Bioinformatics, genomics, and proteomics are rapidly advancing fields that integrate the tools and knowledge from biology, chemistry, computer science, mathematics, physics, and statistics in research at the intersection of the biological and informational sciences. Inspired by the enormous amount of biological data that are being generated from the sequencing of genomes, these new fields will help us pose and answer biological questions that have long been considered too complex to address. Research in genomics, proteomics, and bioinformatics will also significantly impact society affecting medicine, culture, economics, and politics.

The Bioinformatics, Genomics, and Proteomics curriculum involves faculty from the Biology, Chemistry, Computer Science, Mathematics/Statistics, and Physics departments and was designed to provide students with an understanding of these revolutionary new areas of investigation. The introductory level courses, Computation and Biology and Statistics for Biologists are accessible to all students interested in gaining familiarity with the power of genomic analysis. Students interested in graduate work in bioinformatics, genomics, and proteomics should take the core courses and five of the recommended courses. Interested students are also encouraged to participate in independent research with members of the advisory faculty as they explore the development of these new fields.

**BIGP Core Courses**

**BIOL 319 (F) Integrative Bioinformatics, Genomics, and Proteomics Lab** (QFR)

**Cross-listings:** BIOL 319  CSCI 319  MATH 319  PHYS 319  CHEM 319

**Primary Cross-listing**

What can computational biology teach us about cancer? In this capstone experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, phylogenetics, and recombinant DNA techniques to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the MAPK signal transduction pathway in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells. Flow cytometry and mass spectrometry will be used to study networks of interacting proteins in colon tumor cells.

**Class Format:** two afternoons of lab, with one hour of lecture, per week

**Requirements/Evaluation:** lab participation, several short homework assignments, one lab report, a programming project, and a grant proposal

**Prerequisites:** BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and CSCI 315 or PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

**Enrollment Limit:** 12

**Enrollment Preferences:** seniors, then juniors, then sophomores

**Expected Class Size:** 12

**Grading:** yes pass/fail option, yes fifth course option

**Unit Notes:** does not satisfy the distribution requirement for the Biology major

**Distributions:** (D3) (QFR)
This course is cross-listed and the prefixes carry the following divisional credit:
BIOL 319 (D3) CSCI 319 (D3) MATH 319 (D3) PHYS 319 (D3) CHEM 319 (D3)

Attributes: BIGP Core Courses  BIMO Interdepartmental Electives
Not offered current academic year

BIGP Recommended Courses

**BIOL 202 (F) Genetics (QFR)**
Genetics, classically defined as the study of heredity, has evolved into a discipline whose limits are continually expanded by innovative molecular technologies. This course covers the experimental basis for our current understanding of the inheritance, structures, and functions of genes. It introduces approaches used by contemporary geneticists and molecular biologists to explore questions in areas of biology ranging from evolution to medicine. The laboratory part of the course provides an experimental introduction to modern genetic analysis. Laboratory experiments include linkage analysis, bacterial transformation with plasmids and DNA restriction mapping.

Class Format: lecture/laboratory, six hours per week

Requirements/Evaluation: evaluation will be based on bi-weekly problem sets, weekly laboratory exercises and laboratory reports, and examinations

Prerequisites: BIOL 101 and 102

Enrollment Limit: none

Expected Class Size: 84

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (QFR)

Attributes: BIGP Recommended Courses  BIMO Required Courses

Fall 2019
LAB Section: 03  T 1:00 pm - 4:00 pm  Derek Dean
LAB Section: 05  R 1:00 pm - 4:00 pm  Derek Dean
LAB Section: 04  W 1:00 pm - 4:00 pm  Derek Dean
LEC Section: 01  MWF 11:00 am - 11:50 am  David W. Loehlin
LAB Section: 02  M 1:00 pm - 4:00 pm  Derek Dean

**BIOL 305 (S) Evolution (QFR)**
This course offers a critical analysis of contemporary concepts in biological evolution. We focus on the relation of evolutionary mechanisms (e.g., selection, drift, and migration) to long term evolutionary patterns (e.g., evolutionary innovations, origin of major groups, and the emergence of diversity). Topics include micro-evolutionary models, natural selection and adaptation, sexual selection, speciation, the inference of evolutionary history among others.

Class Format: lecture/discussion/laboratory, six hours per week

Requirements/Evaluation: evaluation will be based on independent research project, problem sets, participation in discussions and exams

Prerequisites: BIOL 202

Enrollment Limit: 24

Enrollment Preferences: Seniors and biology majors

Expected Class Size: 24

Grading: yes pass/fail option, yes fifth course option

Unit Notes: satisfies the distribution requirement for the Biology major
Distributions: (D3) (QFR)

Attributes: BIGP Recommended Courses  BIMO Interdepartmental Electives  COGS Related Courses

Spring 2020
LAB Section: 02  T 1:00 pm - 4:00 pm  Luana S. Maroja
LEC Section: 01  MWF 10:00 am - 10:50 am  Luana S. Maroja
LAB Section: 03  R 1:00 pm - 4:00 pm  Luana S. Maroja

BIOL 430  (S)  Genome Sciences: At the Cutting Edge  (WS)
Research in genomics has integrated and revolutionized the field of biology, including areas of medicine, plant biology, microbiology, and evolutionary biology. Moreover, recent developments in “metagenomics” (genomic studies of entire communities of microorganisms in natural environments, such as the mammalian gut and the deep sea) and “metatranscriptomics” (studies of genome wide changes in expression and mRNA levels in natural communities of organisms) have generated unprecedented knowledge about the genomic potential of a community and the in situ biological activity of different ecological niches. In this course we will explore how research in these and related areas, including proteomics, have advanced our fundamental understanding of (1) organisms in the three domains of life, and their interactions and evolutionary relationships; (2) biological systems and environments, such as the human body, extreme environments, and the oceans; (3) strategies for solving global challenges in medicine, agriculture, energy resources, and environmental sciences. During the course, students will meet each week for one hour with a tutorial partner and the instructor. Every other week, students will present a written and oral critical analysis of the assigned research articles. On alternate weeks, students will question/critique the work of their colleague.

Class Format: tutorial
Requirements/Evaluation: five (4-5 page) papers, tutorial presentations, and the student's effectiveness as a critic
Prerequisites: BIOL 202
Enrollment Limit: 10
Enrollment Preferences: open to juniors and seniors; senior Biology majors who have not taken a 400-level course
Expected Class Size: 10
Grading: no pass/fail option, no fifth course option
Unit Notes: BIMO, BIGP; does not satisfy the distribution requirement for the Biology major
Distributions: (D3) (WS)
Writing Skills Notes: Weekly written assignments consisting of four-page critique papers (five total during a semester) and two-page response papers (five total during a semester). Students will receive from the instructor timely comments on their writing skills, with suggestions for improvement.
Attributes: BIGP Recommended Courses  BIMO Interdepartmental Electives

Spring 2020
TUT Section: T1  TR 9:55 am - 11:10 am  Claire S. Ting

CSCI 134  (F)(S)  Introduction to Computer Science  (QFR)
This course introduces students to the science of computation by exploring the representation and manipulation of data and algorithms. We organize and transform information in order to solve problems using algorithms written in a modern object-oriented language. Topics include organization of data using objects and classes, and the description of processes using conditional control, iteration, methods and classes. We also begin the study of abstraction, self-reference, reuse, and performance analysis. While the choice of programming language and application area will vary in different offerings, the skills students develop will transfer equally well to more advanced study in many areas. In particular, this course is designed to provide the programming skills needed for further study in computer science and is expected to satisfy introductory programming requirements in other departments.

Class Format: lecture/laboratory
Requirements/Evaluation: weekly assignments, programming projects, and examinations
Prerequisites: none, except for the standard prerequisites for a (QFR) course; previous programming experience is not required
Enrollment Limit: 90(18/lab)

Expected Class Size: 90

Grading: yes pass/fail option, yes fifth course option

Unit Notes: students with prior experience with object-oriented programming should discuss appropriate course placement with members of the department

Distributions: (D3) (QFR)

Attributes: BIGP Recommended Courses  COGS Interdepartmental Electives

Fall 2019
LEC Section: 03  MWF 11:00 am - 11:50 am  Jeannie R Albrecht
LAB Section: 08  T 1:00 pm - 4:00 pm  Jeannie R Albrecht
LAB Section: 05  M 7:00 pm - 10:00 pm  Thomas P. Murtagh
LEC Section: 02  Cancelled
LAB Section: 07  M 1:00 pm - 4:00 pm  Jeannie R Albrecht
LAB Section: 06  T 1:00 pm - 4:00 pm  Thomas P. Murtagh
LAB Section: 04  M 1:00 pm - 4:00 pm  Thomas P. Murtagh
LEC Section: 01  MWF 9:00 am - 9:50 am  Thomas P. Murtagh

Spring 2020
LEC Section: 03  MWF 11:00 am - 11:50 am  Iris Howley
LAB Section: 04  M 1:00 pm - 2:30 pm  Iris Howley
LAB Section: 06  M 1:00 pm - 2:30 pm  Andrea Danyluk
LAB Section: 05  M 2:30 pm - 4:00 pm  Iris Howley
LAB Section: 07  M 2:30 pm - 4:00 pm  Andrea Danyluk
LEC Section: 02  MWF 9:00 am - 9:50 am  Shikha Singh
LAB Section: 09  T 2:30 pm - 4:00 pm  Shikha Singh
LEC Section: 01  MWF 8:00 am - 8:50 am  Andrea Danyluk
LAB Section: 08  T 1:00 pm - 2:30 pm  Shikha Singh

CSCI 136  (F)(S)  Data Structures and Advanced Programming  (QFR)

This course builds on the programming skills acquired in Computer Science 134. It couples work on program design, analysis, and verification with an introduction to the study of data structures. Data structures capture common ways in which to store and manipulate data, and they are important in the construction of sophisticated computer programs. Students are introduced to some of the most important and frequently used data structures: lists, stacks, queues, trees, hash tables, graphs, and files. Students will be expected to write several programs, ranging from very short programs to more elaborate systems. Emphasis will be placed on the development of clear, modular programs that are easy to read, debug, verify, analyze, and modify.

Class Format: lecture/laboratory

Requirements/Evaluation: evaluation will be based on programming assignments, homework and/or examinations

Prerequisites: CSCI 134 or equivalent; fulfilling the Discrete Mathematics Proficiency requirement is recommended, but not required

Enrollment Limit: 60(15/lab)

Enrollment Preferences: If the course is over-enrolled, enrollment will be determined by lottery

Expected Class Size: 60

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3) (QFR)

Attributes: BIGP Recommended Courses
Fall 2019
LAB Section: 05  W 12:00 pm - 2:00 pm  Samuel McCauley
LEC Section: 02  MWF 10:00 am - 10:50 am  Samuel McCauley
LEC Section: 01  MWF 9:00 am - 9:50 am  William J. Lenhart
LAB Section: 06  W 2:00 pm - 4:00 pm  Samuel McCauley
LAB Section: 04  W 2:00 pm - 4:00 pm  William J. Lenhart
LAB Section: 03  W 12:00 pm - 2:00 pm  William J. Lenhart

Spring 2020
LEC Section: 02  MWF 10:00 am - 10:50 am  Bill K. Jannen
LEC Section: 01  MWF 9:00 am - 9:50 am  Daniel W. Barowy
LAB Section: 04  W 2:00 pm - 4:00 pm  Daniel W. Barowy
LAB Section: 03  W 12:00 pm - 2:00 pm  Daniel W. Barowy
LAB Section: 05  W 12:00 pm - 2:00 pm  Bill K. Jannen
LAB Section: 06  W 2:00 pm - 4:00 pm  Bill K. Jannen

CSCI 256  (F)(S)  Algorithm Design and Analysis  (QFR)
This course investigates methods for designing efficient and reliable algorithms. By carefully analyzing the structure of a problem within a mathematical framework, it is often possible to dramatically decrease the computational resources needed to find a solution. In addition, analysis provides a method for verifying the correctness of an algorithm and accurately estimating its running time and space requirements. We will study several algorithm design strategies that build on data structures and programming techniques introduced in Computer Science 136. These include induction, divide-and-conquer, dynamic programming, and greedy algorithms. Additional topics of study include algorithms on graphs and strategies for handling potentially intractable problems.

Class Format: lecture
Requirements/Evaluation: evaluation will be based on problem sets and programming assignments, and midterm and final examinations
Prerequisites: CSCI 136 and fulfillment of the Discrete Mathematics Proficiency requirement
Enrollment Limit: 24
Enrollment Preferences: current or expected Computer Science majors
Expected Class Size: 24
Grading: no pass/fail option, no fifth course option
Distributions: (D3) (QFR)
Attributes: BGP Recommended Courses

Fall 2019
LEC Section: 01  MWF 12:00 pm - 12:50 pm  Shikha Singh

Spring 2020
LEC Section: 01  MWF 11:00 am - 11:50 am  Shikha Singh
LEC Section: 02  MWF 12:00 pm - 12:50 pm  Aaron M. Williams

CSCI 315  (S)  Computational Biology  (QFR)
Cross-listings: PHYS 315  CSCI 315
Secondary Cross-listing
This course will provide an overview of Computational Biology, the application of computational, mathematical, statistical, and physical problem-solving techniques to interpret the rapidly expanding amount of biological data. Topics covered will include database searching, DNA sequence alignment, clustering, RNA structure prediction, protein structural alignment, methods of analyzing gene expression, networks, and genome assembly using techniques such as string matching, dynamic programming, hidden Markov models, and expectation-maximization.
Class Format: lab three hours per week plus weekly tutorial meeting

Requirements/Evaluation: evaluation will be based on weekly Python programming assignments, problem sets, a few quizzes and a final project

Prerequisites: programming experience (e.g., CSCI 136), mathematics (PHYS/MATH 210 or MATH 150), and physical science (PHYS 142 or 151, or CHEM 151 or 153 or 155), or permission of instructor

Enrollment Limit: 10

Enrollment Preferences: based on seniority

Expected Class Size: 8

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

PHYS 315 (D3) CSCI 315 (D3)

Attributes: BIGP Recommended Courses

Spring 2020

TUT Section: T1 TBA Daniel P. Aalberts
LAB Section: T2 MR 2:35 pm - 3:50 pm Daniel P. Aalberts
TUT Section: T1 TBA Daniel P. Aalberts
LAB Section: T2 MR 2:35 pm - 3:50 pm Daniel P. Aalberts

STAT 101 (F)(S) Elementary Statistics and Data Analysis (QFR)

It is impossible to be an informed citizen in the world today without an understanding of data and information. Whether opinion polls, unemployment rates, salary differences between men and women, the efficacy of vaccines or consumer webdata, we need to be able to separate the signal from the noise. We will learn the statistical methods used to analyze and interpret data from a wide variety of sources. The goal of the course is to help reach conclusions and make informed decisions based on data.

Class Format: lecture

Requirements/Evaluation: based primarily on performances on quizzes and exams

Prerequisites: MATH 102 (or demonstrated proficiency on a diagnostic test)

Enrollment Limit: 50

Expected Class Size: 40

Grading: no pass/fail option, no fifth course option

Unit Notes: students with calculus background and social science interest should consider STAT 161; students with MATH 150 should enroll in STAT 201; students with a 5 on AP Stats should enroll in STAT 202; students with a 4 on AP Stat should consult the department

Distributions: (D3) (QFR)

Attributes: BIGP Recommended Courses COGS Related Courses PHLH Statistics Courses

Fall 2019

LEC Section: 01 TF 2:35 pm - 3:50 pm Elizabeth M. Upton

Spring 2020

LEC Section: 01 TR 9:55 am - 11:10 am Elizabeth M. Upton
LEC Section: 02 TR 11:20 am - 12:35 pm Elizabeth M. Upton

STAT 201 (F)(S) Statistics and Data Analysis (QFR)

Statistics can be viewed as the art and science of turning data into information. Real world decision-making, whether in business or science is often based on data and the perceived information it contains. Sherlock Holmes, when prematurely asked the merits of a case by Dr. Watson, snapped back, "Data, data, data! I can't make bricks without clay." In this course, we will study the basic methods by which statisticians attempt to extract
information from data. These will include many of the standard tools of statistical inference such as hypothesis testing, confidence intervals, and linear regression as well as exploratory and graphical data analysis techniques. This is an accelerated introductory statistics course that involves computational programming and incorporates modern statistical techniques.

**Class Format:** lecture

**Requirements/Evaluation:** based primarily on performance on quizzes and exams

**Prerequisites:** MATH 150 or equivalent; not open to students who have completed STAT 101 or STAT 161 or equivalent

**Enrollment Limit:** 40

**Expected Class Size:** 40

**Grading:** yes pass/fail option, yes fifth course option

**Unit Notes:** students with a 5 on AP Stats should enroll in STAT 202; students with a 4 on AP Stats should consult the department; students with MATH 130/140 background should consider STAT 161; students with no calc. should consider STAT 101

**Distributions:** (D3) (QFR)

**Attributes:** BIGP Recommended Courses  COGS Related Courses  EVST Methods Courses  PHLH Statistics Courses

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**BIGP Related Courses**

**BIMO 321 (F)(S) Biochemistry I: Structure and Function of Biological Molecules (QFR)**

**Cross-listings:** CHEM 321  BIMO 321  BIOL 321

**Primary Cross-listing**

This course introduces the basic concepts of biochemistry with an emphasis on the structure and function of biological macromolecules. Specifically, the structure of proteins and nucleic acids are examined in detail in order to determine how their chemical properties and their biological behavior result from those structures. Other topics covered include catalysis, enzyme kinetics, mechanism and regulation; the molecular organization of biomembranes; and the flow of information from nucleic acids to proteins. In addition, the principles and applications of the methods used to characterize macromolecules in solution and the interactions between macromolecules are discussed. The laboratory provides a hands-on opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays.

**Class Format:** lecture, three hours per week; laboratory, four hours per week

**Requirements/Evaluation:** evaluation is based on quizzes, a midterm exam, a final exam, problem sets and performance in the laboratories including lab reports

**Prerequisites:** BIOL 101 and CHEM 251/255 and CHEM 155/256

**Enrollment Limit:** 16/lab

**Enrollment Preferences:** junior and senior Biology and Chemistry majors and BIMO concentrators

**Expected Class Size:** 16/lab

**Grading:** no pass/fail option, yes fifth course option

**Unit Notes:** does not satisfy the distribution requirement for the Biology major

**Distributions:** (D3) (QFR)

**This course is cross-listed and the prefixes carry the following divisional credit:**

CHEM 321 (D3) BIMO 321 (D3) BIOL 321 (D3)
**BIMO 322** (S) **Biochemistry II: Metabolism**  (QFR)

**Cross-listings:** BIOL 322 CHEM 322 BIMO 322

**Primary Cross-listing**

This lecture course provides an in-depth presentation of the complex metabolic reactions which are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

**Class Format:** lecture, three hours per week; laboratory, three hours per week

**Requirements/Evaluation:** several exams and performance in the laboratories including lab reports that emphasize conceptual and quantitative and/or graphic analysis of the

**Prerequisites:** BIOL 101 and CHEM 251/255 or permission of instructor

**Enrollment Limit:** 64

**Enrollment Preferences:** junior and senior Biology and Chemistry majors and BIMO concentrators

**Expected Class Size:** 64

**Grading:** no pass/fail option, no fifth course option

**Unit Notes:** does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

**Distributions:** (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 322 (D3) CHEM 322 (D3) BIMO 322 (D3)

**Attributes:** BIGP Related Courses  BIMO Required Courses
This course introduces the basic concepts of biochemistry with an emphasis on the structure and function of biological macromolecules. Specifically, the structure of proteins and nucleic acids are examined in detail in order to determine how their chemical properties and their biological behavior result from those structures. Other topics covered include catalysis, enzyme kinetics, mechanism and regulation; the molecular organization of biomembranes; and the flow of information from nucleic acids to proteins. In addition, the principles and applications of the methods used to characterize macromolecules in solution and the interactions between macromolecules are discussed. The laboratory provides a hands-on opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays.

**Class Format:** lecture, three hours per week; laboratory, four hours per week

**Requirements/Evaluation:** evaluation is based on quizzes, a midterm exam, a final exam, problem sets and performance in the laboratories including lab reports

**Prerequisites:** BIOL 101 and CHEM 251/255 and CHEM 155/256

**Enrollment Limit:** 16/lab

**Enrollment Preferences:** junior and senior Biology and Chemistry majors and BIMO concentrators

**Expected Class Size:** 16/lab

**Grading:** no pass/fail option, yes fifth course option

**Unit Notes:** does not satisfy the distribution requirement for the Biology major

**Distributions:** (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

CHEM 321 (D3) BIMO 321 (D3) BIOL 321 (D3)

**Attributes:** BIGP Related Courses  BIMO Required Courses

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**Fall 2019**

LEC Section: 01  MWF 10:00 am - 10:50 am  Bob Rawle

LAB Section: 02  M 1:00 pm - 5:00 pm  Bob Rawle

LAB Section: 03  R 1:00 pm - 5:00 pm

LAB Section: 04  W 1:00 pm - 5:00 pm

**Spring 2020**

LAB Section: 03  T 8:00 am - 12:00 pm

LAB Section: 02  M 1:00 pm - 5:00 pm  Katie M. Hart

LEC Section: 01  MWF 9:00 am - 9:50 am  Katie M. Hart

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**BIOL 322  (S) Biochemistry II: Metabolism** (QFR)

**Cross-listings:** BIOL 322  CHEM 322  BIMO 322

**Secondary Cross-listing**

This lecture course provides an in-depth presentation of the complex metabolic reactions which are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

**Class Format:** lecture, three hours per week; laboratory, three hours per week

**Requirements/Evaluation:** several exams and performance in the laboratories including lab reports that emphasize conceptual and quantitative and/or graphic analysis of the

**Prerequisites:** BIOL 101 and CHEM 251/255 or permission of instructor

**Enrollment Limit:** 64

**Enrollment Preferences:** junior and senior Biology and Chemistry majors and BIMO concentrators
**Expected Class Size:** 64

**Grading:** no pass/fail option, no fifth course option

**Unit Notes:** does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

**Distributions:** (D3) (QFR)

**This course is cross-listed and the prefixes carry the following divisional credit:**
BIOL 322 (D3) CHEM 322 (D3) BIMO 322 (D3)

**Attributes:** BIGP Related Courses  BIMO Required Courses

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**CHEM 321 (F)(S) Biochemistry I: Structure and Function of Biological Molecules (QFR)**

**Cross-listings:** CHEM 321  BIMO 321  BIOL 321

**Secondary Cross-listing**

This course introduces the basic concepts of biochemistry with an emphasis on the structure and function of biological macromolecules. Specifically, the structure of proteins and nucleic acids are examined in detail in order to determine how their chemical properties and their biological behavior result from those structures. Other topics covered include catalysis, enzyme kinetics, mechanism and regulation; the molecular organization of biomembranes; and the flow of information from nucleic acids to proteins. In addition, the principles and applications of the methods used to characterize macromolecules in solution and the interactions between macromolecules are discussed. The laboratory provides a hands-on opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays.

**Class Format:** lecture, three hours per week; laboratory, four hours per week

**Requirements/Evaluation:** evaluation is based on quizzes, a midterm exam, a final exam, problem sets and performance in the laboratories including lab reports

**Prerequisites:** BIOL 101 and CHEM 251/255 and CHEM 155/256

**Enrollment Limit:** 16/lab

**Enrollment Preferences:** junior and senior Biology and Chemistry majors and BIMO concentrators

**Expected Class Size:** 16/lab

**Grading:** no pass/fail option, yes fifth course option

**Unit Notes:** does not satisfy the distribution requirement for the Biology major

**Distributions:** (D3) (QFR)

**This course is cross-listed and the prefixes carry the following divisional credit:**
CHEM 321 (D3) BIMO 321 (D3) BIOL 321 (D3)

**Attributes:** BIGP Related Courses  BIMO Required Courses

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**Fall 2019**

LAB Section: 03  R 1:00 pm - 5:00 pm  Cynthia K. Holland
LAB Section: 02  T 1:00 pm - 4:00 pm  Janis E. Bravo
LEC Section: 01  MWF 11:00 am - 11:50 am  Steven J. Swoap

**Spring 2020**

LAB Section: 02  M 1:00 pm - 5:00 pm  Katie M. Hart
CHEM 322  (S)  Biochemistry II: Metabolism  (QFR)

Cross-listings:  BIOL 322  CHEM 322  BIMO 322

Secondary Cross-listing
This lecture course provides an in-depth presentation of the complex metabolic reactions which are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

Class Format: lecture, three hours per week; laboratory, three hours per week

Requirements/Evaluation:  several exams and performance in the laboratories including lab reports that emphasize conceptual and quantitative and/or graphic analysis of the

Prerequisites:  BIOL 101 and CHEM 251/255 or permission of instructor

Enrollment Limit:  64

Enrollment Preferences:  junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size:  64

Grading:  no pass/fail option,  no fifth course option

Unit Notes:  does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions:  (D3)  (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 322 (D3) CHEM 322 (D3) BIMO 322 (D3)

Attributes:  BIGP Related Courses  BIMO Required Courses

Spring 2020

LAB Section: 03  T 8:00 am - 12:00 pm  Katie M. Hart

CHEM 322  (S)  Biochemistry II: Metabolism  (QFR)

Cross-listings:  BIOL 322  CHEM 322  BIMO 322

Secondary Cross-listing
This lecture course provides an in-depth presentation of the complex metabolic reactions which are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

Class Format: lecture, three hours per week; laboratory, three hours per week

Requirements/Evaluation:  several exams and performance in the laboratories including lab reports that emphasize conceptual and quantitative and/or graphic analysis of the

Prerequisites:  BIOL 101 and CHEM 251/255 or permission of instructor

Enrollment Limit:  64

Enrollment Preferences:  junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size:  64

Grading:  no pass/fail option,  no fifth course option

Unit Notes:  does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions:  (D3)  (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 322 (D3) CHEM 322 (D3) BIMO 322 (D3)

Attributes:  BIGP Related Courses  BIMO Required Courses

PHYS 302  (S)  Stat Mechanics & Thermodynamics  (QFR)

Macroscopic objects are made up of huge numbers of fundamental particles interacting in simple ways--obeying the Schrödinger equation, Newton's and Coulomb's Laws--and these objects can be described by macroscopic properties like temperature, pressure, magnetization, heat capacity, conductivity, etc. In this course we will develop the tools of statistical physics, which will allow us to predict the cooperative phenomena that emerge in large ensembles of interacting particles. We will apply those tools to a wide variety of physical questions, including the behavior of gases, polymers, heat engines, biological and astrophysical systems, magnets, and electrons in solids.

Class Format: lecture/discussion, three hours per week; laboratory, three hours per week

Requirements/Evaluation:  evaluation will be based on weekly problem sets, exams, and labs, all of which have a substantial quantitative component

Prerequisites:  required: PHYS 201, PHYS/MATH 210 or MATH 209; recommended: PHYS 202, PHYS 301

Enrollment Limit:  24

Expected Class Size:  15

Grading:  yes pass/fail option,  yes fifth course option

Distributions:  (D3)  (QFR)

Attributes:  BIGP Related Courses
STAT 410  (F)  Statistical Genetics  (QFR)

Genetic studies explore patterns of genetic variation in populations and the effect of genes on diseases or traits. This course provides an introduction to statistical and computational methods for genetic studies. Topics will include Mendelian traits (such as single nucleotide polymorphisms), genome-wide association studies, pathway-based analysis, and methods for population genetics. Students will be introduced to some of the major computational tools for genetic analysis, including PLINK and R/Bioconductor. The necessary background in genetics and biology will be provided alongside the statistical and computational methods.

Class Format: lecture
Requirements/Evaluation: project work, homework, exams, and contribution to discussion
Prerequisites: STAT 346 and STAT 360, or permission of instructor
Enrollment Limit: 14
Enrollment Preferences: Statistics majors, juniors and seniors
Expected Class Size: 10
Grading: no pass/fail option, no fifth course option
Distributions: (D3) (QFR)
Quantative/Formal Reasoning Notes: This is a statistics class with a focus on mathematical, computational, and data analysis skills as well as appropriate practical application of analysis methods.
Attributes: BIGP Related Courses  PHLH Statistics Courses