CM Program Code
BS Chemical Biology

Under Review | Fall 2023

Proposal Information

Workflow Status

In Progress

Faculty Senate Approval, Faculty Senate

expand

Waiting for Approval | Faculty Senate Approval

Rick Holmes
Nancy Middlebrook

Proposal Information

Sponsoring faculty member

Jeremy Edwards

Faculty email

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College

College of Arts & Sciences

Department

Chemistry

Campus

Main Campus

Effective Term and Year

Proposed Effective Term and Year

Fall 2023

Justification

Program Justification

The University of New Mexico (UNM) Department of Chemistry and Chemical Biology proposes the creation of a new Bachelor of Science Degree Program for Chemical Biology.

Chemical biology is a relatively new scientific discipline that applies concepts and techniques from the fields of biology, chemistry, physics, mathematics, engineering, medicine, and the pharmaceutical sciences, to address society's most complex questions. It involves application of chemical and fabrication techniques, with a particular focus on the synthesis and spectroscopic analysis of small molecules and proteins, with molecular and systems analysis methods, including biophysical modeling and simulation, for investigating and manipulating complex biological systems that are both natural and designed.

The United States (US) Bureau of Labor and Statistics does not yet track the scientific discipline of Chemical Biology, but lists the median salary for biochemists and biophysicists working in research and development at over $88K in 2016. Moreover, the projected job growth for biochemists and biophysicists is faster than the national average at 11% between 2016 and 2026. Therefore, creation of a Bachelor of Science degree program for Chemical Biology will address a critical need for the formal education and laboratory training of personnel necessary for this emerging multidisciplinary scientific field.

The requirement for admission into this degree program requires 26 credit hours of prerequisite courses which is consistent with the B.S. of Chemistry requirements. Moreover, the additional upper division and elective courses satisfies the requirements for a degree as well as the 120 credit hour total.

Approval of this proposal will increase the number of opportunities for UNM students to gain knowledge in a forefront area of the biological and chemical sciences, and will lead to increased admissions because no similar programs exist on campus or within the State of New Mexico.

The Program's major goals are as follows:

1. Provide a novel degree program option for students not currently provided by other institutions within New Mexico.
2. Provide a novel degree option for students that not currently well served by the current undergraduate degree options at the UNM.

3. To generate Chemical Biology graduates who are well prepared to pursue postgraduate education and training in other science and/or professional fields (M.S., Ph.D., M.D., or Pharm.D.) at the UNM or other colleges/universities.

Associated Forms

Select any associated course forms that exist

CHEM 390 - Chemical Biology Research Methods Seminar Series (1)
CHEM 422 - Biological Chemistry / Chemical Biology II (3)
CHEM 423 - Introduction to Synthetic Biology (3)
CHEM 426 - Genome Technologies and Bioinformatics (3)
CHEM 433 - Bioinorganic Chemistry (3)
CHEM 421 - Biological Chemistry/Chemical Biology I (3)
CHEM 424 - Bioorthogonal Chemistry: Chemical Functionalization of Biomolecules (3) | **Under Review**
CHEM 428 - Molecular Biophysics (3)
CHEM 422L - Biological Chemistry and Chemical Biology Laboratory Methods (3)

Select any associated program forms that exist

Program Category and Level

Program Category	Program Level	Degree, Minor, or Certificate Name
Program	Undergraduate	BS Chemical Biology

New Graduate Program	Dual Degree	New Undergrad Degree/Certificate
No	No	Yes

Catalog Information

Program Description

Chemical biology is a scientific discipline that applies concepts and techniques from the fields of biology, chemistry, physics, mathematics, engineering, medicine, and the pharmaceutical sciences, to address society's most complex questions. It involves application of chemical and fabrication techniques, with a particular focus on the synthesis and spectroscopic analysis of small molecules and proteins, with molecular and systems analysis methods, including biophysical modeling and simulation, for investigating and manipulating complex biological systems that are both natural and designed.

Admissions Requirements

College of Arts and Sciences and Department of Chemistry and Chemical 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 2.00 transfer GPA.
- Continuing UNM students must have a 2.00 institutional GPA.

Demonstrated academic achievement by satisfying the following:

- Completion of General Education Curriculum: Communication.
- Completion of General Education Curriculum: Mathematics and Statistics.
- Completion of General Education Curriculum: Second Language.

Completion of Department of Chemistry and Chemical Biology admission course work with grades of "C" or better:

- CHEM 1225 or 1227.
- MATH 1430 or 1512.

Graduation Requirements

UNM Graduation requirements for B.S. in Chemical Biology

University requirements

The General Education curriculum requires a minimum of 31 credit hours of courses in the following areas of study (the "Gen Ed requirement",
http://catalog.unm.edu/catalogs/2021-2022/undergrad-program.html):

1. Communication (6 credit hours)
2. *Mathematics and Statistics (3 credit hours)*
3. *Physical and Natural Sciences (4 credit hours)*
4. Social and Behavioral Sciences (3 credit hours)*
5. Humanities (3 credit hours)
6. Second Language (3 credit hours)
7. Arts and Design (3 credit hours)
8. *Student Choice (6 credit hours)*

Note- the BS in Chemical Biology requires specific courses for areas 2, 3 and 8 which are listed below, so only **18 additional CH** are mandated by this requirement.

The university also requires a **minimum of 120 CH,** 3 CH in an approved Diversity and Inclusion course (which may also satisfy one of the above requirements) and a GPA ≥2.00.

* Supportive coursework may complete this requirement for general education (area 4) if you chose an economics course.

Arts and Sciences requirements

In addition to the university requirements, the College of A&S has the following requirements (http://catalog.unm.edu /catalogs/2021-2022/colleges/arts-sciences/index.html):

A&S 4. A minimum of 90 CH of courses taught by Arts and Sciences departments.

A&S 5. A major and minor or a double major, or one of the special curricula of the College. At least one of which must be housed within the College of Arts and Sciences.

A&S 6. One year of enrollment subsequent to the transition to Major status the College of Arts and Sciences with a minimum of 12 earned CH.

A&S 7. At least 48 CH of upper-division (3xx and 4xx) coursework (GPA ≥2.00) on all upper-division CH accepted by the College of Arts and Sciences.

Note- most students should easily meet requirement A&S 4, since most Gen Ed courses (above) and all specific degree requirements (below) are taught by A&S departments.

Required upper division coursework for the BS Chemical Biology totals 31 CH, so 17 additional CH are needed to meet requirement A&S 7.

Specific degree requirements

Supporting program

Number Title CH

MATH 1430 (or 1512) Applications of Calculus I 3

MATH 1440 (or 1522) Applications of Calculus II 3

MATH 1350 (or STAT 345) Introduction to Statistics 3

Total 9

Physics

Number Title CH

PHYS 1230 (or 1310) Algebra-based Physics I 3

PHYS 1230L (or 1310L) Algebra-based Physics I Laboratory 1

PHYS 1240 (or 1320) Algebra-based Physics II 3

PHYS 1240L (or 1320L) Algebra-based Physics II Laboratory 1

Total 8

Biology

Number Title CH

BIOL 2101 Principles of Biology: Molecules to Cells 3

BIOL 2102 Principles of Biology: Organisms to Ecosystems 3

BIOL 2103 Principles of Biology: Introductory Laboratory 1

Total 7

Total 24

Major program

Number Title CH

CHEM 1215 (or 1217) General Chemistry I for STEM Majors 3

CHEM 1215L General Chemistry I for STEM Majors Laboratory 1

CHEM 1225 (or 1227) General Chemistry II for STEM Majors1 3

CHEM 1225L General Chemistry II for STEM Majors Laboratory 1

CHEM 2310C Quantitative Analysis Lecture and Laboratory 4

CHEM 301 Organic Chemistry 3

CHEM 302 Organic Chemistry 3

CHEM 303L Organic Chemistry Laboratory 1

CHEM 304L Organic Chemistry Laboratory 1

CHEM 315 Introductory Physical Chemistry 4

CHEM 421 Biological Chemistry and Chemical Biology 3

CHEM 422 Biological Chemistry and Chemical Biology 3

CHEM 422L Biological Chemistry and Chemical Biology Laboratory Methods 3

CHEM 433 Bioinorganic Chemistry 3

CHEM 390 Chemical Biology Research Methods Seminar Series 1

Total 37

Plus 6 CH of upper-division electives from the following list gives a total of 43 CH in the major and 32 CH of upper-division courses.

Upper Division Chemistry Elective Courses

CHEM 423: Introduction to Synthetic Biology

CHEM 424: Bioorthogonal Chemistry: Chemical Functionalization of Biomolecules

CHEM 426: Genome Technologies and Bioinformatics

CHEM 428: Molecular Biophysics

CHEM 431: Advanced Inorganic

CHEM 452: Polymer Chemistry

CHEM453L - Analytical Instrumentation: Theory and Application

CHEM 457: Environmental Chemistry

The degree then has a total of 18 GenEd + 24 supporting program + 43 major program = 85 total credit hours, leaving 35 CH (from the other supporting courses) to reach the minimum of 120 CH for a bachelor's degree (including 17 CH of upper-division courses for the A&S requirement).

Other Supporting Courses

- Earn at least 35 credits from the following:
    - BIOL2210 - Human Anatomy and Physiology I (3)
    - BIOL2210L - Human Anatomy and Physiology I Laboratory (1)
    - BIOL300C - Evolution (4)

- BIOL301C - Molecular and Cellular Biology (4)
- BIOL302C - Genes to Genomes: Lecture and Laboratory (4)
- BIOL303 - Ecology and Evolution (3)
- BIOL304 - Plant and Animal Form and Function (3)
- BIOL303L - Ecology and Evolution Laboratory (1)
- BIOL304L - Plant and Animal Form and Function Laboratory (1)
- BIOL310C - Principles of Ecology (3)
- BIOL351 - General Microbiology (3)
- BIOL352L - General Microbiology Laboratory (1)
- BIOL425 - Molecular Genetics (3)
- BIOL445 - Biology of Toxins (3)
- BIOL456 - Immunology (3)
- BIOL482L - Parasitology (4)
- BIOL490 - Biology of Infectious Organisms (3)
- BIOL491 - Population Genetics (3)
- MATH314 - Linear Algebra with Applications (3)
- MATH316 - Applied Ordinary Differential Equations (3)
- MATH375 - Introduction to Numerical Computing (3)
- MATH471 - Introduction to Scientific Computing (3)
- PHYS301 - Thermodynamics and Statistical Mechanics (3)
- PHYS303 - Analytical Mechanics I (3)
- PHYS466 - Methods of Theoretical Physics I (3)
- PHYS491 - Intermediate Quantum Mechanics I (3)
- CHEM423 - Introduction to Synthetic Biology (3)
- CHEM424 - Bioorthogonal Chemistry: Chemical Functionalization of Biomolecules (3)
- CHEM426 - Genome Technologies and Bioinformatics (3)
- CHEM431 - Advanced Inorganic Chemistry (3)
- CHEM453L - Analytical Instrumentation: Theory and Application (4)
- CHEM457 - Environmental Chemistry (3)
- ECON2110 - Macroeconomic Principles (3)
- ECON2120 - Microeconomic Principles (3)
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Program Information

Degree Type
Bachelor of Science

Degree/Certificate Type	CIP Code	CIP Title
Undergraduate	26.0501	Chemistry, General

Professional Credential/Licensure Program Information

Licensure Information
Neither

File Uploads

Proposal File Upload

- Full Proposal (3-6-23).docx

Executive Summary Upload

- BS in Chemical Biology Exec summary.docx

Associate Provost Memo

- ProvostLetter_Chemical Biology 10_29_21.pdf

Degree Information

Degree Hours

120

Minimum Major Hours

43

Professional Accrediting Bodies

Degree Requirements

Requirements

Major

43
Total Credits

- Complete all of the following
  - Earned a minimum grade of C in each of the following:
    - CHEM1215 - General Chemistry I for STEM Majors (3)
    - CHEM1215L - General Chemistry I for STEM Majors Laboratory (1)
    - CHEM1225 - General Chemistry II for STEM Majors (3)
    - CHEM1225L - General Chemistry II for STEM Majors Laboratory (1)
    - CHEM2310C - Quantitative Analysis Lecture and Laboratory (4)
    - CHEM301 - Organic Chemistry (3)
    - CHEM302 - Organic Chemistry (3)
    - CHEM303L - Organic Chemistry Laboratory (1)
    - CHEM304L - Organic Chemistry Laboratory (1)
    - CHEM421 - Biological Chemistry/Chemical Biology I (3)
    - CHEM422 - Biological Chemistry / Chemical Biology II (3)
    - CHEM433 - Bioinorganic Chemistry (3)
    - CHEM390 - Chemical Biology Research Methods Seminar Series (1)
    - CHEM315 - Introductory Physical Chemistry (4)
    - CHEM422L - Biological Chemistry and Chemical Biology Laboratory Methods (3)
  - Earn at least 6 credits from the following:
    - CHEM423 - Introduction to Synthetic Biology (3)
    - CHEM424 - Bioorthogonal Chemistry: Chemical Functionalization of Biomolecules (3)
    - CHEM426 - Genome Technologies and Bioinformatics (3)
    - CHEM431 - Advanced Inorganic Chemistry (3)
    - CHEM457 - Environmental Chemistry (3)
    - CHEM452 - Polymer Chemistry (3)
    - CHEM453L - Analytical Instrumentation: Theory and Application (4)

Supportive Program

59 - 61
Total Credits

No Rules

Statistics

3
Total Credits

- Earned a minimum grade of C in at least 1 of the following:
  - MATH1350 - Introduction to Statistics (3)
  - STAT345 - Elements of Mathematical Statistics and Probability Theory (3)

Math

6 - 8
Total Credits

- Complete 1 of the following
  - Earned a minimum grade of C in each of the following:
    - MATH1430 - Applications of Calculus I (3)
    - MATH1440 - Applications of Calculus II (3)
  - Earned a minimum grade of C in each of the following:

        - MATH1512 - Calculus I (4)
        - MATH1522 - Calculus II (4)

Physics

8
Total Credits

- Complete 1 of the following
    - Earned a minimum grade of C in each of the following:
        - PHYS1230 - Algebra-Based Physics I (3)
        - PHYS1230L - Algebra-Based Physics I Laboratory (1)
        - PHYS1240 - Algebra-Based Physics II (3)
        - PHYS1240L - Algebra-Based Physics II Laboratory (1)
    - Earned a minimum grade of in each of the following:
        - PHYS1310 - Calculus-Based Physics I (3)
        - PHYS1310L - Calculus-Based Physics I Laboratory (1)
        - PHYS1320 - Calculus-Based Physics II (3)
        - PHYS1320L - Calculus-Based Physics II Laboratory (1)

Biology

7
Total Credits

- Earned a minimum grade of C in each of the following:
    - BIOL2101 - Principles of Biology: Molecules to Cells (3)
    - BIOL2102 - Principles of Biology: Organisms to Ecosystems (3)
    - BIOL2103L - Principles of Biology: Introductory Laboratory (1)

Other Supportive Coursework

35
Total Credits

- Earn at least 35 credits from the following:
    - BIOL303 - Ecology and Evolution (3)
    - BIOL304 - Plant and Animal Form and Function (3)
    - BIOL303L - Ecology and Evolution Laboratory (1)
    - BIOL304L - Plant and Animal Form and Function Laboratory (1)
    - BIOL445 - Biology of Toxins (3)
    - BIOL456 - Immunology (3)
    - BIOL482L - Parasitology (4)
    - BIOL490 - Biology of Infectious Organisms (3)
    - BIOL425 - Molecular Genetics (3)
    - BIOL491 - Population Genetics (3)
    - MATH314 - Linear Algebra with Applications (3)
    - MATH316 - Applied Ordinary Differential Equations (3)
    - MATH375 - Introduction to Numerical Computing (3)
    - MATH471 - Introduction to Scientific Computing (3)
    - PHYS301 - Thermodynamics and Statistical Mechanics (3)
    - PHYS303 - Analytical Mechanics I (3)
    - PHYS466 - Methods of Theoretical Physics I (3)
    - PHYS491 - Intermediate Quantum Mechanics I (3)
    - CHEM453L - Analytical Instrumentation: Theory and Application (4)

- CHEM423 - Introduction to Synthetic Biology (3)
- CHEM424 - Bioorthogonal Chemistry: Chemical Functionalization of Biomolecules (3)
- CHEM426 - Genome Technologies and Bioinformatics (3)
- CHEM431 - Advanced Inorganic Chemistry (3)
- CHEM457 - Environmental Chemistry (3)
- BIOL2210 - Human Anatomy and Physiology I (3)
- BIOL2210L - Human Anatomy and Physiology I Laboratory (1)
- ECON2110 - Macroeconomic Principles (3)
- ECON2120 - Microeconomic Principles (3)
- BIOL302C - Genes to Genomes: Lecture and Laboratory (4)
- BIOL301C - Molecular and Cellular Biology (4)
- BIOL300C - Evolution (4)
- BIOL351 - General Microbiology (3)
- BIOL352L - General Microbiology Laboratory (1)
- BIOL310C - Principles of Ecology (3)

Additional Requirements

18
Total Credits

- Earn at least 18 credits from the following types of courses:
  Students must at least 120 credit hours to complete this degree. In addition to the major courses, students must also earn 16 additional credit hours to complete any General Education requirements not already satisfied by the courses listed above.

Grand Total Credits: 120 - 122

Concentrations

Program Concentrations

Code	Title

Concentration Required
No

Emphases

Emphasis required
No

Emphasis Hours

Emphasis Rules

No Rules

Sample Degree Plan

Sample Degree Plan Upload

- 4yrPlan.docx

Program Learning Outcomes

Learning Outcomes

The students will develop basic knowledge of the combined major fields (biology, chemistry, and physics) and a broad knowledge of the various associated interdisciplinary subfields that include medicinal chemistry, cell biology, biochemistry, molecular biophysics, protein crystallography, computational genomics, and proteomics. The students will demonstrate their basic knowledge through formal written assessments, practical laboratory experimentation, and before graduation having the opportunity to perform original research with departmental faculty and staff.

The successful student will develop effective oral and communication skills as indicated:

1. Compose complete and grammatically correct sentences.
2. Express ideas in clear language appropriate to the format and audience.
3. Communicate complex concepts and ideas in an understandable manner.
4. Present ideas and information in a logically organized manner.
5. Adhere to legal and ethical standards for citing and crediting the intellectual property.
6. Establish rapport, engage attention, and elicit information through use of effective verbal, nonverbal, explanatory, questioning and listening skills.
7. Speak in a respectful manner (attentive, non-judgmental, non-threatening, and compassionate).
8. Express thoughts accurately that are appropriate for the situation and audience.

The successful student will develop an ability to integrate knowledge and use statistical analysis, mathematical methods, and computational models to solve problems as indicated:

1. Differentiate between relevant and irrelevant information to clarify the problem(s).
2. Explore/research multiple resources as needed to gather data and answer the question.
3. Analyze data to synthesize all relevant information and draw defensible conclusion(s).
4. Develop solution/decision/ conclusion/recommendation based on data.
5. Recommend or implement solution.
6. Demonstrate ability to monitor and refine effectiveness of solution.
7. Demonstrate understanding and competence in the mathematical, statistical, and computational techniques for modeling and simulating biochemical and biophysical interactions;
8. Demonstrate understanding of how the principles of physics (mechanics, electrostatics, thermodynamics, and kinetics) are applied to the study of biochemical and biophysical systems, interactions, chemical reactions, dynamics, and biological function and regulation.
9. Demonstrate understanding of the chemistry of the cell, biological organization, single-molecule and ensemble dynamics, and broadly speaking, the impact of the biological milieu on molecular interactions.

The successful student will develop an ability to identify and exhibit ethical, socially responsible, and be exhibit socially acceptable behaviors in the classroom, workplace, and society in general as indicated.

1. Demonstrate awareness of cultural and social diversity through interactions with students, staff, and faculty.
2. Demonstrate sensitivity to personal values and ethical principles in professional and social contexts.