



RIDER
UNIVERSITY

GEMS Student Handbook



Geology
Environmental Sciences
Marine Sciences
Environmental Studies
Earth Sciences



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Department of Geological, Environmental, and Marine Sciences (GEMS)
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Department of Geological, Environmental, and Marine Sciences (GEMS)

This handbook provides a thorough overview of the department, its faculty, and student accomplishments and opportunities. Additional information about our faculty, course offerings, program requirements, student research, and alumni information, please visit the department's website at rider.edu/gems. The department's annual newsletter, *Surf and Turf*, is available for download from the website. The newsletter's articles highlight student, alumni, and faculty activities; research and awards; and updates on events, speakers, and field trips. If you have any questions regarding this information, or about the department in general, please feel free to contact us.

GEMS Programs

The GEMS Department offers multiple majors and minors to accommodate the various interests of our students. Majors include more science-focused programs (Geology, Environmental Sciences, and Marine Sciences), all of which provide students with a B.S. degree when successfully completed. We also offer more interdisciplinary programs that include studies in liberal arts and humanities for students interested in using a science background in a variety of related professions (Environmental Studies, Earth Sciences for secondary education majors, and Integrated Sciences and Math for middle school teaching certification). These majors provide students with a B.A. degree when successfully completed.

1. Geology (B.S.)

The geology major incorporates a broad and challenging curriculum, which emphasizes and investigates many of the important geologic subdisciplines. These include rock-forming mechanisms and controls, deformational and tectonic processes, weathering and erosion of geologic materials, transportation and deposition of derived sediments, and the physical and biological history of Earth. In addition, all geology majors must attend a senior-level geology field camp (not offered at Rider) prior to graduation where they learn and practice fundamental field and mapping skills, including how to professionally apply and integrate what they have learned in their individual classes and laboratory courses to complex, real-world geologic problems.

2. Environmental Sciences (B.S.)

Drawing on programs and faculty from the departments of Biology, Chemistry, Physics, and GEMS, the environmental sciences major crosses social, political, and scientific boundaries. All environmental sciences majors will participate in extensive fieldwork, explore a rich diversity of ecological environments, and acquire the knowledge and skills needed for a wide range of potential careers. Depending on an individual student's interest, environmental sciences majors can investigate such subdisciplines as climate change, forest dynamics, coastal processes, cell and molecular biology, environmental biogeochemistry, organic and inorganic chemistry, plant ecology, or sustainability studies; the latter is available as a multidisciplinary (non-GEMS) minor program.

3. Marine Sciences (B.S.)

The marine sciences major investigates and emphasizes the multiple feedback interactions among unicellular to vertebrate marine organisms, the physiochemistry of seawater, and the characteristics of the substrates in or on which these organisms live. Typically, students who major in the marine sciences also double major or minor in one or more of the following programs: biology, chemistry,

earth and environmental sciences, environmental sciences, geology, or psychology (useful for a career involving marine mammal training).

4. Environmental Studies (B.A.)

The environmental studies major is designed to meet the interests of students wishing to address environmental issues through multiple disciplinary perspectives, including relevant sciences as well as social and political aspects. The program is meant for students interested in careers in environmental policy, advocacy, justice, nonprofit organizations, ecotourism, and other related career opportunities; or graduate school in non-science focused environmental and other disciplines, including environmental law.

Note: This B.A. program is **not** designed to prepare students for graduate-level science programs, nor is it designed to enable students to gain employment as professional scientists. Consider the B.S. in environmental science if you plan to pursue either of these career paths.

5. Earth Sciences (B.A.)

The earth sciences major is designed specifically as a second major for students in the College of Education and Human Services interested in teaching Earth science in high schools. The program is tailored to meet the Earth science-related objectives of secondary education majors and to facilitate the timely completion of their dual requirements in the College of Education and Human Services and the School of Liberal Arts and Sciences. This program is **not** designed to prepare students for further study in science disciplines at the graduate or professional level.

6. Integrated Sciences and Math (B.A.) (See separate handbook)

Most of the above majors require, or offer as an elective, a field course. These courses provide an introduction to field work conducted by scientists in various GEMS-related professions. Consult with your advisor to determine which options best fit your major. Two such courses are described below:

Marine Science Field Course: GEMS offers a two-week, marine science field course taught during the spring/summer in alternating years at the Roatan Institute of Marine Sciences (RIMS), Roatan, Honduras (additional costs apply). This required course for marine sciences majors focuses on the biological and physical interactions common to specific habitats. Habitats studied include coral reefs, rocky intertidal zones, mangroves, and turtle grass beds. Course emphasis is on team exercises, team mapping activities, and individual experimental projects. Most habitats are located in shallow water accessible by wading or snorkeling. SCUBA certification is not required nor needed, though students who are certified have the opportunity to dive for some exercises.

Geology Field Camps: The satisfactory completion of an approved geology field camp course (not offered by Rider) is required for the geology major. Many educational institutions and organizations offer field camps (including overseas) and students typically take this course during the summer after their junior or senior year (additional costs apply). Although many Rider geology majors enroll in the field course offered by the University of Houston–Yellowstone Bighorn Research Association (YBRA) at Red Lodge, Montana, any geology field camp approved by the department is acceptable.

GEMS Student Information

Internships and Summer/In-Semester Employment Opportunities

A number of private environmental consulting firms and organizations, including Climate Central, Delaware River Basin Commission, Mercer County Wildlife Center, NJ Department of Environmental Protection, NJ Geological Survey, and Water Resources Division of the U.S. Geological Survey, have provided part-time employment to our students as part of formal internship programs. Students have also secured paid summer internships at environmental consulting firms. In addition, GEMS majors with an interest in the marine sciences have interned at: Conserve Wildlife Foundation of NJ, Jenkinson's Aquarium, NJ; the Marine Aquarium at Norwalk, CT; Mote Marine Laboratory, FL; Newfound Harbor Marine Institute, FL; the Adventure Aquarium at Camden; the Philadelphia Zoo; the NJ Marine Mammal Stranding Center in Brigantine; Rutgers Marine Field Station, NJ; and the Universities of Maryland and Delaware Sea Grant Programs. Furthermore, GEMS students can be employed by the department through Rider's work-study program during the summer or the regular school year. All of these opportunities can earn Engaged Learning Points required for graduation.

Organizations and Activities

GEMS students can become active in a number of on-campus student organizations and clubs the *Science Learning Community*, *GEMS & Friends*, and Rider's *Green Team*. The primary function of these organizations is to enhance the educational, professional, and social development of member students. These organizations also host invited lectures by professional environmental scientists. National organizations also may fund student independent research.

GEMS students can attend professional meetings and field trips sponsored by many sponsoring organizations. These include the Alliance for New Jersey Environmental Education, American Fisheries Society, American Society of Limnology and Oceanography, Association of American Geographers, Geological Society of America, Geological Association of NJ, NJ Academy of Science, NJ Water Works Association, and New York and Pennsylvania State Geological Associations. Attending these meetings and field trips provides students with a greater awareness and understanding of current research topics and allows GEMS majors to meet faculty and students from potential graduate schools.

Student Honors and Awards

College of Liberal Arts and Sciences Honor Society: Awarded in recognition of the highest scholastic achievement and distinction in the College of Liberal Arts, Education, and Sciences. Minimum GPA of 3.5 in senior year or 3.75 in junior year required for consideration.

GEMS Honors Program: Graduation with honors in any GEMS major is awarded in recognition of majors who have demonstrated outstanding academic and research abilities. Enrollment in the program is by invitation of the GEMS faculty. Eligibility requirements include a minimum GPA of 3.5 in courses required for the major and the satisfactory completion of a Senior Thesis or a three- or four-credit Independent Research and Study course, depending on the specific major. In addition, an honors candidate must maintain an overall minimum GPA of 3.0.

GEMS Exceptional Research Award: Given to a graduating GEMS major who has completed one or more unusually distinguished research projects and has presented the work at a professional conference and/or published it in a peer-reviewed journal.

Beta Beta Beta: “Tri-Beta” is a national honor society affiliated with the American Association for Advancement of Science and the American Institute of Biological Sciences. Membership is extended to science and science education majors who have demonstrated superior academic achievement.

Sigma Xi: National Scientific Honor Society, Rider Chapter. Demonstration of research proficiency is required through publication or presentation of senior thesis or independent research on campus or at a local, state, or national meeting. In GEMS, a minimum research grade of B+ is required for nomination consideration by the faculty research supervisor.

Rider Undergraduate Travel Grant: Provides up to \$500/year toward registration, travel, and/or housing for undergraduate students to participate in a professional meeting in their discipline. Students must present their research at the meeting to be eligible for this award.

Selected Recent GEMS Student Research

Student research is a fundamental component of our programs. Faculty have successfully obtained grants to support student research from a diverse group of outside agencies such as, Bristol Myers-Squibb Foundation, Corporation for Jefferson’s Poplar Forest, Mount Vernon Ladies’ Association, National Science Foundation (NSF), NJ Department of Environmental Protection, Undergraduate Summer Research Award (USRA). Additional financial support for undergraduate research also is available from Sigma Gamma Epsilon, Sigma Xi, and the Rider University GEMS Student Research Fund. Following are examples of recent student research projects.

Alina Bardaji: Determining pith offset of pine and oak species using a geometric method. (Ronald E. McNair Scholar Research).

Amber Barton, Muhammad Sarwar, and Elaine Panuccio: Role of phosphate in the mobilization of arsenic from soil and aquifer (student co-authors of a paper presented at the 2015 Annual Meeting of the *Northeast Section of the Geological Society of America*).

Nicole Chakowski: Dendrochronological dating of two tulip poplars on the west lawn of Monticello (student co-author of a manuscript published in *Tree-Ring Research*, v. 70, p. 41-48).

Julianna Ciccarelli: Estimating methane emissions from natural gas extraction using tower-based atmospheric monitoring (student co-author of a paper presented at the Thirteenth Annual *Student Conference of the American Meteorological Association*).

Carissa Moore: Evaluating the Reliability of Low-Cost Air-Quality Monitoring Sensors (Only undergraduate student invited to present at the *Mid Atlantic Regional Air Management Association with NJ Department of Environmental Protection*).

Nicole Donato and Maria Chaves: Variations of lead concentrations in soil profiles near and Interstate highway in New Jersey (student co-authors of a paper presented at the 2017 Annual Meeting of the *Geological Society of America Northeast Section*).

Ian Flynn: Past and future rates of stream erosion along Crosswicks Creek, Mercer County, NJ (student co-author of a paper presented at the 2017 *Annual Meeting of the Geological Society of America Northeast Section*).

Tim Forrest: Topography and tree growth at the Fernow Experimental Forest, West Virginia. Oral (student co-author of paper presented at 2018 *Mid-Atlantic Ecological Soc. of Amer. Chapter Meeting*).

Imani Guest: Strengthening a historical climate record in south-central PA with tree rings dating back 600 years (student co-author of papers presented at the 2017 *Annual Meetings of the Mid-Atlantic Chapt. of the Ecol. Soc. of Amer.* and at the *SAEOPP McNair/SSS Scholars Research Conf.*).

Laura Moritzen: Habitat preference and tidal variation in native and invasive shrimp along the Long Island coast following the invasion of *Palaemon macrodactylus* (student co-author of a paper presented at the 2015 *Annual Benthic Ecology Meeting*).

Jessica Munyan: Dendrochemical analysis and forest history at Thomas Jefferson's Poplar Forest: A case study on two frost-damaged growth rings (student co-author of a paper presented at the 2016 *Annual Meeting of Mid-Atlantic Ecological Society of America*).

Patrik Rollefson: Problem Solving Capabilities of Coati Mundis in Captivity (Independent Research at Six Flags Great Adventure, Jackson, NJ).

GEMS Graduate School Placements

Over the past 35 years, GEMS graduates have pursued advanced degrees at some of the most prestigious graduate schools in the country. These include Arizona State University, University of Arizona, Boston College, Boston University, Brown University, University of California-Santa Barbara, Colorado School of Mines, Columbia University, University of Delaware, Drexel University, Florida State University, Florida International University, University of Florida, University of Illinois, University of London (UK), Louisiana State University, University of Maine, University of Maryland, University of Massachusetts, University of Michigan, Mississippi State University, Montclair State University, New York University, SUNY-Stony Brook, North Carolina State University, University of North Carolina, Nova Southeastern University, Ohio State University, Old Dominion University, University of Pennsylvania, Pennsylvania State University, University of Pittsburgh, Rutgers University, University of South Carolina, University of Southern California, University of Southern Mississippi, University of Tennessee, Tsinghua University (China), University of Virginia, Virginia Tech, and The College of Williams and Mary (VIMS). Most GEMS students attend these graduate programs with financial support, often as merit-based teaching or research assistantships.

GEMS Graduates Employers

GEMS graduates are employed in a variety of different areas, such as forestry, natural resources, consulting firms, museums, and aquaria. Examples include:

Federal Agencies: U.S. Geological Survey, Army Corps of Engineers, National Oceanographic and Atmospheric Administration, Department of the Navy, and the National Park Service.

State Agencies: NJ Geological Survey, NJ Department of Environmental Protection, NJ Marine Fisheries Administration, NJ Nature Conservancy, NY City Department of Environmental Protection, Maryland Department of Natural Resources, Virginia Department of Environmental Quality, Virginia Marine Resources Commission, South Florida Water Management District, NJ AmeriCorps, and the Florida Department of Environmental Protection.

Environmental Firms: Antea Group International, Aqua Survey, Inc., Aquatech Environmental Systems, Arcadis, Clean Earth Inc., Earth Engineering Incorporated, EarthTech Inc., ENSR Inc., Envirogen Technologies, First Environment, Inc., Geo-Cleanse International, Golder Associates, Groundwater and Environmental Services, Langan Engineering & Environmental Services, Kleinfelder, Peak Environmental, Sovereign Consulting, Inc., Techsea International, and Weston Solutions Inc.

Aquaria: Adventure Aquarium-Camden NJ, Florida Aquarium, Jenkinson Aquarium-NJ, National Aquarium-Baltimore, and the Maritime Aquarium of Norwalk CT.

Petroleum Industry: Amoco Oil, CASA Exploration, ConocoPhillips, ExxonMobil, Sun Oil, Union Texas Petroleum, and Remora Energy.

Academic and Research Institutions: Gemological Institute of America, Haskins Shellfish Research Lab, Lamont-Doherty Earth Observatory, Paleontological Research Institute, Penn State University, and Rutgers University.

GEMS Full-Time Faculty

Dr. Kathleen M. Browne received her Ph.D. from the University of Miami in 1993 and currently holds the rank of Associate Professor of Geological and Marine Sciences. Her Ph.D. thesis investigated the processes controlling the formation of lamination in Bahamian cyanobacterial mats and mounds known as stromatolites. Recently, Kathy has been working with students to study eutrophic lakes and implement solutions to address identified issues. Her work also includes science education projects, including the use of digital media to enhance learning, develop connection-making skills, improve education student learning by using the NGSS, and the use of civic engagement in the learning process. Dr. Browne can be reached at 609-895-5408 (e-mail: browne@rider.edu; office: Science 324C).

Selected Publication Titles

- Anoxic Events. *OOI Data Labs Collection*.
- Future of Natural Resources (ENV-110). *National Science Education for New Civic Engagements and Responsibilities (SENCER) Model Course*. <http://ncsce.net/future-of-natural-resources>.
- Modern marine stromatolitic structures: the sediment dilemma. *Stromatolites: Interaction of Microbes with Sediments*.
- Normal-marine salinity of intertidal stromatolites, Exuma Islands, Bahamas. *Geology*.

Dr. Daniel L. Druckenbrod is the Chair of the Department of Geological, Environmental, and Marine Sciences. He received his Ph.D. in environmental sciences from the University of Virginia in 2003 and currently holds the rank of Professor of Environmental Sciences. Before joining the department in 2009, Dan was an Instructor of Biology at Sweet Briar College in 2001, a Postdoctoral Research Associate at the Environmental Sciences Division of the Oak Ridge National Laboratory from 2003 to 2005, and an Assistant Professor of Environmental Sciences at Longwood University from 2005 to 2009. Dan uses tree rings, computer models, historical documents, and geographic information systems (GIS) to study how forests and their environments change over decades to centuries. His projects include studies of forests at historical sites, including George Washington's Mount Vernon Plantation and Thomas Jefferson's Monticello Plantation. He is also researching the historical connection between Rider University's woods and Aldo Leopold during his time in Lawrenceville over a century ago. Dan has collaborated with other scientists on a National Science Foundation grant to study the

growth and water use of eastern deciduous forests in response to acid rain and climate change. He is currently collaborating on a National Science Foundation grant investigating past climate change from tree rings. Dan also encourages students to participate in his research or to develop research projects on environmental sciences topics. Previous student projects have led to presentations at regional and national scientific conferences. Dan previously served as the Director of Rider's Sustainability Studies Program from 2012 to 2021. Dr. Druckenbrod can be reached at 609-896-5422 (e-mail: ddruckenbrod@rider.edu; office: Science 323F).

Selected Publication Titles

- Redefining temperate forest responses to climate and disturbance in the eastern United States: New insights at the mesoscale. *Global Ecology and Biogeography*.
- Land-use legacies in forests at Jefferson's Monticello Plantation. *Journal of Vegetation Science*.
- Rediscovering Aldo Leopold's Big Woods. *New Jersey Studies: An Interdisciplinary Journal*
- Spatial pattern and process in forest stands within the Virginia piedmont. *Journal of Vegetation Science*.

Dr. Reed A. Schwimmer, a 1984 Rider geosciences graduate, received his Ph.D. in geology from the University of Delaware in 1999 and currently holds the rank of Associate Professor of Geological and Marine Sciences. Reed has a broad background in the Earth sciences, particularly in coastal geology and geomorphology. He has taught a variety of courses and classes for the University of Delaware, Kutztown University, and the National Audubon Society. He also worked as an environmental scientist in Maryland and as the wetlands compliance officer for the town of Greenwich, Connecticut. Reed's Ph.D. research focused on the evolution and erosion of salt marshes in Rehoboth Bay, DE. Currently, his research interests, and those of his students, include the geochemical variability of garnet grains along the New Jersey shoreline. Reed also is the department representative to the Geological Society of America. Dr. Schwimmer can be reached at 609-896-5346 (e-mail: rschwimmer@rider.edu; office: Science 323E).

Selected Publication Titles

- *Teaching Field Marine Science along the New Jersey Shoreline: An Integrated Approach*. Amazon Digital Services LLC, 58 p.
- A temporal geometric analysis of eroding marsh shorelines: Can fractal dimensions be related to process? *Journal of Coastal Research*.
- Rates and styles of marsh shoreline erosion in Rehoboth Bay, Delaware, U.S.A. *Journal of Coastal Research*.
- A model for the evolution of marsh shorelines. *Journal of Sedimentary Research*.

Dr. Gabriela Smalley received her Ph.D. in marine and estuarine environmental sciences from the University of Maryland in 2002 and currently holds the rank of Associate Professor of Marine Sciences. Before coming to Rider in 2004, Gabi was a postdoctoral fellow at the Georgia Institute of Technology's Chemical Ecology Laboratory in Savannah. Gabi has a broad background in oceanography, particularly in biological oceanography, and teaches the oceanography courses for marine science majors at Rider. Her research interests focus on plankton ecology, specifically on microbial trophic interactions, algal bloom dynamics, and chemical signaling between planktonic predator and prey. Students are encouraged to participate in this research. Gabi also is involved in a project funded by the National Science Foundation studying data literacy and scientific reasoning skills. Dr. Smalley can be reached at 609-896-5097 (e-mail: gsmalley@rider.edu; office: Science 323A).

Selected Publication Titles

- Distribution and tidal variation of palaemonid shrimps (Decapoda: Caridea: Palaemonidae) in artificial and natural habitats. *Journal of Crustacean Biology*.
- Comparison of the Functional Response of *Acartia tonsa* to PUA-Producing and Non-PUA Producing Strains of the Diatom *Skeletonema marinoi*. *Ocean Sciences Meeting*.
- Chemical cues induce consumer-specific defenses in a bloom-forming marine phytoplankton. *Proceedings of the Nat. Academy of Sciences of the United States of America*.
- Influence of inorganic nutrients, irradiance, and time of day on food uptake by the mixotrophic dinoflagellate *Neoceratium furca*. *Aquatic Microbial Ecology*.

Dr. Hongbing Sun received his doctorate from Florida State University in 1995, specializing in hydrology and water and soil quality related issues. He currently holds the rank of Professor of Geological and Environmental Sciences. Hongbing's broad research interests include environmental health, hydrogeology, soil science and quality, and coastal oceanography. His current research focus involves issues related to the mobilization of arsenic, lead, and mercury due to the application of winter road salt, the associations of Parkinson's and Alzheimer's diseases with soil selenium, sulfur, and other anti-oxidants, and the association of multiple sclerosis with temperature-heat events. Most recently, Hongbing has been investigating the impact of water contamination (heavy metals and organophosphate pesticide) in the Mississippi and Delaware Rivers on the elevated occurrence of hypertension and colon cancer in these watersheds, as well as the relationship among blood levels for mercury and lead, and liver function-biomarkers with environmental exposure to these elements. Dr. Sun can be reached at 609-896-5185 (e-mail: hsun@rider.edu; office: Science 323C).

Selected Publication Titles

- Exposure to organophosphorus insecticides and increased risks of health and cancer in US women. *Environmental Toxicology and Pharmacology*.
- North-south gradient of mesothelioma and asbestos consumption-production in the United States-Progresses since the 1st asbestos partial ban in 1973. *American Journal of Industrial Medicine*.
- Mineralogical and anthropogenic controls of stream water chemistry in salted watersheds. *Applied Geochemistry*.
- New equations for density, entropy, heat capacity, and potential temperature of a saline thermal fluid. *Deep-Sea Research I*.

GEMS Adjunct Faculty

Dr. Kim Feltre received her Ed.D. in Educational Leadership from Rowan University her M.S. degree in Pharmacology from Rutgers University and her B.A. degree in biology from Drew University. She presently serves as the K-12 Science Supervisor and middle school STEM supervisor for Hillsborough Township Public Schools. She is active in numerous grant-funded science education projects run at Rider in the School of Education. Dr. Feltre is also the *Region A* Director for the National Science Education Leadership Association (NSELA). Dr. Feltre provides essential science education background for our ISM seminar course.

Dr. William B. Gallagher received his Ph.D. in geology from the University of Pennsylvania in 1990 where his doctoral dissertation investigated the Cretaceous/Tertiary boundary and its associated mass extinction event. Bill currently holds the rank of Adjunct Assistant Professor and was, until his retirement in 2008, the Assistant Curator of Natural History, Collections and Exhibits, Natural History

Bureau, New Jersey State Museum. He also was a GEMS Visiting Assistant Professor for the 2008-2009 academic year, a Rider University Science and Technology Advanced Research Institute (STARI) Fellow from 2009 until 2011, and a full-time Visiting Assistant Professor from 2011 until 2014. Bill has traveled the world during the course of his field studies on dinosaurs and other vertebrate species, including stops in Argentina, China, Egypt, England, France, Germany, Iran, Ireland, Italy, the Netherlands, Russia, and Switzerland, as well as much of eastern North America and most of the American west. Bill has taught both undergraduate and graduate courses at numerous other institutions, including the University of Pennsylvania, Rutgers University, and Drexel University, and has authored over 70 scientific papers, articles, and abstracts, as well as the popular book, When Dinosaurs Roamed New Jersey. His current research interests include the paleoecological dynamics of mass extinction events, especially the Cretaceous/Paleogene (K/P) Boundary mass extinction event, which coincided with the disappearance of the dinosaurs. Most recently he was a contributor to the PBS Documentary *Day the Dinosaurs Died*. Dr. Gallagher can be reached at 609-896-5092 (e-mail: wgallagher@rider.edu; office: Science 130).

Selected Publication Titles

- Stratigraphy, depositional environment, taphonomy, and geochemistry of the Babyback Triceratops Quarry, Hell Creek Formation (Late Cretaceous), Garfield County, MT. *The Mosasaur*.
- On the last mosasaurs: Late Maastrichtian mosasaurs and the Cretaceous-Paleogene boundary in New Jersey. *Bulletin de Societe Geologique du France*.
- Relationship between mass extinction and iridium across the Cretaceous/Paleogene boundary in New Jersey. *Geology*.
- Faunal changes across the Cretaceous-Tertiary (K-T) boundary in the Atlantic coastal plain of New Jersey: Restructuring the marine community after the K-T mass-extinction event. *Geological Society of America Special Paper 356*.

Randy S. Kertes, PG, CPG, is the Principal Owner of Nautilus Environmental Group, LLC. Randy received his B.S. in Geosciences from Rider University in 1984 and a M.S. in Geology from the University of Cincinnati in 1995. He has been an adjunct instructor for GEMS since 1999. Randy has over 30 years of professional experience in environmental consulting. He manages a range of environmental projects, from soil and groundwater cleanups, in accordance with state and federal regulations, to local and state land use-related permits associated with land development projects and landfill closures. In addition, Randy provides expert testimony to municipal zoning and planning boards relating to environmental remediation and to the minimization of adverse impacts for residential and commercial developments. He has mentored Rider seniors during their independent research projects and has participated in the Rider Shadow Experience. Randy served on the Rider University Science Advisory Board and was the creator of, and driving force behind, the innovative Centennial Lake Watershed Restoration Project on campus. As a result of his contributions to Rider, Randy has been honored by the University and the Rider University Alumni Association, and was inducted into the Rider Science Stairway of Fame in June 2009.

Selected Publication Titles

- Complicating factors relating to parent bedrock, riparian corridors, and anthropogenic impacts in the identification of wetlands for a minor subdivision, Montgomery Township, Somerset County, NJ: A case study. *Society of Wetland Scientists Mid-Atlantic Chapter Conference*.
- The trouble with mottles – a case study in the misidentification of redoxomorphic features in relation to a proposed subdivision, Upper Freehold Township, NJ. *Annual NOWRA Conference*.

- Projected and measured wastewater flows for Westerly Road Church and implications for site planning, proposed Westerly Road Church, Princeton, NJ. *Annual NOWRA Conference*.
- Centennial Lake (Rider University, NJ) - A case study of an urban watershed restoration project. *Society of Wetland Scientists Annual Meeting*.

Danielle Schmitt has been an Adjunct Instructor in the department since 2007, teaching Oceanography and the GEMS marine field course at the Roatan Institute for Marine Science in Honduras. Danielle received her B.A. in geology from Hofstra University and her M.S. in geology from Western Michigan University. In 2004, she accepted a position as an Academic Laboratory Manager in the Department of Geosciences at Princeton University. Her primary focus is on curriculum development (including laboratory activities, experiments, and field trips) for introductory-level courses related to the ocean, the atmosphere, and the climate. In addition, she develops and leads education and outreach workshops for K-12 teachers.

Selected Publication Titles:

- Visualization of the Coriolis Effect and its role in hurricane formation. *Science Education Resource Center*.
- Want coherency in your professional development and classrooms? Consider the CONNECT-ED model: focusing K-12 teachers on Big Ideas in science and mathematics. *Geological Society of America Annual Meeting*.
- Multiple isotopic studies of calcium carbonate growths in concrete structures. *Applied Geochemistry*.

GEMS Affiliated Faculty

Dr. Paul Jivoff, chairperson for the Department of Biology, Behavioral Neuroscience and Health Sciences, received his Ph.D. in zoology from the University of Maryland in 1995 and currently holds the rank of Professor of Biology. He has been a researcher at the Smithsonian Environmental Research Center, and is a visiting scientist at the Rutgers University Marine Field Station. Paul's research interests include: reproduction of the commercial blue crab; interactions between the blue crab and the invasive European green crab; the influence of urbanization, including artificial shorelines, on estuarine habitats and organisms; and the ecological importance of the Sedge Island Marine Conservation Zone in Barnegat Bay. Dr. Jivoff can be reached at 609-895-5421 (e-mail: pjivoff@rider.edu; office: Science 339A).

Selected Publication Titles

- Population Structure of Adult Blue Crabs, *Callinectes sapidus*, in Relation to Physical Characteristics in Barnegat Bay, New Jersey. *Estuaries and Coasts*.
- Evaluating salt marsh restoration in Delaware Bay: The response of blue crabs, *Callinectes sapidus*, at former salt hay farms. *Estuaries*.
- A review of male mating success in the blue crab, *Callinectes sapidus*, in reference to the potential for fisheries-induced sperm limitation. *Bulletin of Marine Science*.
- Biotic resistance to invasion: native predator limits abundance and distribution of an introduced crab. *Ecology*.

GEMS Major/Minor Requirements

PLEASE NOTE: Some of the requirements for each of the following GEMS majors or minors may be satisfied by taking similar coursework through Rider's Approved Study Abroad Programs. Contact your academic advisor, the GEMS department chair, and/or Rider's Center for International Education (CIE) for further information.

REQUIREMENTS FOR THE GEOLOGY MAJOR (B.S.)

GEMS (46+ credits)		<u>Credits</u>
_____	ENV-200 Statistical and Computer App. in the Nat. Sciences	4
_____	ENV-205 Introduction to Geographical Information Systems	3
_____	GEO-100 Earth Systems Science	3
_____	GEO-102 Earth Materials and Processes Lab	1
_____	GEO-304 Elements of Mineralogy	4
_____	GEO-305 Petrology and Petrography	4
_____	GEO-306 Sedimentology and Stratigraphy	4
_____	GEO-310 Structural Geology	4
_____	GEO-350 Soils and Surficial Processes	4
_____	GEO-407 Hydrology and Water Resources	4
_____	MAR-120 Oceanography	3
_____	MAR-121 Introductory Oceanography Lab	1
_____	MAR-210 Marine Life Through Time	4
_____	----- Approved Geology Field Camp (not offered at Rider)	3+
Chemistry (8 credits)		
_____	CHE-120 Principles of Chemistry	3
_____	CHE-121 Principles of Chemistry Lab	1
_____	CHE-122 Introduction to Chemical Systems	3
_____	CHE-123 Quantitative Methods Lab	1
Physics (4 credits)		
_____	PHY-100 Principles of Physics I	3
_____	PHY-100L Principles of Physics I Lab	1
Electives (6 credits; select two)		
_____	ENV-220 Weather and Climate Change	3
_____	ENV-375 Environmental Biogeochemistry	3
_____	GEO-168 Mesozoic Ruling Reptiles	3
_____	MAR-340 Marine Processes and Environments Seminar	3

Geology majors also will take either MTH-105 Algebra and Trigonometry or MTH-210 Calculus I to satisfy the CLAS core requirement.

TOTAL CREDITS: 64+

The Earth and Environmental Sciences minor cannot be combined with the Environmental Science major

REQUIREMENTS FOR THE ENVIRONMENTAL SCIENCES MAJOR (B.S.)

GEMS (26 credits)			<u>Credits</u>
_____	ENV-100	Introduction to Environmental Science	4
_____	ENV-200	Statistical and Computer App. in the Natural Sciences	4
_____	ENV-205	Introduction to Geographical Information Systems	3
_____	ENV-220	Weather and Climate Change	3
_____	GEO-100/113	Earth Systems Science or Environmental Geology	3
_____	GEO-102	Earth Materials and Processes Lab	1
_____	GEO-350	Soils & Surficial Processes	4
_____	GEO-407	Hydrology and Water Resources	4

Biology (12 credits)			
_____	BIO-115	Principles of Biology I	4
_____	BIO-116	Principles of Biology II	4
_____	BIO-350	General Ecology	4

Chemistry (12 credits)			
_____	BCH-225	Introduction to Organic and Biochemistry	4
_____	CHE-120/121	Principles of Chemistry & Lab	3/1
_____	CHE-122/123	Introduction to Chemical Systems & Lab	3/1

Physics (4 credits)			
_____	PHY-100	Principles of Physics I	3
_____	PHY-100L	Principles of Physics I Lab	1

Electives (9-11 credits; select three different courses; one from each group.)

Group A: Biotic Processes

_____	BIO-272/L	Intro. Marine Bio/Lab	3
_____	BIO-321	Microbiology	3/1
_____	BIO-335	Plant Biology	4
_____	ENV-340	Env. Field Methods	3
_____	MAR-300	Field Marine Sci.	4
_____	MAR-360	Plankton Ecology	4

Group B: Abiotic Processes

_____	ENV-340	Env. Field Methods	3
_____	ENV-350	Env. Toxicology	3
_____	ENV-375	Env. Biogeochem.	3
_____	GEO-304	Elements of Min.	4
_____	GEO-306	Sed. and Strat.	4
_____	MAR-330	Chemical Ocean.	4
_____	MAR-410	Physical Ocean.	3

Group C: Social Processes

_____	AMS-304	Tech./Science in Amer.	3	_____	IND-316	Nature's Business	3
_____	BHP-231	Natural Adventures	3	_____	PHL-215	Environ. Ethics	3
_____	BHP-232	NJ Shoreline-Sci./Pol.	3	_____	POL-328	Env. Policy/Politics	3
_____	BHP-259	The Env: Conflict of Int.	3	_____	POL-329	Comp. Env. Policy	3
_____	HIS-224	Am. Env. History	3	_____	SOC-225	Population Study	3

Environmental Sciences majors also will take either MTH-105 Algebra and Trigonometry or MTH-210 Calculus I to satisfy the CLAS core requirement. Upper-level MAR courses require MAR-120 and MAR-121 as prerequisites.

TOTAL CREDITS: 63-65

**The Earth and Environmental Sciences minor cannot be combined with the Environmental Sciences major.*

REQUIREMENTS FOR THE MARINE SCIENCES MAJOR (B.S.)

GEMS (34 credits)		<u>Credits</u>
_____	ENV-200 Statistical and Computer App. in the Natural Sciences	4
_____	GEO-100 Earth Systems Science	3
_____	GEO-102 Earth Materials and Processes Lab	1
_____	GEO-306 Sedimentology and Stratigraphy	4
_____	MAR-120 Oceanography	3
_____	MAR-121 Introductory Oceanography Lab	1
_____	MAR-300 Introduction to Field Marine Science	4
_____	MAR-330 Chemical Oceanography	4
_____	MAR-340 Marine Processes and Environments: Seminar	3
_____	MAR-401 Marine Ecology	4
_____	MAR-410 Physical Oceanography	3
Biology (8 credits)		
_____	BIO-115 Principles of Biology I	4
	or	
_____	BIO-116 Principles of Biology II	4

_____	BIO-272 Intro to Marine Biology	3
_____	BIO-272L Marine Biology Lab	1
Chemistry (8 credits)		
_____	CHE-120 Principles of Chemistry	3
_____	CHE-121 Principles of Chemistry Lab	1
_____	CHE-122 Introduction to Chemical Systems	3
_____	CHE-123 Quantitative Methods Laboratory	1
Physics (8 credits)		
_____	PHY-100 Principles of Physics I	3
_____	PHY-100L Principles of Physics I Lab	1
_____	PHY-101 Principles of Physics II	3
_____	PHY-101L Principles of Physics II Lab	1
Electives (7-8 credits; select two)		
_____	BIO-372 Behavior of Marine Organisms	4
_____	ENV-205 Introduction to Geographical Information Systems	3
_____	MAR-210 Marine Life Through Time and Lab	4
_____	MAR-325 Marine Vertebrates: Fish to Mammals	4
_____	MAR-360 Plankton Ecology	4

Marine Sciences majors also will take either MTH-105 Algebra and Trigonometry or MTH-210 Calculus I to satisfy the CLAS core requirement.

TOTAL CREDITS: 65-66

**The Marine Sciences minor cannot be combined with the Marine Sciences major.*

REQUIREMENTS FOR THE ENVIRONMENTAL STUDIES MAJOR (B.A.)

GEMS (18 credits)			<u>Credits</u>
_____	ENV-100	Introduction to Environmental Science	4
_____	ENV-200	Statistical and Computer App. in the Natural Sciences	4
_____	ENV-205	Introduction to Geographical Information Systems	3
_____	ENV-220	Weather and Climate Change	3
_____	GEO-100/113	Earth Systems Science or Environmental Geology	3
_____	GEO-102	Earth Materials and Processes Lab	1
GEMS Upper Level Elective (3-4 credits; select one)			
_____	ENV-340	Environmental Field Methods and Data	3
_____	ENV-375	Environmental Biogeochemistry	3
_____	GEO-350	Soils and Surficial Processes	4
_____	GEO-407	Hydrology and Water Resources	4
Biology (12 credits)			
_____	BIO-115	Principles of Biology I	4
_____	BIO-116	Principles of Biology II	4
_____	BIO-350	General Ecology	4
Chemistry (4 credits)			
_____	CHE-120	Principles of Chemistry	3
_____	CHE-121	Principles of Chemistry Laboratory	1
Physics (4 credits)			
_____	PHY-100/L	Principles of Physics I and Lab	3/1
Policy and Humanities (9 credits; select three)			
_____	HIS-224	American Environmental History	3
_____	PHL-215	Environmental Ethics	3
_____	POL-328	Environmental Policy and Politics	3
_____	POL-329	Comparative Environmental Policy	3
Policy and Humanities Elective (6 credits; select two not selected above)			
_____	AMS-304	Tech. & Sci. in America	3
_____	BHP-231	Natural Adventures	3
_____	BHP-232	NJ Shoreline-Sci./Pol.	3
_____	BHP-259	The Env: Conflict of Int.	3
_____	HIS-224	American Env. History	3
_____	IND-316	Nature's Business	3
_____	PHL-215	Environ. Ethics	3
_____	POL-215	Global Politics	3
_____	POL-328	Env. Policy & Pol.	3
_____	POL-329	Comp. Env. Policy	3
_____	POL-330	Geopol. of Energy	3
_____	SOC-225	Population Study	3

Environmental Studies majors also will take either MTH-105 Algebra and Trigonometry or MTH-210 Calculus I to satisfy the CLAS core requirement.

TOTAL CREDITS: 56-57

**The Earth and Environmental Sciences minor cannot be combined with the Environmental Studies major.*

REQUIREMENTS FOR THE EARTH SCIENCES (B.A.)

REQUIRED FOUNDATIONS COURSES (29-30 credits)

_____	ENV-200	Stat and Comp. App. Nat Sci	4	_____	MAR-120	Oceanography	3
_____	ENV-220	Weather and Climate Change	3	_____	MAR-121	Intro Oceans Lab	1
_____	GEO-100/113	Earth Sys Sci or Env Geo	3	_____	PHY-180	Astronomy	3
_____	GEO-102	Earth Mat and Processes Lab	1				

Field Experience (select one of the following) (3+ credits)

_____	ENV-340	Env Field Methods	3	_____	MAR-300	Intro to Field Mar Sci	4
_____	GEO-xxx	Approved Geology Field Camp	3+	_____	MAR-380	Learn & Teach Mar Sci	4

Additional Required Courses (8 credits)

_____	CHE-120/121	Prin. of Chemistry & Lab	3/1	_____	MTH-105	Algebra & Trig	4
						OR any MTH course at the 200-level or above	

CONCENTRATION (select one of the following concentrations)

A. Geology Concentration (22-24 credits)

Electives: select 6 (at least 4 courses with a lab)

_____	ENV-205	Introduction to GIS	3	_____	GEO-310	Structural Geology	3
_____	GEO-304	Elements of Mineralogy	4	_____	GEO-350	Soils and Surficial Proc.	4
_____	GEO-305	Petrology and Petrography	4	_____	GEO-407	Hydro and Water Res.	4
_____	GEO-306	Seds and Stratigraphy	4	_____	MAR-210	Mar Life Through Time	4

B. Environmental Concentration (22-24 credits)

Required (12 credits)

_____	ENV-100	Intro to Env Sciences	4	_____	BIO-350	General Ecology*	4
_____	BIO-116	Principles of Biology II	4				

Electives: select 3 (at least 1 course with a lab) (10-12 credits)

_____	ENV-350	Env Toxicology**	3	_____	MAR-330	Chemical Oceanography	4
_____	ENV-375	Env Biogeochemistry**	3	_____	MAR-360	Plankton Ecology	4
_____	GEO-306	Seds and Stratigraphy	4	_____	MAR-401	Marine Ecology	4
_____	GEO-350	Soils and Surf Processes	4	_____	MAR-410	Physical Oceanography	3
_____	GEO-407	Hydrology and Water Res.	4				

C. Marine Concentration (22-24 credits)

Required (8 credits)

_____	BIO-115 or 116	Principles of Biology I or II	4				
_____	BIO-272/L	Intro to Marine Biology & Lab	4				

Electives: select 4 (at least 2 courses with a lab; at least 3 courses at the 300-400 level) (14-16 credits)

_____	ENV-205	Intro to GIS	3	_____	MAR-340	Marine Processes	3
_____	GEO-306	Sed. and Strat.	4	_____	MAR-360	Plankton Ecology	4
_____	MAR-210	Mar Life Through Time	4	_____	MAR-401	Marine Ecology	4
_____	MAR-325	Marine Vertebrates	4	_____	MAR-410	Physical Oceanography	3
_____	MAR-330	Chemical Oceanography	4				

Total Credits: 51-54

* Students will need to be signed into this course which normally requires BIO-115 and BIO-116 as prerequisites.

**Requires additional courses as prerequisites.

REQUIREMENTS FOR THE MARINE SCIENCES MINOR

GEMS (12 credits)			<u>Credits</u>
_____	GEO-100	Earth Systems Science	3
_____	GEO-102	Earth Materials and Processes Lab	1
_____	MAR-120	Oceanography	3
_____	MAR-121	Introductory Oceanography Lab	1

_____	MAR-380	Learning and Teaching of Marine Science	4
or			
_____	MAR-300	Introduction to Field Marine Science	4
 Biology (8 credits)			
_____	BIO-115	Principles of Biology I	4
or			
_____	BIO-116	Principles of Biology II	4

_____	BIO-272	Introduction to Marine Biology	3
_____	BIO-272L	Marine Biology Lab	1
 Elective (3-4 credits; select one)			
_____	GEO-306	Sedimentology and Stratigraphy	4
_____	MAR-325	Marine Vertebrates: Fish to Mammals	4
_____	MAR-330	Chemical Oceanography	4
_____	MAR-360	Plankton Ecology	4
_____	MAR-410	Physical Oceanography	3
TOTAL CREDITS:			23-24

**Marine Sciences majors may not select this minor.*

REQUIREMENTS FOR THE EARTH AND ENVIRONMENTAL SCIENCES MINOR

Foundational Courses (14 credits)			<u>Credits</u>
_____	ENV-100	Introduction to Environmental Science	4
_____	GEO-100	Earth Systems Science or GEO-113 Environmental Geology	3
_____	GEO-102	Earth Materials and Processes Lab	1
_____	ENV-205	Introduction to Geographical Information Systems	3
_____	ENV-220	Weather and Climate Change	3
 Electives (6-8 credits; select two; at least one must be a 300- or 400-level course)			
_____	ENV-375	Environmental Biogeochemistry** (requires 2 chemistry courses)	3
_____	ENV-340	Environmental Field Methods and Data Analysis	3
_____	GEO-304	Elements of Mineralogy [±] (requires 1 chemistry course)	4
_____	GEO-306	Sedimentology and Stratigraphy	4
_____	GEO-350	Soils and Surficial Processes	4
_____	GEO-407	Hydrology and Water Resources** (requires MTH-105)	4
_____	MAR-210	Marine Life Through Time	4
TOTAL CREDITS:			20-22

**Geology and Environmental Sciences majors may not select this minor.*

***Course has a prerequisite(s) that would be in addition to courses required for this minor.*