets in a comprehensible manner. For instance, Rehman says if you are confronted with a computer screen full of numbers and asked to pick out the 9s, it will be difficult. But if the computer displays the 9s in a different color, it is easy to focus on the information the algorithm is flagging as important.

"Visual analytics and machine learning are going to be the future of medicine," Rehman says.

Embracing the Future

Johns Hopkins All Children's started a Health Informatics Core in 2016. Recruiting Rehman is part of a broader effort by the hospital to attract scientists, research assistants and informaticians—physicians trained in biomedical informatics—with the vision of becoming a leader in the field.

"The Health Informatics Core will be key to our focus on evidence-based medicine and value-based care," says Jonathan Ellen, M.D., president and physician-in-chief of Johns Hopkins All Children's Hospital and vice dean and professor of pediatrics at the Johns Hopkins University School of Medicine. "It will support our clinicians pursuing precision medicine and investigators conducting research studies to help us develop new treatments, discover cures and improve children's health from the perinatal period into adulthood."

The result could be transformative not only for children's health but throughout those children's lives.

"I think we're just at the very early phase of big data, visual analytics and machine learning," Rehman says. "There are not many hospitals that have the vision to invest into this. Visual analytics and machine learning are going to be a core competence of Johns Hopkins All Children's Hospital and help it become one of the premier institutions in the country."

Abuzar Kabir, below left, and Kenneth Furton found that cotton muslin, when coated with a special polymer, could better allow scientists and other experts to separate compounds in samples.

FIU

Analysis Breakthrough

Here's the problem in chemical testing for medical labs, coroners and environmental scientists: Analyzing a substance — blood on a towel, for example, means separating it from the sample, and that takes time, solvents and expensive equipment. At Florida International University, Kenneth Furton, FIU's provost and an analytical chemist, and Abuzar Kabir, an analytical chemist and materials expert, found a way to simplify things. They found that by coating cotton muslin — an everyday textile — with a special polymer, it would soak up enough of a component from a sample in 15 minutes to allow a chemical analysis. More component means more conclusive results. FIU, which holds a patent on the method and process, is working on commercializing it. FIU says researchers at 30 universities globally have invested time in validating different applications of the technology and have produced more than 25 peer-reviewed articles for publication. "We hope this will be a game changer for the industry," Furton says.

FAU

Neuroscience Pillar

No Florida university has been as well sited to take advantage of the state's massive investment in out-of-state life science research organizations as Florida Atlantic University.

Rather than pump the money into its own public universities, Florida chose, beginning in 2003, to lay out hundreds of millions of dollars to recruit branches of renowned researchers Scripps, Max Planck and Sanford Burnham Prebys to Florida. FAU wound up home to two of the recruits; Scripps and Max Planck have their state-of-the-art buildings on FAU's Jupiter campus.

The two high-profile institutions came as FAU itself was developing and launching its own med school and raising its life sciences profile. But FAU looks to do more than ride the coattails of its internationally known campus-mates. FAU has made neuroscience one of the university's four research "pillars." (The others are healthy aging, environmental and ocean science and sensing and smart systems.)

In 2016, FAU hired Vanderbilt University scientist Randy Blakely to head its newly formed FAU Brain Institute with offices on FAU's Boca and Jupiter campuses. The institute aims to understand how the brain works and how diseases such as autism, schizophrenia, depression and Alzheimer's come to be. (FAU President John Kelly says Max Planck CEO and scientific director David Fitzpatrick and Scripps chair Ronald Davis served on the search committee that went after Blakely.)

Blakely brought 12 faculty, postdocs and grad students with him from Vanderbilt, has brought in more since arriving and plans to hire still more. The institute also draws on existing FAU faculty from its four campuses — 52 faculty in all — and 17 affiliate faculty from Max Planck and Scripps.

Scientist Randy Blakely heads FAU's Brain Institute.

The Legislature in its past two sessions gave FAU a total of $12 million to develop plans for a building for the Brain Institute. The university needs another $20 million to erect it. Meanwhile, FAU this academic year launches a neuroscience graduate program that aims to have 50 grad students in five years able to pursue Ph.D. studies with FAU and Max Planck researchers. FAU and Scripps already offer a joint M.D./Ph.D. degree.

It helps FAU's direction that Scripps Florida is heavily invested in neuroscience and Max Planck Florida is devoted exclusively to it. They all share equipment and facilities. "Anything they have is available to us, and anything we have is available to them," says Kelly. Like Max Planck and Scripps, FAU has put money into microscopes. One of FAU's first core facilities is cell imaging with $1 million in high-end microscopes and a designation as the only Nikon Center of Excellence in the Southeast United States. Blakely nevertheless cheered the arrival of Max Planck's super-resolution microscope. "The kind of faculty I want to recruit will be the people that thrive in this environment," Blakely says.

Scripps, left, shares equipment and facilities with the Brain Institute.

photos: FIU left; FAU top right

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Health Care Discoveries for the Modern Age

Nova Southeastern University's Center for Collaborative Research sits at the leading edge of life-saving and market-changing medical research for the Fort Lauderdale university and its partners.

NSU Researchers to Tackle Sarcoma

Researchers around the world are investigating ways to effectively train immune cells, including natural killer (NK) cells, to target specific types of tumors. NK cells represent a form of immunotherapy that is potentially a less toxic and more effective way to combat tumor cells than current standard cancer treatment protocols, which heavily rely on chemotherapy and radiation. There is a lack of private research funding investment in this promising area of study due to the lag time involved in translating these discoveries from the bench to bedside. Academia is stepping up to fill this much-needed void.

The Nova Southeastern University (NSU) Cell Therapy Institute, led by accomplished cancer researcher Richard Jove, Ph.D., is actively collaborating with scientists from the world-renowned Karolinska Institutet (KI) in Sweden, home of the scientists who discovered NK cells, to develop a full-circle investigative process to expedite discoveries. The research team is led by KI's Evren Alici, M.D., Ph.D., a world leader in the field, and H. Thomas Temple, M.D., NSU's senior vice president for translational research and economic development. They are initially focusing on pediatric sarcomas, which receive less research funding than more common forms of cancer. The goal is to take these discoveries and ultimately transfer them to develop durable cures for various other forms of cancer.

The research team has developed a process in which sarcoma tissues that would normally be incinerated following surgical removal are being repurposed for scientific investigation. The tissues are taken directly to NSU's Cell Therapy Core immediately after surgical removal by Dr. Temple, who, in addition to leading NSU's research endeavor, is a well-respected orthopedic oncology surgeon. From there, a scientific team led by Adil Duru, Ph.D., isolates cells and are able to send them directly to the university's other core facilities for sequencing, genomic modification and analysis, imaging and testing.

NSU is also using these cells to create an expanded tumor library for further research, through collaboration with the NSU AutoNation Institute for Breast and Solid Tumor Cancer Research, which focuses on how DNA damage and defects in DNA repair contribute to cancer. This research is being led by Jean Latimer, Ph.D., AutoNation Institute director and professor in the NSU College of Pharmacy. Lines from this library are available for purchase and partnership opportunities for researchers seeking an expanded resource to conduct pharmaceutical and genetic research.

A surgical team led by NSU's H. Thomas Temple, M.D., collects sarcomas for further research.

Tamper-Proof Technology to Confront Prescription Drug Abuse

Opioid abuse is a national epidemic. Researchers at NSU hope to help deter the number of lives these drugs negatively affect.

Following U.S. Food and Drug Administration guidelines to develop abuse-deterrent formulations, NSU researchers, led by Hossein Omidian, Ph.D., have developed tamper-resistant opioid tablets.

NSU's deterrent technologies prevent abusers from crushing, cracking, liquefying or otherwise altering the pill's original state. When taken as prescribed, the tamper-resistant pill dissolves only in stomach acid.

Hossein Omidian, Ph.D.

"Since abusers do not follow a standard protocol and use a wide range of unconventional methods to abuse opioids, no single technology can promise full deterrence to abuse," says Dr. Omidian, a professor at NSU's College of Pharmacy. "We strategically designed technologies that can effectively and safely be used in developing both immediate and sustained-release formulations with effective abuse-deterrent properties."

Currently in late-stage research, the product is protected by several patent applications as NSU seeks collaborative partnerships and licensing opportunities to bring the technology to market.

Researchers Rewriting "Pen" for Epinephrine Fast-Delivery

For 30 years, epinephrine auto-injectors have been the go-to life-saving devices for people suffering severe, acute allergic reactions. Yet some auto injectors, including the EpiPen®, have seen a 500% price increase.

Now, a team of Nova Southeastern University (NSU) pharmaceutical researchers is developing a fast-acting epinephrine tablet to deliver the same remedy.

The sublingual epinephrine tablets being developed by Mutasem Rawas-Qalaji, Ph.D., and Ph.D. and Pharm.D. students at NSU disintegrate quickly under the patient's tongue and are absorbed directly into the blood stream.

Epinephrine tablets have proven less bulky, are easier to handle, have a longer shelf life and enable more precise dosages than epinephrine injectors. They're also a less intimidating, less invasive method of self-administration of epinephrine.

"Some patients don't like to inject themselves, and sometimes there's an anxiety associated with administering the epinephrine injection," says

Mutasem Rawas-Qalaji, Ph.D.

Dr. Rawas-Qalaji, an associate professor at the NSU College of Pharmacy. "The new tablet will break down in a few seconds under the tongue and can reach the same concentration achieved by the injection." The product could reach the market by 2020.

Nova Southeastern University's Center for Collaborative Research is a premier $100-million, 215,000-sq.-ft. research facility. Qualified tenants in the private, flexible leased space can access wet and dry labs; leading research equipment; core facilities for flow cytometry, genomics, imaging and cell therapies; clinical trial services; the Florida LambdaRail high-speed broadband service delivery network; and administrative services essential to growing entrepreneurial enterprises. Affiliation allows for collaboration with NSU deans, decision-makers, researchers, tech transfer and grant writing staff, and undergraduate and graduate intern talent.
nova.edu/ccr

For more than 50 years, Nova Southeastern University has provided undergraduate, graduate and first-professional degrees in a wide range of fields and fostered groundbreaking research. NSU is classified as a Carnegie Foundation for the Advancement of Teaching "High Research Activity" university and one of only 50 universities nationwide also awarded Carnegie's Community Engagement Classification. Whether online or from campuses in Fort Lauderdale, Fort Myers, Jacksonville, Miami, Miramar, Orlando, Palm Beach and Tampa, Florida, and San Juan, Puerto Rico, NSU is the nation's largest private, not-for-profit institution that meets the U.S. Department of Education's criteria as a Hispanic-serving Institution.
nova.edu

To learn how your organization can partner with NSU on these and other innovative and marketable technologies, contact Gary Margules, Sc.D., vice president of research and technology transfer.
margules@nova.edu
(954) 262-7507

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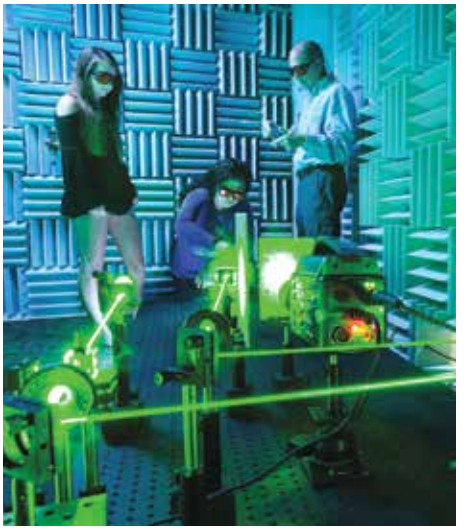
ROLLINS COLLEGE

Tooting Their Own Horns

Thomas Moore, physics professor at Rollins College, received a $371,645 National Science Foundation grant to involve undergrads in original scientific research to settle a topic debated in scientific literature for more than a century: Whether the vibrations of the metal of brass musical instruments affects the sound. Along with students, he and his colleague, assistant professor Whitney Coyle, also will study clarinet reeds to see whether it's possible to accurately model how they'll perform when played. The research should provide instrument makers with information on how to improve instruments and make it easier to synthesize the sound of woodwind instruments while contributing to the understanding of the physics of the instrument. Musicians, especially woodwind players, are at the mercy of their instruments. "With a little luck, we will at least understand the issues, if not the solutions," Moore says.



Professor Thomas Moore and students Chloe Keefer, left, and Samantha Collin study the physics of musical instruments using a process called high speed electronic speckle pattern interferometry.

FIT

Virtual Reality as Therapy?

Design Interactive, an Orlando augmented, virtual and mixed reality company, and Florida Institute of Technology received a $148,924 early-concept National Science Foundation grant to see whether virtual reality- and game-based tech can improve the physical abilities of children with cerebral palsy. Design Interactive and FIT will work with Maitland-based tech company BlueOrb and the non-profit Conductive Education Center of Orlando.

Road workers discovered a 5-million-year-old bone site in 2015 southwest of Gainesville.

FLORIDA MUSEUM

Fossil Find

Earlier this year, Florida Museum of Natural History paleontologists and community volunteers raced to empty a Levy County site southwest of Gainesville of fossil bones. The 5-million-year-old bone site was uncovered in 2015 on private property by workers digging up clay for roadwork. It proved quite a site, with complete skeletons in some cases. The landowner was willing to give paleontologists until the spring 2017 to collect what they could before putting it into agricultural use. Bones from 55 different vertebrate species were found, including rodents and river-dwelling creatures like alligators, and turtles but also extinct rhinos, llamas, horses and an elephant-like creature called a gomphothere. "No other fossil site of this age in the southeastern United States produces such a rich abundance of freshwater vertebrates," said Florida Museum curator of vertebrate paleontology Jonathan Bloch.

photos: Rollins College top left; Design Interactive right; Florida Museum of Natural History/UF

PREMIER
EYE CARE

Keeping up with the fast-paced, highly regulated healthcare industry and the constantly expanding capabilities of technology presents continuous challenges to healthcare companies and providers.

By Jason Panos and Jeff Nowak

Given these technology-related challenges, how do companies adapt without losing focus on delivering quality customer service every day?

At Premier Eye Care, we have found that technology solutions come down to making investments in quality people and the right technology. Here are two tips that can be helpful:

1. Develop a technology platform that's flexible.

Build processes that allow for long-term growth and near-term process adjustments. Have a process in place to define future needs and identify next-generation technology, while constantly searching for innovative solutions to meet immediate needs.

Big data is worthless unless it's easily accessible. Charge your IT team with designing, implementing and maintaining technology systems that can quickly extract the data your team needs without manipulation.

Organizations must remain nimble and be willing to pivot quickly to meet the demands of an ever-changing environment. At Premier, we accomplish this by forming interdisciplinary teams that bring different skills and sensibilities to each challenge.

2. Build an IT brain trust.

As you look to hire talented IT professionals, hire the person first and the skill set second. Given that the IT professionals considered for joining your team will have the requisite mastery of their technology, vet candidates to see if they match the values of your corporate culture. At Premier, these values include self-direction, open communication, continuous feedback and solutions orientation.

Business users have to be part of designing the solution to ensure it will address their needs, as well as those of external clients. Our commitment to a multi-directional integration of the IT team with our business teams promotes technology solutions that are laser focused and relevant to changing internal and external customer needs. The more engaged your IT team is with your entire organization, the better positioned it will be to contribute to the growth and success of the company.

Knowing how the industry works and how your company meets the needs of the space is as critical to IT professionals as it is to the business teams.

Jason Panos (left) is Chief Operating Officer, and Jeff Nowak (right) is Chief Solutions Officer at Premier Eye Care, a national leader in providing quality, innovative and affordable solutions for managed medical and routine eye care.

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>
> **Jason Hallstrom,** Ph.D., Director, I-SENSE at FAU

Florida Atlantic University is becoming America's fastest-improving research university under the direction of an ambitious strategic plan that focuses on four areas of strength. Faculty, staff and students are setting **FAU** apart in neuroscience, healthy aging, environmental and ocean science, and sensing and smart systems.

We've made significant investments to build on our strengths, existing partnerships and the assets of our physical footprint that few universities can match: 150 miles of coastline linking six campuses. **FAU** is attracting the best and the brightest, building core facilities and driving scientific discovery and economic opportunity in Florida. ■

HEALTHY AGING

Researchers at FAU's Institute for Healthy Aging and Lifespan Studies (I-HeAL) are building a clinical-translational research infrastructure that will rapidly test new therapies and accelerate these innovations to market.

They're gaining a deep understanding of the aging process and reducing the risk of chronic conditions, such as dementia, frailty and diabetes. The team examines more effective ways to provide early diagnosis, improve quality of care, prevent loss of function, and reduce healthcare costs. Their research is not only dedicated to increasing lifespan (living longer), but also to increasing healthspan (living better). ■

NEUROSCIENCE

The FAU Brain Institute supports research, education and community outreach spanning all of our campuses. The Brain Institute supports state-of-the-art research and innovative educational activities of more than 100 neuroscience faculty-level investigators located at FAU and affiliate research centers, and is the sponsor of the FAU Neuroscience Student Organization.

The institute's scientists seek to unlock the secrets of brain development, function and plasticity, and how mechanisms can be compromised to drive devastating brain disorders such as autism, schizophrenia, depression and Alzheimer's disease. ■

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OCEAN SCIENCE & ENGINEERING/ ENVIRONMENTAL SCIENCES

FAU Harbor Branch equates ecosystem health with human health and has a vision for ecosystem science to become a translational science that bridges science, policy and management.

It focuses on reaching across all disciplines from the University's colleges to address this goal in marine science and oceanography, ocean engineering, applied and environmental science, and coastal affairs. While driving ecosystem research of the future, FAU Harbor Branch will also initiate new education programs, have a focus on connecting marine science to our communities, and engage business and industry. ■

SENSING AND SMART SYSTEMS

The Institute for Sensing and Embedded Network Systems Engineering (I-SENSE) is an interdisciplinary research hub that incorporates engineering, sensing and computation expertise throughout the University. Its growing network of partners include organizations such as Telit, Dioxide Materials, Atmel, Scripps Florida, Max Planck Florida, and Mayo Clinic.

Applied sensing and the emerging "Internet of Things" provide endless possibilities for making the "invisible" visible. I-SENSE is developing technologies for a broad spectrum of applications, ranging from monitoring physiological changes in patients, to mitigating natural and man-made disasters, such as hurricanes and biological threats. ■

RESEARCH Florida

UCF

Knowledge in the Ruins

University of Central Florida archaeologist Scott Branting's summer took him to central Turkey to research a short-lived Iron Age city that's the subject of the long-running UCF-based Kerkenes Project to uncover its secrets. The city lasted about 60 years until the mid-500s BC, when it was burned and abandoned during a war between the Persian and Lydian empires. The Kerkenes Project, under Branting's direction, brings together an international scientific team to excavate and use new technology to study the city. This year, the project won a new National Science Foundation grant to study the city's social organization. The grant says the analysis could help modern cities plan better for change.

photo: UCF

Archaeologist Scott Branting studies the short-lived city of Kerkenes in Turkey.

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FIU Center for Leadership Delivers Decade of 21st Century Training

High-energy, interactive and relevant leadership development programs take good leaders and make them even better.

"Our participants are leaders who oversee operations, people and businesses and are looking to hone those skills to have an even greater impact in their workplace. Our programs are designed to take good leaders and make them even better."

Mayra Beers, Ph.D.
Director of Strategy
FIU Center for Leadership

High-performing organizations have adaptive and skilled leaders. The award-winning Center for Leadership at Florida International University delivers concrete toolkit growth and remarkable results for organizational leaders from across all industries — health care, banking and finance, technology, retail, education, government and the military, to name just a few.

Top-ranked for executive leadership programming by HR.com and *Leadership Excellence* for four consecutive years, the center's programs redefine leadership training. Based on extensive research and a novel approach, the center consistently provides high-energy, interactive and relevant leadership development programs for corporate partners. Programs combine theory, real-world application, reflection, peer-to-peer learning and critical feedback to meet specific organizational and executive needs. Executives leave with the insights they need to positively and effectively transform themselves, their organizations and their communities.

"The vision from the start was to create world-class programs that highlight and accentuate the strengths of each participant," says Dr. Nathan Hiller, the center's academic director who regularly consults on leadership with Fortune 500 corporations and leading organizations around the globe. "This is no theoretical discussion of ideas. We are practicing and modifying ideas and learning skills, and we're coaching each other on how to execute them better. Participants leave with action plans focused on leading better by making small adjustments. The best leaders are continually working at getting better."

The residential-based programs leverage instructors' time-tested practices, institutional expertise and personality assessment capabilities to develop and deliver sophisticated organizational leadership capacity for participants from across Florida, the U.S., the Americas, Canada, Europe and Africa. Executives from State Farm, U.S. Southern Command, Daikin Applied, Baptist Health South Florida, Sunshine Health, Preferred Care Partners, Baxter, Miami-Dade County Public Schools and many other organizations have discovered that high-impact leaders create high-performing organizations.

FIU | Center for Leadership

FLORIDA INTERNATIONAL UNIVERSITY

CASE STUDY

Executive Excels after Leadership Program

Brian Clay
Director, BankUnited

Brian Clay was a fast-rising director with BankUnited in 2015 when he enrolled in the FIU Center for Leadership's High-Impact Leadership Program. Four days later, he emerged more focused and self-attuned – with an action plan penned to create an even stronger path toward purposeful leadership.

Working with an extensive behavior and personality profile he completed before the course began, Clay found that course materials and professor prompts seemed to speak directly to his personality type. One-on-one breakouts with an executive coach further honed materials to his leadership style — both his strengths and "derailers," or traits that can be perceived negatively by others.

During his sessions, Clay found himself nodding in agreement as he learned that yes, he challenges the status quo as executive vice president and business banking director. His derailer? People might view him as a disruptive change agent.

"Maybe my opinions are right, but I needed a different tack with people to get the best outcome," Clay realized. "This program is not about formulas and lectures, but rather taking us through a process that encourages us to really hone our skills and personal insights."

Ultimately, Clay discovered — and sees in his relationships — how leveraging what he learned can help him achieve his and his team's full potential. "The program really hits each participant where they are at, and it struck me that every person leaves with a clear understanding of how to be a better leader based on their unique strengths."

Discovery and Partnership with the FIU Center for Leadership

The award-winning Center for Leadership at FIU provides both open-enrollment and custom, company-specific leadership development programs for corporate partners and leaders from organizations of any size, and features access to some of the world's best leadership thinkers and practitioners through the Leadership Lectures series that is free and open to the public.

Discover how our programs for women leaders, senior executives and high-impact leaders can maximize your organizational and individual goals. Learn more at lead.fiu.edu or by calling Shannon Hanson, Assistant Director, at 305-348-5323.

Award-Winning, Results-Based Executive Development Programs Meet Your Needs

Grounded in the latest research and with a unique, participant-focused approach, the FIU Center for Leadership's programs have a track record of developing executives to become better leaders for their organizations and in their communities. Award-winning programs include:

The High-Impact Leadership Program

Designed to help leaders accelerate their career trajectory by developing a portfolio of strategic leadership capabilities in areas such as leading during crisis, managing change, building robust teams and actualizing strategic vision.

lead.fiu.edu/highimpactleaders

Next Program: October 2017

The Women Leaders Program

Ideal for established or emerging women executives seeking to take charge of their leadership development. The program combines the Center's groundbreaking research with best practices and the depth of experience of veteran women leaders.

lead.fiu.edu/womenleaders

Next Program: May 2018

The Senior Executive Leaders Program

Designed to maximize the leadership capacity of C-Suite and senior executives with significant and broad organizational responsibilities. Sessions tailor customized feedback and insights from global experts and provide tools and techniques that leaders can leverage immediately.

lead.fiu.edu/seniorexecutives

Next Program: Spring 2019

Mayo's Pamela McLean and Sanford Burnham's Layton Smith work to combat Parkinson's.

MAYO & SANFORD BURNHAM

Parkinson's Progress

Working with a grant from the Michael J. Fox Foundation, scientists from the Mayo Clinic Jacksonville and Sanford Burnham Prebys in Orlando spent two years searching through 800,000 chemical compounds for substances that might stop or reverse the accumulation of proteins in the brain that causes Parkinson's. They found eight that were promising. Now, with further support from the foundation, Mayo's Pamela McLean and Sanford Burnham's Layton Smith will work to understand how the molecules affect the protein buildup and how to improve them to safely combat the disease. Animal trials will follow the initial research.

Professor Henrik Cronqvist: Investors are turned off by red.

UM

In the Red

Avoid this story at your peril.

The field of color psychology teaches that people associate red with danger. University of Miami finance professor Henrik Cronqvist and colleagues set out to study how color affects people's investing choices. The takeaway: Avoid red in your presentations — unless you're in China — if you want people to buy. If you want to scuttle an investment, present it in red.

Cronqvist found investors grew pessimistic when presented data in red. When shown a stock decline in red ink, investors predicted more declines and invested nearly 24% less in the stock. They were less likely to invest when potential losses were shown in red.

In China, where red is associated with good luck, the national flag, the Communist Party and important festivals, rather than as in the U.S. where we have red ink, red alerts and red herrings, investing behavior didn't change based on color.

Cronqvist's conclusion: "It would be smart for IR (investor relations) professionals to steer clear of red in their next financial reports, for instance, and instead use only black for negative numbers. It is a small change that could make a big impact."

photos: Steven Burr Williams top; UM bottom