

tional consideration of cerebral palsy. Therapeutic procedures for the speech of the cerebral palsied.

**C. DELAYED LANGUAGE DEVELOPMENT**

Winter. 4(3-0)

Evaluative techniques including audiometry, psychometry, and case history as aids to the differential evaluation of delayed language development.

**D. MENTAL RETARDATION**

Winter. 4(3-0)

Language behavior and speech development of the mentally retarded as related to all facets of personal-social development and adjustment.

**E. STUTTERING**

Summer. 4(3-0)

Longitudinal studies of stuttering theories and the therapies accompanying them.

**F. CLEFT PALATE**

Fall. 4(2-0)

Etiology, symptomatology, structural and functional consideration of cleft palate. Therapeutic procedures for the speech habilitation of cleft palate individuals.

**833. Specialized Clinical Audiology**

**A. DIFFERENTIAL AUDIOMETRY**

Winter. 4(3-0)

Pure tone audiometric tests as an aid to the otologist in evaluating the pathology of hearing loss; including the development of norms. Consideration of nonorganic loss.

**B. SPEECH AUDIOMETRY AND EVALUATION OF HEARING AIDS**

Fall. 4(4-0)

Speech audiometry; principles and methods in the selection of hearing aids; physical characteristics of hearing aids.

**C. INDUSTRIAL AUDIOLOGY**

Summer. 4(2-2)

Evaluation of the role of the audiologist in industry emphasizing identification procedures, damage-risk criteria, measurement and control of noise, conservation procedures, and medico-legal problems.

**D. ADVANCED AUDIOLOGICAL EVALUATION**

Spring. 4(3-1)

Theory, administration and evaluation of selected tests including Bekeesy, EDR, EEG, and advanced speech-audiometric tests.

**E. PEDIATRIC AUDIOLOGY**

Spring. 4(2-2)

Evaluative procedures including play audiometry, language assessment, and case studies as aids to the differential diagnosis of auditory disorders in children; habilitative procedures for the acoustically handicapped child.

**854. Psychophysics and Theories of Audition**

(854B.) Spring. 4(3-0)

Nature of auditory stimuli and the results of psychophysical experimentation in audition.

**874. Speech and Hearing Problems in Public Schools**

Summer. 4(3-0) May re-enroll for a maximum of 16 credits.

Graduate seminar in speech and hearing involving problems that arise in relation to speech and hearing therapy in the public schools.

**880A. Algorithms for Speech and Hearing Sciences**

Fall. 4(4-0)

A discussion of useful algorithms applicable to quantification of phenomena related to audiology and speech sciences.

**880B. Acoustic Phonetics**

(875C.) Winter. 4(2-2) 880A or approval of department.

An analytic study of the acoustics of speech.

**880C. Instruments and Electronics for Audiology and Speech Sciences**

(875A.) Spring. 4(3-3) 880B or approval of department.

A discussion of the electronic principles and instruments necessary to measure parameters related to hearing and speech processes.

**880D. Experimental Phonetics**

(875B.) Summer. 4(2-0) 880C or approval of department.

Critical review of the literature in experimental phonetics with special reference to the historical development of the field and subsequent experimentation in physiological and acoustical phonetics.

**899. Research**

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**940. Seminar in Audiology and Speech Sciences**

Spring, Summer. 4(2-0) May re-enroll for maximum of 16 credits.

**990. Special Problems in Audiology and Speech Sciences**

Fall, Winter, Spring, Summer. 1 to 6 credits.

Special projects in audiology and speech sciences.

**999. Research**

Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**BIOCHEMISTRY BCH**

**College of Agriculture and Natural Resources**

**College of Human Medicine**

**College of Natural Science**

**College of Osteopathic Medicine**

**163. Biochemistry Laboratory**

Spring. 2(0-6) Honors section of CEM 162, and approval of department.

Experimental aspects of biochemistry for biochemistry majors with an honors chemistry background.

**200. Introduction to Biochemistry**

Winter, Summer. 5(5-0) Credit may not be earned in both 200 and 401. General chemistry; one term organic chemistry. Not acceptable for a B.S. degree in biochemistry.

Survey of biochemistry emphasizing the major metabolic activities of living organisms.

**363. Clinical Biochemistry**

Spring. 3(2-3) 200; CEM 162. Primarily for Medical Technology majors; not acceptable for a B.S. degree in biochemistry.

Quantitative clinical laboratory methods.

**400H. Honors Work**

Fall, Winter, Spring. Variable credit. Approval of department.

Assigned reading and experimentation.

**401. Basic Biochemistry**

Fall, Spring. 5(5-0) Credit may not be earned in both 200 and 401. One year organic chemistry or CEM 242; not open to biochemistry majors.

A one-term presentation of biochemistry emphasizing structure and function of major biomolecules, metabolism and regulation. Examples used for illustrative purposes will emphasize the mammalian organism.

**404. General Biochemistry Laboratory**

Fall, Winter, Spring. 3(1-6) Analytical chemistry; 401 or 451.

Experimental aspects of biochemistry.

**451. Biochemistry**

Fall, Winter. 4(4-0) Credit may not be earned in both 401 and 451. One year organic chemistry or CEM 242.

A comprehensive presentation of biochemistry designed for undergraduate biochemistry majors, students of medicine, and other students desiring an intensive treatment of the subject. In the winter term, students in the College of Human Medicine are given enrollment priority and the course emphasizes examples from the mammalian organism in contrast to the more cellular approach used in the fall term.

**452. Biochemistry**

Winter, Spring. 4(4-0) 451.

Continuation of 451. In the spring term, students in the College of Human Medicine are given enrollment priority and the course emphasizes examples from the mammalian organism in contrast to the more cellular approach used in the winter term.

**478. Senior Seminar**

Fall, Winter, Spring. 0 or 1(1-0). May re-enroll for a maximum of 2 credits. Undergraduate biochemistry major or approval of department.

Discussion, by undergraduate students and staff, of recent advances in biochemistry.

**499. Research**

Fall, Winter, Spring, Summer. 1 to 4 credits. May re-enroll for a maximum of 12 credits. Approval of department.

A course designed to give qualified undergraduate students an opportunity to gain experience in biochemical research.

**801. Biochemical Research Methods**

Fall. 1(0-3) One year of organic chemistry or CEM 242; 451 or 811, or concurrently.

Discussions and demonstrations of selected experimental techniques of wide application in biochemistry.

**804. Advanced Biochemistry Laboratory**

Fall. 3(1-6) Analytical chemistry; 801 and 811, or concurrently; biochemistry majors or approval of department.

Experiments to be selected from a representative group illustrating modern biochemical research.

**805. Advanced Biochemistry Laboratory**

Winter. 3(1-6) 804; 812 concurrently.

Experiments to be selected from a representative group illustrating modern biochemical research.

**806. Advanced Biochemistry Laboratory**

Spring. 3(1-6) 805; 813 concurrently.

Special experiments in advanced laboratory techniques.

**811. Advanced Biochemistry**

Fall. 4(4-0) One year of organic chemistry, one year of physical chemistry, one term of introductory biochemistry, 801 taken previously or concurrently, or approval of department. Limited to graduate students in biochemistry or other students needing a similar professional preparation.

The structure and function of biomolecules, energy transformations and chemical reactions in living cells, regulation of cell reactions, and the replication of living organisms.

**812. Advanced Biochemistry**

Winter. 4(4-0) 811

Continuation of 811.

- 813. Advanced Biochemistry**  
Spring. 4(4-0) 812.  
Continuation of 812.
- 855. Special Problems**  
Fall, Winter, Spring, Summer. Variable credit. May re-enroll for a maximum of 12 credits. Approval of department.  
Consideration of current problems.
- 899. Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.
- 952. Plant Physiology and Biochemistry I**  
Winter of odd-numbered years. 3(3-0)  
Approval of department. Interdepartmental with the Botany and Plant Pathology Department.  
Selected topics concerning photosynthesis and related processes.
- 955. Plant Physiology and Biochemistry II**  
Winter of even-numbered years. 3(3-0)  
Approval of department. Interdepartmental with the Botany and Plant Pathology Department.  
Metabolic pathways of unique significance to plants.
- 960. Selected Topics in Biochemistry**  
Fall, Winter, Spring, Summer. 1(1-0) or 2(2-0) May re-enroll for a maximum of 6 credits if a different topic is taken. Approval of department.  
Topics will be selected from the areas of biochemical genetics, biochemistry of development, biochemical evolution, complex proteins, lipid metabolism, immunochemistry, hormones, control mechanisms and structure of biological macromolecules.
- 961. Selected Topics in Biochemistry**  
Fall, Winter, Spring, Summer. 1(1-0) or 2(2-0) May re-enroll for a maximum of 6 credits if a different topic is taken. Approval of department.  
Topics will be selected from the areas of bioenergetics, bioinstrumentation, complex carbohydrates, mechanisms of enzyme action, natural products, carbohydrate metabolism, mass spectrometry and biochemistry of isoprenoid compounds.
- 978. Seminar in Biochemistry**  
Fall, Winter, Spring. 0 or 1(1-0)  
Presentation and discussion of reports by graduate students on biochemical topics of current interest.
- 999. Research**  
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

**BIOLOGICAL SCIENCE      B S**

**College of Natural Science**

- 202. Foundations of Biological Science**  
Fall, Winter, Spring. 4(3-3) N S 183 or 193.  
Fundamental principles of biology which provide background appropriate for preparation for elementary education teaching.
- 210. General Biology**  
Fall, Winter. 4(4-2)  
Concepts relating to basic attributes and diversity of living things.

- 211. General Biology**  
Winter, Spring. 4(4-2) CEM 130 or high school chemistry. Not open to students with credit in LBC 140.  
The structure and behavior of cells and their subunits, interactions of tissues, genetics, and the development, history and relations of organisms.
- 212. General Biology**  
Fall, Spring. 4(4-2) Not open to students with credit in LBC 141.  
Continuation of 211.
- 401. Biological Science for Teachers**  
Fall. 4(3-3) Bachelor's degree.  
Designed to show the nature of biological science in both its empirical and conceptual aspects. Emphasis is placed on life processes. The theories of the gene and of evolution are stressed. Macromorphology and micromorphology are covered as well as the topics of reproduction, metabolism, physiology, nutrition, enzymes, taxonomy and ecology. Quantitative developments are included whenever possible.
- 402. Biological Science for Teachers**  
Fall, Winter. 4(3-3) 401.  
Continuation of 401.
- 403. Biological Science for Teachers**  
Spring. 4(3-3) 402.  
Continuation of 402.
- 410. Biotic and Environmental Relationships**  
Summer. 6 credits. Approval of department. Given at W. K. Kellogg Biological Station.  
Interrelationship of the biota with its environment. Factors determining distribution and abundance. Interaction of organisms.
- 420. Seminar in Recent Advances in Biological Science**  
Fall, Winter, Spring, Summer. 3(3-0)  
May re-enroll for a maximum of 6 credits if different topic is taken. Approval of department.  
A series of lectures by senior faculty of topics on the history, development, the most recent advances and the possible future and limits of the Biological Sciences.
- 421. Seminar on Man, "The Human Organism"**  
Fall, Winter, Spring, Summer. 3(3-0)  
Approval of department.  
The importance of new discoveries in biology for our understanding of the human organism with emphasis from the fields of genetics, molecular biology, behavior, developmental biology, physiology, and ecology.
- 800. Problems in Biological Science**  
Fall, Winter, Spring. Variable credit.  
B.S. degree in biological science.
- 999. Research**  
Fall, Winter, Spring. Variable credit.  
M.S. degree in biological science or equivalent.  
Research in some phase of biological science, data to form the basis for the thesis required for the doctoral degree in biological science.

**BIOPHYSICS      BPY**

**College of Human Medicine  
College of Natural Science  
College of Osteopathic Medicine**

- 402. Introduction to Biophysics**  
Spring. 5(5-0) PHY 259, MTH 113,  
1 year organic chemistry and 1 year biology.

- Salient features of biophysics, methods and principles. Structure and organization of biological materials, bioenergetics, radiation biophysics, bioelectric phenomena, biomechanics and psychophysics.
- 499. Independent Study**  
Fall, Winter, Spring, Summer. 1 to 5 credits. May re-enroll for a maximum of 15 credits. Approval of department.  
Undergraduate research under one of our faculty.
- 804. Experimental Biophysics**  
Fall of odd-numbered years. 3 credits.  
Approval of department.  
Neuro-electric properties of cells, organs and animals, and methods of processing information in humans.
- 805. Experimental Biophysics**  
Winter of even-numbered years. 3 credits. Approval of department.  
Electrical and physical properties of significant biological molecules and structures.
- 806. Experimental Biophysics**  
Spring of even-numbered years. 3 credits. Approval of department.  
Interaction of protons and high energy particles with biological molecules and structures.
- 821. Molecular Biophysics**  
Fall of odd-numbered years. 5(3-4)  
Approval of department.  
Theoretical/experimental methods for determination of electronic structure, excited states and spectroscopy of biological systems. Biological energy transfer. Quantum processes in photosynthesis. Exciton effects in photoreceptors and pigments. Conformational changes.
- 822. Charge Transport and Solid State Processes**  
Winter of even-numbered years. 4(3-2)  
Approval of department.  
Fundamental electrical properties, dielectric properties and photoconductivity effects and their relevance to the biological functioning of these molecules.
- 823. Radiation Biophysics**  
Spring of even-numbered years. 3(2-2)  
Approval of department.  
Effects of various types of ionizing radiation and ultraviolet and visible light on proteins, nucleic acids, viruses and plant and animal cells. Damage and repair mechanisms at the molecular level.
- 824. Membrane Biophysics**  
Fall of even-numbered years. 4(3-2)  
Approval of department.  
Membrane Biophysics will cover interfacial phenomena in biology and chemistry; structure and function, theoretical and experimental models for biological membranes; membrane biochemistry. Labs will emphasize bimolecular lipid membrane (BLM) techniques.
- 825. Basic Neurobiology**  
Winter of odd-numbered years. 4(3-2)  
Approval of department.  
A comparative survey of fundamental principles of nervous organization will be undertaken in lectures. Laboratory will emphasize examination of prepared neuroanatomical material and a demonstration of important neurophysiological phenomena.
- 826. Biophysics of Perception and Learning**  
Spring. 4(3-2) Approval of department.  
Lectures will consider sensory systems, including transduction, coding and information processing. Muscle contraction, muscle control, learned and unlearned behavior will be considered. Laboratory will include neural recording and behavioral observations.