

- 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.
- 800 Research Methods**  
Fall, Spring, Summer. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. RB: (AST 801)  
Apprenticeship in astrophysical research. Student will work closely with faculty member to learn research techniques.
- 801 Introduction to Astrophysics**  
Fall. 3(3-0)  
Survey of contemporary astrophysics. Stellar evolution, the structure of the Milky Way, the properties of external galaxies, and cosmology.
- 802 Techniques of Modern Astrophysics**  
Fall, Spring. 3 credits. RB: (AST 801)  
Students are introduced to modern astrophysics through participation in short projects involving literature surveys, professional planning, and research in observational, theoretical, and computational astrophysics.
- 805 Research Project**  
Fall, Spring. 3(0-3) A student may earn a maximum of 6 credits in all enrollments for this course.  
Research project to be completed under the guidance of an astronomy faculty member.
- 810 Radiation Astrophysics**  
Fall of odd years. 3(3-0)  
Transfer of radiation through plasmas and processes for emission and absorption of photons. Interpretation of the spectra of stars, the interstellar medium, and galaxies.
- 820 Advanced Topics in Astrophysics**  
Fall, Spring. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course. RB: (AST 801)  
Advanced work in a specialized astrophysical topic.
- 825 Galactic Astronomy**  
Spring of odd years. 3(3-0)  
The Milky Way as a galaxy. Observations and techniques of theoretical analysis that are used to discover the features of our galaxy.
- 835 Extragalactic Astronomy**  
Fall of even years. 3(3-0)  
Galaxies beyond the Milky Way. Large-scale structure of the universe. Cosmology.
- 840 Stellar Astrophysics**  
Spring of even years. 3(3-0)  
Physics of stellar interiors. Methods for calculating stellar models. Principles of stellar evolution.

- 850 Electrodynamics of Plasmas**  
Spring of odd years. 3(3-0) Interdepartmental with Electrical and Computer Engineering; Physics. Administered by Department of Electrical and Computer Engineering. RB: (ECE 835 or PHY 488) SA: EE 850  
Plasma kinetic and macroscopic plasma transport theory. Electromagnetic wave propagation and charged particle diffusion processes in plasma. Electromagnetic energy absorption via elastic and inelastic collisions. Dc, rf, and microwave discharges.
- 860 Gravitational Astrophysics**  
Fall. 3(3-0) A student may earn a maximum of 6 credits in all enrollments for this course. RB: (PHY 820 and PHY 841)  
Experimental foundations, theory, and applications of gravitational physics and general relativity. Tests of the equivalence principle, modern solar system tests of general relativity, Schwarzschild metric, Hawking effect, Einstein's field equations.
- 861 Cosmology**  
Spring. 3(3-0) R: Open only to graduate students in the Department of Physics and Astronomy. SA: AST 860A  
Current research in cosmology: observational basis for the Big Bang, the cosmic background radiation, primordial nucleosynthesis, content and distribution of matter, cosmic geometry, growth of perturbations.
- 899 Master's Thesis Research**  
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 36 credits in all enrollments for this course. R: Open only to graduate students in Astronomy and Astrophysics.  
MS Thesis Research
- 999 Doctoral Dissertation Research**  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 120 credits in all enrollments for this course. R: Open only to doctoral students in Astronomy and Astrophysics.  
Doctoral dissertation research.

## AUDIOLOGY AND SPEECH SCIENCES

### 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 or LIN 200 or LIN 401 or ENG 302) 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.
- 419 International Aspects of Communication Disorders**  
Spring, Summer. 1 to 6 credits. A student may earn a maximum of 9 credits in all enrollments for this course. P:M: (ASC 214 and ASC 303 and ASC 313 and ASC 333) R: Approval of department.  
Human communication disorders in international settings.

## Audiology and Speech Sciences—ASC

- 433 Language Dialect Differences in Applied Contexts**  
Spring. 3(3-0) P:M: (ASC 333 or LIN 200 or LIN 401 or ENG 302)  
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.
- 453 Mind-Body Communication**  
Fall, Spring. 3(3-0) R: Not open to freshmen or sophomores.  
Beliefs, thoughts, and emotions affecting the human body and behavior. Intrapersonal communication. Applications to health, education, business, and motor performance.
- 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.
- 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.
- 491 Topics in Communication Sciences and Disorders**  
Fall, Spring. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Approval of department.  
Varying topics related to normal or disordered communication.
- 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.
- 803 Research Methods in Communication Sciences and Disorders**  
Fall. 3(3-0) R: Open only to graduate students in Audiology and Speech Sciences.  
Hypothesis generation, experimental design, data collection, data analysis and presentation.
- 813 Neuroanatomy and Neurophysiology of Speech, Language, and Hearing**  
Fall. 3(3-0) R: Open only to graduate students in Audiology and Speech Sciences.  
Structural and functional descriptions of the nervous system as it relates to communication sciences and disorders.
- 823A Acquired Language Disorders**  
Spring. 3(3-0) P:M: (ASC 813) R: Open only to graduate students in Audiology and Speech Sciences.  
Neuropathology, symptomatology, and speech-language rehabilitation of individuals with aphasia and related disorders.
- 823B Motor Speech Disorders**  
Fall. 3(3-0) RB: (ASC 813 or concurrently) R: Open only to graduate students in Audiology and Speech Sciences.  
Neuropathology, symptomatology, and speech-language habilitation and rehabilitation of individuals with motor speech disorders.
- 823C Voice Disorders**  
Spring. 3(3-0) R: Open only to graduate students in Audiology and Speech Sciences.  
Etiology, symptomatology, diagnosis, and treatment of voice disorders in children and adults.
- 823D Fluency Disorders**  
Fall. 3(3-0) R: Open only to graduate students in Audiology and Speech Sciences.  
History, theories, symptomatology, diagnosis, and treatment of fluency disorders in children and adults.
- 823E Assessment of Childhood Language Disorders**  
Fall. 3(2-2) R: Open only to graduate students in the Department of Audiology and Speech Sciences.  
Evaluation of language disorders of preschool, school-aged, and adolescent populations.
- 823F Language Intervention: Early Stages**  
Spring. 3(3-0) RB: (ASC 823E) or approval of department. R: Open only to graduate students in Audiology and Speech Sciences.  
Principles of intervention in language disorders for children functioning at or below preschool levels, regardless of chronological age.
- 823G Language Intervention: Later Stages**  
Summer. 3(3-0) RB: (ASC 823E) or approval of department. R: Open only to graduate students in Audiology and Speech Sciences.  
Principles of intervention in language disorders for school-age children and adolescents functioning above preschool levels.
- 823I Cognitive-Communicative Disorders**  
Spring. 3(3-0) P:M: (ASC 813 and ASC 823A and ASC 823B)  
Neurophysiological, speech-language, cognitive, neuropsychological, and social/emotional rehabilitation associated with traumatic brain injury, dementia, and right hemisphere neurological disorders.
- 823J Medical Aspects of Speech-Language Pathology**  
Fall. 3(2-2) P:M: (ASC 813 and ASC 823C) C: ASC 823B concurrently.  
Introduction to assessment, intervention, and management of persons with laryngectomy, tracheostomy, ventilator-dependence, and cleft lip and palate. Intensive study of the clinical procedures and instrumentation employed by speech-language pathologists who practice in medical settings.
- 823K Assessment and Treatment of Dysphagia**  
Summer. 3(3-0) P:M: (ASC 813) RB: (ASC 823A and ASC 823C)  
Introduction to assessment, intervention, and management of persons with swallowing disorders.
- 823L Counseling in Communication Disorders**  
Summer. 3(3-0) P:M: (ASC 364 or ASC 344)  
Overview of counseling issues related to communication disorders.
- 823X Augmentative Communication**  
Spring. 3(3-0)  
History and philosophy of augmentative communication. Assessment, system selection, and intervention considerations for aided and unaided systems. Synthesized voice output and micro-processor-based systems.
- 833 Auditory Psychophysics**  
Spring. 3(3-0) RB: (ASC 803)  
Psychophysical theory and methods as applied to the study of hearing phenomena.
- 843A Diagnostic Audiology I**  
Fall. 3(3-0) RB: (ASC 344 and ASC 443) R: Open only to graduate students in Audiology and Speech Sciences.  
Behavioral audiologic assessment of the peripheral and central auditory system.
- 843B Diagnostic Audiology II**  
Spring. 3(3-0) P:M: (ASC 843A)  
Electrophysiologic audiologic assessment of the peripheral and central auditory system.
- 843C Hearing Amplification I**  
Fall. 3(3-0) P:M: (ASC843A or concurrently)  
Historical and contemporary overview of personal amplification for individuals with hearing impairment. Theoretical and clinical strategies for evaluating and fitting contemporary hearing aids.
- 843E Pediatric Audiology**  
Summer. 3(3-0) P:M: (ASC 843A and ASC 843B)  
Audiologic diagnostic procedures for the pediatric population. Includes the impact of disabilities other than hearing loss.
- 843F Advanced Rehabilitative Audiology**  
Fall. 3(2-2) P:M: (ASC 443) RB: (ASC 894A or ASC 894B) R: Open only to graduate students in Audiology and Speech Sciences.  
Impact of hearing impairment on communication processes. History of and current practices in intervention for children and adults who have hearing impairment.
- 843G Medical Aspects of Audiology**  
Fall. 3(3-0) R: Open only to graduate students in the Department of Audiology and Speech Sciences.  
Nature and bases of hearing impairment, and management principles from a medical perspective.

- 843I Hearing Amplification II**  
Spring. 3(3-0) P:M: (ASC 843C)  
Advanced theoretical and clinical strategies for evaluating and fitting contemporary hearing aids. Assistive-listening devices, classroom amplification, hearing-aid dispensing, and contemporary clinical and research issues in amplification.
- 843J Manual Communication for Clinical Settings**  
Summer. 3(3-0) P:M: (ASC 344)  
Introduction to the use of manually coded English sign systems and Pidgin Sign English in diagnostic and treatment sessions.
- 890 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: Open only to M.A. students in Audiology and Speech Sciences. Approval of department.  
Individualized study under faculty direction.
- 894A Clinical Practicum in Speech-Language Pathology**  
Fall, Spring, Summer. 1 credit. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to graduate students in Audiology and Speech Sciences. Approval of department.  
Supervised clinical experience in the management of clients with speech-language disorders.
- 894B Clinical Practicum in Audiology**  
Fall, Spring, Summer. 1 credit. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to graduate students in Audiology and Speech Sciences. Approval of department.  
Supervised clinical experience in the management of clients with hearing disorders.
- 899 Master's Thesis Research**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to graduate students in Audiology and Speech Sciences. Approval of department.  
Master's thesis research.
- 914A Speech Production**  
Spring of even years. 4(3-2)  
Issues in speech production. Reference to human communication and its disorders.
- 914B Speech Perception**  
Spring of odd years. 4(3-2)  
Issues in speech perception. Reference to human communication and its disorders.
- 990 Independent Study**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 16 credits in all enrollments for this course. R: Open only to Ph.D. students. Approval of department.  
Individualized study under faculty direction.
- 991 Special Topics in Communication Sciences and Disorders**  
Fall, Spring, Summer. 1 to 4 credits. A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in Audiology and Speech Sciences or approval of department.  
Selected topics in human communication and its disorders.

- 992 Seminar in Communication Sciences and Disorders**  
Fall, Spring, Summer. 3(3-0) A student may earn a maximum of 12 credits in all enrollments for this course. R: Open only to graduate students in Audiology and Speech Sciences.  
Topical themes in human communication and its disorders.
- 994 Research Practicum in Communication Sciences and Disorders**  
Fall, Spring, Summer. 1 credit. A student may earn a maximum of 12 credits in all enrollments for this course. RB: (ASC 803 or concurrently) R: Approval of department.  
Individual research under faculty supervision.
- 999 Doctoral Dissertation Research**  
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to Ph.D. students in Audiology and Speech Sciences. Approval of department.  
Doctoral dissertation research.

- 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.
- 514 Medical Biochemistry**  
Fall. 3 credits. R: Restricted to students enrolled in M.D. (CHM) or D.O. (COM) programs. SA: BCH 514 Not open to students with credit in BMB 521.  
Basic biochemical principles and terminology; metabolism and function of biomolecules of importance in medical biology and human pathophysiology.

## 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.