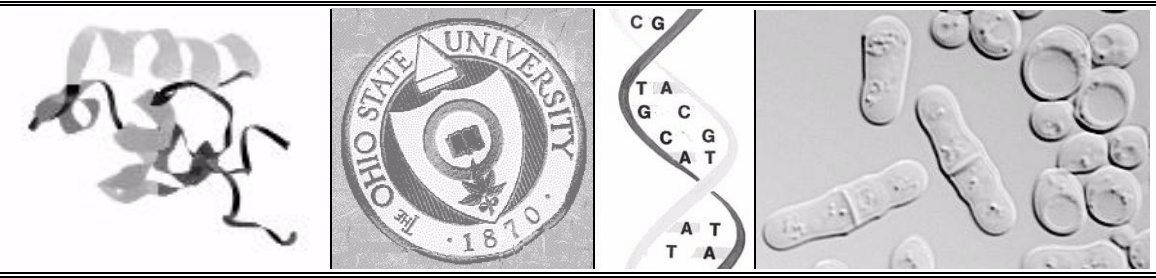
Manual for Undergraduate Studies

Molecular Genetics



Department of Molecular Genetics

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College of Biological Sciences, The Ohio State University

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Undergraduate Degrees Offered: Bachelor of Science

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Description

The faculty of the Department of Molecular Genetics teaches and conducts research in genetics, epigenetics, molecular biology, cell biology, and developmental biology. They investigate scientific problems from the molecular to the population level, and they study viruses, fungi, protists, plants and animals as well as human beings. In spite of this diversity of interests and the broad mission of the department, the faculty shares the use of techniques from genetics and molecular biology, and common interest in the structure, expression, and evolution of genes.

The use of molecular genetic tools is revolutionizing many areas of biology. The Molecular Genetics major provides the student with the background needed for success in a graduate program leading to an exciting career in the most active areas of pure and applied biology. The major provides an excellent entry route for professional schools in dentistry, medicine and veterinary medicine, where expertise in molecular, cellular, developmental, and traditional genetics is of increasing importance.

Planning a Major program.

All students are required to meet with their advisor as soon as possible when planning a major program. It is strongly encouraged that students begin the molecular genetic core courses in their sophomore year (see sample curriculum on page 8).

Completion of The Molecular Genetics Major also satisfies the GE – Statistics requirement. Molecular Genetics 5650 provides additional statistical material to those requiring additional experience.

Students with 2 consecutive semesters of independent laboratory research (Mol Gen 4998/4998H/4999/4999H) may forgo the Molecular Genetics 5601 and 5602 requirements. Your advisor must approve this substitution.

A sample curriculum is shown on page 8 of this manual.

COURSES IN THE MAJOR MUST BE APPROVED BY YOUR ADVISOR

A minimum grade of C- is required in each course in the molecular genetics major (Core Requirements and Electives)

30 or more semester hours are required for the molecular genetics major, for more details please see the list of core and elective courses beginning on page 4

Molecular Genetics Undergraduate Major

Part A. Required Prerequisites (do not count toward the 30 hour major)

1. Bio 1113 (4) AND 1114 (4)
2. Chem 1210 (5) AND Chem 1220 (5)
3. Chem 2510 (4), 2520 (4), 2540 (2), and 2550 (2)
4. Math 1149 or Math 1150 Pre-Calculus (5) AND Math 1156 Calculus for Biological Sciences (5) or Math 1151 (5)
5. Physics 1200 (5) AND 1201 (5)

Honors or more advanced versions for any of these courses are acceptable.

Part B. Core Requirements (the core comprises at least 19 credit hours of the 30 credit hour major):

1. Biochemistry 4511 (4) OR
   Biochemistry 5613 (3) AND Biochemistry 5614 (3)
2. Mol Gen4606 Molecular Genetics (4).
3. Mol Gen 5607 Cell Biology (3) or Mol Gen 5607E (4)
4. Mol Gen 5608 Genes and Development (3) or Mol Gen 5608E (4)
5. Mol Gen 5645 Quantitative, Population and Evolutionary Genetics (2)
6. Mol Gen 5601 Molecular Genetics Lab (3-4) or Mol Gen 5602 Cell and Developmental Biology Lab (3-4). Both lab courses require either Mol Gen 4606 or Mol Gen 4500 as a prerequisite. Mol Gen majors may substitute 4 semester credit hours of Undergraduate Research (either Mol Gen 4998, 4998H, 4999, or 4999H from two consequitive semesters) for the Mol Gen laboratory requirement.

Part C. Electives (choose at least 3 electives from the following list; electives plus the core must total at least 30 credit hours):

Mol Gen 2220H Introduction to Molecular Life Sciences: Research Opportunities and Career Options (1)
Mol Gen 4503 Molecular Genetics Writing Project (1)
Mol Gen 4591S DNA Fingerprinting Workshop (1)
Mol Gen 4998 (or 4998H) Undergraduate Research and/or Mol Gen 4999 (or 4999H) Thesis Research (up to 3 semester credit hours can counts towards the 30 credit hour major requirement and can count as one of the three required electives if not used as a substitute for the Mol Gen lab requirement)
Mol Gen 5193 Individual Studies (1-3) (No more than 3 semester credit hours can count towards the major)

Mol Gen 5194 Group Studies (1-3) (No more than 3 semester credit hours can count towards the major)
Mol Gen 5632 Insect Molecular Genetics (2)
Mol Gen 5643 Plant Anatomy (3)
Mol Gen 5650 Analysis and Interpretation of Biological Data (3)
Mol Gen 5797 Study at a Foreign Institution (1-15) (No more than 3 semester credit hours of 5797 or 5798 can count towards the major)
Mol Gen 5798 Study Tour: Domestic (1-15) (No more than 3 semester credit hours of 5797 or 5798 can count towards the major)

Completion of the Mol Gen Core (Mol Gen 4606, 5607, 5608, and 5645) is a prerequisite for most other 5000 or 6000 level Mol Gen courses.

Mol Gen 5623 Genetics and Genomics (2)
Mol Gen 5630 Plant Physiology (3)
Mol Gen 5700 Systems of Genetic Analysis (3)
Mol Gen 5701 DNA Transactions and Gene Regulation (4)
Mol Gen 5705 Advances in Cell Biology (2)
Mol Gen 5715 Developmental Genetics (2)
Mol Gen 5733 Human Genetics (2)
Mol Gen 5735 Plant Biochemistry (3)
Mol Gen 5796 Current Topics in Signal Transduction (1 or 2)
Mol Gen 6625 Plant Metabolic Engineering (2)
Mol Gen 6725 Circadian Biology (2)
Mol Gen 6741 Reproductive Biology of Flowering Plants (2)
Mol Gen 6795 Special Topics in Molecular Genetics (1-3)

Biochem 5621 Introduction to Biological Chemistry Laboratory (4)

EEOB 4520 Comparative Physiology (3)
EEOB 6310 Molecular Evolution (3)

Micro 4100 General Microbiology (5)
*NOTE: Micro 4000 is **NOT** eligible as a molecular genetics elective course*
Micro 4130 Microbial Genetics (3)
Micro 4140 Molecular Microbiology Lab (3)
Micro 5161H Bioinformatics and Molecular Microbiology (3)
Micro 6080 Advanced Microbial Genetics (3)

Other elective courses may be substituted with permission of advisor.

Molecular Genetics Undergraduate Major with a Plant Cellular and Molecular Biology (PCMB) Specialization - Semesters

Part A. Required Prerequisites (do not count toward the 30 hour major)

1. Bio 1113 (4) AND 1114 (4)
2. Chem 1210 (5) AND Chem 1220 (5)
3. Chem 2510 (4), 2520 (4), 2540 (2), and 2550 (2)
4. Math 1149 or Math 1150 Pre-Calculus (5) AND Math 1156 Calculus for Biological Sciences (5) or Math 1151 (5)
5. Physics 1200 (5) AND 1201 (5)

Honors or more advanced versions for any of these courses are acceptable.

Part B. Core Requirements (the core comprises at least 20 credit hours of the 30 credit hour major):

1. Biochemistry 4511 (4) OR
   Biochemistry 5613 (3) AND Biochemistry 5614 (3)
2. Mol Gen 4606 Molecular Genetics (4).
3. Mol Gen 5607 Cell Biology (3) or Mol Gen 5607E (4)
4. Mol Gen 5608 Genes and Development (3) or Mol Gen 5608E (4)
5. Mol Gen 3300 General Plant Biology (3)
6. Mol Gen 3436 Introductory Plant Physiology (3)

Part C. Electives (choose at least 3 electives from the following list; electives plus the core must total at least 30 credit hours):

Mol Gen 4503 Molecular Genetics Writing Project (on a PCMB topic) (1)
Mol Gen 4998 (or 4998H) Undergraduate Research and/or Mol Gen 4999 (or 4999H) Thesis Research (up to 4 semester credit hours of research in a plant lab can count towards the PCMB specialization)
Mol Gen 5193 Individual Studies (on a PCMB topic) (1-3) (No more than 3 semester credit hours can count towards the major)
Mol Gen 5194 Group Studies (on a PCMB topic) (1-3) (No more than 3 semester credit hours can count towards the major)
Mol Gen 5601 Molecular Genetics Lab or Mol Gen 5602 Cell and Developmental Biology Lab with a plant module (3-4)
Mol Gen 5630 Plant Physiology (3)
Mol Gen 5643 Plant Anatomy (3)
Mol Gen 5645 Quantitative, Population and Evolutionary Genetics (2)
Mol Gen 5735 Plant Biochemistry (3)
Mol Gen 5797 Study at a Foreign Institution (1-15) with a plant focus (No more than 3 semester credit hours of 5797 or 5798 can count towards the major)

Mol Gen 5798 Study Tour: Domestic (1-15) with a plant focus (No more than 3 semester credit hours of 5797 or 5798 can count towards the major)
Mol Gen 6625 Plant Metabolic Engineering (2)
Mol Gen 6741 Reproductive Biology of Flowering Plants (2)
Mol Gen 6795 Special Topics in Molecular Genetics (on a PCMB topic) (1-3)

Plant Pathology 703 Successor: Agricultural Genomics: Principles and Applications (2?)

Other elective courses may be substituted with permission of advisor.

BS/MS in Molecular Genetics

A combined BS/MS Degree in Molecular Genetics is an opportunity for qualified undergraduates in Molecular Genetics to begin the Master's program in Molecular Genetics during their senior year, with the possibility of completing the Master's degree the following year. Students who are accepted in to the Molecular Genetics BS/MS Program are allowed to double count up to 10 semester credit hours of classes toward both the undergraduate and graduate degrees.

If you are interested in the pathway, please talk to your Molecular Genetics major advisor!

Eligibility

Students must meet all requirements set by the Graduate School for combined BS/MS programs. These requirements can be found in in Section VIII.1 of the Graduate School Handbook (http://www.gradsch.osu.edu/8.1-combined-programs.html) and include the following criteria:

- Senior level standing in Molecular Genetics
- Completion of 90 undergraduate credit hours
- Minimum 3.5 cumulative GPA in all previous undergraduate work (this is a Graduate School requirement).
- Application for admission to the Molecular Genetics Master's program (indication that you want to complete a BS/MS degree)
  Admission by the Molecular Genetics Graduate Studies Committee and the OSU Graduate School

Molecular Genetics Undergraduate Major
Sample Semester Program **

Year 1			
Autumn:		**Spring:**	
Biology 1113	4	Biology 1114	4
Chemistry 1210	5	Chemistry 1220	5
Math 1149 or 1150	5	Math 1156	5
A&S Survey	1	GE/Free Electives	3
Semester Total	**15**	**Semester Total**	**17**

Year 2			
Autumn:		**Spring:**	
Mol Gen 4606	4	Physics 1201	5
Chemistry 2510	4	Chemistry 2520	4
Physics 1200	5	Chemistry 2540	2
GE/Free Electives	3	GE/Free Electives	4
Semester Total	**16**	**Semester Total**	**15**

Year 3			
Autumn:		**Spring:**	
Mol Gen 5607	3	Mol Gen 5608	3
Biochemistry 4511	4	Mol Gen 5645	2
Chemistry 2550	2	Mol Gen 5601 or 5602	4
GE/Free Electives	6	GE/Free Electives	6
Semester Total	**15**	**Semester Total**	**15**

Year 4			
Autumn:		**Spring:**	
Major Elective I	3	Major Elective III	3
Major Elective II	3	GE/Free Electives	11
GE/Free Electives	8		
Semester Total	**14**	**Semester Total**	**14**

GRAND TOTAL: 121 Semester Credit Hours

**** Please note, this is a "sample" program, the timing of your individual plan may vary.**

Mol Gen 4606 is offered autumn and spring semester
Lab courses: Mol Gen 5601 (autumn); Mol Gen 5602 (spring)
Mol Gen5645 is tentatively scheduled to be offered in spring semester

Molecular Genetics Undergraduate Minor*

Required prerequisites

- ❑ Biology 1113 and Biology 1114
- ❑ Chemistry 1210 and 1220

Honors or more advanced versions of these prerequisite courses can be substituted.

Required Core Courses

One of the following courses:

- ❑ Mol Gen 4500 (3) or Mol Gen 4500E (4)
- ❑ Mol Gen 4606 (4)

At least two of the following courses:

- ❑ Mol Gen 5607 (3) or 5607E (4)
- ❑ Mol Gen 5608 (3) or 5608E (4)
- ❑ Mol Gen 5645 (2)

Elective Courses

(Core plus electives must total at least 14 semester credit hours; no more than 5 semester credit hours can be graded S/U and count towards the Minor)

- ❑ Mol Gen 2220H (1)
- ❑ Mol Gen 4503 (1)
- ❑ Mol Gen 4591S (1)
- ❑ Mol Gen 4998 or 4998H (1-5)
- ❑ Mol Gen 5193 (1-3)
- ❑ Mol Gen 5194 (1-3)
- ❑ Mol Gen 5601 or 5602 (3-4)
- ❑ Mol Gen 5632 (2)
- ❑ Mol Gen 5650 (3)
- ❑ Micro 5081 (3)
- ❑ Micro 5161H (3)

- ❑ Alternative elective(s) may be approved by MG advisor

* A minimum grade of C- is required in each course in the molecular genetics minor

Plant Biology Undergraduate Minor

Required prerequisites

❏ Biology 1113 and Biology 1114
❏ Chemistry 1210 and 1220
Honors or more advanced versions of these courses are acceptable.

Required Core Course

❏ Mol Gen 3300 General Plant Biology (3)

Elective Courses

(Electives must total at least 11 semester credit hours; no more than 5 semester credit hours can be graded S/U and count towards the Minor)

❏ Mol Gen 3436 Introductory Plant Physiology (3)

❏ Mol Gen 4503 Molecular Genetics Writing Project **on** a plant topic (1)

❏ Mol Gen 4998 or 4998H Undergraduate Research (in a plant lab). Up to 4 semester hours can count towards the minor.

❏ Mol Gen 5193 Individual Studies on a plant topic (Up to 3 semester hours can count towards the minor).

❏ Mol Gen 5194 Group Studies on a plant topic (Up to 3 semester hours can count towards the minor).

❏ Mol Gen 5601 Molecular Genetics Lab or 5602 Cell and Developmental Biology Lab **with** a plant module (3-4)

❏ Mol Gen 5630 Plant Physiology (3)

❏ Mol Gen 5643 Plant Anatomy (3)

❏ Mol Gen 5735 Plant Biochemistry (3)

❏ Mol Gen 6625 Plant Metabolic Engineering (2)

❏ Alternative elective(s) may be approved by Mol Gen Plant advisor

The minor program must be approved by a Plant Biology faculty advisor from the Department of Molecular Genetics.

* A minimum grade of C- is required in each course in the molecular genetics minor

Dual majors.

Must consist of at least 23 unique hours in each major. The Mol Gen major has the usual 30-hour minimum and format.

Molecular Genetics Courses for Undergraduate Majors and Minors

2220H Introduction to Molecular Life Sciences: Research Opportunities and Career Options U 1
Faculty presentations and facility tours to introduce first- and second- year students to research opportunities in molecular life sciences.

- Autumn semester.
- 1 55-min class.
- Graded S/U
- Prerequisite: Honors standing or permission of instructor
- Not open to students with credit for Mol Gen 220H

3300 General Plant Biology U 3
Plant structure and function; growth and development; diversity, reproduction, and evolution of lower and flowering plants; people, the biosphere, and plant diversity.

- Spring semester
- 2 55-min lectures and 1 3-hr lab
- Prerequisite: Biology 1101 (101) or 1113 (113) or 1113H (115H)
- Not open to students with credit for Plant Bio 300 or HCS 300

3436 Introductory Plant Physiology U 3
Topics in plant physiology at the introductory level: diffusion, transpiration, water stress, translocation, photosynthesis, plant growth hormones, tropisms, flowering, and fruit development.

- Autumn semester
- 3 55-min lectures
- Prerequisite: Biology 1113 (113) or 1113H (115H), and 1114 (114) or 1114H (116H), and 6 cr hrs in Chem; or permission of instructor
- Not open to students with credit for Mol Gen 5630, Plant Bio 436, 630, or 631

4500 General Genetics U 3
The principles of genetics, including molecular genetics, transmission genetics of prokaryotes and eukaryotes, developmental and non-chromosomal genetics, recombinant DNA and genomics, and the genetics and evolution of populations.

- Autumn, Spring, Summer semesters
- 3 55-min lectures
- Prerequisite: Biology 1101 (101) or 1113 (113) or 1113H (115H), and 3 additional cr hrs in Biological Sciences
- Not open to students with credit for Mol Gen 4606 (605 or 606), 500, or 500H

4500E General Genetics U 4
The principles of genetics, including molecular genetics, transmission genetics of prokaryotes and eukaryotes, developmental and non-chromosomal genetics, recombinant DNA and genomics, and the genetics and evolution of populations.

- Autumn, Spring semester
- 3 55-min lectures plus 1 55-min honors specific recitation
- Prerequisite: Biology 1101 (101) or 1113 (113) or 1113H, (115H), and 3 additional cr hrs in Biological Sciences, and Honors standing; or permission of instructor
- Not open to students with credit for Mol Gen 4606 (605 or 606), 500, or 500H

4503 Molecular Genetics Writing Project U 1
Practice in searching, reading, and analyzing literature in molecular genetics, and in written and oral presentation. Please see additional information provided on page 12.

- Summer, Autumn, Spring semesters.
- Time arranged.
- Open to Molecular Genetics majors only or by permission of instructor.
- Prerequisite: Mol Gen 4500 (500) or 4606 (606)
- Not open to students with credit for 503

4591S DNA Finger Printing Workshops in Columbus Public Schools U 1
A service learning course whereby undergraduates mentor high school students in molecular biology workshops.

- Spring semester.
- Repeatable to a maximum of 3 cr hours.
- Undergraduates present workshops in Columbus Public Schools
- Prerequisite: Mol Gen 4500 (500) or 4606 (606).
- Cross-listed in Biochemistry and Microbiology
- Graded S/U

4606 Molecular Genetics U 4
A comprehensive genetics course for majors covering transmission and molecular genetics; DNA replication, repair and mutation; transcription and translation; analysis and manipulation of genes at the molecular level.

- Autumn, Spring semester.
- 3 55-min lectures and 1 55-min recitation
- Prerequisite: Biology 1113 (113) or 1113H (115H), and 1114 (114) or 1114H (116H), and Chem 1210 and 1220 or equivalent; or permission of instructor
- Not open to students with credit for 605 or 606, or 4500 (500) unless waived by instructor

4998/4998H Undergraduate Research in Molecular Genetics U 1-5
Undergraduate research in molecular genetics.

- Arrange
- Graded S/U

4999/4999H Thesis Research in Molecular Genetics U 1-5
A program of reading and research leading to a senior thesis.

- Arrange
- Graded S/U

5193 Individual Studies U G 1-3
Problem may be selected in the fields of molecular genetics, genomics, cell biology, developmental biology and plant sciences.

- Arrange

5194 Group Studies U G 1-3
Group study of special topics in the fields of molecular genetics, genomics, cell biology, developmental biology, and plant sciences.

- Arrange

5601 Eukaryotic Molecular Genetics Laboratory U G 3 or 4
Current laboratory techniques used in the genetic, cellular, and molecular analyses of yeast, Drosophila, and other model systems.

- Autumn semester
- Typically 2 5-hr labs
- Prerequisite: Mol Gen 4500 (500) or 4606 (606), and Biochemistry 4511 (511) or equiv; or permission of instructor
- Not open to students with credit for 5602 (602) without permission of instructor, or Mol Gen 601

5602 Eukaryotic Cell and Developmental Biology Laboratory U G 3 or 4
Laboratory course emphasizing techniques and methods central to cell and developmental biology of eukaryotes.

- Spring semester.
- Typically 2 5-hr labs
- Prerequisite: Mol Gen 4500 (500) or 4606 (606), and Biochemistry 4511 (511) or equiv; or permission of instructor
- Not open to students with credit for 5601 (601) without permission of instructor, or Mol Gen 602

5607 Cell Biology U G 3
Analysis of the structure and function of animal and plant cells and their components, stressing molecular genetic and biochemical approaches.

- 3 55-min lectures.
- Autumn semester
- Prerequisite: Mol Gen 4500 (500) or 4606 (606)
- Not open to students with credit for Mol Gen 607, 607H, 5607E

5607E Cell Biology U G 4
Analysis of the structure and function of animal and plant cells and their components, stressing molecular genetic and biochemical approaches. Embedded Honors includes a recitation that explores cell biology topics from the primary literature.

- 3 55-min lectures and 1 55-min recitation.
- Autumn semester
- Prerequisite: Honors standing, and either Mol Gen 4500 (500) or 4606 (606); or permission of instructor
- Not open to students with credit for Mol Gen 607, 607H, 5607E

5608 Genes & Development U G 3
Analysis of animal and plant development using modern genetic approaches.

- Spring semester
- 3 55-min lectures.
- Prerequisite: Mol Gen 4500 (500) or 4606 (606)
- Not open to students with credit for Mol Gen 5608E or 608

5608E Genes & Development U G 4
Analysis of animal and plant development using modern genetic approaches. Honors Embedded includes a faculty led recitation that explores developmental biology topics from the primary literature.

- Spring semester
- 3 55-min lectures and 1 55-min recitation.
- Prerequisite: Honors standing, and either Mol Gen 4500 (500) or 4606 (606); or permission of instructor
- Not open to students with credit for Mol Gen 5608E or 60.

5623 Genetics and Genomics U G 2
A survey and discussion of genomic studies applied to fungal, animal, or plants systems.

- Autumn or Spring semester
- 2 55-min lectures.
- Prerequisite: Either Mol Gen 4500 (500) or 4606 (606), and 5607 (607),,and 5608 (608); or Grad standing; or permission of instructor
- Not open to students with credit for Plant Bio 623

5630 Plant Physiology U G 3
Advanced study of plant physiology; regulation of plant growth and development, hormones, and stress physiology

- Autumn semester
- 3 55-min lectures.
- Prerequisite 3300 (Plant Bio 300 or HCS 300), 4500 (500) or 4606 (606), Biology 1114 (114) or 1114H (116H); or permission of instructor
- Not open to students with credit for Plant Bio 630 or 631

5632 Insect Molecular Genetics U G 2
Structure, genetics, and methodology of insect genes and genomes.

- TBD
- 2 55-min lectures.
- Prerequisite Mol Gen 4500 (500) or 4606 (606).
- Not open to students with credit for 632 or Entomology 632

5643 Plant Anatomy U G 3
The structure, function, and development of cells, tissues, and organs of vascular plants.

- Spring semester
- Prerequisite 3300 (Plant Bio 300 or HCS 300), Biology 1114 (114) or 1114H (116H), and 6 cr hrs in Life Sciences; or permission of instructor
- Not open to students with credit for Plant Bio 643

5645 Quantitative, Population, and Evolutionary Genetics U G 2
The genetics of populations, including quantitative, population, and evolutionary genetics.

- Autumn or Spring semester
- 2 55-min lectures
- Prerequisite Mol Gen 4500 (500) or 4606 (606).
- Not open to students with credit for 640 or EEOB 640 or EEOB 6310

5650 Analysis & Interpretation of Biological Data I U G 5
Methods of analyzing biological data including: sampling, descriptive statistics, distributions, analysis of variance, inference, regression, and correlation. Emphasizes practical applications of statistics in the biological sciences.

- Autumn semester.
- 3-55min lectures
- Prerequisite: Math 1149 or 1150 (150) or equivalent, and 10 semester cr hrs at the 3000-level (or 300 level in the quarter system) or above in Agricultural or Biological Sciences; or permission of instructor
- Not open to students with credit for 650

5660 Integrated Molecular and Cellular Biology for Non-Biologists U G 5
Overview of molecular and cellular biology of single cells, tissues, organisms and their interactions, including genetics and biochemistry of single cells.

- Autumn semester.
- Prerequisite: Biology 1101 (101) or equivalent; or permission of instructor
- Not open to students with credit for 4500 (500), 4606 (606), 605, 660, 661, or Math 5660

5700 Systems of Genetic Analysis U G 3
Analysis of select fungal, invertebrate, vertebrate, and plant model systems used in modern experimental genetics.

- Autumn semester.
- 3 55-min classes.
- Prerequisite: Either 4500 (500) or 4606 (606), and 5607 (607), and 5608 (608); or Grad standing; or permission of instructor
- Not open to students with credit for 700

5701 DNA Transactions and Gene Regulation U G 4
Understanding mechanisms of DNA replication, DNA repair and recombination, transcription, translation, regulation of gene expression, and the experimental approaches to these topics.

- Autumn semester.
- 3 74--min classes.
- Prerequisite: Either 4500 (500) or 4606 (606), and Biochemistry 4511 (511) or equiv, and Sr. standing; or Grad standing; or permission of instructor
- Not open to students with credit for Biochemistry 5701 (701) or 702 or Mol Gen 701

5705 Advances in Cell Biology U G 2
An advanced study of selected key areas of research in eukaryotic cell biology.

- Spring semester, 1st Term
- Prerequisite: Either 4500 (500) or 4606 (606), and 5607 (607), and 5608 (608), and 5701 (701); or Grad standing; or permission of instructor
- Not open to students with credit for 705

5715 Developmental Genetics U G 2
An advanced study of the regulation of developmentally significant genes and cellular interactions involved in differentiation and pattern formation in invertebrate, vertebrate, and plant model organisms.

- Spring semester, 2nd Term
- Prerequisite: Either 4500 (500) or 4606 (606), and 5607 (607), and 5608 (608), and 5700 (700), 5701 (701); or Grad standing; or permission of instructor
- Not open to students with credit for 71.

5733 Human Genetics U G 2
The principles of human genetics covering mapping of disease genes, defects causing human disease, the cloning of disease genes, gene therapy, transgenes, and specific pathological disorders.

- Autumn or Spring semester.
- Prerequisite: Either 4500 (500) or 4606 (606) or equivalent, and Sr. standing; or Grad standing; or permission of instructor
- Not open to students with credit for 733, MolBioC 5733(733), or Pathology 5733 (733)

5735 Plant Biochemistry U G 3
Focus on biochemical processes unique to plants, including photosynthesis, respiration, carbon fixation and carbohydrate metabolic networks, cell wall and lipid synthesis, and nitrogen and sulfur assimilation for macromolecular synthesis.

- Spring semester
- Prerequisite: Biochemistry 4511 (511) or equivalent
- Not open to students with credit for Plant Bio 736

5796 Current Topics in Signal Transduction U G 1 or 2
A discussion of signal transduction mechanisms in animal, fungal, and plant systems.

- Autumn or Spring semester
- Prerequisite: 5607 (607), 5608 (608), Biochemistry 4511 (511) or equivalent; or Grad standing; or permission of instructor
- Not open to students with credit for Plant Bio 796

5797 Study at a Foreign Institution U G 1 - 15
Specific content, location, semester(s) of offering, and prerequisites vary; contact department office for details.

- Arrange
- Prerequisite: Permission of instructor

5798 Study Tour: Domestic U G 1 - 15
Specific content, location, semester(s) of offering, and prerequisites vary; contact department office for details.

- Arrange
- Prerequisite: Permission of instructor

6625 Plant Metabolic Engineering U G 2
Plant metabolic engineering with particular emphasis on the emerging role of plants and cultured plant cells as bioreactors.

- Autumn or Spring semester.
- Prerequisite: Either 4500 (500) or 4606 (606), 5735 or Plant Bio 735; or permission of instructor
- Not open to students with credit for Plant Bio 625

6725 Circadian Biology U G 2
Introduction to and discussion of the phenomenology and molecular mechanisms of the circadian timing system of five model systems.

- TBD
- Prerequisite: Either 4500 (500) or 4606 (606); or permission of instructor
- Not open to students with credit for Plant Bio 725

6741 Reproductive Biology of Flowering Plants U G 2
An advanced course on reproductive processes in flowering plants with emphasis on recent biochemical, molecular, and genetic approaches.

- TBD
- Prerequisite: Grad standing or permission of instructor
- Not open to students with credit for Plant Bio 741

6795 Special Topics in Molecular Genetics U G 1-3
Lecture/discussion in a seminar format of publications, current research, or research techniques in the areas of cell biology, development, genetics, genomics, molecular biology, or plant biology.

- TBD
- Prerequisite: Permission of instructor

Molecular Genetics 4503: Molecular Genetics Writing Project

1. Who should take Mol Gen 4503?

Mol Gen 4503 is appropriate for students who wish to develop their writing skills while conducting library research on a topic of interest to them.

2. How do I enroll in Mol Gen 4503?

To enroll in Mol Gen 4503, you must first obtain permission from a faculty member who is willing to supervise you. You should first match your interests with one or more faculty. The faculty and their interests are listed in the Molecular Genetics Undergraduate Handbook or from the departmental web site (http://molgen.osu.edu/). After you have chosen one or more faculty as potential Mol Gen 4503 advisors, you should make appointments to visit them and discuss the potential project. After a faculty member has agreed to advise you, you will need to go to the Molecular Genetics Office (112 Biological Sciences Building) and obtain the call number that corresponds to the advising faculty member.

3. After I enroll in Mol Gen 4503, what will I do?

What will be expected of you will depend, to some extent, on the supervising faculty member. A paper (normally 10-15 pages double spaced) and a 15 minute oral presentation are required in all cases. The oral presentations are often given at lab meetings of the supervising faculty's lab group. Generally it is good to make an appointment with the supervising faculty member as early as possible in the semester so that you can clarify requirements and schedule. In most cases, you will be expected to carry out a thorough literature search of your topic, prepare an outline for the paper and one or more draft versions of the paper before preparing and submitting the final version. You should meet with the supervising faculty member at each stage to discuss your progress and have her/him critique your outline and drafts.

If you have questions, or a problem develops, you may contact the coordinating advisor:

Dr. Gregory Booton, Telephone 688-1355, E-mail: booton.1@osu.edu

Research Opportunities for Undergraduates in Molecular Genetics

Undergraduate students in Molecular Genetics have many exciting career options. Many of our graduates go on to medical, dental, veterinary, or other professional schools. Some pursue graduate degrees in order to qualify for university faculty appointments or research positions in industrial or government laboratories. Other graduates go directly to positions in biology-oriented businesses such as biotechnology, pharmaceuticals, or agriculture.

Biologists are increasingly able to analyze and manipulate the genetic material of important organisms. This includes, for example, the ability to sequence DNA and move genes between different organisms. Now, more than ever before, rigorous and modern programs in life sciences must include an intensive laboratory experience.

While in the past every biologist had to know how to use a microscope, today's students must be familiar with methods such as recombinant DNA techniques. For the student with hands-on experience in modern laboratory techniques, access to all the career choices mentioned above is more open.

The Department of Molecular Genetics has created an academic program that emphasizes the laboratory experience in two ways.

1. Junior and senior students take at least one of two laboratory courses involving rigorous and intensive training in Molecular Biology and Molecular Genetics (**Mol Gen5601**) and in Cell Biology and Developmental Biology (**Mol Gen 5602**). Additionally, our students are encouraged to take non-departmental (elective) laboratory courses offered in Biochemistry and Microbiology. These formal courses are general in the sense that students are exposed to a wide variety of techniques and exercises.
2. Our students are encouraged to work in one of our research laboratories for credit under **Mol Gen 4998/4998H/4999/4999H**. This research experience allows the student to focus on a specific area of the field and gives exposure to modern research techniques. Students are encouraged to contact MG faculty regarding research opportunities early in their academic career, e.g., in their sophomore year.
3. Non-honors students receiving credit for Mol Gen 4998/4999 are potentially able to present the results of these investigations in an oral presentation, and in a written thesis and be eligible to receive a degree with "research distinction" in molecular genetics. Interested students should contact their Mol Gen advisor for additional information.
4. Honors students receiving credit for 4888H/4999H should review the additional information below regarding Honors research.

As noted above, the faculty of the Department of Molecular Genetics conducts research in genetics, molecular biology, cell biology and developmental biology. They approach scientific problems from the molecular to the population level in a number of different research areas. The faculty members study viruses, fungi, protists, plants and animals, as well as human beings. Although these systems and organisms are diverse, it is important to recognize that -- at the molecular level -- all organisms are founded upon a uniform genetic plan, based upon nucleic acids.

A student interested in this research experience should access the department web site to research information about faculty members: **http://molgen.osu.edu** After reviewing this information, the student should confer with their advisor about their top selections, or directly proceed to visit those labs of greatest interest.

The student arranges to meet with one or more of the faculty to discuss the possibility of doing research in the faculty member's lab. When a faculty member has agreed to supervise the student's research, the student enrolls in **Mol Gen 4998/4998H** (Individual Studies) to receive from one-to-three credit hours per semester for working in the laboratory. Initially, the student should regularly meet with the faculty research advisor and their graduate students, to receive the training necessary to implement the project.

The training period usually lasts one to two semesters, during which time the student will accumulate credit hours toward their degree. In most cases, after the student is trained in a variety of practical aspects of the discipline, they become a valuable and productive member of the laboratory staff and may continue the independent study for two-to-four additional semesters. The goal for the student should be to obtain sufficient data to warrant a publication in a respected journal.

A Research Track for Molecular Genetics Honors Students

For students in the honors program, an additional option is **Mol Gen 4998H**, Honors Research. Students enrolled in this program carry out research projects that culminate in a written thesis. After successfully completing the thesis --and with approval from the Arts and Sciences Committee -- the student is eligible for "Graduation with Distinction in Molecular Genetics." Graduation with distinction is a mark of excellence that documents the student's desire to pursue an active research career.

Students enrolled in the honors program who wish to participate in research should contact the undergraduate honors advisor. Because of the protracted training period of one-to-three semesters, it is necessary for students to begin their research well before their senior year. We recommend that students make initial contacts with potential research advisors early in their academic career. This contact can even occur before students begin their molecular genetics core courses, e.g. early in their sophomore year. This allows ample time for the training period and planning for the **Mol Gen 4998H** project. Early lab experience also provides the students with the opportunity to do summer research.

This summer experience is especially important for **Mol Gen 4998H**. A number of scholarships are available to undergraduate researchers for summer support, and in some cases, the faculty advisor may be able to provide support. Interested students should contact the honors office for recent information regarding funding sources for undergraduate research. The honors program in Molecular Genetics is a research-experience based curriculum and all honors students are encouraged to participate.

Although undergraduate honors research is not required for graduation, the Department strongly emphasizes this research. A frequently asked question is ***"***Why should a student spend their time and effort on an undergraduate research project?" There are several important points that address this question:

1. A research experience helps the student to decide between career options. The undergraduate research option exposes the student to the real world of experimentation and inquiry. Some students will find research exciting. Others will find it tedious after a semester or so and decide that bench-level science is not their optimal career objective, in which case the student can withdraw from the laboratory without penalty and is still enriched by the experience.

2. A research specialty is a mark of distinction. By taking advantage of research opportunities, the student becomes an attractive and competitive candidate for the best professional and graduate schools. These graduate and professional programs are fiercely competitive and entrance committees carefully look for evidence that the student has done more than merely attend classes and pass exams with high marks. Tangible signs of success -- such as the student's name on a scientific publication or abstract, an honors thesis, or obtaining scholarships or awards for research -- are very attractive additions to an application. Even without these, the student's record will document their expertise in performing specialized techniques that could be listed on their resume. Finally, the student performs original research and finds it intellectually gratifying to make new findings in science.

3. Working in a laboratory allows the student to get to know the faculty and vice versa. It is unfortunate, but true, that some students receive a degree and never get to know any faculty members outside of the classroom. Our faculty members have national and international reputations in the scientific community. Their letters of recommendation are an important component of successful applications to graduate school or potential employers.

4. The biotechnology and pharmaceutical companies tend to favor applicants with hands-on laboratory experience. Some graduates find work immediately as laboratory technicians. It is a well-known fact that it costs time and money to train new employees.

A WARNING ABOUT GRADES: It is absolutely essential that students perform to their best abilities in the classroom. On one hand, undergraduate research is an attractive part of the educational process; on the other hand, working in a lab takes one away from other endeavors, such as free time and study time. Because grades are important, we advocate that students with marginal grades (below a 3.0 GPA) spend their time improving their course performance rather that devoting the time to research.

Department of Molecular Genetics
List of Faculty and Abbreviated Research Interests

ANA PAULA ALANSO (614) 688-7404 alonso.19@osu.edu
Assistant Professor; Molecular Genetics
Ph.D., University Victor Segalen, Bordeaux, France
Metabolic flux analysis; carbohydrate metabolism in plants; metabolic engineering.

SHARON AMACHER (614) 292-1277amacher.64@osu.edu
Assistant Professor; Molecular Genetics, Molecular and Cell Biochemistry
Ph.D., University of Washington
Cell fate during vertebrate embryonic development; cell position and interactions among neighboring cells

AMANDA BIRD (614) 247-1559 bird.96@osu.edu
Assistant Professor; Molecular Genetics; Nutrition
Ph.D., University of Newcastle, UK
Sensing of metal elements by eukaryotes; regulatory roles of novel RNAs and small proteins.

DAVID M. BISARO (614) 292-3281 bisaro.1@osu.edu
Professor; Molecular Genetics; Director, MCDB Graduate Program
Ph.D., Wayne State University.
Molecular biology of gemini viruses; regulation of viral DNA replication and transcription; mechanisms of virus transmitted by whiteflies; engineering plants for resistance to geminivirus.

GREGORY BOOTON (614) 292-4570 booton.1@osu.edu
Assistant Professor; Molecular Genetics
Ph.D., Ohio State University.
Evolution and pathogenic potential of free-living ameba of the genera Acanthamoeba and Balamuthia.

CHRISTINE BURD (614) 688-7569 burd.25@osu.edu
Assistant Professor; Molecular Genetics, Molecular and Cell Biochemistry
Ph.D., University of Cincinnati
Cancer models; Melanoma; Senescence and aging; INK4/ARF gene regulation

CRAIG BURD (614) 688-7548 burd.7 @osu.edu
Assistant Professor; Molecular Genetics
Ph.D., University of Cincinnati
Transcriptional regulation; Chromatin and epigenetics; Steroid hormone receptors; Endocrine disrupting compounds

ARTHUR H. M. BURGHES (614) 688-4759 burghes.1@osu.edu
Affiliated Professor; Molecular and Cellular Biochemistry
Ph.D., London (England).
Human molecular genetics, molecular genetic analysis of neurologic diseases in particular motor neuron disorders and the muscular dystrophies.

Department of Molecular Genetics
List of Faculty and Abbreviated Research Interests

HELEN CHAMBERLIN (614) 688-0043 chamberlin.27@osu.edu
Associate Professor; Molecular Genetics
Ph.D., California Institute of Technology.
Organogenesis and cell fate specification during development. Developmental regulation of transcription.

SUSAN COLE (614) 292-3276 cole.354@osu.edu
Associate Professor; Molecular Genetics
Ph.D., The John Hopkins University School of Medicine.
Roles of fringe genes and Notch signaling during development. Analysis of cyclic mRNA expression during somitogenesis: linking the Notch pathway and the segmentation clock.

ADRIANA DAWES (614) 292-0395 dawes.33@osu.edu
Assistant Professor; Molecular Genetics; Mathematics
Ph.D., University of British Columbia
In the Dawes lab, we use a combination of theoretical and experimental approaches to study intracellular polarization in the early *C. elegans* embryo.

ALBERT de la CHAPELLE (614) 688-4781 delachapelle-1@medctr.osu.edu
Affiliated Professor, Molecular Virology, Immunology and Medical Genetics
Ph.D., University of Helsinki, Finland.
Identification, mapping and analysis of human cancer genes.

BIAO DING (614) 247-6077 ding.35@osu.edu
Professor; Molecular Genetics
Ph.D., Cornell University
Structure and function of plasmodesmata, intercellular trafficking of proteins, RNAs, viruses and viroids.

ANDREA I. DOSEFF (614) 292-9507 doseff.1@medctr.osu.edu
Associate Professor; Molecular Genetics; Internal Medicine
PhD., Cold Spring Harbor Laboratory and State University of New York at Stony Brook
Regulation of proteins involved in cell death during innate immune response, cell differentiation and cancer. Signal transduction pathways that control apoptosis during septic shock, inflammation, atherosclerosis and cancer.

HAROLD A. FISK (614) 247-8715 fisk.13@osu.edu
Associate Professor; Molecular Genetics; Molecular Virology, Immunology and Medical Genetics
Ph.D., University of California, San Diego.
Cell cycle regulation of centrosome duplication and the Mps1 protein kinase.

Department of Molecular Genetics
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PAUL A. FUERST (614) 292-6403 fuerst.1@osu.edu
Affiliated Professor; EEOB
Ph.D., Brown University
Molecular evolutionary genetics, especially DNA variability in natural populations; molecular approaches to conservation genetics; theory of the effects of finite population size on genetic parameters; genetics of bacterial host endosymbiotic interactions.

VIDU GARG (614) 355-3091 Vidu.Garg@nationwidechildrens.org
Affiliated Professor; Cardiovascular and Pulmonary Research
M.D., Penn State University
Molecular pathways regulating cardiovascular development and genetics of congenital heart disease

VENKAT GOPALAN (614 292-1332) gopalan.5@osu.edu
Affiliated Professor; Biochemistry
Ph.D., University of New Mexico
Protein-aided RNA catalysis

ERICH GROTEWOLD (614) 292-2483 grotewold.1@osu.edu
Professor; Molecular Genetics; Horticulture and Crop Sciences
Ph.D., University of Buenos Aires, Argentina
Our group is interested in establishing the structure of plant gene regulatory networks and understanding the mechanisms underlying combinatorial gene regulation.

PATRICE HAMEL (614) 292-3817 hamel.16@osu.edu
Associate Professor; Molecular Genetics; Molecular and Cellular Biochemistry
Ph.D., University of Orsay, Paris, France
Maturation of c-type cytochromes in organelles, redox components and heme delivery systems in yeast mitochondria and green alga plastids.

PAUL K. HERMAN (614) 688-5581 herman.81@osu.edu
Professor; Molecular Genetics
Ph.D., California Institute of Technology.
Regulation growth and cell cycle progression in *Saccharomyces cerevisiae*; molecular genetics of spore germination; gene expression in stationary.

JAY HOLLICK (614) 292-9869 hollick.3@osu.edu
Associate Professor; Molecular Genetics
Ph.D., University of Washington
Epigenetic mechanisms that generate and maintain heritable phenotypic variation

ANITA HOPPER (614) 688-3306 hopper.64@osu.edu
Professor and Chair; Molecular Genetics
PhD, University of Illinois
Intracellular trafficking of RNA and proteins; Nucleus organization; RNA processing

Department of Molecular Genetics
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Professor; Molecular Genetics; Biochemistry
PhD, University of Wisconsin
Mechanisms of Gene Regulation in Eucaryotes: Gene Switches

J.C. JANG (614) 292-8496 jang.40@OSU.edu
Affiliated Professor; Horticulture and Crop Sciences
Ph.D., Clemson University
Sugar and hormone signal transduction in plants; Function and assembly of plant P-bodies and stress granules

REBECCA LAMB (614) 688-4322 lamb.129@osu.edu
Associate Professor; Molecular Genetics
Ph.D., Duke University
Transcription regulation of gene expression during flower development in Arabidopsis thaliana; MADS box transcription factor specificity.

GUSTAVO W. LEONE (614) 688-4567 leone-1@medctr.osu.edu
Associate Professor; Molecular Genetics; Molecular Virology, Immunology and Medical Genetics
Ph.D., University of Calgary (Canada)
Coordinating signal transduction pathways and transcriptional programs in normal and cancer cells.

DAVID MACKEY (614) 292-5879 mackey.86@osu.edu
Affiliated Professor; Horticulture and Crop Sciences
Ph.D., University of Wisconsin
The interplay between virulence factors of plant pathogenic bacteria and the immune system of plants.

IRIS MEIER (614) 292-8323 meier.56@osu.edu
Professor; Molecular Genetics
Ph.D., University of Duesseldorf, Germany
Positioning and function of the plant Ran cycle; Arabidopsis nuclear pore and nuclear envelope proteins; Structure and function of long coiled-coil proteins.

STEPHEN A. OSMANI (614) 292-8084 osmani.2@osu.edu
Professor and Ohio Eminent Scholar; Molecular Genetics
Ph.D. Kings College, London, England.
Research on cell cycle regulation and nuclear migration.

MICHAEL C. OSTROWSKI (614) 298-3824 ostrowski.4@osu.edu
Affiliated Professor; Molecular and Cellular Biochemistry
Ph.D., University of South Carolina.
Signal transduction by ras oncogenes; ets transcription factors; protein kinases; regulation of mammalian cell proliferation; cancer; transgenic mice.

Department of Molecular Genetics
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HAY-OAK PARK (614) 688-4575 park.294@osu.edu
Associate Professor; Molecular Genetics
Ph.D., University of Wisconsin
Oriented cell-division; *ras*-like small GTPases; GTPase-activating protein; cell-cycle control of polarity establishment in budding yeast; morphogenesis.

DEBORAH S. PARRIS (614) 292-0735 parris.1@osu.edu
Affiliated Professor; Molecular Virology, Immunology and Medical Genetics
Ph.D., Virginia Tech
Molecular biology of herpes simplex virus replication; DNA replication; viral genetics; regulation of gene expression.

MARK A. SEEGER (614) 292-5106 seeger.9@osu.edu
Associate Professor and Associate Chair; Molecular Genetics
Ph.D., Indiana.
Molecular genetic analysis of neuronal development in *Drosophila*.

AMANDA A. SIMCOX (614) 292-8857 simcox.1@osu.edu
Professor; Molecular Genetics
Ph.D., Sussex (England)
Pattern formation and growth regulation during *Drosophila* development.

R. KEITH SLOTKIN (614) 292-1087 slotkin.2@osu.edu
Assistant Professor; Molecular Genetics
Ph.D., University of California, Berkeley
My laboratory aims to discover how potentially mutagenic "jumping genes" or transposable elements are epigenetically repressed from generation to generation, as well as how this system has been adopted over evolutionary time to regulate non-transposable element genes.

DAVID SOMERS (614) 292-2551 somers.24@osu.edu
Professor; Molecular Genetics
Ph.D., University of California, Berkeley
Molecular and genetic analysis of the plant circadian system.

ROBERT TABITA (614) 292-4297 tabita.1@osu.edu
Affiliated Professor; Microbiology
Ph.D., Syracuse University

HARALD E. F. VAESSIN (614) 292-3594 vaessin.1@osu.edu
Professor; Molecular Genetics
Ph.D., Cologne (Germany).
Molecular genetics of neurogenesis; regulation of neuronal precursor formation and neuronal lineage differentiation in *Drosophila*.

Department of Molecular Genetics
List of Faculty and Abbreviated Research Interests

DESH PAL S. VERMA (614) 292-3625 verma.1@osu.edu
Professor; Molecular Genetics
Ph.D., Western Ontario.
Molecular genetics of symbiotic nitrogen fixation; regulation and function of nodulin genes; trans-acting factors and transgenic legumes.

MICHAEL WEINSTEIN (614) 688-0164 weinstein.41@osu.edu
Associate Professor; Molecular Genetics; Molecular Virology, Immunology and Medical Genetics
Ph.D., University of California at San Diego.
Transforming Growth Factor Beta (TGFß) and Fibroblast Growth Factor (FGF), on mammalianembryogenesis, tumorigenesis, and lung development.

ROBIN WHARTON (614) 247-1960 robin.wharton@osumc.edu
Professor; Molecular Genetics; Molecular Virology, Immunology and Medical Genetics
PhD, Harvard
Study of the control of mRNA translation and stability, which plays a key role in early development of many organisms and is an essential aspect of gene regulation in germ cells of animals from nematodes to humans.

JIAN-QIU WU (614) 247-6680 wu.620@osu.edu
Associate Professor; Molecular Genetics; Molecular & Cellular Biochemistry
Ph.D., University of North Carolina at Chapel Hill.
Roles of cytoskeletal and signaling proteins in cellular polarization and cell division in normal and cancer cells