

MCDB

DEPARTMENT OF MOLECULAR, CELLULAR AND DEVELOPMENTAL BIOLOGY

Guide for Undergraduate Majors

2006 - 2007

Teaching and research in the Department of Molecular, Cellular, and Developmental Biology are directed at understanding the molecular and cellular mechanisms that are the basis of biological structure, growth, evolution, embryonic development, and genetic inheritance. As undergraduate majors, students learn about the scientific methods, experimental approaches, and groundbreaking discoveries that have made modern molecular and cellular biology such an important force in medicine, agriculture, and the biotechnology industry. They also learn about the diverse tools of modern biology, recombinant DNA, genomic mapping, transgenic organisms, gene targeting, analysis of mutants, biochemical purification, antibody probes, laser manipulation of living cells, electron microscopy, and computer modeling. In addition to general and specialized classes, students have ample opportunities to participate in ongoing research in the laboratories of the department.

An online, hypertext version and PDF of this document is available at <http://mcdb.colorado.edu>

ADVISING FOR MCDB MAJORS

All undergraduate advising for the MCDB major, including Core Curriculum and other Arts and Sciences requirements, is done in the Department. Each new MCDB major is assigned to one of the MCDB advisors. Students who enter MCDB from another major will normally be assigned to the advisor who processes their change of major.

MCDB advisors

Ms. Susan Brehm, MCDB A1B42, (303) 735-0256, Susan.Brehm@colorado.edu

Ms. Vicki Hildreth, MCDB A1B44, (303) 735-5626, vicki.hildreth@colorado.edu

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REQUIREMENTS FOR THE MCDB UNDERGRADUATE MAJOR

OVERVIEW

The MCDB undergraduate major leads to a Bachelor of Arts (B.A.) degree from the College of Arts and Sciences (A&S). Students majoring in MCDB must satisfy MCDB major and ancillary requirements as well as A&S requirements. These requirements are summarized in a one-page **checklist** on page 20.

- See detailed descriptions in University catalog.
- Sample degree plans are on pages 17.

MAJOR COURSE REQUIREMENTS - GENERAL

- A minimum of 30 semester hours in MCDB, including 19 hours of specified courses and a minimum of 11 hours of upper-division electives.
- All courses counted in the 30 hours of MCDB coursework must have C- or better grades.
- A grade point average (GPA) of 2.0 is required for all MCDB courses attempted (including repeats and courses not counted as part of the 30 hours). (Somewhat less stringent grade requirements apply to the MCDB ancillary requirements, as explained on page 6.)
- Transfer students must take a minimum of 12 hours of upper-division courses with MCDB course numbers at CU Boulder, including at least one MCDB upper-division elective (see page 5).

MCDB REQUIRED COURSES

Note: Some courses are available only once a year. Be sure to plan accordingly.

MCDB 1150, Introduction to Cell and Molecular Biology, 3 hours (Fall only)

AND

MCDB 1151, Introduction to Cell and Molecular Biology Laboratory, 1 hour (Fall only)

OR

MCDB 1111, Biofundamentals 4 hrs (Spring only)

- EBIO 1210/1230, CHEN 3838 or equivalent transfer credit, International Baccalaureate or Advanced Placement may be used to satisfy the requirement for MCDB 1150/1151.
- However, we strongly urge each student to discuss the available options with an MCDB advisor. MCDB 1150 covers molecular and cellular topics in greater depth than most alternative courses and thus provides a stronger foundation for advanced MCDB courses. A&S recognizes MCDB 1150/1151 as sufficiently different from EBIO 1210/1230 so that no credit is lost by also taking MCDB 1150/1151.

MCDB 2150, Principles of Genetics, 3 hours (Spring and Fall)

AND

MCDB 2151, Principles of Genetics Laboratory, 1 hour (Spring and Fall)

- MCDB 2150 (or genetics transfer credit) is a strict prerequisite for MCDB 3500.
- MCDB 1150 or equivalent is a prerequisite.

MCDB 3120, Cell Biology, 3 hours (Fall and Spring)

AND

MCDB 3140, Cell Biology Laboratory, 2 hours (Fall and Spring)

- MCDB 2150 is a prerequisite and CHEM 1131 a pre/co-requisite.

MCDB 3500, Molecular Biology, 3 hours (Fall & Spring)

MCDB 2150 and CHEM 1131 are prerequisites. CHEM 3311 a pre/co-requisite.

Most advanced MCDB courses require both MCDB 3120 and MCDB 3500 as prerequisites. It is therefore desirable to complete all required MCDB courses through MCDB 3500 as early as possible to maintain maximum flexibility in the junior and senior years.

MCDB 4300, Immunology, 3 hours (Fall)

OR

MCDB 4650, Developmental Biology, 3 hours (Spring)

MCDB 3120 and MCDB 3500 are prerequisites

Students taking MCDB 4650 are encouraged to take MCDB 4660, Developmental Biology Laboratory as one of their MCDB Electives.

MCDB ELECTIVE COURSES

MCDB majors must also complete a minimum of 11 hours of MCDB upper-division electives.

- **Elective Courses:** At least two of the MCDB upper division elective courses (6 hours) must be lecture courses and/or critical thinking courses. One of these must be an MCDB course.
- Students who have used transfer courses with lesser credit in place of required MCDB courses must take additional electives to bring total MCDB credits to 30 hours.
- There is no upper limit on MCDB electives, but A&S will not count more than 45 MCDB hours toward the 120 needed for graduation. Up to six additional MCDB hours are allowed for MCDB Honors research and thesis.
- **Independent study:** Six hours of MCDB upper-division independent study (MCDB 4840), honors research (MCDB 4980) or honors thesis (MCDB 4990) may be counted as two of the elective courses.
- Additional independent study, up to a total of 8 hours in any one department, (16 hours in all departments) can be counted toward the 120 hours for graduation.
- MCDB majors are encouraged to do independent study research, which together with a grade point average of 3.3 or better can lead to graduation with Honors. (See page 7 - 8 for details.)
- **Electives from other departments:** Six credit hours from two of the courses listed on page 16 may be used as MCDB electives.
- Approved independent study in another department may be counted as an MCDB elective if the project is closely related to MCD Biology. A member of the MCDB Faculty must sponsor the project.
- Students may petition the Undergraduate Committee *in advance* to have one course (three credit hours) not on the list, from another department count as an MCDB elective.

MCDB ANCILLARY COURSE REQUIREMENTS

In addition to the 30 hours of major courses, MCDB requires the following ancillary courses in Chemistry, Calculus, and Physics.

All courses in a sequence must be completed with a grade of C- or better before taking a subsequent course. This grade requirement also applies to General Chemistry II.

CHEM 1111 and 1131, General Chemistry I and II, 10 hours (Fall, Spring, Summer)

- Students with no high school chemistry or a weak background in chemistry should take CHEM 1021, Introductory Chemistry, before attempting General Chemistry.
- Students who would like an additional challenge are encouraged to take Honors General Chemistry, CHEM 1151 and 1171.
- Students transferring from Engineering may substitute CHEN 1211 and CHEM 1221 for CHEM 1111, but must still take CHEM 1131.

CHEM 3311, Organic Chemistry I, 4 hours (Fall, Spring, Summer)

AND

CHEM 3321, Organic Chemistry Lab I, 2 hours (Fall, Spring, Summer)

- Prerequisite for CHEM 3311: General Chemistry II.
- CHEM 3351 and 3361, Organic Chemistry I and Lab for Majors are recommended for BCHM double majors, and may be taken by any MCDB major as alternatives to CHEM 3311 and 3331. CHEM 3361 involves two labs per week.

CHEM 4611, Survey of Biochemistry, 3 hours (Fall and Summer) Prerequisite: C- or better in CHEM 3311.

OR

CHEM 4711, General Biochemistry I, 3 hours (Fall & Spring) Prerequisite: C- or better in CHEM 3331.

- A minimum grade of C- in CHEM 4611 or CHEM 4711 is required for the MCDB Major.

MATH 1300, Calculus and Analytical Geometry I, 5 hours (Fall, Spring, Summer)

- MATH 1310, Calculus with Biological Applications or APPM 1350, Engineering Calculus I are acceptable alternatives. However, BCHM double majors should not take MATH 1310 (or 1320).
- All of the calculus courses require advanced algebra and trigonometry as prerequisites. Students with weak backgrounds should first take MATH 1150. **Do not take MATH 1071 & 1081, which are courses for business and social science students.**
- The MCDB major requires one semester of calculus. However, students planning to take calculus-based physics will need Calculus II (Math 2300) for PHYS 1120 & 1140.
- BCHM double majors and others planning to take Physical Chemistry (recommended for graduate school) must take Calculus III (MATH 2400).

General Physics I and II with Lab, 9-10 hours (Fall, Spring, Summer)

- MCDB majors may select algebra-based General Physics, PHYS 2010/2020 (10 hours) or calculus-based General Physics, PHYS 1110/1120/1140 (9 hours). PHYS 1120 & 1140 require Calculus II.
- BCHM double majors and other students planning to take Physical Chemistry must take calculus-based physics.

ARTS AND SCIENCES REQUIREMENTS

MCDB majors must also satisfy all of these requirements of the College of Arts and Sciences.

MINIMUM ACADEMIC PREPARATION STANDARDS (MAPS)

Students who graduated from U.S. high schools in Spring 1988 or later must satisfy MAPS requirements with high school or college courses.

- Students are notified of MAPS deficiencies when they first enroll. MAPS appeals are handled by A&S, but the MCDB advisors can help to determine whether an appeal is likely to succeed.

FOREIGN LANGUAGE

The Foreign Language requirement (3 years in high school or 3 semesters in college, all in the same language) applies to all students, including those waived from MAPS.

- Students for whom English is a second language are not required to take language courses, but must verify their proficiency by presenting school records in a foreign language or by other means.

CORE CURRICULUM

The A&S Core Curriculum requirements include coursework or demonstration of knowledge and skills in the following areas:

- Foreign Language (discussed above)
- Quantitative Reasoning and Mathematical Skills
- Written Communication (lower & upper division)
- Critical Thinking
- Historical Context
- Culture and Gender Diversity
- United States Context
- Literature and the Arts (6 Credit Hours)
- Natural Sciences
- Contemporary Societies
- Ideals and Values.

Courses that satisfy Core Curriculum requirements are listed in the Course Listing on the Registrar's Website or in the University Catalog.

All courses taken for MAPS and CORE must be taken for a letter grade not pass/fail

RELATIONSHIP OF THE CORE CURRICULUM TO THE MCDB MAJOR

- MCDB majors are exempt from the Core Curriculum Natural Science requirement.
- Calculus, which is required for the MCDB major, satisfies the QRMS requirement.
- Critical Thinking requirement is usually satisfied with an MCDB elective course, although any approved Critical Thinking course may be used.

A&S MINIMUM GRADE REQUIREMENTS

- Any course with a grade of D- or better is credited by A&S as hours toward graduation, and can be used in the Core Curriculum.
- Grades of C- or better are required in all major courses.
- A grade point average (GPA) of at least 2.000 is required in all CU coursework and in the major.
- Both grades count in the GPA when a course is repeated unless course repetition is applicable and elected. Course repetition information is available at: <http://registrar.colorado.edu/>
- MCDB ancillary requirements are excluded from A&S rules for major courses (see page 6).
- Any student whose cumulative GPA falls below 2.0 is placed on academic probation. Failure to raise the cumulative GPA to 2.0 by the end of the next semester results in academic dismissal.

CREDIT HOUR REQUIREMENTS

- Graduation from A&S requires a total of 120 semester hours, of which no more than 30 hours can be non-A&S courses (Business, Engineering, Music, etc.). The rest must be from A&S or comparable transfer credit.
- No more than 45 of the 120 hours can be from any one department (51 hours for Departmental Honors students).
- Courses that are repeated are not counted again (except for GPA calculations).

UPPER-DIVISION CREDITS

A&S requires 45 hours of upper-division credit (courses numbered 3000 or higher) for graduation. There are only 36 hours of required upper-division courses in the MCDB major plus the Core (33 if one of the 6 hour HUMN courses is used for both parts of Literature and Arts). ***Thus, all MCDB majors must take additional upper-division courses to reach a total of 45 credits.***

TEACHER CERTIFICATION

The MCDB Department is currently working with the College of Education to develop a program that will enable MCDB majors to fulfill the major as well as obtain their Teacher Certification. Students interested in education should contact the College of Education.

STUDY ABROAD

If you are planning a study abroad, we recommend that you take CORE or non-science courses. Consult with your departmental advisor in advance to plan this experience.

TRANSFER STUDENTS

Transfer students should meet with an MCDB advisor as soon as possible after arrival to review the CU equivalencies that have been given to their transferred credits, to determine which credits may be used for the MCDB major, and to develop an efficient plan for completion of the remaining requirements for graduation. Transfer students need to give special attention to the following items:

- Arts and sciences students must complete a minimum of 45 credit hours in University of Colorado courses on the Boulder campus. Of these 45 credits, a minimum of 30 credits must be in arts and sciences upper-division credit hours completed as a matriculated student in the College of Arts and Sciences at the University of Colorado at Boulder and at least 12 of these upper-division hours must be in the major. A maximum of 6 credit hours taken at other University of Colorado campuses (CU-Denver and CU-Colorado Springs) can be counted toward the minimum 45 credits required on the Boulder campus. Courses taken while on CU-Boulder study abroad programs, through CU-Boulder continuing education, or CU-Boulder correspondence courses are considered to be in residence.
- If courses are transferred with lesser credit than equivalent MCDB courses, additional MCDB electives must be taken to satisfy the A&S required minimum of 30 hours in the major.
- Graduation requires 45 hours of upper-division credit. It is important to verify that upper-division transfer credit has been granted for upper-division courses from previous schools. Courses taken as lower-division at other schools will not be given upper-division credit even if the equivalent course is upper-division here.

MINIMUM GRADE REQUIREMENTS FOR MCDB MAJORS

Grade requirements in the major are set by A&S.

- All courses counted toward the required 30 hours in MCDB must have grades of C- or better.
- In addition, the GPA in all MCDB courses plus any non-MCDB course used as an MCDB elective must be at least 2.000. This includes all repeated courses and all MCDB courses not counted in the 30 hours.

For the ancillary courses required in Chemistry, Calculus, and Physics, these MCDB rules apply:

- MCDB majors must earn a grade of C- or better in required courses in CHEM, MATH, and PHYS, except that one grade of D-, D or D+ will be accepted in MATH or PHYS.
- ***This special rule is only for MCDB ancillary requirements. Grades below C- cannot be counted toward any major or minor.***
- The Undergraduate Committee may approve "special cases" not covered in these rules, where an exception may be justified. A student must present a written petition fully explaining special circumstances that justify deviations from the normal rules.

FOUR-YEAR GRADUATION

A&S guarantees four-year graduation for students with no MAPS deficiencies who meet criteria of adequate progress set by the College and the major department. The plan is only available to students admitted as new freshmen. The MCDB statement of requirements and adequate progress is as follows.

The MCDB major must be started in the first semester. Adequate progress is defined as cumulative completion of at least one fourth of the required coursework for the major during each academic year, including the following specific requirements: a) either general chemistry or the introductory MCDB sequence must be completed during the first year; b) general chemistry and the introductory MCDB sequence must both be completed by the end of the second year; c) organic chemistry and the second level sequence in MCDB (cell biology and molecular biology) must be completed by the end of the third year.

- The MCDB major requires at least 63 hours of required coursework. Thus, at least 17 hours must be completed yearly, including timely completion of advanced course prerequisites.

- The four-year guarantee also requires completion of 30 hours of core curriculum courses by the end of the sophomore year. Calculus counts as *three* hours of QRMS.

The MCDB/BCHM double major can also be completed in 4 years (plan B, page 17) but the four-year guarantee only applies to one major.

RESEARCH OPPORTUNITIES FOR UNDERGRADUATES

Research plays a major role in the overall program of MCDB. Many of the faculty are recognized leaders in their specialties, and the Department is rated among the best research departments in its field. Many opportunities are available for undergraduate research experience and the Department actively encourages students to participate in its research activities.

Students can receive course credit for Independent Study research, and a successful project combined with good grades can lead to graduation with Honors. There are also work-study and part-time paid positions in many laboratories.

The University also has Bioscience Undergraduate Research Skills and Training Program (BURST) and Undergraduate Research Opportunities Program (UROP) to encourage development of joint student-faculty research projects and to help with their costs. Details are available online at:

<http://www.colorado.edu/Outreach/BSI/>

Advantages of undergraduate research include the following:

- ***Laboratory experience.*** A research project is an excellent way to learn modern experimental techniques in depth and also learn first-hand how scientific discoveries are made. Such experience is valuable both to students seeking laboratory employment after graduation and to those preparing for advanced study.
- ***Close contact with professional researchers.*** This is the best way to learn science and also makes it easier for students to obtain meaningful letters of recommendation from individuals who know their abilities well.
- ***Publication.*** Significant undergraduate research can sometimes lead to co-authorship of publications in scientific journals.
- ***Admission to graduate school.*** Strong undergraduate research experience is one of the most important qualifications for admission to the leading graduate programs in areas related to MCDB.

Independent Study Credit

The College of Arts and Sciences will accept up to 16 hours of independent study credit toward the 120 hours required for graduation, but **the limit from any one department is 8 hours.**

Students who are candidates for Departmental Honors can take Honors Research (MCDB 4980) and Honors Thesis (MCDB 4990), which allow a total of six additional hours of research credit beyond the normal limits of 8 hours of independent study and 45 total hours in any one department.

MCDB 4840, Upper Division Independent Study, requires MCDB 2150 as a prerequisite.

How To Get Involved In MCDB Research

Students must first identify and contact a faculty member who is willing to serve as a sponsor. A brief summary of faculty research interests is provided on page 9 of this guide. More detailed information is available at:

<http://mcdm.colorado.edu/faculty/>

After the student and faculty sponsor have agreed on a project, they must complete and sign an independent study contract. The Independent Study Contract is available from the MCDB Student Affairs Office (MCDB A1B48). The signed contract should be submitted for approval before the end of the first week of classes. Registration must be completed by the end of the drop/add period for the semester in which the research will be done.

WHEN TO APPLY

Most research projects begin in the sophomore or junior years and continue until graduation. Individual faculty members differ in the amount of classroom experience they expect before accepting a student for independent study. However, it is always helpful to complete as many of the required MCDB and CHEM courses as early as possible in order to be better qualified to undertake independent study and to have more time available for the research during the junior and senior years.

GRADUATION WITH DISTINCTION OR HONORS

Outstanding accomplishment by undergraduates at UCB is recognized in two ways: graduation with distinction and graduation with honors.

Graduation with distinction is based solely on academic performance and is automatically conferred on all students graduating with a grade point average (GPA) of 3.75 or better, both at UCB and in all collegiate work completed.

Graduation with Honors requires a GPA of at least 3.3 plus active participation in an Honors program. Two types of Honors programs are available, General Honors and Departmental Honors.

The General Honors Program is operated solely by the Honors Department and emphasizes a broad liberal arts education rather than specialization. Candidates for General Honors must participate in at least four Honors Department courses and must take a series of written and oral examinations as specified by the Honors Department. Students who wish to participate must contact the Honors Department in Norlin Library M400 to apply to graduate with Honors. This application must be turned in early in the semester preceding the intended graduation date. Deadlines are posted on the honors website

www.colorado.edu/honors/graduation.html

The Departmental Honors Program is organized around a student research project undertaken in MCDB or a related department. It is not necessary to take Honors Department courses to qualify. Candidates for Departmental Honors must satisfy GPA requirements, complete a research project, prepare an Honors thesis describing the research project in a scholarly fashion and pass an oral examination.

To be considered for Departmental Honors, **candidates must have an overall GPA of 3.3 or better.** A GPA of 3.5 in required major courses is required for *magna cum laude* and 3.8 for *summa cum laude*.

Departmental Honors in MCDB will ordinarily be based on laboratory research. In special cases, a library or computer research project may be considered. However, candidates for Honors should recognize that *magna* or *summa cum laude* will rarely be recommended if the thesis is not based on laboratory research.

For laboratory-based Honors, a minimum of two semesters of undergraduate research directly related to the Honors project must be completed prior to the start of the graduation semester. This can be independent study credit (MCDB 4840) or equivalent research experience, including projects supported by undergraduate fellowships (UROP, URAP, etc.). The quality of the preliminary research must be equivalent to a B or better grade. For research not done for academic credit, the faculty mentor must certify the quality.

The **deadline to apply to become a candidate for Departmental Honors** is the 5th week of the semester *prior* to the semester in which the thesis will be presented. This is a strict deadline established by the Honors Department. The student must prepare a brief outline of the proposed thesis research (one or two typewritten pages). The outline, together with written approval from the faculty sponsor must be submitted to the MCDB Honors Representative by the deadline date.

Honors candidates may register for MCDB 4990, Honors Thesis, and will receive credit in the semester when the thesis is successfully defended. (Students who will graduate in August should plan to complete their Honors thesis during the Spring Semester). In MCDB, the Honors thesis is normally written following the format of a journal article describing the results of the research project. The thesis must be approved by the faculty sponsor and submitted to the MCDB Honors Representative no later than the tenth week of the semester in which the oral examination occurs, normally within two weeks after the thesis is submitted.

In MCDB, the **Honors oral examination consists of an informal public seminar on the Honors research followed by questions** from the audience and the examining committee, which normally consists of the faculty sponsor, the MCDB Honors Representative, and one member of the Honors Council from outside the department. A completed statement of major status must be on file in the Departmental office prior to the oral examination.

The examining committee will make a recommendation to the University Honors Council as to whether Honors should be granted and whether they should be *cum laude*, *magna cum laude*, or *summa cum laude*. Factors considered in the recommendation include the quality of the research, the quality of the thesis, the student's performance during the oral examination, and the student's overall academic record. The University Honors Council makes final decisions on Honors.

Current Honors information can be obtained at

<http://www.colorado.edu/honors>

DEPARTMENTAL FACULTY RESEARCH INTERESTS

- Tom Blumenthal**Professor and Chair
How organization of genes on *C. elegans* chromosomes relates to RNA processing, splicing and 3' end formation.
- Robert E. Boswell** Professor
Molecular and developmental genetics of *Drosophila*, cytoplasmic localization, germ cell determination
- Thomas R. Cech** Distinguished Professor
X-ray crystallography of RNA; biological catalysis by RNA; DNA-protein interactions at chromosome telomeres
- Shelley D. Copley** Professor
Evolution of enzymes and metabolic pathways; biodegradation of xenobiotic pollutants; bioinformatics
- Corrella Detweiler** Assistant Professor
How bacteria evade and manipulate mammalian immune systems. Molecular mechanisms of typhoid fever.
- Mark W. Dubin**.....Professor
Cognitive neuroscience; Virtual Reality as a rehab tool
- Joaquin Espinosa**Assistant Professor
Mechanisms of transcriptional regulation by the tumor suppressor p53
- Nancy A. Guild**..... Professor Attendant Rank
Biology Education
- Min Han**Professor
Genetic and molecular analysis of *C. elegans* development
- Andreas Hoenger**Associate Professor
Structural and functional investigations into cytoskeletal assemblies by cryo electron microscopy and 3D image analysis.
- Kevin R. Jones**..... Associate Professor
Molecular genetics of mouse neural development
- Michael W. Klymkowsky**Professor
Cell adhesion, cytoskeletal organization, and gene expression. Teaching and technology
- Jennifer Knight**Senior Instructor
Biology Education
- Kenneth Krauter**Professor
Human genetics; comparative DNA sequence analysis; behavioral genetics; complex trait mapping
- Leslie A. Leinwand**Professor
Genetic manipulation of cardiac and skeletal muscle development and function in mice; gene therapy
- Jens Lykke-Anderson** Assistant Professor
mRNA decay in mammalian cells; gene expression
- Jennifer M. Martin**..... Assistant Professor
B-cell immortalization by Epstein-Barr virus; signal transduction; tumor virology; malignant transformation
- David Mastronarde** Professor Attendant Rank
3-D reconstruction and analysis of cellular structures
- Greg Odorizzi** Assistant Professor
Genetics and cell biology; membrane trafficking and phosphoinositide signaling in eukaryotic cells
- Bradley B. Olwin**..... Professor
Molecular and developmental biology of the heart and skeletal muscle; skeletal muscle stem cells and gene therapy
- Norman R. Pace**..... Professor
Ribozyme biochemistry; molecular ecology of extreme ecosystems
- Thomas T. Perkins**Adjoint Assistant Professor
Single-molecule biophysics; molecular motors; protein-DNA interactions
- Robert O. Poyton**..... Professor
Oxygen sensing and control of gene expression; yeast mitochondrial biogenesis
- Ravinder Singh**..... Associate Professor
RNA-protein interactions in gene regulation; pre-mRNA splicing and sex determination
- Gretchen H. Stein** Lecturer, Sr. Research Associate
Control of cell proliferation in human cells; cellular aging
- Michael Stowell** Assistant Professor
Structure and Mechanism at the chemical synapse
- William M. Strauss** Assistant Research Professor
Molecular mechanism of mammalian dosage compensation in embryogenesis
- Tin Tin Su**..... Associate Professor
Coordination of mitosis and DNA replication in *Drosophila*
- Jonathan Van Blerkom**Research Professor
Regulation of oogenesis and early mammalian embryogenesis
- Mark Winey** Professor
Genetics and molecular biology of the yeast *S. cerevisiae*; centrosome assembly
- William B. Wood**Distinguished Professor
Genetic control and molecular biology of embryonic development in the nematode *Caenorhabditis elegans*, biology education
- Ding Xue** Associate Professor
Mechanisms of regulation and execution of programmed cell death in the nematode *C. elegans* and mammals.
- Michael J. Yarus** Professor
Nucleic acid-protein interactions, RNA catalysis; mechanisms and origins of translation

MCDB MAJOR IN CONJUNCTION WITH OTHER MAJORS

DOUBLE MAJOR WITH BIOCHEMISTRY

The Department of Chemistry & Biochemistry offers two majors: Chemistry (CHEM) and Biochemistry (BCHM). The number of courses in chemistry, mathematics and physics that are required for the MCDB major make it relatively easy to add a few more courses and also satisfy the requirements for the BCHM major. The combined requirements for the MCDB/BCHM double major are listed below. Each department establishes its own graduation requirements. Double majors should therefore check regularly with BCHM advisors to evaluate their progress in that major. Transfer students must take at least 12 hours of upper-division courses at CU in each major to graduate with a double major.

Chemistry Courses

CHEM 1111+1131--General Chemistry with Lab.....	10
*CHEM 3311+3321 & 3331+3341--Organic Chemistry + Lab.....	10
**CHEM 4411+4431--Physical Chemistry (Biological Emphasis).....	6
CHEM 4711+4731--General Biochemistry.....	6
CHEM 4761--Biochemistry Laboratory.....	4
Total Chemistry/Biochemistry Courses	36

*BCHM recommends CHEM 3351, 3361 and 3371, 3381.

**Alternative Physical Chemistry courses can also be used. However, we encourage double majors to select CHEM 4411 and CHEM 4431.

MCDB courses

MCDB 1150+1151-Intro to Cell & Molec. Biol + Lab or MCDB 1111- Biofundamentals.....	4
MCDB 2150+2151--Intro to Genetics + Lab.....	4
MCDB 3120+3140--Cell Biology + Lab	5
MCDB 3500--Molecular Biology	3
MCDB 4300 or MCDB 4650	3
*Electives in MCDB	11
Total MCDB Courses.....	30

CHEM 4731 and 4761 can be counted as an MCDB elective without petitioning.

Other Courses

MATH 1300+2300+2400 or APPM 1350+1360+2350*, Calculus I, II, III..... 12-14
BCHM does not accept MATH 1310

PHYS 1110+1120+1140 Calculus-Based Physics + Lab

Total Other Courses 21-23

Total courses in all categories (including 6 hours of chemistry as MCDB electives)..... 84-86

OTHER DOUBLE MAJORS

Graduation is possible with a double major in MCDB and any other major offered in the College of Arts and Sciences. To do so, the student must satisfy all requirements for both majors.

DISTRIBUTED STUDIES MAJOR

A Distributed Studies major can involve either two or three departments. There are separate rules for each situation. There are specific requirements for minimum grades and upper-division credits in ALL of the departments involved in a Distributed Studies degree, and each department may have specific course requirements.

TWO DEPARTMENTS

In a two department distribution, both departments are ranked equally. The student must complete 30 hours or more of C- or better credit including 15 hours of upper-division credits in EACH of the departments, and must have a 2.0 GPA in EACH of the departments. In addition, specific course requirements established by EACH of the departments must be satisfied. The MCDB departmental requirements are as follows:

	Hours
MCDB 1150/1151 or MCDB 1111	4
MCDB 2150/2151	4
MCDB 3120/3140	5
MCDB 3500	3
Additional Upper-division MCDB Courses.....	14

Additional upper-division MCDB courses for majors or electives approved for MCDB major (CHEM 4711 may be used without special approval *if not used for credit in a second department*)

Note that CHEM 1111 and 1131 are prerequisites for upper-division MCDB classes and CHEM 3311 is a corequisite for MCDB 3500.

Transfer students must take at least 12 hours of upper-division MCDB courses at CU.

THREE DEPARTMENTS

In a three department distribution, there is one primary department plus two secondary departments. In the primary department, the student must complete 30 hours of C- or better credit including 15 hours of upper-division credit. In EACH of the two secondary departments, the student must complete 15 hours of C- or better including 8 hours of upper-division work. A GPA of 2.0 or better is required in each of the three departments.

If MCDB is the primary department, the same departmental requirements as for the two department distribution must be satisfied.

If MCDB is a secondary department, the required 15 hours must be in MCDB courses or electives that carry credit toward the MCDB major. CHEM 4711 will be accepted without special approval if not used for credit in a second department.

GENERAL COMMENTS

There are no Departmental requirements for mathematics or physics in any of the MCDB Distributed Studies programs. Each program must be approved by ALL of the departments that are involved and by the College of Arts and Sciences. You should therefore discuss your plans with advisors from all the departments and the College as early as possible to be certain that you will satisfy all requirements.

The Distributed Studies program is administered from the A&S Academic Advising Center. If you are interested in a Distributed Studies major, you should contact an advisor in that office for application materials. Additional information on the program is contained in the University catalog.

NEUROSCIENCE CERTIFICATE

MCDB students interested in Neurobiology have the opportunity to obtain a Neuroscience Undergraduate Certificate. Information for this program is available at:

<http://www.colorado.edu/neuroscienceprogram/ugcert/>

MCDB COURSES

PREREQUISITES

Prerequisites for MCDB courses are described in terms of CU course numbers. Equivalent transfer credits are generally acceptable. **Potentially qualified students who lack the formal prerequisites for an MCDB course must obtain consent from the instructor before enrolling.** Please note that a computerized system for checking prerequisites is under development and may become part of the registration process in the near future. All students are encouraged to take prerequisites very seriously.

SEMESTER OFFERED

In most cases, the semester in which the course is usually offered is shown. However, class schedules differ from year to year and some classes are not offered every year. The most reliable source of information is PLUS Planning Tools for each semester.

4000/5000 COURSES

Courses that carry 4000/5000 numbers can be taken either at the 4000 level for undergraduate credit or at the 5000 level for graduate credit. Students who register at the 5000 level will be required to complete extra work, such as a term paper, to receive graduate credit. **Courses used to satisfy the Arts and Sciences Critical Thinking requirement must be taken at the 4000 level.**

USE OF VERTEBRATE ANIMALS IN LABORATORY COURSES

Biology is the science of life; therefore a major in MCDB must include some "hands-on" experience with living organisms to be complete. Exercises involving the use of living animals or animal tissues are included in required MCDB laboratory courses. Majors with moral objections may arrange to limit their participation in these exercises, although doing so will compromise their educational experiences. Non-majors may take MCDB lecture courses without the accompanying laboratories. Laboratory courses in which living vertebrate animals or tissues are used are identified in the list of courses that follows, and also in the University Catalog and Schedule of Courses. For additional information, please contact the Department.

COURSES FOR MCDB MAJORS

MCDB 1111-4 Biofundamentals: The Evolutionary, Molecular, and Cellular Basis of Life. (Spring)

A web-based, in-class discussion and online laboratory course covering the fundamental properties of biologic systems. Focused on common evolutionary, ecological, molecular and cellular mechanism, the course provides a thorough introduction to the biological sciences. Students may not receive credit for both MCDB 1111 and MCDB 1150 or 1151. Approved for arts and sciences core curriculum: natural science. SIMILAR TO MCDB 1150, 1151.

MCDB 1150-3. Introduction to Cell and Molecular Biology. (Fall)

Covers biologically important macromolecules and biological processes, together with an introduction to cell structure, function, and physiology. Provides the foundation for advanced MCDB courses to majors, and a rigorous overview of modern biology to non-majors. MCDB 1151 must be taken concurrently by majors in MCDB and Biochemistry and pre-health science students. Students may not receive credit for both MCDB 1150 and 1111. Prerequisite: high school chemistry and algebra. Approved for A&S Core: Natural Sciences.

MCDB 1151-1. Introduction to Cell and Molecular Biology Laboratory. (Fall)

One 2-hour lab per week designed to acquaint students with current research techniques and concepts in molecular and cellular biology. Topics include cell structure, function, physiology, and recombinant DNA. MCDB 1150 must be taken concurrently. Students may not receive credit for both MCDB 1151 and 1111. Approved for A&S Core: Natural Sciences

MCDB 2150-3. Principles of Genetics. (Fall and Spring)

Introduces the behavior of genes and chromosomes in eukaryotic and prokaryotic organisms. Covers three areas: transmission genetics, molecular genetics and population genetics. Attention given to genetic mapping, recombinant DNA procedures and gene expression. MCDB 2151 must be taken concurrently by majors in MCDB or Biochemistry, and by pre-health science students. Prerequisite: MCDB 1150, EBIO 1210 or CHEN 3838. Approved for A&S Core: Natural Sciences.

MCDB 2151-1. Principles of Genetics Laboratory. (Fall and Spring)

One 2-hour lab per week. Provides "hands on" experience with principles introduced in MCDB 2150. Topics include mitosis, meiosis, classical genetics, complementation, mutagenesis, DNA replication, natural selection and evolution. Prerequisites: MCDB 1150 & 1151, EBIO 1210 & 1230 or CHEN 3838. Corequisite: MCDB 2150. Approved for the A&S Core: Natural Sciences.

MCDB 2840-(1-3). Lower Division Independent Study. Instructor consent and Independent Study Contract required (see MCDB 4840 for details). May be repeated for credit, but only 8 hours of MCDB 2840 plus MCDB 4840 can be counted toward graduation. Students with adequate prerequisites should take MCDB 4840. Corequisite: MCDB 1150.

MCDB 3120-3. Cell Biology. (Fall and Spring)

Introduction to modern cell biology. Includes molecular basis of cellular organization and function, cellular membrane systems, intracellular organelles, the cytoskeleton, extracellular matrix, and the functional organization of genetic material. Recommended for students planning careers in health sciences. MCDB 3140 must be taken concurrently by MCDB and Distributed Studies Majors. Prereq: MCDB 2150 or EBIO 2070. Corequisite: CHEM 1131.

MCDB 3140-2. Cell Biology Laboratory. (Fall and Spring)

One 3.5-hour lab/week. Provides hands-on experience with modern cell biology laboratory techniques. Topics include microscopy, vital staining and cytochemistry, immunocytochemistry. Course does not use vertebrate animals. Coreq: MCDB 3120.

MCDB 3150-3. Biology of the Cancer Cell. (Spring and occasionally Summer)

Highlights dimensions of the cancer problem; cancer as a genetic/cellular disease; chemicals, viruses, and radiation as causes of cancer; cancer and diet; cancer epidemiology; proto-oncogenes, oncogenes, and cancer suppressor genes; prevention of cancer. Prerequisite: MCDB 2150 or EBIO 2070 or instructor consent. Approved for A&S Core: Natural Sciences, non-sequence.

MCDB 3280-3. Molecular Cell Physiology.

Cellular mechanisms analyzed from a molecular perspective. Examines unicellular organisms and tissues of animals to learn how cells process signals from both in and outside themselves, and use this information to react and accomplish physiological tasks. Prerequisites: MCDB 3120 and CHEM 1131.

MCDB 3330-3. Evolution and Creationism.

Intensive lecture/discussion course on the interrelationships among science, religion, and social policy. Includes historical and scientific development of evolution theory, social Darwinism/sociobiology, and the public perception of science. Prereq., MCDB 1111 or 1150 or instructor consent. Fulfills A&S Critical Thinking requirement.

MCDB 3350-3. Fertility, Sterility and Early Mammalian Development. Describes the production of germ cells, ovulation, fertilization, reproductive cycles, controls of reproduction, early development of the embryo, methods of contraception, and the causes and treatments of sterility. Prerequisite: MCDB 1150 or EBIO 1210.

MCDB 3500-3. Molecular Biology. (Fall and Spring) Studies how molecular techniques are being used to characterize genes and their expression. Topics include mechanisms of mutation and repair, recombination, prokaryotic and eukaryotic gene expression, transposable genetic elements, current applications of recombinant DNA procedures and mapping the human genome. Prerequisite: CHEM 1131 and MCDB 2150 (or comparable introductory genetics course). Corequisite: CHEM 3311 or CHEM 3351.

MCDB 3650-3. Brain, Thought, and Action. Examines the brain's role in thought, action and consciousness by exploring issues such as: relationship of cognition and localized brain function; functional neuroimaging, behavioral neurochemistry; learning and memory; animal consciousness; machine consciousness, artificial intelligence, and implications of modern physics. Prereqs: MCDB 1150 and MCDB 2150 (or equivalent).

MCDB 4110 1-3. Special topics.

MCDB 4130/5130-3. Biological Electron Microscopy: Principles and Recent Advances. Covers basic mechanisms for imaging and recent advances used in current biological research: elements of electron optics, image optimization, resolution, radiation damage, various imaging modes (TEM, HVEM, SEM, STEM, STM), specimen quantitation and reconstruction (stereo and 3D), microanalysis, electron diffraction. Specimen preparation treated only incidentally. Three lectures per week and occasional demonstrations. Prerequisite: MCDB 1150, or EBIO 1220, or MCDB 4500/5500, or PHYS 1120 or 2020.

MCDB 4140/5140-3. Plant Molecular Biology and Biotechnology. Introduces some of the frontiers in experimental plant research with applications in modern biotechnology, including seed development, hormonal control of growth, photomorphogenesis, stress responses (heat, water, salt), host-pathogen systems (bacteria, fungi, viruses, viroids), plant defense mechanisms, plant cell tissue culture, and genetic engineering of plants. Prerequisites: MCDB 3120 and MCDB 3500. Fulfills A&S Critical Thinking requirement.

MCDB 4300-3. Immunology. Emphasizes cellular and molecular mechanisms by which organisms protect themselves from pathogens and the experimental basis for our understanding of these processes. Discusses development, function and malfunction of T-cells, B-cells and other immune system components, focusing on the human immune system. Prereqs., MCDB 3120 and MCDB 3500.

MCDB 4330/5330-3. Bacterial Disease Mechanisms. Explores molecular and cellular interactions between bacteria and their eukaryotic hosts that precipitate disease. Activities include critical reading of research articles and student presentations. Recommended prereqs., MCDB 2150, 3120, and 3500. Fulfills A&S Critical Thinking requirement.

MCDB 4350-3. Microbial Diversity and the Biosphere. Provides a molecular phylogeny-based perspective on microbial diversity and the interactions between organisms that result in the Biosphere. Overview of recent methods and findings in microbial ecology. Computer-based workshop in molecular phylogeny. Required prerequisite: CHEM 1131 or 1171. Recommended prerequisites: EBIO 3400 and CHEM 3311.

MCDB 4410-3. Human Molecular Genetics. Studies the human organism as a genetic system. Effect of mutation on protein structure and function; biochemical basis of human genetic disease; polymorphic gene loci; gene mapping; impact of human genetics on medicine and society. Prerequisite: MCDB 3500. Fulfills A&S Critical Thinking requirement.

MCDB 4426-3. Cell Signaling and Developmental Regulation. Introduces several cell signaling processes and their biological functions. Students will read and analyze original research articles to learn the thinking processes of scientific research. Writing assignments and oral presentations will be part of the requirements. Prerequisites: MCDB 3120, MCDB 3500 and CHEM 4711. Fulfills A&S Critical Thinking requirement.

MCDB 4444-3. The Cellular Basis of Disease. Explores the cellular basis of disease. Discusses diseases arising from defects in intracellular targeting, cytoskeletal function, intracellular signaling, genomic instability, gene regulation, cell proliferation and cell death will be discussed. The course involves student organized presentations and classroom discussion. Prerequisites: MCDB 2150, MCDB 3120 and MCDB 3500. Fulfills A&S Critical Thinking requirement.

MCDB 4471/5471-3. Mechanisms of Gene Regulation in Eukaryotes. Focuses on manifestations of regulated gene expression. Studies gene regulation at multiple steps, *i.e.*, transcription, RNA processing and translation. Written assignments and oral presentations are required. Prerequisite: MCDB 3500. Fulfills A&S Critical Thinking requirement.

MCDB 4520-3. Bioinformatics and Genomics. Computational and experimental methods in bioinformatics and genomics, and how these methods provide insights into protein structure and function, molecular evolution, biological diversity, cell biology, and human disease. Topics include database searching, multiple sequence alignment, molecular phylogeny, micorarrays, protcomics, and pharmacogenomics. Prereqs., CHEM 4711 & 4731, or CHEM 4711 and MCDB 3500. Same as MCDB 5520.

MCDB 4550/5550-3. Cellular and Molecular Motion, A Biophysical Approach. Focuses on the biophysics governing enzyme mechanisms, cellular mechanisms, cellular structure and motion. Synthesizes ideas from molecular biology, physics, and biochemistry, emphasizing how low Reynolds number physics, not Newtonian physics, is relevant to life inside the cell. Prereq., CHEM 1131 or 1171, general biology, or instructor consent. Recommended prereq., EBIO 3400 and/or CHEM 3311. Fulfills A&S Critical Thinking requirement.

MCDB 4600-3. Molecular Approaches to Human Diseases. Studies basic research using molecular biology and its contribution to treatment of human diseases. Includes an overview of physiology, clinical presentation, basic research, and detailed analyses of molecular approaches taken to understand and treat human diseases. Prereqs., MCDB 2150, 3120, and 3500. Fulfill A&S Critical Thinking requirement.

MCDB 4615/5615-3. Biology of Stem Cells. The course will examine the stem cell concept by a critical examination of the primary scientific literature. Topics will include pluripotency and plasticity, environment, technology, self-renewal, transdifferentiation, molecular signature, epigenetic programming and stem cell versus cancer cell. Prereqs., MCDB 2150, 3120, 3500 or instructor consent. Fulfills A&S Critical Thinking requirement.

MCDB 4650-3. Developmental Biology. Analyzes development, emphasizing cellular, molecular, and genetic mechanisms. Topics covered include descriptive embryology, control of gene expression in eukaryotic cells, mechanisms of differentiation, morphogenesis, and developmental genetics. Prerequisites: MCDB 3120 and MCDB 3500. MCDB 4660 must be taken concurrently.

MCDB 4660-2. Developmental Biology Laboratory. Lab for MCDB 4650. Studies live and prepared embryos from a variety of organisms, including amphibia, chickens, nematodes, and fruit flies. Topics include descriptive and experimental embryology, developmental genetics and molecular biology methods applied to developing systems. Corequisite: MCDB 4650. This course uses living vertebrate animals/tissues.

MCDB 4680/5680-3. Mechanisms of Aging. Studies aging as a developmental process emphasizing cellular and molecular mechanisms involved. Prerequisites: MCDB 3120 and MCDB 3500. Fulfills A&S Critical Thinking requirement.

MCDB 4750-3. Animal Virology. Encompasses the structure and replication of both lytic and transforming animal viruses. Emphasizes diversity of naturally occurring genomic structures and the resulting strategies of infection as well as the impact of viral epidemics on society. Prereq: MCDB 3500. Fulfills A&S Critical Thinking requirement.

MCDB 4777/5777-3. Molecular Neurobiology. Introduces the functional anatomy of the nervous system, and explores current knowledge regarding the molecular and genetic basis of the development and function of the nervous system. Studies recent insights into the molecular basis of neuro-degenerative diseases, in the last part of the course. Prerequisites: MCDB 3120 and MCDB 3500.

MCDB 4790-3. Experimental Embryology. Embryology is studied by considering experiments relevant to specific topics of early development. Both historical and contemporary material will be considered. This course emphasizes reading, interpretation and discussion of research articles. Frequent writing assignments and active participation in discussions are required. Prereqs: MCDB 3120 and MCDB 3500. Fulfills A&S Critical Thinking requirement.

MCDB 4810/5810-3. Insane in the Membrane: The Biology and Biophysics of the Membrane. Studies the biology and physics of the biomembrane. Topics include structure and mechanism of membrane proteins; membrane biogenesis; membrane protein folding and stability; membrane homeostasis; mechanisms of membrane fusion and fission; lipid trafficking. Prereq., CHEM 4711 or instructor consent. Fulfills A&S Critical Thinking requirement.

MCDB 4840-(1-6). Upper Division Independent Study. Prerequisites: MCDB 2150 and consent of instructor. A research contract must be completed and signed by the student and the faculty sponsor and approved by the MCDB Coordinator of Independent Study. Enrollment must be completed by the end of the drop-add period. The signed contract should be submitted by the end of the first week of classes of the semester in which the research will be done. Contact the MCDB Student Affairs Office (MCDB A1B48) for details. May be repeated for credit, but only 8 hours of MCDB 2840 and MCDB 4840 can be counted toward graduation. Three hours can be used as an MCDB elective.

MCDB 4970/5970-3. Seminar on Physical Methods in Biology. Covers basic mechanisms and applications of physical methods used in current biological research: microprobe analysis and EELS, elementary electron and X-ray crystallography, biomedical imaging (NMR, PET, CAT). Fourier analysis, synchrotron radiation, EXAFS, neutron scattering, and novel ultramicroscopy techniques. Includes lectures, student presentations, and occasional demonstrations. Emphasis depends on student interest. Same as PHYS 4970/5970. Prerequisite: MCDB 1150 or MCDB 3120 or EBIO 1220 and PHYS 2020 or PHYS 1120 and PHYS 1140.

MCDB 4980-3. Honors Research. Faculty-supervised research by students who have been approved by the Departmental Honors Committee. This course is normally taken during the semester before completion of the Honors Thesis. Prerequisites: one semester MCDB 4840, or equivalent research experience; GPA of 3.20 or better.

MCDB 4990-3. Honors Thesis. Preparation and defense of an Honors Thesis based on faculty-supervised original research, including final phases of the research project. Prerequisites: MCDB 4840 or 4980, GPA of 3.30 or better, and approval by the MCDB Honors Committee.

Courses numbered 5000-5999 are intended primarily for graduate students, but are also available to qualified undergraduates.

MCDB 5210-3. Cell Structure and Function (Lecture & Discussion). Instructor consent required

MCDB 5220-3. Molecular Genetics (Methods and Logic). Instructor consent required.

MCDB 5230-3. Gene Expression (Lecture and Discussion). Instructor consent required.

MCDB 5250-3. Topics in Developmental Biology (Methods and Logic). Instructor consent required.

MCDB 5780-2. Topics in Plant Cell Biology. Highlights discussions and reports on research advances in biological membranes, plant cell secretion, assembly of plant cell walls, protein targeting and plant cell transformation. May be repeated. Prereq: instructor consent. Does not count as a lecture course.

NON-MCDB COURSES THAT MAY BE USED AS MCDB ELECTIVES

Electives from other departments: MCDB majors may take 2 courses from the following list as MCDB upper division electives without petitioning. When choosing to take courses from this list, check for prerequisites and major restrictions. It is also possible to petition the MCDB Undergraduate Committee to use a course that is not on the following list as an MCDB elective.

CHEM 3331-4. Organic Chemistry 2

CHEM 3341-1. Organic Chemistry 2 Laboratory

CHEM 4411-3. Physical Chemistry with Biochemistry Applications 1

CHEM 4731-3. General Biochemistry 2

CHEM 4751-3. Current Topics in Biochemical Research

CHEM 4761-4. Biochemistry Laboratory

EBIO 3400-4. Microbiology

EBIO 4800-3. Critical Thinking. See MCDB Advisor for specific sections that have been approved as an upper division MCDB Elective.

EDUC 4312-3. Nature of Science & Science Education

IPHY 3410-3. Introduction to Human Anatomy

IPHY 3415-2. Human Anatomy Laboratory

IPHY 3430-3. Human Physiology

IPHY 3435-2. Human Physiology Laboratory

IPHY 3450-5. Comparative Animal Physiology

IPHY 3500-2. Applied Clinical Research

IPHY 3800-3. Forensic Biology

IPHY 3810-1. Forensic Biology Laboratory

IPHY 4440-4. Endocrinology

IPHY 4720-4. Neurophysiology

PSYC 4052-4. Behavioral Neuroscience

PSYC 4072-3. Clinical Neuroscience: A Clinical and Pathological Perspective.

Please see your advisor for updates to this list.

COURSES FOR NON-MAJORS

The following courses satisfy various A&S Core Curriculum requirements, as indicated. However, they do not count toward the MCDB major.

MCDB 1030-3. Plagues, People and Microorganisms. Lecture. Discusses the biology, history, ecology and social impact of human plagues, including AIDS, smallpox, polio, bubonic plague, tuberculosis, leprosy, the impact of the Irish potato blight, and emerging human pathogens. The biology of the pathogens and the human immune responses are treated in detail. Discusses the impact of molecular biology on curtailing the impact of diseases. No prerequisites. Does not count toward MCDB major. Approved for A&S Core Curriculum: Natural Science, non-sequence.

MCDB 1041-3. Fundamentals of Human Genetics. Covers the basic principles of genetics, human pedigree analysis, and how genetic diseases affect DNA, RNA, and proteins. Considers implications of this research for medicine and society. For non-majors. Good background in high school chemistry and biology is recommended. Approved for A&S Core Curriculum: Natural Science, non-sequence.

MCDB 1042-3. Biological Basis of Human Disease. Discusses the molecular and cellular bases of non-infectious human diseases, such as cancer, heart disease, Alzheimer's, depression, osteoporosis, and diabetes. Provides a basis for understanding "molecular medicine," i.e. treatments and prevention strategies based on knowledge of genes and molecules that are altered in the disease state. Prereq., strong background in high school biology and chemistry. Approved for arts and sciences core curriculum: natural sciences non-sequence. Prereq MCDB 1041 or Instructor Consent.

MCDB 2115/ARSC 2115-3. Life Science of the Earth system. Scientific concepts are taught in the context of life science. This course is especially suited for future K-6 teachers. Characteristics of life, genetics, evolution, ecology and the human body will be emphasized in a constructivist, student-centered, hands on format. Prereq., Two high school science courses at college-prep level. Recommended prereq., ARSC 2110 OR GEOL 2110. SAME AS ARSC 2115. Approved for arts and sciences core curriculum: natural science.

SAMPLE DEGREE PROGRAMS

There are many ways to fit all of the Departmental and College graduation requirements into a four-year degree plan. We encourage each student to develop a personalized degree plan in consultation with a departmental advisor. An individualized plan is very important for students planning to take the MCAT in the spring of their junior year. The following sample degree plans assume no MAPS deficiencies. The following notations and assumptions are incorporated in all plans:

- MATH 1300 is used for QRMS. MCDB majors may substitute MATH 1310. MCDB/BCHM double majors should take MATH 1300 (or APPM 1350).
- The required writing courses are designated "LD-writing" and "UD-writing".
- The abbreviation used for Critical Thinking is "(CT)".
- "MCDB-elective" refers to an upper-division MCDB elective approved for majors.

A. Assumes a high school background adequate to enter directly into MATH 1300 and CHEM 1111. Must complete a total of at least 120 credit hours of which 45 credit hours must be upper division.

	Freshman	hrs	Sophomore	hrs	Junior	hrs	Senior	hrs	
F	MCDB 1150/1151	4	MCDB 3120/3140	5	MCDB Elective	3	*MCDB 4300	3	
A	CHEM 1111	5	CHEM 3311/3321	5	CHEM 4611	3	MCDB Elective	3	
L	LD-writing	3	A&S-CORE	3	PHYS 2010	5	A&S-CORE (UD)	3	
L	A&S-CORE	3	A&S Elective	3	A&S-CORE	3	2 A&S Electives	6	
	<i>Total hours</i>	15	<i>Total hours</i>	16	<i>Total hours</i>	14	<i>Total hours</i>	15	
S	MCDB 2150/2151	4	MCDB 3500	3	MCDB Elective CT	3	*MCDB 4650	3	
P	CHEM 1131	5	MATH 1300	5	PHYS 2020	5	MCDB Elective	3	
R	A&S-CORE	3	A&S-CORE	3	2 A&S Elective (UD)	6	A&S-CORE	3	
N	A&S-Elective	3	A&S Elective	3	UD-writing	3	2 A&S Elective (1 UD)	6	
G	<i>Total hours</i>	15	<i>Total hours</i>	14	<i>Total hours</i>	17	<i>Total hours</i>	15	
	<i>Total hours</i>	30	<i>Total hours</i>	30	<i>Total hours</i>	31	<i>Total hours</i>	30	121

B. Designed for a double major in MCDB and BCHM. Assumes a high school background adequate to enter directly into MATH 1300 and CHEM 1111. CHEM 4731 and CHEM 4761 count as MCDB upper division electives.

	Freshman	hrs	Sophomore	hrs	Junior	hrs	Senior	hrs	
F	MCDB 1150/1151	4	MCDB 3120/3140	5	CHEM 4711	3	*MCDB 4300	3	
A	CHEM 1111	5	CHEM 3351/3321	5	PHYS 1110	4	CHEM 4411	3	
L	A&S-CORE	3	MATH 2300*	5	A&S-CORE	3	UD-writing	3	
L	LD-writing	3			A&S Elective	3	2 A&S Electives	6	
	<i>Total hours</i>	15	<i>Total hours</i>	15	<i>Total hours</i>	13	<i>Total hours</i>	15	
S	MCDB 2150/2151	4	MCDB 3500	3	CHEM 4731	3	*MCDB 4650	3	
P	CHEM 1131	5	CHEM 3371/3341	5	CHEM 4761 (CT)	4	MCDB elective	3	
R	MATH 1300	5	MATH 2400	4	PHYS 1120/1140	5	CHEM 4431	3	
N	A&S-CORE	3	A&S-CORE	3	A&S-CORE (UD)	3	A&S Elective	3	
G							A&S-CORE	3	
	<i>Total hours</i>	17	<i>Total hours</i>	15	<i>Total hours</i>	15	<i>Total hours</i>	15	
	<i>Total hours</i>	32	<i>Total hours</i>	30	<i>Total hours</i>	28	<i>Total hours</i>	30	120

*One of these two courses is required as a "capstone" course for the MCDB Major. The other may be taken as an MCDB elective, or another elective may be substituted.

GRADUATION CHECKLIST FOR MCDB MAJORS

Required Major Courses (Grades must be C- or better, including MCDB electives. See page 6 for details.) **Alternatives (AP, testing, transfer, etc.)**

- | | |
|--|--|
| ___ MCDB 1150 Introduction to Cell and Molecular Biology - | |
| ___ MCDB 1151 Introduction to Cell and Molecular Biology Lab | |
| or | |
| ___ MCDB 1111 Biofundamentals - - - - - | |
| ___ MCDB 2150 Principles of Genetics - - - - - | |
| ___ MCDB 2151 Principles of Genetics Laboratory - - - - | |
| ___ MCDB 3120 Cell Biology - - - - - | |
| ___ MCDB 3140 Cell Biology Laboratory - - - - - | |
| ___ MCDB 3500 Molecular Biology - - - - - | |
| ___ MCDB 4300 Immunology - - - - - | |
| or | |
| ___ MCDB 4650 Developmental Biology - - - - - | |

MCDB Electives (At least 11 hrs. total; 2 must be MCDB.)

- | | |
|----------------------|--|
| ___ MCDB _____ - - - | |
| ___ MCDB _____ - - - | |
| ___ _____ - - - | |
| ___ _____ - - - | |

MCDB Ancillary Requirements in CHEM, MATH, PHYS (See page 6 for minimum grade requirements.)

- | | |
|--|--|
| ___ CHEM 1111 General Chemistry I - - - - - | |
| ___ CHEM 1131 General Chemistry II - - - - - | |
| ___ CHEM 3311 Organic Chemistry I - - - - - | |
| ___ CHEM 3321 Organic Chemistry Laboratory I - - - - - | |
| ___ CHEM 4611 or 4711 Biochemistry I - - - - - | |
| ___ MATH 1300 or 1310 Calculus and Analytical Geometry I - | |
| ___ PHYS 2010 or 1110 General Physics I - - - - - | |
| ___ PHYS 2020 or 1120 General Physics II - - - - - | |
| ___ PHYS 2020 or 1140 General Physics Laboratory - - - | |

Core Curriculum Requirements not Satisfied by MCDB Major or Ancillary Courses (D- or better grades)

Requirement	Course #	Comments: AP, Test, Transfer, etc.
___ Written Communication (lower division) -		
___ Historical Context- - - - -		
___ Culture and Gender Diversity - - - - -		
___ United States Context - - - - -		
___ Literature and the Arts (lower division)-		
___ Contemporary Societies - - - - -		
___ Ideals and Values - - - - -		
___ Literature and the Arts (upper division)-		
___ Written Communication (upper division) -		
___ Critical Thinking - - - - -		