REQUIREMENTS FOR THE BIOCHEMISTRY MAJOR

Grade Requirement: All courses required for the Biochemistry major (CH, MATH, PHYS, BI courses) must be graded and passed with a grade of C- or better.

Core Chemistry Courses:

General Chemistry	CH 221, 222, 223 OR CH 224H, 225H, 226H
General Chemistry Lab	CH 227, 228, 229 OR CH 237, 238, 239
Organic Chemistry[1]	CH 341, 342, 343
Organic Chemistry Lab	CH 337, 348
Biochemistry	CH 461, 462, 463
Biochemistry Lab	CH 467
Physical Chemistry	CH 411, 412

Biology, Math & Physics:

Biology	BI 281H, 282H, 320
Calculus	MATH 251, 252, 253
Physics	PHYS 201, 202, 203 OR PHYS 251, 252, 253

Physical Lab Requirement:[2]

PHYS 204, 205, 206 OR PHYS 290, 290, 290 OR CH 417, 418

Advanced Lab Requirement:[2]

Option 1) One term of a 400 level chemistry lab course

Option 2) At least one year of undergraduate research (written report required)

Advanced Electives:[2]

Five approved courses at the 400-level in Chemistry, Biology and Physics.

In addition to the courses listed above, the UO General Education Requirements must be satisfied (either by taking sufficient Writing, Multicultural, Arts & Letters, and Social Science classes or completing the R. D. Clark Honors College requirements).

Sample Biochemistry Major Program

	Core Chemistry Courses	Additional Courses	Related Science Requirements	Required University
First Year	General Chemistry General Chemistry Lab		Math**	WR 121-122
Second Year	Organic Chemistry Organic Chemistry Lab	Undergraduate Research	Biology	Group satisfying courses from Arts and Letters and Social Sciences (15 credits for each group)
Third Year	Biochemistry Biochemistry Lab	Physical Lab	Physics	
Fourth Year	Physical Chemistry	Advanced Electives		2 Multicultural Courses

[1] CH 331, 335, 336 may be substituted for CH 341, 342, 343

[2] Courses cannot be used to satisfy requirements in more than one area

[3]If your math placement test does not place you in MATH 251, begin with the course you are placed into and take one math course each term until you finish all required math courses.

Updated March 2015

Name: *ID#:*

Biochemistry: B.S. Degree Checklist

General Chemistry[1]

☐ CH 221 or 224H ☐ CH 227 or 237
☐ CH 222 or 225H ☐ CH 228 or 238
☐ CH 223 or 226H ☐ CH 229 or 239

Organic Chemistry[1]

☐ CH 331 or 341 ☐ CH 337
☐ CH 335 or 342 ☐ CH 348 [2]
☐ CH 336 or 343

Biochemistry[1]

☐ CH 461 ☐ CH 467
☐ CH 462
☐ CH 463

Physical Chemistry[1]

☐ CH 411
☐ CH 412

Physical Lab Requirement:[1,3] ☐ PHYS 204, 205, 206 or ☐ CH 417, 418

Advanced Lab Requirement[1,3]: (one option below)

☐ One 400-level Chemistry Lab: CH _____
☐ At least one year of Undergraduate Research (written report required)

Advanced Electives[1,3] (Five 400-level approved courses in Chemistry and Biology)[4]

☐ ☐ ☐ ☐ ☐

Biology[1]

☐ BI 281H
☐ BI 282H
☐ BI 320

Math[1]

☐ MATH 251
☐ MATH 252
☐ MATH 253

Physics[1]

☐ PHYS 201 or 251
☐ PHYS 202 or 252
☐ PHYS 203 or 253

University Requirements

☐ WR 121 ☐ WR 122 or 123
☐ Two multicultural courses (check two): ☐ AC ☐ IP ☐ IC
☐ Arts & Letters Group (15 cr. – must double up in one subject)[5]
☐ Social Science Group (15 cr. – must double up in one subject)[5]
☐ 180 credits
☐ 62 upper division credits
☐ UO Residency Requirement (After completing 120 cr., at least 45 cr. must be at the UO)
☐ 168 ABCDP* credits (ABCDP* = graded or P if the course is taught P/N only)
☐ 45 ABCD credits at UO (ABCD = graded credits)

[1] The course must be graded and passed with a C- or better
[2] CH 338 and CH 339 satisfy the organic lab requirement if taken before Fall 2012
[3] Courses cannot be used to satisfy requirements in more than one area
[4] Students may use ONE approved 300-level biology course (BI 321, 322, 328 or 360)
[5] No more than three courses in any subject may be used to satisfy the group requirements

Advisor: *Date:*

List of Approved Advanced Electives for the Biochemistry Major*:

Pay careful attention to prerequisites when choosing Advanced Electives.

Chemistry Courses:

CH 410. Application of Quantum Chemistry. 4 Credits. This course provides and overview of contemporary computational chemistry techniques used to model both single molecule and extended solids. Computations will be conducted on the new University of Oregon super computer, Talapas.

CH 410. Design Principles of Dynamic Biological Systems. 4 Credits. In this course, we will discuss major technological advances over the past 30 years that accelerated scientific discovery at the interface between cell biology and biochemistry. Emphasis will be placed on defining the relationships between protein structure, function, and emergent properties in complex biological systems. Pre req CH 461; MATH 253.

CH 413. Physical Chemistry. 4 Credits. Methods of physics applied to chemical problems, including inorganic, organic, and biochemistry. Introduction to quantum chemistry. Prereq: two years of college chemistry (except for physics majors), PHYS 201, 202, 203; MATH 253; MATH 256, 281, 282 strongly recommended.

CH 417. Physical Chemistry Laboratory. 4 Credits. Experiments in thermodynamics, modern electronic measurements, computer modeling, and data reduction. Pre or coreq: CH 411.

CH 418. Physical Chemistry Laboratory. 4 Credits. Experiments in statistical mechanics, chemical kinetics, plasma chemistry, and mass spectrometry. Prerequisite CH 417; Pre or coreq: CH 412.

CH 419. Physical Chemistry Laboratory. 4 Credits. Experiments molecular spectroscopy, quantum chemistry, and laser-excited chemical and physical processes to illustrate theoretical principles. Prereq: CH 417; pre or coreq: CH 413.

CH 420. Physical Organic Chemistry I. 4 Credits. Modern physical organic chemistry including chemical bonding, acid-base chemistry, thermochemistry, noncovalent interactions, and introduction to computational chemistry. Sequence with CH 421/521. Prereq: CH 336 or CH 341.

CH 421. Physical Organic Chemistry II. 4 Credits. Modern physical organic chemistry including tools to study reaction mechanisms, kinetic analysis, isotope effects, and qualitative molecular orbital theory. Sequence with CH 420/520. Prereq: CH 420/520.

CH 429. Instrumental Analysis. 5 Credits. Use of instrumental methods for quantitative determinations of unknown chemical samples. Prereq: CH 417.

CH 431. Inorganic Chemistry. 4 Credits. Introduction to group theory for molecular symmetry; syntheses, structures, reactions, and reaction mechanisms of coordination complexes and organometallic complexes.

CH 432. Inorganic Chemistry. 4 Credits. Bioinorganic chemistry: metals in biological systems; coordination chemistry, reactions, spectroscopy, metalloclusters, and synthetic modeling. Prereq: CH 431.

CH 433. Inorganic Chemistry. 4 Credits. Solid-state inorganic chemistry: solid-state structure and its determination; the electrical, magnetic, and mechanical properties of materials and their physical description. Prereq: CH 431.

CH 441. Quantum Chemistry. 4 Credits. The principles of time-independent quantum mechanics and their application to model atomic and molecular systems. Prereq: CH 413 or equivalent.

CH 442. Quantum Chemistry and Spectroscopy. 4 Credits. Molecular structure theory, perturbation theory, time-dependent quantum mechanics, theory of spectra, selection rules. Prereq: CH 441 or equivalent.

CH 443. Quantum Chemistry and Spectroscopy. 4 Credits. Experimental spectra of atomic and molecular systems and surfaces. Prereq: CH 442 or equivalent.

CH 444. Chemical Thermodynamics. 4 Credits. The laws of thermodynamics and their applications, including those to nonideal chemical systems. Prereq: CH 413 or equivalent.

CH 445. Statistical Mechanics. 4 Credits. Molecular basis of thermodynamics. Applications to the calculation of the properties of noninteracting and weakly interacting systems. Prereq: CH 413 or equivalent.

CH 446. Chemical Kinetics: [Topic]. 4 Credits. Repeatable. Description and interpretation of the time evolution of chemical systems. Prereq: CH 413 or equivalent.

CH 447. Computational Chemistry. 4 Credits. Introduction to modern computational methods used to understand the properties of molecules. Prereq: CH 411, 412; or PHYS 353.

CH 451. Advanced Organic-Inorganic Chemistry. 4 Credits. Principles of organic-inorganic reaction dynamics; kinetics and mechanisms, linear free-energy relationships, isotope effects, substitution reactions, dynamic behavior of reactive intermediates, electron transfer chemistry. Prereq: CH 336 or CH 341.

CH 452. Advanced Organic Chemistry—Stereochemistry and Reactions. 4 Credits. Principles and applications of stereochemistry; reagents and reactions, with mechanisms, used in contemporary organic synthesis; examples taken from the current literature.

CH 464. RNA Biochemistry. 4 Credits. Introduction to the diverse field of RNA biochemistry. Prereq: CH 463 or BI 320.

CH 465. Physical Biochemistry. 4 Credits. Physical chemical properties of biological macromolecules; forces and interactions to establish and maintain macromolecular conformations; physical bases of spectroscopic, hydrodynamic, and rapid-reaction investigative techniques. Offered alternate years. Prereq: CH 461.

CH 466. Structural Biochemistry. 4 Credits. Protein and nucleic acid structures and energetics. Structure determination by x-ray crystallography and nuclear magnetic resonance. Computational methods for structural analysis. Offered alternate years. Prereq: CH 461.

Biology Courses:

****BI 322. Cell Biology.** Eukaryotic cell nuclear structure and exchange, protein trafficking, endocytosis, chaperones, cytoskeletal functions, intercellular junctions, extracellular materials, signaling, cell division mechanics and controls, aging and death. Lectures, discussions. Prereq: BI 214 or BI 282H; CH 331 recommended.

****BI 328. Developmental Biology.** 4 Credits. Topics include genetic regulation, nucleocytoplasmic interactions, organogenesis, morphogenesis, pattern formation, cell differentiation, and neoplasia. Lectures, laboratories. Prereq: BI 214 or BI 282H.

****BI 360. Neurobiology.** 4 Credits. Function of the nervous system from the single neuron to complex neural networks. Topics range from molecular and cellular neurobiological mechanisms to systems and behavioral analyses. Lectures, discussions. Prereq: BI 214 or 282H

Please note that only the BI 410 courses with the titles below have been approved as BIC advanced electives.

BI 410. Analysis Neural Data. 4 Credits. Analysis of Neural Data provides an introduction to statistical and visualization methods for analysis of neuroscientific data using the Matlab programming environment. Students will learn basic concepts and methods from statistics and linear algebra for analysis of high-dimensional data, and learn how to apply these to experimental data by writing Matlab programs. No previous programming experience is required. Pre-reqs: BI 211-214 or BI 281H -283H; and Math 246-247 or Math 251-252. (Suggested additional pre-reqs either Math 243 or BI 399 Intro Experimental Design & Stats.)

BI 410. Biology of Aging. 4 Credits. Aging affects most living organisms and is the primary risk factor for common human diseases such as cancer, cardiovascular disorders, and neurodegeneration. Perhaps surprisingly, rates of aging are under genetic control and vary widely among different species. This course will use primary literature to examine the molecular and cellular mechanisms that regulate aging and to explore approaches that slow or reverse the aging process. Suggested pre-req: Bi 320

BI 410. Chromatin Structure & Function. 4 Credits This course will examine how eukaryotic DNA is packaged into chromatin, and will explore the structural and regulatory roles of chromatin in DNA-dependent processes. Topics will include nucleosome structure, chromatin modifications, chromatin remodeling enzymes, genome-wide chromatin organization, and emerging methods in chromatin engineering. Prereq: BI 320

BI 410. Intro Programming Bio. 4 Credits. Intro Bioinformatics Program is an introduction to computer programming specifically designed for Biology majors. Students will learn basic programming skills, how to write Python scripts to manage project workflows, and gain experience with data analysis and data managements software. No previous programming experience is required, but CIS 122 is a recommended prerequisite.

BI 410. Matlab for Biologists. 4 Credits. Matlab for Biologists provides an introduction to analysis of biological data using the Matlab programming environment. Students will learn basic programming skills and how to apply this to experimental data and numerical simulations. No previous programming experience is required.

BI 410. Neural Basis Cognition. 4 Credits. The course will examine the neural mechanism that mediate cognitive processes such as attention, memory and decisions making. We will focus on studies that use animal models to relate the activity of single neurons to cognition. The course is intended to bridge the gap between sensory physiology and cognitive neuroscience. Prereq: BI 353 or BI 360.

BI 421. Advanced Molecular Genetics Research Laboratory. 5 Credits. Intensive multipart research project using fungus *Neurospora*; includes mutagenesis, genetic selection-screening, complementation testing, mapping, DNA purification, restriction analysis, polymerase chain reaction, Southern blotting. Prereq: BI 320.

BI 422. Protein Toxins in Cell Biology. 4 Credits. Mechanisms used by protein toxins to kill other organisms and how they have been used as molecular scalpels to dissect pathways in cell and neurobiology. Lectures, discussions. Prereq: BI 322, BI 356, or BI 360.

BI 423. Human Molecular Genetics. 4 Credits. Advanced topics in genetics that relate to human development and disease. The human genome, sex determination, X chromosome inactivation, chromosomal abnormalities, trinucleotide repeat expansions, cancer. Lectures, discussions. Prereq: BI 320.

BI 424. Advanced Molecular Genetics. 4 Credits. Structure and function of chromosomes with emphasis on unsolved genetic problems such as genomic imprinting, position effects, and gene silencing. Lectures, discussions. Prereq: BI 320.

BI 425. Advanced Molecular Biology Research Laboratory. 5 Credits. Provides an intensive, structured research experience that incorporates molecular biology, genetics, and genomic methodologies. Lectures, laboratories. Prereq: one from BI 320, BI 322, BI 328.

BI 426. Genetics of Cancer. 4 Credits. Genetic regulation of cancer. Topics include oncogenes and tumor suppressor genes, signal transduction pathways, genetic animal models, and rationale treatment design. Lectures, discussions. Prereq: BI 320 or BI 322.

BI 427. Molecular Genetics of Human Disease. 4 Credits. Advanced discussions of heritable diseases from single-gene mutations such as cystic fibrosis to complex multigenetic diseases such as autism and schizophrenia. Lectures, discussions. Prereq: BI 320.

BI 428. Developmental Genetics. 4 Credits. Genetic regulation of development, including investigations of molecular mechanisms and studies of developmental mutants. Topics include molecular biology of eukaryotic chromosomes, genetic mosaics, and models of gene regulation. Lectures, discussions. Prereq: BI 320, 328.

BI 433. Bacterial-Host Interactions. 4 Credits. Examines spectrum of interactions between bacteria and animals, from pathogenesis to symbiosis, focusing on the molecular and cellular bases of these interactions. Lectures, discussions. Prereq: BI 320 or 322 or 330.

BI 461. Systems Neuroscience. 4 Credits. Principles of organization of nervous systems with emphasis on vertebrate brain and spinal cord. Functional implications of synaptic organization and pattern of projections, and comparative aspects. Lectures, discussions. Prereq: BI 353 or 360 or equivalent.

BI 463. Cellular Neuroscience. 4 Credits. Physiology of excitation, conduction, and synaptic transmission. Lectures, discussions. Prereq: BI 360.

BI 466. Developmental Neurobiology. 4 Credits. Mechanisms underlying development of the nervous system. The genesis of nerve cells; differentiation of neurons; synaptogenesis and neuronal specificity; plasticity, regeneration, and degeneration of nervous tissue. Lectures, discussions. Prereq: BI 320, 328.

BI 484. Molecular Evolution. 4 Credits. General description of patterns of molecular variation within and between species, underlying mechanisms, and methods of analysis. Prereq: BI 320 or 380.

BI 486. Population Genetics. 4 Credits. Analysis of the genetic mechanisms of evolutionary change. Study of artificial and natural selection, mutation, migration, population structure, and genetic drift.

BI 487. Molecular Phylogenetics. 4 Credits. A critical introduction to the concepts and techniques of modern molecular phylogenetic analysis—the inference of evolutionary relationships from gene sequence data. Lectures, discussions. Prereq: BI 380

BI 493. Genomic Approaches and Analysis. 4 Credits. ntroduction to experimental methods and analytical techniques for studying biological questions on a genome-wide scale. Lectures, discussions. Prereq: BI 320.

Physics Courses:

PHYS 362. Biological Physics. 4 Credits. Physical principles governing biological systems. Topics include: stochastic and entropic forces, diffusion, electrostatics in solution, molecular binding, DNA/polymer mechanics, gene regulation, simple genetic circuits, membrane mechanics, protein folding, simple stochastic processes, and physical mechanisms of self-organization. Pre-requisites: MATH 256, 281.

Note: Check with the appropriate department to determine when any specific course will be offered.

** Other courses may be submitted for consideration and approval by the department*

***Students may use ONE approved 300-level biology course (BI 321, 322, 328 or 360) as one of the 5 advanced electives.*