News from the Hampden-Sydney Sciences 2020-21

Work continues on new Pauley Science Center; Spring 2022 opening planned

Out With the Old, In With the New: The cupola of the former Bagby Hall stands next to the construction on the new Pauley Science Center which is being built on Bagby's old footprint.

The pictures on the left show the substantial progress made on the new Pauley Science Center as of April 2021. The new Center, standing on the site of the former Bagby Hall, is expected to open in the spring of 2022. The building will house several new features, including a full vivarium for care of animals involved in science projects, and the Hinton-Baxter-Overcash Immersive Biology Laboratory, a well-equipped, state-of-the-art research space made possible by an anonymous $1 million donation to the College.

Biology—by Kristian M. Hargadon '01

The 2020-2021 academic year, marked by the COVID-19 pandemic, was certainly a different year at colleges and universities across the country, but it was nevertheless a busy and productive year for faculty of the Biology Department at H-SC. Serving in her first year as Chair of the Department, **Dr. Rachel Goodman** led the department through many COVID-19-related challenges, including two tenure-track searches that were conducted for the first time using a virtual format. Though the pandemic precluded Dr. Goodman's planned field projects with students this past year, she mentored **Jacob Whitney '21** in the summer research session, during which Jacob conducted a literature review of COVID-19, specifically focusing on the origins of the virus in wildlife populations, the mechanisms of infection, the biological impact on humans, and treatments and preventative measures at the personal and population level.

Dr. Alex Werth, who was on sabbatical leave for the entire 2020-21 academic year, was also significantly impacted by COVID-19, which led to the cancellation of many research travels that had been planned prior to the pandemic. Despite these setbacks, during his year away from teaching Dr. Werth stayed quite busy working on multiple research projects involving several whale species. He also supervised the senior research project of **Charlie Lemon '21** , along with Physics Professor **Dr. Stan Cheyne**, on how bubbles produced by humpback whales work to corral schooling fish.

Dr. Kristian Hargadon '01 continued to work on various projects related to his cancer research program over the last year. Building on his recent work related to the tumor-promoting activities of the FOXC2 transcription factor in melanoma, Dr. Hargadon published an article highlighting the regulatory role of FOXC2 in multiple oncogenic pathways in the journal *Frontiers in Oncology*. This article included **Corey Williams '19** as a co-author. In addition to his focus on melanoma, Dr. Hargadon also recently extended his analysis of FOXC2 to several other cancer types and published an article, featuring **Eli Strong '20** as co-author, in *Cancer Genetics* – this article specifically highlights the prognostic significance of FOXC2 as a predictor of patient survival and response to chemotherapy across a diverse array of solid malignancies. In addition to his work on FOXC2, Dr. Hargadon also mentored **Jeb Wall '22** and **Taylor McGee '23** on bioinformatics-based projects during the College's Summer Research Program. Jeb's work

involved assessing putative oxidative stress response biomarkers for cancer, while Taylor investigated the correlation between IFNγ pathway gene expression in tumor biopsies and patient survival. This latter work led to Taylor's co-authorship with Dr. Hargadon on an article published in *Expert Review of Clinical Immunology*. Following these forays into the world of cancer bioinformatics, Dr. Hargadon also developed a novel course-based research experience (CURE) that he introduced into his Biology 201 – Genetics and Cell Biology course in the Fall 2020 semester. Utilizing tumor biopsy data from The Cancer Genome Atlas and online bioinformatics analysis tools, Dr. Hargadon's students investigated the most common genetics aberrations (mutations, copy number alterations, and differentially expressed genes) in cancer in order to gain insights into the genetic drivers of tumor progression. This course module and its impact on student learning led to an article that Dr. Hargadon recently published in the *Journal of Cancer Education*. In addition to these projects, Dr. Hargadon also published an invited review article on immunologic and metabolic checkpoints in the tumor microenvironment in *Clinical and Translational Medicine*, and he continued his role as Editor of a new volume (Melanoma – Methods and Protocols) for the prestigious *Methods in Molecular Biology* book series. This two-year project brings together cutting-edge basic science, translational, and clinical protocols from leading researchers and oncologists around the world, and the 45 chapter volume will be released by Springer Nature in the spring of 2021. Included in the volume are two protocol chapters authored by Dr. Hargadon, one on CRISPR-Cas9 gene editing of melanoma cells that features **Corey Williams '19, Coleman Johnson '19,** and **David Bushhouse '19** as co-authors, and another on tumor cell-lymphatic endothelial cell adhesion assays that also features Coleman Johnson as a co-author. Outside of his teaching and research activities, Dr. Hargadon also served as reviewer for the Congressionally Directed Medical Research Program's (CDMRP) Melanoma Research Program, and he delivered various virtual information sessions on COVID-19 to audiences across the country.

Dr. Michael Wolyniak had a busy year serving as the President of the Virginia Academy of Science. The big challenge of the year involved managing the public events of the Academy during a pandemic year in which all events were held on a virtual basis. Several H-SC students became involved in a new Academy initiative designed to mentor middle and high school classrooms around the Commonwealth in implementing authentic research projects in classes disrupted by the pandemic. The results of this pilot have been encouraging and suggest that the program will only increase in size as things get back to normal. Dr. Wolyniak also advised Honors research projects for **Doug Hogan '21**, **Will Sparks '21**, and **Harrison Whaley '21** and summer research projects for **Luke Carter '22**, **Caleb Manu '23**, and **Jacob Siler '23**. Several of these students had the opportunity to present their work at regional and national conferences, with Carter presenting his summer work at the Sigma Xi National Student Research Conference in the Fall of 2020, Siler presenting his work at the Virginia Academy of Science Fall Undergraduate Research Meeting in the Fall of 2020, and Manu presenting at the National Conference on Undergraduate Research and the HHMI SEA-PHAGES Symposium in the Spring of 2021. Dr. Wolyniak also became a Fellow of the PULSE (Partnership for Undergraduate Life Science Education) Network, a group dedicated to departmental level reform to biology curricula, and he served on a pair of National Science Foundation grant review panels, published multiple articles in *The Journal of Microbiology and Biology Education*, and took part in an external review of the Biology Department at Fort Lewis College in Durango, Colorado.

While most summer research in 2020 was conducted virtually, a few students like Luke Carter '22 (left) and Caleb Manu '23 (right) were able to get in some in-person lab time in Gilmer.

Dr. Kristin Fischer recently had an article entitled "Using Critical Analysis of Scientific Literature to Maintain an Interactive Learning Environment for In-Person and Online Course Modalities" was accepted for publication in *The Journal of Microbiology & Biology Education*. This article focused on the methods used to transition her Tissue Engineering class during the COVID-19 pandemic and was accepted for the special edition of Teaching in a Time of Crisis. Dr. Fischer's review article entitled "Hydrogels for Skeletal Muscle Regeneration" published in 2020 in

Regenerative Engineering and Translational Medicine for the special Robert Langer 70th Birthday edition was the 2nd most downloaded article for the journal. This review included work that Dr. Fischer conducted with **Tyler McGaughey'18** and **Dr. Michael Wolyniak**. Dr. Fischer continued to collaborate with **Dr. Paul Mueller** on exploring ZIF-8 nanoparticles as an additive to increase skeletal muscle maturation with **Jonathan Duarte'21**. **Alex Dent'21**, **Dr. Trey Thurman**, and Dr. Fischer also worked on several components to create a working stretch bioreactor to increase in vitro skeletal muscle maturation this year.

Dr. Ed Lowry continued his exciting work on invasive plant biology, which has been as relevant as ever during this past year. As Dr. Lowry says, "Even while meetings in-person have been fewer, that has meant more time to meet with plants!" The research of the Lowry Lab in the greenhouse moved in new fascinating directions with **Jake Beavers '22**, who received a VFIC undergraduate research grant to further the Lab's investigations into plants coping with environmental stress and tolerance in extreme environments. Earlier in 2019, the Lab and Jake organized the class projects of Ecology to look at plant growth in simulated Mars-like soil, following published work of undergraduate classes at other institutions like Villanova and the University of Chicago. Jake then took the idea one step further, planning experiments and setting up high-energy UV lights in the H-SC greenhouse to simulate the sort of radiation that could be encountered one day by plants grown in extraterrestrial environments, such as on Mars or space habitats that would lack the protective layers of atmosphere of the Earth. The preliminary data have been fascinating and have led to more class projects this past year and a further set of experiments planned for this summer. Jake and Dr. Lowry hope to present results of the research this coming year at a national scientific conference.

Professor T. Bryan Tims '98 spent time during the spring and summer of 2020 in Richmond at the Division of Consolidated Laboratory Services, the Public Health Lab of Virginia. This lab was instrumental for bringing up COVID-19 testing for the citizens of Virginia at a time when little commercial or hospital testing was available. His work there in support of the Molecular Laboratory focused on validating new methods from the CDC for high-throughput COVID-19 testing, supply management, and reporting of results to local health departments. Professor Tims tested various other outbreaks during the 15 years he worked at DCLS before coming to Hampden-Sydney.

Chemistry—by Timothy M. Reichart

The Chemistry Department did chemistry during a pandemic as chemists do chemistry during a pandemic. We adapted both lecture and laboratory experiences to accommodate quarantines, isolations, and the 10-4 schedule, with safety as our chief concern. In the Spring semester both the introductory and intermediate laboratory courses were run in the four-week term, giving students a realistic flavor of what doing chemistry every day feels like. This was probably hardest on **Mrs. Beverly Hines**, who admirably and wonderfully adapted from one laboratory course meeting per day, to every laboratory course meeting every day.

Dr. Tim Reichart joined the H-SC Chemistry faculty in 2020 as the new biochemist

These adaptions did not diminish the research efforts of our students. Department Chair **Dr. Nicholas Deifel** guided the Honors Projects of **Brahm Dean '21**, who investigated the synthesis of one-pot non-C2 symmetric Schiff base ligands for catalytic oxidations, and **Brennan Vaught '21**, who designed and synthesized FRET-based probes to detect transition metals in solution. **Nathan Houser '21** had both Dr. Deifel and **Dr. Herb Sipe** serve as joint mentors for an Honors Project in which he synthesized some copper (II) compounds with various ligands and studied their EPR spectra, with an eye towards correlating those compounds' catalytic activity with said spectra.

Ryan Yeates '21, working with **Dr. Paul Mueller**, pursued a computational Honors Project wherein he identified potential antibiotics by analyzing the binding of small peptides to bacterial IgA1 proteases. **Jonathan Duarte '21** worked with both Dr. Mueller and Assistant Professor of Biology **Dr. Kristin Fischer** synthesized zeolite imidazole framework-8 nanoparticles as potential additives to enhance myoblast proliferation. Several of our seniors, **Skylar Akers '21**, **Andrew Hay '21**, and **Marcellus Wiggins '21**, chose breadth instead of depth to finish their undergraduate chemical training

and completed additional advanced lab projects with multiple professors. Likewise, **Dr. Kevin Dunn** balanced the direction of advanced lab projects with an offering of the always popular course in Caveman Chemistry, showing a wider Hampden-Sydney audience the power of everyday chemistry.

Several of our majors and a pair of biology majors pursued yearlong research projects on the synthesis and analysis of transmembrane domains of different proteins of the SARS-CoV-2 virus with new Assistant Professor **Timothy Reichart**. **Alexander Washington '21** spent his Honors Project studying the Spike protein, while **Damian Martinez-Pineda '21** studied the accessory protein 7a. Biology majors **Matthew Rehak '21** and **Donovan Quinn '21** studied the Envelope and Membrane proteins, respectively.

Dr. Herb Sipe and Daniel Smith '22 pose with the department's new JEOL X-310 ESR.

Dr. Timothy Reichart joined us this academic year as an assistant professor. He grew up in Fairfax, Virginia, earned a B.S. in Chemistry at the University of Virginia, before a series of long moves. He received his Ph.D. in Chemistry from Scripps Research in La Jolla, California. He won a National Research Council Fellowship in Chemical and Biological Defense to pursue postdoctoral research at the US Army Combat Capabilities Command Soldier Center in Natick, Massachusetts, before pursuing further postdoctoral studies at the Ecole Polytechnique Fédérale de Lausanne in Switzerland as a Marie Sklodowska-Curie / EPFL Fellow. He returns to Virginia excited to teach courses throughout the chemistry curriculum and to pursue research in peptide and protein chemistry, with a special emphasis on identifying new targets for the development of antiviral therapies.

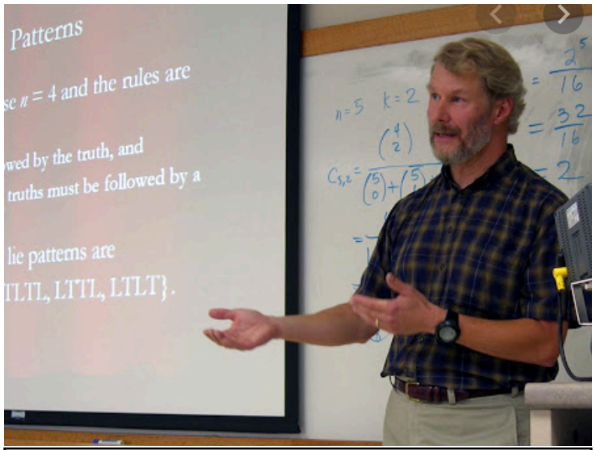
As a personal note, Dr. Reichart would like to thank the entire department—students and colleagues—for being so welcoming to me during such a difficult year. This year was atyptical in nearly every way, but even a newcomer can see that the kindness, camaraderie, and fellowship seen so far is but a sign of great things to come. He is looking forward to continuing our journeys together, with the next step of an exciting program of summer research.

Mathematics and Computer Science — by Brian C. Lins

Despite the coronavirus pandemic, members of the Math & Computer Science department have stayed busy this year. **Dr. Brian Lins** wrote a paper "Numerical ranges encircled by analytic curves" which was recently accepted to appear in the journal *Operators and Matrices*.

Dr. Rebecca Jayne had a publication accepted in the journal *Algebras and Representation Theory* entitled "Multiplicities of Some Maximal Dominant Weights of the ŝl(n)-Modules V(kΛ_0)" with coauthor K.C. Misra.

Dr Michael Stayer's papers "Unified characterizations of minuscule Kac–Moody representations built from colored posets" and "Classifications of Γ-colored d-complete posets and upper P-minuscule Borel representations" both appeared in the Electronic Journal of Combinatorics, the former in June 2020 and the latter in January 2021. Dr. Strayer also wrote a third paper, "Classifications of Γ-colored minuscule posets and P-minuscule Kac–Moody representations," which is currently under review in another journal.



Dr. Robb Koether retired in 2020 after almost 40 years of teaching at Hampden-Sydney

Senior computer science major **Ryan Irizarry** has been working on an honors research project entitled "Machine learning with convolutional neural networks" with **Dr. Paul Hemler** as his faculty advisor.

After teaching at Hampden-Sydney since 1981, **Dr. Robb Koether** retired last spring. Dr. Koether has been a huge part of our department, teaching both math and computer science

courses. He is an avid hiker and loved riding his bike to work. We will all miss Dr. Koether's dry humor and his good-natured support for the students and other faculty of the math & computer science department. We wish him all the best in his retirement.

Physics & Astronomy – by Hugh O. “Trey” Thurman III

The 2020-21 academic year was another busy year for the Physics and Astronomy department. **Dr. Steve Bloom** was on sabbatical and **Dr. Mike McDermott** continued his service to the College as the Dean of the Faculty. The department is pleased to have 11 graduating seniors. One of these seniors, **Tyler Howerton ‘21**, was awarded a Goldwater Scholarship and another, **Phil Pullen ‘21**, is finishing his term as Student Body President.

Dr. Bloom has been on sabbatical for the 2020-2021 academic year, primarily working on journal articles related to numerical assignments from his Physics 331 (Mechanics) class. The first publication is related to runway lengths and how they relate to the forces acting on an airplane. This has been submitted to the American Journal of Physics and Dr. Bloom is now working on revisions suggested by reviewers. His next project will be related to rockets and possible travel to Mars. He also continues his work on the origin of gamma rays from quasars and is interested in monitoring quasars with the HSC Observatory.

During the 2020 – 21 academic year, Professor **Stan Cheyne** and **Eliot Chandler ‘22** continued research on sound speed measurements in ethanol/water solutions. Sound speed measurements were made with a standard time-of-flight technique while changing the percent ethanol and temperature. The data obtained will be used as a database for an acoustic hydrometer to be designed and construct during the summer of 2021. Professor Cheyne also had a paper accepted for publication in the Journal of the Acoustical Society of America on previous work entitled, “Sound speed measurements in ethanol/water solutions and Kentucky bourbon whiskey”.

During the past year **Dr. Jonathan Keohane’s** primary accomplishment has been the automation of the Hampden-Sydney Observatory. This has primarily required upgrading the observatory dome mechanisms, by installing new dome control hardware and software, upgrading weather sensor capabilities, and installing a rails to power the dome slit. Senior astronomy minor **Brennon Kimbler ‘21** and physics major **Nicolas Graziano ‘21** are currently working on the project, along with our technician **Anthony Pinchefsky**. In addition, Dr. Keohane’s textbook titled, “An Introduction to Classical Electrodynamics,” by J.W. Keohane and J.P. Foy, sold 120 copies over that past 12 months.

During the 2020-21 academic year, **Professor Trey Thurman** conducted three independent study courses with **Christian Reed ‘21**, **Jared Medwar ‘21**, and **AJ Howard ‘21**. Mr. Reed conducted independent research on AC impedance spectroscopy of concrete to determine the strength of the concrete through electrical methods. Mr. Medwar developed a series of experiments that are focused on structural engineering. These will be incorporated in our Experimental Physics and Statics courses. Lastly, Mr. Howard worked on developing ethics assignments for students in engineering and science.

Psychology—by Ivo I. Gyurovski ‘09

The last year has been marked by many challenges brought by the pandemic. Nonetheless, the Psychology Department continues to contribute to the College’s mission to form good men and good citizens in an atmosphere of sound learning by focusing on research and teaching. We have been implementing the newly restructured Psychology Major while maintaining active research programs in and out of the classroom experience.

While on sabbatical, **Professor Dan Weese** continued his line of research examining the role of the rostal thalamic reticular nucleus (rTRN) in action selection. In a recent study he demonstrated that the diminished inhibition of the motor nuclei on the side of the rTRN lesion produces a weakened ability to deselect the incorrect contralateral response. He proposed that the sensory and motor sectors of the TRN are functionally similar and the rTRN increases the contrast between a selected and non-selected action. Professor Weese is also continuing his collaboration with Professor Josh Burk at the College of William and Mary where they focus on studying the role of

orexin (a neurotransmitter released by neurons originating in the lateral hypothalamus) in the regulation of attention. He has also worked with senior **Damian Martinez Pineda ’21** on setting up the lab with new apparatus to establish a single-unit recording procedure in rats.

Professor Jennifer Vitale and **Professor Ivo Gyurovski** have been collaborating on project investigating how individual differences in personal finance management impact consumers’ choices and behavior as well as their income and creditworthiness. **Professor Dan Mossler** will be retiring in the Spring of 2021 having served the college in many ways, primarily as a faculty member in the department. His courses centered mainly on understanding the psychology of lifespan development, such as his popular course Psychology of Adolescence. Professor Mossler has influenced every student majoring in psychology through his Quantitative Analysis course. He also taught topics courses examining controversial issues in psychology and wellbeing during the pandemic.

Dr. Dan Mossler is retiring in 2021 after 28 years of service at Hampden-Sydney

Professor Gyurovski and **Evan Lester ’21** collaborated on research examining the effects of political affiliation on outcome bias. It has been established that information pertaining to the outcome of a decision has a significant impact on people’s attitudes of the decision itself. This effect is referred to as outcome bias. Republican and Democratic participants were presented with descriptions and outcomes of decisions made by politicians. The decisions concerned public policies in response to the Coronavirus (COVID-19) pandemic. Participants’ task was to evaluate decision quality. Their results showed that policies that yielded successful outcomes received significantly better evaluations than policies that yielded failures. Democrats exhibited this tendency to a greater extent compared to Republicans. Conversely, Republicans exhibited a greater bias toward their own political party than did Democrats, but Republicans gave higher ratings overall across all conditions. They are currently working on follow-up studies extending this work. Evan Lester ’21 presented the findings of this project at the *Mid-Atlantic Regional Conference of Undergraduate Research (MARCUS)* in October 2020 and Professor Gyurovski summarized results at the annual meeting of the *Society for Judgment and Decision Making* in December of the same year.

The newly restructured major in Psychology features research-intensive courses where students have an opportunity to be involved in research every step of the way. In one such project **Tyler Hewitt ’21, Reilly French ’21, Tucker Moore ’21,** and **Edmund Newman ’21** worked with Professor Gyurovski on a project examining the effects of wearing a facemask on face perception and dating preferences. The team manipulated whether faces were masked or unmasked, and whether it was an underage person or a person of legal age. The results showed that wearing masks significantly impairs judgements of age and further shapes how social perceivers judge attractiveness and desire to initiate contact.

The department was excite to initiate **Tyler Hewitt ’21**, **Allen Smith ’21**, **Coleman Meadows ’22**, **Jackson Eisele ’23**, **Reilly French ’21**, and **Nick Grohowski ’21** to our chapter of the Psi Chi Honor Society.