Molecular and Cellular Biology

Professor Richard M. Losick, Head Tutor

The Molecular and Cellular Biology concentration is primarily concerned with the understanding of biological processes based on the study of molecules and their interactions in the context of cells and tissues. It integrates many different methodologies ranging from chemistry and genetics to computer science and engineering. The concentration is administered by the Department of Molecular and Cellular Biology and the Board of Tutors in Biochemical Sciences, which includes faculty members from other science departments in the Faculty of Arts and Sciences and the Harvard Medical School.

The cell is the fundamental unit of all living things and is therefore an ideal framework for integrating one's understanding of the structure and chemistry of macromolecules with their higher order organization and behavior in a living context. Molecular and Cellular Biology is therefore intended for students who wish to synthesize fundamental concepts in chemistry, physics, and mathematics through the study of cellular processes. It is designed especially for those who anticipate careers in the biological sciences, including developmental biology, immunology, stem cell biology, microbiology, genomics, and bioinformatics, or in medicine.

Many critical advances in molecular and cellular biology have been made possible by the use of sophisticated chemical and physical methods; others have involved a combination of genetic and biochemical techniques. The explosive growth in our understanding of the properties and functions of individual macromolecules creates new opportunities to integrate this knowledge into a more coherent understanding of fundamental biological processes. The concentration requirements establish a solid foundation in basic biology, chemistry, mathematics, and physics, which is followed by more advanced course work designed to expose students to major avenues of inquiry in molecular and cellular biology. Questions that can now be studied directly include many of the central issues in biology: How is genetic information transformed into the structure of an organism? How does one cell divide accurately into two? How do individual cells coordinate with their neighbors in the context of a multicellular organism? Molecular descriptions are being sought for the ways in which cells differentiate and communicate, for the nature of hormonal control, for mechanisms that convert sensory stimuli into nerve impulses, for events in the immune response, and for the pathogenesis of human diseases.

A minimum of 14 half-courses is required for the concentration, one of which must have a significant component of independent laboratory research. A written thesis or the non-thesis option is required for honors candidates. This option requires one additional half-course chosen from advanced project lab offerings or supervised research and an honors essay assigned by the Board of Tutors that integrates their research experiences. Concentration requirements may not be taken Pass/Fail. Transfer credits are considered on an individual basis by the Head Tutor.

The Board of Tutors in Biochemical Sciences, which was established in 1926, runs the Tutorial program for the Molecular and Cellular Biology concentration and the Chemical and Physical Biology concentration. The Tutorial program offers individualized instruction to all concentrators beginning at the time of declaration. Concentrators typically meet with their tutors every two weeks and discuss primary research literature in a small group or one-on-one setting. Mentoring on career choices, the research experience, and other academic issues is a logical extension of the tutorial. The Head Tutor makes all tutorial assignments and is available throughout the academic year to answer questions from students or their tutors.

For information on the secondary field in Molecular and Cellular Biology, please see page 354 of this *Handbook* or the secondary fields website (*www.secondaryfields.fas.harvard.edu/MCB/program-desc-MCB.htm*).

REQUIREMENTS
Basic Requirements: 14 half-courses

1. *Required courses:*
   a. *Life Sciences:* Life Sciences 1a and Life Sciences 1b.
   b. *Biology:* MCB 52 and 54 (formerly Biological Sciences 52 and 54).
   c. *Chemistry:* Three half-courses. One of these courses should be general chemistry and may be chosen from Chemistry 7 or Physical Sciences 1. The remaining two courses should be organic chemistry and may be chosen from Chemistry 17 and Chemistry 27, or Chemistry 20 and Chemistry 30.
   d. *Mathematics:* One half-course at the level of Mathematics 19a, Mathematics 21a, or equivalent.
   e. *Physics:* Two half-courses which may be chosen from Physics 1a and Physics 1b, or Physical Sciences 2 and Physical Sciences 3.
   f. *Advanced courses:* Three half-courses above the introductory level. Students are advised to select courses in each of the following broad areas of inquiry: molecular analyses of gene regulation, cell structure and function, and cell differentiation and developmental biology. All 100- and 200-level MCB courses may be used to fulfill this requirement. Certain advanced courses in Chemistry and OEB may also be used to fulfill this requirement. Consult the concentration office for a list of courses categorized by area of inquiry.
   g. *Research experience:* One half-course chosen from advanced project lab offerings such as MCB 100r, Life Sciences 100r, or supervised research such as MCB 91r. Students doing thesis work ordinarily enroll in two terms of MCB 99r, one of which will fulfill this requirement.
2. *Tutorial:* Required of all concentrators beginning after declaration; non-credit.
3. *General Examination:* None.
4. *Other information:*
   a. *Pass/Fail:* Courses counted for concentration credit may not be taken Pass/Fail.
   b. Advanced Placement credits may be counted (with or without Advanced Standing), provided the total number of concentration courses taken at Harvard does not fall below twelve half-courses, and provided the student does not enroll in a course for which the advanced placement credit was granted.
   c. Courses offered by the School of Engineering and Applied Sciences and by the Division of Medical Sciences may be counted for concentration credit wherever appropriate. Please consult the concentration office for more information.
   d. Courses given under the Core Curriculum may not be counted for concentration credit, except by special approval.

Requirements for Honors Eligibility: 15 half-courses

THESIS OPTION

1. *Required courses:* Same as **Basic Requirements**.
2. *Thesis:* Required. See item 1g above.
3. *Tutorial:* Same as **Basic Requirements**.
4. *Other information:* Same as **Basic Requirements**.

NON-THESIS OPTION

1. *Required courses:* Same as **Basic Requirements**, plus one additional half-course chosen from advanced project lab offerings or supervised research, as described in 1g above, is required. Students completing this advanced course option for honors eligibility will be required to submit an honors essay assigned by the Board of Tutors that integrates their research experiences.
2. *Thesis:* None.
3. *Tutorial:* Same as **Basic Requirements**.
4. *Other information:* Same as **Basic Requirements**.

ADVISING

The MCB concentration adviser, Dr. Thomas Torello, is available to concentrators and pre-concentrators to provide guidance on course selection, laboratory research, and the fulfillment of concentration requirements. Visit *lifescience.fas.harvard.edu* and follow the link for Molecular and Cellular Biology under the "concentrations" tab or contact Dr. Torello (*torello@fas.harvard.edu* or 617-495-4106) for more information.

The Board of Tutors in Biochemical Sciences oversees the tutorial program, which offers individualized instruction to all concentrators beginning after declaration. Mentoring on career choices, the research experience, and other academic issues is a logical extension of the tutorial. The Head Tutor makes all tutorial assignments and is available throughout the academic year to answer questions from students or their tutors.

For up-to-date information on advising in Molecular and Cellular Biology, please see the Advising Programs Office website: *www.fas.harvard.edu/~advising/concentrations/Molecular-CellularBiology.html*.

RESOURCES

A Tutorial Reference Library is housed in the Student Affairs Office at 7 Divinity Avenue, and contains books and journals frequently used for tutorial reading.

HOW TO FIND OUT MORE

The Head Tutor of Molecular and Cellular Biology is Professor Richard Losick, and the concentration adviser is Dr. Thomas Torello, 7 Divinity Ave (617-495-4106). Lists of members of the Board of Tutors in Biochemical Sciences and of the Department of Molecular and Cellular Biology and descriptions of their research interests are available in the Student Affairs Office, 7 Divinity Avenue, Sherman Fairchild 195. For more information about the MCB concentration, visit *lifescience.fas.harvard.edu* and follow the link for Molecular and Cellular Biology under the "concentrations" tab.

ENROLLMENT STATISTICS

Concentrators as of November

Concentrators	2006
Molecular and Cellular Biology	55
MCB + another field	0
Another field + MCB	0