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Manual for Undergraduate Studies  
*Molecular Genetics*

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Department of Molecular Genetics

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## DEPARTMENT OF MOLECULAR GENETICS

### College of Biological Sciences, The Ohio State University

984 Biological Sciences Building, 484 West 12<sup>th</sup> Avenue, Columbus OH 43210-1292 USA  
Telephone 614/292-8084 Facsimile 614/292-4466 <http://www.osumolgen.org>

**Undergraduate Degrees Offered:** Bachelor of Science, Bachelor of Arts

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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.

#### Required Prerequisites or Supplements to the Major (Do not count towards the Major)

Course	Hours
• Biology 113 (H115), 114 (H116)	10
• Chemistry 121, 122, 123	15
• Chemistry 251, 252; 245 or 254; 246 or 255	10-12
• Mathematics 148, 150, 151, 152	19
• Physics 111 (131), 112 (132), 113 (133)	15

#### Core Requirements (Substitutions are rarely if ever permitted)

• Biochemistry 511, or 613 and 614	05-08
• Molecular Genetics 605, 606, 607, 608; 601 or 602	19

#### Electives within the Major

• Molecular Genetics courses: 503, 591, 622, 640, 650, 700, 701, 705, 711, 715, 770, 733, 734, 770	03-18
• Biological Sciences courses:	0-15
Biochemistry 521, 613, 614, 615, 702, 710, 735, 736, 761, 762, 763, 765, 766, 770	
EEOB 410, 413, 505, 512, 630, 632	
Entomology 500, 623, 631, 641	
Microbiology 520, 521, 522, 581, 632, 649, 655, 661, 680, 760	
Plant Biology 436, 630, 631, 643, 648, 735, 736	
• Molecular Virology, Immunology and Medical Genetics 734, 770	

- 5 hours of undergraduate research (MG 699; H783) may be counted towards the major.

### 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 4).

To ensure completion of the major in 4 years it is imperative to start the chemistry series in a timely fashion, as these courses are prerequisites for Biochemistry 511 ( or 613 and 614), which are required for graduation.

Completion of The Molecular Genetics Major satisfies the GEC – Third writing course requirement. Therefore, Molecular Genetics students are not required to take a third writing course.

Completion of The Molecular Genetics Major also satisfies the GEC – Statistics requirement. Molecular Genetics 650 provides additional statistical material to those requiring additional experience.

Students with 3 consecutive quarters of independent laboratory research (MG 699 or H783) may forgo the Molecular Genetics 601 and 602 requirements. Your advisor must approve this substitution.

Please refer to notes on pages 4 thru 10 for important additional course information.

**A sample curriculum is shown on page 4 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 major (Core Requirements and Electives)

40 or more hours are required, with at least 35 hours at the 500 or above level.

## Dual Majors and the Molecular Genetics Minor

### **Dual majors.**

Must consist of at least 30 unique hours in each major. The MG major has the usual 40-hour minimum and format.

### **The Molecular Genetics minor.**

20 hours consisting of (605, 606, 607, 608, 601 or 602, and Biochemistry 511). The lab requirement can be waived provided the student has other sufficient lab experience.

Please consult the current Master Schedule of Courses and

Course Offerings Bulletin for availability of courses.

## Molecular Genetics Sample Curriculum

FRESHMAN YEAR:	Autumn:	Chemistry 121 Mathematics 150 GEC- English 110
	Winter:	Chemistry 122 Biology 113 Mathematics 151
	Spring:	Chemistry 123 Biology 114 Mathematics 152 GEC- Foreign Language
SOPHOMORE YEAR:	Autumn:	Chemistry 251 GEC- Second Writing Course GEC- Foreign Language
	Winter:	Molecular Genetics 605* Chemistry 252 Chemistry 245 GEC- Foreign Language
	Spring:	Molecular Genetics 606* Chemistry 246 GEC-Foreign Language Physics 111
JUNIOR YEAR:	Autumn:	Molecular Genetics 607* Biochemistry 511 Physics 112
	Winter:	Molecular Genetics 608* GEC- Arts & Humanities – History I Physics 113
	Spring:	GEC- Arts & Humanities – History II GEC-Arts & Humanities-Visual/Performing Arts Major Course
SENIOR YEAR:	Autumn:	GEC- Social Science GEC- Arts & Humanities – Cultures and Ideas Elective or Major Course
	Winter:	Molecular Genetics 601* GEC-Social Science GEC- Arts & Humanities – Literature Elective or Major Course
	Spring:	Molecular Genetics 602* Major Course Major Course GEC-Social Science

\* Course is generally offered only the particular quarter it is listed.

# The Molecular Genetics Core Program

## Lecture Course Descriptions

- ❑ **Molecular Genetics 605, 606, 607 & 608** are the four introductory-level, three-credit-hour, core courses for the Molecular Genetics major. They are well suited to other biology majors who want a broad and integrated introduction to the application of molecular, biological and genetic techniques to problems of heredity, development and cell function. They are prerequisites to many other Molecular Genetics courses.
- ❑ **Biochemistry 511** This course should be taken as soon as possible following completion of the organic chemistry prerequisites. The lab courses, 601 and 602, require Biochemistry 511 as a prerequisite; however, students may take 511 concurrently with the lab and thereby satisfy the prerequisite.
- ❑ **Biochemistry 613, 614** can be substituted for Biochemistry 511 by honors students only and are recommended for students with a strong background in Chemistry.
- ❑ **Molecular Genetics 605: Molecular Genetics I (Winter quarter)**
  - Prerequisite: Math 152
  - Hereditary information as sequence information; DNA replication, transcription, and translation; analysis and manipulation of genes at the molecular level; asexual, sexual reproduction in eukaryotes.
- ❑ **Molecular Genetics 606: Molecular Genetics II (Spring quarter)**
  - Prerequisite: Molecular Genetics 605
  - Sexual reproduction in prokaryotes, replication of viruses and organelles; molecular mechanisms of DNA replication, repair, mutation, recombination, and expression; genome structure; molecular evolution.
- ❑ **Molecular Genetics 607: Cell Biology (Autumn quarter)**
  - Prerequisites: Molecular Genetics 500 or Molecular Genetics 606
  - A course focusing on cell biology. Analysis of the structure and function of cells and their components stressing molecular genetic and biochemical approaches.
- ❑ **Molecular Genetics 608: Genes and Development (Winter quarter)**
  - Prerequisites: Molecular Genetics 500 or Molecular Genetics 606
  - Analysis of development using modern genetic approaches.

## Laboratory Course Descriptions

- ❑ **Molecular Genetics 601 and 602** are the two laboratory, five-credit-hour, courses in the Core Program. Students are required to take one of these lab courses; however, students may bypass the laboratory requirement by enrolling in at least three consecutive quarters of research in a research laboratory (Molecular Genetics 699 or H783). Prerequisite for these labs is Biochemistry 511. It is suggested that these courses be taken in the senior year. However, students requiring lab courses for applications to professional school or other programs may elect to take a lab in the junior year.
- ❑ **Molecular Genetics 601: Eukaryotic Molecular Genetics Laboratory**
  - This laboratory focuses on genetic and molecular analysis using yeast and *Drosophila* as experimental systems.
- ❑ **Molecular Genetics 602: Eukaryotic Cell and Developmental Biology Laboratory**
  - Experiments in animal cell culture, cell biology and development.

## Molecular Genetics Courses

### **H220 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 Quarter.
- 1 1-hour class.
- Graded S/U

Prerequisite: Biology 113 or H115, and permission of instructor

### **500 General Genetics U G 5**

The principles of genetics, including molecular genetics, transmission genetics of prokaryotes & eukaryotes, developmental & non-chromosomal genetics & the genetics & evolution of populations.

- Autumn, Winter, Spring, and Summer Quarters.
- 3 1.5-hour classes.
- Prerequisite: Biology 101 (introduction) or 113 (energy transfer) or H115, plus 5 additional credit hours in biological sciences & Chemistry 252 (organic).

### **H500 General Genetics U G 6**

The principles of genetics, including molecular genetics, transmission genetics of prokaryotes & eukaryotes, developmental & non-chromosomal genetics & the genetics & evolution of populations.

- Autumn Quarter.
- 3 1.5-hour classes and 1 3-hour lab.
- Prerequisite: Biology 101 (introduction) or 113 (energy transfer) or H115, plus 5 additional credit hours in biological sciences & Chemistry 252 (organic).

### **503 Molecular Genetics Writing Project U 2**

Practice in searching, reading & analyzing literature in molecular genetics & in written & oral presentation. Please see additional information provided on page 12.

- Summer, Autumn, Winter, Spring Quarters.
- 2 class hours.
- Open to Molecular Genetics majors only or by permission of instructor.
- General Education Curriculum (GEC) course.

### **591 DNA Finger Printing Workshops in Columbus Public Schools U 2**

Service learning course whereby undergraduates mentor high school students in molecular biology workshops.

- Spring Quarter.
- Repeatable to a maximum of 6 cr hours.
- Undergraduates present workshops in Columbus Public Schools
- Prerequisite: Biochemistry 511 (introduction) or permission of instructor.
- Cross-listed in Biochemistry and Microbiology
- Graded S/U

### **601 Eukaryotic Molecular Genetics Laboratory U G 5**

Current laboratory techniques used in the genetic & molecular analyses of *Saccharomyces cerevisiae* & *Drosophila*.

- Winter Quarter.
- 2 5-hour classes.
- Prerequisite: Biochemistry 511 (introduction) or permission of instructor.

### **602 Eukaryotic Cell & Developmental Biology Laboratory U G 5**

Laboratory course emphasizing recent advances in techniques & methods central to cell biology & developmental biology of eukaryotes.

- Spring Quarter.
- 2 5-hour classes.
- Prerequisite: Biochemistry 511 (introduction) or permission of instructor.

## Molecular Genetics Courses

### **605 Molecular Genetics I U G 4**

Hereditary information as sequence information; DNA replication, transcription, and translation; analysis and manipulation of genes at the molecular level; asexual, sexual reproduction in eukaryotes.

- Winter Quarter
- 3 1-hour classes, 11-hr recitation
- Prerequisite: Math 152 (calculus).
- Not open to students with credit for MG 500.

### **606 Molecular Genetics II U G 4**

Sexual reproduction in prokaryotes, viruses and organelles; molecular mechanisms of DNA replication, repair, mutation, recombination, and expression; genome structure; molecular evolution.

- Spring Quarter.
- 3 1-hour classes, 11-hr recitation.
- Prerequisite: MG 605.

### **607 Cell Biology U G 3**

Analysis of the structure & function of cells & their components stressing molecular genetic & biochemical approaches.

- Autumn Quarter.
- 3 1-hour classes.
- Prerequisite: MG 500 or 606.

### **H607 Cell Biology U G 4**

Analysis of the structure & function of cells & their components stressing molecular genetic & biochemical approaches.

- Autumn Quarter.
- 3 1-hour classes.
- Prerequisite: MG 500 or 606.

### **608 Genes & Development U G 3**

Analysis of development using modern genetic approaches.

- Winter Quarter.
- 3 1-hour classes.
- Prerequisite: MG 500 or 606.

### **622 Plant Genetics & Molecular Biology U G 5**

An in-depth survey of classical & molecular genetic systems in plants with emphasis on current research topics.

- Spring Quarter.
- 3 class hours, 1 2-hr discussion.
- Prerequisite: MG 500 and Biochemistry 511 or MG 605 or permission of instructor.
- Not open to students with credit for MG 632 or PCMB 622.
- Cross-listed in Plant Cellular and Molecular Biology.

### **632 Insect Molecular Genetics U G 3**

Structure, genetics and methodology of insect genes and genomes.

- Winter Quarter.
- 2 1.5-hour classes.
- Prerequisite: Biochem 511, MG 500 or equiv.
- Cross-listed in Entomology

## Molecular Genetics Courses

### **640 The Genetical Basis of Evolution U G 5**

The modern theory of evolution & its underlying genetic basis.

- Spring Quarter.
- 3 1.5-hour classes.
- Prerequisite: MG 500 or 606 or equiv. Not open to student with credit for EEOB 640
- Cross-listed in Evolution, Ecology, and Organismal Biology

### **650 Analysis & Interpretation of Biological Data I U G 5**

Methods of analyzing biological data including: sampling, descriptive statistics, distributions, group comparisons, statistical inference, one-way & nested analysis of variance & linear regression & correlation.

- Autumn Quarter.
- 3-1hr lectures, 1-1hr recitation, 1-1hr hour computer-assisted instruction.
- Prerequisite: Math 150 (functions) or equivalent & 15 credit hours of courses at the 300 level or higher in department of agriculture or in the biological sciences.

### **693 Individual Studies U 2-5 G 2-10**

Individual work in the field of the chosen problems.

- Summer, Autumn, Winter, Spring Quarters.
- Prerequisite: Permission of instructor.
- Repeatable to a maximum of 20 credit hours for undergraduate credit & to a maximum of 35 credit hours for graduate credit.
- This course is graded Satisfactory/Unsatisfactory (S/U).

### **699 Undergraduate Research in Molecular Genetics U 1-15**

Undergraduate research in molecular Genetics.

- Summer, Autumn, Winter, Spring Quarters.
- Prerequisite: Permission of instructor.
- Repeatable to a maximum of 15.
- This course is graded Satisfactory/Unsatisfactory (S/U).

### **700 Systems of Genetic Analysis U G 3**

Analysis of several major systems used in modern experimental genetics.

- Autumn Quarter.
- 3 1-hour classes.
- Prerequisite: MG 606 or equivalent.

### **701 Molecular Genetics: DNA Transactions U G 3**

Survey of experimental methods of molecular genetics & their application to the elucidation of pathways of DNA replication, mutation, repair & recombination.

- Autumn Quarter.
- 3 1-hour classes.
- Prerequisite: MG 500 or 606, or Biochemistry 511 or equivalent; & 10 additional credit hours in the biological sciences above the 300 level.

### **705 Advances in Cell Biology U G 3**

An advanced study of selected key areas of research in eukaryotic cell biology.

- Winter Quarter.
- 3 1-hour classes.
- Prerequisite: MG 607 & 701 or equivalent.

## Molecular Genetics Courses

### 711 Molecular Evolution U G 3

Evolution & population genetics as seen at the molecular level: phenomena, concepts, methods of study and implications for molecular biology & other disciplines.

- Winter Quarter.
- Arranged.
- Prerequisite: MG 500 or 606, & 640 or 701 or EEOB 400 or EEOB 640 or equiv or permission of instructor. Not open to students with credit for EEOB 711.
- Cross-listed in Evolution, Ecology and Organismal Biology

### 715 Developmental Genetics U G 3

A study of the regulation of developmentally significant genes & cellular interactions involved in differentiation & pattern formation in *Drosophila* & metazoans.

- Spring Quarter.
- 3 1-hour classes.
- Prerequisite: MG 608, 700 & 701 or equivalent.

### 733 Human Genetics U G 3

The principles of human genetics covering mapping of disease genes, defects covering mapping of disease genes, defects causing human disease, the cloning of disease genes, gene therapy & transgenes.

- Spring Quarter.
- Prerequisite: MG 500 or 606 or equivalent.
- Not open to students with credit for Mol Bioch 733 or Pathology 733.
- Cross-listed in Mol Biochem and Pathology.

### 734 Cancer Genetics: High Throughput Technologies U G 4

An introduction to the high throughput technologies and bioinformatics in cancer genetics

- Spring Quarter.
- 2 2-hr cl
- Prerequisite: Biochem 511 or equiv.
- Not open to students with credit for Mol Bioch 733 or Pathology 733.
- Cross-listed in Mol Biochem and Pathology.

### 770\* Molecular Biology of Animal & Plant Viruses U G 3

An advanced virology course using selected animal & plant viruses as models of eukaryotic gene regulation.

- Spring Quarter.
- 1 3-hour class.
- Prerequisite: Biochemistry 702 (gene expression) or equivalent with permission of instructor.

### H783 Honors Research U 3-5

A program of reading & research for each student with individual conferences, reports & honors thesis.

- Summer, Autumn, Winter, Spring Quarters.
- Prerequisite: 4th year standing with a grade of A in at least half of the courses in biological sciences and an average of B in the remainder; permission of instructor under whose supervision the work is to be completed and the Arts & Sciences Honors Committee.
- At least 2 quarters are required of candidates for the degree BA or BS with distinction in Molecular Genetics.
- Failure to receive a mark of S in this course is a disqualification for special honors.
- Repeatable to a maximum of 15 credit hours.
- This course is graded Satisfactory/Unsatisfactory (S/U).

### 795 Special Topics in Molecular Genetics U G 2

Lecture/discussion in a seminar format of publications; current research or research techniques in molecular genetics, cell biology, or developmental biology.

- Summer, Autumn, Winter, Spring Quarters.
- 1 2-hour class.
- Prerequisite: MG 500 or 606 & permission of instructor.
- Repeatable to a maximum of 20 credit hours for undergraduates & to a maximum of 56 credit hours for graduates.
- This course is graded Satisfactory/Unsatisfactory (S/U).

## Molecular Genetics Courses

### 800 Genetic Seminar G 1-3

Faculty, graduate students & outside speakers will participate.

- Winter, Spring Quarters.
- Repeatable to a maximum of 12 credit hours.
- This course is graded Satisfactory/Unsatisfactory (S/U).

### 801 Research Opportunities in Molecular Genetics G 2

Discussion of research projects being carried out in laboratories of the department.

- Autumn Quarter.
- 1 2-hour class.
- Prerequisite: graduate standing in Molecular Genetics.
- This course is graded Satisfactory/Unsatisfactory (S/U).

### 804 Molecular Genetics Laboratory Rotations G 3

Laboratory research procedures, literature readings & discussions to familiarize the students with a specific research area.

- Autumn, Winter, Spring Quarters.
- Arranged lab.
- Prerequisite: graduate standing in Molecular Genetics.
- Required of all first year molecular genetics graduate students.
- Repeatable to a maximum of 9 credit hours.
- This course is graded Satisfactory/Unsatisfactory (S/U).

### 831 Eukaryotic Genome: Structure & Expression G 3

Current research on the structure & expression of genes in higher eukaryotes.

- Autumn Quarter.
- 3 class hours.
- Prerequisite: Biochemistry 702 (gene expression) or equivalent.
- Not open to students with credit for Biochemistry 781, or Biochemistry 781 or 831, or Medical Biochemistry 831.
- Cross-listed in Biochemistry & Medical Biochemistry.

### 880 Research Seminars G 1-3

Intensive study of problems in graduate fields of specialization.

- Summer, Autumn, Winter, Spring Quarters.
- Arranged.
- Prerequisite: 10 graduate credit hours or permission of instructor.
- Repeatable to a maximum of 30 credit hours.
- 880.01 Developmental Genetics
- 880.02 Cell Biology
- 880.03 Molecular Evolution/Population Genetics
- 880.04 Viral Genetics
- 880.05 DNA Replication, Recombination, Repair
- 880.06 Gene Expression: Transcriptional Control
- 880.07 Gene Expression: Post-Transcriptional Control
- 880.08 Yeast Molecular Biology
- 880.10 Human Genetics
- 880.11 Transgenic Models

### 999 Research in Genetics G

Research for thesis & dissertation purposes only.

- Summer, Autumn, Winter, Spring Quarters.
- Hours are arranged.
- This course is graded Satisfactory/Unsatisfactory (S/U).

## Suitable Elective Courses\* from Other Departments

Course Number	☑	Course Title
Biochemistry 521	A-P-U	Introduction to Biological Chemistry: Laboratory
Biochemistry 613	A	Biochemistry and Molecular Biology
Biochemistry 614	W	Biochemistry and Molecular Biology (continuation of 613)
Biochemistry 615	P	Biochemistry and Molecular Biology (continuation of 614)
Biochemistry 702	W	Molecular Genetics: Regulation of Gene Expression
Biochemistry 710	P	Molecular Biology Laboratory
Biochemistry 735	A	Plant Biochemistry I
Biochemistry 761	A	Advanced Biochemistry: Proteins
Biochemistry 762	A	Advanced Biochemistry: Enzymes
Biochemistry 763	W	Advanced Biochemistry: Membranes and Bioenergetics
Biochemistry 765	P	Advanced Biochemistry: Physical Biochemistry
Biochemistry 766	W	Advanced Biochemistry: Nucleic Acid Chemistry and Structure
Biochemistry 770	A	Protein Engineering
Entomology 500	A-U	General Entomology
Entomology 623	W	Insect Morphology
Entomology 631	A	Insect Physiology
Entomology 641	A	Insect Ecology
EEOB 410 *	A-W	Animal Form and Function I*
EEOB 413	A-W (H)-P	Introduction to Ecology - lecture (same as Plant Biology 413.01)
EEOB 505	U	Marine Biology and Ecology (@ Stone Lab)
EEOB 512	A-W-P	Laboratory in Vertebrate Dissection
EEOB 632	W	Neurobiology
Microbiology 520	A	General Microbiology I
Microbiology 521	W	General Microbiology II
Microbiology 581	A	Microbial Genetics
Microbiology 632	A	Cellular Aspects of the Immune Response (632.01 lecture & 632.02 lab)
Microbiology 649	W	Introductory Virology
Microbiology 655	A	Animal Cell Culture Techniques
Microbiology 661	W	General Microbial Physiology
Microbiology 680	P	Advanced Microbial Genetics
Microbiology 760	P	Advanced Bacterial Physiology
Plant Biology 436	A-P	Introductory Plant Physiology
Plant Biology 630	A	Plant Physiology
Plant Biology 631	W	Plant Physiology
Plant Biology 643	W	Plant Anatomy
Plant Biology 648	W	Plant Cell Biology

W – Winter      P – Spring      U – Summer      A - Autumn

\* Course should be taken during the junior year

Microbiology 509 will not count towards the Molecular Genetics major.

Course offerings may change and other courses not listed may satisfy the MG major. Please consult with your advisor and the current Master Schedule of Classes and the Course Offerings Bulletin for current availability.

# Molecular Genetics 503: Molecular Genetics Writing Project

## 1. Who should take MG 503?

Molecular Genetics no longer requires a third writing course. MG 503 is, thus, not required for MG majors, but it may be taken as an elective. In general, MG 503 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 MG 503?

To enroll in MG 503, you must 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://www.biosci.ohio-state.edu/~molgen/molgen.html>). After you have chosen one or more faculty as potential MG 503 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 (984 Biological Sciences Building) and obtain the call number that corresponds to the advising faculty member.

## 3. After I enroll in MG 503, 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 quarter 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 292-4570, E-mail: [booton.1@osu.edu](mailto: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.

Just as, 20 years ago, 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 (**Molecular Genetics 601**) and in Cell Biology and Developmental Biology (**Molecular Genetics 602**). 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 **Molecular Genetics 699 or H783**. 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.

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://www.osumolgen.org> 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 **Molecular Genetics 699** (Individual Studies) to receive from two-to-five credit hours per quarter 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 two-to-four quarters, 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 four-to-eight additional quarters. 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 **Molecular Genetics H783**, 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 two-to-four quarters, 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 **Molecular Genetics H783** project. Early lab experience also provides the students with the opportunity to do summer research.

This summer experience is especially important for **Molecular Genetics H783**. 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 quarter 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 than devoting the time to research.

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Roles of cytoskeletal and signaling proteins in cellular polarization and cell division in normal and cancer cells.