



# Changes are in Red

## Biology

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### Distinguished Professors

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Randy Thornhill, Ph.D., University of Michigan

### Regents Professor

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Margaret Werner-Washburne, Ph.D., University of Wisconsin (Madison)

### Professors

Joseph A. Cook, Ph.D., The University of New Mexico  
Richard M. Cripps, D.Phil., University of York  
Clifford N. Dahm, Ph.D., Oregon State University  
Timothy K. Lowrey, Ph.D., University of California (Berkeley)  
Diane L. Marshall, Ph.D., University of Texas  
Robert D. Miller, Ph.D., Thomas Jefferson University  
Bruce T. Milne, Ph.D., Rutgers University  
Donald O. Natvig, Ph.D., University of California (Berkeley)  
William T. Pockman, Ph.D., University of Utah  
David J. Schmidly, Ph.D., University of Illinois (Champaign/Urbana)  
Robert Sinsabaugh, Ph.D., Virginia Polytechnic Institute and State University  
Felisa Smith, Ph.D., University of California (Irvine)  
Howard L. Snell, Ph.D., Colorado State University  
Stephen A. Stricker, Ph.D., University of Washington  
Eric C. Toolson, Ph.D., Arizona State University  
Thomas Turner, Ph.D., Florida International University  
Robert Waide, Ph.D., University of Wisconsin (Madison)

### Associate Professors

Coenraad Adema, Ph.D., Free University (Amsterdam)  
Ulfar Bergthorsson, Ph.D., University of Rochester  
Charles Cunningham, Ph.D., University of Aberdeen, Scotland  
David Hanson, Ph.D., University of Wisconsin (Madison)

Marcy E. Litvak, Ph.D., University of Colorado  
Kelly Miller, Ph.D., Cornell University  
Steven Poe, Ph.D., University of Texas (Austin)  
Jennifer A. Rudgers, Ph.D., University of California (Davis)  
Cristina Takacs-Vesbach, Ph.D., Montana State University (Bozeman)  
Andreas Wagner, Ph.D., Yale University  
Kenneth D. Whitney, Ph.D., University of California (Davis)  
Blair Wolf, Ph.D., Arizona State University

### **Assistant Professors**

Vaishali Katju, Ph.D., Indiana University  
Christopher A. Johnston, Ph.D., University of North Carolina (Chapel Hill)  
Seth D. Newsome, Ph.D., University of California (Santa Cruz)  
Olga M.F. Pontes, Ph.D., Technical University of Lisbon  
Irene Salinas, Ph.D., University of Murcia  
Helen Wearing, Ph.D., Heriot-Watt University  
Christopher Witt, Ph.D., Louisiana State University

### **Lecturers**

Cara Lea Council-Garcia, M.S., Iowa State University  
Lee Couch, M.S., The University of New Mexico  
Bruce Hofkin, Ph.D., The University of New Mexico  
Kelly Howe, Ph.D., The University of New Mexico  
Marieken Shaner, M.S., University of New Mexico  
Jim Swan, M.S., Florida State University

### **Professors Emeriti**

J. Scott Altenbach, Ph.D., Colorado State University  
Oswald G. Baca Ph.D., University of Kansas  
Larry L. Barton, Ph.D., University of Nebraska  
James H. Brown, Ph.D., University of Michigan  
Earl W. Bourne, Ph.D., Oklahoma State University  
Eric L. Charnov, Ph.D., University of Washington  
Clifford S. Crawford, Ph.D., Washington State University  
William G. Degenhardt, Ph.D., Texas A&M University  
Howard J. Dittmer, Ph.D., State University of Iowa  
Donald W. Duszynski, Ph.D., Colorado State University  
James S. Findley, Ph.D., University of Kansas  
James R. Gosz, Ph.D., University of Arizona  
Gordon V. Johnson, Ph.D., University of Arizona  
Paul Kerkof, Ph.D., University of California (Berkeley)  
Astrid Kodric-Brown, Ph.D., University of Southern California  
J. David Ligon, Ph.D., University of Michigan  
Manuel C. Molles, Ph.D., University of Arizona  
Mary Anne Nelson, Ph.D., University of Colorado  
Loren D. Potter, Ph.D., University of Minnesota  
John Trujillo, Ph.D., University of Texas Medical Branch (Galveston)  
Kathryn G. Vogel, Ph.D., University of California (Los Angeles)

## **Introduction**

Students majoring in Biology learn about the basic organization, processes and dynamics of the living world. The program of study provides students with a liberal education emphasizing the life sciences. The many subdisciplines of biology can prepare students for a wide range of careers and professional schools.

## **Museum of Southwestern Biology**

The **Museum of Southwestern Biology (MSB)** is an integral part of the University of New Mexico Department of Biology. It contains collections of plants and animals of national and international significance. The MSB also maintains a division devoted to frozen tissues, which is among the largest in the world. The western research collections of the National Biological Service are integrated with those of the MSB. The museum concentrates on research and teaching and is not open to the public except by appointment. The MSB publishes two scholarly periodicals, *Occasional Papers* and *Special Publications*.

# Graduate Programs

## Graduate Advisor

Randy Thornhill

## Application Deadline

Priority Deadline: **January 3**. Applications will continue to be accepted until the class is filled.

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## Degrees Offered

### Master of Science

Biology

### Doctor of Philosophy

Biology

Areas of study: arid land ecology, behavioral ecology, botany, cellular and molecular biology, community ecology, comparative immunology, comparative physiology, computational biology, conservation biology, ecology, ecosystem ecology, evolutionary genetics, evolutionary biology, genomics, microbiology, molecular genetics, parasitology, physiology, physiological ecology, population biology, systematics, vertebrate and invertebrate zoology.

### Nanoscience and Microsystems Engineering M.S. and Ph.D. Degree Program

This department participates in the interdisciplinary Nanoscience and Microsystems Engineering program; for more information, see the Graduate Interdisciplinary Studies section of this catalog.

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## Admission

Students considering applying for graduate study are encouraged to write to the Department of Biology or consult our Web site for information and application material. Each applicant's course background is evaluated and emphasis is placed on the applicant's scholarship and research potential. Letters of reference are particularly important. The General Graduate Record Exam test scores are required. Each applicant must include a letter of intent stating the reasons for attending, goals and tentative academic area in which he/she hopes to work. All applicants must be sponsored by at least one member of the graduate faculty before admission to graduate study can be recommended by the Graduate Student Selection Committee.

The Department of Biology offers the Ph.D., M.S. Plan I (thesis option) and M.S. Plan II (non-thesis option). The M.S. Plan II is not a research degree and normally does not lead to work in the doctoral program. It is intended primarily for individuals who wish to supplement their

baccalaureate programs with additional course work. The M.S. Plan I is a research degree with the same philosophy as the Ph.D. It is not a prerequisite for the Ph.D. but may lead to work on that degree. Students whose ultimate goal is a Ph.D. are encouraged to consult with potential advisors within the department about applying directly to the Ph.D. program. The research degree is the heart of the graduate program. The Biology Department Graduate Handbook gives additional information on all aspects of the graduate program. The Department of Biology Graduate Handbook should be consulted by all students who have been admitted to the Program.

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## **Degree Requirements**

General requirements for the Ph.D. degree in Biology are presented in earlier pages of this catalog. In addition to the comprehensive and final examinations required by the Office of Graduate Studies, departmental requirements include a series of graduate core courses and a public final defense. At least one outside referee (extradepartmental) is mandatory for reviewing the dissertation and participating in the public final defense of dissertation. Formal experience in lecturing and laboratory direction under the supervision of a professor in an appropriate field is required. The candidate for the Ph.D. in certain fields of biology may carry on research for the dissertation at the Los Alamos National Laboratory, Lovelace Respiratory Research Institute, Sandia National Laboratories or Santa Fe Institute under the terms of an agreement for cooperation between the University of New Mexico and these institutions. Certain conditions have been specified for the acceptance of students for research at these institutions; each case is considered on an individual basis. Several researchers at all four institutions, as well as the U.S. Fish and Wildlife Service, the New Mexico Game and Fish Department, and the New Mexico Museum of Natural History, have adjunct faculty status in the Biology Department and may co-chair graduate student committees.

**M.S. I.** General requirements for this degree in biology are presented earlier in this catalog.

**M.S. II.** General requirements for this degree are presented earlier in this catalog. The program of studies is determined in consultation with the student's major advisor.

**Non-Biological Skills.** Candidates for both M.S. degrees are required to satisfy one non-biological skill, while Ph.D. candidates must satisfy two skill areas. Areas of non-biological tool skills include advanced training in mathematics and/or statistics, computer science, chemistry or biomedical instrumentation. A minimum of 6 credit hours per skill with a grade point average of 3.0 (B) or better can satisfy the requirement. Courses taken to meet the non-biological skill requirements cannot be counted toward semester hour credits required for graduate degrees. Tool skill requirements may also be met by demonstrating proficiency in consultation with a student's graduate committee.

### **Ph.D. Concentration in Integrated Biology**

Awarded to students who, in addition to satisfying the general requirements for a Ph.D. in Biology, satisfactorily complete three core Program in Interdisciplinary Biological and

Biomedical Sciences classes. These are: BIOL 520 (3 credit hours; also offered as ANTH 620, CS 520, ECE 620), BIOL 503 (3 credit hours), and BIOL 524 (3 credit hours; also offered as ANTH 624, CS 524, ECE 524, STAT 524). In addition, students must satisfactorily complete a post-doctoral preparatory course (1 credit hour; currently offered as BIOL 502), a scientific ethics course/seminar taught or approved by PiBBs, and two additional integrated courses outside of biology to demonstrate depth in a secondary discipline. Finally, students must establish an interdisciplinary doctoral dissertation committee, which should have co-mentorship or active participation by faculty from two or more different departments, including Biology.

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### **Ph.D. Minor in Integrative Biology**

The minor is awarded to students who satisfactorily complete three core classes offered by the Program in Interdisciplinary Biological and Biomedical Sciences (PiBBs). These are:

BIOL 520 (3 credit hours; also offered as ANTH 620, CS 520, ECE 620, STAT 520)  
BIOL 503 (3 credit hours; also offered as ANTH 560, CS 591, STAT 579, MATH 579)  
BIOL 524 (3 credit hours; also offered as ANTH 624, CS 524, ECE 524, STAT 524).

In addition, students must satisfactorily complete a post-doctoral preparatory course (1 hour; currently offered as BIOL 502), and a scientific ethics course/seminar taught or approved by PiBBs, along with two additional integrated courses in biology, or, for biology students, two additional integrated courses outside of biology to demonstrate depth in a secondary discipline.

Finally, students must establish an interdisciplinary doctoral dissertation committee, which should have co-mentorship or active participation by faculty from two or more different departments, including biology. A total of 16 credit hours are required for the award of a transcribed minor at the Ph.D. level.

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# Undergraduate Programs

## College of Arts and Sciences and Department of Biology Undergraduate Admission Requirements

A minimum of 26 credit hours; 23 credit hours must be in courses acceptable toward graduation.

A cumulative grade point average of at least 2.00 on all work.

- Transfer students must have a 2.0 transfer GPA.
- Continuing UNM students must have a 2.00 institutional GPA.

Demonstrated academic achievement by satisfying the following:

- Completion of the University Speaking and Writing Core.
- Completion of the University Mathematics Core.
- Completion of the University Foreign Language Core.

Completion of Department of Biology admission coursework with grades of "C" or better:

- BIOL 201L.
- CHEM 121.

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## Major Study Requirements

Majors in biology seeking a Bachelor of Science degree must satisfy the requirements given in sections 1, 2, and 3. Majors in biology seeking a Bachelor of Arts degree must satisfy the requirements given in sections 4 and 5. (BIOL. 110, 112L, 123, 124L and 239L are not allowed for biology major credit.). **No minor study is required for the Bachelor of Science.**

1. The B.S. Program requires a minimum of 37 credit hours earned in biology courses. These courses must include 201L, 202L, 203 and 203L, 204 and 204L; at least one of the following: 351 and 352L, 360L, 371L, 386L. The remainder hours are to be earned in elective biology courses. (BIOC 423 may be included.)
2. To satisfy an upper-division breadth requirement for the Biology B.S., each student must complete at least **four** 400-level courses that are spread across three of the following five categories: 1) Cell/Molecular (CM); 2) Physiology (PH); 3) Organismal (OR); 4) Ecology/Evolution (EE) or 5) Interdisciplinary Science (ID). Note: the category to which each eligible course belongs is listed in parentheses (CM, PH, OR, EE, or ID), and completing three of these courses from only one or two categories will NOT satisfy the breadth requirement.
3. Required Supportive Courses for the B. S.: MATH 180-181 or 162-163; PHYC 151-152 (or 160-161); CHEM 121, 123L, 122, 124L (or 131L-132L) and 301-303L (or 212). (For



those interested in microbiology, molecular/cellular biology, physiology or medicine, CHEM 301-303L and 302-304L are recommended.)

4. The B.A. Program requires a minimum of 32 credit hours earned in biology courses. These courses must include 201L, 202L, 203 and 203L, 204 and 204L. The remainder of the total required credit hours is to be earned in elective biology courses. The elective courses must include two upper-division courses (300 or 400 level) each of which carries at least 3 credit hours and is exclusive of BIOL 400, 402, and 499. (BIOC 423 may be included.) (BIOL 110, 112L, 123, 124L and 239L are not allowed for biology major credit.)
5. Required Supportive Courses for the B.A.: A total of seven semesters of math, physics, and chemistry courses must be completed from the following four sets of courses: 1) two semesters of math courses: (MATH 180 or MATH 162) and (MATH 181 or MATH 163 or STAT 145 or CS 150L); and 2) two semesters of physics courses: (PHYC 151 and 152) or (PHYC 160 and 161) or (PHYC 102 and E&PS 101); and 3) two semesters of general chemistry courses: (CHEM 121/123L and CHEM 122/124L) or (CHEM 131L and CHEM 132L); and 4) one semester of organic chemistry: (CHEM 301/303L or CHEM 212).

For both the B.A. and B.S., a grade of C or better is required for: i) the Biology core (201L, 202L, 203 and 203L, 204 and 204L), ii) all required supporting courses in Computer Sciences, Chemistry, Earth and Planetary Sciences, Mathematics, and Physics; and iii) all elective courses in Biology. No credit toward the major will be given for courses completed with a grade of C- or below. Transfer students must obtain 19 Biology credits at UNM for the B.S., or 16 credits for the B.A. Only Biology courses completed within the previous ten years will apply.

### **Areas of Study**

The courses offered by the Biology Department can be used to pursue specialized programs in the following areas: Botany, Computational Biology, Evolution/Ecology, Microbiology, Molecular/Cellular Biology, Physiology, Systematics, and Zoology. Departmental advisement is recommended for students who wish to complete one of these informal specializations. A formal concentration in Conservation biology is also offered (see below).

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### **Concentration in Conservation Biology\***

The growing emphasis on Conservation in the biological sciences supports this concentration. Students may receive either the Bachelor of Science or Bachelor of Arts degree in Biology with a concentration in Conservation Biology. The concentration provides students with a strong background in biology as well as the complementary interdisciplinary skills critical to understanding and addressing contemporary conservation questions.

Majors in biology seeking a Bachelor of Science degree with a concentration in Conservation Biology must satisfy the requirements given in sections 1, 2, 3 and 6. Majors in biology seeking

a Bachelor of Arts degree must satisfy the requirements in sections 4, 5, and 6. **No minor study is required for a B.S. with Concentration in Conservation Biology.**

1. The B.S. Program with a Concentration in Conservation Biology requires a minimum of 45 credit hours earned in biology courses. These courses must include: 201L, 202L, 203 and 203L, 204 and 204L, 310L, 360L, 379; at least one of the following: 351 and 352L, 371L, 386L. A minimum of 3 credit hours must be from the Conservation Biology Seminar 402.
2. To satisfy an upper-division breadth requirement for the Biology B.S., each student must complete at least three 400-level courses that are spread across three of the following five categories: 1) Cell/Molecular (CM); 2) Physiology (PH); 3) Organismal (OR); 4) Ecology/Evolution (EE) or 5) Interdisciplinary Science (ID). Note: the category to which each eligible course belongs is listed in parentheses (CM, PH, OR, EE, or ID), and completing three of these courses from only one or two categories will NOT satisfy the breadth requirement.
3. The B.A. Program with a concentration in Conservation Biology requires a minimum of 37 credit hours earned in biology courses. These courses must include: 201L, 202L, 203 and 203L, 204 and 204L, 310L, 360L, 379; and at least one of the following: 351 and 352L, 371L, 386L. A minimum of 3 credit hours must be from the Conservation Biology Seminar 402. A minimum of one 400-level course must be successfully completed.
4. Required Supportive Courses for the B. S.: MATH 180-181 or 162-163; PHYC 151-152 (or 160-161); CHEM 121, 123L, 122, 124L (or 131L-132L) and 301-303L (or 212). (For those interested in microbiology, molecular/cellular biology, physiology or medicine, CHEM 301-303L and 302-304L are recommended.)
5. Required Supportive Courses for the B.A.: A total of seven semesters of math, physics, and chemistry courses must be completed from the following four sets of courses: 1) two semesters of math courses: (MATH 180 or MATH 162) and (MATH 181 or MATH 163 or STAT 145 or CS 150L); and 2) two semesters of physics courses: (PHYC 151 and 152) or (PHYC 160 and 161) or (PHYC 102 and E&PS 101); and 3) two semesters of general chemistry courses: (CHEM 121/123L and CHEM 122/124L) or (CHEM 131L and CHEM 132L); and 4) one semester of organic chemistry: (CHEM 301/303L or CHEM 212).
6. Candidates for both the B.A. and the B.S. degrees in Biology with a concentration in Conservation Biology must take a minimum of 6 credit hours to be taken from a list of complementary interdisciplinary electives available from the department advisor.

Grade of C or better required in all of the above courses.

**\*NOTE:** Departmental advisement is required for students who wish to complete the concentration in Conservation Biology.

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## Minor Study Requirements

BIOL 201L, 202L, 203 and 203L, 204 and 204L, plus 6 additional hours of biology. (BIOL 110, 112L, 123, 124L, 239L, and 499 are not allowed for biology minor credit.)

Grade of C or better required in all courses counted for the minor. Transfer students must obtain 6 Biology credits at UNM.

### **Curricula Preparatory to Health Sciences**

See School of Medicine.

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### **Departmental Honors**

Students interested in the Biology Honors program must complete and submit the application form to the Biology Program Coordinator. Upon entering the honors program, the student's research must be approved by both members of the honors committee. Students ideally should apply for this program in their junior year.

1. Students pursuing Biology honors must form their honors committee consisting of two faculty members, a research advisor and a reader, as described below:
  - o • One committee member must be a member of the Biology core faculty. Students must register in the section of BIOL 400 taught by this faculty member.
  - o • The other committee member may also be selected from the Biology core faculty, or may be an adjunct, research, or regular faculty member at UNM with approval of the Biology Department Honors Program Chair.
2. One of the two honors committee members must be designated as the research advisor, usually the committee member with whom the student will conduct the majority of their research project.
  - o • The student will work with the research advisor to develop a program of independent research that results in the preparation and submission of an honors thesis and a formal presentation.
  - o • Students must submit their final thesis, approved by their honors committee, to the Biology Department Honors Program Coordinator by the end of the 5th week in the semester in which they intend to graduate.
3. The formal presentations can be an oral or poster presentation at the Biology Research Day or at an approved scientific venue. Presentations must also be submitted to the Biology Department Honors Program Coordinator by the 5th week in the semester in which they intend to graduate. Students may present up to the end of their graduating semester.
4. Enrollment in BIOL 400 is required for two semesters while in the Biology Department Honors Program. In addition to working on their project, students in BIOL 400 are required to participate in periodic meetings.
5. The Biology Department Honors Committee will consult with the student's committee to determine the level of honors to be awarded.

## Undergraduate Program Tab

## Proposal to drop minor requirement in Biology

In an effort to create a more equitable situation for the hundreds of Biology majors, the UNM Biology Department proposes to drop the requirement for a minor for a B.S. in Biology and require an additional upper level Biology course instead. The Biology faculty voted on this in Spring 2014 and overwhelmingly felt that this change would help biology students graduate, have no impact on the quality of the major, and be more equitable compared to other majors.

Reasoning for this change is as follows:

1. There are inconsistencies in required curricula across the college (Table 1). For example, the Biochemistry BA and BS degrees do not require that students complete a minor. The reason we were given is because both degrees require a large number of hours (62 hours required for the BA and 65 for the BS). The Biology BS degree currently requires 37 hours of Biology and 24 hours of supporting courses, for a total of 61 hours. This is only 1 less hour and yet students have to complete a minor as well. The easiest minor is chemistry, but it requires 8 additional hours of courses. The Chemistry BS degree allows for a distributed minor where students take one additional math course or technical writing, getting a minor with only 3 additional credits. We feel our students would get more out of taking an additional upper level Biology course.

Degree Program	In discipline	supportive	Total credit hours	Minor required	Additional hours for approved distributed minor
Biochemistry BS			65	no	
Biochemistry BA			62	no	
Chemistry BS	35	22	57		3(one additional course from Math 311, 314, 316 or Engl 219
EPS BS	43	32	75	no	included
EPS BA	37	16	53	yes	
ENVS BS	46	19	63	yes	14 hours
Biology BS	37	24	61	yes	no

2. Students will still be able to do a minor or a second major if they choose. By dropping the requirement for the minor, we are leaving it open for students to choose what will be best for them, e.g. doing a minor, or spending more time specializing in upper level courses. In addition, those trying to complete the Conservation Biology or Ecology and Evolution Concentrations will need more time for biology courses. Dropping the requirement for a minor will give them the extra time they need to do that.

3. Given that Arts and Sciences requirements have recently changed, students must take more upper division hours and need time in their curriculum to do so. Dropping the requirement for a minor in Biology will aid in this process.

4. Statewide and nationwide concerns exist about time to graduation. The length of time that students can get Pell grants has already decreased. It is very likely that the number of semesters that students can get the Lottery Scholarship will decrease. The funding formula is changing to pay for students completing degrees not just students taking courses. Dropping the requirement for a minor in Biology will not be a magic bullet, but will at least enable on-time graduation rates.

5. By dropping the minor, it will be possible for students to complete a BS in Biology in 120 hours

It will have no budgetary consequences for the Department because we have plenty of upper division courses for our students to take.

The one consequence outside the department might be to the Chemistry Department. The greatest number of Biology majors are Chemistry minors currently. Our expectation is that the number of students taking second semester organic chemistry will remain nearly the same because this is required for applications for medical school. Enrollment in Chemistry 253L, Quantitative Analysis, will likely decrease. However, the Chemistry Department has difficulty meeting needs for this course and can use any resources that are freed up to offer courses needed by their majors.

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