C. Voice Disorders
Winter. 4(4-0)
Etiology, symptomatology, diagnosis, and treatment of voice disorders including the specific communication problems of the laryngectomized.

D. Stuttering
Fall. 4(4-0)
History, symptomatology, development, evaluation, and theories of stuttering. Focus is to facilitate clinical involvement with stutterers.

E. Orofacial Anomalies
Spring. 4(4-0)
Etiology, symptomatology, diagnosis, and treatment of various orofacial anomalies including lip and/or palatal cleft, glossectomy, jaw resection, dental anomalies, and tongue thrust.

F. Delayed Language Assessment
Fall. 4(4-0)
Evaluative techniques including audiometry, psychometry, and case history as aids to the differential evaluation of delayed language development.

G. Language Intervention: Early Stages
Winter. 4(4-0) Approval of department.
Language intervention for those children functioning at or below a four-year-old level in their language behavior; mental retardation, autism, and other developmental delays associated with severe language impairments.

H. Language Intervention: Later Stages
Summer. 4(4-0) Approval of department.
Treatment of developmental language delays and disorders with emphasis upon children functioning at or above the four-year-old level in language behavior; preadolescent and adolescent language disorders are included.

842. Augmentative and Alternative Communication Systems
Summer. 4(4-0) Approval of department.
Historical perspective and philosophy of augmentative/alternative communication systems. Aided and unaided nonspeech communication systems. Assessment, selection, and intervention procedures.

843. Transfer and Maintenance of Speech Behaviors
Spring. 4(4-0)
Various clinical procedures; assisting others in transferring and maintaining these behaviors outside the clinical environment.

853. Speech Perception: Theory and Measurement
Summer. 4(4-0) Approval of department.
Evaluation and analysis of various theories of speech perception and their implications for speech and language pathologists, audiologists, and speech and hearing scientists.

854. Psychophysics and Theories of Audition
Fall. 4(4-0) Approval of instructor.
Nature of auditory stimuli and the results of psychophysical experimentation in audition.

875A. Clinical Practicum in Speech and Language Pathology
Fall, Winter, Spring, Summer. 1 credit. May reenroll for a maximum of 8 credits. ASC 474 and satisfactory completion of a speech, language, and hearing screening/evaluation at the MSU Speech and Hearing Clinic.
Directed diagnostic, therapeutic, and prognostic experience in speech and language pathology.

875B. Clinical Practicum in Audiology
Fall, Winter, Spring, Summer. 1 credit. May reenroll for a maximum of 8 credits. ASC 454 and satisfactory completion of a speech, language, and hearing screening/evaluation at the MSU Speech and Hearing Clinic.
Directed diagnostic, therapeutic and prognostic experience in audiology in various clinical settings.

876. Communication Disorders: Neuroanatomy-Neurophysiology
Fall. 4(3-2) Approval of department.
Neuroanatomical and neurophysiological correlates of speech, language, and hearing.

899. Master's Thesis Research
Fall, Winter, Spring, Summer. Variable credit. Approval of department.

940. Seminar in Audiology and Speech Sciences
Fall, Winter, Spring, Summer. 4(4-0) May reenroll for a 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. Doctoral Dissertation 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

100. Lectures in Biochemistry
Spring. 1(1-0) Biochemistry majors; others by approval of department.
An introduction to modern biochemistry using an historical approach.

200. Introduction to Biochemistry
Winter, Summer. 5(5-0) Credit may not be earned in both BCH 200 and BCH 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.

401. Basic Biochemistry
Fall, Spring. 5(5-0) Credit may not be earned in both BCH 200 and BCH 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. Biochemistry Laboratory
Winter. 3(0-9) CEM 162, one year organic chemistry with laboratory, MTH 113 or approval of department, BCH 401 or BCH 451.
Enzymes (proteins), lipids, and cell organelles.

405. Biochemistry Laboratory
Spring. 3(0-9) BCH 453 or concurrently; undergraduate biochemistry majors or approval of department.
Modern biochemical techniques to study nucleic acid structure and function.

451. Biochemistry I
Fall. 3(3-0) Credit may not be earned in both BCH 401 and BCH 451. One year organic chemistry or CEM 242.
A comprehensive survey of biochemistry, with emphasis on protein structure and function, enzymology, and bioenergetics.

452. Biochemistry II
Winter. 3(3-0) BCH 451.
Continuation of BCH 451, with emphasis on intermediary metabolism.

453. Biochemistry III
Spring. 3(3-0) BCH 452.
Continuation of BCH 452, with emphasis on the replication and expression of genetic information.

460. Principles of Biochemical Methods
Winter. 3(3-0) One year of physical chemistry or CEM 385 concurrently; BCH 453 or BCH 401.
Principles of biochemical methods with emphasis on electrophoresis, chromatography, immunological techniques, sedimentation, diffusion, viscosity, radiochemistry, and absorption and emission spectroscopy.

470. Biological Membranes
(IDC 470.) Spring. 3(3-0) BCH 401. Interdepartmental with the departments of Microbiology and Public Health, and Physiology. Administered by the Department of Physiology.
The chemistry, physics and mathematics of the permeability, energy transductions and surface functions of differentiated cell membranes and membranous organelles are compared. A brief discussion of theoretical and experimental models is included.

499. Research
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 12 credits. Undergraduates; approval of department.
Participation in research projects.

501. Medical Biochemistry
Fall. 3(3-0) Open only to students in the professional programs in the College of Human Medicine and the College of Osteopathic Medicine.
Basic biochemical principles and terminology of importance in medical biology.

502. Medical Biochemistry
Winter. 3(3-0) BCH 501 or approval of department.
A continuation of BCH 501.

511. Medical Biochemistry I
Winter. 4(4-0) One year of organic chemistry. Open only to students in the professional programs in the College of Human Medicine and the College of Osteopathic Medicine.
Basic biochemical principles and terminology with emphasis on metabolism and function of biomolecules of importance in medical biology.

512. Medical Biochemistry II
Spring. 4(4-0) BCH 511.
Basic biochemical principles and processes pertinent to specific areas of human pathophysiology.

811. Nucleic Acid Structure and Function

Fall. 4(4-0) One year of organic chemistry, one year of physical chemistry, and one year of basic biochemistry or BCH 453; or approval of department. A course in fundamental genetics is strongly recommended. Limited to graduate students in biochemistry or other students needing a similar professional preparation.

Organization and expression of procaryotic and eucaryotic genes, including gene structure, regulation of gene expression, replication, and recombination. Molecular cloning, DNA sequencing, and gene transfer techniques.

812. Protein Structure and Function

Winter. 4(4-0) One year of organic chemistry, one year of physical chemistry, and one year of basic biochemistry; or approval of department. Limited to graduate students in biochemistry or other students needing a similar professional preparation.

Protein structure and function relationships, macromolecule-ligand interactions, enzyme kinetics and principles of methods used in enzymology.

813. Metabolism and Its Regulation

Spring. 4(4-0) One year of organic chemistry, one year of physical chemistry, and one year of basic biochemistry; or approval of department. Limited to graduate students in biochemistry or other students needing a similar professional preparation.

Molecular basis of metabolic regulation, compartmentation and interrelationships of metabolic cycles involving carbohydrates, proteins and lipids.

821. Biochemical Mechanisms and Structure

Fall. 4(4-0) One year of organic chemistry; introductory biochemistry; and physical chemistry or concurrently.

Structures, methods of structural analysis, synthesis, and reaction mechanisms of biological substances including proteins, carbohydrates, lipids, porphyrins, phosphate esters, enzymes and coenzymes.

825. Cell Structure and Function

Spring. 4(4-0) BCH 451 or BCH 401 or approval of instructor. Interdepartmental with the departments of Microbiology and Public Health, and Physiology.

Molecular basis of structure and function of cells. Fundamental properties of cells: reproduction, dynamic organization, integration, programmed and interactive information transfer considered through original investigations in all five kingdoms.

831. Physiological Biochemistry I

Winter. 3(3-0) BCH 401.

Physiological biochemistry, with emphasis on metabolic interpretation of normal and altered physiological states of the human organism and appropriate animal models.

832. Physiological Biochemistry II

Spring. 3(3-0) BCH 831.

Continuation of BCH 831.

855. Special Problems

Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 12 credits. Approval of department.

Consideration of current problems.

856. Plant Genetics and Molecular Biology

Spring. 3(3-0) Approval of department and a course in introductory genetics. Interdepartmental with Genetics, and the Department of Botany and Plant Pathology. Administered by the Department of Botany and Plant Pathology.

Recent advances in genetics and molecular biology of higher plants.

864. Plant Biochemistry

Spring. 4(4-0) BCH 401, BOT 301 or approval of department. Interdepartmental with the Department of Botany and Plant Pathology.

Metabolism of nitrogen-compounds, carbohydrates, and lipids unique to plants' cell organelles; photosynthesis; photorespiration; dark respiration; cell walls; lectins; nitrogen cycle including nitrogen fixation; sulfur cycle.

888. Laboratory Rotation

Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 18 credits. Graduate student majors; approval of department.

Participation in research laboratories to learn experimental techniques and research approaches, broaden research experience, and assess research interests prior to selecting a thesis adviser.

899. Master's Thesis Research

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

960. Selected Topics in Biochemistry

Fall, Winter, Spring. 1 to 3 credits. May reenroll for a maximum of 10 credits if different topics are 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. 1 to 3 credits. May reenroll for a maximum of 10 credits if different topics are 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. 1(1-0). May reenroll for a maximum of 8 credits. Approval of department.

999. Doctoral Dissertation Research

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

BIOLOGICAL SCIENCE B S

College of Natural Science

The content of courses 400 and 405, as well as the research and problems courses 499, 800 and 899, may vary from term to term. Brochures giving detailed information about individual courses are available in the Office of the Assistant Dean for Lifelong Education in the College of Natural Science. These courses are primarily designed for in-service teachers and interested adults and are offered in off-campus locations.

202. Introductory Biology for Non-Science Majors

Fall, Winter, Spring, Summer. 4(3-3) 12 credits in general education natural science courses.

Concepts, procedures, and perspectives appropriate to developing a basic literacy in biology with emphasis on fundamental biological principles and their relation to world society. Appropriate preparation for pre-service elementary teachers.

210. General Biology

Fall, Spring. 4(4-2) Not open to students with credit in LBS 141.

Principles of biological organization: scientific method, biochemistry, cell biology, and evolution.

211. General Biology

Fall, Winter, Summer. 4(4-2) CEM 140 or high school chemistry. Not open to students with credit in LBS 242.

Principles of biological regulation and integration: genetics, development, and selected physiological topics.

212. General Biology

Winter, Spring, Summer. 4(4-2) Not open to students with credit in LBS 140.

Principles of biological diversity: taxonomy and systematics, comparative physiology, and ecology.

400. Biological Science for Teachers

Fall, Winter, Spring, Summer. 1 to 6 credits. May reenroll for a maximum of 12 credits. Teacher certification with science major or minor.

A course for in-service teachers, topics will be selected from actual classroom problems of the participants. Stress will be placed on field, laboratory and inquiry teaching.

405. Topics in Biological Science

Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 8 credits if different topic is taken. Approval of department.

Presentation of single topics from the biological sciences by senior faculty and guest lecturers. Topics are selected to facilitate development of strong biological science programs in schools.

418. Field Biology for Teachers

Fall, Winter, Spring, Summer. 4 credits. Biology course or approval of department.

Field investigation and interpretation of prairie, dune, forest and wetland communities. An ecosystem approach to ecological concepts. Natural history and identification of key species. Field trips required.

460. Ornithology for Teachers

Summer. 3 credits. A course in biology or approval of department. Not open to Zoology majors. Given at W. K. Kellogg Biological Station. Interdepartmental with and administered by the Department of Zoology.

Distribution, breeding cycles, migration, food and feeding habits, voice and other important areas of avian biology. Emphasis on field identification and natural history.

499. Research

Fall, Winter, Spring. 2 to 4 credits. May reenroll for a maximum of 12 credits. Approval of director of biological science program and student's adviser.

Undergraduates are invited on an individual basis into research laboratories of faculty in biological departments of the college. After three terms of research, a presentation in thesis form is produced and defended.