

News from the Science Departments, 2013-14

Biology—by Michael J. Wolyniak

The 2013-14 academic year began in the Biology department began with the temporary departure of **Dr. Alex Werth** on his sabbatical. Dr. Werth spent the fall 2013 semester in Vancouver and the spring semester on several shorter trips in pursuit of his research. In Dr. Werth's absence, the department welcomed **Dr. Stacey Gorski**, a recent Ph.D. graduate of the University of Virginia.



Dr. Stacey Gorski

Dr. Gorski taught the Principles of Biology introductory lecture and laboratory as well as vertebrate anatomy. She will begin a tenure-track position at her *alma mater*, the University of the Sciences in Philadelphia, this fall.

This past summer saw 11 biology majors undertake research projects under the guidance of a member of the department faculty. All of these students presented their work as part of the College's September 2013 "C-Day" activities, and several have also presented seminars as part of the department's Biology Colloquium series. In addition, several of these students presented their work at national and regional conferences, including the national student meeting of Sigma Xi scientific research society, the Virginia branch of the American Society for

Microbiology, the Virginia Herpetological Society, and the Mid-Atlantic Conference of Undergraduate Scholars. Research projects such as these will be further encouraged by the resurrected Hampden-Sydney/Longwood chapter of Sigma Xi and new Hampden-Sydney undergraduate affiliate network of the American Society for Biochemistry and Molecular Biology (ASBMB), both of which began operations during the fall 2013 semester.

Several members of the department received boosts to their research in the form of external funding. **Drs. Rachel Goodman and Kristian Hargadon** received grants from the Jeffress Trust while **Drs. William Shear and Michael Wolyniak** received funding from the National Science Foundation. The department has also benefitted from several new pieces of research equipment, including a flow cytometer, a gel documentation system, and a second PCR machine. These acquisitions make it easier for the department to offer coursework that engages its students in authentic research experiences.

Dr. Ed Lowry offered a new course in biogeography and is building his research group to explore invasive species among local plants. **Dr. Ed Devlin** is completing a 4-year term as chair of the department and is celebrating in the summer of 2014 with his third cross-country bicycle trip, this time from west to east. Dr. Wolyniak was the 2013 recipient of Hampden-Sydney's John Peter Mettauer Award for Excellence in Research and was elected to the College's chapter of Omicron Delta Kappa, the national leadership honor society.

Chemistry—by Nicholas P. Deifel

Dr. Bill Anderson gave two talks this spring at the Pittcon instrumentation meeting in Chicago. He and **Arley Morelock '14** have been working on a 'Brain-Instrument Interface' that allows for muscle free control of chemical instrumentation.



Dr. Bill Anderson controlling the FT-IR with his brain.

The chemistry department is currently soliciting for an instrument endowment program that is being spearheaded by **Dr. Herb Sipe** and Venable Professor of Chemistry Emeritus, **Dr. Bill Porterfield**. This fund is designed to periodically replace important instrumentation. As part of this effort, the department invited several chemistry and pre-medicine alumni from the 1960's to reunite in October. Summer research students **Dane Asuigui '16** and **Jefferson Thompson '16** presented their findings to the alumni and demonstrations of our current instrumentation followed. In an identical fashion, the department will host alumni from the 1970's this upcoming fall.



John Dekarske '14 demonstrates the Agilent microwave plasma atomic emission spectrometer to several visiting alumni.

Finally, the department is proud of the accomplishments of John Dekarske '14 who completed an REU experience with Texas A&M University last summer under the supervision of Dr. Oleg Ozerov. He studied the synthesis of tridentate anionic carbazolyl/bis(imine) pincer complexes of platinum and presented his findings to the department in a seminar. **R. Lee Ayscue '15** has been selected for an REU at the University of Tennessee this summer.

Mathematics and Computer Science—by Rebecca L. Jayne

The Department of Mathematics and Computer Science is having a great year! **Dr. Marcus Pendergrass** has had a paper "Two Musical Orders" accepted by the *Journal of Mathematics and Music*. The paper uses a mathematical structure called a partial order to probe two different questions in music theory. The first question concerns the prevalence of certain chords and scales in Western music. Anyone who has played piano or guitar knows that there are a huge number of chords and scales that are possible. But only a few come up over and over again in classical and popular music: major scales, minor scales, pentatonic scales, and so forth. Why are these scales so special musically? Do they have special mathematical properties too? It turns out that they do, and the paper uses partial orders to prove this. The second question revolves around our judgments of musical timbre. "Timbre" is the term musicians use to describe the intrinsic quality of a sound; it is what makes the sound of a violin distinctively "violin-like", for instance, and different from the sound of other instruments. Musicians tend to speak of timbre metaphorically: the sound of trumpet is "brighter" than the sound of a flute, for instance. Is it possible to make these subjective judgments more rigorous? It turns out this it is, and the paper again uses partial orders to accomplish this.

Dr. Heidi Hulsizer had an article, "A 'Modern Mathematical Adventure in Call of Duty: Black Ops'" published in *Math Horizons*. The article describes an application of linear algebra and modular arithmetic to the video game Call of Duty: Black Ops. It shows a method for solving an Easter egg (or hidden puzzle) that will help players get an achievement in the game.

In addition, **Dr. Rebecca Jayne**, along with a coauthor, recently had a paper "On multiplicities of maximal weights of $\widehat{sl}(n)$ -modules" accepted by the journal *Algebras and Representation Theory*. The paper gives an explicit description of the maximal dominant weights of certain modules and a combinatorial relationship between the multiplicities of some of these weights and sequences of lattice paths.

The department's students are also accomplishing great things. **Carson Maki '15** is doing an independent study with Professor Pendergrass on musical timbre. In this project, he has been testing the theory in Professor Pendergrass's recent paper on recordings of real orchestral and wind instruments. The initial results are good and may lead to a presentation at the spring meeting of the Maryland-DC-Virginia section of the Mathematical Association of America.

We have also had many students participate in mathematics and computer science competitions this year. In particular, **Casey Grimes '14** and **Shawn Stum '15** scored well on the Virginia Tech Regional Mathematics Contest. Several students also participated in the William Lowell Putnam Mathematical Competition, a challenging competition for which the median score is usually 0 or 1 out of 120 possible points. We have not yet received scores for the Putnam Competition. In addition, three students – **Alex Angermeier '14**, **Linh Nguyen '16**, and **Branch Vincent '16** – devoted an entire weekend to the Mathematical Contest in Modeling (given by COMAP). The MCM is the most prestigious international competition in applied mathematics for undergraduates. This year, the team built a mathematical model to choose the best college coaches among both genders and a variety of sports. We look forward to receiving the team's score.

Physics and Astronomy—by David G. Whelan

As a new face in the Department of Physics and Astronomy at Hampden-Sydney College, I have been impressed by the many ways in which technology has been utilized for pursuing research. Over the summer, I took "first light" images with the College's new 17" optical telescope, and **Dr. Mike McDermott** engineered a fix to the altitude motor of the radio telescope. Both of those tools have been used extensively for classes. **Dylan Schlaak '14** is pursuing research in calibrating the CCD camera on the optical telescope. Dylan is also working on a computer modeling project for understanding the Epoch of Reionization -- a cosmological time period when the Universe was very young. Additionally, **Joshua Taylor '16** and I are working on two projects to improve the observatory's dome and to make better use of the smaller lab telescopes.

Dr. Stan Cheyne has been mentoring **Carson Maki '15** as he models the audible 'dead spots' in Crawley Forum—a computer-intensive project that Carson has largely lead himself! Dr. McDermott's new 3-D printer is an eye-catcher, but his intensive research in examining new radioactive isotopes for use in medical applications keeps students **Alex Angermeier '14**, **Peter Clarke '15**, **Zack Carter '17**, **Ned Bowden '14**, and **Tim Cyburt '14** busy. **Dr. Trey Thurman** is pursuing a number of projects with students: interesting studies on fluid viscosity (**Tyler Williams '14**), work to understand oil well drilling methods (**Chris Stockinger '14**), simple analytical planet formation models (**Jamshaid Chaudhry '16**), and several others. Dr. Thurman is also doing projects with other students, such as **Robinson Sagar '15**, **Linh Nguyen '16**, **David Coe '14**, and **David Campbell '15**. **Dr. Jonathan Keohane's** student **Shaquann Seadrow '16** continues to do research in neutrino production in supernova explosions at a very high level.

There are a huge number of opportunities for students to be involved in research, whether they are interested in pursuing careers in engineering, teaching, or research.

Psychology—by Jennifer E. Vitale

The professors in the department of psychology are involved in a number of ongoing research projects. **Dr. Dan Weese** is engaged in a research program examining the functioning of the thalamic-reticular-nucleus and its role in attention processing. **Dr. Jennifer Vitale** continues to investigate the attention abnormalities associated with psychopathy in male and female offenders.

Recently, **Dr. Dan Mossler** has initiated a new program of research on multitasking and the use of social media among children and adolescents. According to a recent news report, over one billion people have Facebook accounts (including 15% of children younger than nine years of age). Teenagers and college students spend an average of nine hours each day accessing and using media, while children 8-10 years old spend an average of 5 1/2 hours each day using various media. Many students are now using laptops in college classrooms. Eighty percent of students in one recent large survey reported texting during lectures and 15 % reported sending and receiving an average of 11 or more texts during a 50 minute lecture. In another study, 60% of students reported using their laptops in class to surf the web or check their Facebook pages.

According to Dr. Mossler, students seem to feel the need to stay in touch every minute of the day and can't resist answering a text or checking their Facebook pages. In one study, Rosen (2013) gave college students some material to study for 15 minutes before testing them for their comprehension of that material. The real purpose of the study was to measure how long students could stay on task studying before beginning to text, check Facebook,

or surf the Internet. Students' on-task behavior began to decline after 2 minutes and by the end of the 15 minute mark, 65% of the students were off task.

A number of recent studies have begun to investigate the ability of college students to multi-task and the consequences of their multi-tasking. Wood, *et al.* (2011) compared the comprehension of groups of students who were multi-tasking (texting, accessing Facebook, and/or Instant Messaging) during a classroom lecture with a control group of students who were taking pencil and paper notes. She found significantly less comprehension for the groups of multi-taskers. Junco (in press) and his colleagues have conducted a number of recent studies and have concluded that time spent on the texting, surfing the Internet, and specifically on Facebook is strongly and negatively correlated with grades.

Dr. Mossler points out that these findings come as no surprise to those who understand how humans process information. There are limits to how much and how fast we can process information. We can only closely attend to one thing at a time. Multi-tasking doesn't really involve doing several things at once, but rather it involves switching attention from one thing to another. The experimental research on multi-tasking consistently demonstrates that people who attempt to multi-task take longer doing each thing and do each thing more poorly. The irony is that many people think they are good at multi-tasking.

Dr. Mossler and his students are beginning this new line of research this semester with investigations into multi-tasking by college students. While a number of recent studies have demonstrated the adverse consequences of multi-tasking in the classroom, none have focused on the consequences of multi-tasking while studying or preparing for an exam. Students routinely study for exams while listening to music, with the television on in the background, with a mobile device in their hand sending and receiving text messages, and with their computer screens refreshing their Facebook pages.

In one study, Dr. Mossler and his students are comparing a control group studying without distractions with groups having increasing levels of distraction (just television or music, with TV/music and texting, with TV/music, texting, and computers) on their comprehension of the studied material immediately after they have finished studying and again 24 hours after they have finished studying. They are predicting that comprehension will be poorer for groups that are trying to multi-task and ESPECIALLY poorer 24 hours after they have finished studying. From what we know about how memory works, they expect deficits from divided attention during the encoding phase to be very pronounced after the memory consolidation process and during retrieval.

Starting next year, Dr. Mossler will begin to focus his research on the use of technology, the Internet, and social media by younger children. Very little research has been conducted on this population, with the majority of studies conducted using college-age participants. As a result, important questions are left needing to be addressed: When do children start trying to multi-task? Are they able to deal with the distractions as they become immersed in and surrounded by these seductive technologies and media? We know that young children are less able to process information and have more fragile impulse control and selective attention capabilities. As they begin trying to multi-task, are these distractions creating something akin to Attention Deficit Disorder as they attempt to switch from one task to another? How does that affect their comprehension and learning? Are they at greater risk than adolescents and college students?

Dr. Mossler is also interested in understanding the impact of these technologies and media on the social development of young children. The Internet and social media are changing the social environment for young children. The nature of social interaction is very different with these technologies. With older children, we are seeing an explosion of aggressive behavior and cyber-bullying. Teenagers are saying and doing things on the Internet and over social media that they would never do in face-to-face interactions. It is relatively easy to anonymously "flame" a person online or to carry on a mean spirited vicious campaign since there are no real checks or immediate consequences from these cyber space interactions. How is this media and technology affecting the development of social interaction skills in a 6 year old? Are young children who are relatively heavy Internet users or social media users developmentally delayed in terms of their social interaction skills? Are there personality differences among young children who are heavy Internet or social media users?

With so many important, unanswered questions, Dr. Mossler anticipates a lengthy program of research conducted by him and by his students in the years ahead.