

# MOLECULAR, CELLULAR, AND DEVELOPMENTAL BIOLOGY

## MCDB Interdepartmental Graduate Program

Work is offered for the doctor of philosophy degree with a major in Molecular, Cellular, and Developmental Biology. Faculty are drawn from sixteen 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; Ecology, Evolution, & Organismal Biology; Entomology; Food Science & Human Nutrition; Genetics, Development & Cell Biology; Horticulture; Kinesiology; 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, fungal, plant, and animal systems. Additional information about the program and faculty is available at: [www.mcdb.iastate.edu](http://www.mcdb.iastate.edu) (<http://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 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.

## 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
BIOL 428	Cell Biology	3

## 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.

Additional coursework may be selected by the student in consultation with their 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 in another Iowa State program, or 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:

BBMB 404	Biochemistry I	3
BBMB 405	Biochemistry II	3

Students with a Biochemistry background can elect to take the 500-level sequence:

BBMB 504	Amino Acids and Proteins	2
BBMB 505	Bioenergetics and Metabolism	2
BBMB 506	Membrane Biochemistry	2
BBMB 507	Biochemistry of Nucleic Acids	2

**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 545	Plant Molecular, Cell and Developmental Biology *See footnote	3
B M S 575	Cell Biology	3
BBMB 645	Molecular Signaling	2

**B. Developmental Biology**

GDCB 533	Advances in Developmental Biology	3
GDCB 545	Plant Molecular, Cell and Developmental Biology *See footnote	3

**C. Molecular Biology**

MICRO 502	Microbial Genetics and Genomics	3
GDCB 511	Advanced Molecular Genetics	3
GDCB 545	Plant Molecular, Cell and Developmental 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.**

Fall semester students will enroll in 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, typically chosen from one of the following departments: Agronomy, Animal Science; Biochemistry, Biophysics & Molecular Biology; Biomedical Sciences; Chemistry; Chemical & Biological Engineering; Ecology, Evolution, & Organismal Biology; Entomology; Food Science & Human Nutrition; Genetics, Development & Cell Biology; Horticulture; Kinesiology; Physics & Astronomy; Plant Pathology; Veterinary Microbiology & Preventive Medicine; and Veterinary Pathology. (Options 2 and 3 are subject to approval by the POS committee).

Spring semester register for MCDB 698, Seminar in Molecular, Cellular, and Developmental Biology. In seminar, students will make journal and research presentations and attend MCDB seminars. Three semesters of MCDB 698 are required. Beyond this requirement, students must enroll in additional semesters of MCDB 698 or enroll in seminar series as described above for fall semesters.

**2. One credit hour of ethics training.**

GR ST 565	Responsible Conduct of Research in Science and Engineering	1
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**Not required, but highly recommended for MCDB graduate students:**

BCB 544	Fundamentals of 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 Oral English Certification Test (OECT) 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](mailto:idgp@iastate.edu).

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

BBMB 404	Biochemistry I	3
BBMB 405	Biochemistry II	3

Students with a Biochemistry background can elect to take the 500-level sequence:

BBMB 504	Amino Acids and Proteins	2
BBMB 505	Bioenergetics and Metabolism	2
BBMB 506	Membrane Biochemistry	2
BBMB 507	Biochemistry of Nucleic Acids	2

**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 545	Plant Molecular, Cell and Developmental Biology *See footnote	3
B M S 575	Cell Biology	3
BBMB 645	Molecular Signaling	2

**B. Developmental Biology**

GDCB 533	Advances in Developmental Biology	3
GDCB 545	Plant Molecular, Cell and Developmental Biology *See footnote	3

**C. Molecular Biology**

MICRO 502	Microbial Genetics and Genomics	3
GDCB 511	Advanced Molecular Genetics	3
GDCB 545	Plant Molecular, Cell and Developmental 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: Advanced Molecular Genetics**

(Cross-listed with GDCB). (3-0) Cr. 3. S.

*Prereq: BIOL 313 and BBMB 405*

Mechanisms of molecular genetic processes in eukaryotes and prokaryotes, including DNA replication and repair, transcription, translation and regulation of gene expression. Critical evaluation and discussion of current primary literature, methodologies and experimental data.

**MCDB 528: Advances in Molecular Cell Biology**

(Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered even-numbered years.

*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 533: Advances in Developmental Biology**

(Cross-listed with GDCB). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

*Prereq: BIOL 314 or Biol 423*

Fundamental principles in multicellular development. Emphasis on cellular and molecular regulation of developmental processes, and experimental approaches as illustrated in the current literature.

**MCDB 545: Plant Molecular, Cell and Developmental Biology**

(Cross-listed with GDCB, PLBIO). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

*Prereq: Biol 313, BIOL 314, BIOL 330 or BBMB 405*

Plant nuclear and organelle genomes; regulation of gene expression; hormone signaling; organization, function, and development of plant cells and subcellular structures; regulation of plant growth and development.

**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 even-numbered years.

*Prereq: BBMB 404 and BBMB 504; and BBMB 506 and BBMB 507; or BBMB 405 or BBMB 505 and 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. S.

Student and faculty presentations.

**MCDB 699: Research**

Cr. arr. Repeatable.