

Molecular, Cellular, and Developmental Biology

MCDB Interdepartmental Graduate Program

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Undergraduate Study

A special program in Molecular, Cellular, and Developmental Biology is not offered for the baccalaureate. Undergraduates wishing to prepare for graduate study in molecular, cellular, and developmental biology should elect courses in biochemistry, biology, genetics, microbiology; and mathematics through calculus; chemistry through organic; and one year of physics.

The following are recommended to undergraduates desiring an introduction to this area:

BIOL 313	Principles of Genetics	3
BIOL 313L	Genetics Laboratory	1
BIOL 314	Principles of Molecular Cell Biology	3
BIOL 423	Developmental Biology	3
BIOL 423L	Developmental Biology Laboratory	1

Graduate Study in MCDB

Work is offered for the master of science and doctor of philosophy degrees with a major in Molecular, Cellular, and Developmental Biology. Faculty are drawn from fourteen university departments along with researchers from the National Animal Disease Center. Participating departments include: Agronomy; Animal Science; Biochemistry, Biophysics & Molecular Biology; Biomedical Sciences; Chemistry; Chemical & Biological Engineering; Entomology; Food Science & Human Nutrition; Genetics, Development & Cell Biology; Horticulture; Physics & Astronomy; Plant Pathology; Veterinary Microbiology & Preventive Medicine; and Veterinary Pathology. Facilities and qualified faculty are available in these departments for conducting fundamental research in the various aspects of molecular, cellular, and developmental biology. Ongoing research projects include molecular and cellular studies of viral, prokaryotic, plant, and animal systems. Additional information about the program and faculty is available at: www.mcdb.iastate.edu.

Prospective students are admitted by the MCDB program following receipt of a complete application and after review by the MCDB Admissions Committee. Students are admitted either to participate in research rotations with several faculty before deciding on a major professor and laboratory, or by direct admission into a specific lab and department. Ph.D. students typically enter via rotation and M.S. students typically enter via a direct admit. Those students admitted through a rotation admit are required to complete a minimum of three research lab rotations with faculty of interest and take MCDB 697 Graduate Research Rotation, during their first two semesters. At the end of their second semester, students on rotation must select a major professor from the faculty participating in the program. Current ISU graduate students may be admitted as a co-major or minor with MCDB.

Before entering the MCDB program, prospective students should have a strong background in the biological sciences; typically including work in biological sciences (two years), organic chemistry (one year), physics (one year), and mathematics (through one year of calculus). Prior research experience is highly encouraged. The submission of GRE General Test scores is required for admission.

Curriculum Requirements for MCDB

Ph.D. candidates majoring in MCDB must take at least 72 graduate credits. These 72 credits include the core course requirements (below) and applicable research credits earned. Credits taken during a student's M.S. program in MCDB at Iowa State University may count towards their Ph.D. in MCDB.

Students seeking an M.S. degree must take a total of 30 credits, with not less than 22 credits earned at ISU. M.S. students must take the core curriculum but need to complete only two of the three components in molecular biology, cell biology, or developmental biology.

Additional coursework for both Ph.D. and M.S. degrees may be selected by the student in consultation with his/her Program of Study (POS) Committee to meet departmental requirements and to satisfactorily prepare the student for their research project.

Graduate credits of B or better earned at another institution may be transferred at the discretion of the POS Committee and with the approval of the MCDB Program and the ISU Graduate College.

Additional information relating to credits required for graduate degrees can be found in the ISU Graduate College Handbook (<http://www.grad-college.iastate.edu/common/handbook>).

MCDB Core Curriculum requirements include:

Two semester sequence of Biochemistry (either BBMB 404/BBMB 405 or BBMB 501/BBMB 502)

BBMB 404	Biochemistry I	3
BBMB 405	Biochemistry II	3
BBMB 501	Comprehensive Biochemistry I	4
BBMB 502	Comprehensive Biochemistry II	4

All Ph.D. students must take one course from each of the following areas: A) Cellular Biology, B) Developmental Biology, & C) Molecular Biology.

A. Cellular Biology

GDCB 528	Advances in Molecular Cell Biology	3
GDCB 529	Plant Cell Biology *See footnote	2
B M S 575	Cell Biology	3
BBMB 645	Molecular Signaling	2

B. Developmental Biology

GDCB 512	Plant Growth and Development *See footnote	2
GDCB 533	Principles of Developmental Biology	3

C. Molecular Biology

MICRO 502	Microbial Genetics and Genomics	3
GDCB 511	Molecular Genetics	3
GDCB 520	Genetic Engineering	3
GDCB 545	Plant Molecular Biology *See footnote	3
V MPM 608	Molecular Virology	3
BBMB 676	Biochemistry of Gene Expression in Eucaryotes	2

*Footnote: GDCB 545 - Plant Molecular, Cellular, and Developmental Biology may be used to fulfill any **one** of the required component areas.

In addition to the above course requirements, MCDB graduate students are required to take:

1. Two semesters of research seminar every year.

One of these seminars must be MCDB 698, Seminar in Molecular, Cellular, and Developmental Biology. In seminar, students will make journal and research presentations and attend MCDB seminars. Subject to approval by the POS committee, acceptable alternatives to fulfill the second seminar requirement include 1) a "for credit" research seminar series offered by the student's home department, 2) a workshop comprised of a research seminar series, or 3) another ISU research seminar series.

2. One credit hour of ethics training.

Not required, but highly recommended for MCDB graduate students:

BCB 544	Introduction to Bioinformatics	4
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Non-native English speakers must pass the English Requirement as established by the university. Depending on the results of this exam additional courses may be required to meet English proficiency standards.

MCDB graduate students need to teach one semester as part of their training for an advanced degree. Students whose first language is not English must take and pass the SPEAK/TEACH test to be eligible to teach.

Curriculum Requirements for Graduate Students Seeking a MCDB Minor

Graduate students studying at Iowa State University with an interest in completing a MCDB minor for their Ph.D. are required to complete the following curriculum requirements.

Students must be approved for the minor by the MCDB program and must follow Graduate College guidelines for POS Committee membership.

Graduate students wishing to seek a minor in MCDB are encouraged to contact the MCDB Interdepartmental Graduate Program Coordinator for further information. Inquiries can be submitted to idgp@iastate.edu.

MCDB Minor Curriculum at the Ph.D. Level Includes:

Two semester sequence of Biochemistry (either BBMB 404/BBMB 405 or BBMB 501/BBMB 502)

BBMB 404	Biochemistry I	3
BBMB 405	Biochemistry II	3
BBMB 501	Comprehensive Biochemistry I	4
BBMB 502	Comprehensive Biochemistry II	4

One course in each of two of the following three areas: A) Cellular Biology, B) Developmental Biology, & C) Molecular Biology.

A. Cellular Biology

GDCB 528	Advances in Molecular Cell Biology	3
GDCB 529	Plant Cell Biology *See footnote	2
B M S 575	Cell Biology	3
BBMB 645	Molecular Signaling	2

B. Developmental Biology

GDCB 512	Plant Growth and Development *See footnote	2
GDCB 533	Principles of Developmental Biology	3

C. Molecular Biology

MICRO 502	Microbial Genetics and Genomics	3
GDCB 511	Molecular Genetics	3
GDCB 520	Genetic Engineering	3
GDCB 545	Plant Molecular Biology *See footnote	3
V MPM 608	Molecular Virology	3
BBMB 676	Biochemistry of Gene Expression in Eucaryotes	2

*Footnote: GDCB 545 - Plant Molecular, Cellular, and Developmental Biology may be used to fulfill any **one** of the required component areas.

In addition to the above course requirements, MCDB graduate minors are required to register once for:

MCDB 698	Seminar in Molecular, Cellular, and Developmental Biology	1-2
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Courses primarily for graduate students, open to qualified undergraduates:

MCDB 511. Molecular Genetics.

(Cross-listed with GDCB). (3-0) Cr. 3. S. *Prereq: BIOL 313 and BBMB 405*
The principles of molecular genetics: gene structure and function at the molecular level, including regulation of gene expression, genetic rearrangement, and the organization of genetic information in prokaryotes and eukaryotes.

MCDB 512. Plant Growth and Development.

(Cross-listed with GDCB, PLBIO). (2-0) Cr. 2. S. *Prereq: BIOL 330 or a course in developmental biology; GDCB 545 or BBMB 404, BBMB 405 or GDCB 520*
Plant growth and development and its molecular genetic regulation. Hormone biosynthesis, metabolism, and action. Signal transduction in plants.

MCDB 520. Genetic Engineering.

(Cross-listed with BBMB, GDCB). (3-0) Cr. 3. Alt. S., offered 2012. *Prereq: GEN 411 or BBMB 405*

Strategies and rationale of recombinant DNA technologies. The methodology of genetic engineering in basic research and implications for applied research will be considered. Topics include: basic tools of molecular cloning, targeted mutagenesis, fluorescent proteins, protein expression systems, and transgenic model systems.

MCDB 528. Advances in Molecular Cell Biology.

(Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered 2012. *Prereq: Courses in general cell biology and biochemistry*
Cell biological processes including cell signaling, cell division, intracellular trafficking, biogenesis of organelles, cell adhesion and motility.

MCDB 529. Plant Cell Biology.

(Cross-listed with GDCB). (2-0) Cr. 2. Alt. F., offered 2011. *Prereq: BIOL 313, BIOL 314, BIOL 330 or BBMB 405*
Organization, function, and development of plant cells and subcellular structures.

MCDB 533. Principles of Developmental Biology.

(Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered 2011. *Prereq: BIOL 314*
Fundamental principles in multicellular development. Emphasis on cellular and molecular regulation of developmental processes, and experimental approaches as illustrated in classical studies and current literature.

MCDB 545. Plant Molecular Biology.

(Cross-listed with GDCB, PLBIO). (3-0) Cr. 3. Alt. F., offered 2011. *Prereq: BIOL 314, BIOL 330*
Organization and function of plant nuclear and organelle DNA; regulation of gene expression. Methods of generating novel genetic variation. Impact of plant biotechnology on agriculture.

MCDB 590. Special Topics.

Cr. arr. Repeatable.

Courses for graduate students:

MCDB 676. Biochemistry of Gene Expression in Eucaryotes.

(Cross-listed with BBMB). (2-0) Cr. 2. Alt. S., offered 2012. *Prereq: BBMB 404 or BBMB 501, BBMB 405 or BBMB 502 or GDCB 511*

Analysis of the biochemical processes involved in expression of eucaryotic genes and the regulation thereof, including RNA polymerase, transcriptional regulatory proteins, enhancers and silencers, chromosome structure, termination, RNA processing, RNA transport, RNA turnover, small RNAs translational regulation, protein turnover.

MCDB 697. Graduate Research Rotation.

Cr. 1-6. Repeatable. F.S.

Graduate research projects performed under the supervision of selected faculty members in the molecular, cellular, and developmental biology program.

MCDB 698. Seminar in Molecular, Cellular, and Developmental Biology.

(Cross-listed with BBMB, GDCB, MICRO, V MPM). (2-0) Cr. 1-2. Repeatable. F.S.
Student and faculty presentations.

MCDB 699. Research.

Cr. arr. Repeatable.