4-VA@ JAMES MADISON UNIVERSITY

2015 - 2016 Annual Report

4-VA
Advancing The Commonwealth

4-VA at JMU Annual Report

4-VA is a collaborative partnership among five Virginia universities, powered by 4 initiatives. Our mission is to promote collaborations that leverage the strengths of each partner university and improve efficiencies in higher education across the Commonwealth of Virginia.

We carry out this mission by advocating unprecedented partnerships between faculty and departments to generate significant, innovative solutions to educational and real-world problems. Since 4-VA's inception, we've sponsored advancements in research, pilot courses, redesigned courses, shared courses, online programs, industry-focused adult degrees, new technologies, interventions, workshops, conferences and other programs.

As a part of 4-VA, each university has developed unique programs to fulfill the initiatives based on their respective strengths and resources. This 4-VA at JMU annual report features 4-VA projects funded through James Madison University, where we put ideas into action by inviting innovative collaboration across disciplinary boundaries, among the Virginia system of universities, and between educational and business sectors.

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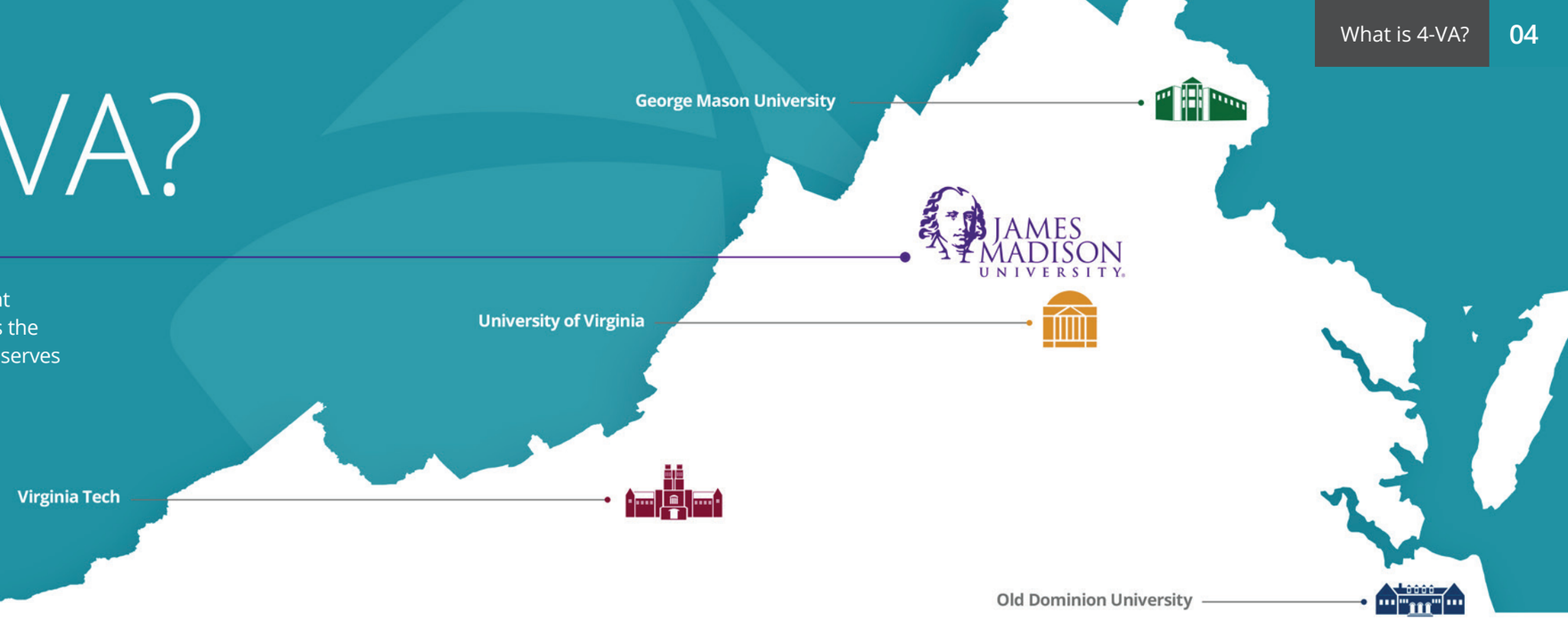
What is 4-VA?

4-VA at JMU

4-VA at JMU is housed jointly under the provost and the assistant vice president of information technology. Nick Swayne serves as the executive director and the campus coordinator and Kelsey Tate serves as the assistant director.



History

In 2010, the presidents of GMU, JMU, UVA and VT combined forces with the governor, other members of Virginia's government, and Cisco Systems, Inc. to launch 4-VA in response to the Governor's Higher Education Commission and the Governor's Commission on Economic Development & Job Creation.

The focus on STEM education and innovation to "better position Virginia to create jobs and grow the economy" led to a broad challenge for the universities that continues to guide the work of the growing collaborative.

Also in 2010, 4-VA began implementing Cisco TelePresence Systems at the universities so the administrators, staff and faculty could work toward their common goals in live, virtual environments. Identical videoconferencing rooms on each campus allow for a seamless conference space that virtually matches the two halves of the room to create a cohesive learning environment and eliminate the time and fiscal costs of travel. By deconstructing barriers to collaboration, classes can take place in real time in two places with disciplinary experts working together to deliver innovative instruction.

Early growth gained momentum and 4-VA continued to expand in scope and further develop its infrastructure. In early 2015, 4-VA welcomed Old Dominion University as its newest member. In the same year, 4-VA transferred management of the executive office to JMU in the Department of Information Technology.

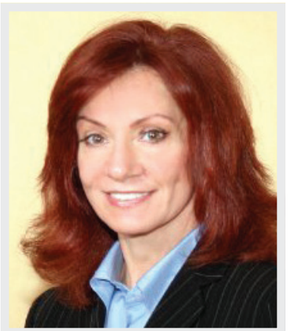
The Board

4-VA's direction is set by the management board, which consists of the five university presidents. Virginia's secretary of education, the executive director of the State Council of Higher Education for Virginia (SCHEV), and a Cisco representative serve as ex officio members of the board.

Recognizing Carol Stillman

Founding Member of 4-VA

As the outgoing Cisco representative, a founding member of 4-VA and a strong advocate of the collaborative, Carol Stillman shares her experience.



Having witnessed the impact of this partnership—on students, faculty, staff, government officials, and industry participants—of which examples have been uniquely documented, we were able to prove that we were stronger working together than apart and could make that which seemed 'impossible'..... 'possible'!!! I will always be grateful for the opportunity to have played a role in the 4-VA effort and hope it leads to other tremendous innovations.

Carol Stillman

In her role as Cisco's senior business development manager dedicated to higher education, **Carol Stillman** was the executive liaison between Cisco senior leadership, the university presidents and respective cabinets, and the governor's office, including the secretary of education, from the very beginning stages of 4-VA in 2010 through her departure from Cisco at the end of 2015.

Initiatives

Mapping the Universe

Dr. Anca Constantin
Associate Professor of Physics and Astronomy

Amount Awarded
Mini-grant – $5,000
Scale-up grant – $20,000

In 2011, Dr. Anca Constantin attended a UVA-NRAO colloquium where Dr. James Braatz was presenting the latest maser disk findings. Dr. Constantin inquired about details relevant to how those findings fit into the bigger picture of how galaxies and their central black holes co-exist and evolve. During discussions, they discovered significant potential for improving survey efficiencies. Dr. Constantin's expertise in optical spectroscopy of galaxy centers and her experience with data mining of large catalogs offered the possibility of tailoring future maser surveys towards finding these elusive systems at significantly greater rates.

Their discussions continued and in May, 2013, Dr. Constantin was awarded a 4-VA mini-grant called **The WISE* Search for Megamasers**. The project, conducted in collaboration with Dr. Braatz, aimed to understand which nuclear galactic optical and mid-infrared properties correlate best with the 22 GHz megamaser emission in order to help define the best methods for finding a significant number of systems necessary for an accurate mapping of the universe.

The success of the mini-grant project led to a 4-VA scale-up grant awarded to Dr. Constantin in October, 2013, called **The First Panchromatic Constraints of the Role of Water Masers in Galaxy Evolution Process.** This research allowed the team to develop tools that are crucial to understanding the links between water megamaser emission and supermassive black hole accretion in galaxy centers. Initial investigations of the WISE signature of galaxies with water megamasers revealed promising avenues for two important outcomes:

1. Building new surveys that were pursued with the Green Bank Telescope in West Virginia in 2014 and 2015
2. Constraining the panchromatic physical characteristics of galaxies most likely associated with maser disks at the highest statistical level achieved to date.

The project left a lasting impression on Dr. Constantin's student, Emil Christensen, who presented his work on this project at the 2013 and 2014 PANDA Symposia as well as at the 223rd American Astronomical Society (AAS) meeting. In 2014, he was awarded 1st place for his 2014 symposium presentation, he accepted a prestigious summer internship at the Space Telescope Science Institute, and he was featured in a JMU news story called Amazing megamasers: *JMU researcher pursuing 'holy grail of astronomy'*.

Over the past several years, the team presented several papers with published abstracts at AAS meetings, the International Astronomical Union General Assembly (IAUGA), the JMU Research Experiences for Undergraduates (REU) Symposia, and the National Conference on Undergraduate Research. With an upcoming publication in The Astrophysical Journal, an established, well-known, peer-reviewed scientific journal of astrophysics, the team is pursuing additional external funding to continue their research.

** WISE = Wide-Field Infrared Survey Explorer*

> *These awards provided a unique opportunity for JMU students to observe the universe through the Green Bank Telescope in collaboration with NRAO and UVA, thereby increasing the use of national resources for learners who usually don't have this kind of access.*
> Dr. Anca Constantin

Collaborators

Dr. James Braatz
Department of Astronomy at UVA

UVA-National Radio Astronomy Observatory (NRAO)

UVA

Benefits to the Commonwealth

- √ Demonstrated Virginia's impact on cutting-edge astronomy research
- √ Developed new models for teaching and learning
- √ Developed new tools crucial to astronomy research in this area
- √ Improved employment opportunities in Virginia

Student Researchers

- Catherine Witherspoon
- Chris Castillo
- Emil Christensen
- Emily Dick

Student Impact

- Unique access to the world's largest, fully steerable radio telescope
- Obtained highly sought-after internships and graduate programs
- Tackled cutting-edge, real-world science problems
- Each student contributed >400 hours of undergraduate research

HIV Prevention

Dr. Christopher Berndsen
Assistant Professor of Chemistry and Biochemistry

Amount Awarded
Mini-grant – $5,000

In August, 2013, Dr. Christopher Berndsen was awarded a 4-VA mini-grant called **Structure of human BST-2 with BST-2 antagonist Vpu** to determine the structure of a human anti-viral protein in collaboration with Dr. Carla Slebodnick at VT. The primary goal was to determine the crystal structure of the human protein BST-2 in a complex with a protein from the HIV-1 genome.

The research also developed into a teaching and training collaboration of students in X-ray crystallography. Students were able to use facilities at VT to study the protein which increased their ability to analyze data collected from VT. The work was carried out entirely by two undergraduates and was published in 2016 with plans to seek external funding.

Although the team wasn't able to determine a structure, they were able to use modeling and solution techniques to provide evidence for tetherin function. In fact, they discovered that interactions between two tetherin molecules strengthen the link between cell and virus, preventing the spread of HIV.

Student researcher Kadir Ozcan is writing an article slated for publication in 2017 that builds on an earlier study by Kelly Du Pont, which was published in 2016 by the American Chemical Society in the journal *Biochemistry*. This new work is providing novel and surprising insights into the antiviral activity of BST-2.

> *I was able to start doing X-ray crystallography with undergraduates—which is very rare. This work provided a pathway to access the facilities at the Advanced Photon Source at Argonne National Laboratory—only one other undergraduate institution has such access. I have since been able to have large groups of undergraduates use these more advanced facilities to collect data and learn X-ray crystallography.*
> Dr. Christopher Berndsen

Collaborators

Dr. Carla Slebodnick
Department of Chemistry at VT
Virginia Tech

Benefits to the Commonwealth

- √ Contributed to solutions for HIV prevention
- √ Demonstrated Virginia's impact on a major global health issue
- √ Increased prevalence and intensity of research collaboration
- √ Increased scholarly impact of Virginia faculty and universities
- √ Shared equipment and maximized university resources

Student Researchers

- Kadir Ozcan
- Kelly Du Pont

Student Impact

- Rare access to facilities at VT and Argonne National Laboratory
- Training in X-ray crystallography
- 200 combined hours of undergraduate research

Antibiotic-Resistant Bacteria

Researching its spread in the environment

Dr. James Herrick
Associate Professor of Biology

Amount Awarded
Mini-grant – $8,300
Scale-up grant from 4-VA at UVA – $27,500

In October, 2013, Dr. James Herrick was awarded a 4-VA mini-grant to conduct research with UVA's Dr. Stephen Turner on a project called **Genomic analysis of multi-drug antibiotic resistance encoded on mobile genetic elements in Virginia stream bacterial populations**. The team pioneered the use of a new DNA sequencing method called nanopore sequencing. Using this new method in conjunction with the Ion Torrent™ DNA sequencing system, they analyzed an antibiotic-resistance plasmid—a circular piece of DNA—obtained from uncultivated bacteria in local streams. Their study demonstrated that the plasmid carries genes that transfer resistance to many antibiotics used in hospitals, making it increasingly difficult to ward off infections.

Their discovery reveals the potential for a vast, relatively unexplored reservoir of resistance genes in stream bacteria which may have a significant impact on public policy for the use of antibiotics. In 2016, 4-VA at UVA awarded Dr. Herrick a scale-up grant of $27,500 to continue the work with Dr. Turner. The project, called **Genomic Analysis of Transmissible Multi-Drug Antibiotic Resistance**, has established an abundance of meaningful collaborations and outcomes:

- A productive collaboration with Dr. Stephen Turner and the UVA Bioinformatics Core. This led to the 4-VA at UVA scale-up grant and a student summer internship at the Virginia Division of Consolidated Laboratory Services (DCLS), which provides analytical testing services for agencies throughout Virginia for human and environmental health and safety.
- The project supported Kevin Libuit's graduate work and led to support for a second graduate student.
- Kevin Libuit now works at the DCLS full-time.
- The team collaborated with a bioinformatician at the University of Toronto.
- They now have the capability to do nanopore sequencing in-house at JMU.
- A presentation in Washington, D.C. in September, 2015 led to a research-teaching collaboration with the FDA and the DCLS on a new project on Salmonella genomic epidemiology.
- The Salmonella project will be developed into a new upper-division microbiology course, *BIO 345. Bacterial Discovery*, which will start at JMU next fall and is projected to impact about 50-100 students a year.
- Dr. Herrick has been invited to speak about this work at the 2nd International Caparica Conference in Antibiotic Resistance in Portugal in June of 2017.
- They were awarded a Madison Trust grant.
- They are close to publication of their work which will facilitate new funding proposals.

> *"This was the first genome study to emerge from the JMU Center for Genome and Metagenome Studies (CGEMS). We forged a collaboration between CGEMS and the UVA Bioinformatics Core which is ongoing and very fruitful.*
> Dr. James Herrick

Presentations

2014
- Presented a poster at the annual Virginia branch of the American Society for Microbiology (ASM) meeting
- Presented two talks at the annual Virginia branch of the ASM meeting
- Presented a talk and a poster at the Oxford Nanopore Conference in New York City, NY

2015
- Presented a poster at the Interscience Conference on Antimicrobial Agents and Chemistry (ICAAC) in San Diego, CA
- Presented a poster at the ASM Conference in Washington, D.C.
- Awarded best poster presentation at the Shenandoah Valley student chapter of the ASM

2016
- Presented a poster at the General Meeting of the ASM in Boston, MA

Collaborators

Dr. Stephen Turner
Assistant Professor of Public Health and Director of the School of Medicine's Bioinformatics Core at UVA

UVA

Benefits to the Commonwealth

- √ Demonstrated Virginia's impact on a major global health issue
- √ Contributed to solutions for antibiotic-resistant bacteria
- √ Opened doors for new research on antibiotic-resistant bacteria
- √ May have a significant impact on public policy for antibiotic use
- √ Increased funding awarded to Virginia faculty and universities
- √ Established collaboration with a federal agency

Student Researchers

- Curtis Kapsak
- Jesmine Roberts-Torres
- Kevin Libuit
- Shahzeb Khan

Student Impact

- Pioneered and advanced technology in their field
- Contributed 350 combined hours of undergraduate research
- Contributed 2,500 combined hours of graduate research
- Career advancement

Sustainable Innovation

Biomimicry in engineering

Dr. Jacquelyn Nagel
Assistant Professor of Engineering

Amount Awarded
Mini-grant – $4,700
Scale-up grant – $15,000

In late 2013, 4-VA awarded Dr. Jacquelyn Nagel, Brook Kennedy, and Dr. Arthur Buikema a mini-grant called **Sustainable Innovation: Integrating teams in Biology, Design and Engineering**. By implementing bio-inspiration design methodologies into an honors course at VT in 2014 and a course at JMU in 2015, they were able to research and refine those methodologies.

The focus of the course was biomimicry,
"...an experimental design methodology that looks to nature's examples for impactful, responsible solutions to humankind's most intractable problems."

Employing this methodology across three disciplines—biology, engineering and design—students worked together to develop solutions to issues such as water stewardship and the environmental impact of transportation. As the students developed their ideas, they discovered new insights into nature's architecture, recognizing patterns that inspired innovative design and engineering solutions.

In December, 2014, 4-VA awarded Dr. Nagel a scale-up grant called **Manufacturing Innovation through Sustainable Design** to continue researching the connection between form and function as found in nature. Integrating biological shape and form into product design minimizes material diversity and increases recyclability while still achieving the desired function.

In September, 2015, Dr. Nagel was one of a team of researchers to receive a $48,000 grant from the National Science Foundation (NSF) to explore pedagogical models that incorporate sustainability awareness and principles in engineering education and introduce them at universities in the Americas.

That same month, Dr. Nagel and Christopher Rose from the JMU Department of Biology received an NSF grant for $128,000 to research, develop, implement, assess and disseminate instructional resources for engineering faculty to teach bio-inspired design across disciplines.

> *Through an innovative curriculum and a variety of pedagogical approaches, we train students to have the cognitive flexibility to solve engineering challenges that transcend disciplinary boundaries.*
> Dr. Jacquelyn Nagel

Collaborators

Brook Kennedy
Associate Professor of Industrial Design at VT

Dr. Arthur Buikema
Alumni Distinguished Professor of Biological Sciences at VT

Virginia Tech

Benefits to the Commonwealth

- √ Demonstrated Virginia's impact on global issues
- √ Developed new models for teaching and learning
- √ Improved and enhanced student performance, retention, and success in STEM programs at Virginia universities
- √ Maximized university resources
- √ Received recognition and funding from a national government agency

Changing Mindsets

Improving student motivation in middle schools

Dr. Kenn Barron
Professor of Psychology

Amount Awarded
Mini-grant – $5,000
Scale-up grant – $20,000

Three psychological components play a significant role in determining our motivation for completing a task:

1. Expectancy – Do I believe that I can do it?
2. Value – Do I want to do it?
3. Cost – Do I have adequate time, energy and resources to do it?

If the answer is "No" to any of these three questions, there's little hope of completing any given task.

With the help of a 4-VA mini-grant awarded in October, 2013, Dr. Kenn Barron, Dr. Chris Hulleman and Computer Scientist Bryce Inouye partnered with middle school teachers at Harrisonburg City Public Schools to begin assessing students' expectancy, value, and cost for their school work and to create computer apps that could be delivered to students on handheld tablets in classrooms to improve students' motivation. Their 4-VA research project was titled **Development of a Real-Time Data Collection and Intervention Platform for Classrooms: The Rapid Assessment Platform and Intervention Delivery (RAPID) System.**

Based on a needs assessment that students' expectancy beliefs were the most significant problem that teachers faced, their initial 4-VA project focused on creating a computer app to improve students' expectancy beliefs for learning. In particular, they created an app to teach students about emerging research in neuroscience and how our brains continue to grow and improve through effort and challenge. Having a better appreciation of how our brains grow helps students shift from a fixed mindset—that their intelligence and ability are innate, to a growth mindset—that intelligence and ability can be improved.
The initial 4-VA project focused on three major goals:

1. Creating the initial prototype of the app to change students' mindsets
2. Developing a stable technology platform to deliver the app in classrooms
3. Creating a positive student experience

The team successfully developed and tested the first version of the app, finding that it significantly improved students' mindsets and was well received by students and teachers. In June, 2014, 4-VA awarded the team a scale-up grant to continue their project. The funding helped expand the number of students who received the initial app and supported additional researcher-practitioner collaborations between JMU, UVA and Harrisonburg City Schools to improve student motivation. The Carnegie Foundation for the Advancement of Teaching took notice and invited them to participate with school systems in San Francisco, San Diego, New York City, and Delaware in a similar program to broaden their scope and share ideas.

Additional Funding

- 2014-2016 – The Raikes Foundation in Seattle: $200,000
- 2014-2017 – The Carnegie Foundation for the Advancement of Teaching: $150,000

> *Our 4-VA project helped fund and develop the prototype of an intervention that could be rapidly delivered to middle school students in their classrooms to improve students' motivation to learn.*
> Dr. Kenn Barron

Collaborators

Dr. Chris Hulleman
Assistant Professor of Psychology at UVA

UVA

Harrisonburg City Public Schools

Student Researchers

- Nick Zurlo
- Thomas Hartka

Benefits to the Commonwealth

- √ Developed innovative technology to improve education in Virginia's schools
- √ Improved effectiveness of instructional models and their costs (money, time, student achievement, quality, student mobility, etc.)
- √ Increased scholarly impact of Virginia faculty and universities
- √ Facilitated collaboration with prestigious institutions across the country
- √ Received recognition and funding from the Raikes Foundation and the Carnegie Foundation for the Advancement of Teaching
- √ Established a partnership with the Carnegie Foundation for the Advancement of Teaching's Student Agency Improvement Community (SAIC) project

The Catalyst for Collaboration

Virginia soft matter community continues to thrive through annual workshops

Dr. Klebert Feitosa
Assistant Professor of Physics and Astronomy

Amount Awarded
Mini-grant – $5,000

October 29th, 2016 marked the fourth annual Virginia Soft Matter Workshop—"an informal gathering of researchers to present their work, hear leaders in the field, exchange ideas and foster collaboration." Hosted this year at the Virginia Commonwealth University School of Engineering, the one-day event has become a highly anticipated gathering for soft matter researchers across Virginia.

Debuting as the result of a mini-grant awarded to Dr. Klebert Feitosa in February, 2014, **Bringing Together a Community of Soft Matter Researchers in Virginia** did just that. When Dr. Feitosa introduced the first Virginia Soft Matter Workshop, it drew about 50 people from six different institutions across the commonwealth. Soft matter researchers eagerly exchanged knowledge and forged connections. It was there that Dr. Feitosa met Dr. Shengfeng Cheng from VT, his current research partner.

As an experimentalist, my own research program is significantly strengthened by the collaboration with my theoretical counterpart, Dr. Cheng. Our areas of expertise are complementary.
Dr. Klebert Feitosa

With these newfound partnerships, the workshop took on a life of its own toward the advancement of soft matter research. Virginia Tech hosted the second workshop, UVA hosted the third workshop and then it spread beyond 4-VA to be hosted by VCU in its fourth year with 95 people in attendance from 10 institutions across Virginia.

As a result of the original mini-grant, Dr. Feitosa and Dr. Cheng have been awarded two 4-VA grants and are currently writing two manuscripts.

Collaborators

- GMU
- VT
- UVA
- VCU

Benefits to the Commonwealth

- √ Established robust, multi-disciplinary, scientific community across Virginia
- √ Advanced Virginia's impact on soft matter research
- √ Formed interdisciplinary research center at VT
- √ Improved employment opportunities in Virginia

Student Researchers

- Keely Cridle
- Seth Heershap
- Daniel Shorts

Student Impact

- Unique access to faculty, postdocs, & students from other institutions
- Tackled cutting-edge, real-world science problems

> *Direct results of the workshop include the formation of new research collaborations, the organization of three other workshops in Virginia, and the formation of the Center for Soft Matter and Biological Physics at Virginia Tech. Undergraduate and graduate students are currently involved, enhancing participation of students in the project. Without 4-VA support and capabilities, this project would not have been possible.*
> Dr. Klebert Feitosa

Impacting Infectious Diseases

Dr. Louise Temple
Professor of Integrated Science & Technology

Since 2013, 4-VA has awarded Dr. Louise Temple seed funding for three primary areas of research that affect human health on a global scale: the spread of antibiotic resistance, the re-emergence of whooping cough, and a poultry vaccine. Through these projects, she and her various teams of collaborators and students have discovered a method for how genes with methicillin resistance spread, laid the groundwork for a new method of whooping cough detection, and started developing a vaccine against a poultry bacterium that is harmful to humans.

Dr. Temple's dedication to scientific discovery—for science and non-science majors alike—has led to discovery of novel viruses and bacteria in soil, as well as earned her a prestigious Fulbright Scholar award. She is committed to providing opportunities for undergraduates to participate in intensive, authentic research.

Benefits to the Commonwealth

√ Demonstrated growth in biotechnology
√ Demonstrated Virginia's impact on major global health issues
√ Contributed to health and medical solutions
√ Provided rare opportunity for undergraduate students to participate in vaccine research
√ Graduates hired in same FDA group as research scientists

> *"This entire study was funded by 4-VA and we couldn't have done any of it without 4-VA.*
> Dr. Louise Temple

> *"This work has yielded more in the way of student success than any others. We are all about training undergraduates to become scientists. This project succeeded "in spades" in this regard.*
> Dr. Louise Temple

The spread of antibiotic resistance

January, 2013

Finding and Analyzing Methicillin Resistance Genes in Viruses from Environmental Samples in the Shenandoah Valley
Mini-grant – $4,100

Collaborators

- **Dr. Gordon Archer**, *Microbiology and Immunology Department at VCU*
- Virginia Commonwealth University (VCU)

Summary

- Undergraduate researchers developed methods to extract bacterial viruses from a variety of environmental samples
- JMU students performed summer research and spent several weeks at VCU partnering with Dr. Archer and a PhD student.
- Students built on a pilot study conducted in an advanced ISAT research class at JMU and on work by a clinician and a graduate student at VCU.
- This work led to the submission of a joint proposal to the Commonwealth Research Board in the fall of 2013 and 2014.

Student Researchers

- 12 biotechnology, biology, and integrated science and technology (ISAT) majors

August, 2013

Analysis of Mobile DNA Elements Containing Methicillin Resistance Genes Discovered in Viruses from Environmental Samples in the Shenandoah Valley
Scale-up grant – $20,000

Collaborators

- **Dr. Gordon Archer**, *Microbiology and Immunology Department at VCU*
- **Dr. Greg Buck**, *Director of the Center for the Study of Biological Complexity at MCV/VCU*
- VCU

Summary

- Aimed to show whether the genes for methicillin-resistant *Staphylococcus aureus* (MRSA) are carried by viruses that infect bacteria
- After analyzing about 100 samples, they found evidence of the genes in about 25 of them.
- Discovered that viruses capable of infecting bacteria sometimes carry and deliver the genes for methicillin resistance. This finding shows one mechanism by which these genes move around in nature and increase the problems of MRSA in human infections.
- Trained over a dozen students in the scientific method
- Three honors theses were completed in this research area.
- Two recent graduates were hired in the same FDA group as research scientists.

Student Researchers

- Emily Pelto
- Brooke Sauder
- Taryn Boyle
- Colin Brooks

The re-emergence of whooping cough

May, 2013

Laying the Groundwork for a Viral Detection System for Pertussis (whooping cough) Diagnosis

Mini-grant – $5,000

Collaborators

- **Dr. Erik Hewlett**, *School of Medicine at UVA*
- UVA

Summary

- Leveraged expertise at two different Virginia universities to isolate viruses that can be developed as tools to detect *Bordetella pertussis*—the cause of whooping cough—in humans
- Began identifying potential bacteriophages that can be developed into such tools
- Biological challenge: Found one virus infecting the bacterium; work is ongoing to widen the host range
- Sequence of the virus obtained

> *A study by the economic research firm John Dunham & Associates for the U.S. Poultry & Egg Association found that the industry's contribution to the Virginia economy in 2014 totaled* **$13.7 billion**, *with* **52,293 jobs** *and* ***$2.8 billion in wages*** *linked to it.*

> *Rockingham, Augusta, Shenandoah and Page counties ranked first, second, third and fifth, respectively, in state poultry and egg sales, agriculture census data indicated. Combined, they accounted for* **$800.2 million**, *or* **69%**, *of Virginia's poultry receipts.*
> Shenandoah Valley Partnership

Development of a poultry vaccine

January, 2013

Evaluation of potential vaccine strain of *Bordetella avium* in turkey poults

Mini-grant – $500

Collaborators

- **Dr. F. William Pierson**, *Professor of Biosecurity and Infection Control and Clinical Specialist, Avian Medicine at VT*
- VT

Summary

- Developing a vaccine to prevent the colonization of bacteria in poultry that cause food poisoning in humans
- Leveraged expertise and facilities at VT to obtain essential data for long-standing research project conducted at JMU with undergraduate researchers. This is particularly significant because vaccine research is not normally associated with undergraduate research.

Student Researchers

- Carly Starke
- Joseph Bannister
- Rachel Korba

December, 2014

Development and testing of a heterologous vaccine to treat *Bordetella avium* and other poultry pathogens

Scale-up grant – $5,000

Collaborators

- **Dr. F. William Pierson**, *Professor of Biosecurity and Infection Control and Clinical Specialist, Avian Medicine at VT*
- VT

Summary

- Funding made the *in vivo* poultry work possible for JMU, which has no such facilities.
- Seeking continued funding by NIH or USDA in the future
- Sought out by a team of scientists and veterinarians from Butterball and an agricultural station in Utah, which developed into a collaboration that could impact the vaccine development and help the turkey industry decide on treatment plans
- Continuing collaboration with follow-up funding from 4-VA at UVA
- Talking to scientists at SRI International for the potential to join hands in this effort

Student Researchers

- Rachel Korba

Spring, 2016

A Virginia Collaborative Effort to Analyze Genomes of Recent Whooping Cough Bacteria

Scale-up grant – $7,000

Collaborators

- **Dr. Josh Eby**, *Assistant Professor of Medicine at UVA*
- UVA

Summary

- Aiming to find out what is different about the bacteria causing the recent increase in whooping cough in Virginia and our nation
- Because genetic adaptation in *Bordetella pertussis* has contributed to the reemergence of whooping cough, the tools built during this process will address an issue important to the health of Virginians.
- Training students in bioinformatics and development of new tools to manipulate the unusual genomic structure of the causative agent of whooping cough, *B. pertussis*
- *B. pertussis* exhibits remarkable genome plasticity, requiring the novel techniques for analysis that will result from this work.
- Funding will provide a summer student internship and additional DNA sequencing capacity.
- Already presented at three conferences
- Recent article published in *Genome Announcements*

Student Researchers

- Carly Neville
- Aurvan Koyee (UVA)
- Bryan Nguyen
- June Qong

> *A collaborator of mine from years ago at Drew University retired and moved to the area to continue our collaboration here at JMU. With the 4-VA funding, we have been able to do the in vitro work related to the vaccine development.*
> Dr. Louise Temple

Intestinal Infections

Examining the role of a protein in traveler's diarrhea

Dr. Nathan Wright
Assistant Professor of Chemistry and Biochemistry

Amount Awarded
Mini-grant – $5,000

In October, 2012, Dr. Nathan Wright was awarded a 4-VA mini-grant called **Structure/Function studies on dispersin homologues in Enterotoxic bacteria** in a collaboration with Dr. James Nataro at UVA and Dr. Christopher Berndsen at JMU. Their research aimed to examine the molecular mechanism of how the protein ORF-60, now called Aar, is involved in traveler's diarrhea. It's not yet understood how the E. coli that cause this disease 'turn on' their toxins when they are in the gut. Although the team didn't get a full structure due to solubility issues, they were able to do a preliminary protein characterization.

The project fostered collaboration between two protein structure labs at JMU and a bacterial pathogen lab at UVA. For the first time, JMU students were trained in molecular modeling and heteronuclear multidimensional nuclear magnetic resonance (NMR) analysis.

Despite unforeseen technical issues, the research still had an impact and advanced the field. The team is continuing with new ways of approaching the same project in continued collaboration with UVA. Ultimately, their objective is to determine the atomic-resolution structure of Aar using X-ray crystallography.

Andy would not have gotten a job at Amgen without this work. He is currently applying to graduate schools in Virginia, and thus this money helped kick-start a highly promising scientist into a growth field.
Dr. Nathan Wright

> *4-VA provided startup funding for our lab to collaborate with a microbiology lab at UVA. We leveraged this seed grant in two ways. First, we used this grant to help publish a microbiology paper, which in turn helped us submit a large NIH proposal with our UVA collaborators this past fall. Also, getting this 4-VA grant helped convince the NSF to award me an RUI grant for almost $300,000 this past summer. If the point of this grant is to make Virginia researchers stronger candidates for federal grants, in my case, it has certainly done its job in spades.*
> Dr. Nathan Wright

Collaborators

Dr. Christopher Berndsen
Assistant Professor of Chemistry and Biochemistry at JMU

Dr. James Nataro
Professor and Chair of Pediatrics at UVA

UVA

Student Researchers

- Andy Heinde

Benefits to the Commonwealth

- √ Contributed to solutions for traveler's diarrhea
- √ Resulted in a student researcher getting a high-paying job in Virginia's biotechnology industry
- √ Increased prevalence and intensity of research collaboration between Virginia institutions
- √ Shared lab equipment and maximized university resources
- √ Demonstrated the impact of Virginia's research on a major global health issue

Student Impact

- Expanded career opportunities
- Resulted in employment at a human therapeutics company in the biotechnology industry in Virginia
- Helped kick-start a highly promising scientist into a growth field
- Learned molecular biology and advanced biochemical techniques
- 500 combined hours of undergraduate research

> *These funded 4-VA grants have led to the generation of preliminary data, novel collaborations, and seed ideas that will be developed into an NSF Improving Undergraduate STEM Education grant proposal that we aim to submit this upcoming November.*
> Dr. Ray Enke

Gene Expression in the Vertebrate Retina

How genes turn on and off during retinal development

Dr. Ray Enke
Assistant Professor of Biology

Amount Awarded
2 Mini-grants – $5,000 each

In December, 2013, during Dr. Ray Enke's first year at JMU, 4-VA awarded him a mini-grant called **Establishing a collaborative undergraduate research program: Characterizing epigenetic regulation of gene expression during development of the vertebrate retina.** Launched as a collaboration to use a laser dissection microscope (LCM) at GMU, the project brought together three investigators with complementary areas of expertise. Dr. Enke focused on mechanisms of gene regulation in the vertebrate retina while Dr. Lance Liotta and Dr. Virginia Espina developed specialized techniques for analyzing retinal histology and laser capture microdissection of retinal tissue.

In 2014, access to the LCM allowed student Emily Grunwald to collect valuable tissue so the team could conduct experiments to demonstrate cell-specific patterns of epigenetic modification in the genomes of retinal neurons.

In December, 2014, 4-VA awarded Dr. Enke a second mini-grant called **Gene expression analysis in the developing vertebrate retina using next generation sequencing** to work with Dr. Stephen Turner at UVA. Complementing his first 4-VA project, this bioinformatics collaboration is focused on analyzing several large genome-wide sequencing data sets generated in his lab as well as previously published public domain data. The plan is to streamline bioinformatics protocols for students to use in the research lab as well as in upper division biology course labs.

> *4-VA has significantly helped both projects in terms of being able to use specialized equipment that we would not have otherwise had access to as well as to develop computational bioinformatics protocols for teaching in the lab and in class.*
> Dr. Ray Enke

Gene Expression in the Vertebrate Retina *Continued*

The teams are making significant progress on both projects with several events and grants in related areas of research:

2014

JMU awarded Dr. Enke a College of Science and Mathematics Summer Research Faculty Assistance Grant of $4,000 for his project "Characterizing epigenetic mechanisms of gene regulation in the vertebrate retina"

2015

Dr. Enke hosted the CGEMS Summer Training Workshop in Genomics, Proteomics & Bioinformatics for Beginners & Beyond with support from 4-VA

Dr. Enke received a $200,000 grant from the Commonwealth Health Research Board for his proposal entitled "Molecular and bioinformatic analysis of epigenetic gene regulation in the normal and diseased retina: Characterizing pathways for diagnosing and treating macular degeneration".

In collaboration with Dr. Elizabeth Doyle and Dr. Oliver Hyman, Dr. Enke was awarded a JMU Geospatial Mini-grant of $500 for the proposal entitled "Integration of GIS and DNA Sequence Data to Characterize Biological Diversity in the Edith J. Carrier Arboretum"

2016

Dr. Enke hosted the second CGEMS Summer Training Workshop in Genomics, Proteomics & Bioinformatics for Beginners & Beyond with support from 4-VA

Conferences & Workshops

- 2015 Association for Research in Vision and Ophthalmology (ARVO) Conference (Denver, CO)
- 2015 Infrastructure & Training to Bring Next-Gen Sequence Analysis into Undergraduate Education Workshop (Bowie, MD)
- 2016 Association for Research in Vision and Ophthalmology (ARVO) Conference (Seattle, WA)
- 2016 Plant & Animal Genome Conference (San Diego, CA)
- 2016 Infrastructure & Training to Bring Next-Gen Sequence Analysis into Undergraduate Education Workshop (Cold Spring Harbor, NY)

Publications

- "Connecting common genetic polymorphisms to protein function: A modular project sequence for lecture or lab", *Biochemistry and Molecular Biology Education* onlinelibrary.wiley.com/doi/10.1002/bmb.20976/abstract
- "RNA sequencing analysis of the developing chicken retina: a resource for the vision research community"; *accepted for publication in Genomics Data*
- "Dnmt1, Dnmt3a and Dnmt3b cooperate in photoreceptor and outer plexiform layer development in the mammalian retina," *Experimental Eye Research*
- "Characterization of intravitreally delivered capsid mutant AAV2-Cre vector to induce tissue-specific mutations in murine retinal ganglion cells," *Experimental Eye Research*

Collaborators

Dr. Lance Liotta
Co-Director & Co-Founder of the Center for Applied Proteomics and Molecular Medicine (CAPMM) at GMU

Dr. Virginia Espina
Research Associate Professor and Director of the CAP accredited clinical proteomics laboratory in the CAPMM at GMU

GMU

Dr. Stephen Turner
Assistant Professor of Public Health and Director of the School of Medicine's Bioinformatics Core at UVA

UVA

Benefits to the Commonwealth

√ Demonstrated Virginia's impact on health and medical research
√ Developed new models for teaching and learning
√ Contributed to medical solutions for retinal diseases
√ Shared lab equipment and maximized university resources

Student Researchers

- Emily Grunwald
- Morgan Hedden
- Nicholas Dunham
- Annamarie Meinsen
- Courtney Stout
- Sraavya Polisetti
- Christophe Langouet-Astrie

Student Impact

- Unique access to a highly specialized piece of equipment in the Liotta Lab at GMU
- Developed computational bioinformatics protocols

Collaborative Research Grants*

Spring, 2012 - Spring, 2016 *(All projects listed originated at JMU)*

2012	
Bob McKown	Feasibility of a Canine Study for Tear Lacritin as a Treatment for Dry Eye
Christine May	Virginia Trout Streams Research Collaboration
Costel Constantin	Kapitza Conductance of Al2O3/GaN Interfaces.
GMU, JMU, VT and UVA	Virginia Early Childhood Foundation Preschool Study
Nathan Wright	Structure/Function studies on dispersin homologues in Enterotoxic bacteria
2013	
Alleyn Harned	Virginia Clean Fuels Student Partnership 2013-2014
Anca Constantin	The WISE Search For Megamasers
Anca Constantin	The First Panchromatic Constraints of the Role of Water Masers in Galaxy Evolution Process
Anne Henriksen	Using the Mouse Four-Core Genotype Model and Estradiol to Elucidate the Effects of Gonadal vs. Genes on RNA Sequences in the Cerebellum
Anne Henriksen	Using High-Throughput, Next-Generation Sequencing to Identify Transgenerational Effects of Bisphenol A on the Epigenome
Carol Hurney	Exploring Tail Development from Three Ends
Christopher Berndsen	Structure of human BST-2 with BST-2 antagonist Vpu
Costel Constantin	Thermal Conductivity and Thermal Boundary Conductance Measurements of Metal/PEDOT:PSS Interfaces as a Function of Electrical Conductivity
Elizabeth Johnson	Laboratory Techniques in Geology: Redesign of a STEM course to prepare students for graduate school and Employment
Giovanna Scarel	Effects on thermoelectric power generation of the source-device distance
Isaiah Sumner	Computational Insights into the Motion of the Protein, GroEL
Jacquelyn Nagel	Sustainable Innovation: Integrating teams in Biology, Design and Engineering
James Herrick	Genomic analysis of multi-drug antibiotic resistance encoded on mobile genetic elements in Virginia stream bacterial populations
James W. Wilson	JMU-ESRI Geoportal Collaborative: A Proposal to Develop a Research Collaborative
Kenn Barron	Development of a Real-Time Data Collection Intervention Platform for Classrooms: The Rapid Assessment Platform and Intervention Delivery (RAPID) system
Kevin Giovanetti	Development of a High Stability, Precise, High Voltage Power System: a Critical Component for the Muon g-2 Experiment at Fermi National Laboratory
Klebert Feitosa	Bringing Together a Community of Soft Matter Researchers in Virginia
LouAnn Lovin	Fraction Schemes and Operations: An Extension to Prospective PreK-8 Teachers
Louise Temple	Finding and Analyzing Methicillin Resistance Genes in Viruses from Environmental Samples in the Shenandoah Valley
Louise Temple	Laying the Groundwork for a Viral Detection System for Pertussis (whooping cough) Diagnosis: a Partnership between JMU and University of Virginia
Louise Temple	Analysis of Mobile DNA Elements Containing Methicillin Resistance Genes Discovered in Viruses from Environmental Samples in the Shenandoah Valley: a Partnership between JMU and VCU
Louise Temple	Evaluation of potential vaccine strain of *Bordetella avium* in turkey poults
Maria DeValpine	A collaborative course redesign combining on-line delivery methods with historic nursing research at two Virginia Universities
Michael Renfroe	Quantitative analysis of antioxidants in Fresh and Dried Herbs and Spices
Michele Estes	Reaching the Greatest Number of Learners: Improving Access to STEM Undergraduate Education Through Online Engineering Labs for Students Across Virginia
Ray Enke	Establishing a collaborative undergraduate research program: Characterizing epigenetic regulation of gene expression during development of the vertebrate retina
Rob Prins	Energy Usage Analysis of an Electric Motorcycle and its Implementation as a Tool to Inform Cross-Country Route Planning
Robert Nagel	Distributable Stereo Hearing Test Kit
Ronald Raab	Antimicrobial activity in the bedbug, Cimex Lectularius
Ronald Raab	Novel lacritin mitochondrial signaling in the treatment of dry eye
Roshna Wunderlich	Design of Innovative Virtual Human Anatomy Modules to be Shared Across the Commonwealth
Seán McCarthy	The Networked Writing Project for Virginia (#nwp4va)
Susan Halsell	Seeding a Research Collaboration: Regulations of Dendritic Morphogenesis in Genetic Model Organism, Drosophila melanogaster
Susan Halsell	Molecular Dissection of Noxious Cold Nociception
Teresa Harris	Effects of Preschool Attendance on Middle School Outcomes in Virginia
Trudy Cole	Visual Literacy, Beyond Linguistic Communication: a Collaborative Research Project
2014	
David A. Stringham	Music Technology Engagement for Adults with Intellectual and Developmental Disabilities
Elizabeth Berkeley	Fossil Evidence for Early Human Predation on Rhinos
Giovanna Scarel	Giving to JMU international visibility in infrared power generation and its link to non-linear phenomena
Grace Barth	Connecting MDID and Omeka: Two Powerful Open Source Products
Jacquelyn Nagel	Manufacturing Innovation through Sustainable Design
Kenn Barron	Development of a Real-time Data Collection and Intervention Platform for Classrooms: The Rapid Assessment Platform and Intervention Delivery (RAPID) System
Klebert Feitosa	Probing Short-range Interactions of Interfacial Bubbles
Lincoln Gray	Deployment of a Working Prototype for Stereo Hearing Tests
LouAnn Lovin	Fraction Schemes and Operations: An Extension to Prospective PreK-8 Teachers
Louise Temple	Development and testing of a heterologous vaccine to treat *Bordetella avium* and other poultry pathogens
Nicole Radziwill	Increasing Engagement in Programming and Problem Solving Using Data Science and R
Ray Enke	Gene expression analysis in the developing vertebrate retina using next generation sequencing
Remy Pangle	Developing a Collaborative Teaching Model through Planning Regional KidWind Challenges at 4-VA Universities
Shannon N. Conley	Towards Assessing the Breadth of Expertise in Science and Engineering Education
2015	
Christine May	Revealing the Current Relation between Stream Acidification and Fish Species Richness: What is the Trend after Almost Two Decades of Recovery?
David McLeod	USING µCT TO STUDY AMPHIBIAN MORPHOLOGY AND SYSTEMATICS
Keigo Fukumura	Observational Signatures of Relativistic Black Hole Accretion in the Context of X-Ray Astrophysics
Kevin Giovanetti	Promoting Nuclear and Particle Physics Collaboration among Virginia Colleges
Maria deValpine	Health care disparities in the Alaskan 1918-1919 Influenza Epidemic
Samy El-Tawab	Improving Transit Bus Operations using Low Cost Bluetooth Technology
2016	
Anca Constantin	The Search for the Origins of Supermassive Black Holes
Ashleigh Baber	Ethanol Chemistry on Titania/Gold Model Catalysts
Costel Constantin	Investigating the Giant Seebeck Coefficient of Manganese Oxide Powders as a Function of Particle Size.
Deborah Gleason	A collaborative digitization of the Dora Cline Fechtmann archival collection at two Virginia Universities
Erica Lewis	A 4-VA Collaborative Interprofessional Education Proposal: Innovations in Collaboration
Giovanna Scarel	Amplification of the electric contribution in infrared power generation
Jonathan Miles	Virginia-Led Consortium to Develop an Offshore Wind Workforce Training Capability for the U.S.
Louise Temple	A Virginia Collaborative Effort to Analyze Genomes of Recent Whooping Cough Bacteria
Marta Bechtel	Characterizing the Role of Flaviviruses in Human Cartilage Arthralgia
Seán McCarthy	From Liquid to STEAM: Fostering Interdisciplinary, Engaged Approaches to the Study of Water in International Contexts

*Only primary principal investigators are listed for these projects

For a comprehensive list of project participants and other information, please visit 4-va.org.

The Virginia Drone Projects

In the spring of 2015, Dr. Kevin Giovanetti taught the first undergraduate drone course in the Commonwealth of Virginia—a feat that put JMU on the map in ways never before imagined. What began as a pilot course has surged into multiple iterations of a collaborative, interdisciplinary course and events shared across the commonwealth.

The initial course focused primarily on the technical components of unmanned aerial vehicles (UAVs) and JMU continues to offer this upper-level physics course in the spring. In the spring of 2016, ODU successfully joined the course via telepresence technology.

In the fall of 2015, 4-VA at JMU launched an expanded and applied version of the UAV course, addressing global problems with drone technology:

- Aerial imaging
- Ecology topics of pollution and riverbeds
- First response for providing medicine to remote locations
- Landmine detection and destruction

The students built working UAV prototypes and documented their efforts through an online blog called The JMU Drones Project, where they chronicled details about each team's project research and UAV development: sites.jmu.edu/jmudroneschallenge .

In the fall of 2016, both ODU and GMU joined the expanded UAV course through telepresence. With a variety of interests across the class, students chose a few additional global issues to explore and solve using drones:

- Augmented communication
- Fire rescue
- Increasing honeybee populations
- Landmine detection and destruction
- Modeling city walls in Cartagena, Colombia. This team will journey to Colombia in January, 2017 to test their prototype and work directly with the PhD candidate there who requested the project.
- Sea rescue
- Tidal flood monitoring

The blog for this class, called The Virginia Drones Project, is available at sites.jmu.edu/vadrones/.

6	7	8
Disciplines	Majors	Faculty Members

UAV Course Faculty

The faculty's unprecedented collaboration has been integral to creating a positive experience for students each semester by securing interdisciplinary courses that serve students from a wide variety of majors.

- Asa Taylor, Facilities Management
- Audrey Barnes, Industrial Design
- Bo Pollett, Nova Labs
- Christopher Vo, Nova Labs
- Erica Lewis, Nursing
- Fred Briggs, Nova Labs
- Kevin Giovanetti, Physics
- Nick Swayne, 4-VA at JMU
- Patrice Ludwig, Biology
- Seán McCarthy, Writing, Rhetoric and Technical Communication

With endless possibilities in innovation and teamwork, these courses prepare students across Virginia not only to work with emerging technologies that may be part of their future careers, but also to work with individuals across diverse backgrounds, undergraduate studies, and geographic locations.

Outcomes

TOM Global

In July, 2016 Bo Pollett and Fred Briggs ran an event at Nova Labs called TOM Global—a 3-day make-a-thon where teams of makers, engineers, developers and doctors developed solutions to positively impact the lives of people with disabilities. Eight teams generated diverse solutions, such as visualizing sound for the hearing impaired through a virtual reality device and building custom motorized shelves for a young boy with cerebral palsy.

Nova Labs invited two JMU students to participate because of their work in the drone classes, one of whom is mentioned in a Washington Post article on the event: wapo.st/2fRTx9q The White House highlighted the event as part of a presentation to applaud the achievements of makerspaces.

> *"The JMU students that participated were amazing and they created some fantastic solutions!*
>
> Fred Briggs, Nova Labs Director

Drone technology experts Bo Pollett, Christopher Vo and Fred Briggs teach students remotely from Nova Labs in both versions of the class using BEAM robots and telepresence technology in the JMU X-Labs. They provide invaluable support and knowledge to students throughout the semester and are a vital part of the faculty team.

VIRTUES

The success of the UAV courses propelled JMU to host the first VIrginia RoboTics and Unmanned Systems Education Summit (VIRTUES) in August, 2016. This working meeting brought individuals involved in unmanned systems industries, research, curriculum, and policy from across the commonwealth and along the East Coast together to discuss actionable ways to collaborate. Much like the interdisciplinary opportunity for UAV students, professionals reached beyond their regions and organizations to discover collaborative solutions to the many challenges of unmanned vehicles in a burgeoning field.

Shared Courses

Courses shared at JMU since 2012

- Arabic 300
- Arabic 320
- Arabic 340
- Biology 452
- Chinese 305
- Chinese Literature
- Environmental Science & Public Policy 490 (STEM Outreach and Community Engagement)
- Graduate Ecology
- Intelligence Analysis 490
- Interprofessional Innovations
- Italian 232
- Italian 300
- Italian 307
- Italian 315
- Italian 446
- Japanese 300
- Kid Wind
- Korean 101
- Korean 102
- Korean 231
- Korean 232
- Management 300
- Persian 111
- Persian 231
- Political Science 398
- Population Ecology
- Portuguese 100
- Portuguese 101
- Portuguese 102
- Portuguese 231
- Portuguese 232
- Portuguese 300
- Spanish 370
- Unmanned Aerial Vehicles 1
- Unmanned Aerial Vehicles 2

Improving Student Performance

Biology and chemistry departments support new STEM students

In 2015, 4-VA offered support to the Department of Chemistry and the Department of Biology in their efforts to aid at-risk students in improving their performance. In 2016, in an unprecedented collaboration, these two different areas of science came together to redesign their curriculum in an effort to decrease student drop, fail and withdraw (DFW) rates.

In the Department of Chemistry, Linette Watkins and her team developed cohort-building activities, tutoring sessions, and a skill-building class that resulted in students successfully completing the CHEM 131 and CHEM 131L courses. There were over 300 students involved in these initiatives and 884 tutoring sessions throughout the course of the semester. Iona Black played an integral role in the redesign process, leading the initiative and serving as a primary faculty tutor. Her 'Relax. Relate. Revise.' strategy provided an effective tool for tutors and the students who attended the sessions.

Joanna Mott and faculty in the Department of Biology redesigned two courses—BIO 140 and BIO 150—aligning them with coursework at other Virginia universities and community colleges as well as with standard advanced placement (AP) tests required by high schools. The redesign also replaced prescriptive experiments with authentic lab research to actively engage students during their first year of study. Over 600 students were engaged as a product of this redesign.

As a result, chemistry and biology faculty not only reduced DFWs among their introductory science courses, they also put sustainable interventions in place to help future students succeed in material comprehension and retention. Over 300 chemistry students and 600 biology students benefited from these targeted interventions and the DFW rates dropped by 2% among at-risk students. This collaborative redesign resulted in powerful, sustainable changes to curriculum that helps retain STEM majors and saves time and money.

> *"My hope is that we can change the focus of introductory courses to cover much less material in order to give students the chance to learn what science is and the opportunity to experience science.*
>
> Bruce Alberts, American Association for the Advancement of Science (AAAS), Editor-in-Chief of *Science* and former President, National Academy of Sciences

Interprofessional Innovations

Students from three majors work together to solve a health issue

Dr. Erica Lewis
Assistant Professor of Nursing

Amount Awarded
Mini-grant – $4,600

In late 2014, 4-VA sponsored a course redesign project that leveraged the strengths of three different disciplines at JMU: biology, engineering and nursing. Dr. Erica Lewis, Dr. Jacquelyn Nagel, and Dr. Patrice Ludwig designed an interprofessional medical innovations pilot course that assembled students from all three majors to apply maker technology to produce and communicate solutions for a relevant community health challenge.

Launched in the spring of 2015, the course challenged mixed teams from different areas of study to formulate ideas for mitigating metabolic syndrome—a disorder which affects about 34% of Americans and increases the risk of heart disease and diabetes.

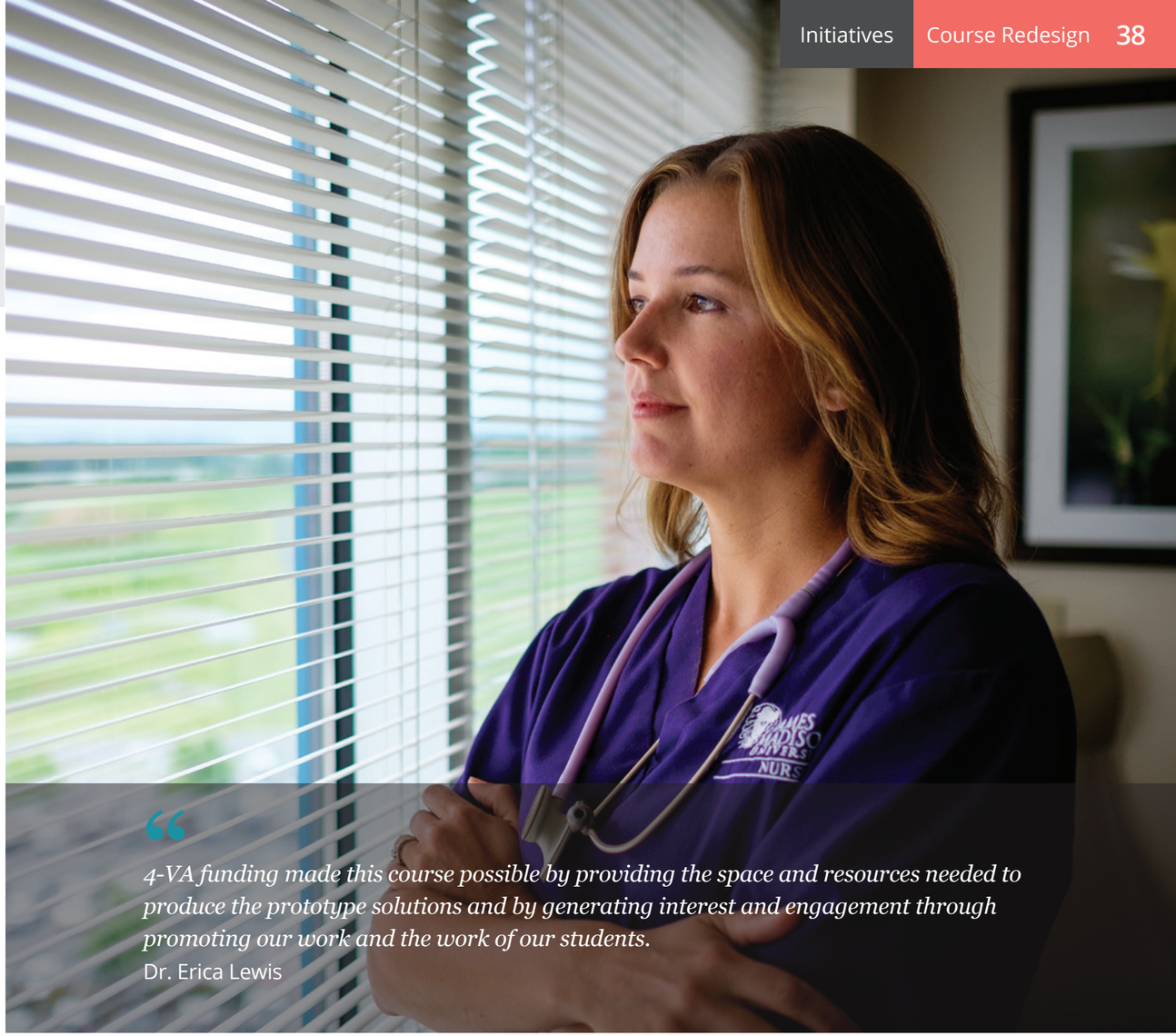
Students found it both challenging and rewarding to learn how to communicate their knowledge and ideas across disciplines and made great strides in solving problems in a collaborative setting. Solutions included a viral, campus-wide, non-profit challenge, a phone app with a built-in spectrometer, and an interactive board game. Guests from the community were invited to meet students, listen to their presentations, ask questions, and provide feedback on their work from a professional standpoint.

The successful pilot segued into a second iteration of the class in 2016, this time with a connection at UVA. David Chen from the UVA BME program offered his expertise on prototyping and provided feedback to the Interprofessional Innovations students at JMU. Similarly, Dr. Lewis and Dr. Ludwig helped Mr. Chen judge projects for his BME design course. Since then the faculty have met several times to learn more about each other's courses and to discuss future partnerships.

Just like their predecessors, the 2016 class invited community members to offer feedback on their final presentations. Students introduced a seat cushion with scale technology and Bluetooth connectivity, a model of an indoor playground for both children and adults, an instructive lamp that encourages activity during the workday, and a pedaling machine to use at your desk.

This past spring the instructors used quantitative measures to assess student learning outcomes. Students were assessed on problem solving, creativity, attitudes about teams, and ethical reasoning. Early analysis showed that students made gains in some of these areas. The team is currently working with Dr. Allison Ames, Assistant Professor in the Department of Graduate Psychology, to finish analyzing and submit these data for publication.

In addition, the faculty have been in conversations with a group from Tennessee Technological University who are teaching a course with engineering and nursing students—very similar to the Interprofessional Innovations course—and who have been considering similar assessments.



> *4-VA funding made this course possible by providing the space and resources needed to produce the prototype solutions and by generating interest and engagement through promoting our work and the work of our students.*
> Dr. Erica Lewis

Collaborators

Dr. Jacquelyn Nagel
Assistant Professor of Engineering at JMU

Dr. Patrice Ludwig
Assistant Professor of Biology at JMU

David Chen
Coulter Program Director at UVA, Department of Biomedical Engineering (BME)

UVA

Benefits to the Commonwealth

- √ Contributed to health & medical solutions
- √ Contributed to solutions in education
- √ Engaged subject matter & health experts across Virginia
- √ Increased course access to students
- √ Empowered students to engage in solving problems

jmUDESIGN

An instructional design institute for faculty

With support from 4-VA, the Center for Faculty Innovation (CFI) at JMU hosted its sixth jmUDESIGN Institute in June, 2016. This engaging five-day course, curriculum, and instructional design institute brought 55 participants together from JMU, Eastern Mennonite University, Ferrum College, Virginia Western Community College, Rappahannock Community College, Thomas Nelson Community College, Northern Virginia Community College, Piedmont Virginia Community College, and Germanna Community College. Participants worked in small groups, or "hubs", on curriculum redesign using backward design principles and aligning assessments, assignments, and outcomes.

Since 2012, the funding provided by 4-VA has been applied where the need is greatest. This year 4-VA provided $14,000 which helped cover stipends for table facilitators, housing for out-of-town participants, and catering for the event.

The impact of jmUDESIGN goes beyond improved curriculum and reflective teaching practices by also offering a greater sense of belonging and morale across departments, JMU, and higher education throughout the Commonwealth of Virginia.

"Resources provided by 4-VA have allowed JMU's Center for Faculty Innovation to widen access to instructional design initiatives, offering 2-year and 4-year colleges and universities across the state the opportunity to attend jmUDESIGN free of charge. A particular highlight has been witnessing JMU faculty and a cluster of community college faculty working together on the redesign of signature assignments for STEM courses. This is innovation in action!

Cara Meixner, CFI Executive Director

"Thank you for your expertise in concrete strategies I can implement to improve my courses. The approach and perspective on student learning gained through the workshop have empowered me to continually manage and revise my courses in a way that is genuinely helpful; no more blind experiments!

2016 participant

"I felt as though I have been roaming around in the fog for several years and this program gave me the clarity I needed to do a more effective job. Additionally, it also helped me to build a special topics course that I have been struggling with for 2 years

2016 participant

> *The funding was extremely valuable in my research of cybersecurity pedagogy. If it wasn't for the funding, I wouldn't have been able to acquire necessary digital and hardware assets that are essential to the course development.*
>
> Dr. John Guo

A newly designed cybersecurity course for 4-VA

Dr. John Guo
Associate Professor of Computing Information Systems and Business Analytics

Amount Awarded
Mini-grant – $5,000

In October, 2013, 4-VA awarded John Guo with a mini-grant called **A newly designed cybersecurity course for 4-VA**. The project introduced a new design for a computer information systems (CIS) security class by utilizing new tools and perspectives to provide students with technical grounding in network attack concepts and technologies. Concepts such as the following are critical to defensive practices:

- Penetration testing environments
- Online threats
- Data security
- System hardening
- Information security compliance

Using hands-on labs and real world exercises, the course examines popular pen testing tools—such as keylogging and phishing attacks, evaluates cybersecurity contexts, and analyzes incident response solutions. Due to the relevant material and the practicality of this course design, the class is highly engaging and designed to produce students who can readily apply their knowledge and skills.

> *Our intention is to build and sustain a vibrant academic-industrial ecosystem where exciting things take place on a regular basis. Members walk away with valuable experience and lessons learned.*
>
> Dr. John Guo

Benefits to the Commonwealth

√ Demonstrated Virginia's impact on education in cybersecurity
√ Developed new models for teaching and learning
√ Improves employment opportunities in Virginia

Course Redesign Projects & Trainings

2012

	Biology Vision and Change Conference

2013

	Biology Articulation Conference
Cara Meixner **Carol Hurney**	jmUDESIGN Institute
Patrice Ludwig **Marta Bechtel** **Kerry Cresawn**	Scientific Teaching Workshop

2014

Cara Meixner **Carol Hurney**	jmUDESIGN Institute
Erica Lewis **Jacquelyn Nagel** **Patrice Ludwig**	Interprofessional Innovations Class

2015

Cara Meixner **Carol Hurney**	jmUDESIGN Institute
Karim Altaii	Flipping a Thermodynamics Course
Erica Lewis **Jacquelyn Nagel** **Patrice Ludwig**	Interprofessional Innovations Class
Mace Bentley	Bringing an Understanding of Southeast Asia Environments & Hazards to Virginia
Kerry Cresawn	Scientific Teaching Workshop
David Fordham	Development of Hybrid Course Materials for Introductory Information Security Course
Kyle Gipson	Development and Implementation of the Madison Engineering Leadership Program
John Guo	Redesign the Class of Cyber Security & Defense
Seán McCarthy	The Networked Writing Project for Virginia

Redesigned Courses

ART 391E	DIY Photography
BIO 290	Human Anatomy Lab
BIO 452	Population Ecology
CIS 101	Introduction to Computer Science
CIS 139	Programming Fundamentals
CIS 424	Computer Security Management
IA 490	Special Studies Intelligence Analysis
INDU 492	Topics in Industrial Design
ISAT	Environmental Hazards
MBA 680	Introduction to Information Security
NSG 317	History of Nursing
POSC 398	Simulations

Degree Completion

Since 1977, Outreach and Engagement's Adult Degree Program (ADP) at JMU has served adult students who are returning to college to complete their bachelor's degrees. More than 400 students have graduated from the program, and this year 22 students completed their bachelor's degrees.

Over the past several years, ADP began offering online modules, providing access to those who require remote study. Since students have been able to complete 50 percent or more of their degree online, admissions have annually increased by an average of 10 percent.

Since then, funding from 4-VA helped double the number of available modules and added online general education classes as well. New classes developed and taught this year include ISCI 101: Physics, Chemistry and the Human Experience, and SCOM 121: Fundamental Human Communication. In total, 15 classes funded through 4-VA were offered this academic year with a total enrollment of 148 students. For the 2016-2017 academic year, ADP plans to add two more general education classes to the online roster—an additional science class and a math class.

4-VA also provides funding for faculty to work with instructional designers from JMU's Center for Instructional Technology (CIT) to create dynamic, content-rich online classes. To date, over 20 faculty have participated in the CIT training and have taught the online classes to ADP students.

In addition, 4-VA helped fund the 9th Period Dual-Enrollment Program to boost the number of qualified high school computer science (CS) teachers and to offer dual enrollment CS courses to the students.

Overall the courses are gaining momentum as non-traditional students are provided access and more faculty teach these online courses. The RN to BSN program continues to be tremendously successful and the business, innovation and entrepreneurship courses are thriving as they empower people to run small businesses successfully.

These online courses are critical because they target economic development in the commonwealth as identified by the governor, who aims to fill the 17,000 cybersecurity jobs that are currently vacant in Virginia. (Governor McAuliffe, October 18th, 2016). The computer science courses, for example, provide data analytics and computing skills (e.g., network security) which are essential to small businesses.

2015—2016

2 new online courses	**148** students enrolled in online courses	**871** students enrolled in RN to BSN program

Nursing RN to BSN Program

In 2012, hospitals across the nation started requiring that their registered nurses (RNs) go back to school to earn Bachelor of Science in Nursing (BSN) degrees. To fulfill that need, 4-VA funded the development of the RN to BSN curriculum through Outreach & Engagement. The most successful degree completion program to date, the course provides flexible online learning opportunities while allowing students to maintain employment. The balance between work and study drives the success of the program for students who lead busy professional and personal lives. During the 2015-2016 academic year, 871 students enrolled in the program.

> *"The online aspect of this program makes earning a degree possible. There just aren't enough hours in the day for me to work, have a family, and physically attend school. In online programs, you can work at your own pace and you are not bound by attending classes. Programs such as these require a tremendous amount of self-motivation and structure, but the fact that you can do it on your own time and still be active in all other aspects of your life makes it all worth it.*
> Kiran Ahmad, Registered Nurse

Also Inside

VIRTUES Drone Conference

VIrginia RoboTics and Unmanned systems Education Summit

With an estimated economic impact of $82 billion*, growth in the unmanned aircraft systems (UAS) industry continues to spark interest and competition. Starting in 2015, that interest catalyzed the success of the 4-VA-sponsored drone class shared between JMU, GMU and ODU, precipitating the perfect opportunity for 4-VA to sponsor and host the VIrginia RoboTics and Unmanned systems Education Summit (VIRTUES). The first working group meeting of its kind, the conference brought the UAS community together to produce actionable objectives toward Governor Terry McAuliffe and Senator Mark Warner's vision called The New Virginia Economy.

Leaders from around the commonwealth and beyond met August 17th and 18th, 2016 at JMU's Lakeview Hall where they were welcomed by keynote speaker David Hinton. Appointed by Governor McAuliffe to head the Virginia Unmanned Systems (UMS) Commission, Mr. Hinton serves as the senior advisor for unmanned systems under Virginia Secretary of Technology, Karen Jackson. Mr. Hinton told the group, "Anything we can do to connect the universities to each other and to connect the universities with industry—that is to our advantage."

The connections were strengthened over the course of two days as breakout groups focusing on research, curriculum, industry, and policy met and created action items to move Virginia forward as a leader in unmanned systems. Experts in each area addressed the summit during the morning and afternoon sessions, generating discussion points around the topics.

A wide variety of attendees and speakers hailed from all across Virginia and the East Coast. JMU, SAIC, Lockheed Martin, GMU, VT, and the Federal Aviation Administration (FAA) are just a few of the organizations that were represented.

In 2015, Governor Terry McAuliffe signed Executive Order 43, establishing the Virginia Unmanned Systems (UMS) Commission to bring public and private sector experts together to make recommendations on how to make Virginia the national leader in unmanned systems.

"Capitalizing on Virginia's advantages in the unmanned systems industry is key to building a new Virginia economy," said Governor McAuliffe. "This executive order will lay the foundation for my administration's efforts to make this Commonwealth the world's leader in unmanned systems and seize the enormous economic opportunities that accompany growing this industry."

The Virginia Unmanned Systems Commission will be a key asset in charting the way forward to grow this industry and create new, good jobs and economic opportunities across the Commonwealth.
vus.virginia.gov/ums-commission

The UMS Commission encourages coming together in collaboration to prepare for an industry that will create 100,000 jobs by 2025. "This conference is doing the type of thing that the commission found needed to be done," observed Mr. Hinton. Events like VIRTUES position Virginia to lead the country in creating and maintaining those jobs here in the commonwealth.

**Association for Unmanned Vehicle Systems International (AUVSI) Report, 2013*

Announcement

VIRTUES II is scheduled for February, 2017 at JMU and will focus on strategic coordination between academia and industry. Our goal is to develop experienced UAV leaders and establish Virginia as the nation's premier provider of the top candidates in these emerging technologies.

"

These are really exciting times for the unmanned systems industry. The advancement of unmanned systems of all types—air, land and sea—is taking off exponentially. We have some unparalleled opportunities developing as we speak, including economic development and job creation in the Commonwealth of Virginia and the nation as a whole. Some national estimates place the economic impacts—by 2025—with around 100,000 jobs created, so we'd obviously like to have quite a few of those in the Commonwealth of Virginia.

David Hinton, Senior Advisor for Unmanned Systems, Office of the Secretary of Technology, Commonwealth of Virginia

> *After the first meeting with Stanford, our contact in DC took the initiative to follow up and plan a visit to JMU. They're working on a lot of things that inspire our students (and me)—advanced systems to save lives and prevent injuries. In my 26 years in the army, I have never seen anything like this happen. Amazing opportunity!*
>
> Nick Swayne, 4-VA Executive Director

H4D

Hacking 4 Defense with Stanford University

Jack O'Neill
Undergraduate in Intelligence Analysis, National Security Concentration

In March, 2016, intelligence analysis major Jack O'Neill found himself captivated by a Hacking 4 Defense (H4D) talk by serial-entrepreneur Steve Blank at the University Innovation Fellow's (UIF) Annual Meetup at Stanford University. H4D is a nationwide project launched by Stanford and "designed to provide students the opportunity to learn how to work with the Department of Defense (DoD) and Intelligence Community (IC) to better address the nation's emerging threats and security challenges".[1] After the talk, Jack spoke with Mr. Blank and followed up with him to attend the H4D® Educators & Sponsors Course with 4-VA Executive Director Nick Swayne and Dr. John Guo to sponsor and develop a cross-disciplinary H4D class at JMU.

Six months later, the JMU team traveled to Stanford University for the in-depth training on the H4D program with its focus on project management, innovation, and solving real world issues. While JMU plans to launch the pilot class in the spring of 2017, it has already attracted a high level of interest among students and many applicants are on a waiting list. Nick Swayne will lead the class with Jack O'Neill's assistance. Dr. Guo (CIS), Dr. Seán McCarthy (WRTC), Dr. Nicole Radziwill (ISAT), Dr. Keith Holland (Engineering), Dr. Patrice Ludwig (Biology), and Dr. Erica Lewis (Nursing) will also be teaching the class, which will be held in 4-VA's STEMx-Lab at Lakeview Hall.

[1] hacking4defense.stanford.edu/details.html

> *It is utterly important for our students to grow skills in various domains and then integrate them in a collaborative way. This is why Hacking 4 Defense is a great fit with JMU's culture in terms of diversity, service, and innovation.*
>
> Dr. John Guo

In 2017, JMU will become the first undergraduate-focused university in the country to offer an H4D class.

*Class description from **hacking4defense.stanford.edu**:*

Learn how to innovate at speed while helping make the world a safer place

In a crisis, national security initiatives move at the speed of a startup, yet in peacetime they default to decades-long acquisition and procurement cycles. Startups operate with continual speed and urgency 24/7. Over the last few years they've learned how to be not only fast, but extremely efficient with resources and time using lean startup methodologies.

In this class student teams will take actual national security problems and learn how to apply lean startup principles, ("business model canvas," "customer development," and "agile engineering") to discover and validate customer needs and to continually build iterative prototypes to test whether they understood the problem and solution. Teams take a hands-on approach requiring close engagement with actual military, the United States Department of Defense and other government agency end-users.

"

After listening to Steve Blank speak about the first iteration of H4D, I knew I had to find a way to bring this course to JMU. I wasn't sure how, or when, but I was determined to bring it to JMU before I graduated. Steve wasn't able to stay back and network with people after his talk so I took it upon myself to find him and figure out a way we could work together. I ran through Stanford's campus chasing him down until we finally caught up and discussed the potential for a JMU-Stanford collaboration. After a long exchange of emails with Steve Blank and Pete Newell of National Defense University, an H4D conference at Stanford, and a search for professors eager to take on this challenge, H4D will be launching at JMU in the spring of 2017.

The reason I was so enamored with H4D is that it paired my two passions—national security and entrepreneurship. It's rare to come across the two so tightly knit so I knew I had to jump on the opportunity. I was even more drawn to it because it brought real world experience to higher education, which doesn't always allow for these types of opportunities. Helping the government solve difficult issues gives students incredibly rare opportunities to provide an important service to their country, to understand certain government operations firsthand, and to experience real, challenging, and meaningful work that future clients will actually utilize.

Jack O'Neill, JMU undergraduate

Collaborators

Steve Blank
Adjunct Professor at Stanford University, Silicon Valley serial-entrepreneur

Peter Newell
Managing Partner at BMNT, Visiting Senior Research Fellow at National Defense University

Hacking 4 Defense

Stanford University

Benefits to the Commonwealth

- √ First undergraduate-focused university (JMU) in the nation to offer Hacking 4 Defense class
- √ Demonstrates Virginia's leadership in innovation
- √ Demonstrates Virginia's impact on education in cybersecurity
- √ Developing new models for teaching and learning
- √ Improves employment opportunities in Virginia

Remodeling Math Education

Teaching math through hands-on applications

"Why do I need to learn that?"
It's the perennial question posed to virtually every high school math teacher since schools were first introduced. The typical reply is "You'll need that when you get to college." But that's just not a good enough answer—everyone needs math but not everyone goes to college.

With that in mind, 4-VA at JMU started asking a different question—"How can we teach high school students to apply math in engaging, meaningful and memorable ways so the 'why' question loses all relevance?"

Through its new course, 4-VA at JMU has already started discovering answers to that question by using maker technology to generate understanding through hands-on math methods in the JMU X-Labs. First offered in the fall of 2016, the new course combines an expert in teaching math—known as math methods in the College of Education—with a leading math theorist in the College of Science and Mathematics.

Geoff Estes teaches AP and dual enrollment math courses at Harrisonburg High School where he has been the robotics coach for five years. He's also been teaching math methods in the College of Education for several years.

Dr. Laura Taalman literally wrote the book on calculus—her book is the math text at JMU. Laura founded the JMU 3-Space, a 3D printing lab designed to help students understand math concepts and how they relate to physical objects.

By combining the expertise of these two math connoisseurs, the plan is to deepen understanding of math concepts so future teachers can develop a mastery of methods. As a result, it will help a wider range of learners and give these future teachers a way to demonstrate the application of everything they're teaching. The experience has already transformed the way the professors instruct student teachers, as they play off each other's expertise and experience.

Even more important, it has been transformative for the students. They are learning how to operate in a flipped classroom and understand how complex calculus integrals can be transformed into physical objects on the 3D printer and laser cutter. The kinesthetic learning has deepened their understanding of the underlying principles and given them the confidence to reach their future students.

During a visit in October, 2016 by members of the Staunton City Schools central office, the math administrator gave out his business card and offered the student teachers immediate employment if they wanted to teach in Staunton. Mr. Estes added, "Tell all of the Human Resource people you interview with that you were a part of this course. You'll be sought after by every school division."

Dr. Taalman and Mr. Estes are completing the course in December, 2016 and plan to reflect on the experience and publish what they've learned in an upcoming math education journal.

IPE Nursing Lecture

Telepresence technology provides increased access

In February, 2016, 4-VA provided telepresence technology for the **Interprofessional Education (IPE) Lecture for Nursing: The Role of Interprofessional Team Training in Providing Effective Collaborative Care**. The lecture was given by Dr. Tina Brashers, MD, FACP, FNAP, Professor of Nursing and Attending Physician in Internal Medicine at UVA.

Although the lecture was hosted at JMU, shared telepresence videoconference sites at the other 4-VA universities also provided access to attendees at GMU, ODU, UVA and VT. Roughly 110 people attended the lecture across seven different sites including the 4-VA telepresence rooms, by phone and online.

As a result of networking from this event, in the spring of 2016, 4-VA awarded a mini-grant to faculty from JMU, ODU, UVA, and VT to develop a shared IPE activity.

Collaborators

- GMU
- ODU
- UVA
- VT

Benefits to the Commonwealth

- √ Engaged subject matter & health experts across Virginia
- √ Increased lecture access to educators
- √ Demonstrated added value of a broad telepresence network

> *I am extremely proud of our students who are participating in UIF, and who are not confined by disciplinary boundaries or traditional ways of thinking and approaching problems. Through their efforts, I believe that these students will light a spark of innovation that can spread across the entire campus.*
> Jonathan Alger, President of James Madison University

University Innovation Fellows

Student leaders of change in higher education

The University Innovation Fellows (UIF)—sponsored by the National Science Foundation, Stanford University and VentureWell—is a nationwide program that requires students to undergo a week of training at Stanford and conduct programming at their own universities.

JMU's chapter of UIF began in the fall of 2014 and has continued to provide a new cohort of students each year with opportunities to innovate on campus and across the nation. Through hosting numerous events, they've had great success in building a culture of innovation, entrepreneurship, and creativity at JMU.

In the fall of 2015, UIF headquarters at Stanford selected JMU to host the regional meetup, a weekend event for UIF students from across the country. Held at the Lakeview Hall JMU X-Lab on November 14th and 15th, 2015, 40 students from 13 different schools attended the "Own It. Do It." event. During the meetup students participated in human-centered design and design thinking workshops while collaborating with UIF peers from other schools in entrepreneurship and innovation.

Cultivating innovation is paramount to the fellows at JMU and in the spring of 2015, they established an annual 24-hour hackathon called Bluestone Hacks. Each year this signature event generates a host of opportunities for innovation where students devise tangible solutions to real world problems. In 2016, students of all majors were welcomed again to compete around this year's theme, "Life Hacks".

After a day of creating, rapid prototyping, and collaboration, an experienced panel from JMU and the community judged the student projects. Award-winning inventions included: 1) An otoscope phone attachment in which the camera turns into a magnifying lens and the flash becomes a flashlight to record images of the ear that can be sent to a medical doctor for screening, 2) An application of virtual reality to help treat phobias through virtual immersion, and 3) An augmented reality application. These winning projects were designed and created by students across disciplines including finance, accounting, computer science, and engineering.

In addition to Bluestone Hacks, UIF students host free pop-up classes—unique non-credit classes offered in a variety of topics such as laser cutting, glassblowing (lampworking), 3D printing, and LED programming. JMU students learn not just how to innovate, but how to build creative confidence in themselves, becoming fearless in their approach to learning.

The University Innovation Fellows program empowers students to become leaders of change in higher education. Fellows are creating a national movement to ensure that all students gain the necessary attitudes, skills and knowledge to compete in the economy of the future.
universityinnovationfellows.org

Participation in the UIF program has attracted prominent speakers to JMU events, provided students with opportunities to visit industry leaders like Google, Microsoft, and Lucasfilm, and resulted in an invitation for students and faculty to present with Stanford University at South by Southwest (SXSWedu), a conference on educational innovation.

Every year new UIF students look forward to training in California where they get to network with other UIF students from across the country and bring inspirational new ideas back to JMU's campus. Each successive group continues to thrive and serve as leaders at JMU, leaving a legacy of fellows that will improve JMU's entrepreneurship and innovation for years to come.

Benefits to the Commonwealth

- √ Developing innovative, industrious student leaders
- √ Contributing to innovative solutions
- √ Leveraging resources through nationwide collaborations
- √ Expanding career opportunities for students after graduation

> *I got a lot out of UIF so far and it is no doubt thanks to all my "teammates", but most importantly to Nick and Keith, who are like mentors or coaches. I have become more of an engaged learner in and outside of the classroom. I also developed great relationships with people in and outside of JMU that I couldn't have imagined. It is crazy to think accepting an invitation to apply for UIF was one of the most pivotal moments of my JMU experience.*
>
> Nahom Fissaha, University Innovation Fellow

Virtual Reality on the Horizon

Skylar Wolen
Undergraduate earning Bachelor of Business Administration (BBA) in Computer Information Systems (CIS) and Finance

In late 2015, when 4-VA at JMU relocated to Lakeview Hall, its new maker space—one of the JMU X-Labs—was already filling up with equipment like telepresence software, 3D printers, a laser cutter, a CNC milling machine, a vinyl cutter and, most unfamiliar, an Oculus head-mounted display (HMD).

An HMD is a device that covers the eyes and displays a 3D simulated environment in which people can interact in an almost realistic way, making it the primary tool used in virtual reality (VR) technology. Early on, few people knew about the HMD and even fewer knew how to use it, so it didn't get as much attention as the other equipment. That is, until Skylar Wolen came along.

Skylar is a senior earning his BBA in CIS and Finance at JMU where he is also a member of the Society of Entrepreneurs (SOE). The SOE meets weekly at the STEMx-Lab at Lakeview Hall where Skylar first heard about the annual student-run hackathon, Bluestone Hacks. In the spring of 2016, while preparing their ideas at the hackathon, his team came across a VR headset which inspired them to create a VR simulation during the 24-hour event.

They developed a virtual reality exposure therapy simulation and called it ExposVR. The simulation helps people conquer phobias through virtual reality at their own pace, in a safe place, and at a low financial cost. The simulation won Skylar's team the Most Impactful Award and the Crowd Favorite Award, providing them with $750 to continue developing their idea. Currently, they're applying for a grant through VentureWell and seeking mentorship.

Designing a simulation may have been Skylar's first real experience with VR, but it wouldn't be his last. Envisioning the potential for students to discover, learn and innovate in new ways, he advocated for additional VR equipment in the lab and offered to conceptualize, develop and organize a curriculum for a new class at JMU that features VR.

To learn more, he requested 4-VA sponsorship to attend a summit in California called Shifting the Paradigm. From October 9th-14th, 2016, professionals in finance, law, public health, social justice, and social psychology collaborated with industry leaders from companies like Google, Verizon and Oculus to discuss how VR and similar technologies can change the world.

The summit introduced Skylar to the upper echelon of the VR industry where people are passionate about finding solutions to world problems that serve humanity. One idea was to use VR to experience living in a refugee camp, which would support the United Nations' goal of bringing relatable awareness to the issue.

VR has also been used to treat health issues, such as acrophobia, where people can experience heights virtually while knowing they are safe on the ground. At the summit, Skylar met Cris Miranda from San Francisco who works for Vivid Vision, a company that offers a virtual reality solution for amblyopia and strabismus, two eye disorders. James Blaha, CEO and founder of Vivid Vision cured his own lazy eye condition with VR and founded the company using that method.

With these newfound connections, Skylar plans to invite Cris Miranda and others to share their expertise with the pilot VR class. Interest in VR is growing at JMU and Skylar estimates that 25 people experiment with the VR equipment at the STEMx-Lab every week. 4-VA at JMU will be participating with GMU in this pilot shared course in the spring of 2017.

Benefits to the Commonwealth

- √ Developing curriculum for cutting-edge technology
- √ Contributing to innovative solutions
- √ Leveraging resources through nationwide collaborations
- √ Expanding career opportunities for students after graduation

> *I learned about 4-VA at Bluestone Hacks when my team won the best application. I saw the potential to develop a new class and wanted to be more involved with what 4-VA was doing. Working on this project, I think I can actually make a difference here at JMU.*
> Skylar Wolen, JMU undergraduate

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4-VA Advancing The Commonwealth

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