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HensonNews

Produced by Salisbury University's Henson School of Science and Technology

From the Henson Dean's Office

Greetings from the Dean's Office of the Henson School of Science and Technology!

On behalf of the faculty, staff and students, greetings from Richard A. Henson School of Science and Technology at Salisbury University! We have had another outstanding start to the academic year, with a great deal of anticipation for the opportunities to engage with and learn from our community of scholars. Henson Science Hall is buzzing with 350 new STEM majors – their energy is contagious!

Please join me in welcoming five new faculty to the Henson School. In the Biological Sciences Department, Kirsten Guckes (Ph.D. in microbiology and immunology from Vanderbilt University) and Kathryn Gill (Ph.D. in physiology and pharmacology from Wake Forest University) joined the faculty this fall. In the Department of Chemistry, Jessica Heimann (Ph.D. in chemistry from Yale University) and Zulma Jiménez (Ph.D. in chemistry from Florida State University) will be teaching inorganic and physical chemistry, respectively. Ben Goodberry (Ph.D. in mathematics from Virginia Tech) added his talents to our Department of Mathematical Sciences. And finally, Andrew Thompson (M.S. in mathematics education from Salisbury University) converted from an adjunct to a full-time member of the faculty of the Computer Sciences Department.

The faculty of the Henson School continue to lead us in new and innovative curriculum upgrades. Forensic science is now a program within our integrated science major and is offered thanks to a unique partnership with Wor-Wic Community College. We now offer a certificate in pre-medical studies, a suite of courses specifically designed to prepare students to successfully complete the entrance exams for medical, dental and veterinary schools. Our computer science students can now focus their studies on software engineering, computer networks and cybersecurity, and/or foundations, algorithms and artificial intelligence. These are exciting times to be a STEM major at Salisbury University.

We have chosen to focus our newsletter on the outstanding work of our faculty in the realm of pedagogical innovations. The challenge of earning a STEM degree is well known. The faculty of the Henson School are working constantly to devise new techniques to facilitate the learning of both foundational concepts and advanced topics. These vignettes will give you a taste of the work our faculty engage in daily to improve the educational outcomes for our students. If you would like to learn more about our curricular innovations or how you could help support both our students and our faculty in this critical work, please reach me anytime at msscott@salisbury.edu

– Dr. Michael Scott, Dean

Innovations in TEACHING

In this issue of *Henson News*, members of the Henson School faculty share their innovative teaching methods that ensure Salisbury University students are on the path to success.

Using AR to Create Learning Materials

Dr. Steven Binz, Associate Professor of Physics

Introducing a topic with a wide variety of representations can help students learn material. Concrete representations, like pictures or models, are particularly helpful early in the learning process.

One difficulty students experience when learning physics is there are many concepts that haven't had robust concrete representations. An example of a topic with this limitation is electric fields – their affects can be observed but the fields cannot be seen nor interacted with directly. However, modern

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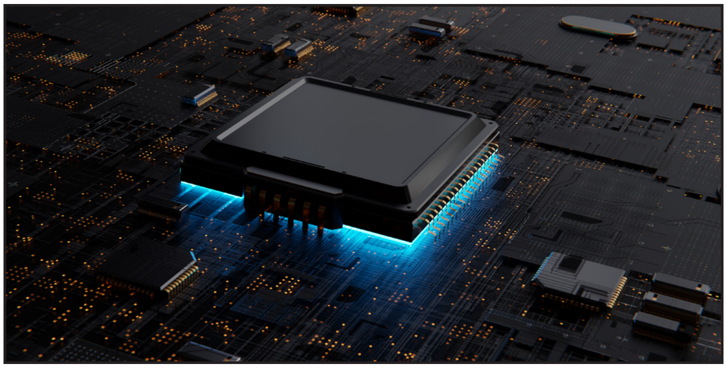

Augmented Reality (AR) devices like the HoloLens 2 display 3D computer-generated content that looks like it's in the room without blocking the users view of the world around them, making it possible to display representations of physics concepts that can be easier to understand and more accurate than traditional representations.

Upon seeing the opportunity this represents to physics education, I started creating and studying the effectiveness of applications that harness modern AR to improve student learning. One application allows students to create and move electric charges while seeing how the 3D electric field changes in real time. Students move charges by grabbing and moving them with their hands. The position of the field and charges is fixed to the room, so when a student moves, they see the same content but from a different perspective. Further, everyone using an AR device sees the same content in the same place, so students can collaborate seamlessly.

Another application is a game where students place electric and magnetic fields in the room to direct moving charges toward a goal. In yet another application, students exert forces on a pipe with curves and a fixed base so they can see how forces cause the structure to rotate.

Recently, I have been collaborating with Dr. Howard Winston and Dr. Diego Valente at the University of Connecticut, determining the effectiveness of five simulations created by UCONN to introduce electricity and magnetism topics. Work is ongoing, but it is clear that students are excited to try these new technologies. I also am collaborating with Dr. Megan Kelly, an assistant professor in SU's Accounting and Legal Studies Department, where accounting students present to virtual board members to develop soft skills, such as confidence and communication.

Grading to Encourage Mastery

Dr. Alexander Halperin, Associate Professor of Mathematics

Since 2016, I have implemented mastery grading in my algebra, calculus and linear algebra classes. Mastery grading is a pass/fail grading system that requires high standards for students to receive credit, but it allows for full-credit reattempts.

Every homework assignment, quiz and exam question is graded on an Mastery/Progressing/Needs Improvement (M/P/NI) scale, with only completely correct work receiving an M. Every quiz and homework assignment may be resubmitted, while exam topics can be reattempted on future exams, which are given every three weeks. This encourages students to review their work, attend office hours and thoroughly understand each course topic. A student's course grade is based on the cumulative number of Ms they receive by the end of the semester.

I detailed my approach, grade outcomes and student feedback in the paper "Mastery-Based Testing in Calculus with a Final Exam," which was published in the issue "Implementing Mastery Grading in the Undergraduate Mathematics Classroom" of the journal PRIMUS (Problems, Resources, and Issues in Mathematics Undergraduate Studies). I also spoke about mastery grading at the Joint Mathematics Meetings of the American Mathematical Society and Mathematical Association of America and SU's annual Teaching and Learning Conference.

Flipping the Class for Active Learning

David Keifer, Associate Professor of Chemistry

In fall 2020, I decided to change my whole approach to teaching. My general chemistry course was on Zoom that semester, and for 50 minutes, three times a week, I talked to a few dozen black boxes on my laptop screen. No one talked back. I had had non-communicative, in-person sections before, but at least in person, I could stand at the front of the room silently stroking my chin and staring at them until someone couldn't take the awkwardness anymore and finally answered the question. I decided that I needed to make a big change to my general chemistry courses so that I could get students engaged in their learning without several consecutive minutes of silent chin-stroking.

I dove into the educational literature. I already knew that incorporating active learning into class led to improved learning outcomes, so I had always broken up my lectures with in-class problems, small-group work, polling, etc., but the majority of time during my classes was still lecture. For the spring 2021 semester, I decided to go all-in on active learning and flip my general chemistry courses.

My version of flipping my classes was to record myself

covering the lecture material and to require students to watch the recording before coming to class. Students spend nearly the entire class in small groups working on practice problems that cover the recording's topic. I spend class time meandering around the room, checking in on student progress and answering questions. Many students are uncomfortable with this strange class format, so I offer them this analogy. If all you do is listen to someone talk about how to play guitar, you will never actually learn to play. You have to practice playing guitar to learn how to do it, and ideally you should practice in the presence of an expert who can correct your technique and celebrate when you get it right. That is what the flipped class is all about.

One thing I have learned since flipping my classes is that it takes an extraordinary effort. Recording the content is a major time commitment, as is coming up with a semester's worth of in-class worksheets and all the other work that goes into completely changing how you teach. For me, the commitment was worth it because I believe that my best version of flipping a class helps my students learn better than my best version of lecturing.

A second thing I have learned is that flipping can be done well, and it can be done poorly, just like any other mode of teaching. The first time I flipped a class, I did it poorly. Every semester since then, I have tweaked my approach and gotten better and better at it.

I wish I could say that my students' performance in class has skyrocketed since I flipped my courses. The truth is complicated. I started flipping during a pandemic that had tremendous negative effects on students' mental health,

study habits and preparation. My students have not done any worse since I started flipping than they did when I lectured, and I consider that a victory given the context. I am optimistic that as I continue to improve my flipping skills, my students will improve alongside me.

Finding the CURE in Introductory Biology

Kim Quillin, Professor of the Practice of Biological Sciences

When the Department of Biological Sciences launched our new BIOL 201/202 introductory biology curriculum in fall 2021, we incorporated over a dozen educational strategies that have been shown in the literature to reduce the opportunity gap and improve retention of diverse students in STEM courses, especially the large enrollment "gateway" courses at the start of STEM majors. The strategies include high structure, flipped course design with active learning, team-based community culture (rather than competitive culture), alternative grading practices with multiple attempts at meeting transparent outcomes, value-affirmation and belonging interventions, multi-modal learning, diverse scientists role models, metacognitive development, and course-based undergraduate research experience (CURE).

CUREs are high-impact practices that provide research experience to more students than possible via independent mentored research alone. The characteristics that tend to distinguish CUREs are breadth of experience in the scientific process, collaboration, iteration, discovery (in the sense that the outcome is not known to the instructors) and broad relevance outside the course.

CUREs can be taught at any level. The benefit of including them at the introductory level is that students get an authentic research experience right out of the gate in college. Further, the CURE in BIOL 201/202, the Salisbury University Phenology Project (SUPP), engages students in regular collaborative data collection from 120 native trees right on SU's campus. Thus, the project is intended to promote not only research experience, engagement, science identity, and self-efficacy, but also sense of place, social belonging and social acceptance. The early CURE experience also provides citable evidence of marketable science skills to improve students'

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success at winning scholarships and internships.

In BIOL 202: Introduction to Biology: Evolution and Ecology, the SUPP project partners with the SU Arboretum and the U.S.A. National Phenology Network (NPN) to measure phenology – timing of life cycle events like bud burst and flowering – of 120 individuals of eight native tree species as a local metric of climate change and land-use effects and their biological implications to ecosystem function. The project works on multiple levels: each student adopts a tree for the semester and reports data to NPN; each team of students synthesizes the results of several trees and presents insights in a capstone poster; the collective longitudinal data is evaluated by students conducting independent research; and the SUPP data are available via NPN to scientists to conduct national research. SUPP has produced over 38,000 data records so far.

In BIOL 201: Introduction to Biology: Molecular and Cellular Biology, the SUPP project engages students in a plant-based drug discovery. Students collect tissue samples from SUPP trees at different timepoints during the semester and create extracts to screen for stimulatory or sedative properties using heart rate of a small planktonic crustacean, *Daphnia magna* (water flea), as a measure. Students also evaluate DNA extracts from SUPP tree samples to build a database of genetic diversity to help BIOL 202 students interpret variability in phenology data. Just as in BIOL 202, student teams work together to develop hypotheses, evaluate data and present their research outcomes in a capstone poster presentation.

Overall, the innovative curriculum in BIOL 201/202 provides unique learning opportunities for students at Salisbury University and has several promising avenues for growth and community connection in the years to come.

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