Biomedical Sciences Ph.D. Program

Health Sciences 484
Web site: http://www.uwyo.edu/biomedphd/
Program Director: Sreejayan Nair, Ph.D.

Degree Offered

Ph.D. in Biomedical Sciences

Biomedical sciences is the study of human biological processes; the complex interactions between physiological, genetic and environmental factors that influence disease and health. It spans the spectrum from fundamental discovery to innovation and application.

Areas of focus may include but not limited to cardiac health, nutrition, reproductive biology, toxicology, diagnostic & imaging and medical engineering.

The PhD program in biomedical sciences is designed to position graduates for long-term competitive success in the rapidly changing and multifaceted health-related arena in the 21st century. It is a comprehensive, interdisciplinary program, making connections between various disciplines to gain new insights, discover and apply new knowledge, and promote self-directed, life-long learning.

Biomedical Sciences is a research & discovery focused program balancing depth and breadth of content knowledge with "enabling" skills including problem solving, innovation, entrepreneurship, communication and leadership.

Program of Study

Rationale: The program of study is designed according to student learning goals and research opportunities. It blends depth and breadth of preparation by providing broad core requirements with electives promoting specialization in a "parent" discipline. This is recognized on program documentation by a Doctorate in Biomedical Sciences/"specialization" area. For example, Doctorate in Biomedical Sciences/Reproductive Biology.

Student Learning Outcomes: The BMS program provides unique array of formal courses and informal discovery experiences focused on ensuring aptitudes, behaviors and skills necessary for leadership and competitive success in the biomedical science arena. Although the foundation enabling innovative, independent thinking and knowledge discovery is deep discipline knowledge, the BMS program is also designed to promote student competency in information assessment, synthesis and integration, communication and translation to the broader community, teamwork, leadership and project management.

The BMS program trains graduates to be competent, skilled experimentalists, problem solvers, critical and independent thinkers, expert in their field, with both depth and breadth of knowledge.

In addition, the program aims to instill characteristics that are essential to long-term professional success, preparing scientists who are effective and dedicated mentors and teachers, organized administrators, exemplars of high ethical standards, and effective collaborators. Upon completion of the program, graduates will demonstrate:

- Independent, critical thinking skills
- Ability to identify appropriate biographical resources
- Knowledge of recent advances in discipline and related areas
- Understanding of a broad spectrum of research methodologies and their applications
- Ability to critically analyze research findings
- Ability to design and independently execute research
- Ability to use appropriate information technology to record, manage, and disseminate information
- Understanding of issues related to researcher and subject rights
- Motivation and aptitude needed to acquire knowledge
- Communication skills that are appropriate for a range of audiences and purposes
- Ability to construct and articulate arguments to a wide range of audiences
- Ability to effectively support the acquisition of knowledge by others when teaching or mentoring students
- Willingness to assume responsibility for their work
- Ability to design and teach undergraduate or graduate courses
- Ability to publish single/first authored papers in peer-reviewed journals

Biomedical Sciences (BMS)

5880. Biomedical Sciences Research Ethics. 2. Introduction to the field of bioethics, including major ethical theories and principles, with an emphasis on understanding the ethical issues that may arise while conducting biomedical research and potential strategies for properly addressing these ethical issues.

5920. Continuing Registration: On Campus, 1-12 (Max. 24). *Prerequisite*: graduate standing.

5940. Continuing Registration: Off Campus, 1-24 (Max. 24). *Prerequisite*: graduate standing.

5960. Thesis Research, 1-24 (Max. 24). Designed for students who are involved in research for their thesis project. Also used for students whose coursework is complete and are writing their thesis. *Prerequisite*: enrollment in a graduate degree program.

5980. Dissertation Research, 1-24 (Max. 24). Designed for students who are involved in research for their thesis project. Also used for students whose coursework is complete and are writing their thesis. *Prerequisite*: enrollment in a graduate degree program.

5985. Seminar. 1 (Max. 3). A series of weekly seminars presented by faculty from other universities, private or public sector health industries or by Biomedical Science Program faculty and students. Examines current topics and research in biomedical sciences through oral presentations and discussion. *Prerequisites:* graduate standing and consent of instructor.

Program in Ecology

Berry Center 231
Phone: (307) 766-6240
E-mail: ecology@uwyo.edu
Web site: www.uwyo.edu/pie
Program Director: Melanie Murphy

Degree Offered

Ph.D. in Ecology

The Program in Ecology prepares doctoral students to lead the discipline of ecology during the coming decades. The program is grounded in the natural history of organisms in their environment, but incorporates tools and perspectives from across the biological, physical, mathematical, computational, and earth sciences. Students develop conceptual, historical, and philosophical perspectives spanning the entire range of subdisciplines in ecology, while receiving advanced training in the subdiscipline of their individual interest.

The program fosters long-term career development by exploring the linkages of ecology with other disciplines, and by scanning the ecological horizon for emerging questions, concepts, and approaches that will shape the field in years to come.

Faculty members from several departments and colleges participate in the Program in Ecology. Their interests span the full range of topics covered in the field of ecology, and students in the program reflect this diversity.

Program Specific Admission Requirements

Only students seeking a doctoral degree will be admitted into the program. Minimum criteria for admission to the Program in Ecology are:

- Minimum undergraduate GPA of 3.000
- Agreement by a member of the PiE faculty to sponsor the student, or to co-sponsor the student together with a PiE affiliate
- Admission to a home department at the University of Wyoming

All applications to the program will be reviewed by the Graduate Affairs Committee, which has authority on admissions. Students applying to the program who lack a master's degree must show exceptional promise and commitment (e.g., through undergraduate or post-graduate research experiences, peer-reviewed publications, and/or success in competing for research fellowships). Such students are encouraged to consult with their prospective adviser on whether to apply directly to PiE or to master's programs in individual home departments of PiE faculty.

Students already admitted to doctoral programs in individual departments at the University of Wyoming may apply to transfer to the program. Transfer is not pro forma. Transfer applications are subject to the same criteria as for entering students, and admission to the program for transfer students must be approved by the Graduate Affairs Committee.

Program Specific Degree Requirements

Advisory Committee

Before the end of the second semester of study, the student should nominate a five-member advisory committee to the Office of the Registrar. At least three members of the committee, including the committee chair (usually the student's adviser), will be members of the PiE faculty. One other member, who will serve as Graduate Faculty representative, must be from outside the home department of the major adviser, although (s)he can be a faculty member in a department that participates in the program. The committee will advise the student on his/her program of graduate study, execute and evaluate the student's preliminary examination, evaluate the student's dissertation proposal and dissertation, and conduct the student's dissertation defense.

Program of Study

All students are required to take ECOL 5100 or equivalent. This course should be taken during the first year of residency. Exceptions or substitutions of these requirements are subject to approval by the graduate affairs committee.

The program of study must include at least 6 credit hours aimed at developing a tool skill, which except for rare cases shall be in the quantitative/analytical domain (e.g., statistics, modeling, GIS, remote sensing, bioinformatics). Courses relating to research tools should be taken early in the student's residency to ensure that they can be used in thesis research and advanced studies. Specific coursework and tool-skill development for the student's program of study will be developed in consultation with and subject to approval by the student's advisory committee.

Admission to Candidacy

Admission to candidacy for the Ph.D. requires two steps: 1) providing evidence that the student is prepared to identify a research question, design an approach for investigating that question, and a plan for executing the approach, all in the format of an NSF-style research proposal, and 2) illustrating adequate proficiency in the subject matter of ecology through a process involving both written and oral exams.

Proposal

Students must submit a NSF-style proposal to their committee outlining their project, typically by the end of the fourth semester. Each committee member will provide feedback to the student on the proposed research and indicate approval of the proposal or request revision. The proposal must be approved by all committee members prior to starting the preliminary exams.

While this proposal should be a plan for actual dissertation research, unforeseen circumstances may require altering the student's dissertation work after the proposal has been approved by the committee. In the case of a major alteration, the student should reformulate a research plan and submit it to the committee in writing for committee approval.

Preliminary Exam

Passing the preliminary exam is the official admission to candidacy.

Written portion of the preliminary exam. The student will take the written exam portion of the preliminary exam no fewer than two weeks following approval of the research proposal. The goal of this exam is to test breadth of knowledge in ecology. The design of this exam will be coordinated by the graduate committee under the leadership of the adviser. Each written exam will cover the following topics:

- Ecological topics ranging from organismal/evolutionary to ecosystem-level perspectives, integrating concepts and perspectives from across the discipline, over a wide range of spatial and temporal scales.
- The philosophical and historical development of ecology.
- The conceptual background of the student's area of specialization.

The exam will consist of four to six questions developed collectively by the committee and organized by the student's major professor. The exam will be open book; however, the answers will be solely the work of the student. Answers should be fully cited and collectively should be no longer than 30 pages double-spaced exclusive of references cited. Students will have one full week (seven days) to complete the exam. Committee members will indicate pass/fail within one week following completion of written exams. Four of five passing votes are required.

Oral Portion of the Preliminary Exam. No sooner than two weeks after successfully passing the written exam, the student may proceed to an oral exam administered by his/her graduate committee. Oral exams center around three goals from which questions will be derived:

- To verify that the student is prepared, conceptually and methodologically, to carry out successful dissertation research.
- To evaluate the student's ability to conceptualize specific questions in a broad, integrative context.
- To evaluate the student's ability to think spontaneously and creatively and to articulate responses about unexpected or novel questions.

The advisory committee will discuss and organize specific questions based on these goals in a short session at the beginning of the exam period before admitting the student to the examination room and starting the exam. Following the exam each committee member will provide non-binding paper votes of pass/fail for each of the three goals of the oral exam. Following discussion of the student's performance, committee members will each assign a grade of pass/fail for the overall exam. Four of five committee members must vote for passing the overall oral exam.

Students whose performance is unsatisfactory will be given one opportunity for retaking the oral examination. This retake will occur no later than the academic-year semester following the first examination.

Public Seminars

Students are required to give two oral presentations on their research. The purposes of these presentations are to provide the student with practice in oral presentations and to keep the PiE community informed of the student's progress. The first will describe the student's dissertation research proposal. This presentation will be given before the student submits his/her thesis proposal. The second presentation will summarize the student's completed dissertation research, and will normally be given the same semester as the student's dissertation defense. Under extraordinary circumstances (subject to approval by the Graduate Affairs Committee), this presentation may be given at an earlier time. These presentations must be open to the public, and may comprise part of a departmental or Program in Ecology seminar or brown-bag series.

Ecology (ECOL)

5050. Techniques in Environmental Data Management. 4. Centers on the role of information technology in support of scientific research. Through integration of multiple software packages (e.g. Relational databases, ProgramR and ArcGIS), proven database designs, and SQL scripting, increased efficiency and utility will occur during data analyses. These information science principles are demonstrated using project-based examples. Cross listed with ENR/GEOG 5050. Prerequisite: graduate standing.

5060. Fundamental Concepts in Evolution. 3. Explores fundamental concepts in evolutionary biology including evolutionary ecology, population genetics, and speciation with an emphasis on both theoretical frameworks and practical applications. Discussion included. Cross listed with BOT/ZOOL 5060. *Prerequisite:* graduate student in good standing. (Offered every other year)

5100. Ecology as a Discipline. 3. Covers the range of ecological questions, processes, scales, and research approaches, in context of the history and philosophy of science in general and of ecology in particular. Aimed at first-year students in the doctoral program in Ecology, although students in other graduate programs are welcome. *Prerequisite:* graduate standing.

5400. Community Ecology. 3. Community ecology is the study of interactions within and among groups of species. This course focuses on (1) the major classical concepts and theories in community ecology, (2) the ways in which population dynamics can impact communities and how community dynamics can impact ecosystem processes and functioning, and (3) implementation of quantitative methods for conducting research that includes community ecology. Cross listed with REWM 5400. *Prerequisite:* LIFE 3410 or equivalent.

5500. Quantitative Analysis of Field Data. 3. A practical guide to the analysis of messy field data, including data exploration, generalized linear and additive models, mixed models, autocorrelation, and model selection using Program R. Students will spend one intensive week learning methods and the rest of the semester analyzing their own data and writing a manuscript. *Prerequisite:* graduate standing.

5540. Microbial Diversity and Ecology. 4. Introduces the diversity and ecology of soil microbes through an integrated lecture and laboratory course. Emphasis on molecular approaches to analyzing microbial diversity and evolution, and student-directed experimental design. Provides a continuum of realistic research experiences in molecular microbial ecology, from field work to evolutionary analysis of DNA sequence data. Cross listed with MOLB/MICR/SOIL 4540. Dual listed with MOLB/SOIL 5540. *Prerequisites:* MOLB 2210.

5550. Ecology as a Scientific Profession. 2. A capstone that prepares doctoral students for success and leadership in their careers as professional ecologists. Intended for students enrolled in the doctoral Program in Ecology in their final year. *Prerequisite:* graduate standing.

5580. Rangeland Restoration Ecology. 3. Detailed analysis of various ecosystems unique to western rangelands. Primary emphasis on plant community restoration following degradation from edaphic, biotic, hydrologic, and topographic factors. Application of ecological principles to rehabilitate vegetation and restore ecosystem function. Strong emphasis on current research to formulate restoration strategies. Cross listed with REWM 5580.

5610. Quantitative Modeling in Landscape Ecology. 3. Emphasis on quantitative, spatial analysis of landscapes and application of these quantitative tools to making sound management decisions. Work with real data, acquire high-level quantitative skills, develop problem-solving skills, and discuss management application of model results. Analysis will encompass abiotic, biotic (plant and animal), and human use of ecological systems in a spatial context. Cross listed with REWM 5610. *Prerequisites:* upper division stats course (e.g., STAT 4015 or STAT 4025) and graduate standing. (Offered during even-year fall semesters)

5620. Advanced Topics in Ecology. 1-4. (Max. 12). Provides advanced treatment of specific topics in ecology that are not covered in regular courses. *Prerequisites:* graduate standing and consent of instructor.

5650. Tropical Field Ecology Ecuador. 4. Course comprises 10 days in Ecuador in January (before spring semester), followed by one lecture per week during spring semester. Focus will be ecology, biodiversity and conservation of tropical forests and behavioral ecology of birds and mammals. Field site is at 1100m on west slope of the Andes. Cross listed with ECOL 5650. *Prerequisite:* graduate standing.

5680. Landscape Genetics. 3-4. Provides a unique opportunity for interdisciplinary training and international collaboration uniting some of the most active landscape genetics groups in North America and Europe. A key objective of landscape genetics is to study how landscape modification and habitat fragmentation affect organism dispersal and gene flow across the landscape. Meeting this and other landscape genetic objectives requires highly interdisciplinary specialized skills making intensive use of technical population genetic skills and spatial analysis tools (spatial statistics, GIS tools and remote sensing). To bring these diverse topics and skills together effectively, we are using a distributed model of teaching. Population genetics, spatial analysis/statistics, and previous experience in Rare all extremely useful but not required. Cross listed with: REWM 5680.

5775. Forest Ecology. 4. Integrative study of the structure, function, and ecological diversity of forested ecosystems, and the physical factors that influence this diversity, including emergent properties of energy flow and nutrient cycling. Special emphasis is given to understanding forest disturbances and succession, and implications for impacts of management and sustainability are discussed throughout. Cross listed with RNEW 5775 and BOT 5775. *Prerequisite:* LIFE 3400. (Offered during even-year fall semesters)

5780. Research in Ecology. 1-6 (Max. 12). Designed for doctoral students pursuing exploratory research before they have determined a dissertation project, and for students to pursue independent research that will not comprise part of their dissertation. Research must be conducted under supervision of an Ecology Faculty member or Affiliate. *Prerequisite:* admission to doctoral Program in Ecology.
5920. Continuing Registration: On Campus, 1-2 (Max. 16). *Prerequisite:* graduate standing.
5940. Continuing Registration: Off Campus, 1-12 (Max. 16). *Prerequisite:* graduate standing.
5980. Dissertation Research. 1-12 (Max. 48). Designed for students who are involved in research for their dissertation project. Also used for students whose coursework is complete and are writing their dissertation. *Prerequisite:* enrollment in a graduate level degree program.

Food Science and Human Nutrition

Phone: (307) 766-2224 or (307) 766-4145
Web Address: www.uwyo.edu/anisci or www.uwyo.edu/fcs

Degree Offered

M.S. in Food Science and Human Nutrition

The interdisciplinary food science and human nutrition master's degree program, jointly sponsored by the departments of Animal Science and Family and Consumer Sciences, affords students the opportunity to pursue graduate work in the areas of human nutrition and/or food science. Prior to admission to the program, students will select the major department (Animal Science or Family and Consumer Sciences) that best suits their desired research area(s) and indicate which faculty member from that department they would prefer as a mentor. Students choosing the interdisciplinary program in food science and human nutrition will gain expertise in theory as well as research in some combination of the areas of food microbiology, meat science and food chemistry, human nutrition and metabolism, food product development, and community nutrition. All students will be exposed to laboratory as well as classroom learning experiences.

Program Specific Admission Requirements

Recommended prerequisites for students entering the program:

One semester of organic chemistry (may include laboratory)

Human or animal anatomy and physiology

Introductory statistics

Program Specific Degree Requirements

One semester of biochemistry (may include laboratory)

Human or animal anatomy and physiology

Statistics

A minimum of 30 credit hours is required for this degree. Students may be required to take more than the minimum number of credit hours, either because they have to satisfy prerequisites for some of their graduate-level courses, or because a student's committee determines that more than 30 hours will be needed for the student to reach his/her professional objective. The student's program of study must include at least one credit hour of graduate-level seminar. A thesis is required. Students may request their area of thesis research be in food science or in human nutrition.

Students may use facilities such as the meat processing laboratory, sensory evaluation rooms, experimental kitchens, and a variety of modern facilities for research involving small animals and human subjects. Laboratory instruments including high performance liquid chromatographs, electrophoresis equipment, densitometers, gas chromatographs, ultracentrifuges, scintillation counters, differential scanning calorimeters, and histological equipment as well as computers are also available.

See the Food Science (FDSC) and Family and Consumer Sciences (FCSC) section of this catalog for course listings.

Molecular and Cellular Life Sciences

203 Animal Science/Molecular Biology Complex
Phone: (307) 766-3300
E-mail: mcls@uwyo.edu
Web Address: www.uwyo.edu/mcls

Program Director: Jesse Gatlin, Ph.D.
Admissions Director: Dan Levy, Ph.D.

Degree Offered

Ph.D. in Molecular and Cellular Life Sciences

This interdisciplinary program with more than 30 faculty participants spans a wide range of research topics, such as:

Biotechnology, bioengineering, biomaterials, and pharmacology
Cell biology and signaling
Genetics and development
Genomics, proteomics, and computational biology
Microbiology and infectious disease
Structural biology and biophysics

Coursework focuses on core courses in biochemistry and molecular biology, with electives that include such diverse courses as:

Topics in Genomics
Biophysics
Microbial Physiology and Metabolism
Cell and Developmental Genetics
Mass Spectrometry and Analytical Chemistry
Biomedical Engineering
Mammalian Endocrinology
Cell Culture and Virology
Introduction to Bioinformatics
Protein Structure and Function
Microbial Genetics
Computational Biology
Quantitative Microscopy

Program Specific Admission Requirements

Admission to MCLS is a two-step process. The first level of evaluation is carried out by the MCLS admissions committee. This step does not require any fee but does require that all requested materials be submitted as described on our website. After an initial review of all complete applications, a subset of qualified applicants will be selected for video conference interviews with members of the MCLS admissions committee. Applicants who are chosen for admission to the MCLS program will then complete the final application step through the University of Wyoming Admissions office. This latter step requires the completion of several additional forms. Students are then officially notified by the university of their acceptance into the MCLS program.

We encourage students to submit their completed applications at the very latest by January 15 of each calendar year. However, because our review of applications will begin in the late fall, early submissions are encouraged and may stand a greater likelihood of success. Also note that we will continue to review new applications received after January 15 in the event that additional slots are available.

Program Specific Degree Requirements

MCLS doctoral students must fulfill the minimum requirements outlined by the university. In addition, students must obtain a high level of proficiency in the core foundations of the molecular and cellular life sciences through required courses in biochemistry/molecular biology, scientific literature analysis proficiency, and the MCLS cornerstone course. Because of the broad range of research interests pursued by MCLS faculty and students, considerable flexibility will be exercised regarding the specific nature of the graduate-level elective courses that students may take.

Students must successfully complete four eight-week rotations in MCLS laboratories of their choice during the first year.

Students must pass a comprehensive assessment exam at the end of the first year. Towards the end of the second year, students will undertake a qualifying examination in order to be formally admitted to graduate degree candidacy. This exam will have both written and oral components and will cover areas of science that are relevant to the students' research.

The research and coursework progress of MCLS students will also be monitored and evaluated every year by the MCLS curriculum committee. In addition, an annual meeting with a research-specific dissertation committee will facilitate and evaluate the research progress of MCLS students beginning in the second year.

Students must attend weekly outside seminars on topics in the molecular life sciences for the durations of their studies.

For more information, please see the program's Web site at: www.uwyo.edu/MCLS/.

Natural Science (NASC)

4790. Topics in Natural Science. 1-6 (Max. 10). Presents selected science topics to acquaint teachers or prospective teachers with new concepts, materials or techniques, as introduced in various new school curricula. Topics may include earth science for the middle school, computer learning and/or elementary school environmental science. Includes laboratory. *Prerequisite:* junior standing.

4800. Field Studies in Natural Science. 1-6 (Max. 10). Explores topics best studied in the field, on location, or otherwise outside the traditional classroom. Topics may include grassland ecosystem, geology field trips for elementary children and/or schoolyard study areas. Includes laboratory. *Prerequisite:* junior standing.

5110. Physical Science in Global Context, MSC. 3. One in a series of three courses investigating earth as a system. Examines the global dynamics of energy, hydrocarbon combustion, and the physics and chemistry of water. Investigates relationships between energy transformations and pollutants. Considers environmental limitations of fresh water availability and the buffering effect of sea and fresh water. *Prerequisite:* graduate standing and teaching certification in elementary, middle school or general science; or, graduate standing and concurrent enrollment in a program leading to teacher certification in Elementary, middle school or general science education.

5120. Earth Science in Global Context, MSC. 3. One in a series of three courses investigating earth as a system. Emphasizes the lithosphere and atmosphere and their interactions with the hydrosphere and biosphere. Examines the interplay between tectonic processes, earth's radiation balance, ocean processes, ozone depletion and the greenhouse effect. Includes evaluation of methods of measuring and monitoring these phenomena. *Prerequisite:* graduate standing and teaching certification in elementary, middle school or general science; or, graduate standing and concurrent enrollment in a program leading to teach certification in elementary, middle school or general science education.

5130. Life Science in Global Context, MSC. 3. One in a series of three courses investigating earth as a system. Investigates ecosystem composition and processes, and biological responses to changes in ecosystem parameters. Examines terrestrial and aquatic communities, photosynthesis, energy flow, biogeochemical cycles, global climate change, climate warning, deforestation, population ecology, DNA/RNA structure, function, genetic engineering and forensic applications. *Prerequisite:* graduate standing and teaching certification in elementary, middle school or general science education.

5140. Numbers, Operations, and Patterns for the Middle-Level Learner, MMA. 3. Provides working middle-level mathematics teachers opportunities to understand and discuss numbers, their representations, and operations on them, from an abstract perspective that includes elegant proof. Also emphasized is the role of language and purpose in composing definitions. Cross listed with MATH 5140. *Prerequisite:* admission to a UW graduate program, either degree or non-degree seeking status, and acceptance into the Middle-level mathematics program.

5160. Social and Historical Issues in Mathematics and the Middle-Level Learner, MMA. 3. Empowers teachers of middle-level mathematics to design engaging experiences. Emphasizes the historical context for the development of mathematics, especially its symbols, tools, personalities, and classic problems. Cross-listed with MATH 5160. *Prerequisite:* admission to a UW graduate program, in either degree or non-degree seeking status, and acceptance into the Middle-level Mathematics program.

5170. Connecting Geometry with Problem-Solving for the Middle-Level Learner, MMA. 3. Showcases two aspects of 2D and 3D geometry: measurement and transformation. Emphasis reflects current State and National standards for middle-level mathematics classroom and teacher preparation, especially appropriate uses of technology, geometric tools, mathematical language, and problem-solving strategies. Cross listed with MATH 5170. *Prerequisite:* admission to a UW graduate program, in either degree or non-degree seeking status, acceptance into the Middle-level mathematics program.

5185. Analysis of Data in the Media for the Middle-Level Learner, MMA. 3. Focuses on data collection, analysis, interpretation, and communication, using contexts relevant to everyday situations. Topics chosen integrate well with the concerns of middle-level teachers and connect with such curriculum areas as health, science, and social studies. This is not a research methods course. Cross listed with MATH 5185. *Prerequisite:* admission to a UW graduate program, in either degree or non-degree seeking status, and acceptance into the Middle-level Mathematics program.

5190. Mathematics of Change and the Middle-Level Learner, MMA. 3. Students gain a solid understanding of data and functions in the service of calculus. Hands-on, project-driven, and focuses on the essential concepts of functions and calculus and their role in middle-level mathematics. Emphasis is on writing and technology (calculators and probeware). Cross-listed with MATH 5190. *Prerequisite:* admission to a UW graduate program, in either degree or non-degree seeking status, and acceptance into the Middle-level Mathematics program.

5205. Methods of Teaching Middle-Level Mathematics, MMA. 3. Research-based pedagogy and pedagogical content knowledge for teaching middle-level mathematics. De-

signed for practicing teachers of middle-grades mathematics. Cross-listed with EDCI 5205. Prerequisite: admission to the SMTC Program.

5215. Using Instructional Technology for Middle-Level Mathematics, MMA. 3. Covers the use of technology appropriate to middle-level mathematics teaching, such as microworlds, geographic information systems, spreadsheets, and other content appropriate technologies. Cross-listed with EDCI 5215. *Prerequisite:* admission to the SMTC Program.

5225. Assessment for Middle-Level Mathematics, MMA. 3. Middle-level Mathematics Initiative teacher participants examine, analyze, and implement a variety of assessments that are aligned with standards and instruction appropriate to the middle level math learner. Cross listed with EDCI 5225. *Prerequisite:* admission to the SMTC Program.

5300. Classroom Assessment in Middle-level Science, MSC. 2. Deals with the design, construction, and testing of curriculum materials to bring the spirit of scientific inquiry to elementary school pupils. Research to be conducted in the Science and Mathematics Teaching Center.

5400. Spatial Data Instructional Technology. 1. Teaching strategies appropriate for elementary/middle school students' conceptual level of development. Positive attitudes toward teaching children about the Earth, its physical environment and human/environment relationships will be promoted. The course content will be supported by the use of geospatial technologies, such as GPS and GIS. *Prerequisite:* graduate standing.

5510. Integrated Instructional Strategies, MSC. 2. Appropriate instructional strategies are discussed and modeled for aligning standards, expectations, and experiences in an integrated science environment. Attention is given to unique characteristics of each strategy, including a review of research on the effectiveness of each strategy on student achievement and attitudes. *Prerequisite:* graduate standing and teaching certification in elementary, middle school or general science; or graduate standing and concurrent enrollment in a program leading to teacher certification in elementary, middle school or general science education.

5600. Mathematics and Statistics in Science Teaching, MSC. 2. Provides science teachers with the knowledge and experience necessary to help students use statistics in the scientific process. Activities emphasize a hands-on inductive approach closely related to the school science curriculum. Important statistical ideas and methods are studied as they arise naturally in the biological, physical, and earth sciences. *Prerequisite:* graduate standing and teaching certification in elementary, middle school or general science; or, graduate standing and concurrent enrollment in a program leading to teacher certification in elementary, middle school or general science education.

5610. Field Studies in Environmental Education, NED. 4. Expands student's knowledge of ecological and physiological animal and plant adaptations to environmental conditions, the use of teaching methods and tools of naturalists, the range of resources available for designing and evaluating curriculum, and promotes an appreciation and understanding of the diversity of environments. Contains 4 modules. *Prerequisite:* graduate standing; must be accepted into the Teton Science School Program and matriculating at the TSS site.

5620. Advanced Elements of Field Ecology Course Design, NED. 5 (Max. 6). Addresses designing field ecology courses that include research, outdoor leadership, and natural history components. Opportunities are provided to gain deeper understanding of key natural history and ecology concepts of the bioregion; practical strategies for teaching these concepts in field programs; and to formally present student work. *Prerequisite:* graduate standing; must be accepted into the Teton Science School Program and matriculating at the TSS site.

5625. Place-Based Education - Teton Science School. 3. Introduces graduate students at Teton Science Schools to the theory and practice of place-based education. The design of the course exposes students to the historical, political, and eco-social underpinnings of place-based education while supporting students in developing thoughtful place-based pedagogies. *Prerequisite:* graduate student status.

5630. Teaching Practicum-Teton Science School. 2-4 (Max. 6). To improve teaching methods and techniques and expand professional skills. Integrates the foundation of Teton Science Schools, applies coursework content understanding and develops leadership. The course is intended to challenge previously held instructional beliefs and nurture an evolving set of skills and instructional identity. Not equivalent to EDSE 4500 or EDCI 5990 or EDEL 4500. *Prerequisite:* current enrollment at Teton Science School.

5640. Introduction to Field Science Teaching. 3. Designed to introduce graduate students at Teton Science Schools' to the field of environmental education and instructional concepts for teaching environmental science in the outdoors. Learn field science content, principals of connecting to place, teaching techniques, and learning theories related to environmental education and field science teaching. *Prerequisite:* current enrollment at Teton Science School.

5650. Place-Based Learning. 3. Place-based learning is explored and related to cognitive development, assessment, and education for a democracy. The focus in on science and mathematics and how to use "place" to provide meaningful learning experiences for students while making contributions to the community. Students develop a local place-based project.

5660. Standards, Pedagogy and Research. 2. This course is designed to provide Master of Science in Natural Science students with background in three areas: current science standards, pedagogical practices, and the understanding of various types of educational research as well as some of the practices related to conducting their own research projects. *Prerequisite:* Master of Natural Science - MMA, MSC, or NED who have completed at least one year of coursework, or permission of the instructor or SMTC program coordinator; graduate standing.

5670. Research Methodology. 4. This course provides foundational information on asking appropriate questions, researching (including IRB), writing, formatting, and defending a Plan B project. At the end of the semester students will have a committee, a preliminary draft, and present their research. Spring semester will be used to complete projects with committee members. *Prerequisite:* Master of Natural Science - MMA, MSC, or NED who have completed at least one year of coursework, or permission of the instructor or SMTC program coordinator; graduate standing.

5700. Seminar in Science for Secondary School Teachers. 1-6 (Max. 6). A course to give graduate students in education, or in-service teachers, an in-depth view of the new materials for teaching science in secondary schools. *Prerequisite:* consent of instructor.

5770. Investigation in Natural Science for Secondary Teachers. 1-5 (Max. 10). Deals with the design, construction, and testing of curricula materials to bring the spirit of scientific inquiry to secondary school students. Research to be conducted in the Science and Mathematics Teaching Center. *Prerequisite:* consent of instructor.

5810. ML Science & Math Practicum. 3. Practica for graduate students in the MS-Natural Science MSC and MMA programs in Middle and Junior High schools. Mathematics and science classrooms will serve as sites for assignments. Students complete assignments for the content area of certification as well as appropriate discussions. *Prerequisite:* Graduate

students in department who have passed at least four departmental courses or consent of the instructor.

5890. Directed Professional Study. 1-6 (Max. 6). Primarily for upper-division students who can benefit from independent study with minimal supervision. Given to allow interested students to pursue specific aspects of curriculum and instruction. Prerequisites: consent of instructor and graduate standing.

5900. Practicum in College Teaching. 1-3 (Max. 3). Work in classroom with a major professor. Expected to give some lectures and gain classroom experience. *Prerequisite:* graduate status.

5920. Continuing Registration: On Campus. 1-2 (Max. 16). *Prerequisite:* advanced degree candidacy.

5940. Continuing Registration: Off Campus. 1-2 (Max. 16). *Prerequisite:* advanced degree candidacy.

5959. Enrichment Studies. 1-3 (Max. 99). Designed to provide an enrichment experience in a variety of topics. Note: credit in this course may not be included in a graduate program of study for degree purposes. S/U only. *Prerequisite:* graduate standing.

5960. Thesis Research. 1-12 (Max. 24). Designed for students who are involved in research for their thesis project. Also used for students whose coursework is complete and are writing their thesis. *Prerequisite:* enrollment in a graduate degree program.

5961. Plan B Project. 1-4 (Max. 4). Limited to those students enrolled in a Plan B graduate program. Students should be involved in non-course scholarly activities in support of their Plan B project. *Prerequisite:* must be enrolled in Plan B program and have program approval.

5990. Internship. 1-12 (Max. 24). *Prerequisite:* graduate standing.

Neuroscience

Phone: (307) 766-9953
E-mail: jfox7@uwyo.edu
Web Address: www.uwyo.edu/neuroscience
Program Director: Jonathan Fox, Ph.D.

Degree Offered

Ph.D. in Neuroscience

The Graduate Neuroscience Program offers training leading to the Ph.D. degree in Neuroscience. The Neuroscience Program emphasizes systems and integrative approaches, and our goal is to provide the students with the necessary background to be broadly trained research neuroscientists and to carry out independent research in neuroscience. The Neuroscience Program emphasizes continuing interaction with faculty from several departments and we have a low student to faculty ratio. Advisors spend considerable time supervising and training each doctoral student. The educational philosophy of the Neuroscience Program is to encourage a problem-oriented rather than a strict discipline-bound approach to research. You will emerge from this program with the scientific and experimental training needed to comprehensively address a very wide range of research questions using a variety of techniques and analytic tools.

The Graduate Neuroscience Program is designed to enable graduate students to acquire competence in the various disciplines necessary for research and teaching careers in neuroscience. The current interests of the Neuroscience faculty include sensory neurophysiology, behavioral neuropharmacology, neurodevelopment, neurodegeneration, and synaptic plasticity.

Students and faculty have access to outstanding resources established by NIH Neuroscience and Sensory Biology Core grants. The Microscopy Core houses both light (Zeiss laser scanning, fluorescent) and electron (Transmission and Scanning) microscopes. Resources needed to conduct research ranging from molecular, cellular circuit level to behavior are readily available within the Neuroscience Center.

Doctoral Program Admission Minimum Requirements

GRE: 153 on the verbal reasoning sections and a score of at least 144 on the quantitative reasoning section is required;
GPA: 3.000 (4.000 scale);
Three favorable letters of recommendation;
Bachelor's degree in a biological science from an accredited institution;
Statement of research interests and career objectives. We recommend that students study the Neuroscience faculty web sites and contact faculty regarding openings and shared research interests.

You will be best prepared for our program if you have successfully completed courses in neuroscience, chemistry, biology, physiology, and cell/molecular biology. Students may be admitted with deficiencies in some of the areas if they are strong in many or all others. If so, the student's advisory committee will determine what additional work is necessary during the first year to correct any deficiency.

Program Specific Degree Requirements

Doctoral Program

All doctoral Neuroscience students are required to complete a program of core classwork that includes the following required courses: Introduction to Neuroscience, Structure and Function of the Nervous System and Neurophysiology. Students are required to take one course in Statistics (e.g. STAT 5050, STAT 5210) and the course that meets this requirement will be arranged with the student's committee. The statistics requirement must be met by the end of the second year. The Neuroscience Program is a research-oriented program and students are expected to take a minimum of 2 to 3 credit hours of research per semester. Students are also expected to enroll in an on-going Seminar in Neuroscience. The Neuroscience Seminar, which meets weekly and is attended by students and faculty members, provides an opportunity for intellectual and social exchange, as well as for the development of professional skills in critical thinking. The topic for seminar and the faculty member directing the seminar changes each semester. The remainder of the coursework for the doctor of philosophy degree is selected from designated courses in Neuroscience, physiology, pharmacology, and molecular biology. A grade of B or better is required for all Neuroscience courses.

A student is expected to have a graduate adviser at all times. The faculty adviser must be a participating member of the Neuroscience faculty. The adviser is responsible for directing the student's research and academic coursework. During the second year, the student will have an advisory committee. The advisory committee will consist of at least three neuroscience faculty members and an outside member. Normally, the student's adviser will chair the committee and help identify members of the committee who best match the student's area of interest. The role of the advisory committee is to oversee all aspects of the student's education after the first year.

Students give two public research presentations 6-12 months before the preliminary and final defense exams. In the student's second or third year, the advisory committee will set and evaluate the student's qualifying examination. After successful completion of the preliminary examination the student will profess to Ph.D. candidate status.

The dissertation is the single most important component of the graduate program. It reports the results and significance of the student's research. In addition to the written dissertation, the doctoral candidate will deliver a formal seminar based on their research. The seminar will be followed by an examination by the student's advisory committee.

Neuroscience (NEUR)

4295. Neurodevelopment. 3. Through lecture and discussion of research articles, students learn mechanisms of nervous system development, from the birth and differentiation of neurons to the formation of synapses and circuits. Focus is on classical experiments done in vertebrates (Xenopus tadpole, chick, zebrafish, and mouse) and invertebrates (nematode and drosophila). Dual listed with NEUR 5295; cross listed with ZOO 4295. *Prerequisite:* ZOO 4280.

4720. Neuroscience Speaker Seminar. 2 (Max. 6). The purpose of this course is to use the Neuroscience/sensory biology visiting speaker series to build student knowledge in neuroscience, as well as skills in critical evaluation of the research literature, and oral/written communication. This will maximize student learning from the speaker series. The course maybe taken up to three times. Dual listed with NEUR 5720. *Prerequisite:* Graduate level standing in neuroscience, biomedical sciences, zoology/physiology, or other life science programs. Undergraduates: concurrent or prior ZOO 4280.

5100. Structure and Function of the Nervous System. 4. Aimed at understanding the structure and interconnections within the nervous system, and how structure gives rise to the complex functions mediated by the brain. This is an essential feature of neuroscience. Covers gross anatomy of the central and peripheral nervous system, followed by detailed consideration of the divisions of the brain and their functional significance. Cross listed with ZOO 5100. *Prerequisites:* admission to the graduate neuroscience program, or graduate standing in another related program, or permission for undergraduate enrollment following discussion with the instructor.

5280. Introduction to Neuroscience. 3. Examines the basic properties of neurons and from there identifies determinants of brain development and how neuronal circuits are formed. How neuronal circuits underlie processing sensory information, coordinated movement, complex functions (e.g. sleep, learning) and homeostasis are discussed. Cross listed with ZOO 5280. *Prerequisite:* ZOO 3115 or equivalent.

5295. Neurodevelopment. 3. Through lecture and discussion of research articles, students learn mechanisms of nervous system development, from the birth and differentiation of neurons to the formation of synapses and circuits. Focus is on classical experiments done in vertebrates (Xenopus tadpole, chick, zebrafish, and mouse) and invertebrates (nematode and drosophila). Dual listed with NEUR 4295; cross listed with ZOO 5295.

5685. Neurophysiology. 3. Designed to investigate the structure and function of nervous systems, drawing information from both vertebrate and invertebrate organisms. Topics such as sensory systems, motor coordination and central integrative mechanisms will be covered in addition to the basic neurophysiology of nerve cells. Cross listed with ZOO 5685. *Prerequisite:* one course in physiology, chemistry, physics.

5715. Seminar in Neuroscience. 1-2 (Max. 20). A continuing seminar. All students in the graduate neuroscience program are expected to register for this seminar each semester. The interdisciplinary approach to the nervous system is used employing work from physiology, neuroanatomy and neurochemistry, psychology, pharmacology and biochemistry. Cross listed with ZOO 5715. *Prerequisites:* admission to the graduate neuroscience program or graduate standing.

5720. Neuroscience Speaker Seminar. 2 (Max. 6). The purpose of this course is to use the Neuroscience/sensory biology visiting speaker series to build student knowledge in neuroscience, as well as skills in critical evaluation of the research literature, and oral/written communication. This will maximize student learning from the speaker series. The course maybe taken up to three times. Dual listed with NEUR 4720. *Prerequisite:* Graduate level standing in neuroscience, biomedical sciences, zoology/physiology, or other life science programs. Undergraduates: concurrent or prior ZOO 4280.

5800. Research in Neuroscience. 1-16 (Max. 16). The research must be conducted under the supervision of one of the neuroscience program faculty. Laboratory opportunities for research include neuroendocrinology, behavioral neuroscience, sensory neurophysiology, neuroanatomy, neuropharmacology, neurotoxicology, neural cell biology, and neurochemistry. *Prerequisite:* admission to the graduate neuroscience program or graduate standing.

5887. Molecular Neuropharmacology. 3. Focus on the molecularly-induced functional changes within the nervous system in normal and disease states. In addition, will provide a thorough explanation of the cellular and molecular actions of drugs on synaptic transmission and discuss the neurochemical basis of behavior. *Prerequisites:* PharmD current standing and instructor's permission or NEUR 5280.

5920. Continuing Registration: On Campus. 1-2 (Max. 16). *Prerequisite:* advanced degree candidacy.

5940. Continuing Registration: Off Campus. 1-2 (Max. 16). Prerequisite: advanced degree candidacy.

5960. Thesis Research. 1-12 (Max. 24). *Prerequisite:* advanced degree candidacy.

5980. Dissertation Research. 1-12 (Max. 48). *Prerequisite:* advanced degree candidacy.

Reproductive Biology

Phone: (307) 766-6278 or 766-4378
E-mail: balex@uwyo.edu or enette@uwyo.edu
Web Address: www.uwyo.edu/reprobio
Program Directors: Brenda Alexander, Ph.D. and Enette Larson-Meyer, Ph.D., R.D.

Degrees Offered

M.S. and Ph.D. in Biomedical Science/ Reproductive Biology

The University of Wyoming offers an innovative program of graduate studies in vertebrate reproductive biology under the Biomedical Science umbrella. This interdisciplinary graduate program was established in 1986 and combines the expertise of faculty members who have established records of accomplishment. Areas of emphasis include: ovarian biology, fetal/placental physiology, neuroendocrinology, nutrition/reproduction interactions, lactation, pituitary cytoarchitecture, human nutrition/exercise/reproduction, reproductive immunology, and the fetal origins of growth efficiency, reproductive function, and adult disease.

The opportunity to study in these exciting areas is made available primarily through the collaborative efforts of the faculty in the departments of Animal Science, Family and Consumer Sciences, Molecular Biology, Veterinary Science, and Zoology and Physiology, as well as the School of Pharmacy. Programs are offered leading to the M.S. degree in Reproductive Biology or Ph.D. degrees in Biomedical Sciences/Reproductive Biology. Qualified students are eligible to compete for a graduate

assistantship assigned to the program. Postdoctoral positions provide advanced training in research and teaching.

Both the research and teaching aspects of the program reflect a truly interdisciplinary approach. Research activities range from directly applied to fundamental. Animals used for investigation can include livestock and laboratory species. Modern laboratories are designed for hormonal, chemical, and molecular analysis of biological samples, light, electron and confocal microscopy, incubation of cells, tissues and small animal experimentation. Well-equipped large animal surgical and handling facilities are located at the Laramie Agriculture and Extension Center and Red Buttes Research Center. A well equipped human nutrition and exercise facility is located on campus.

Program Specific Admission Requirements

GRE composite score of 291 and 297 for M.S. and Ph.D. students, respectively.
GPA of 3.000 (with A=4.000).
TOEFL score of 540 for students whose native language is not English.

Program Specific Degree Requirements

Requirements are based on the university minimum requirements.

Science and Mathematics Teaching Center

242 Hill Hall, (307) 766 6381, smtc@uwyo.edu, http://uwyo.edu/smtc

The Science and Mathematics Teaching Center (SMTC) was established in 1970 and is committed to excellence in science, mathematics and technology education. As part of the Office of Graduate Education in Academic Affairs, the SMTC, in cooperation with the Wyoming Department of Education (WDE) and the Professional Teaching Standards Board (PTSB), serves as a resource and professional development center for the state. The SMTC offers transdisciplinary graduate degree programs with multiple degree concentrations, certification options, and endorsement options. All of the programs emphasize both strong content knowledge and instructional practices. The affiliate faculty for the SMTC is comprised of include faculty from the Colleges of Agriculture and Natural Resources, Arts and Science, Education, and Engineering and Applied Science, and the Haub School of Environment and Natural Sciences.

The SMTC provides extensive off-campus professional development that serves throughout Wyo¬ming that serves teachers, students, administrators, school districts and communities. SMTC in-service and extension courses, workshops, institutes, and conferences are designed collaboratively to improve science and mathematics teaching in Wyoming.

The SMTC administers and supports five master's degree programs:

(1) the Master of Science degrees in Natural Science with concentrations in Middle Level Math (MMA) and (2) Middle Level Science (MSC); these programs are designed for Wyoming's in-service elementary, middle, and high school teachers. They focus on general science and mathematics content with an emphasis on teaching middle school level learners. The course work leads to middle level certification provided by the Wyoming PTSB. Teachers must have two years of teaching experience to participate in these programs.

(3) Master of Science in Teaching – Natural Science (MST – Natural Science). This is a self-directed master's degree program working with the SMTC, SER, and the Haub School as well as other colleges. The program is developed individually with the guidance of a graduate committee based on the interests of the graduate student and may emphasize formal or informal learning settings.

(4) Master of Science – Natural Science (MS – Natural Science). This is a self-directed master's degree program working with the SMTC, SER, and the Haub School and other colleges. The program is developed individually based on the interests of the graduate student.

(5) Master of Science in Natural Science with a concentration in Natural Science Education (NED). This Master's degree program is designed for students pursuing careers as environmental and natural science educators in non-public school or non-formal education settings. These students spend one year at the Teton Science Schools (TSS) in Jackson. A long-standing MOU between the SMTC and TSS allows students to use 15 graduate credit hours earned at TSS towards a master's degree if they are accepted into the second year at UW within the SMTC.

Admission Requirements

For the MSC, MMA, MST and MS-Natural Science Master's Degrees:

Two years of teaching experience and a valid teaching license
Application Fee, unless a UW Graduate
Official Transcripts from all Institutions attended and Bachelor Degree conferring institution
3.0 undergraduate grade point average; provisional admission with a lesser GPA only with consent from Academic Affairs
GRE (minimum 292 score) or an Alternative Portfolio including evidence that supports the potential success of the candidate as a graduate student and a document that interprets the evidence
Writing Sample in response to three provided questions
Resume
Three Letters of Recommendation including a letter from the teacher's principal and two other colleagues.
Note: if a prior Master's degree has been awarded, GRE Scores or an Alternative Portfolio are not required

The NED Degree – First Year Application:

Official Transcripts from all institutions attended and Bachelor Degree conferring institution
Application Fee, unless a UW Graduate

The NED Degree – Second Year Application:

GRE (minimum 292 score) or an Alternative Portfolio including evidence that supports the potential success of the candidate as a graduate student and a document that interprets the evidence
Writing Sample in response to three provided questions
Resume
Three Letters of Recommendation including a letter from a TSS Graduate Program Faculty Member, one from another TSS employee such as a Classroom Instructor or Field Instructor, and one from the first year application.

All the above information needs to be uploaded onto a UW graduate application, which will be reviewed by the SMTC and then if accepted, by the University of Wyoming Admissions and the SMTC. Any of the above requirements plus the university's minimum 3.000 grade point average can be waived if the

proper documentation and reasoning is given and approved by the Associate Vice President of the Graduate Program.

Degree Requirements

For the MSC, MMA, MST and MS- Natural Science Master Degrees

Plan B (non-thesis)

- 30 Credit Hours of coursework is required. This includes 24 credit hours in required coursework that includes mathematical content courses, mathematical history, pedagogy and assessment; earth science, life science, physical science, depending on the program. 6 credit hours of additional coursework that can include a research class and an elective.
- The MSC is a 3-year program, for the required coursework, in the summers only on UW's main campus.
- The MMA is a 2-year program with classes offered virtually in the fall and spring and in-person on the main campus in the summer, for the required courses.
- The MST and the MS- Natural Science Master Degrees are Main campus degrees.
- A Plan A (thesis) may be completed with an extra year of research.

For the NED Master Degree – 2nd year.

Plan B (non-thesis)

- This is a one-year program on the main campus.
- 30 credit hours of coursework is required, of which 15 credit hours of agreed upon courses, are transferable from TSS. The other 15 credit hours include a research class, environmental science and science pedagogy classes as chosen by the graduate student and their advisor.
- A concurrent major in Environmental and Natural Resources is an option with this Master's
- A Plan A (thesis) may be completed with an extra year of research.

Graduate Assistantships and Scholarships

The SMTC has scholarships and graduate assistantships available for all graduates accepted for the above Master's degree programs. More information upon admission and acceptance.

Water Resources

College of Agriculture and Natural Resources
Department of Ecosystem Science and Management
2013 Agriculture Building
Phone: (307) 766-4274
E-mail: snmiller@uwyo.edu
Web Address: www.uwyo.edu/ware/
Program Director: Scott N. Miller

Degrees Offered

M.A. or M.S. in (Program Name)/Water Resources

Academic departments across the university cooperate to provide master of arts or master of science degree programs that contain multidisciplinary training in water resources. The master's degree offered through these affiliations is awarded as a major with each of the sponsoring department's graduate programs. The water resources interdisciplinary major will be acknowledged on the graduate transcript and thereby certify to potential employers that the candidate has completed an in-depth multidisciplinary course program in the broad area of water resources.

The educational underpinnings of this program include the following:

- The purpose of the program is to provide multidisciplinary education and to impart a multidisciplinary perspective to candidates.
- Training is to be consistent with the rigor of professional water resources demands.
- The interdisciplinary major program is flexible so as to meet the candidates' individual professional objectives.

Primary responsibility for student guidance and graduate program formulation resides with the sponsoring department and sponsoring major professor.

Please refer to latest updated information on the Web site listed above.

Upon acceptance to the program, the sponsoring department must assign a member of the Water Resources Curriculum Committee to the candidate's graduate committee. The Water Resources Curriculum Committee's representatives on the candidate's graduate committee shall aid in formulating deficiency requirements, course program design, academic performance criteria, and research objectives throughout the candidate's tenure in the program.

Program Specific Admission Requirements

- University application and fee;
- Application fee is valid for three years;
- Official documentation indicating bachelor's degree earned (not necessary if UW is the most recent institution attended);
- Potential candidates are encouraged to apply for admission to this program by contacting the participating department and by specifying at the initiation that they desire admission to the water resources interdisciplinary major. Their credentials will be evaluated by the sponsoring department and the department recommends admission of the individual into the program to the UW Admissions office.

Program Specific Degree Requirements

The academic program of study undertaken by the candidate must be designed to enhance the student's background and expertise through formal graduate level coursework in the areas of: (1) technical hydrology, (2) natural resources economics and/or law, and (3) water quality. To insure a minimum multidisciplinary character, the course program must contain nine hours of coursework with at least 3 hours from each of the aforementioned areas and at least 6 of those credit hours must be from outside the student's sponsoring department, along with a 1 credit hour seminar on water resources organized through the Department of Ecosystem Science and Management. Only Plan A master's degree programs, which require the writing of a thesis in the water resources area, are acceptable for the water resources degree option.

A. Hydrology (3 hours)

CE 4800 Hydrology 3
CE 4820 Groundwater and Drainage Engineering 3
CE 5810 Groundwater Hydrology.....3
GEOG 5050 Fluvial Geomorphology.....3
GEOL 5444 Geohydrology.....3
GEOL 5550 Numerical Methods Groundwater Geology.....3
GEOL 5570 Advanced Geohydrology 3
REWM 5285 Wildland Hydrology.....3
SOIL/MATH 5110 Modelling Flow Transport in Soil and Groundwater Systems 4

B. Law/Natural Resource Economics (3 hours)

AGEC 4710 Natural Resources Law & Policy 3
AGEC 4720 Water Resource Economics.....3
AGEC 5630 Advanced Natural Resource Economics 3
ECON 4400 Environmental Economics 3
ECON 4410 Natural Resource Economics .3
ECON 5400 Advanced Resource & Environmental Economics.....3
LAW 6660 Environmental Law.....3
LAW 6860 Water Rights.....3

C. Water Quality (3 hours)

GEOL 4490 Geochemistry 3
GEOL 5450 Water Quality Modeling 3
GEOL 5777 Geochemistry of Natural Waters 3
REWM 4710/5710 Watershed Water Quality Management 3
SOIL 4130/5130 Chemistry of the Soil Environment 4
ZOO 4440 Limnology 3

D. One-Hour Seminar in Water Issues

REWM 5250. Seminar in Water Resources .1

Each student in the water resources interdisciplinary major program will be required to complete this course once during their graduate program. As part of the requirements for the seminar: (a) students will be required to present a seminar on a current water resource issue in Wyoming and to develop an executive summary of their issue to distribute to class participants. Each student is also required to participate in a discussion group following each seminar which stresses the interdisciplinary nature of the issue; (b) during the course of a student's graduate program, he/she will be required to present one seminar for the seminar series (preferably on some aspect of their thesis research). This presentation does not have to occur during the semester that the student is officially signed up for seminar credit.

Agricultural Economics/ Water Resources

Department of Agricultural and Applied Economics
206 Agriculture Building
Phone: (307) 766-2386
E-mail: ag-econ@uwyo.edu
Web Site: www.uwyo.edu/agecon/

The objective of this program is to provide students with specialized study in water resources and to signify this specialization by the designation of the water resources interdisciplinary major on the transcript.

Coursework and Thesis

Students must complete the 24 credit hour agricultural and applied economics including M.S. core requirements plus 4 thesis hours and 9 credit hours in water resources approved courses.

Achieve a cumulative 3.000 GPA in the AGEC M.S. core requirements.

The candidate's graduate committee, nominated by the major professor, the student and the department head determine the final program of study and thesis research topic, which must be in the water resources area.

Presentation of research results at a formal public seminar.

Completion of an oral examination covering the student's thesis research administered by the graduate committee.

Oral Exam Requirement

In addition to coursework and a Plan A Thesis, students must pass a final oral examination. The student's committee may also require a written examination.

Interdisciplinary Component

nine hours
(see Water Resources degree requirements)

Botany/Water Resources

Department of Botany
114 Aven Nelson Building
Phone: (307) 766-2380
Web Address: www.uwyo.edu/botany

In addition to the general requirements for admission to the existing master's program in botany, the master of science in botany/water resources interdisciplinary major requirements will include the following variations:

Coursework and Thesis

16 semester hours are required in botany, plus 9 semester hours in water resources courses. Other courses in mathematics, physics, chemistry, and statistics also may be required as the special program and undergraduate preparation require.

Due to the various, potential subspecialities that students might follow in connection with a botany/water resources interdisciplinary major, no particular botany courses are prescribed. An appropriate array of courses for the desired specialty will be determined by agreement between the advisery committee, graduate student adviser, student, and with the approval of the Water Resources Curriculum Committee.

For the water resources interdisciplinary major, a Plan A Thesis is required. The student must present his or her research in a seminar before the department, and must pass an oral exam on the thesis research.

Interdisciplinary Component

9 hours
(see Water Resources degree requirements)

Civil Engineering/Water Resources

Department of Civil and Architectural Engineering
3074 Engineering Building
Phone: (307) 766-5255
E-mail: ceinfo@uwyo.edu
Web Address: www.eng.uwyo.edu/civil/

The purpose of this program is to broaden the students' master of science program in the water resource area in civil engineering.

Plan A Thesis Requirement

Only students with a M.S. Plan A thesis option are eligible. The student's graduate committee will include at least one member of the Water Resources Curriculum Committee.

Coursework and Thesis

Each student must complete a minimum of 28 hours of graduate level coursework and a thesis under Plan A (4 credit hours) to qualify for the master of science in civil engineering/ water resources.

The student must obtain at least 18 credit hours of graduate level coursework in engineering, emphasizing a concentration of core courses in a particular area of emphasis in civil engineering. The core course areas of emphasis for this program are hydrologic and hydraulic engineering. The particular set of courses for a given area of emphasis will be designated by the faculty in the water resources area for these areas of emphasis with the approval of the Civil Engineering Graduate Committee.

Interdisciplinary Component

9 hours

A. Technical Hydrology (3 hours)

GEOL 5444 Geohydrology.....3
GEOL 5550 Numerical Methods in Groundwater Geology I 3
GEOL 5570 Advanced Geohydrology 3
REWM 5285 Wildland Hydrology.....3
REWM 5280 Stream Habitat Management..3

B. Law/Natural Resource Economics 3
(please refer to the general degree requirements for a list of courses)

C. Water Quality (three hours)
GEOL 5450 Water Quality Modeling 3
GEOL 5777 Geochemistry of Natural Waters 3
MOLB 4410 Water Microbiology 3
MOLB 4500 Microbial Ecology 3
ZOO 4440 Limnology 3

Entomology/Water Resources

Department of Ecosystem Science and Management
2013 Agriculture Building
Phone: (307) 766-3114
Web Address: www.uwyo.edu/esm
Ecosystem Science and Management
E-mail: esm@uwyo.edu

The purpose of this program is to enhance the cross-disciplinary linkage between entomology and water resources, and to provide students an entomology degree program which emphasizes the important issues in water resources. Aquatic insects are increasingly being used as bioindicators of aquatic ecosystem health. This is an area of environmental assessment that is rapidly expanding, as is the job market for scientists with this blend of skills.

Coursework and Thesis

Each student must complete a minimum of 26 credit hours of graduate level coursework and 4 thesis credit hours of ENTO 5960 to qualify for a master of science degree in entomology/water resources. Specific coursework will be determined by the student's graduate committee; however, each student is required to enhance his/her background and expertise in the water resources area through specialized coursework and a seminar as shown below.

A. ENTO 5678 Aquatic Entomology (3)
B. Interdisciplinary component
9 hours
(see Water Resources degree requirements)

Plan A Thesis Requirement

Only Plan A thesis students are eligible for the master of science in entomology/water resources. In addition to coursework and a Plan A thesis, students must pass a final written and oral examination. The student's graduate committee will include at least one member of the Water Resources Curriculum Committee to help ensure adherence to the master of science in entomology/water resources degree requirements and that research efforts are in the water area.

Geology/Water Resources & Geophysics/Water Resources

Department of Geology and Geophysics
122 S.H. Knight Geology Building
Phone: (307) 766-3386
E-mail: acadcoord.gg@uwyo.edu
Web Address: http://geology.uwyo.edu

The purpose of this program is to formalize and broaden strong department offerings at the master of science level in ground water geology, natural waters geochemistry, mathematical hydrology, and fluvial geomorphology.

Coursework and Thesis

Each student must complete a minimum of 26 hours of graduate level coursework and a Plan A thesis. In addition, the following specific core courses are required for the master of science in geology/water resources and geophysics/water resources degrees.

A. GEOL 5444 Geohydrology.....3
B. 1 of the following:
GEOL 4830 Introduction Quantitative Methods in Geology 3
GEOL 4880 Surfacial Processes 3
GEOL 5050 Introduction to Isotope Geology 3
C. GEOL 5777 Geochemistry of Natural Waters 3
GEOL 5444 can be used to satisfy the 3 hour technical course requirement or GEOL 5777 can be used to satisfy the 3 hour water quality course requirement.

Admission Requirements

In addition to the department admission requirements, the undergraduate degree program earned by the incoming candidate must meet the minimum undergraduate requirements for the UW geology curriculum in mathematics, physics, and chemistry. The transcript should also demonstrate a strong background in physical geology.

Plan A Thesis Requirement

Only students with a Plan A thesis option are eligible. Students must follow the same program requirements as stated under Geology and Geophysics department section. The student's graduate committee will include at least one member of the Water Resources Curriculum Committee.

Interdisciplinary Component

9 hours
(see Water Resources degree requirements)

Rangeland Ecology and Watershed Management/ Water Resources

Department of Ecosystem Science and Management
2013 Agriculture C Building
Phone: (307) 766-3114
E-mail: esm@uwyo.edu
Web Site: www.uwyo.edu/esm

The purpose of this program is to enhance the cross-disciplinary linkage between range and forest management and water resources, and to provide students with a degree program in rangeland ecology and watershed management which emphasizes the important issues in water resources.

Coursework and Thesis

Water Resources requirements*: 10
Statistics: 3
Range Management Seminar (REWM 5620): 1
Other recommended graduate courses or substitution courses with adviser consent: 12
Plan A thesis credit: 4
Minimum: 30

*Water Resources Requirements
Interdisciplinary component
9 hours
(see Water Resources degree requirements)
REWM 5250. Seminar in Water Resources (1)

Soil Science/Water Resources

Department of Ecosystem Science and Management
2013 Agriculture C Building
Phone: (307) 766-3114
E-mail: esm@uwyo.edu
Web Address: www.uwyo.edu/esm

The purpose of this program is to enhance the cross-disciplinary linkage between soil science and water resources, and to provide students a soil science degree program which emphasizes the important issues in water resources.

Coursework and Thesis

Each student must complete a minimum of 26 credit hours of graduate level coursework and 4 thesis credit hours of SOIL 5960 to qualify for a master of science degree in soil science/water resources. Specific coursework will be determined by the student's graduate committee; however, each student is required to enhance his/her background and expertise in the water resources area through specialized coursework and a seminar as shown below.

A. Core courses - Students must take or have taken equivalent courses in the four soils disciplines: physics, pedology, chemistry, and microbiology.
   SOIL 5100 Soil Physics (4)
   SOIL 5120 Genesis, Morphology and Classification of Soils (3)
   SOIL 5130 Chemistry of the Soil Environment (3)
   SOIL 5140 Soil Microbiology (4)
B. Enhancement courses - Students must take at least one of the following courses:
   SOIL 5110 Modeling Flow Transport in Soil and Groundwater Systems
   SOIL 5150 Forest and Range Soils
   SOIL 5160 Soil Fertility and Fertilizers
   SOIL 5170 Analytical Methods for Ecosystems Research
C. Interdisciplinary component
   9 hours
   (see Water Resources degree requirements)
D. REWM 5250 Sem in Water Resources 1
E. SOIL 5720. Graduate Seminar in Soil Science 1

Plan A Thesis Requirement

Only Plan A thesis students are eligible for the master of science in soil science/water resources. In addition to coursework and a Plan A thesis, students must pass a final oral examination. The student's graduate committee will include at least one member of the Water Resources Curriculum Committee to help ensure adherence to the master of science in soil science/water resources degree requirements and that research efforts are in the water area.

Water Resources/ Environmental Science & Engineering

The Water Resources/Environmental Science and Engineering (WRESE) program facilitates Ph.D.-level course offerings in water-related disciplines, and coordinates offerings of these courses. Furthermore, the WRESE program serves as a focal-point for water-related graduate research and education at the University of Wyoming.

This interdisciplinary degree program encourages cross-department and inter-college coordination for research and education in hydrology and water resources.

Zoology and Physiology/ Water Resources

Department of Zoology and Physiology
114 Aven Nelson
Phone: (307) 766-4207
E-mail: zprequest@uwyo.edu
Web Address: www.uwyo.edu/zoology

The purpose of this program is to broaden the master of science program in the water resources area by having students take 10 semester hours of coursework associated with water resources.

Coursework and Thesis

Each student must complete a minimum of 26 hours of graduate level coursework and 4 hours of Plan A thesis credit to qualify for the master of science in zoology and physiology/ water resources. Specific coursework requirements will be determined by the student's graduate committee. The student must obtain at least 10 credit hours as indicated. Depending upon the student's undergraduate background and career interests, the graduate committee may require that these 10 credits be part of, or in addition to, the 26 credit hours required for a master of science in zoology and physiology.

Interdisciplinary Component

9 hours
(see Water Resources degree requirements)

The Willard C. and Elaine N. Rhoads Scholarship for Graduate Students in Water Resources at the University of Wyoming

The Willard C. and Elaine N. Rhoads Scholarship for Graduate Studies in Water Resources was established to honor Willard Rhoads, a member of the Research Review and Priorities Committee for the Wyoming Water Resources Center and a long-time member of the Wyoming Water Development Commission. Funds for the Rhoads Scholarship were donated to the University of Wyoming by Mrs. Rhoads and her family and friends, with some matching funds provided by the university. Two annual awards for the academic year will be made in the amount of $1,000 to a master's degree candidates for use in furthering research on Wyoming's water resources.

Eligibility Requirements and Evaluation Procedures

The applicant must be accepted into the interdisciplinary water resources major program administered by the student's academic department.

The applicant must agree to take a minimum of 9 credit hours (including thesis credits) in each of the two semesters for which the award applies.

Applicants for the scholarship can apply more than once, with the exception of past recipients.

The recipient will be chosen by a selection committee appointed by the Water Resources Curriculum Committee.

Applicants meeting the eligibility requirements above will be judged on the basis of promise of academic excellence as evident in grades for graduate level courses, and a recommendation from the student's graduate adviser.

Funds for the academic year will be dispersed to the recipient equally in the fall and spring semesters for half of the total amount.

Application Guidelines

Applicants meeting the above requirements should submit the following:

Application deadline is April 1.

A letter from the applicant listing the name of the scholarship for which he/she is applying, which includes a statement that the applicant agrees to enroll for a minimum of nine hours of graduate level courses (including thesis credits) in each of the two semesters for which the award applies, and a statement of academic and career goals related to water research. The applicant must also state the purpose for which the scholarship funds will be used.

An official transcript of grades for graduate level courses earned at the University of Wyoming or other institutions.

A note from the the academic department, verifying that the applicant has been accepted into a water resources interdisciplinary major program.

A confidential letter of recommendation from the applicant's graduate adviser addressing the applicant's promise for attaining academic and career goals through his/her research in water resources. Up to two additional letters of recommendation can be provided at the applicant's discretion.

The applicant should arrange for all materials to be sent to:

Scott Miller
Chair, Rhoads Scholarship Committee
Department of Ecosystem
Science and Management
Dept. 3354, 1000 E. University Ave.
Laramie , WY 82071-3354