

## News from the Hampden-Sydney Sciences 2018-19

### Biology—by Michael J. Wolyniak

This past year in the Biology Department was highlighted by several exciting research experiences between our faculty and students. This past May, **Dr. Kristin Fischer** and **Tyler McGaughey'18** attended the Virginia Academy of Sciences (VAS) conference at Longwood University. Tyler won best poster presentation for the biomedical and general engineering section. Over the summer, Dr. Fischer investigated several additives to cell culture media to induce skeletal muscle maturation with **Blake Martin'19**, **David Fluharty'20**, and **Ryan Tomlin'20**. Blake is continuing his investigation of whey protein isolate on skeletal muscle maturation for his honor's project this year. Dr. Fischer also collaborated with Dr. Paul Mueller and Dr. Nick Deifel on synthesizing poly(ethylene glycol) diacrylate (PEGDA) with **Hunter Lee'19**. **Shawn Gillikin'20** combined his love of fine arts and biology to create figures to represent specific cell culture techniques for Dr. Fischer's tissue engineering course. After learning about bioreactors in Dr. Fischer's tissue engineering course, **Andrew Howell'20** wanted to bring the ability to provide external cues such as stretch to *in vitro* cell culture. Andrew and Dr. Fischer went through several design iterations before finally settling on a two chamber, eight well system. A new 3D printer was purchased and the bioreactor was printed using poly(lactic acid) (PLA) as a proof of concept.

Dr. Fischer also designed and implemented a new experimental learning summer research course. Students worked closely with a professor to further develop both the scholarly project and applied, employable skills that relate to



David Fluharty '20, Blake Martin '19, and Dr. Fischer working on cell culture technique

that project. Examples of projects included creating visual representations of laboratory procedures, archiving H-SC historical data, synthesizing a polymer, fabricating a 3D printed bioreactor, and investigating skeletal muscle tissue replacements. In the first week, students wrote a one-page project summary and developed 3-5 project goals with their professor. Over the course of eight weeks, students wrote critical reflections on their successes, failures, problem solving capability, ability to receive feedback, and progress on both the project and themselves. An oral presentation was given by the student during the summer and a final poster or oral presentation to the college community was completed at the beginning of the fall semester.

In 2018-2019, **Dr. Kristian M. Hargadon '01** continued his work with students to gain insights into factors that promote melanoma progression and immune suppression, with a particular focus on lymph node invasion by melanoma cells and the role of the FOXC2 transcription factor in this process. Part of this work was supported by a Virginia Foundation for Independent Colleges Mednick Memorial Fellowship that Dr. Hargadon received in 2018, and these funds have supported the work of three



A product from the new 3D printer

undergraduate students (**Corey Williams '19**, **Coleman Johnson '19**, and **David Bushhouse '19**) in various aspects of these projects. Their collective efforts led to the successful generation of a CRISPR-Cas9 gene-edited FOXC2 knockout melanoma cell line that will be a powerful tool driving future studies to understand the role of FOXC2 in tumor progression.

In addition to this work, Dr. Hargadon was invited by the editors of the journal *International Immunopharmacology* to contribute a review article on cancer immunotherapy, and he used this opportunity to

involve Corey and Cole (two pre-medical students) in the analysis of clinical trial outcomes for cancer patients receiving checkpoint blockade immunotherapy. This article, entitled "Immune Checkpoint Blockade Therapy for Cancer: An Overview of FDA-approved Immune Checkpoint Inhibitors," was published in the summer of 2018 and will also be featured in a special issue of the journal focused on "Cellular Therapeutics in the Context of Immunopharmacology." Corey, Cole, and David will also be presenting their work at the 2019 Annual Meeting of the American Association for Cancer Research in Atlanta, Georgia, an international conference that will attract ~22,000 oncologists and cancer researchers from around the world.

Dr. Hargadon continues to bring his research into the classroom as well, and he presented a talk entitled "A Model System for the Study of Gene Expression in the Undergraduate Laboratory" at the 2018 Annual Meeting of the Virginia Academy of Science. The work presented in this talk centers on Dr. Hargadon's introduction of cancer research into the College's Genetics and Cell Biology laboratory course and led to his receipt of a "Programs That Work" Award from the Virginia Mathematics and Science Coalition (an honor also received by **Dr. Mike Wolyniak** for his efforts to introduce a research-based laboratory program to investigate the Hops microbiome in the Biology Department's Principles of Biology Laboratory course).



Corey Williams '19 hard at work at the lab bench

Dr. Wolyniak continues his work with the Howard Hughes Medical Institute (HHMI) Science Education Alliance-Phage Hunters Advancing Genomics and Evolutionary Science (SEA-PHAGES) program, with **Cory Allgood '19, Woodson Bagnol '20, Bobby Jackson '18, Lucio Maestrello '19, Tyler McGaughey '18, Wood Morgan '18, Dakota Reinartz '18, and Hunter Weiland '19** all earning authorships on genomic sequence annotation for two bacteriophage virus genomes. Allgood and Weiland joined **Hunter Lee '19, Jason Pough '19 and Eli Strong '20** in presenting their research at the Annual Meeting of American Society for Biochemistry and Molecular Biology (ASBMB) in Orlando, Florida while **Blake Martin '19, Brendan Schwartz '19, Brian Tarnai '20, and Zach Wiggin '19** presented their research at the National Conference on Undergraduate Research (NCUR) at Kennesaw State University in Kennesaw, Georgia. Dr. Wolyniak was reelected to another three year term as a Councilor in the Biology Division of the Council on Undergraduate Research (CUR) and is the Vice-President of the Virginia Academy of Science. He is also continuing his collaborative work with Dr. Anil Challa at the University of Alabama-Birmingham to develop ways to make CRISPR-Cas9 technology to undergraduate audiences. With support from the National Science Foundation, they held a workshop at The Ohio State University in conjunction with the Annual Meeting of the Association of Biology Laboratory Educators (ABLE) in June 2018 and recently published a report along with the technical aspects of doing CRISPR-Cas9 experiments in *The Journal of Microbiology and Biology Education* with student co-author **Lucian Bloodworth '18**.



Harrison Whaley '21 works on whale baleen research in Dr. Alex Werth's lab.

Students of **Dr. Rachel Goodman** are also celebrating a new research publication, this one in *The Journal of Wildlife Diseases*. **Joe Tyler '17** and Dakota Reinartz '18 worked with Dr. Goodman on her work to survey Hawaiian frog populations for ranavirus and fungal disease.

Several Biology students pursued Distinction or Honors-level research as part of their senior year experience. David Bushhouse '19, Cole Johnson '19, Blake Martin '19, Brendan Schwartz '19, **Eduardo Valentin-Morales '19**, and Zach Wiggin '19 all pursued Honors Capstone projects while Cory Allgood '19, **Lucas Blankenship '19**, Jason Pough '19, Hunter Weiland '19, and Corey Williams '19 pursued Department Distinction projects.

### **Chemistry**—by *Charles A. Wolfe '20*

The 2018-2019 year has been productive for the H-SC chemistry department. **Dr. Nick Deifel**, Department Chair, continues to explore the catalytic properties of asymmetric Schiff-base salen ligands. He also welcomed a new son into his family, Graham Peter, on February 1, 2019, joining Assistant Professor of Mathematics Rebecca



Chemistry Seniors with Drs. Sipe and Anderson at Pittcon 2019 in Philadelphia.

Jayne and son Maxwell Henry. **Dr. Bill Anderson** worked with **Reed Mingione '19** to explore the properties of acoustic levitation and its applications in chemistry. Together they built an acoustic levitator capable of suspending small particles in air. **Dr. Herb Sipe** worked with **Eric Bowen '19** and **Charles Wolfe '20** using fast flow Electron Spin Resonance spectroscopy to investigate reactive oxygen species of acetaminophen-like structures and curcumin respectively. **Dr. Paul Mueller** worked with **Neil Smith '20**, exploring the synthesis of novel Schiff-base ligand complexes. Lucas Blankenship '19, meanwhile, worked to tackle the challenge of making uniformly sized nanoparticles. **Dr. Kevin Dunn** worked with **Zach Smiley '19** and Coleman Johnson '19 in a joint project investigating a claim made by Unilever "Dove soap does not leave soap scum on skin." Smiley and Johnson formulated a standardized collection procedure and calibrated a set of GC/MS response factors in order to quantify GC/MS results.

The annual Pittcon trip was held in Philadelphia, PA this year. Dr. Anderson and Dr. Sipe accompanied the senior chemistry

majors as they learned about and networked with various major chemical companies such as Shimadzu.

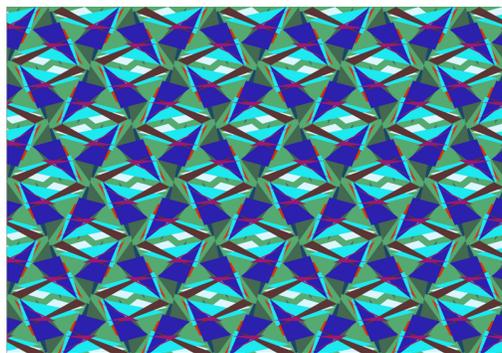
Some minor construction has taken place in the H-SC Chemistry department this year. We have received new ventilation equipment in the solvent cabinet, and a new fume hood was installed in the stockroom

### **Mathematics and Computer Science**—by Sarah Loeb

This year, **Griffin Salyer '19** has been doing research into the effects of residence life policies on drug and alcohol usage on college campuses for his senior honors capstone project. In his project, he has used R to explore and analyze publicly available data on alcohol and drug abuse, and he has been interviewing residence life staff at several regional colleges to connect the data with actual residence life policies. **Dr. Brian Lins** has served as the faculty advisor for this project.

**Leonardo Anselmo '19** has been working with **Dr. Rebecca Jayne** and **Dr. Paul Hemler** on his senior capstone project "The Mathematical Art of Tessellations." He has studied the seventeen wallpaper groups which are used to classify certain tessellations. He has also written code in python to create images for each, developing a way to design each tessellated tile that relies on randomness. Through his program, Leonardo has created some beautiful art.

Over the summer, Dr. Lins wrote a paper with co-author Dr. Ilya Spitkovsky from NYU - Abu Dhabi. The paper, "Inverse continuity of the numerical range map for Hilbert space operators" has been accepted to appear in the journal *Operators and Matrices*.



Mathematics as Art: Tessellation patterns by Leonardo Anselmo '19

**Dr. Sarah Loeb** joins the Department of Mathematics and Computer Science as an assistant professor. She earned her B.S. from Harvey Mudd College and her doctorate at the University of Illinois, Urbana-Champaign. Dr. Loeb's research is in graph theory. In this setting, graphs are collections of objects, called vertices, with edges between pairs of them. These are often visualized as dots with lines connecting them. This topic is included in her Math 111 and will be the subject of her special topics course in Fall '19. A coloring of a graph is an assignment of labels, referred to as colors, to the vertices so that vertices that share an edge receive distinct labels. A graph is planar if it can be drawn as points and lines so that the lines do not cross. Dr. Loeb's recent research involves finding bounds on a variation on coloring for some special classes planar graphs. Her work with Dr. Gexin Yu and Dr. Rolek Martin of the College of William and Mary and Runrun Liu and Yuxue Yin of Central China Normal University has resulted two papers. The first, "DP-3-coloring of some planar graphs," appeared in *Discrete Mathematics* in the fall, while the second, "DP-3-coloring of



New Assistant Professor of Mathematics  
Dr. Sarah Loeb

planar graphs without 4-,9-cycles and two cycles from {6,7,8}" has been recently accepted by *Graphs and Combinatorics*. Dr. Loeb also presented this research at the Joint Mathematics Meetings in Baltimore in January.

**Physics and Astronomy/Engineering Physics—by Alexander W. Auner**

The H-SC physics department has been active in research over the past year, the following is an update of what our colleagues and students have been working on.

This May, **Dr. Stanley A Cheyne** will be presenting a paper titled, Sound speed measurements in Kentucky bourbon whiskey, at the 177th meeting of the Acoustical Society of America in Louisville, KY. **Professors Trey Thurman** and **Mike McDermott** are coauthors. Sound speed measurements in ethanol/water mixtures will be compared to a variety of bourbons. Sound speed not only depends on the percentage of ethanol but also the temperature. By measuring the temperature and sound speed of a mixture, the alcohol content can be determined. It is our hope that this will result in a tool that can instantly determine alcohol content using acoustics. Professor Cheyne is also studying acoustic cavitation and sonoluminescence.

Dr. Thurman is working with **Lane Winesett '19** on measuring the electrical resistivity of concrete. This is a non-destructive technique to measure the quality of the concrete. He has completed the direct two probe technique to determine the electrical resistivity of a concrete sample. Lane is currently working on a measurement of the electrical resistivity using electrochemical impedance spectroscopy.

**Dr. Steven D. Bloom III** currently enjoys working on the automation of our observatory using ACP software. He is using the observatory for monitoring of everything from quasars to exoplanets. He is also writing articles on pedagogy of upper level physics courses such as Mechanics. Dr. Bloom continues his scholarship regarding the origin of high energy radiation from quasars. **Dr. Jonathan W Keohane** published his textbook titled "An Introduction to Classical Electrodynamics."



New Visiting Assistant Professor of Physics  
Dr. Alexander Auner

**Dr. Alexander W Auner** joined the physics department filling in for Dr. McDermott. Dr. Auner earned his B.S. in Physics at the University of Michigan-Dearborn. Following this, he earned his doctorate at Vanderbilt University. Dr. Auner is offering a course in modern physics in the fall and is thrilled to offer a course in biophysics in Spr 20'. Dr. Auner's research in biophysics focuses on spectroscopic methods of chemical detection and intracellular forces in developing tissue. The first is focused on chemical detection in soft polymer microfluidic devices used by the EPA to

assess organ toxicity. His second line of research investigates developmental defects that result in mechanical changes to the tension between cells in fruit fly embryos.

In the past year Dr. Auner published research in *Lab on a Chip* modelling toxic chemical diffusion through a porous polymer and establishing a link between chemical hydrophobicity, electron donor number and diffusion rate.

### **Psychology**—by Ivo I. Gyurovski '09

It is the time of year again to highlight some of the exciting developments in the Department of Psychology. Our faculty remain focused on supporting student research endeavors through independent projects and across courses.

The department recently restructured the Psychology Major. The goal was to emphasize research experience and quantitative expertise. Some of the changes include a new way to teach quantitative and research methods in a combined course. In addition, the department has changed the sequence of senior capstone courses, and it has introduced a number of laboratory research opportunities. We are thrilled to implement the new major for the 2020/2021 academic year.

This past year **Dr. Dan Weese** presented research at the annual meeting of the *Society for Neuroscience* in San Diego, California. A significant proportion of his work has focused on understanding the Thalamic Reticular Nucleus. The Thalamic Reticular Nucleus (TRN) monitors bidirectional transmissions between the dorsal thalamus and cortex and filters the output of the thalamus by way of GABAergic synapses. In the case of sensory systems, the TRN is given a role in selecting thalamocortical signals related to specific stimuli, the process of selective attention. The rostral TRN exerts a similar inhibitory modulation of thalamocortical transmissions originating in motor thalamic nuclei. This suggests an analogous role for the rostral TRN in the selection of situationally appropriate responses. For this study, unilateral lesions in the rostral TRN are hypothesized to remove inhibitory control of responses made contralateral to the lesion leading to a decreased ability to make cued responses ipsilateral to the lesion. Eight Long-Evans male rats (250-350g) were trained to make an observing response in the center of 3 holes. Then a light presented either directly above or below the rat's head cued nosepokes into the left or right hole. Correct responses were reinforced by water; incorrect responses were punished by a 3 sec timeout. After reaching criterion performance, unilateral injections of ibotenic acid produced lesions in the rostral TRN, some of which extended into portions of the ventral anterior nucleus of the thalamus and/or the internal capsule. The proportion of correct responses directed ipsilateral to the lesion declined during a 9-day period after testing resumed. There was a concomitant increase in the number of incorrect responses made in the hole contralateral to the lesion. The proportion of trials when a response was not made following either cue and the number of intertrial nose pokes into either side hole did not change. Reaction times to the cues and times to execute response to either side also were unchanged. Thus, the impairments in making responses ipsilateral to the lesion occur only when they are cued and are not due to the inability to respond to the cue. The data suggest that while the rat is making an observing response, it is primed to respond in either direction. When the cue for a response ipsilateral to the lesion follows, however, the diminished inhibition of the motor nuclei on that side weakens the ability to deselect the incorrect contralateral response. We propose that the sensory and motor sectors of the TRN are functionally similar.

During the past year **Dr. Ivo Gyurovski** and **Dr. Dan Mossler** began a program of research dedicated to understanding the fake news phenomenon that has proliferated on social media, with a focus on trying to determine the factors that make one more susceptible to misinformation. Even though fake news is not a recent invention, its recent rise and proliferation has become a global cause for concern. Fake news represents fabricated information designed to appear as if it is true media content, but importantly lacks editorial oversight and it is not subject to accuracy and credibility standards. It is crucial to approach fake news as a scientific phenomenon to be investigated, since it represents a credible threat to democracies worldwide. However, surprisingly little scientific information exists on the subject. Some of our studies have focused on identifying cognitive predictors of vulnerability to Fake News. The data so far reveal that cognitive reflection and critical thinking are key determinants of news'

veracity judgments. In another study we examined how social influence can shape people's ability to correctly discriminate between fake and real news. Fake news is often disseminated via social media platforms, such as Facebook. Individuals and entities that spread fake news aim to engage their target audience by increasing the number of likes, comments, and shares. Previous research demonstrates that relative to the most viral real news, the most viral fake news are liked more, commented on more, and shared more. Fake news also tends to spread significantly faster than real news. Therefore in one of our studies we manipulated the social engagement with which news are presented on social media. The results reveal that under conditions of strong social support, indicated by a high number of likes and shares, participants' ability to correctly identify fake news as such was significantly lowered. These findings are important as they illustrate people's ability to judge veracity is drastically compromised when others have expressed a liking for a given piece of information, therefore making individuals more susceptible to the influence of fake news. We were excited to present research findings at the annual meetings of the *Society for Judgment and Decision Making* in New Orleans, Louisiana and the *Society for Personality and Social Psychology* in Portland, Oregon. **Jimmy Butler '19, Jacob Fontana '19, Jonathan Huml '19, and Lawson Omer '19** traveled with Dr. Mossler to the annual meeting of the *Eastern Psychological Association* in New York City, New York, where they presented research on the predictors of fake news recognition accuracy.