

# STEM at Middlebury College

## 2015–2016 Annual Report of the Sciences and Mathematics

*Biology*  
*Chemistry and Biochemistry*  
*Computer Science*  
*Geography*  
*Geology*  
*Mathematics*  
*Molecular Biology and Biochemistry*  
*Neuroscience*  
*Physics*  
*Psychology*

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# Introduction

The faculty of the math and science departments and interdepartmental programs here at Middlebury College are justifiably proud of our accomplishments during this past year, as teachers, scholars, and advocates for the STEM (Science, Technology, Engineering, and Mathematics) disciplines to the wider community. We represent a diverse group of disciplines — including the life and physical sciences, mathematics, and departments that bridge both natural and social domains — but we are united by a shared commitment to science and math as a way of knowing and as a foundational component to a literate, free, and progressive society. Our work during this past year, summarized below as [publications](#), [external grant support](#), [major curricular changes](#), [student research](#), and [public outreach](#), exemplifies both the breadth and depth of this commitment.

All of this, of course, is in addition to each member of the faculty's on-going work in teaching courses, advising and mentoring students, and service both to the college and our wider professional communities. By any measure, STEM at Middlebury College sets — and achieves — high standards in education and scholarship, and our accomplishments during the 2015–2016 academic year were no exception.

# Publications

calendar year 2015

Amidon, W. H., Hobbs, D., & Hynek, S. A. (2015).

Retention of cosmogenic  $^3\text{He}$  in calcite. *Quaternary Geochronology*, 27, 172–184. <http://doi.org/10.1016/j.quageo.2015.03.004>

Andrews, C., & Billings, J. (2015). Middguard at Dino-Fun World (pp. 129–130). Presented at the 2015 IEEE Conference on Visual Analytics Science and Technology, VAST 2015 – Proceedings. <http://doi.org/10.1109/VAST.2015.7347644>

Andriamaharavo, N. R., Garraffo, H. M., Spande, T. F., Giddings, L.-A., Vieites, D. R., Vences, M., & Saporito, R. A. (2015). Individual and Geographic Variation of Skin Alkaloids in Three Swamp-Forest Species of Madagascan Poison Frogs (*Mantella*). *Journal of Chemical Ecology*, 41(9), 837–847. <http://doi.org/10.1007/s10886-015-0616-4>

Arndt, J. (2015). The Influence of Forward and Backward associative strength on false memories for encoding context. *Memory*, 23(2015).

Blair, W. P., Winkler, P. F., Long, K. S., Whitmore, B. C., Kim, H., Soria, R., ... Stockdale, C. (2015). A newly recognized very young supernova remnant in M83. *Astrophysical Journal*, 800(2). <http://doi.org/10.1088/0004-637X/800/2/118>

Blose, E. N., Ghimire, B., Graham, N., & Stratton-Smith, J. (2015). Edge corrections to electromagnetic Casimir energies from general-purpose Mathieu-function routines. *Physical Review A – Atomic, Molecular, and Optical Physics*, 91(1). <http://doi.org/10.1103/PhysRevA.91.012501>

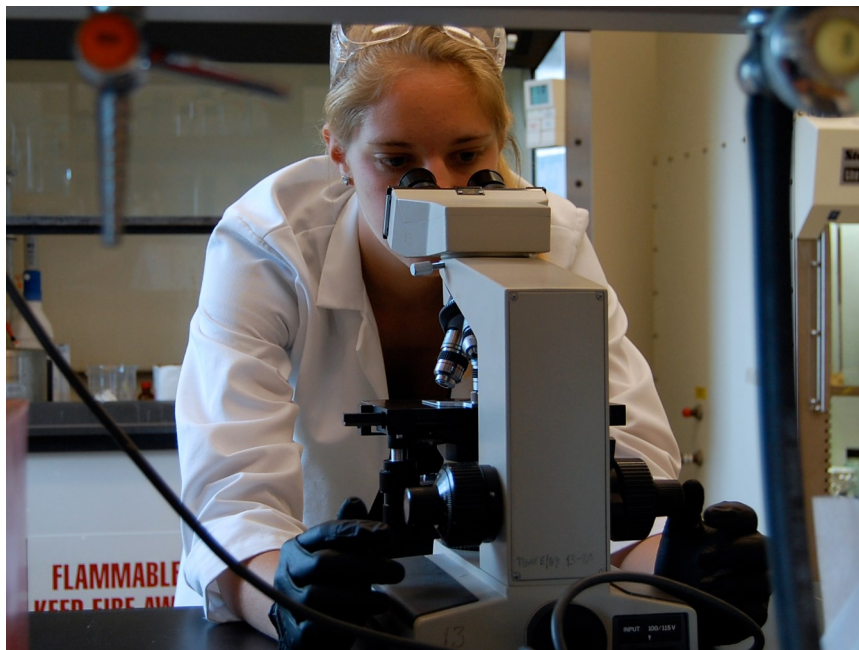
Boetius, A., Anesio, A. M., Deming, J. W., Mikucki, J. A., & Rapp, J. Z. (2015). Microbial ecology of the cryosphere: sea ice and glacial habitats. *Nature Reviews, Microbiology*, 13(11), 677–690. <http://doi.org/10.1038/nrmicro3522>

Briggs, A., Bau, D., Meeks, C., & Yongpradit, P. (2015). Supporting the computer science learning process (pp. 269–270). Presented at the SIGCSE 2015 – Proceedings of the 46th ACM Technical Symposium on Computer Science Education. <http://doi.org/10.1145/2676723.2677334>

Briggs, A., & Brown, Q. (2015). AP® computer science principles: A conversation with the college board. *ACM Inroads*, 6(4), 102–104. <http://doi.org/10.1145/2835851>

Brown, Q., & Briggs, A. (2015). The CS10K initiative – Progress in K-12 through “exploring computer science”: Part 1. *ACM Inroads*, 6(3), 52–53. <http://doi.org/10.1145/2735851>





[doi.org/10.1145/2803178](https://doi.org/10.1145/2803178)

Caminiti, N. S., Goodstein, M. B., Leibler, I. N.-M., Holtzman, B. S., Jia, Z. B., Martini, M. L., ... **Bunt, R. C.** (2015). Reversible nucleophilic addition can lower the observed enantioselectivity in palladium-catalyzed allylic amination reactions with a variety of chiral ligands. *Tetrahedron Letters*, 56(40), 5445–5448. <http://doi.org/10.1016/j.tetlet.2015.08.010>

Carpenter, J., Dray, T., Olinick, M., Pollatsek, H., Redish, E., and Wagner, J. (2015), *CUPM Curriculum Guide Program Area Study Group: Physics*, Mathematical Association of America. [http://www2.kenyon.edu/Depts/Math/schumacherc/public\\_html/Professional/CUPM/2015Guide/Program%20Reports/PhysicsPASGReportLong.pdf](http://www2.kenyon.edu/Depts/Math/schumacherc/public_html/Professional/CUPM/2015Guide/Program%20Reports/PhysicsPASGReportLong.pdf)

Cherniak, D. J., **Amidon, W.**, Hobbs, D., & Watson, E. B. (2015). Diffusion of helium in carbonates: Effects of mineral structure and composition. *Geochimica et Cosmochimica Acta*, 165, 449–465. <http://doi.org/10.1016/j.gca.2015.06.033>

Clifton, J., **Seehuus, M.**, & Rellini, A. H. (2015). Testing cognitive predictors of individual differences in the sexual psychophysiological responses of sexually functional women. *Psychophysiology*, 52(7), 957–968.

<http://doi.org/10.1111/psyp.12423>

**Coish, R.**, Kim, J., Twelker, E., Zolkos, S., & Walsh, G. (2015). Geochemistry and origin of metamorphosed mafic rocks from the lower paleozoic Moretown and Cram Hill formations of north-central Vermont: Delamination magmatism in the Western New England Appalachians. *American Journal of Science*, 315(9), 809–845. <http://doi.org/10.2475/09.2015.02>

Crepps, S. C., Fields, E. E., Galan, D., Corbett, J. P., Von Hasseln, E. R., & **Spatafora, G. A.** (2015). The SloR Metalloregulator is Involved in the *Streptococcus mutans* Oxidative Stress Response. *Molecular Oral Microbiology*. <http://doi.org/10.1111/omi.12147>

D'Aloia, C. C., Azodi, C. B., **Sheldon, S. P.**, Trombulak, S. C., & Ardren, W. R. (2015). Genetic models reveal historical patterns of sea lamprey population fluctuations within Lake Champlain. *PeerJ*, 2015(10). <http://doi.org/10.7717/peerj.1369>

Dugan, H. A., Doran, P. T., Tulaczyk, S., **Mikucki, J. A.**, Arcone, S. A., Auker, E., ... Virginia, R. A. (2015). Subsurface imaging reveals a confined aquifer beneath an ice-sealed Antarctic lake. *Geophysical Research Letters*, 42(1), 96–103. <http://doi.org/10.1002/2014GL062431>



Ervin, V., Kubacki, M., Layton, W., Moraiti, M., Si, Z., & Trenchea, C. (2015). On limiting behavior of contaminant transport models in coupled surface and groundwater flows. *Axioms*, 4, 518–529. <http://doi.org/10.3390/axioms4040518>

Flack, W. F., Jr., Kimble, M. O., Campbell, B. E., Hopper, A. B., Petercă, O., & Heller, E. J. (2015). Sexual Assault Victimization Among Female Undergraduates During Study Abroad: A Single Campus Survey Study. *Journal of Interpersonal Violence*, 30(20), 3453–3466. <http://doi.org/10.1177/0886260514563833>

Foust, R.D., Bauer, A. M., Costanza-Robinson, M. S., Blinn, D. W., Prince, R. C., Pickering, I. J., & George, G. N. (2015). Arsenic Transfer and Bio-transformation in a Fully Characterized Freshwater Food Web. *Coordination Chemistry Reviews*, 2015. <http://doi.org/10.1016/j.ccr.2015.03.005>

Giddings, L. A. & Newman, D. J. (2015). *Bioactive Compounds from Extremophiles: Genomic Studies, Biosynthetic Gene Clusters, and New Dereplication Methods*. Cham: Springer International Publishing. <http://link.springer.com/10.1007/978-3-319-14836-6>

Giddings, L. A. & Newman, D. J. (2015). *Bioactive Compounds from Marine Extremophiles*. Cham: Springer-

er International Publishing. <http://link.springer.com/10.1007/978-3-319-14361-3>

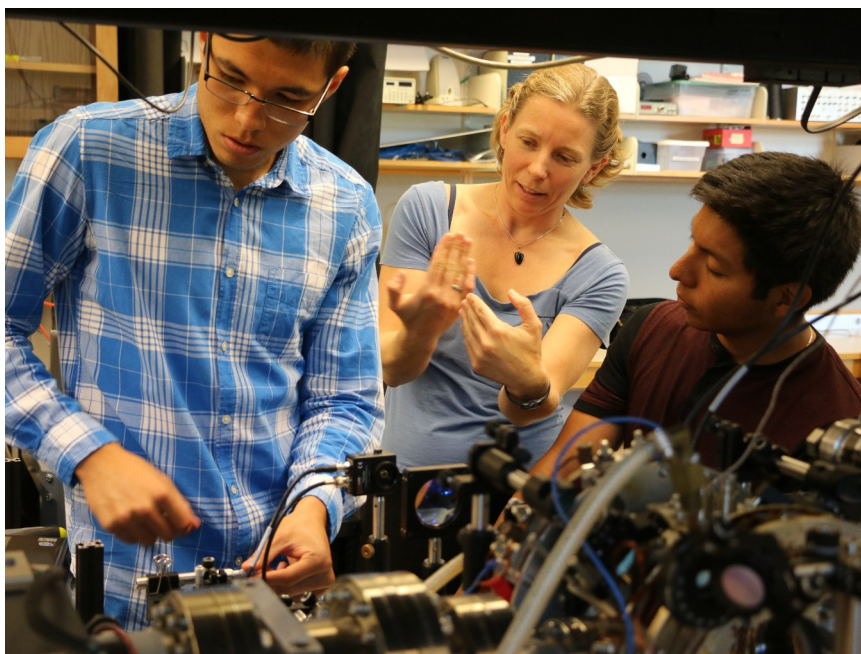
Giddings, L. A. & Newman, D. J. (2015). *Bioactive Compounds from Terrestrial Extremophiles*. Cham: Springer International Publishing. <http://link.springer.com/10.1007/978-3-319-13260-0>

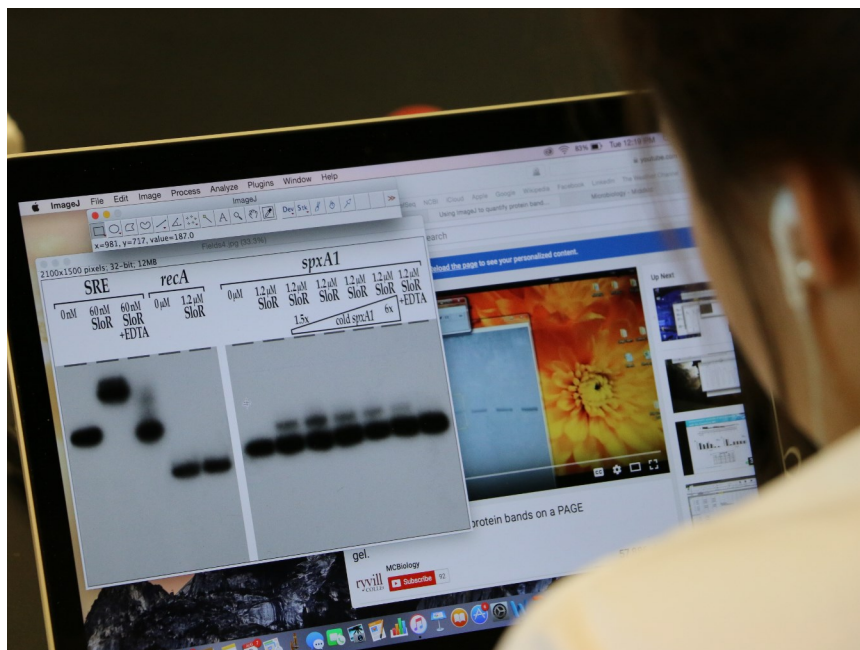
Glikman, E., Simmons, B., Mailly, M., Schawinski, K., Urry, C. M., & Lacy, M. (2015). Major mergers host the most-luminous red quasars at  $z \sim 2$ : A *Hubble Space Telescope* WFC3/IR study. *Astrophysical Journal*, 806 (2). <http://doi.org/10.1088/0004-637X/806/2/218>

Graham, M. J., Djorgovski, S. G., Stern, D., Drake, A. J., Mahabal, A. A., Donalek, C., ... Glikman, E. (2015). A systematic search for close supermassive black hole binaries in the Catalina real-time transient survey. *Monthly Notices of the Royal Astronomical Society*, 453(2), 1562–1576. <http://doi.org/10.1093/mnras/stv1726>

Graham, M. J., Djorgovski, S. G., Stern, D., Glikman, E., Drake, A. J., Mahabal, A. A., ... Christensen, E. (2015). A possible close supermassive black-hole binary in a quasar with optical periodicity. *Nature*, 518(7537), 74–76. <http://doi.org/10.1038/nature14143>

Gurland, S. T., & Evangelista, J. E. (2015). Teacher-





student relationship quality as a function of children's expectancies. *Journal of Social and Personal Relationships*, 32(7), 879–904. <http://doi.org/10.1177/0265407514554511>

Hennet, M. L., & Combelles, C. M. H. (2015). Animal models for developing clinical lab procedures. In *Biennial Review of Infertility* (Vol. 4, pp. 1–107).

Howarth, J. (2015). Learning by solving problems: Cognitive load theory and the re-design of an introductory GIS course. *Cartographic Perspectives*, 2015(80), 18–34. <http://doi.org/10.14714/CP80.1320>

Howarth, J. T. (2015). A framework for teaching the timeless way of mapmaking. *Cartography and Geographic Information Science*, 42, S6–S10. <http://doi.org/10.1080/15230406.2015.1058693>

Jiang, N., Kubacki, M., Layton, W., Moraiti, M., & Tran, H. (2015). A Crank-Nicolson Leapfrog stabilization: Unconditional stability and two applications. *Journal of Computational and Applied Mathematics*, 281, 263–276. <http://doi.org/10.1016/j.cam.2014.09.026>

Kim, D., Im, M., Glikman, E., Woo, J.-H., & Urrutia, T. (2015). Accretion Rates of Red Quasars from the Hydrogen P-Beta Line. *Astrophysical Journal*, 812(1). <http://doi.org/10.1088/0004-637X/812/1/66>

Kipouros, I., Fica-Contreras, S. M., Bowe, G. J. K., & Choi, S. (2015). Oxidation of 5'-dGMP, 5'-dGDP, and 5'-dGTP by a Platinum(IV) Complex. *Journal of Biological Inorganic Chemistry*, 2015(20), 1327–1341. <http://doi.org/10.1007/s00775-015-1312-0>

Klyza, C. M., & Trombulak, S. C. (2015). *The Story of Vermont: A Natural and Cultural History, Second Edition* (2 edition). Hanover: UPNE.

Kubacki, M., & Moraiti, M. (2015). Analysis of a second-order, unconditionally stable, partitioned method for the evolutionary stokes-darcy model. *International Journal of Numerical Analysis and Modeling*, 12(4), 704–730.

Larrabee, J. A., Schenk, G., Mitić, N., & Riley, M. J. (2015). Use of magnetic circular dichroism to study dinuclear metallohydrolases and the corresponding biometics. *European Biophysics Journal*, 44(6), 393–415. <http://doi.org/10.1007/s00249-015-1053-6>

Les, D. H., Peredo, E. L., Tippery, N. P., Benoit, L. K., Razifard, H., King, U. M., ... Sheldon, S. P. (2015). *Najas minor* (Hydrocharitaceae) in North America: A reappraisal. *Aquatic Botany*, 126, 60–72. <http://doi.org/10.1016/j.aquabot.2015.06.005>

Macdonald, F. A., Ryan-Davis, J., Coish, R. A., Crow-

ley, J. L., & Karabinos, P. M. (2015). A newly identified Gondwanan terrane in the northern Appalachian Mountains: Implications for the Taconic orogeny and closure of the Iapetus Ocean. *Geology*, 43(4), e360. <http://doi.org/10.1130/G36575Y.1>

Mango, H., & Ryan, P. (2015). Source of arsenic-bearing pyrite in southwestern Vermont, USA: Sulfur isotope evidence. *Science of the Total Environment*, 505, 1331–1339. <http://doi.org/10.1016/j.scitotenv.2014.03.072>

Mikucki, J. A., Auken, E., Tulaczyk, S., Virginia, R. A., Schamper, C., Sørensen, K. I., ... Foley, N. (2015). Deep groundwater and potential subsurface habitats beneath an Antarctic dry valley. *Nature Communications*, 6. <http://doi.org/10.1038/ncomms7831>

Munroe, J. S., Attwood, E. C., O'Keefe, S. S., & Quackenbush, P. J. M. (2015). Eolian deposition in the alpine zone of the Uinta Mountains, Utah, USA. *Catena*, 124, 119–129. <http://doi.org/10.1016/j.catena.2014.09.008>

Nelson, L., Trautman, L., & Nelson, P. B. (2015). Latino Immigrants and Rural Gentrification: Race, “Illegality,” and Precarious Labor Regimes in the United States. *Annals of the Association of American Geog-*

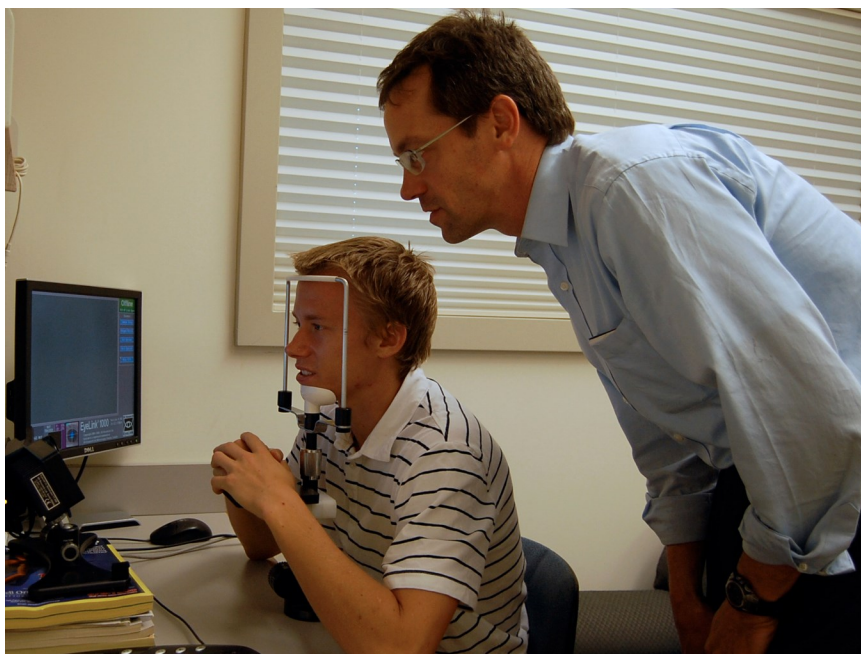
*raphers*, 105(4), 841–858. <http://doi.org/10.1080/00045608.2015.1052338>

Noss, R. F., Dobson, A. P., Baldwin, R., Beier, P., Davis, C. R., Dellasala, D. A., ... Trombulak, S. C. (2015). Bolder thinking for conservation. In *Protecting the Wild: Parks and Wilderness the Foundation for Conservation* (pp. 16–20).

Olinick, M. (2015). Discovering Infinity. *Journal of Inquiry Based Learning in Mathematics*, 38(2015). <http://www.jiblm.org/downloads/dlitem.php?id=102&category=jiblmjournal>

Olinick, M. (2015) “Recidivism in the Criminal Justice System,” “Evolutionary Game Theory,” and “Agent Based Simulation,” online chapters to supplement *Mathematical Modeling in the Social and Life Sciences*, John Wiley & Sons. <http://bcs.wiley.com/he-bcs/Books?action=contents&itemId=1118642694&bcsId=8975>

Pigeon, W. R., Heffner, K. L., Crean, H., Gallegos, A. M., Walsh, P., Seehuus, M., & Cerulli, C. (2015). Responding to the need for sleep among survivors of interpersonal violence: A randomized controlled trial of a cognitive-behavioral insomnia intervention followed by PTSD treatment. *Contemporary Clinical Trials*, 45(Pt B), 252–260. <http://doi.org/10.1016/j.cct.2015.08.019>







Pallares, L. F., Carbonetto, P., Gopalakrishnan, S., Parker, C. C., Ackert-Bicknell, C. L., Palmer, A. A., & Tautz, D. (2015). Mapping of Craniofacial Traits in Outbred Mice Identifies Major Developmental Genes Involved in Shape Determination. *PLoS Genetics*, 11 (11). <http://doi.org/10.1371/journal.pgen.1005607>

Ryan, P. C., West, D. P., Hattori, K., Studwell, S., Allen, D. N., & Kim, J. (2015). The influence of metamorphic grade on arsenic in metasedimentary bedrock aquifers: A case study from Western New England, USA. *Science of the Total Environment*, 505, 1320–1330. <http://doi.org/10.1016/j.scitotenv.2014.05.021>

Schide, K. H., & Munroe, J. S. (2015). Alpine Soil Parent Materials and Pedogenesis in the Presidential Range of New Hampshire, U.S.A. *Arctic, Antarctic, and Alpine Research*, 47(3), 481–494. <http://doi.org/10.1657/AAAR0014-052>

Schmitz, O. J., Lawler, J. J., Beier, P., Groves, C., Knight, G., Boyce, D. A., Jr., ... Trombulak, S. C. (2015). Conserving biodiversity: Practical guidance about climate change adaptation approaches in support of land-use planning. *Natural Areas Journal*, 35(1), 190–203. <http://doi.org/10.3375/043.035.0120>

Schoenefeld, J. J., & McCauley, M. R. (2015). Local is

not always better: the impact of climate information on values, behavior and policy support. *Journal of Environmental Studies and Sciences*, 1–9. <http://doi.org/10.1007/s13412-015-0288-y>

Siconolfi, D. E., Kapadia, F., Moeller, R. W., Eddy, J. A., Kupprat, S. A., Kingdon, M. J., & Halkitis, P. N. (2015). *Body Dissatisfaction in a Diverse Sample of Young Men Who Have Sex With Men: The P18 Cohort Study*. <http://doi.org/10.1007/s10508-015-0592-3>

Siconolfi, D. E., Halkitis, P. N., & Moeller, R. W. (2015). Homo economicus: young gay and bisexual men and the new public health. *Critical Public Health*, 25(5), 554–568. <http://doi.org/10.1080/09581596.2014.906565>

Soria, R., Kuntz, K. D., Long, K. S., Blair, W. P., Plucinsky, P. P., & Winkler, P. F. (2015). The slim-disk state of the ultraluminous X-ray source in M83. *Astrophysical Journal*, 799(2). <http://doi.org/10.1088/0004-637X/799/2/140>

Spatafora, G., Corbett, J., Cornacchione, L., Daly, W., Galan, D., Wysota, M., ... Glasfeld, A. (2015). Interactions of the metalloregulatory protein SloR from *Streptococcus mutans* with its metal ion effectors and DNA binding site. *Journal of Bacteriology*, 197(22), 3601–



3615. <http://doi.org/10.1128/JB.00612-15>

Starus, A., Nocek, B., Bennett, B., Larrabee, J. A., Shaw, D. L., Sae-Lee, W., ... Holz, R. C. (2015). Inhibition of the *dapE*-Encoded *N*-Succinyl-L, L-diaminopimelic Acid Desuccinylase from *Neisseria meningitidis* by L-Captopril. *Biochemistry*, 54(31), 4834–4844. <http://doi.org/10.1021/acs.biochem.5b00475>

Weigel, H., Quandt, M., & Graham, N. (2015). Quantum stabilization of cosmic strings. *Modern Physics Letters A*, 30(27). <http://doi.org/10.1142/S0217732315300220>

Williams, B. F., Wold, B., Haberl, F., Garofali, K., Blair, W. P., Gaetz, T. J., ... Winkler, P. F. (2015). A deep XMM-Newton survey of M33: Point-source catalog, source detection, and characterization of overlapping fields. *Astrophysical Journal, Supplement Series*, 218(1). <http://doi.org/10.1088/0067-0049/218/1/9>

Wu, H., Spatafora, G., Fenno, C., & Mintz, K. (2015). Tribute. *Molecular Oral Microbiology*, 30(4), 253–254. <http://doi.org/10.1111/omi.12105>

Yazdani, N., Parker, C. C., Shen, Y., Reed, E. R., Guido, M. A., Kole, L. A., ... Bryant, C. D. (2015). *Hnnrph1* Is A Quantitative Trait Gene for Methamphetamine

Sensitivity. *PLoS Genetics*, 11(12). <http://doi.org/10.1371/journal.pgen.1005713>

Yurcheshen, M., Seehuus, M., & Pigeon, W. (2015). Updates on Nutraceutical Sleep Therapeutics and Investigational Research. *Evidence-Based Complementary and Alternative Medicine: eCAM*, 2015, 105256. <http://doi.org/10.1155/2015/105256>



# New Research Grants

**Stephen Abbott** (Mathematics) has been awarded a one-month research fellowship from the Harry Ransom Center at the University of Texas in support of the book project, titled *Mathematics as Art in Contemporary Theater*, that he will be pursuing during his academic leave in 2016–17. The fellowship will enable him to conduct research on the Center’s collection of Tom Stoppard materials, as well as other 20th century theater materials.

**Priscilla Bremser** (Mathematics) is Middlebury’s representative in a network of 61 liberal arts institutions that will benefit from a Teaching Experiences for Undergraduates (TEU) grant awarded to Vassar College by the National Science Foundation. Entitled Summer STEM Teaching Experiences for Undergraduates from Liberal Arts Institutions, this grant will provide opportunities in each of the next five summers for 24 students from the network to participate in programs that involve a pedagogy course (math or science) and a teaching practicum with urban high school students. Co-investigators are faculty at Barnard College, Brown University, Bryn Mawr College, and Trinity College. Although no funds come directly to Middlebury, this grant provides an exciting opportunity for which our students are eligible to apply.

**Catherine Combelles** (Biology and Molecular Biology & Biochemistry) received a sabbatical grant from the U.S. Department of Agriculture’s National Institute of Food and Agriculture to support her 2015–16 academic leave. The grant covered leave salary and expenses related to research that she conducted at the French National Institute for Agricultural Research (INRA) in Toulouse, France. This grant enabled Catherine to acquire advanced metabolomic approaches for use in studies on the microenvironment of the developing follicle in cow ovaries.

**Molly Costanza-Robinson** (Environmental Studies and Chemistry & Biochemistry) has been awarded a three-year grant from the National Science Foundation through its Research at Undergraduate Institutions mechanism for a project titled *Elucidating Interlayer Chemistry for Design of Novel, Nontoxic Organoclays for Contaminant Remediation*. The project involves 2–3 undergraduate researchers each year to elucidate how the chemistry of activated clay minerals (organoclays), specifically their interlayer crystallinity, relates to their ability to remove organic contaminants from water. The lab will apply this information to the task of designing novel organoclays for more effective contaminant removal. Students in the Environmental Chemistry course will also participate in the project by testing the toxicity





of the novel organoclays.

**Michael Durst** (Physics) received a project grant from the Vermont Genetics Network grants for Research in the Biomedical Sciences through the National Institutes of Health. The project is titled High-Speed 3D Multiphoton Fluorescence Imaging with Temporal Focusing Microscopy. The proposed work aims to improve the speed of 3D multiphoton microscopy through temporal focusing, with the goal of reaching video-rate 3D imaging in biological tissue. The grant provides funding for summer and academic-year effort for Prof Durst from June 2015–May 2016 and includes a summer stipend for one undergraduate student.

**Glen Ernstrom** (Biology and Neuroscience) won a competitive renewal of his project grant from the Vermont Genetics Network for research in the Biomedical Sciences through the National Institutes of Health. It is titled Genetic Analysis of Neurotransmitter Release in *C. elegans*. The proposed research will help to clarify nerve signaling mechanisms and potentially lead to improved drug therapies for neural disorders. The grant provides funding for summer and academic-year effort for Prof. Ernstrom from June 2016–May 2017 and includes a summer stipend for four undergraduate students.

**Eilat Glikman** (Physics) and colleagues at California Institute of Technology have received a grant from the National Science Foundation for a project titled New Insights from a Systematic Approach to Quasar Variability. The goal of this project is to understand the physics of supermassive black hole growth in the nuclei of galaxies by utilizing time-domain information. The grant provides support for two Middlebury undergraduates who will work with scientists at Caltech, and use cutting-edge techniques in data science, to extract meaningful results from these large data sets.

**Eilat Glikman** (Physics) has been awarded a grant from the National Aeronautics and Space Administration to lead a research project titled Probing Accretion and Obscuration in Luminous Red Quasars. This one year project, involving collaborators from Yale University, the National Radio Astronomy Observatory, the Astronomical Observatory of Rome and the Leibniz Institute of Astrophysics in Potsdam, Germany, is based on observations of two luminous quasars with the XMM-Newton X-ray space observatory. These quasars are hypothesized to be growing at their maximally allowed rate, giving off tremendous luminosity. However, because of dust in their immediate environments, their visible light is extinguished. These X-ray observations will measure the amount of gas that is blocking visible



light and probe the growth of the quasars independently for comparison with other existing estimates. The result of this work will complete the multi-wavelength study of this key population of quasars.

**Noah Graham** (Physics) has been awarded a three-year grant from the National Science Foundation for work on a project titled Casimir Forces From Scattering Theory. The project will carry out calculations of Casimir forces, which arise from quantum-mechanical fluctuations at the short distance scales relevant to nanotechnology. The approach is based on developing broadly applicable numerical techniques for computing the reflection and transmission of light. This work will be carried out in collaboration with a research group based at the Massachusetts Institute of Technology and will involve at least four Middlebury student researchers.

**Tom Manley** (Geology) has received a grant from the Lintilhac Foundation for the second year of a project titled High-Resolution Bottom Mapping of Lake Champlain. This long term effort will update the 2005 bottom bathymetric map of Lake Champlain and provide a significant increase in the resolution of the map of the lake bottom that is important to the recreation, research, and management communities.

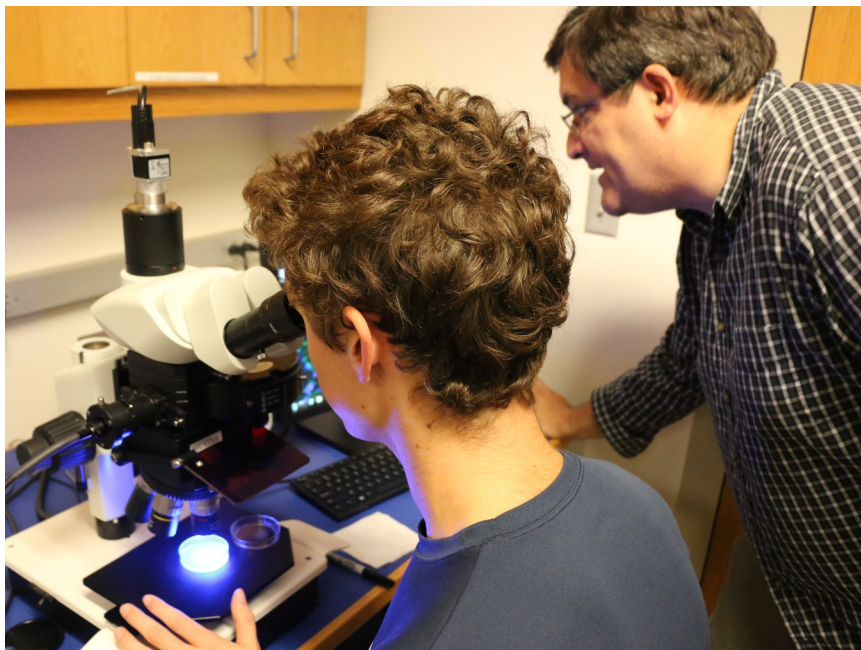
**Pat Manley** (Geology) has been awarded a fellowship

from the Marion and Jasper Whiting Foundation for a project titled Reading the Rocks: A History of Modern Geology. The grant will fund travel in England and Scotland this summer to geologic locations that are key to understanding the history of modern geology and to museums and historic sites that will bring to life the geologists who founded this field. Pat's goal is to enhance her teaching of introductory and advanced geology by adding sections on the history of geologic thought.

**Jill Mikucki** (Biology) has received funding from the National Science Foundation for her expenses in a collaborative research project titled Minimally Invasive Drilling Glacial Exploration (MIDGE). Originally awarded to Jill when she was at the University of Tennessee, the grant has now been transferred to Middlebury and will support the design and testing of a minimally invasive thermoelectric probe for sample retrieval from subglacial environments in Antarctica. These dark environments provide an excellent opportunity for researching survivability and adaptability of microbial life, and they represent potential terrestrial analogues for life habitats on icy planetary bodies. This grant will support the efforts of a Ph.D.-level technician and at least one undergraduate student.

**Jeff Munroe** (Geology) has received a three-year grant





from the National Science Foundation through its Research in Undergraduate Institutions mechanism for a research project titled RUI: Alpine Loess, Periglacial Uplands, and Exotic Additions: Investigating Past and Present Dust Deposition in the Alpine Zone of the Uinta Mountains, Utah. At least six undergraduate students will be involved in this research, which will lead to better knowledge about modern and past dust deposition in this part of the western United States and thus has the potential to aid in land management decisions in the future.

**Jeff Munroe** (Geology) received an award from the American Philosophical Society for a research project titled Developing a Record of Holocene Environmental Change from an Idaho Ice Cave. The project, which was matched by an award from Middlebury, supported Jeff and two undergraduate students as they explored the potential paleoclimate significance of a recently discovered subterranean ice deposit.

**Clarissa Parker** (Psychology and Neuroscience) received a project grant from the Vermont Genetics Network grants for Research in the Biomedical Sciences through the National Institutes of Health. The project is titled Genome-wide Association for Ethanol Sensitivity in the DO Mouse Population. The goal of this

work is to use a highly recombinant mouse population to map genes associated with ethanol sensitivity. Understanding the pathways linking genetic variation and expression to neuronal function may enable targeting of specific molecules to treat alcohol use disorders in humans. The grant provides funding for summer and academic-year effort for Prof. Parker from June 2015–May 2016 and includes summer stipends for two undergraduate students.

**AnGayle (AJ) Vasiliou** (Chemistry & Biochemistry) received a renewal of her project grant from the Vermont Genetics Network grants for Research in the Biomedical Sciences through the National Institutes of Health. It is titled Thermal Composition of Biomass: Molecular Pathways for Sulfur Chemistry. The aim of this research is to elucidate the detailed chemical mechanisms and kinetics associated with the thermal decomposition of sulfur compounds found in biomass feedstock. The results of this work can be used to develop a sound strategy to suppress the formation of poisonous sulfur compounds during biomass decomposition, generating clean liquid fuels and ultimately lowering sulfur emissions. The grant provides funding for summer and academic-year effort for Prof. Vasiliou from June 2015–May 2016 and includes summer stipends for two undergraduate students.

**Frank Winkler** (Physics, Emeritus) has been awarded funding from the NASA-funded Space Telescope Science Institute for his role in two collaborative research projects, both of which entail new observations using the Hubble Space Telescope. One project, entitled Thermal Equilibration and Cosmic-Ray Acceleration in Astrophysical Shocks: UV Spectra of the SN1006 Remnant, will combine forthcoming Hubble ultraviolet spectra with new data Winkler hopes to gather at the 6.5 meter Magellan telescope in Chile in April, to explore the fundamental physics of shock waves in a cosmic environment. The other project, entitled State Transitions of the Ultra-luminous X-ray Source in M83, is intended as a follow-up to better understand a highly unusual object in the “nearby” (15 million light years away) galaxy M83, where matter falling into a black hole produces so much radiation that fundamental laws of physics are close to being violated. The projects involve collaboration with colleagues at the Harvard-Smithsonian Center for Astrophysics, Johns Hopkins University, and Curtin University in Australia.





# Major Curricular Developments

**Susan Baldrige** (Psychology, Provost) and **Marcia Collaer** (Psychology and Neuroscience) co-taught a new senior seminar entitled *Lenses on Sex and Gender* which explored the topics of sex and gender from diverging perspectives drawing predominantly on diverse biological and social psychological approaches.

**Amy Briggs** (Computer Science) offered a new winter-term course entitled “Programming for Novices.”

**Ananya Christman** (Computer Science) offered a new senior elective, “Advanced Algorithms”, and also redesigned the elective “Introduction to Cryptography.”

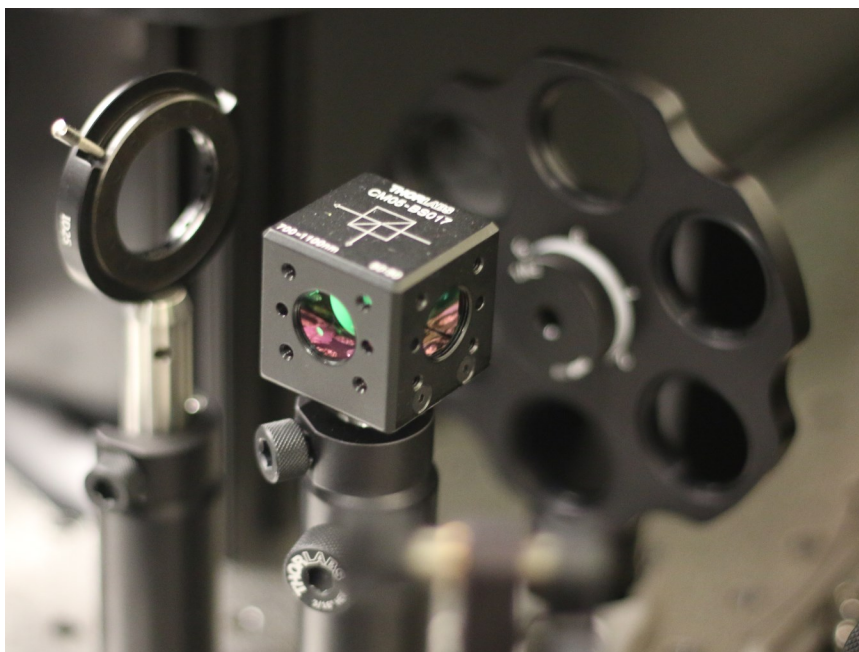
**Molly Costanza-Robinson** (Environmental Studies and Chemistry & Biochemistry) retitled and significantly revised her environmental chemistry course. *Environmental Chemistry & Health* includes a greater emphasis on human health impacts and environmental justice aspects of chemical pollution.

**Michael Durst** (Physics) offered a new physics course called *Biomedical Imaging*.

**Glen Ernstom** (Biology and Neuroscience) and **Amanda Crocker** (Neuroscience) offered Middlebury’s first course in Cellular and Molecular Neuroscience as part of the new Neuroscience core curriculum. Among the exciting new laboratory experiments that were devel-

oped was the use of new equipment that allows students to perform intracellular membrane potential recordings in crayfish muscles and in leech neural ganglia. In addition, new extracellular recording equipment was used to analyze action potential propagation in earthworms. Students used research-grade microscopes and cameras to perform live-cell neural-imaging experiments, and they learned how to process and analyze images using advanced image analysis software. Further, this course provided an opportunity for students to work with model organisms primarily studied by Ernstom (the roundworm *C. elegans*) and Crocker (the fruitfly *Drosophila melanogaster*) — model organisms studied by researchers throughout the world. This course combined with the new core course in neural systems and cognitive neuroscience aims to provide all majors with a state-of-the-art, well-rounded foundation in neuroscience.

**Pete Johnson** (Computer Science) offered a new winter-term course entitled “Crash Course in Systems Security” in which students worked for 25 hours each week exploring and fixing vulnerable software and network systems.





# Student Research

**Olivia Artaiz and Eliza Ferrari** (Neuroscience majors) worked with Mark Spritzer (Biology and Neuroscience) during the academic year on a Neuroscience 700 project. Their project tested for possible memory restorative effects of a growth factor mimic using a transgenic mouse model of Alzheimer's disease.

**Laura Bashor** (Biology major) conducted summer research with Sallie Sheldon (Biology) collecting and analyzing Lake Champlain sediment cores at the mouth of rivers.

**Katherine Bauman, Jeremy Carter, Katherine Johnson, Miller Judge, and Lauren McLean** (Chemistry & Biochemistry and Molecular Biology & Biochemistry majors) worked with Lesley-Ann Giddings (Chemistry & Biochemistry) during the summer and academic year on a thesis project (Bauman) and independent research projects focused on producing new secondary metabolites by activating cryptic gene clusters in Antarctic *Marinobacter*. They activated these gene clusters by coculturing *Marinobacter* sp. with other fungi, extracted cocultures, and partially characterized new metabolites.

**Bayliegh Biebel** (Molecular Biology & Biochemistry major) worked with Bob Cluss (Chemistry & Biochemistry and Molecular Biology & Biochemistry) during the summer and academic year on a project that investigat-

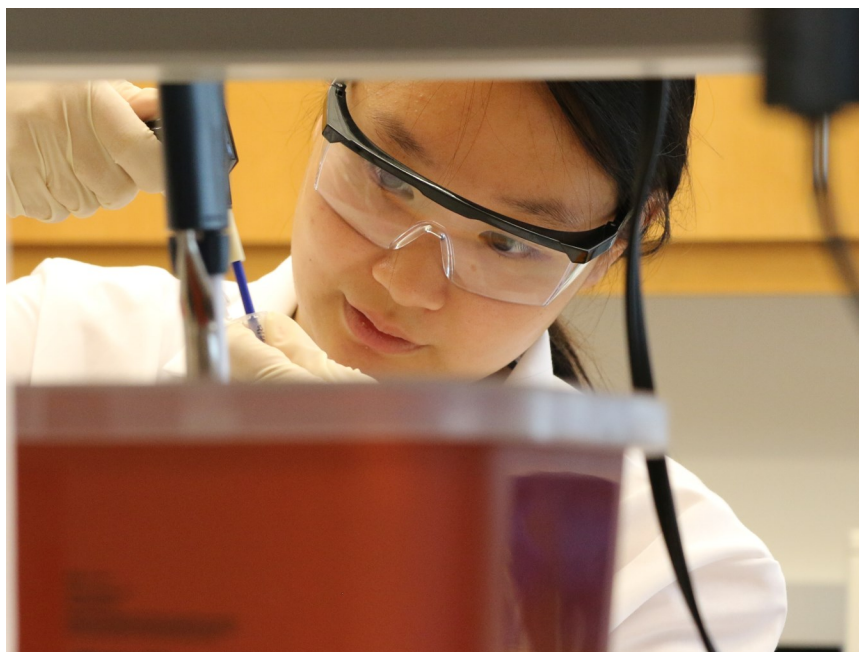
ed how specific mutations in the enolase produced by *Borrelia burgdorferi* affect enzyme kinetics.

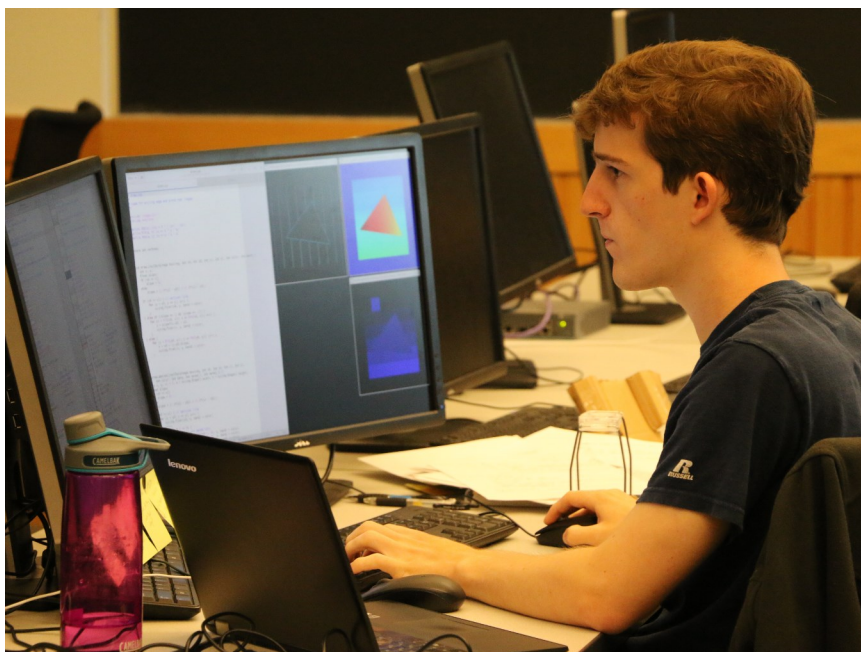
**Julian Billing** (Computer Science major) worked with Christopher Andrews (Computer Science) on MiddGuard, a platform for developing visual analytics tools.

**Erin Birdsall and Waleed Helweh** (Chemistry & Biochemistry majors) worked with Jim Larrabee (Chemistry & Biochemistry) during the academic year on a senior thesis project (Birdsall) and an independent research project (Helweh) that used magnetic circular dichroism spectroscopy to characterize the electronic structures of cobalt(II) ions in the active sites of dicobalt (II) hydrolase enzymes.

**Benjamin Bogin** (Molecular Biology & Biochemistry major) conducted research with Catherine Combelles (Biology and Molecular Biology & Biochemistry) to examine the effect of bisphenol-A on oocyte maturation in the bovine. His work was presented in a poster at the annual meeting of the Society for the Study of Reproduction.

**Valarie Braddick** (Neuroscience major) worked with Mark Spritzer (Biology and Neuroscience) during the academic year on a Neuroscience 700 project. Her





experiment tested for dose-dependent effects testosterone on spatial memory in male rats. Her results will be presented at the Society for Neuroscience meeting in 2016, and she is a co-author on a manuscript that is in preparation.

**Amity Calvin** (Biology major) worked with Tom Root (Biology and Neuroscience) during the academic year on an independent project studying individual differences of octopuses and how they respond to novel stimuli.

**Vera Chan** (Biology major) conducted research with Helen Young (Biology) to examine the effect of growing crops on soil previously occupied by buckwheat during the summer and academic year on her senior project. In addition, she examined the colonization of roots of these plants by beneficial mycorrhizal fungi.

**Davin Chia** (Computer Science and Mathematics major) worked with Ananya Christman (Computer Science) during the academic year on algorithms for fault-tolerant application hosting for server clusters.

**Kevin Conroy and Danny Plunkett** (Physics majors) worked with Eilat Glikman (Physics) during the spring semester on their senior research project to calibrate and determine the performance of the Middlebury Col-

lege Observatory's new camera and newly aluminized mirror. The students conducted observations with the College Observatory of standard stars. They reduced and analyzed the data to determine the zero-point magnitude of the Observatory's filter set.

**Ali Cook** (Molecular Biology & Biochemistry major) worked with Jeremy Ward (Biology and Molecular Biology & Biochemistry) continued work begun at Stanford on the chromatin states normal vs. virulent yeast strains as measured by advanced genomic sequencing techniques.

**Alexis Coolidge** (Molecular Biology & Biochemistry major) conducted research with Catherine Combelles (Biology and Molecular Biology & Biochemistry) to investigate the effect of bisphenol-A on theca cells in a bovine model.

**Rachel Copulsky** (Psychology major) worked with Michelle McCauley (Psychology) on a project entitled *Humor, Metaphor, and the Environment*. This project was focused on science communication. In particular, the role of metaphor in helping people understand and remember environmental information. Specifically, she tested which types of metaphors facilitate attention to environmental science, recall of presented information, and policy support.

**Tim Crocker, Bianca Messner, and Matt Stanley** (Computer Science majors) worked with Daniel Scharstein (Computer Science) on developing challenging test cases for stereo matching algorithms, as well as visualization tools for various stereo matching costs.

**Milêna Crnogorčević and Larson Lovdal** (Physics majors) together with **Carol Hundal** and **Henry Daniels-Koch** (KNAC REU students from Wellesley and Bowdoin, respectively) worked with Eilat Glikman (Physics) to study a sample of red quasars in a region of sky possessing multi-wavelength observations across the electromagnetic spectrum. They processed and analyzed optical and near-infrared spectra from ground-based telescope facilities on Mauna Kea, Hawaii, and X-ray spectra from the *Chandra* Space Telescope, a NASA facility. Larson continued this work in an independent study in winter term, 2016, to complete his analysis.

**Brandon Cushman** (Molecular Biology & Biochemistry major) completed a thesis for honors with Bob Cluss (Chemistry & Biochemistry and Molecular Biology & Biochemistry) on “The Expression and Partial Characterization of a Borrelial Phosphofructokinase.”

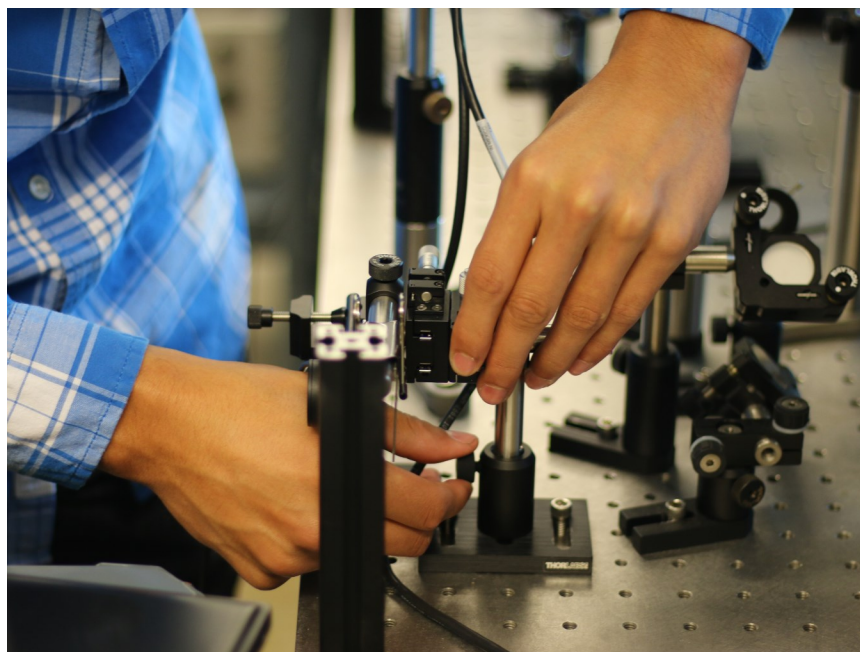
**C. Brennan Delattre** (Neuroscience major) worked with Marcia Collaer (Psychology and Neuroscience)

during the fall semester to analyze data collected in Brazil for a senior project entitled, *Capoeira: The Relationship of an Afro-Brazilian Movement Art to State Anxiety, State Self-Efficacy, and Prosocial Behavior Tendencies*.

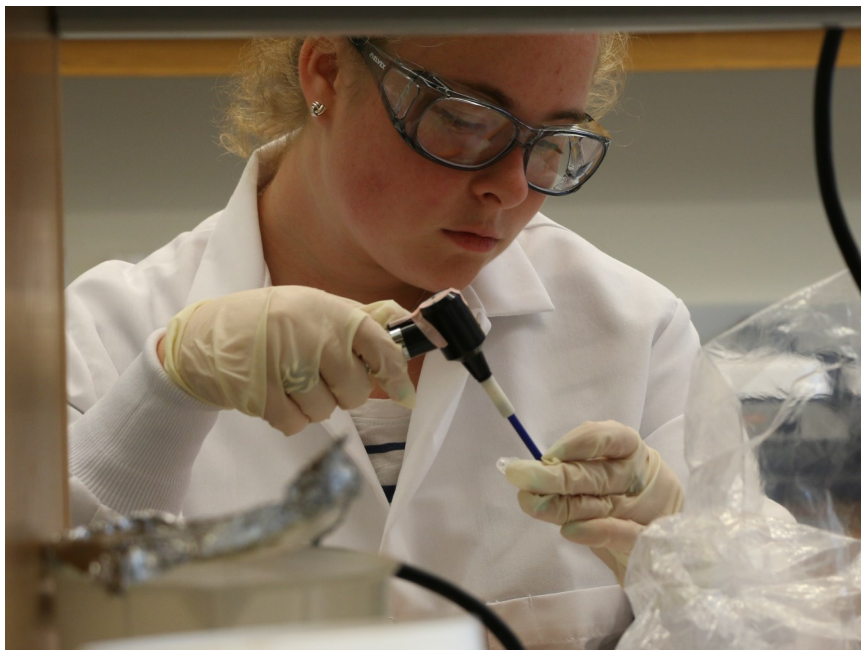
**Jack Desmarais** (Molecular Biology & Biochemistry major) worked with Jeremy Ward (Biology and Molecular Biology & Biochemistry) designed and built a sensor for the causative agent of Lyme disease using RNA-based riboswitches.

**Alec Drobac and Rob Bracken** (Physics majors) worked with Eilat Glikman (Physics) during the fall semester on their senior research project studying the optical and infrared properties of a sample of nearby Active Galactic Nuclei (AGN) to infer the distribution of dust and gas clouds surrounding the supermassive black hole in these unresolved systems.

**Julie Ehrlich** (Neuroscience major) conducted research with Catherine Combelles (Biology and Molecular Biology & Biochemistry) and Kelly Campen (Biology) to examine the effect of bisphenol-S on oocyte maturation in the bovine. Her work resulted in a poster presentation at the annual meeting of the Society for the Study of Reproduction.







**Jacob Epstein** (Physics major) worked with Michael Durst (Physics) during the summer and academic year on his senior thesis, building and characterizing an upright two-photon laser-scanning fluorescence microscope for 3D imaging of biological tissue. Jacob presented a poster titled “Construction of a Custom Two-Photon Microscope” at the Symposium on Undergraduate Research at the annual meeting of the Division of Laser Science of the American Physical Society in 2015.

**Eli Feinberg** and **James Ronan** (Physics majors) worked with Susan Watson (Physics) during the summer on a National Science Foundation-funded research project involving schemes for detecting the quantum states of solid state quantum bits used for quantum computation. The work is a collaboration with the Marcus group at the Center for Quantum Devices, University of Copenhagen.

**Kae Fink**, **Rachael Morris**, and **Emory Payne** (Chemistry & Biochemistry majors) worked with Molly Costanza-Robinson (Environmental Studies and Chemistry & Biochemistry) on senior theses and independent study projects to produce and characterize novel organoclay materials for use in remediation of organic contaminants from water. They also conducted contaminant adsorption experiments to begin understanding

what physicochemical properties of the materials govern their ability to remove contaminants from water. The students presented their work at the spring and summer research symposia and publicly as part of the senior thesis program.

**Drew Friedrichs** (Physics major) worked with Rich Wolfson (Physics) on fluid dynamic modeling of Middlebury’s new research vessel, the R/V Folger. He used a the finite-element modeling software COMSOL Multiphysics to show that the two-hull Folger has less drag and is therefore more energy efficient than its predecessor, the R/V Baldwin.

**Hannah Gelderman**, **Andrew Grant**, and **Betty Kobia** (Chemistry & Biochemistry and Environmental Studies majors) worked with Molly Costanza-Robinson (Environmental Studies and Chemistry & Biochemistry) on senior theses and a senior independent study project to investigate the use of a novel, non-intrusive indicator (in adults) of developmental exposure to chemicals that disrupt the hormone system. The students presented their work at the spring and summer research symposia and to the public as part of the thesis program, as well as provided preliminary data for a grant proposal submission to the National Institutes of Health.

**Teddy Gordon** (Physics major) worked with Michael

Durst (Physics) during the academic year on his senior project, designing and fabricating a printed circuit board for high-speed detection of electrical pulses for laser-scanning microscopy.

**Drew Gorin** (Geology major) worked with Jeff Munroe (Geology) on a year-long project developing a late Holocene stable-isotope based paleoclimate record from a speleothem collected from Weybridge Cave.

**Ilana M. Gratch** (Psychology major) worked with Robert Moeller (Psychology) on a senior thesis exploring leadership aspirations, perceived career barriers and social support in college-aged women. The research conducted from this thesis was presented at the 96<sup>th</sup> annual convention of the Western Psychological Association.

**Nathaniel Henning, Sebastian Fica Contreras, and Josephine Trichka** (Chemistry & Biochemistry majors) did independent research on the mechanism of Alzheimer's disease (AD) with Sunhee Choi (Chemistry & Biochemistry). Their preliminary results showed that the reaction of sugar and Amyloid Beta (a major protein in the AD brain) produced toxic reactive oxygen species (ROS) in the presence of copper ion. The reaction further resulted in the aggregated Amyloid Beta. Henning and Fica Contreras will continue this research as their

senior thesis projects under the working hypothesis that glycation (reaction of sugar and Amyloid Beta) in the presence of copper ion is the major chemical reaction which leads to AD.

**Will Henriques** (Molecular Biology & Biochemistry major) worked with Jeremy Ward (Biology and Molecular Biology & Biochemistry) to continue a project studying gene expression in the mouse hippocampus (a brain region).

**Lauren Henry** (Psychology major) worked with Michelle McCauley (Psychology) during the academic year investigating the extent that quality of teammate-teammate and teammate-coach relationships affect motivation, moral, and performance.

**Emily Hoff** (Molecular Biology & Biochemistry major) completed a research project with Catherine Combelles (Biology and Molecular Biology & Biochemistry) investigating the effect of bisphenol-A on glutathione in bovine granulosa cells.

**Sam Horn and Andrew Goulet** (Molecular Biology & Biochemistry majors) worked with Jeremy Ward (Biology and Molecular Biology & Biochemistry) to study the protein Hei10 in the context of human cancer and meiosis.





**Michelle Irei** (Neuroscience major) worked with Tom Root (Biology and Neuroscience) during the academic year on an independent project examining the literature on impulsivity in criminals with antisocial personality disorder.

**Eliza Jaeger** (Neuroscience major) worked with Mark Spritzer (Biology and Neuroscience) during the summer of 2015 on various research projects. She completed analyses on the relationship between hormone levels and neurogenesis in wild caught voles, and she will be presenting these results at the Society for Neuroscience meeting in 2016. She will be continuing an experiment testing the dose-dependent effects of testosterone on spatial memory in aged rats as her senior thesis.

**Jenny Jones** (Neuroscience major) worked with Tom Root (Biology and Neuroscience) during the academic year on an independent project examining how the movement of prey affects the predatory responses of octopuses.

**Chan Kim** (Chemistry & Biochemistry major) completed a thesis for honors with Bob Cluss (Chemistry & Biochemistry and Molecular Biology & Biochemistry) titled “Expression and Characterization of Glycerol Kinase and Glycerol-3-Phosphate Dehydrogenase in *Borrelia burgdorferi*”.

**Kristin Knutzen** (Neuroscience major) worked with Tom Root (Biology and Neuroscience) during the academic year on an independent project using clinical data from her work at Dartmouth Hitchcock Hospital on factors that predict aneurysm and treatment outcomes, which she presented at Posters on the Hill in Washington, D.C. in April.

**Katherine Kucharczyk** (Molecular Biology & Biochemistry major) conducted research with Catherine Combelles (Biology and Molecular Biology & Biochemistry) and Kelly Campen (Biology) to examine the effect of very low doses of bisphenol-A on oocyte maturation in the bovine. Her work resulted in a poster presentation at the annual meeting of the Society for the Study of Reproduction.

**Colin Laurence** (Physics major) worked with Michael Durst (Physics) during the summer on a project measuring the pulse width of a femtosecond-pulsed laser used for two-photon excitation. Colin presented a poster titled “Characterization of Ultrashort Laser Pulses” at the Symposium on Undergraduate Research at the annual meeting of the Division of Laser Science of the American Physical Society in 2015.

**Muriel Lavallee** (Molecular Biology & Biochemistry major) completed a research project with Catherine



Combelles (Biology and Molecular Biology & Biochemistry) and Kelly Campen (Biology). The research examined the effect of bisphenol-S on viability and steroid production in bovine granulosa cells. Her results were presented in a poster at the Gordon Research Conference on Environmental Endocrine Disruptors.

**Lea LeGardeur** and **Anna Cerf** (Geography majors) worked with Guntram Herb (Geography) investigating indigenous nations along the US-Canada border and how policies and physical barriers are affecting cultural practices as well as access to traditional lands.

**Ashley Chui-Kay Leung** (Psychology and English & American Literatures major) worked with Suzanne Gurland (Psychology) during the academic year on a senior thesis in which she tested the effects of autonomy support versus control on incidental word learning.

**John Lower** (Neuroscience major) worked with Mark Spritzer (Biology and Neuroscience) during the academic year on a Neuroscience 700 project, which tested for possible dose-dependent effects of testosterone on spatial memory in aged male rats.

**Alexa Manley** (Biology major) worked with Catherine Combelles (Biology and Molecular Biology & Biochemistry) to examine the effect of bisphenol-A on the viability

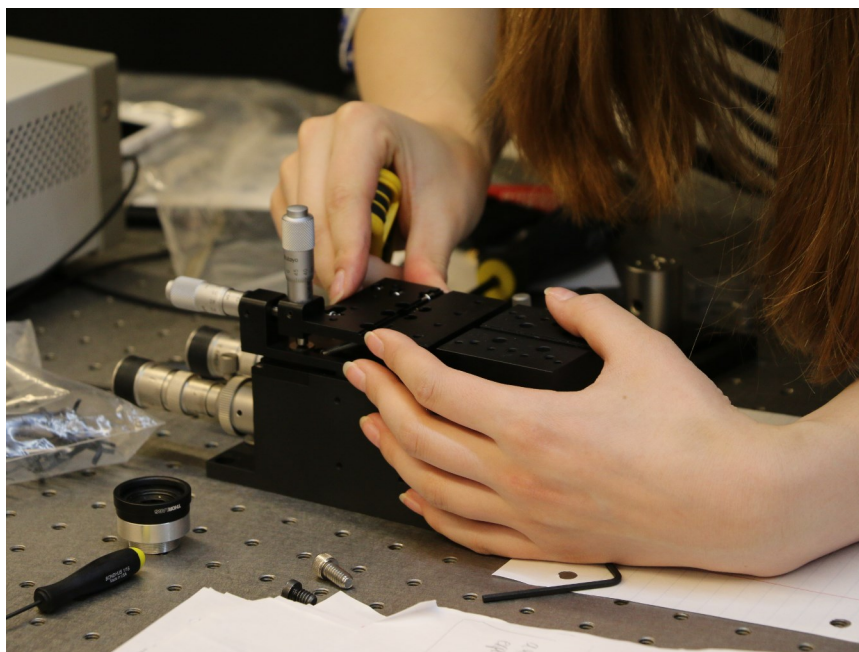
and steroidogenesis of bovine granulosa cells *in vitro*.

**Ryan McElroy** and **Sam O'Keefe** (Geology majors) worked with Jeff Munroe (Geology) during the academic year on connected senior theses reconstructing the post-glacial delivery of eolian mineral dust to alpine lakes in the Uinta Mountains, Utah.

**Jennie Mejaes** (Neuroscience major) worked with Catherine Combelles (Biology and Molecular Biology & Biochemistry) and Kelly Campen (Biology) to examine the effect of bisphenol-S on bovine theca cells.

**Julie Merchant** (Biology major) worked with Glen Ernstrom (Biology and Neuroscience) to lead a team of undergraduate researchers to analyze a large neuronal fluorescence imaging data set collected by Glen Ernstrom with collaborators at the University of Utah and the Howard Hughes Medical Institute. The study documented the extent to which a genetically-engineered proton pump acidifies synaptic vesicles in the nematode *C. elegans* to analyze how chemical neural signaling is regulated.

**Carter Merenstein** (Molecular Biology & Biochemistry major) worked with Jeremy Ward (Biology and Molecular Biology & Biochemistry) on a metagenomic study of the microorganisms present in ticks in Vermont.







**Paola Meza** (undeclared major) conducted research with Catherine Combelles (Biology and Molecular Biology & Biochemistry) and Kelly Campen (Biology) in the summer, investigating the effect of bisphenol-F on bovine oocytes.

**Lindsey Erin Miller** (Neuroscience major) worked with Mark Spritzer (Biology and Neuroscience) during the summer and academic year on her senior thesis, which tested the relative effects of testosterone on spatial memory in young and aged male rats. She also examined the potential effects of age and testosterone on brain derived neurotrophic factor. She will be presenting her work at the Society for Neuroscience meeting in 2016.

**Erzsebet Nagy** (Molecular Biology & Biochemistry) completed a research project with Catherine Combelles (Biology and Molecular Biology & Biochemistry) on the impact of bisphenol-A on the glutathione content of individual bovine oocytes.

**Leslie Panella** (Neuroscience major) worked with Mark Spritzer (Biology and Neuroscience) during the summer and academic year on a Neuroscience 700 project testing the effects of estradiol on the stages of adult neurogenesis among male rats.

**Anna Paritsky** (Neuroscience major) worked with Tom Root (Biology and Neuroscience) during the academic year on an independent project using literature to report on the sensory manipulations used to affect consumer choices.

**Zachery Perzan** (Geology major) worked with Pat and Tom Manley (Geology) on data from the five-year study of the circulation and sedimentation within Missisquoi Bay in Lake Champlain. He presented this work at the 2015 summer meeting of the American Society of Limnology and Oceanography.

**Kelsey Phinney** (Neuroscience major) worked with Tom Root (Biology and Neuroscience) during the academic year on an independent project for an audio/blog project on the less tangible effects of Parkinson's Disease, including non-motor symptoms and especially REM sleep behavior disorder.

**Erin Phlegar** (Neuroscience major) worked with Tom Root (Biology and Neuroscience) during the academic year on an independent project examining the development of behavior in newly hatched octopuses.

**B. Christina Pil** (Neuroscience major) worked with Marcia Collaer (Psychology and Neuroscience) during the academic year on a senior honors thesis that ex-

explored the influence of stress on judgments about the morality of ethically challenging situations and whether emotional states might moderate stress effects.

**Luc Pomerance** (Molecular Biology & Biochemistry major) worked with Glen Ernstrom (Biology and Neuroscience) during the summer and academic year on a senior thesis analyzing how neuronal synaptic vesicle acidification regulates neurotransmitter release. Luc presented his work at the annual Vermont Genetics Network spring symposium, and his research poster received a top prize.

**Kyle Robey** (Physics major) worked with Michael Durst (Physics) during the summer and academic year on his senior thesis, building and characterizing a temporal focusing microscope for wide-field two-photon fluorescence imaging of biological tissue.

**Julia Rossen and Emily Vicks** (Neuroscience majors) worked with Mark Spritzer (Biology and Neuroscience) during the academic year on a Neuroscience 700 project. Their project tested the relative effects of estradiol and dihydrotestosterone on the spatial memory of aged male rats.

**Madeline Schneider** (Molecular Biology & Biochemistry major) conducted research with Catherine

Combelles (Biology and Molecular Biology & Biochemistry) and Kelly Campen (Biology) to determine the impact of bisphenol-A on the oxidative stress status of bovine granulosa cells.

**Hayden Shea** (Biology major) worked with Steve Trombulak (Biology and Environmental Studies) on a senior thesis that evaluated the sensitivity and congruence of various species distribution models, using the brown bog sedge (*Carex bauxbaumi*) in New York State as a test case.

**Perri Silverhart** (Geology major) worked with Pat and Tom Manley (Geology) on a year-long project using subaqueous landslides in Lake Champlain as paleoseismic and paleohazard indicators. She presented her thesis at the Northeast section of the Geologic Society of America meeting, as well as at the 2016 National meeting of Geologic Society of America.

**Peter Slotkin** (Physics major) worked with Rich Wolfson (Physics) on modeling the impact of a hypothetical dark-matter halo around Earth on the orbits of GPS satellites.

**Nathaniel Smith** (Molecular Biology & Biochemistry major) worked with Bob Cluss (Chemistry & Biochemistry and Molecular Biology & Biochemistry) on a project





to refine an ELISA assay to measure the plasminogen-binding activity of enolase produced by the Lyme disease spirochete.

**Alexandra Spencer-Wong** (Neuroscience major) worked with Tom Root (Biology and Neuroscience) during the academic year on an independent project on the responses of octopuses to chemical signals on prey.

**Ethan Strayer** (Biology major) conducted summer research with Sallie Sheldon (Biology) mapping the Bicentennial Hall wetland.

**Hannah Street** (Neuroscience major) worked with Jason Arndt (Psychology and Neuroscience) during the academic year on a senior independent research project that examined how emotion impacts memory. Hannah's project examined whether experiencing multiple emotional events simultaneously leads to competition for attentional resources, and in turn reduces or eliminates the normal memory advantage for emotional events over neutral (non-emotional) events.

**Annie Taylor** (Biology major) worked with Dave Allen (Biology) during the academic year on a senior thesis. For this thesis Annie created an algorithm to assess Bishop pine mortality, caused by drought and bark beetle, on Santa Cruz, CA from remotely sensed data. She

went to Santa Cruz island during J-term and measured this mortality to ground truth her algorithm.

**Logan Wahl and Ilana M. Gratch** (Psychology majors) worked with Robert Moeller and Martin Seehuus (Psychology) on a project exploring mental health and sexual risk taking correlates of Pre-Exposure Prophylaxis use. The research examined the effects of this new HIV-prevention measure among sexual minority men. Results from this research were presented at the International AIDS Conference in South Africa.

**Sarah Wall** (Neuroscience major) worked with Tom Root (Biology and Neuroscience) and Amanda Crocker (Neuroscience) during the academic year on an independent project examining the effect of gut bacteria on feeding behavior of *Drosophila melanogaster*.

**Matthew Wojciechowicz** (Physics major) worked with Susan Watson (Physics) on a senior research project to measure the integer quantum Hall effect in a GaAs heterostructure at low temperature and high magnetic field. In the near future, the experiment will be incorporated into the Experimental Techniques in Physics course at Middlebury.



# Education Outreach Activities

**Priscilla Bremser** (Mathematics) was lead instructor for Number Theory, a required course for teachers in the Vermont Mathematics Initiative, a three-year master's degree program at the University of Vermont. This summer marked her tenth year of instruction at VMI. Priscilla also led activities as part of the STEAM (STEM + Arts) Camp for middle-school girls offered by the Town of Middlebury Recreation Department during the girls' spring vacation.

**Molly Costanza-Robinson** (Environmental Studies and Chemistry & Biochemistry) and **Michele Dubé** (Chemistry & Biochemistry) offered a polymer chemistry “playshop” to 5–8 grade girls as part of the spring break Girls' STEAM (Science, Technology, Engineering, Arts, and Math) Camp hosted by Middlebury Parks and Recreation. The playshop was featured in the Addison Independent (<http://www.addisonindependent.com/201604steam-camp-steers-local-girls-toward-science>).

**Molly Costanza-Robinson** (Environmental Studies and Chemistry & Biochemistry) offered a new alumni college course *Toxic Trespass: Before Bhopal and Beyond Flint*.

**Michael Durst** (Physics) worked with the Cornwall Elementary School as an advisor for physics-related posters as part of the Curiosity Project, a school-wide

science fair.

**Glen Ernstrom** (Biology and Neuroscience) talked with Ms. Harder's second-grade class at Weybridge Elementary school about the biology of worms. The second-graders had a first-hand opportunity to look at live specimens through dissecting microscopes brought over from Glen Ernstrom's research lab.

**Eilat Glikman** (Physics) presented a public talk titled “Quasars: How to grow an enormous black hole” to an audience of approximately 100 Vermonters at the Fair Haven Inn as part of the Science PUB program. Science PUB is a science outreach program co-sponsored by the Friends of the Castleton Free Library and the Rutland Free Library.

**Eilat Glikman** (Physics) offered enrichment activity to the Aurora School on finding planets around far-away stars as part of their “frontiers” theme. Students built models of a star-planet system and learned how planets “tug” on their companion star, making it wobble, and thus discoverable.

**Jonathan Kemp** (Sciences Technical Support Services) managed an outreach program at Middlebury College Observatory that welcomed local schoolchildren, the College community, and the general public. He worked





with and trained College students and local high school students as part of the Observatory's outreach program. He also served as advisor for the newly-formed Space Club student organization and collaborated with various science faculty to bring telescopes and astronomy to a broader selection of science disciplines. Kemp managed major upgrades at the Observatory.

**Marc Lapin** (Environmental Studies) is part of a multi-year educational collaboration with Wes Jackson (The Land Institute, Salina, KS) and over a dozen colleagues from numerous colleges and universities and representing disciplines including philosophy, environmental history, journalism, agronomy, plant breeding, economics and geography. The group is developing principles and curriculum for Ecospheric Studies, a reworking of environmental studies to address, from root causes to solutions, the multi-dimensional problems of the 21<sup>st</sup> Century.

**Michael Olinick** (Mathematics) presented two workshops on the mathematics of making and secret codes at Bethel High School in May, 2016.

**Emily Proctor** (Mathematics) taught a class for the Governor's Institutes of Vermont titled "Some surprising things you can do with triangles" in Summer 2016.

**Mark Spritzer** (Biology and Neuroscience) worked with community members and local high schools to organize "Discover Brain Day." This event exposed local high school students to various topics in neuroscience through a combination of talks, interactive workshops, and a brain bee. Mark also gave a short presentation on bird diversity to Quarry Hill Preschool, and he gave a one-hour interactive discussion on biodiversity to a third grade class at Mary Hogan Elementary.

**Tom Root** (Biology and Neuroscience) taught his Neural Disorders course with a substantial outreach component this spring, in which over 30 students assisted residents and staff at the Helen Porter Health Care and Nursing Center.

**Roger Sandwick** (Chemistry & Biochemistry and Molecular Biology & Biochemistry) provided entertainment to about 100 local children and their families in a chemistry show titled *Alchemy pHun*.

**Rich Wolfson** (Physics) gave a talk entitled "Global Warming: Update 2015" to the Middlebury Town & Gown group, and a similar talk, "Global Warming: Update 2016" as the keynote at the annual meeting of the Addison County Retired Teachers.

**Rich Wolfson** (Physics) participated in the symposium

“Power and Protest: Global Responses to Atomic Energy” at Middlebury College, where he gave a talk entitled “Nuclear Power: A Future after COP 21?”

**Helen Young** (Biology) taught MiddCORE (along with three other Middlebury faculty) at Sierra Nevada College on Lake Tahoe in the summer.





# Department and Program Statements

*submitted by department chairs and program directors*



## Dr. Jeremy Ward, chair

The Department of Biology had a strong year that included the recruitment and set up of Dr. Jill Mikucki as our new molecular microbial ecologist, continued support of our own pedagogical efforts as well as those of Molecular Biology & Biochemistry and Neuroscience, and a broad and fascinating array of student faculty research collaborations. Biology is also particularly excited to announce the promotion of Dr. David Allen from Visiting Assistant Professor to Assistant Professor on the tenure track.

Biology provides foundational support for its own majors as well as those of Neuroscience and Molecular Biology & Biochemistry in the form of classes, student research funding, and mentoring. Rapidly increasing

enrollments in all three majors have challenged the department but are a reminder of the pivotal role biology plays in science education grounded in the liberal arts tradition.

Because of its broad and deep perspective on the life sciences, Biology (and Molecular Biology & Biochemistry and Neuroscience) majors worked on a remarkable range of collaborations with faculty last year. These projects included analysis of microbial diversity in Antarctic ice core samples, forest ecology effects on Lyme disease in Vermont, and the building of RNA biosensors using the technology of synthetic biology. The students involved in these projects headed on to medical school and some of the best graduate schools in the country while the faculty continue to be successful at their scholarship and launching a challenging curriculum.



## Dr. Sunhee Choi, chair

Three major events in the Department of Chemistry & Biochemistry this year stand out: (1) hiring Dr. Mary Jane Simpson, (2) national recognition of Dr. Lesley-Ann Giddings in the *Chemical and Engineering News*, and (3) a strong level of student-faculty collaborative scholarship.

*Dr. Mary Jane Simpson* — Dr. Simpson did her graduate work at Duke University where she used laser microscopy to spot abnormal pigment chemistry in melanomas. This work was featured in Science Translational Medicine. For her post-doctoral studies, she went to Oak

Ridge National Lab where she designed and built a one-of-a-kind laser-scanning microscope that provided new insight into problems surrounding solar cell efficiency. Her most recent research on perovskite solar cells was announced in press conference (<http://www.ornl.gov/news/new-ornl-method-could-unleash-solar-power-potential>). As an Associate in Science Instruction, her main responsibilities are teaching general chemistry laboratories and developing new laboratory curricula.

*Dr. Lesley-Ann Giddings* — In September 2015, the American Chemical Society (ACS) featured Dr. Giddings in the ACS Chemical and Chemical Engineering



News magazine (Widner, A. Chemical & Chemical Engineering News “Lesley-Ann Giddings: A love for teaching led this ACS Scholar to become a professor” Chemical & Chemical Engineering News. Sept. 28th, 2015, Vol. 93 (38), p. 50). The article discusses where her interests in science and teaching stem from and how they ultimately led her to her current tenure-track position at Middlebury College. In addition, another profile of Dr. Giddings is featured on the website for the American Society for Biochemistry and Molecular Biology,

another organization that brings global attention to the latest research, public policies, and educational opportunities in the fields of biochemistry and molecular biology.

*Student and Faculty Scholarship* — Total of six research papers were published in peer-reviewed-journals by faculty members in the department with 14 student co-authors. Three Chemistry & Biochemistry graduates will matriculate Ph.D. degrees this fall.



#### Dr. Daniel Scharstein, chair

The Department of Computer Science had a busy and productive year, with enrollments continuing to climb to new record levels. We taught more than 830 students this year — a four-fold increase over the last 5 years.

Several colleagues collaborated on research problems with Middlebury students during the summer. One project, by Computer Science major Julian Billings and professor Christopher Andrews, won an award at the annual VAST Challenge.

Professor Daniel Scharstein was recognized for his contributions to the field of computer vision with the Mark Everingham Award, which was presented at the International Conference on Computer Vision in Santiago, Chile. The award honors the Middlebury datasets, which were created together with undergraduates over the last 15 years, and which have become a primary benchmark for programmers around the globe to test their work.



#### Dr. Jeff Munroe, chair

Fifteen seniors were active members of the Department of Geology in the 2015–16 academic year. Riley Ebel graduated in February, and six other students walked in May. All of these seniors completed a year-long thesis project. Thesis topics included bedrock sources of con-

tamination in Champlain Valley groundwater, post-glacial dust deposition in the mountains of northern Utah, new applications of LIDAR datasets in Addison County, and climatic factors influencing soil development in Costa Rica. Will Burke '16.5 received the Charles G. Doll award from the Vermont Geological Society for his senior-thesis work with Dave West stud-

ying volcanic rocks exposed along the coast of Maine. A record group of a dozen students attended the annual GSA meeting in Baltimore. Many of these students then presented their own senior research at the Northeastern Section meeting in Albany during the spring. Sam O'Keefe '16.5 gave an oral presentation on his senior research at the International Dust Conference in

Castelanetta Marina, Italy in June. The longest serving member of the department faculty, Ray Coish, retired at the end of the academic year. An international search for a petrologist to fill his position led to the hiring of Kristina Walowski, who will join the department in January, 2017.



#### Dr. Priscilla Bremser, chair

The Department of Mathematics welcomed Assistant Professor Albert Kim in the fall of 2015. Professor Kim, a statistician, is working with department colleagues to incorporate recent innovations in statistics instruction into our curriculum. The department is also working to adapt our introductory calculus sequence to the changing profiles of students in the early courses.

Twenty-four of our students participated in the annual Green Chicken mathematics contest against Williams College in the fall. They did not prevail, but enjoyed themselves nonetheless. We had seven students participate in the Putnam Mathematical Competition in December. This difficult exam is taken by mathematics students across the United States and Canada.

Highlights of our seminar series during the year included

*Singing Along with Math: The Mathematical Career of Opera Singer Jerome Hines* and *Inside Enigma: The Story of the Enigma and Other Historic Cipher Machines*. We also heard from seniors writing theses. As always, all of our graduates — 20 this time around — did independent senior work.

Many of our majors work as graders and peer tutors. In addition, Noel Antonisse, class of 2017, organized a volunteer mathematics tutoring program at Middlebury Union High School.

The academic year ended with a reception in honor of John Emerson, who retired on July 1. We have all been inspired by John's dedication to teaching, his service to the department and the College, and his many published statistical analyses of topics in health care and higher education.



#### Dr. Tom Root, director

The Program in Neuroscience grew on several fronts last

year. We reached over 140 majors, fully instituted a new curriculum, had more students heavily involved in the community, saw more graduates enter varied pres-

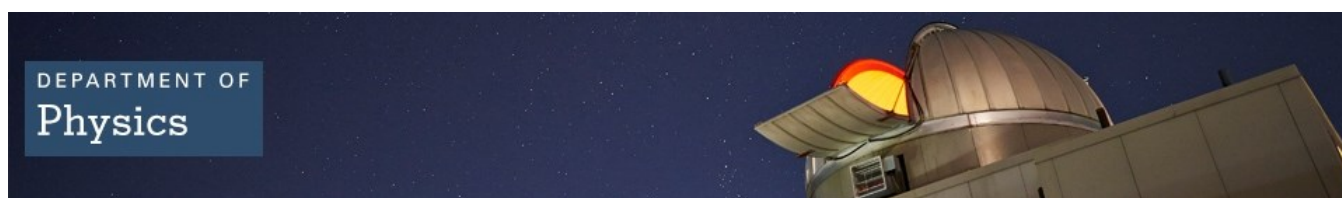
tigious career directions, and added a new Assistant Professor of Neuroscience, Amanda Crocker.

Our curriculum now has new electives and sophomore-level “foundations” courses tailored to Neuroscience majors, embraced by both students and faculty. Clarissa Parker, Glen Ernstrom and Amanda Crocker taught these new courses, and Amanda also created new courses in Neural Coding, Methods in Systems Neuroscience and the Evolution of the Brain. Besides their acclaim as teachers, our faculty also received notable grants and published in the best journals, revealing our potential as one of the more accomplished and effective neuroscience programs.

A large group of Neuroscience students participated in

outreach to local high schools, helped with the Brain Bee hosted by Middlebury College and run by Mark Spritzer (Associate Professor of Biology) and Lisa Bernardin (Vermont Brain Bee Club), and students from the Neural Disorders course did extensive work with residents of the Helen Porter Heath Care and Nursing Center in the spring. Recent graduates left for positions in diverse areas from writing and teaching, to clinical and laboratory research as well as several medical schools.

So although the Neuroscience program continues its dramatic growth, our students, faculty, and supporting staff have managed that growth to make us more focused and accomplished than ever.



### Dr. Susan Watson, chair

The Department of Physics continues to maintain a program that is rigorous and welcoming to students. In Fall 2015 we were joined by Angus Findlay, Assistant in Science Instruction, who is helping to revitalize the introductory laboratory sequence. Twenty-one seniors were graduated during the 2015-16 academic year, including seven Febs and two students who participated in the Dartmouth dual-degree engineering program. All seniors gained advanced training in research and communication skills by undertaking independent research projects with faculty members in the department. Many of those projects arose as natural extensions of summer research in collaboration with Middlebury faculty on topics including observational astronomy, optical imaging, atom trapping, spectroscopy, field theory, nonlinear physics and quantum device physics. Students reported their findings in a wide range of venues including the Spring Research Symposium and national conferences. The vibrant atmosphere of student-faculty research has

been made possible in part through the success of our faculty in securing funding through NASA (Eilat Glikman), the Vermont Genetics Network (Mike Durst) and the National Science Foundation (Noah Graham).

Equally important, our classrooms are dynamic settings where students actively engage in learning and faculty members remain innovative. That innovation is evident through the introduction of new courses (Mike Durst/Biomedical Imaging), through creative uses of the College Observatory in our courses (Eilat Glikman and Jonathan Kemp/Introduction to the Universe) and through programs that blur the boundaries between classroom and experiential learning (Noah Graham/STEM Innovation Program).

Notable this year were the recognition received by our faculty for excellence in teaching and mentoring (Anne Goodsell/Gladstone Award) and by one of our juniors for outstanding academic achievement (Jing He/Goldwater Scholar).



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