

490 Independent Study
 Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to juniors or seniors. Approval of department.
 Special projects in Asian Languages arranged by an individual student and a faculty member in areas supplementing regular course offerings.

491 Special Topics in Asian Languages
 Fall, Spring. 1 to 6 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Open only to juniors or seniors. Approval of department.
 Special topics supplementing regular course offerings proposed by faculty on a group study basis.

ASTRONOMY AND ASTROPHYSICS AST

Department of Physics and Astronomy College of Natural Science

101 The Celestial Clockworks
 Spring. 1(1-0)
 Relationship between ancient skylore and timekeeping. Establishment of a calendar and celestial navigation. Development of the Greek horoscope as a time recorder and coordinate system.

207 The Science of Astronomy
 Fall. 3(3-0) P:M: (PHY 231 or concurrently or PHY 231B or concurrently or ISP 205 or concurrently or PHY 181B or concurrently or PHY 183 or concurrently or PHY 183B or concurrently or LBS 271 or concurrently or PHY 231C or concurrently) and (MTH 116 or concurrently or MTH 114 or concurrently or LBS 117 or concurrently) Not open to students with credit in AST 201.
 In-depth study of one topic in astronomy with emphasis on key discoveries. Topics may be cosmology, the solar system, and the life of stars. Observing with portable telescopes.

301 Junior Research Seminar
 Fall, Spring. 1(1-0) P:M: Completion of Tier I writing requirement.
 Preparation and presentation of a review paper on a current topic in astronomy or astrophysics.

303 Planetary System Astronomy
 Fall of even years. 3(3-0) P:M: (PHY 183 or PHY 193H or PHY 183B) and (MTH 132 or MTH 152H or LBS 118) SA: AST 201
 Origin and nature of the solar system. Planets of the solar system and other star systems. Asteroids, meteorites, and comets. Determination of time and celestial coordinates.

304 Stars
 Spring of odd years. 3(3-0) P:M: (PHY 184 or PHY 184B or PHY 294H) and (AST 303) and (MTH 234 or concurrently or MTH 254H or concurrently or LBS 220 or concurrently) SA: AST 401
 Physical processes that determine the structure and evolution of stars. Observations of stars and star clusters. Spectra of stars.

307 The Milky Way
 Fall of odd years. 3(3-0) P:M: (PHY 183 or PHY 193H or PHY 183B) and (MTH 132 or MTH 152H or LBS 118) SA: AST 202
 Structure and history of the Milky Way Galaxy. Stellar populations. Interstellar medium.

308 Galaxies and Cosmology
 Spring of even years. 3(3-0) P:M: (AST 307) and (PHY 184 or PHY 184B or PHY 294H) and (MTH 234 or concurrently or MTH 254H or concurrently or LBS 220 or concurrently) SA: AST 402
 Structure and content of galaxies beyond the Milky Way. Active galaxies and quasars. The expanding universe. Modern cosmological models.

310 Directed Studies
 Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 4 credits in all enrollments for this course. R: Approval of department.
 Individual study or project in astronomy or astrophysics under the direction of a faculty member.

312 Observational Astronomy
 Spring. 1(0-2) P:M: (AST 303 or AST 307)
 Basic observational techniques in astronomy. Stellar photometry and spectroscopy.

410 Senior Thesis
 Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 5 credits in all enrollments for this course. P:M: (AST 301) and completion of Tier I writing requirement.
 Design and execute an original experiment or computation. A written and oral report of the research is required.

AUDIOLOGY AND SPEECH SCIENCES ASC

Department of Audiology and Speech Sciences College of Communication Arts and Sciences

203 Introduction to Communication Sciences and Disorders
 Fall, Spring. 3(3-0) Not open to students with credit in ASC 403.
 Survey of research and practice regarding speech, hearing and language disorders in children and adults.

214 Anatomy and Physiology of the Speech and Hearing Mechanism
 Fall. 4(3-2) P:M: (ASC 203 or concurrently)
 Structural and functional analyses of the central and peripheral auditory mechanisms, and of the respiratory, phonatory, and articulatory mechanisms for speech.

232 Descriptive Phonetics
 Fall, Spring. 2(1-2)
 Principles of speech production. Transcription of speech using the International Phonetic Alphabet.

303 Hearing Science
 Fall. 3(2-2) P:M: (MTH 106 or MTH 152H or MTH 110 or MTH 201 or MTH 116 or STT 200 or MTH 124 or STT 201 or MTH 132) RB: Completion of one ISP course. SA: ASC 255
 Physical and psychological aspects of sound and their measurement. Emphasis on the understanding of human communication and its disorders.

313 Speech Science
 Spring. 3(2-2) P:M: (ASC 214 and ASC 232 or concurrently) RB: Completion of one ISP course SA: ASC 255
 Processes underlying the production and perception of speech. Understanding human communication and its disorders.

333 Oral Language Development
 Fall, Spring. 3(3-0) P:M: (PSY 101) and (LIN 401 or ENG 302 or LIN 200) R: Not open to freshmen.
 Development of receptive and expressive aspects of child language.

344 Evaluation Procedures in Audiology
 Spring. 4(3-2) P:M: (ASC 303) and completion of Tier I writing requirement.
 Classification of hearing disorders. Behavioral and electrophysiological measurement of hearing, including subjective and objective testing procedures.

364 Evaluation Procedures in Speech-Language Pathology
 Fall. 4(3-2) P:M: (ASC 313) and completion of Tier I writing requirement.
 Evaluation procedures in speech-language pathology. Test procedures. Analysis of results. Report writing.

394 Observation and Analysis of Clinical Practice
 Fall, Spring, Summer. 1(0-2) P:M: (ASC 344 and ASC 364)
 Case presentations. Interviewing techniques. Behavioral observation and data collection. Behavior management. Counseling. Session plan and report writing.

403 Communication Sciences and Disorders
 Fall. 3(3-0) R: Not open to freshmen or sophomores. Not open to students in the Department of Audiology and Speech Sciences. Not open to students with credit in ASC 203.
 Research and practice regarding communication disorders and the professions of speech-language pathology and audiology.

433 Language Dialect Differences in Applied Contexts
 Spring. 3(3-0) P:M: (ASC 364)
 Regional, ethnic, and cultural characteristics of American English. Comparison of speech-language differences and disorders.

443 Rehabilitative Audiology
 Fall. 3(3-0) P:M: (ASC 344)
 Fundamental aspects of auditory rehabilitation. Individual and group amplification systems, auditory training, speechreading, and counseling with children and adults.

463 Intervention Procedures in Speech-Language Pathology
 Spring. 3(3-0) P:M: (ASC 364)
 Intervention procedures for individuals with developmental and acquired communication disorders.

Audiology and Speech Sciences—ASC

473 Phonological Disorders in Children
Spring. 3(3-0) P:M: (ASC 364)
Phonological theory, speech perception and production, nature of normal and abnormal phonological development. Preparation of assessment and treatment plans. Application of treatment principles to different populations and cultural groups. Practice with narrow phonetic transcription of speech and phonological process-analysis.

483 School-Based Communication Disorders Programs
Spring. 3(3-0) P:M: (ASC 463 or concurrently)
Administrative and regulatory aspects of school-based programs for persons with communication disorders.

490 Independent Study
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Approval of department.
Individualized student activities in human communication sciences and disorders.

494 Clinical Practicum in Communication Disorders
Fall, Spring, Summer. 2(0-4) A student may earn a maximum of 4 credits in all enrollments for this course. P:M: (ASC394 and ASC463) RB: A minimum of 25 hours of approved clinical observation.
Supervised clinical experiences. Work with individuals having speech, language and/or hearing disorders.

BIOCHEMISTRY AND MOLECULAR BIOLOGY

BMB

Department of Biochemistry and Molecular Biology College of Natural Science

100 Current Issues in Biochemistry
Spring. 1(1-0) R: Open only to freshmen or sophomores. SA: BCH 100 Not open to students with credit in BMB 101.
Contemporary biochemistry: its impact on environmental, medical, and social sciences.

101 Frontiers in Biochemistry
Fall. 1(1-0) R: Open only to freshmen or sophomores. SA: BCH 101 Not open to students with credit in BMB 100.
Description of topics in biochemistry research.

200 Introduction to Biochemistry
Fall. 4(4-0) P:M: (CEM 143) SA: BCH 200 Not open to students with credit in BMB 401 or BMB 461.
Basic structures of major classes of biologically important molecules and metabolic activities of major importance in living organisms.

401 Basic Biochemistry
Fall, Spring. 4(4-0) P:M: (CEM 252 or CEM 352) R: Not open to students in the Biochemistry or in the Biochemistry/Biotechnology major. SA: BCH 401 Not open to students with credit in BMB 200 or BMB 461.
Structure and function of major biomolecules, metabolism, and regulation. Examples emphasize the mammalian organism.

461 Biochemistry I
Fall. 3(4-0) P:M: (CEM 252 or CEM 352) and (BS 110) and (MTH 124 or MTH 132 or MTH 152H or LBS 118) and (BS 111L or LBS 145 or LBS 158H or LBS 159H) SA: BCH 461 Not open to students with credit in BMB 200 or BMB 401.
Protein structure and function, enzymology, bioenergetics, and intermediary metabolism.

462 Biochemistry II
Spring. 3(4-0) P:M: (BMB 461) SA: BCH 462
Continuation of BMB 461 with emphasis on metabolic regulation and nucleic acid structure, replication and protein synthesis.

471 Biochemistry Laboratory (W)
Spring. 3(0-9) P:M: (BMB 401 or BMB 461) and (BS 110 and CEM 262 and CEM 356 and CSE 101) and (MTH 124 or MTH 132 or MTH 152H or LBS 118) and (BS 111L or LBS 145 or LBS 158H or LBS 159H) and completion of Tier I writing requirement. SA: BCH 471
Biochemical methods and principles used in the study of enzymes (proteins), carbohydrates, lipids, and cell organelles.

472 Biochemistry Laboratory
Fall. 3(0-9) P:M: (BMB 462 and CEM 262) R: Open only to Biochemistry or Biochemistry/Biotechnology majors or approval of department. SA: BCH 472
Methods of molecular biology and the underlying principles on which these methods are based.

490 Biochemistry Research
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Total credits in BMB 490 and BMB 499 may not exceed 8. Approval of department. SA: BCH 490
Participation in laboratory or library research projects.

495 Undergraduate Seminar
Spring. 2(2-0) P:M: (BMB 462 or concurrently) R: Open only to students in the Biochemistry or Biochemistry/Biotechnology majors. SA: BCH 495
Extension and synthesis of concepts of biochemistry. Relationships to societal issues.

499 Senior Thesis
Fall, Spring, Summer. 1 to 8 credits. A student may earn a maximum of 8 credits in all enrollments for this course. R: Open only to students in the Biochemistry or the Biochemistry/Biotechnology major. Total credits in BMB 490 and BMB 499 may not exceed 8. Approval of department. SA: BCH 499
Laboratory research culminating in a thesis.

BIOLOGICAL SCIENCE **BS**

College of Natural Science

110 Organisms and Populations
Fall, Spring. 4(3-3) Not open to students with credit in LBS 144 or LBS 148H.
Biological diversity and organismal biology. Principles of evolution, population biology, and community structure.

111 Cells and Molecules
Fall, Spring, Summer. 3(3-0) P:M: (CEM 141 or CEM 151 or LBS 171 or CEM 181H) Not open to students with credit in LBS 145 or LBS 149H.
Macromolecular synthesis; energy metabolism; molecular aspects of development; principles of genetics.

111L Cell and Molecular Biology Laboratory
Fall, Spring, Summer. 2(1-3) Interdepartmental with Microbiology and Molecular Genetics; Plant Biology; Zoology. P:M: (BS111 or concurrently) Not open to students with credit in LBS 159H.
Principles and applications of common techniques used in cell and molecular biology.

148H Honors Organismal Biology
Fall. 3(3-0) Interdepartmental with Lyman Briggs School. Administered by Lyman Briggs School. R: Honors College student or approval of school. Not open to students with credit in BS 110 or LBS 144.
Diversity and basic properties of organisms, with emphasis on genetic principles, ecological interactions, and the evolutionary process. Historical approach to knowledge discovery.

149H Honors Cell and Molecular Biology
Spring. 3(3-0) Interdepartmental with Lyman Briggs School. Administered by Lyman Briggs School. P:M: (CEM 141 or concurrently or CEM 151 or concurrently or CEM 181H or concurrently or LBS 171 or concurrently) R: Honors College student or approval of school. Not open to students with credit in BS 111 or LBS 145.
Exploration of the physicochemical and molecular organization of cells as the unifying framework for genetics, evolution, and the social relevance of biology.

158H Honors Organismal Biology Laboratory
Fall. 2(1-3) Interdepartmental with Lyman Briggs School. Administered by Lyman Briggs School. Not open to students with credit in BS 110 or LBS 144. C: LBS 148H concurrently.
Basic procedures used by organismal biologists, including experimental design and statistical methods. Development and implementation of research projects to test hypotheses in genetics, ecology, and evolution.

159H Honors Cell and Molecular Biology Laboratory
Spring. 2(1-3) Interdepartmental with Lyman Briggs School. Administered by Lyman Briggs School. Not open to students with credit in BS 111L or LBS 145. C: LBS 149H concurrently.
Basic techniques of cellular and molecular biology including experimental design and hypothesis formulation. Student-initiated projects to test hypothesis-driven projects in biochemistry, molecular biology or genetics.