Cellular and Molecular Biology (CMB) Major Requirements

Why study Biology?
"Pursuing a career in biology can be immensely rewarding and exciting. Studying biology teaches us to ask questions, make observations, evaluate evidence, and solve problems. Biologists learn how living things work, how they interact with one another, and how they evolve. They may study cells under a microscope, insects in a rainforest, viruses that affect human beings, plants in a greenhouse, or lions in the African grasslands. Their work increases our understanding about the natural world in which we live and helps us address issues of personal well-being and worldwide concern, such as environmental depletion, threats to human health, and maintaining viable and abundant food supplies."

[from: http://www.aibs.org/careers]

Who should major in Cellular and Molecular Biology?
The curriculum in Cellular and Molecular Biology offers students an integrated program of study and training in the biological and physical sciences. It is a pathway to graduate study in areas of biology and medicine that emphasize a quantitative and analytical approach to the life sciences. Students intending to go to medical school should compare degree requirements to the med school requirements found here: http://www.lsa.umich.edu/advising/academicplanning/prehealth. It is strongly recommended that pre-med and other pre-health students meet with an LSA pre-health advisor.

What's the difference between the CMB and Microbiology majors?
CMB and Microbiology are related majors, but CMB focuses on cellular and molecular structures and their functions, whereas Microbiology includes the study of viruses, algae, bacteria, protozoa, fungi, and immunobiology.

Exclusions: Students who elect a major in Cellular and Molecular Biology may not elect the following majors: Biology; General Biology; CMB:BME; Microbiology; Plant Biology; Neuroscience; Biochemistry; or Biomolecular Science. They also may not elect an academic minor in Biology; Plant Biology; Chemistry; or Biochemistry.

How do I declare?
Students interested in any major in the biological sciences are encouraged to meet with an advisor to discuss their academic plans as soon as possible! Students need not have completed all of the major prerequisites to declare, but should have completed the biology introductory sequence with a 2.0 or better and be in good academic standing. Make an advising appointment online through the Biology website: www.lsa.umich.edu/biology.

What courses should I take first?
The biological science introductory sequence consists of: BIOLOGY 171, BIOLOGY 172 or 174, and BIOLOGY 173. (Students with an appropriate AP score receive credit for BIOLOGY 195, which is the equivalent of BIO 171 & 172/174, but does NOT grant credit for 173.) Students should take 171 or 172/174 first and then follow with the second lecture course and 173. (Note that the introductory biology sequence courses cannot be taken pass/fail.)

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<th>BIOLOGY 171</th>
<th>BIOLOGY 172 or 174</th>
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| ...focuses on ecology, biodiversity, and genetics and evolutionary processes. Students engage with biological hypotheses dealing with prominent current issues such as human evolutionary origins, emerging diseases, conservation biology, and global change. | (prerequisite: prior or concurrent credit for CHEM 130) ...
| BIOLOGY 173 | ...
| (prerequisite = BIOLOGY 171, 172, 174, or 195) | (prerequisite: prior or concurrent credit for CHEM 130) ...
| ...is the accompanying lab component to the introductory sequence. The course provides an integrated introduction to experimental biology. Topics focus on biochemistry, molecular genetics, evolution, and ecology. | focuses on how cells, organs, and organisms work. (174 covers the same material as 172 but is geared toward students who prefer a more problem-solving approach to understand biology, rather than a more traditional lecture-based course.) |
How do I get involved in research?
Independent research is a wonderful opportunity to take an active role in studying what you enjoy! Students participate in a lab, field, or modeling project in which they themselves have a say in the design, implementation, and interpretation of experiments. Please visit the Undergraduate Research web pages for the specific requirements for independent research and advice on how to choose a research area and mentor: http://www.lsa.umich.edu/biology/studentresearch.

What are the requirements for Honors?
The Program in Biology administers an Honors Program to train students to conduct independent research in the biological sciences. Participating in the honors program allows students to develop their research skills, deepen their understanding of the field, and form productive relationships with faculty and other students. The achievement is noted on the diploma and official transcript.

In addition to completing all the requirements for the major, an honors degree requires:
1. a major GPA of at least 3.4, and
2. the completion of a significant piece of independent research that is
3. reported in an honors thesis and
4. presented in a public forum.

For more information, consult the Program in Biology Honors Program information page or a Program in Biology advisor.

How do I find out about internships, study abroad, or summer programs?
Information about study abroad, faculty-led intercultural internships, faculty-led courses and field experiences, and Spring/Summer language study is available through the Center for Global and Intercultural Study. Please refer to www.lsa.umich.edu/cgis for detailed information about options.

Can I transfer courses from another institution?
The Program in Biology will review classes taken at other institutions to determine equivalency to University of Michigan Biology, EEB, and MCDB courses. If an external class is determined to be equivalent to a U-M course, it can be posted to your transcript as the U-M Biology, EEB, or MCDB course (with a "T") when you successfully complete the course and the transfer steps listed on the Biology website: www.lsa.umich.edu/biology/transfercredit. Approved equivalent courses may count toward major requirements, but transfer students are encouraged to meet with a major advisor to develop a major plan.

[Note: You are welcome to request review of a course before you take it. You will need to provide a detailed syllabus, and must obtain one from the instructor in advance.]

How can I get involved with student organizations?
There are several student organizations pertinent to biology-related majors. More detailed information is available on the Program in Biology website: www.lsa.umich.edu/biology.

- **Biology Student Alliance (BSA):** intended for Biology, CMB, Microbiology, Plant Biology, Neuroscience, and Biochemistry majors, as well as pre-med or science oriented students interested in learning more about MCDB-related topics. Email BSA-Board@umich.edu for more information.
- **Botany Undergrads Doing Stuff (BUDS):** an extremely informal group of people dedicated to botany. Contact Faculty Advisors Robyn Burnham or Laura Olsen if interested.
- **Neuroscience Students Association (NSA):** an organization for students with an interest in neuroscience. Email nsaleadteam@umich.edu for more information.
- **Society of Biology Students (SBS):** an informal group for students interested in Biology in general. Website: http://www.sitemaker.umich.edu/sbs/home or contact the Faculty Advisor, Robyn Burnham at rburnam@umich.edu for information.
- **Student Society for Stem Cell Research (SSSCR), University of Michigan – Ann Arbor Chapter:** an international network dedicated to the advancement of scientific research for cures. Website: www.umich.edu/~umssscr/index.html. Email ssscrexec@umich.edu.
CURRENT COURSES ACCEPTABLE as ADVANCED CMB COURSES and ELECTIVES

NOTE: No course may be used to satisfy two requirements.

I. ADVANCED CMB LABORATORY COURSES (All are 3 credits.)
MCDB 306 Genetics Laboratory
MCDB 400 Advanced Independent Research
MCDB 423 Research in Cellular and Molecular Neurobiology Laboratory
MCDB 429 Laboratory in Cellular and Molecular Biology

II. ADVANCED CMB COURSES
MCDB 401 Advanced Topics
MCDB 402 Molecular Biology of Pain and Sensation
MCDB 403 Molecular and Cell Biology of the Synapse
MCDB 404 Genetics, Development, and Evolution
MCDB 405 Molecular Basis of Development
MCDB 408 Genomic Biology
MCDB 410 MCB Capstone
MCDB 411 Protein Structure and Function
MCDB 415 Microbial Genetics (formerly MCDB 513)
MCDB 416 Introduction to Bioinformatics
MCDB 417 Chromosome Structure & Function
MCDB 418 Endocrinology
MCDB 421 Topics in Cellular and Molecular Neurobiology
MCDB 422 Brain Development, Plasticity, and Circuits
MCDB 425 Biotechnology: From Concepts to Technologies
MCDB 426 Molecular Endocrinology
MCDB 430 Plant Molecular Biology
MCDB 433 Plant Biochemistry
MCDB 435 Intracellular Trafficking
MCDB 436 Introductory Immunology
MCDB 440 Cell Cycle Control and Cancer
MCDB 441 Cell Biology and Disease
MCDB 444 Bacterial Cell Biology
MCDB 448 Telomerase Function in Stem Cells and Cancers
MCDB 450 Genomics and Molecular Biology of Complex Behavior
MCDB 453 Ion Channels and their Channelopathies
MCDB 454 Cell Biology of the Cytoskeleton
MCDB 455 Cell Biology of Neurodegeneration
MCDB 456 Genes, Circuits, and Behavior
MCDB 457 Neurobiology of Sexual and Aggressive Behavior
MCDB 459 Brain States and Behavior
MCDB 462 Epigenetics
MCDB 469 Signal Transduction
MCDB 471 Advanced Methods in Biochemistry
MCDB 489 Microbial Genes and Genomes
MCDB 589 Microbial Evolution

NOTE: Additional courses from Group I may be used to meet this requirement.

III. BIOLOGY AND CHEMISTRY ELECTIVES
BIO 205 (3) Developmental Biology
BIO 207 (4) Microbiology
BIO 222 (4) Principles of Cellular and Molecular Neuroscience
BIO 225 (3) Principles of Animal Physiology
MCDB 308 (3) Developmental Biology Laboratory
MCDB 321 (3) Introductory Plant Physiology
CHEM 230 (3) Physical Chemistry Principles and Applications
CHEM 241/242 (4) Introduction to Chemical Analysis Lecture and Laboratory
CHEM 245/246/247 (4) Biomedical Analytical Chemistry Lecture and Laboratories
CHEM 452 (4) (for students who elect to take CHEM 451 and 452)

NOTE: An additional course from Group I or II may be used to meet this requirement.

IV. ADDITIONAL ELECTIVES: Choose course(s) from the following list, to reach 32 credits in major:
1. Additional courses from Groups I, II, or III (above)
2. Any specific BIOLOGY, EEB, or MCDB course at the 200-, 300-, or 400-level (except BIOLOGY 200, 201, 202, 215, 241, 262; or EEB 300, 301, 302; or MCDB 300, 301, 302, 320, or 412)
3. Any Chemistry course that has CHEM 260 as a prerequisite
4. MATH courses that have a MATH 116 prerequisite; or STATS 401, 412, or 425
5. MICRBIOL 405 – Medical Microbiology and Infectious Disease
6. BIOLCHEM 650 – Eukaryotic Gene Expression
7. PHARMACOL 425 – Development of New Medications: Pharmacology in Action
### Cellular and Molecular Biology Prerequisites:

#### Introductory Biology Sequence:

- Choose Sequence A or B:
  - A: BIO 171, 172 or 174, & 173
  - B: BIO 195 (AP) & 173

#### Chemistry Sequence:

- CHEM 210 & 211
- CHEM 215 & 216

#### Quantitative Analysis Sequence:

- CALCULUS I: MATH 115, 120 (AP), 175, 185, or 295
- One course from: MATH 116, 121 (AP), 156, 176, 186, or 296; STATS 180 (AP), 250 or 280; STATS 400-level or above (min. 3 credits); BIOLOGY 202; BIOPHYS/PHYSICS 290; EECS 203 or 280; EARTH 468; or other course with a MATH 115 prereq. approved by a major advisor [Note: Any course used to fulfill this requirement cannot also be used as a major elective; i.e., a course cannot "double-count."]

#### Physics Sequence:

- PHYSICS I (lecture + lab): One of the following combinations: PHYSICS 125 & 127; 135 & 136; 140 & 141; or 160 & 161. [PHYSICS 139 (AP) will also fulfill this requirement.]
- PHYSICS II (lecture + lab): One of the following combinations: PHYSICS 126 & 128; 235 & 236; 240 & 241; or 260 & 261. [PHYSICS 239 (AP) will also fulfill this requirement.]

### Cellular and Molecular Biology Major:

#### Core Courses

- Genetics: BIO 305
- Biochemistry: Choose from: MCDB 310, BIOLCHEM 415, or CHEM 351
- Molecular Biology: MCDB 427
- Cell Biology: MCDB 428

#### I. Advanced CMB Laboratory Courses

- Choose two courses from attached list.

#### II. Advanced CMB Courses

- Choose two courses from attached list.

#### III. Biology/Chemistry Elective

- Choose one course from attached list.

#### IV. Additional Elective(s)

- Choose course(s) from attached list, to reach 32 credits in major.

### Constraints:

- Prerequisites, introductory science courses, and non-specific (departmental) transfer courses are EXCLUDED from the 32 cr. required for the major.
- A maximum of three credits of independent research (MCDB 400) may count toward the major. Three credits must be completed in one term to meet the Advanced Laboratory requirement or the Advanced CMB course requirement.

### Total Units and GPA Requirement for Cellular and Molecular Biology

- Minimum 32 cr. in Major
- Minimum 2.0 GPA in Major
  
  GPA is calculated from all mandatory prerequisites, all courses used for major requirements (including cognates), and all courses in BIOLOGY, EEB, and MCDB.