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

200. Introduction to Biochemistry
Winter, Summer. 3(3-0) 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.

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 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. General Biochemistry Laboratory
Winter, Spring. 2(2-0) Analytical chemistry; BCH 401 or BCH 451.
Experimental aspects of biochemistry.

405. Biochemistry Laboratory
Fall, Spring, 3(3-0) BCH 433 or concurrently BCH 414; undergraduate biochemistry majors or approval of department.
Advanced undergraduate laboratory to illustrate modern biochemical methods and techniques.

412. Clinical Biochemistry
(363.) Winter, Summer. 3(2-3) BCH 401; CEM 162. Medical Technology majors. Not acceptable for a B.S. degree in biochemistry. Others: approval of department.
Quantitative clinical laboratory methods.

451. Biochemistry
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 the properties and functions of biomolecules, energy-yielding and energy-requiring processes, and the transfer of genetic information.

452. Biochemistry
Winter. 3(3-0) BCH 451. Continuation of BCH 451.

453. Biochemistry
Spring. 3(3-0) BCH 452. Continuation of BCH 452.

IDC. Biological Membranes
For course description, see Interdisciplinary Courses.

499. Research
Fall, Winter, Spring, Summer. 1 to 4 credits. May reenroll for a maximum of 12 credits. Approval of department.
A course designed to give qualified undergraduates an opportunity to gain experience in biochemical research.

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

503. Cell Biology
Fall. 5(5-0) Admissions to the College of Human Medicine, Interdepartmental with the departments of Microbiology and Public Health, Physiology, and Pharmacology and Toxicology. Admitted by the Department of Microbiology and Public Health.
Principles of cell biology for medical students.

511. Medical Biochemistry I
Winter. 3(3-0) One year of organic chemistry or BCH 200; BCH 401, BOT 301 or approval of department.
One year of organic chemistry or CEM 242; not open to biochemistry majors.

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

801. Biochemical Research Methods
Fall. 3(3-1) or 2(2-1) May reenroll for a maximum of 2 credits. One year of organic chemistry or BCH 414; BCH 451 or BCH 511, or concurrently.
Discussions and demonstrations of selected experimental techniques of wide application in biochemistry.

811. Advanced Biochemistry
Fall. 4(4-0) One year of organic chemistry, one year of physical chemistry, one term of introductory biochemistry, BCH 451 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) BCH 811.
Continuation of BCH 811.

813. Advanced Biochemistry
Spring. 4(4-0) BCH 812.
Continuation of BCH 812.

821. Biochemical Mechanism and Structure I
Fall, 2(2-0) BCH 401, one year of organic chemistry and physical chemistry concurrently; or approval of department.
Continuation of BCH 811.
Structures, methods of structural analysis, synthesis, and reactions mechanisms of biological substances including proteins, carbohydrates, lipids, porphyrins, phosphate esters, enzymes and coenzymes.

822. Biochemical Mechanism and Structure II
Winter, 2(2-0) BCH 821 or approval of department.
Continuation of BCH 821.

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. Variable credit. May reenroll for a maximum of 12 credits. Approval of department.
Consideration of current problems.

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; photosynthesis; 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 15 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, Summer. 1 to 3 credits. May reenroll for a maximum of 6 credits. Approval of department.
Topics will be selected from the areas of biochemical genetics, biochemistry of development, biochemical evolution, complex proteins, lipid metabolism, immunology, hormones, control mechanisms and structure of biological macromolecules.
961. Selected Topics in Biochemistry
Fall, Winter, Spring, Summer. 1 to 3 credits. May be reenrolled for a maximum of 6 credits. Approval of department. Topics will be selected from 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(-9). Presentation and discussion of reports by graduate students on biochemical topics of current interest.

999. Doctoral Dissertation Research
Fall, Winter, Spring. Summer. Variable credit. Approval of department.

BIOLICAL SCIENCE B S

College of Natural Science

The content of courses 400, 405, 420, 440, 450 and 451, as well as the research and problem courses 499, 800 and 999, may vary from term to term. Brochures giving detailed information about individual courses are available in the Science and Mathematics Teaching Center and the Office of the Assistant Dean for Lifelong Education. These courses are primarily designed for inservice teachers and interested adults and are offered in off-campus locations.

202. Introductory Biology for Non-Science Majors
Fall, Winter, Spring. 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.

400. Biological Science for Teachers
Fall, Winter, Spring, Summer. 3 to 4 credits. May be reenrolled 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. Streets will be placed on field, laboratory and inquiry teaching.

405. Topics in Biological Science
Fall, Winter, Spring. Summer. 1 to 3 credits. May be reenrolled for a maximum of 6 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.

408. Freshwater Ecology
Summer. 6 credits. B S 212 or approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with the departments of Zoology, and Botany and Plant Pathology. The ecology of freshwater ecosystems, their biotic structure, and the functional interrelationships of environmental variables regulating population dynamics, productivity and community structure. Extensive field investigations.

410. Terrestrial Ecology
Summer. 6 credits. B S 212 or approval of department. Given at W. K. Kellogg Biological Station. Interdepartmental with the departments of Botany and Plant Pathology, and Zoology. Extensive field investigations of several types of terrestrial communities. Interrelationships of plants, animals, and environment. Factors determining distribution and abundance.

420. Seminar in Recent Advances in Biological Science
Fall, Winter, Spring. Summer. 1 to 3 credits. May be reenrolled 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. Terrestrial Field Biology for Teachers
Summer. 3 credits. A course in biology or approval of department. Given at W. K. Kellogg Biological Station. Ecology of forest, field and prairie ecosystems. Emphasis on natural history and field identification of Michigan's common land plants and animals. Biological collection techniques and reference materials.

425. Aquatic Field Biology for Teachers
Summer of even-numbered years. 3 credits. A course in biology or approval of department. Given at W. K. Kellogg Biological Station. Investigation of Michigan's aquatic and wetland ecosystems with special emphasis on field identification of key plant and animal species, Ecological concepts, reference materials, and biological collection techniques.

440. Man and Environment Workshop for Teachers
Summer. 3 credits. Approval of department. Given at W. K. Kellogg Biological Station. Discussions and practical work sessions concerning the development of ideas and activities for environmental studies in and outside the classroom. Designed for intermediate and secondary inservice teachers.

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 be reenrolled 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.

500. Problems in Biological Science
Fall, Winter, Spring. Variable credit. B.S. degree in biological Science.

505. Outdoor Environmental Studies
(Fall.) Summer. 1 to 4 credits. May be reenrolled for a maximum of 9 credits if different topics are taken. B S 422 or B S 425 or ZOL 490 or approval of department. Given at W. K. Kellogg Biological Station. Emphasis on environmental understanding. Development of educational materials through team research and testing. Interaction with elementary and middle school children in two-week outdoor oriented workshops.

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

BIOMECHANICS BIM

College of Osteopathic Medicine

560. Acupuncture and Other Peripheral Stimulation Therapy
Winter. 1 to 3 credits. Approval of department. Clinical application of traditional Chinese acupuncture and related peripheral stimulation therapies.

561. Clinical Craniosacral Manipulative Therapy
Spring. 1 to 3 credits. Approval of department. Basic concepts of the craniosacral system, clinical applications.