**Biology**

*Professors Kieft, Rogelj (Chair of the Department)*

*Associate Professors Kirk, Reiss*

*Assistant Professor Voyles*

*Adjunct Faculty: Bhasker, Boston, Gonzales, Markwell,*

*Tartis, D. Wilkinson, P. Wilkinson*

*Emeritus Faculty: Shortess, Smoake*

***Degrees Offered: B.S. in Biology, Biology with***

***Environmental Science Option, and Biology with***

***Medical Technology Option; M.S. in Biology and M.S. in***

***Microbiology***

***Program Offered: 5 year BS/MS Program***

The mission of the Biology Department is to provide

students with a relevant education for biomedical and

biotechnological careers, to lead in molecular biological

research, and to serve the university and the scientific

community. The Biology program prepares undergraduate

students for graduate education in the medically allied

professions and in the specialized fields of the biological

sciences. (Students who are interested in pre‐medical, predental,

and pre‐veterinary science programs should see

page 199) A wide variety of career opportunities is

currently available for those individuals possessing

advanced knowledge and skills, particularly in the areas of

biochemistry, molecular biology, microbiology, ecology,

genetics, endocrinology, and immunology. Market demand

in these areas will likely remain strong for the foreseeable

future.

Undergraduate majors typically have diverse career

goals and objectives. To accommodate these differences,

the undergraduate program is very flexible; only a minimal

number of technical core courses is required. Through the

selection of appropriate technical electives, each student

customizes their education based on personal academic

needs and career objectives.

The main approach in the classroom is to stress the

highly quantitative and analytical nature of modern

biological inquiry, which utilizes sophisticated biochemical

and biophysical techniques to answer fundamental

questions about living organisms. Undergraduates are

encouraged to undertake research through various directed

study and special topics offerings and are often employed

as technicians in the research laboratories of the faculty.

**Program Educational Objectives:**

Our graduates will be able to use basic principles of

science to analyze, to explain, and to apply biological

information and concepts.

Our graduates will be able to design and implement

biological research and report findings orally and in

writing.

**Undergraduate Program**

**Bachelor of Science in Biology**

*Minimum credit hours required—130*

*In addition to the General Education Core Curriculum*

*Requirements (page 89), the following courses are required:*

• BIOL 111 (3), 111L (1), 112 (3), 112L (1), 311 (3), 311L (1),

331 (3), 333 (3) & 333L (1) or 341 (3) & 341L, and BIOL

471 (1)

• At least 6 additional credit hours from:

BIOL 341 (3) & 341L (1) or 333(3) & 333L (1), 351 (3), 351L (1), 352

(3), 352L (3), 355 (2), 355L (1), 356 (2), 356L (1),

431 (3), 437 (3)

• At least 6 additional credit hours from:

BIOL 343 (3), 343L (1), 344 (3), 344L (1), 444 (3), 446 (3),

455 (3)

• Additional Biology (12). CHEM 441 and 442

(Biochemistry I and II) may be applied to biology

electives.

• CHEM 333 (3); plus 6 additional hours of the following:

CHEM 311 (3–4), 331 (3–4), 333L (1), 334 (3), 334L (1),

441 (3–4)

• Computer Science or Mathematics: CSE 113 (4) or

MATH 283 (3)

• Electives to complete 130 hours

Biology laboratory classes are required for biology

lecture courses that offer an associated laboratory if credit

for the lecture course is used to meet the required number

of biology credits for a degree in biology. Students

pursuing a B.S. in Biology must take Biology and

Chemistry courses for a letter grade, except for BIOL 101

and BIOL 102. Prerequisites for a particular course may

be waived only with the written permission of the course

instructor and chair of the department.

**Sample Curriculum for the Bachelor of Science in**

**Biology**

*Semester 1*

4 BIOL 111 & 111L (intro)

4 CHEM 121 & 121L (general)

3 ENGL 111 (college English)

4 MATH 131 (calculus)

1 Physical Recreation

16 Total Credit Hours

*Semester 2*

4 BIOL 112 & 112L (intro)

4 CHEM 122 & 122L (general)

3 ENGL 112 (college English)

4 MATH 132 (calculus)

1 Physical Recreation

16 Total Credit hours

97

*Semester 3*

4 BIOL 311 & 311L (genetics)

3 BIOL 331 (cell)

3 Social Science

5 PHYS 121 & 121L (general)

3 CHEM 333 (organic)

18 Total credit hours

*Semester 4*

4 BIOL 333 & 333L (molecular)

3 Social Science

3 Humanities

5 PHYS 122 & 122L (general)

3 Chemistry Elective

18 Total credit hours

*Semester 5*

4 Biology Elective

3 Biology Elective

3 Chemistry Elective

3 Social Science

3 ENGL 341 (technical writing)

16 Total credit hours

*Semester 6*

4 Biology Elective

3 Biology Elective

3–4 CSE 113 (computer science) or

MATH 283 (statistics)

3 Humanities

3 Electives

16‐17 Total credit hours

*Semester 7*

4 Biology Elective

3 Biology Elective

1 BIOL 471 (seminar)

8 Electives

16 Total credit hours

*Semester 8*

4 Biology Elective

3 Biology Elective

3 Humanities/Social Science

6 Electives

16 Total credit hours

**Bachelor of Science in Biology with Environmental**

**Science Option**

*Minimum credit hours required—130*

*In addition to the General Degree Requirements (page 89), the*

*following courses are required:*

*•* BIOL 111 & 111L (4), 112 & 112L (4), 311 & 311L (4), 331 (3), 333

& 333L (4), or BIOL 343 & 343L, and BIOL 471 (1)

• At least 12 additional credit hours from: BIOL 343 (3), 343L (1),

344 (3), 344L (1), 444 (3), 446 (3), 455(3), 493 (4); CHEM 422 (3),

422L (1), ERTH 340 (3), 390 (3), 422 (3), 440 (3)

• Additional Biology (12) CHEM 441 and 442 (Biochemistry I and

II) may be applied to biology electives.

• CHEM 333 (3); plus 6 additional hours of the following: CHEM

311 (3–4), 331 (3–4), 333L (1), 334 (3), 334L (1), 422 (3–4), 441 (3–

4)

• Computer Science or Mathematics: CS 113 (4) or MATH 283 (3)

• Electives to complete 130 hours

Biology laboratory classes are required for biology lecture

courses that offer an associated laboratory if credit for the lecture

course is used to meet the required number of biology credits for a

degree in biology. Students pursuing a B.S. in Biology must take

Biology and Chemistry courses for a letter grade, except for BIOL

101 and BIOL 102. Prerequisites for a particular course may be

waived only with the written permission of the course instructor

and chair of the department.

**Bachelor of Science in Biology with**

**Medical Technology Option**

*Minimum credit hours required—130*

*In addition to the General Education Core Curriculum (page 89), the*

*following courses are required:*

• BIOL 111 & 111L (4), 112 & 112L (4), 341 & 341L (4), 437

(3); and one of the following options:

1. BIOL 311 & 311L (4)

2. BIOL 331 (3) and 333 (3)

3. BIOL 351 (3) and 352 (3)

• CHEM 311 & 311L (4), 333 & 333L (4)

• MATH 283 (3)

• Internship (30) at an approved school of medical technology

**Minor in Biology**

*Minimum credit hours required—18*

*The following courses are required:*

• BIOL 111 & 111L (4)

• BIOL 112 & 112L (4)

• BIOL 331 (3)

• BIOL 344 & 344L (4)

• Additional biology course numbered 300 or above (3)

*Biology classes required for a minor in biology may not be taken on an S/U basis.*

**Graduate Program**

**Master of Science in Biology**

The master’s candidate must demonstrate competence in

mathematics, chemistry, and physics comparable to New

Mexico Tech’s Bachelor of Science in Biology. Requirements

for the Master of Science degree in Biology follow the M.S.

with Thesis option (page 56). Additional requirements are

the following:

• Completion of at least six credit hours of 500‐level

biology coursework other than thesis, directed study, or

seminar.

• Completion of at least six credit hours of 500‐level

coursework other than thesis, directed study, or

seminar in one or more disciplines outside of biology.

*•* Completion of two credit hours of BIOL 501,

Graduate Seminar.

**Five Year Program: Biology B.S./Biology M.S.**

Exceptionally well motivated students may earn both BS

and MS degrees in Biology in five years. The student fulfills

the requirements for a BS degree in four years and for an MS

degree the following year. A minimum of 160 credit hours

are required to complete both degrees. The MS degree

requires the completion of a thesis based on the student’s

own research.

Students may apply for the BS/MS program at the end

of their 4th semester. Admission is contingent on their

having a GPA of at least 3.0, and on the acceptability of their

proposed course of study. Students with upper division

standing may also apply, with the same requirements for

admission.

Students in the five‐year program must apply for

graduate standing, normally in their 6th semester. Once

admitted to the graduate program, the student spends his or

her 8th semester as a dually registered student. During their

senior year, the student must select a graduate advisory

committee and formalize his or her graduate research topic.

Once admitted to the graduate program, a student may

apply for financial support via research assistant or teaching

assistant positions.

**Biology Courses:**

**BIOL 101, Issues in Biological Science, 1 cr, 1 cl hr**

*Graded S/U*

Introduction to modern topics in biotechnology,

biodiversity, and biocomplexity. Discussion of career

options in the biological sciences.

**BIOL 111, 111L, General Biology, 4 cr, 3 cl hrs, 2 lab hrs**

*Corequisite: CHEM 109 or CHEM 121*

A survey of life functions and associated structures

at the cellular level. Energy fixation and utilization,

growth and development through cell division, and

gene action. [NMCCNS BIOL 1214: General Education

Area III]

**BIOL 112, 112L, General Biology II, 3‐4 cr, 3 cl hrs, 3 lab**

**hrs**

*Prerequisite: BIOL 111*

Introduction to evolution, ecology, physiology, and

development. Laboratory is a phylogenetic survey of

the kingdoms of life. [NMCCNS BIOL 1224: General

Education Area III]

**BIOL 311, 311L, Genetics, 3–4 cr, 3 cl hrs, 3 lab hrs**

*Prerequisites: BIOL 111 & 111L; concurrent enrollment in*

*311R highly recommended.*

An overview of the storage, transmission and

expression of biological information. The lab

emphasizes Mendelian analysis in model organisms

and fluorescent analysis of human DNA.

**BIOL 311R, Genetics Recitation, 1 cr, 1cl hrs**

*Corequisite: Biol 311*

**BIOL 331, Cell Biology, 3 cr, 3 cl hrs**

*Prerequisites: BIOL 111; CHEM 121*

Studies of life at the cellular level. The structure and

functions of eukaryotic cells and their organelles. The

molecular basis for energy transfers, growth and

development, and their regulation.

**BIOL 333, 333L, Molecular Biology, 3‐4 cr, 3 cl hr, 3 lab**

**hrs**

*Prerequisites: BIOL 331; CHEM 121*

Principles of modern molecular biology. Laboratory

emphasizes enzyme purification and recombinant DNA

techniques, organized as a gene cloning project. BIOL

333 and BIOL 333L must be taken concurrently.

**BIOL 341, 341L, Introductory Microbiology, 3–4 cr, 3 cl**

**hrs, 3 lab hrs**

*Prerequisite: CHEM 122*

*Corequisite: BIOL 331*

A comparative study of reproduction, growth, and

metabolism of bacteria, rickettsia, and viruses, with

emphasis on the bacteria and their relation to man and

their environment.

**BIOL 343, 343L, Environmental Microbiology, 3–4 cr, 3 cl**

**hrs, 3 lab hrs**

*Prerequisite: BIOL 111*

*Corequisite for Biology majors: BIOL 331; BIOL 331*

*recommended for other majors*

A study of the relationship between microorganisms

and water and soil environments with emphasis on

biogeochemical cycles.

**BIOL 344, 344L, Introductory Ecology, 3–4 cr, 3 cl hrs, 3 lab**

**hrs**

*Prerequisites: BIOL 112; MATH 131*

A study of the principles which govern the interactions

between biological populations and the environment.

**BIOL 351,** *Anatomy and Physiology I***, 3 cr, 3 cl hrs**

*Prerequisite: BIOL 112; 331*

Principles of human anatomy and physiology. Provides a general overview of the form and function of the following human systems: integumentary, skeletal, muscular, nervous, endocrine, cardiovascular, lymphatic, immune, respiratory, digestive, urinary and reproductive.

**BIOL 351L,** *Anatomy and Physiology Lab***, 1cr, 3 lab**

**hrs**

***Co-****requisite: BIOL 351*

An in-depth study of human anatomy and physiology, covering microanatomy and gross anatomy of multiple systems as well as physiological function. Focal systems will include: skeletal, muscular, gastrointestinal, cardiovascular, respiratory systems and the special senses.

**BIOL 352, Anatomy and Physiology Lab II, 3 cr, 3 cl hrs**

*Prerequisite: BIOL 351*

A continuation of BIOL 35I with a more in-depth study of human physiology. Topics will include a variety of physiology systems and expand on systems covered in BIOL 351 and human development.

**BIOL 352L, Physiology II, 1cr, 3 lab**

**hrs**

*Prerequisite: BIOL 351, 351L*

*Corequisite: BIOL 352*

Students will quantify and interpret physiologic responses in experiments using animal and/or human subjects for analysis.

**BIOL 362, Animal Behavior, 3 cr, 3 cl hrs**

*Prerequisites: PSY 121; BIOL 112; or consent of instructor*

General overview of ethological and physiological

approaches to the study of animal behavior. (Same as PSY

362)

**BIOL 411, Advanced Genetics, 3 cr, 3 cl hrs**

*Prerequisites: BIOL 311 and 333*

A study of current topics in genetics, including the

molecular basis of gene structcure and action in

eukaryotes and prokaryotes.

**BIOL 431, Virology, 3–4 cr, 3 cl hrs, 3 lab hrs**

*Prerequisite: BIOL 331*

*Corequisite: BIOL 311*

Molecular biology of viral infection, replication, and

pathogenesis. Animal viruses emphasized.

**BIOL 435 , Bioinformatics , 3 cr, 3 cl hrs**

*Prerequisite: BIOL 311 or consent of instructor*

Computer analysis of biological sequence data used

to perform in silico experiments. Students will design

and perform experiments using public domain software

and databases.

**BIOL 437, Infection and Immunity, 3 cr, 3 cl hrs**

*Prerequisite: BIOL 341*

Study of human infectious disease and the immune

system. Pathogenic microorganisms and mechanisms

of pathogenicity. Innate and acquired immune

responses. Disease ecology and evolution in infectious disease systems.

**BIOL 444, Evolutionary Biology, 3 cr, 3 cl hrs,**

*Prerequisite: BIOL 311, BIOL 344*

The mechanisms and implications of biological

evolution. Topics include population genetics,

adaptation and natural selection, fossil evidence, and

evolutionary medicine.

**BIOL 446, Environmental Toxicology, 3 cr, 3 cl hrs**

*Prerequisite: CHEM 333*

The fate and behavior of toxic pollutants in

terrestrial and aquatic environments, from an

ecosystem perspective.

**BIOL 449 Astrobiology, 3 cr, 3 cl hours**

*Prerequisites: CHEM 121, 122, PHYSICS 121, 122, plus one*

*other science course and consent of instructor. Offered on*

*demand.*

An in–depth and interdisciplinary study of

astrobiology, including interactions between living and

non‐living systems at multiple scales: stellar, planetary,

meso, and microscopic. Addresses fundamental

questions regarding the origin of life, and the possible

extent and distribution of life in the universe. Combines

principles of astrophysics, geosciences, planetary

science, chemistry, and biology. Innovative interactive

exercises and projects working in interdisciplinary

groups and individually. (Same as ERTH 449.)

**BIOL 455, Molecular Ecology, 3 cr, 3 cl hrs**

*Prerequisites: BIOL 311 and 344, or consent of instructor*

Application of molecular biological techniques to

ecological and environmental problems. Current research

projects at Tech are emphasized.

**BIOL 471, Life Sciences Seminar, 1 cr, 1 cl hr**

*Prerequisite: Upper‐class standing in biology or consent of*

*instructor*

Review, discussion, and student presentations of the

current literature on a single topic in biology. Topics are

chosen with the aim of integrating multiple levels of

biological organization and research approaches.

**BIOL 486, Cytogenetics, 3 cr, 3 cl hrs**

*Prerequisites: BIOL 311 and 333*

Principles of chromosome structure and function with

an emphasis on medical diagnostics. Course includes a

field trip to a cytogenetics diagnostic laboratory.

**BIOL 487, 487L Advanced Virology, 3–4 cr, 3 cl hrs, 3 lab hrs**

*Prerequisite: BIOL 431 or 531*

An in‐depth study of one or two viruses, viral vectors for

gene therapy, and herpes or hemorrhagic fever viruses.

The laboratory section of the course will include viral

propagation in tissue culture and methods to investigate

the molecular biology of viral infection.

**BIOL 488, Biology of Cancer, 3 cr, 3 cl hrs**

*Prerequisites: BIOL 331 and 333*

Principles and molecular mechanisms of carcinogenesis.

Involves elements of cell biology, genetics, molecular

biology, immunology, biochemistry, virology,

pharmacology, physiology, developmental biology, and

pathology.

**BIOL 489, Special Topics in Biology, cr and hrs to be**

**arranged**

*Prerequisites: Two semesters of advanced courses and consent of*

*instructor*

Special readings or course in biology.

**BIOL 491, Special Problems, cr and hrs to be arranged**

*Prerequisites: Two semesters of advanced courses and consent of*

*instructor*

An introduction to methods of research. Problems are

chosen from the fields of biology and may be small

independent investigations or part of a research program

being directed by the advisor.

**BIOL 493, Directed Study in Environmental Biology, cr**

**and hrs to be arranged**

*Prerequisites: Senior student majoring in Biology—*

*Environmental Science Option, and consent of instructor*

A student‐designed study of local problems and

processes occurring during interaction between

biological systems and their physico‐chemical

environment including literature review, field and

laboratory research, and result presentation by written

report and seminar.

**BIOL 500, Directed Research, cr to be arranged**

This course may not be used to fulfill graduate degree

requirements. Research under the guidance of a faculty

member.

**BIOL 501, Graduate Seminar, 1 cr, 1 cl hr**

*Prerequisite: Graduate‐level standing or consent of instructor*

Special topics in biology. Readings, student

presentations, and discussions will focus on a single

topic within biology, with a different topic to be selected

by the Biology faculty each semester.

**BIOL 511, Advanced Genetics, 3 cr, 3 cl hrs**

*Prerequisites: BIOL 311 and 333*

A study of current topics in genetics, including the

molecular basis of gene structure and action in

eukaryotes and prokaryotes. Shares lecture with BIOL

411, but is graded separately and additional graduatelevel

work is required.

**BIOL 531, Virology, 3 cr, 3 cl hrs**

*Prerequisite: BIOL 331*

*Corequisite: BIOL 311*

Molecular biology of viral infection, replication, and

pathogenesis. Animal viruses emphasized. Shares

lecture with BIOL 431, but is graded separately and

additional graduate‐level work is required.

**BIOL 535 Bioinformatics 3 cr, 3 cl hrs**

*Prerequisite: BIOL 311 or consent of instructor*

Computer analysis of biological sequence data used to

perform in silico experiments. Students will design and

perform experiments using public domain software and

databases. Shares lecture with BIOL 435, but is graded

separately and additional graduate‐level work is

required.

**BIOL 537, Infection and Immunity, 3 cr, 3 cl hrs**

*Prerequisite: BIOL 341*

Study of human infectious disease and the immune

system. Pathogenic microorganisms and mechanisms of

pathogenicity. Innate and acquired immune responses.

Immunochemistry, cellular immunity, and

immunopathology. Shares lecture with BIOL 437, but

is graded separately and additional graduate‐level work

is required.

**BIOL 542, Advanced Microbiology, 3 cr, 3 cl hrs**

*Prerequisite: BIOL 341 or consent of instructor*

A study of the current topics in structure, function,

genetics, and biochemistry of microorganisms, with

emphasis on recent scientific literature. Medical and

environmental topics will be covered.

**BIOL 544, Evolutionary Biology, 3 cr, 3 cl hrs**

*Prerequisite: BIOL 311, BIOL 344; graduate standing or*

*consent of instructor.*

The mechanisms and implications of biological

evolution. Topics include population genetics,

adaptation and natural selection, fossil evidence, and

evolutionary medicine. Shares lecture with BIOL 444, but

is graded separately and additional graduate‐level work

is required.

**BIOL 549 Astrobiology, 3 cr, 3 cl hours**

*Prerequisites: Graduate status or consent of instructor. Offered*

*on demand.*

An in–depth and interdisciplinary study of

astrobiology, including interactions between living and

non‐living systems at multiple scales: stellar, planetary,

meso, and microscopic. Addresses fundamental questions

regarding the origin of life, and the possible extent and

distribution of life in the universe. Combines principles of

astrophysics, geosciences, planetary science, chemistry,

and biology. Innovative interactive exercises and projects

working in interdisciplinary groups and individually.

Shares lecture with BIOL 449, but is graded separately

and additional graduate‐level work is required. (Same as

GEOL 549.)

**BIOL 560, Population and Community Ecology, 3 cr, 3 cl**

**hrs**

*Prerequisites: BIOL 344; graduate standing or consent of*

*instructor*

Advanced study of demography, population

dynamics, species interactions, and community structure.

**BIOL 564, Molecular Ecology, 3 cr, 3 cl hrs**

*Prerequisite: BIOL 333 or consent of instructor*

Molecular ecology is the application of molecular

genetics to ecological and environmental issues. The

current literature in the field is reviewed. Participants

choose a topic to research and develop a research

proposal as the final project. Graduate students present a

public seminar.

**BIOL 581, Directed Study, cr to be arranged**

Study under the guidance of a member of the biology

staff. In general, subject matter will supplement that

available in other graduate offerings in biology.

**BIOL 586 Cytogenetics, 3 cr, 3 cl hrs**

*Prerequisites: BIOL 311 and 333*

Principles of chromosome structure and function

with an emphasis on medical diagnostics. Course

includes a field trip to a cytogenetics diagnostic

laboratory. Shares lecture with BIOL 486, but is graded

separately and additional graduate‐level work is

required.

**BIOL 587, 587L Advanced Virology, 3–4 cr, 3 cl hrs, 3 lab**

**hrs**

*Prerequisite: BIOL 431 or 531*

An in‐depth study of one or two viruses, viral

vectors for gene therapy; and herpes or hemorrhagic

fever viruses. The laboratory section of the course will

include viral propagation in tissue culture and

methods to investigate the molecular biology of viral

infection. Shares lecture and lab with BIOL 487, 487 L,

but is graded separately and additional graduate‐level

work is required.

**BIOL 588, Biology of Cancer, 3 cr, 3 cl hrs**

*Prerequisites: BIOL 331 and 333*

Principles and molecular mechanisms of

carcinogenesis. Involves elements of cell biology,

genetics, molecular biology, immunology,

biochemistry, virology, pharmacology, physiology,

developmental biology, and pathology. Graduate

students are required to write a grant proposal.

**BIOL 591, Thesis (master’s program), cr to be arranged**

**Faculty Research Interests**

Bhasker—Medical Professions

Boston ‐ Geomicrobiology

Gonzales—Veterinary Professions

Kieft—Microbiology, Environmental Biology

Kirk—Biology of Aging, Evolutionary Ecology

Markwell—Medical Professions

Reiss—Molecular Genetics, Evolution

Rogelj—Cell Biology, Pathogen Detection, Drug

Discovery

Tartis—Chemical Engineering of Drug Delivery

Systems

Dean Wilkinson—Veterinary Professions

Pepita Wilkinson—Veterinary Professions

Smoake—Animal Physiology, Endocrinology