

Biological Sciences

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VIEW FROM THE DEPARTMENT: *KEEPING ON TRACK WITH OUR LEARNING MISSION*

Ask any scholar, citizen, or business person what the outcome of a college education should be, and you will likely hear one or more of the following: (1) the skill to think critically and solve problems, (2) a heightened sense of self, community, and one's relationship to community, (3) an awareness of important social, political, technological and environmental issues that span local to global scales, (4) the capacity to organize and effectively communicate ideas, (5) enough knowledge within a technical or creative field to serve as a basis for the development of a career, and (6) the capacity to lead. At Virginia Tech, we have adopted these ideas and have added a special emphasis on serving society to improve the human condition. In the Department of Biological Sciences, we share these goals and apply them to our programs of learning at the undergraduate, graduate and post-doctoral levels. Furthermore, our teaching spans all levels of biological hierarchy from molecular to global.



Dr. Jack Cranford instructs mammology students in the field. For more information on the work of Dr. Cranford and his students, see page 3. *Photo by Bob Veltri*

In the world of modern higher education, goals such as these have been increasingly re-worded as desired learning outcomes, using language that permits quantification to show very clearly how well stated goals are being met. Our department is now in the process of adding and tracking measurable learning outcomes within individual courses. Over the next several years, we will scale up to the full curriculum. On the surface, this seems easy enough. After all, don't we test students in every course?

Well, yes we do, but not in a way that measures CHANGE in knowledge and ability over time that can be attributed directly to our teaching programs. One means to assess such change is to administer questions or tests before a course is taught, and then the same questions later to see how much performance improves. Another is to embed standard questions or exercises within a course, and then track the responses year after year. We are planning a combination of these and other approaches.

Why do all this? First of all, we want to be accountable. Students and the public deserve to know, without ambiguity, the impacts and successes of our learning programs. Second, we wish to continually strive for excellence, and need a way to determine if we are making progress. Finally, given the increasing popularity of life sciences and student enrollment in our department, it is ever more important for us to use our resources efficiently.

Consider these facts:

- With 1377 students registered in fall 2007, the Department of Biological Sciences has the largest enrollment of all undergraduate degree-granting majors at Virginia Tech.
- In the 2006-2007 academic year, the Department taught 33,364 student credit hours (i.e., the number of students times the number of credits, summed across all courses), which is one of the highest teaching contributions at Virginia Tech.
- Approximately 50% of our teaching is dedicated to the university's Curriculum for Liberal Education, providing science education to many of Virginia Tech's students, including those majoring in humanities, arts, and engineering.

We are happy to have a large component of the university's learning portfolio, and excited by higher education's growing emphasis on learning outcomes. Virginia Tech is doing its part by hiring new assessment professionals and adopting new learning outcomes tracking software. Because we invest a large proportion of our financial and personnel resources into teaching, we are keenly interested in making sure our efforts count.

Sincerely,
Robert H. Jones,
Department Head
Biological Sciences

RESEARCH HIGHLIGHTS

Causes of Incorrect Chromosome Segregation

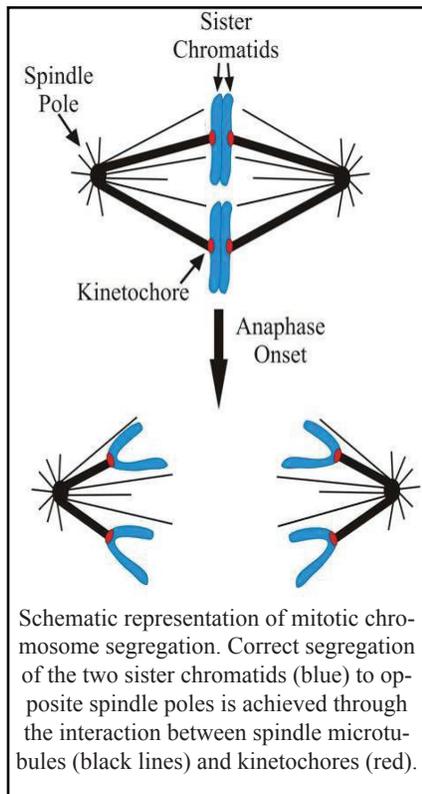
Research in the laboratory of **Dr. Daniela Cimini** (Assistant Professor in Biological Sciences) is uncovering the cellular and molecular mechanisms responsible for inaccurate chromosome segregation during cell division. Correct chromosome numbers are necessary for the development and survival of an organism. Incorrect segregation can lead to a variety of problems, including various syndromes, diseases, and cell death.

For organisms that have genetic structures as complex as we humans, the potential for mistakes is high. Like other higher eukaryotes, we are diploid organisms, i.e. each somatic cell possesses two copies of each chromosome. We have 46 chromosomes, that is, 2 copies of each of 23 chromosomes. Germ cells, or gametes, are instead haploid, i.e. they possess one copy of each chromosome. When fertilization occurs, two gametes fuse together, thus reconstituting the diploid chromosome number typical of the species.

A deviation from the diploid chromosome number is known as aneuploidy. Aneuploidy occurring in germ cells can lead to severe genetic diseases, such as Down syndrome, which affects individuals carrying an extra copy of the human chromosome 21. In addition, scientists have found that aneuploidy is the leading cause of miscarriage and still birth in humans, and may be involved in the development and progression of cancer.

Aneuploidy occurs if there is a mistake in the spindle microtubule alignment during the anaphase of cell mitosis, after chromosomes have been replicated and the duplicates (sister chromatids) are being recognized and pulled apart to form two daughter cells. For proper segregation, microtubules must form proper connections between spindle fiber poles and kinetochores, which are multiprotein complexes located on the chromatids (see illustration above).

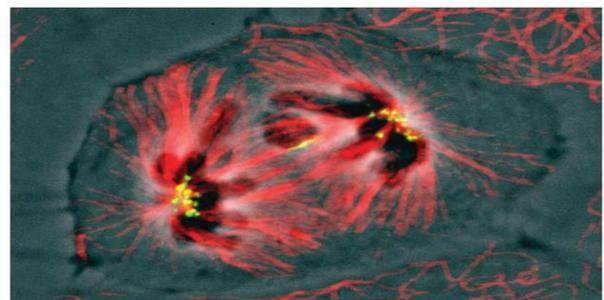
Using a combination of live-cell imaging, microscopy, and biochemical techniques, Dr. Cimini and her students have been studying a particular kinetochore-microtubule misattachment, named merotelic kinetochore orientation (MKO).



MKO is formed when a single kinetochore binds microtubules from both spindle poles rather than just one. MKO can induce a chromosome to lag behind at the cell equator rather than migrate to the spindle pole during anaphase.

Dr. Cimini's lab is investigating the corrective mechanisms that cells have to reduce the frequency of MKO, including two key kinases (i.e., enzymes that add phosphorus to other molecules) that appear to be overabundant in cancerous cells. Dr. Cimini has also initiated a collaboration with Dr. Civelekoglu-Scholey at the University of California Davis, who has used information gathered by Dr. Cimini over the past several years to develop a mathematical/computational model whose numerical solutions mimic well the experimentally observed chromosome dynamics.

A new line of research in Dr. Cimini's lab, funded by the Thomas F. Jeffress and Kate Miller Jeffress Memorial Trust, is contrasting chromosome mis-segregation in different lines of colorectal cancer cells. This type of cancer affects about 7% of the population and is one of the leading causes of cancer-related deaths in the United States, second only to lung cancer. Colorectal cancer cells can be divided into two groups, one characterized by chromosome instability and high levels of aneuploidy and one group characterized by stable chromosome number. Comparing cells from these two subgroups, Dr. Cimini and her lab members hope to find which cellular mechanisms are perturbed in aneuploid cancer cells. The identification of these mechanism(s) is the first step toward the identification of possible therapeutic targets for the treatment of aneuploid human tumors. Preliminary results indicate that aneuploid colorectal cancer cells exhibit a complex mitotic behavior, often leading to multipolar, instead of bipolar, mitotic spindles.



Anaphase cell immunostained for microtubules (red) and kinetochores (green). The chromosomes are visible as dark rod-like structures. One chromosome is lagging behind at the cell equator instead of migrating to the spindle pole. The kinetochore of such chromosome appears to be merotelic, i.e. attached to microtubules from both spindle poles rather than just one.

For more information on Dr. Cimini's research, please visit her website at
<http://www.biology.vt.edu/faculty/cimini>.

RESEARCH HIGHLIGHTS

Acorn mast drives long-term dynamics of rodent and songbird populations

In ecology and organismal biology, studies lasting a decade or longer are rare, but are often necessary if we are to detect patterns in nature and their underlying causes. In a paper that will appear in the journal *Oecologia* in 2008, **Dr. Jack Cranford**, Associate Department Head in Biological Sciences, and six colleagues used 20 years of observation to detect cycles of acorn production and their impacts on birds and mammals. The work was conducted at nearby Mountain Lake Biological Station of the University of Virginia. Data sets collected by Dr. Cranford and his colleagues, and supplemented by students participating in Dr. Cranford's mammalogy course, revealed important relationships between the periodic production of acorns, small mammal, and bird populations.

The central idea of the work is that resource pulses, or temporary periods of high resource availability, occur throughout terrestrial ecosystems and may serve a stabilizing or keystone role in structuring community dynamics. The ecology of oak-dominated forests is significantly influenced by the periodic production of large quantities of acorns as a key food supply for numerous mammals and birds. Highly productive mast events typically occur every 2-6 years but vary among and within species as a function of weather conditions. Within stands (< 10 km) of a given tree species, however, mast production is relatively synchronized, and it has been proposed that masting evolved as a means of satiating seed predators or facilitating dispersal.

This researchers examined interactions among acorn mast, abundance of three rodent species, and reproductive success of the ground nesting dark-eyed junco.

The researchers also evaluated the potential influences of weather patterns on the periodicity of acorn production, and the response of hawks that feed on small mammals and the junco. Co-author E.D. Ketterson had previously demon-



A white-footed mouse (*Peromyscus leucopus*) tagged as part of a capture-recapture technique to census population size

strated that chipmunk abundance was positively correlated with junco nest failure over an 8-year period in an oak-dominated forest in southwestern Virginia, USA. This current study has added 12-16 years of data from the same site and expanded the analyses to include a larger number of parameters. Jack and his colleagues predicted that acorn mast causes increases in rodent populations and thus a time-lagged decrease in junco reproductive success due to predation on bird nests by rodents.



Students in Dr. Cranford's mammalogy course learning how to census small animal populations at Mountain Lake

Weather turned out to be a key underlying factor. Variation in acorn mast, the keystone resource in this community, was explained by weather conditions as far back as two years before the mast event. In turn, mast was a strongly positive predictor of rodent abundance, whereas summer temperature and raptor abundance were negative predictors of rodent abundance. Dark-eyed junco nest success was negatively related to rodent abundance, summer temperatures and, to a lesser extent, raptor abundance. Large rodent and raptor populations also caused declines in the number of juvenile juncos caught per year. These longer term results improve our understanding of the complex ecological interactions in oak-dominated forests by illustrating the importance of both abiotic and biotic factors on/at different trophic levels.



Matteo Cimini, son of Dr. Daniela Cimini, and Dr. Zhaomin Yang discuss the finer points of biological sciences at the Fall 2007 Departmental Picnic.

OUTREACH

New Corporate Partners Program

Virginia Tech's Department of Biological Sciences in the university's College of Science, has launched a corporate partners program to foster collaboration between faculty, students and bioscience oriented corporations in the mid-Atlantic region. The so-named Biological Sciences Partners in Research and Education (BioSPIRE) program is designed to engage companies with an interest and capacity to impact education in the biological sciences.

"With the marketplace continuing to invest in biotechnology and other biologically related products and services, it is essential for companies and education institutions to work together to develop tomorrow's leaders and maintain a strong economy in the region" said Robert Jones, head of the university's Department of Biological Sciences.

The program will include scholarships to enhance diversity in the undergraduate student population and to support undergraduate research projects and other kinds of hands-on learning and training experiences. Corporate partners will also provide feedback on university curricula to better match teaching and learning with the demands college graduates are currently facing.

"The ultimate goal is to build a strong pipeline of well-trained and diverse individuals who will be the creative, critical thinkers, and leaders in bioscience industries," Jones said.

Representatives from several key bioscience industries participated in the planning and official launch of the program. These included Merck, Novozymes Biologicals, Revivicor, and Pfizer Sales.

"With more and more baby boomers retiring or looking toward retirement, we have ever-expanding market opportunities for products and services that rely on biological sciences," said Tim Howland, director of corporate relations in the College of Science.

The Department of Biological Sciences has a reputation for attracting high-level academic achievers. The department has the largest scientific student base on campus, with nearly 1,400 majors.



A majority of these students want to be doctors, veterinarians, or other health science professionals.

"We want to partner with bio-science oriented corporations to provide better prepared professionals entering the workforce," Howland said. "This program will be mutually beneficial."

BioSPIRE will host two annual events—a Fall Partners Day and a Spring Research Symposium. The next scheduled event is the Department of Biological Sciences Research Day, to be held Feb. 23. For more information, contact Howland at thowland@vt.edu or (540) 231-8739.

The College of Science at Virginia Tech gives students a comprehensive foundation in the scientific method. Outstanding faculty members teach courses and conduct research in biology, chemistry, economics, geosciences, mathematics, physics, psychology, and statistics. The college is dedicated to fostering a research intensive environment and offers programs in many cutting edge areas, including those in nanotechnology, biological sciences, information theory and science, and supports the university's research initiatives through the Institute for Critical Technologies and Applied Sciences, and the Institute for Biomedical and Public Health Sciences. The College of Science also houses programs in intellectual property law and pre-medicine.

Article by Catherine Doss, College of Science Communications Manager, Virginia Tech

STAFF NEWS

New Staff Members:

Brent Bowden (Lab Specialist)
 Norbel Brautigam (Lab Specialist)
 Annette Fluri (Fiscal Technician)
 Angela Mathias (Undergraduate Academic Advisor)
 Billy Plum (Equipment Service & Repair Technician)
 Valerie Sutherland (Program Support Technician)
 Dream Webb (Assistant to the Department Head)

New Post-Doctoral Associates:

Suman Banik (Advisor: Dr. Tyson)
 Manli Yang Davis (Advisor: Dr. Yang)
 Tetsuya Gotoh (Advisor: Dr. Sible)
 Baris Hancioglu (Advisor: Dr. Tyson)
 Farooqahmed Kittur (Advisor: Dr. Esen)

Accepting New Positions:

Rob Gunter (Information Technology Specialist)
 Catherine Webb (Freshman Laboratory Coordinator)

Retiring:

Mary Schaeffer is retiring after 12 years with the department. She received her M.S. in Biology from Virginia Tech in 1993, with an emphasis on stream ecology, and went on to work as a Lab Specialist, a Visiting Assistant Professor, and ultimately, as a Laboratory Specialist Advanced. In addition to organizing and implementing all of the Freshman Biology Labs, Mary voluntarily worked with faculty to ensure that the best Graduate Teaching Assistants were selected to teach specific labs. She was also an active participant both the College of Science Staff Association, acting as the Chair from 2006 to 2008, and in the Association of Biology Laboratory Educators, where she regularly presented on innovations in teaching introductory labs at Virginia Tech. Mary will be greatly missed, and we wish her all the best on her future endeavors!

UNDERGRADUATE RESEARCH

Increasing Virginia Tech - Malian Relations to Save Lives

Diseases attributed to mosquitoes are becoming more problematic as the years pass. Arguably, there are many reasons for this increase; some say that it's because the climate is changing, others proclaim it is due to a growing human population extending into mosquito-infested territories, and there are those who believe that there is no growth in cases at all but rather an increase in media coverage. Regardless, mosquito infections such as dengue and yellow fever are a dangerous issue. Virginia Tech senior Christine George is working to fight it.

Last year, as a junior in biological sciences, George began her undergraduate research on *Aedes* mosquitoes, the insect known for spreading the dengue and yellow fever viruses. In the fall of 2006, George was selected into an entomology study course under the guidance of Professors Don Mullins and Richard Fell. Included in this two semester class was a January trip to Mali to learn about Mali culture, agriculture, and public health systems. While there, George worked with researchers and physicians from the Malaria Research and Training Center at the Medical University in Bamako, Mali. George discovered that Mali did not have any research or work being done on mosquito-borne viruses. Given the abundance of these viruses in that particular African region, she decided this must change.

Through her work as an undergraduate research assistant in Zach Adelman's lab, George was aware of the increased funding that Virginia Tech has recently put into the Vector-Borne Disease Research Group. Adelman, an assistant professor of entomology, is a member of the group. George presented Adelman with her ideas for providing Mali with the preliminary data and education to set up a "sustainable mosquito-borne virus surveillance center." Her seemingly lofty goals are now well underway. As the saying goes: When you reach for the moon, you land among the stars.

To conduct the necessary research and surveillance, as well as pay for the trip, George raised \$15,000*, which was matched by \$10,000 from Adelman. She returned to Mali in July of 2007 to begin her project. In order to allocate her time properly while in Mali, George broke her goals into three step-by-step processes. This past summer, she worked on generating her ideal "Near-term Project Impacts," which are to determine the high risk areas of mosquito-borne infections, foster Virginia Tech-Malian working relations to continue work towards a sustainable Malian surveillance center, and provide enough data and information for the Mali people to apply for additional funding and support.

George began the first phase by traveling to high-risk areas and collecting and separating *Aedes* mosquitoes by sex. She and her team then preserved the mosquitoes in liquid nitrogen in order to test their infection status at a later time. Malian public health authorities provided 95 samples of human blood that had possibly been infected with yellow fever. All of the samples were transferred to the Centers for Disease Control and Prevention, Division of Vector-Borne Infectious Diseases, Dengue Branch, in San Juan, Puerto Rico. Upon completion, this research will tell government and non-government organizations where to focus vector control, virus surveillance, and medical assistance.

Phase I has already yielded results. George has established collaborative Virginia Tech-Mali working relations, provided undergraduate and



graduate students with valuable training, and determined field infection levels of dengue and yellow fever. The field testing by George's team determined that every district visited provided the dangerous conditions necessary for viral transmission. Also, after researching the increase in infections during the months of September, October, and early November, Ms. George and her team suggested that the increase may not be entirely due to those months being the end of the rainy season, when the mosquito population is high. Crop harvesting also occurs during these same three months and *Aedes* mosquitoes thrive in the woods and rocks close to fields. Also, nomadic primates, known reservoirs of the diseases, live in the region.

As George explains, "The high density of the vector, plus the presence of a virus reservoir and increased human presence provides the perfect set-up for a mosquito-borne virus outbreak."

Her research will continue until the sustainable surveillance network is created.

Phase II of George's research plan involves training Malian scientists in molecular arbovirology. This training will be provided at Virginia Tech by faculty members associated with the vector-borne infectious disease research program. After training for as little as several months and as long as four years, the Mali students will return to their country and establish themselves as arbovirologists who will maintain the viral surveillance center.

This work is ongoing and truthfully promising. It is research that Virginia Tech should certainly be proud of.

Article by Alyssa Haak, sophomore English major

* Christine George raised the money by meeting with any one who might be interested in the project. Donations came from the Departments of Entomology, Biological Sciences, Biochemistry, and Geography at Virginia Tech. She was awarded scholarships from the College of Science and the University Honors program and a Wilkins/Fralin Undergraduate Research Fellowship with a \$3,000 salary for completing research over the summer. She donated all of the money to her Mali project. When she gave a presentation to the College of Science Dean's Round Table, two alumni donated money. If you are interested in donating to George's cause, contact Jennifer Orzolek in University Development at jorzolek@vt.edu regarding the College of Science's Research in Mali fund.

STUDY ABROAD

Summer Courses in Ecuador and South Africa

In summer 2007, Drs. Ignacio Moore, Robert Jones, and Duncan Porter taught a study abroad course entitled "Ecology, Culture, and History of Ecuador and the Galapagos Islands". Thirteen students took the course. They spent time in four different areas: paramo of the high Andes, cloud forest, lowland rainforest of the Amazon basin, and the Galapagos Islands. At each of the mainland sites, the travellers spent a few days exploring the local ecosystem, and then travelled to the Galapagos, where they spent three days on the island of San Cristobal, and three days on a boat touring some of the other islands. Highlights of the trip included seeing spectacled bears, pink river dolphins, scarlet macaws, howler monkeys, marine iguanas, and giant tortoises.

Dr. Arthur Buikema and Dr. Richard Fell (Entomology) taught a summer study abroad course entitled "Culture and Ecology of South Africa"; thirteen students took the course. While in South Africa, they studied in eight different ecosystems, and in Kruger National Park, they saw the "big five" (Cape buffalo, white rhino, lion, leopard, and elephant) twice in the same day. As they crisscrossed the country, the students were able to meet with the sixteen Virginia Tech students who were enrolled in the semester program at the University of the Free State in Bloemfontein, S.A.. This meeting was very special for both groups of students as they shared the events of April 16th. The administration and faculty at the UFS held a memorial service for those persons lost at Virginia Tech, and presented each participant a copy of the memorial service. Drs. Buikema and Fell deposited their copies in the Virginia Tech Archives. In the fall, the two groups of students met for a South African dinner of boerwors, steak, mealies, and tomato sauce. For many students, this was the first time they had gotten together since returning to the U.S. A good time was had by all.



Traversing a waterfall in the forest of Ecuador



A white rhino, one of the many species of wildlife encountered during the course in South Africa

ALUMNI

Eva Eckert Hickey is a 1978 graduate of Virginia Tech with a B.S. in Health Physics (formerly an option of the Biology Department) at Virginia Tech.; she went on to receive her M.S. in Health Physics from Georgia Tech. She has worked at Battelle Memorial Institute (which operates the Pacific Northwest National Laboratory in Richland, WA, for the US Department of Energy) for over twenty five years as a project manager and technical group manager. Her areas of health physics expertise include emergency preparedness for nuclear and hazardous material facilities, environmental impact evaluation, decontamination and decommissioning, operational health physics, air monitoring instrumentation and environmental monitoring. Ms. Hickey is the Program Manager for the Nuclear Regulatory Commission review of applications for construction and operation of new nuclear reactors. This support includes the environmental review and safety review for Early Site Permits (ESP) and Combined Construction and Operating License (COL). Ms. Hickey has supported NRC in the preparation of numerous environmental impact statements, including Supplemental Environmental Impact Statements for the relicensing of commercial nuclear reactors as well as environmental impact statements for early site permits for new nuclear power reactors. These reviews include site audits and discussions with state, local and federal representatives associated with the action. She provided technical support to the NRC on updating and revising a standard review plan for the review of environmental protection issues related to nuclear power plant licensing and is currently the task lead for the Environmental review of one of the first three early site permit applications.



Eva Eckert Hickey is currently managing a large project for the NRC in Rockville, MD to prepare environmental impact statements for the construction and operation of new nuclear plants to be located in the U.S., mostly in the southeast.

Robert J. "Rob" Wittman was elected in December 2007 as the representative of Virginia's 1st Congressional District (which encompasses much of coastal Virginia). He received a B.S. in Biology from Virginia Tech in 1981, and went on to receive an M.S. in Health Policy and Administration from the University of North Carolina, and a Ph.D. in Public Policy and Administration from Virginia Commonwealth University. He served for many years as an environmental health specialist for local health departments in Virginia's Northern Neck and Middle Peninsula, and, until recently, Dr. Wittman served as the Director of the Field Division of Shellfish Sanitation for the Virginia Health Department, leading the national effort to address the public health risks of *Vibrios* in molluscan shellfish.



Rob Wittman, US Congressman (VA-1), received his B.S. in Biology from Virginia Tech in 1981.

GRANTS, PRESENTATIONS & AWARDS

Dr. **Arthur Buikema**, **Mary Schaeffer**, and **Arya Iranmanesh** presented two educational papers, entitled “Development of an on-line classification program for introductory biology students” and “Effect of an online concept mapping program on understanding biology” at the 18th International Conference on College Teaching and Learning.

Undergraduate student **Rohit Kumar**, researcher in Khidir Hilu’s Lab, presented a poster at the 2007 Annual Meeting for the Virginia Academy of Science on “The Evolution of Canary Grasses”. He received the Best Poster Award.

In July, *Nature Cell Biology* published a commentary by Bela Novak, **John Tyson**, Bela Gyorffy and Attila Csikasz-Nagy entitled “Irreversible cell-cycle transitions are due to systems-level feedback.”

Graduate student **Sunny Crawley**, who works in Khidir Hilu’s laboratory, also a grant from the Virginia Academy of Science for her work on the molecular biology of the plastid matK gene.

Khidir Hilu presented the opening talk at the 11th Evolutionary Meeting held in September in Marseille, France, entitled “When Different Genes Tell the Same Story: Diversification of Land Plants”.

This September, Dr. **John Tyson** was invited to give the Aisenstadt Lecture on “How Do Cells Compute” at the Center for Mathematical Research in Montreal, Canada. The Aisenstadt Chair is awarded each year to two or three renowned mathematicians, who give a series of lectures connected to the thematic program of the year. Tyson’s lectures concerned mathematical modeling of gene-protein interaction networks, as part of the general theme of “Applied Dynamical Systems”.

Jianhua Xing had his paper, “Nonequilibrium Dynamic Mechanism for Allosteric Effect” published in the journal *Physical Review Letters*, Vol. 99, No. 16.

Undergraduate students **Kristen Scheller** and **Kimberly Kirkbride**, majors in Biological Sciences, were recently awarded a \$500 research grant from the Virginia Academy of Sciences for their undergraduate research project in Lisa Belden’s Lab, entitled “Examining Links Between Water Quality and Stress Hormone Levels in Eastern Spotted Newts”. They presented their proposal at the VAS Fall Meeting in Richmond in October. They will present the results of their research at the VAS Meeting in May.

Daniela Cimini’s biography was selected for inclusion in the forthcoming 2008-2009 Edition of the *Marquis Who’s Who in Science and Engineering*, which was published in December 2007.

Khidir Hilu and **Robin Andrews** were each named “Virginia Tech Scholars of the Week” this fall. For more information on their research, visit their individual web sites at <http://www.biol.vt.edu/faculty/index.html>.

Self-organization Among Bacteria

Adapted from an article by Thomas Hesselbert, life-of-science.net

In the past decades, researchers have been working hard on solving the problem of how individual cells in a eukaryotic multicellular organism organize themselves in structures such as hearts, brains, lungs etc. during ontogeny. Although far from fully understood, a picture is slowly emerging of a complex set of control interactions between the genetic commands of the DNA within the cell and protein and RNA information within and among the cells. However, intriguingly it has been known for some time that simple prokaryotic bacteria are capable of self-organizing and cooperating into superstructures to form biofilms, some of which are involved in infectious diseases. Scientists from Sweden and the U.S. (including **Dr. Ann Stevens** and graduate student **Joshua Williams** of Virginia Tech) have now investigated this process in detail.

Biofilm consists of layers of bacteria found closely together in large colonies. They often form in response to adverse environmental conditions. The colonies, however, are formed in such a way as to ensure that nutrients are dispersed efficiently among the individual bacteria and that waste including dead cells can quickly escape the colony. The scientists placed *Escherichia coli* in a newly developed microfluidic device, which consisted of flow-through channels with chambers between them. Bacterial colonies could then form in the chambers but with free exchange of cells and nutrients between the different chambers.

The researchers found that the growth and motion of cells in the colony were correlated and aligned with the direction of the major waste exit-ways in the colony. Computer simulations showed that such organization increases the efficiency of waste removal from the colony as well as increasing supply of nutrients to the colony interior. Individual *E. coli* cells in colonies, furthermore, change their aspect ratios compared to free-living *E. coli*, which presumably is done to minimize forces acting on cells near the chamber exit and near chamber walls.

Although not explicitly studied in their experiments, the scientists speculate that the self-organization observed in their study, can be explained simply by mechanical interactions between the cells and the structure of the chamber. It remains possible that direct mechanical interaction between cells in multicellular organisms can play a role during development of tissues and organs.

Source: Cho, H.¹; Jönsson, H.²; Campbell, K.³; Melke, P.²; **Williams, J. W.**⁴; Jedynak, B.¹; **Stevens, A. M.**⁴; Groisman, A.³ and Levchenko, A.¹ (2007). Self-organization in high-density bacterial colonies: efficient crowd control. *PLoS Biology* 5: e302.

¹Johns Hopkins University, Baltimore, MD

²Lund University, Lund, Sweden

³University of California - San Diego, San Diego, CA

⁴Virginia Polytechnic Institute and State University, Blacksburg, VA

Alumni and Friends

We need your support!

Your gifts to the Department of Biological Sciences and alumni projects have helped us move forward in our quest for excellence. Thank you!

With continued support, you can help us build strong scholars, make higher education affordable, and attract the brightest and best students and faculty to Virginia Tech. Tangible gifts reflect a donor's dedication to enriching the university experience for students and faculty alike.

We are also seeking large gifts to equip the new biology building and establish chaired faculty positions. Your contributions are tax deductible. For more information on "Ways to Give," visit <http://www.giving.vt.edu>.

DONORS CAN TRULY SEE THE FRUITS OF THEIR LABOR AND FEEL A SENSE OF PRIDE WITH EACH VISIT TO CAMPUS

MAKE A GIFT THAT WILL LAST FOREVER

Make check payable to the Virginia Tech Foundation.

Write "for Biological Sciences" on your check and mail to:

**Dr. Robert Jones
Biological Sciences 0406
Virginia Tech
Blacksburg, VA 24061**

Help us keep our records updated

We welcome comments and items of interest for future newsletters. Please contact Dr. Robert Jones, Biological Sciences 0406, Virginia Tech, Blacksburg, VA 24061. You may also send an email to Valerie Sutherland (vsutherl@vt.edu) or Robert Jones (rhjones@vt.edu).

Had a Favorite Teacher?

Please drop us a line (rhjones@vt.edu) about your favorite Biology teacher. We will use your comments to support excellence in teaching at Virginia Tech.



*Snow falls outside
Derring Hall,
December, 2007*



*Biological Sciences 0406
Virginia Tech
Blacksburg, VA 24061
(540)231-8930*

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