


Northeast Chapter of the Washington Native Plant Society. Awarded to: *Sandra (DeeDee) Dooley, undergraduate (mentored by Julie Beckstead). Title: Interaction between a fungal seed pathogen and a deleterious rhizobacteria for biological control of the invasive cheatgrass. 2008. Award Amount: $400.

Northeast Chapter of the Washington Native Plant Society. Awarded to: *Laura Street, undergraduate (mentored by Julie Beckstead). Title: The Effect of Fire on the Infection Rate of a Seed Fungal Pathogen in Bromus tectorum Dominated Shrub-Steppe Ecosystem. 2008. Award Amount: $415.

Faculty Contacts and Specialties

Kirk Anders, Ph.D., University of Wisconsin-Madison, Assistant Professor, specializes in genetics, researching the mechanisms of genomic change during adaptive evolution. (anders@gonzaga.edu)

Julie Beckstead, Ph.D., University of Illinois, Associate Professor, specializes in community ecology with research focusing on invasion biology. (beckstead@gonzaga.edu)

Maria Bertagnolli, Ph.D., University of Utah, Professor, specializes in biochemistry and cell biology, researching cytoskeletal proteins in a colon cancer model. (bertagnolli@gonzaga.edu)

David Boose, Ph.D., University of California, Davis, Associate Professor, specializes in plant ecology, evolution, and molecular genetics. (boose@gonzaga.edu)

Gary Chang, Ph.D., University of Washington, Assistant Professor, specializes in insect ecology. (chang@gonzaga.edu)

Seth Coleman, Ph.D., University of Maryland, Assistant Professor, specializes in the ecology and evolution of mate choice in fish. (colemans@gonzaga.edu)

William Ettinger, Ph.D., Washington State University, Professor, specializes in plant cell biology and the mechanisms and consequences of ion transport in plant chloroplasts. (ettinger@gonzaga.edu)

Joseph Haydock, Ph.D., Purdue University, Associate Professor, specializes in vertebrate behavioral ecology, researching cooperative breeding in avian systems. (haydock@gonzaga.edu)

Hugh Lefcort, Ph.D., Oregon State University, Professor, specializes in physiological ecology and animal behavior, researching the effects of pollution and parasites on invertebrate behavior. (lefcort@gonzaga.edu)

Peter Pauw, Ph.D., University of Missouri-Columbia, Professor, specializes in genetics and cell biology, researching the sodium-potassium ATPase. (pauw@gonzaga.edu)

Marianne Poxleitner, Ph.D., Washington State University, Assistant Professor, specializes in the molecular biology of basal eukaryotes and plants. (poxleitner@gonzaga.edu)

Robert Prusch, Ph.D, Syracuse University, Professor, specializes in comparative physiology and cell biology. (prusch@gonzaga.edu)

Nancy Staub, Ph.D., University of California, Berkeley, Professor, specializes in evolution and vertebrate biology, researching salamander evolution. (staub@gonzaga.edu)

Brook Swanson, Ph.D., Northern Arizona University, Associate Professor, specializes in animal physiology. (swansonb@gonzaga.edu)

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For more information, please see the departmental websites at: http://gonzology.gonzaga.edu or www.gonzaga.edu/biology; (509) 313-6614 or (800) 986-9585 ext. 6614

The Passion

Biology studies the origin, structure, development, reproduction, and evolution of life. Essentially, the study of biology is an attempt to understand life. Biological research holds the key to understanding many modern challenges, including bio-engineering breakthroughs, environmental concerns, ecological relationships, and medical issues. The need for dedicated, innovative, and socially responsible biologists has never been greater than it is today. Thus, at the core of Gonzaga University's Biology Department is the Jesuit mission to combine academic study with the pursuit of social justice and the development of the total self.

The Program

The faculty in the Biology Department are genuinely devoted to teaching and mentoring students, and to helping students fulfill their academic ambitions. The program provides a strong foundation of knowledge and hands-on research experience, while cultivating curiosity and critical thinking.

Degrees:

The Bachelor of Science (B.S.) in Biology provides students with a broad education in biology, supported by a solid grounding in chemistry and physics. This degree is designed to prepare students for careers in biology, including continued training in graduate programs in biological and biomedical sciences, medicine, and dentistry.

The Bachelor of Arts (B.A.) in Biology provides students with a thorough biology education, but with fewer chemistry and physics courses. It allows flexibility for students pursuing additional interests such as teaching or a second major in another area of study.

The Research Option:

The Research Option is a challenging, optional track within the Biology degree. It is designed for motivated students who want to pursue research after graduation (Ph.D. programs, industry, government, medical school, science education). Courses provide additional grounding in math, statistics, and scientific writing, and activities include significant independent research, participation in scientific meetings, and science education outreach.

Coursework:

All biology majors and minors take the same two-year sequence of courses. First-year students study the diversity, structure, and interactions of living organisms; second-year students study cell biology, genetics, and evolution. After completing the introductory biology curriculum, students pursue specific interest areas through electives. Examples include: biochemistry, molecular biology, comparative physiology, vertebrate biology, field botany, developmental biology, parasitology, conservation biology, and advanced courses in cell biology, genetics, or ecology. All students take at least one advanced topic course, which is a small seminar class exploring scientific literature in biology.

Research Opportunities:

The faculty in the Biology Department do their research with students because they are always excited when a student makes a new discovery in their labs, and they are convinced that doing research is a great way to learn science. As a testament to their dedication to undergraduate research, the Biology and Chemistry Departments were awarded a major grant ($1.2 million) by the Howard Hughes Medical Institute to support science education and research. Gonzaga is one of only 48 undergraduate institutions to be awarded this recognition. The four-year grant, which started in the Fall semester of 2008, allows Gonzaga to offer more research positions for undergraduates (both during the academic year and the summer), hire additional faculty, develop new courses, and expand our science-education outreach program. Students can join in the research during the school year and summer. Some students have become co-authors with their faculty mentors, publishing papers in scientific journals and presenting posters at regional and national scientific meetings.

Some current research projects seek to answer such questions as:

- How does cell adhesion relate to colon cancer?
- How did cocaine synthesis evolve in plants?

- Can lady beetles be used in place of pesticides?
- What does calcium do in photosynthesis?
- How does an extra chromosome affect a cell?
- How do social woodpeckers choose mates?
- Can we use a naturally occurring fungus to fight cheatgrass invasions?
- How does heavy metal pollution affect animal behavior?
- Why are spider silk and other biomaterials so strong?
- How do salamanders communicate through their skin?
- How does fish behavior evolve?
- Can parasites reveal the health of the ecosystem?

For more detailed descriptions of faculty research, please see the Biology Department website (address listed on last page).

Study Abroad:

Often, Gonzaga biology students combine research with travel and the development of an understanding of other cultures and ecological systems. Gonzaga currently offers field biology programs in Ecuador and Zambia. Gonzaga is also affiliated with the School for Field Studies, a consortium of colleges and universities that maintain programs throughout the world. Through the Gonzaga courses or the Field Studies programs, Gonzaga students gain "hands-on" experience in a variety of biological and ecological settings:

- Island and Rainforest Biodiversity (Galapagos Islands, Ecuador)
- Coastal Studies (Baja, Mexico)
- Marine Resouce Studies (British West Indies)
- Rainforest Studies (Queensland, Australia)
- Chimfunshi Wildlife Reserve (Zambia)
- Sustainable Development Studies (Costa Rica)
- Wildlife Management Studies (Kenya)

Science Education Outreach:

In addition to valuing research, the Department emphasizes the relationship between biological study and social justice. Many Gonzaga biology students participate in the Gonzaga Indian Education Outreach Program (GIEOP), which links Gonzaga's students, research projects, and facilities to the Spokane, Wellpinit, and Nespelem tribal schools and communities in the Pacific Northwest. Other students choose to participate in our Science in Action! program. This program sends teams of GU students to classrooms in Spokane to do inquiry-based science activities.

The Potential

The Biology Department faculty members are dedicated to excellence in teaching and mentoring students as they navigate the rigorous curriculum of the Biology degree. Consequently, biology majors are well prepared for careers in research, teaching, medicine, and other biology-related fields.

Some students decide to work for biotechnology companies after graduation, such as Hollister-Stier Laboratories, Signature Genomics, and ICOS Biopharmaceuticals. Others take jobs with government agencies, hospitals, or research university laboratories. Still others pursue careers that integrate a passion for biology with other interests, such as genetic counseling, science writing, forensics, and health care.

Graduate Studies:

Through their undergraduate research experience, a number of Gonzaga students discover how exciting and intellectually stimulating scientific research can be, and they decide to pursue graduate study for advanced degrees. Gonzaga graduates are currently working on Ph.D. degrees in neuroscience, infectious diseases, cell and molecular biology, ecology, molecular plant sciences, and others at research universities throughout the country, such as Yale University, Johns Hopkins University, Washington State University, and UC-Berkeley.

Health Science Careers:

Several members of the Biology Department sit on the Committee for Health Science Careers, a group of interdisciplinary faculty who advise Gonzaga students applying for professional schools in medicine, dentistry, and veterinary medicine. Before applying, students submit essays and practice interviewing before the Committee, which offers valuable feedback and advice. Many students are strong candidates for medical, dental, and veterinary schools, and each year a number of Gonzaga graduates are accepted. Gonzaga Biology alumni are currently at schools across the country, including the University of Washington, Washington State University, Creighton University, Emory University, and others.

The People

Gonzaga's Biology Department's core strength is its team of dedicated faculty. Faculty members hold office hours and enjoy mentoring students both personally and professionally. A sample of recent accomplishments of Biology faculty (and our undergraduates, noted with an *) include:

Publications:

Baumgartner A*, Coleman S, Swanson B. "The Cost of the Sword: Escape Performance in Male Swordtails." *PLoS ONE* 6(1): e15837. doi:10.1371/journal.pone.0015837 (2011).

Boose, David L., Steven Harrison, Suzette Clement, and Susan Meyer. "Population genetic structure of the seed pathogen Pyrenophora semeniperda on Bromus tectorum in western North America." *Mycologia*, 103(1):85–93 (2011).

*Dooley, Sandra R. and Julie Beckstead. "Characterizing the interaction between a fungal seed pathogen and a deleterious rhizobacteria for cheatgrass control." *Biological Control*, 53; 197-203 (2010).

Sever, D.M. and N.L. Staub. "Hormones, sex accessory structures and secondary sexual characters in amphibians." In *Hormones and Reproduction of Vertebrates* (D.O. Norris and K.H. Lopez, eds.), vol. 2, pp. 83-98. San Diego: Elsevier (2010).

Beckstead, Julie, Susan E. Meyer, *Brian M. Connolly, *Mike B. Huck, and *Laura E. Street. "Cheatgrass facilitates spillover of a seed bank pathogen onto native grass species." *Journal of Ecology*, 98:168-177 (2010).

Lefcort, H., Vancura, J.*, and Lider, E. "75 Years after mining ends stream insect diversity is still affected by heavy metals." *Ecotoxicology,* 19:1416-1425 (2010).

Swanson, B.O., Anderson, S.*, DiGiovine, C.*, Ross, R., Dorsey, J.* "Evolution of complex biomaterial performance: the case of spider silk." *Integrative and Comparative Biology,* 49:21-31 (2009).

Kleiber, D.; C. Stern; J. Haydock; J. Dickinson; M. Stanback; *V. Schmidt; *E. Eisenberg; and *C. Stolzenberg. "Characterization of polymorphic microsatellite loci in the western bluebird Sialia mexicana and eastern bluebird Sialia sialis." *Molecular Ecology Resources,* 8:1348-1350 (2008).

Lefcort, H.; *Z. Freedman; *S. House; and *M. Pendleton. "Hormetic effects of heavy metals in aquatic snails: Is a little bit of pollution good?" *EcoHealth,* 5:10-17 (2008)

Beckstead, J.; S. E. Meyer; *C.J. Molder; and *C. Smith. "A race for seed resources: can Bromus tectorum seeds escape Pyenophora semeniperda-caused mortality by germinating quickly?" *Annals of Botany,* 99:1-8 (2007).

*Fontana, M.F.; L.D. Houck; and N.L. Staub. "In situ localization of plethodontid courtship pheromone mRNA in formalin-fixed tissue." *General and Comparative Endocrinology*, 150:480-485 (2007).

*Fontana M.F.; *K.A. Ask; *R.J. MacDonald, *A.M. Carnes, and N.L. Staub. "Loss of traditional mucous glands and presence of a novel mucus-producing granular gland in the plethodontid salamander Ensatina eschscholtzii." *Biological Journal of the Linnean Society,* 87:469-477 (2006).

Boose, D.L.; *B.R. Harmeling; and *R.T. Turcotte. Genetic variation in Eastern Washington populations of Navarretia leucocephala (Polemoniaceae) a vernal pool endemic. *Madroño,* 52(2):99-106 (2005).

Grants:

Murdock Partners in Science. Awarded to: Nancy Staub and Kari Sikel (Colton, OR). Variation in pheromones in plethodontid salamanders. 2011. Award Amount: $15,000.

U.S. Air Force Office of Scientific Research Young Investigators Program Award. Awarded to: Brook Swanson. Grant awarded for discovery of high-performance biomaterials for defense applications. 2010. Award Amount: $345,000.

National Science Foundation. Awarded to: Joey Haydock. Grant to fund research with undergraduates in collaboration with Cornell University (which received separate funding to Walter Koenig) on a study of reproductive sharing and fitness in cooperative societies of acorn woodpeckers. 2009. Award Amount: $100,000.

NSF ROA. Awarded to: Nancy Staub and L.D. Houck, OSU Collaborative Research. Grant to study interaction effects in a pheromone signaling system. 2009. Award Amount: $15,740.

Howard Hughes Medical Institute. Awarded to: Gonzaga University Biology and Chemistry & Biochemistry Departments. Grant to strengthen undergraduate research, mentoring, computational skills in the biomedical sciences to Biology and Chemistry Departments. 2008. Award Amount: $1,200,000.

CSREES NRI (USDA). Awarded to: Julie Beckstead and David Boose (with Dr. Meyer, USDA Shrub Science Laboratory; Drs. Allen, Coleman, and Stevens, Brigham Young University). Grant to study evolutionary and community ecology of the seed bank pathogen Pyrenophora semeniperda on cheatgrass-dominated rangelands. 2008. Award Amount: $131,255.

E.L. Wiegand Foundation (Reno, NV). Awarded to: David Boose. Grant to purchase three environmental growth chambers and ten sets of plant physiology analysis equipment. 2007. Award Amount: $191,000.

Institute of Systems Medicine. Awarded to: Nancy Staub. Grant to fund K-12 science outreach in the Spokane community. 2007. Award Amount: $9,000.

U.S. Air Force Office of Scientific Research award. Awarded to: Dr. Brook Swanson. Grant for equipment to study the strength, extensibility, and toughness of biomaterials. 2007. Award Amount: $148,000.

The M.J. Murdock Charitable Trust College Research Program for Life Sciences has also recently funded research projects for Drs. Kirk Anders, Julie Beckstead, Mia Bertagnolli, and Nancy Staub.

Research Grants to Mentored Undergraduates:

Weed Science Society Association Undergraduate Research Award. Awarded to: *Trevor Davis, undergraduate (mentored by Julie Beckstead). Title: Variable virulence of Pyrenophora semeniperda with the presence of other pathogenic fungi in double infections of Bromus tectorum. 2009. Award Amount: $1000.