

Term Information

Effective Term Autumn 2023

General Information

Course Bulletin Listing/Subject Area Molecular Genetics
Fiscal Unit/Academic Org Molecular Genetics - D0340
College/Academic Group Arts and Sciences
Level/Career Undergraduate
Course Number/Catalog 4581S
Course Title BioEYES: Hands-on STEM learning with zebrafish in Columbus Public Elementary Schools
Transcript Abbreviation BioEYES CPS
Course Description A service learning course whereby undergraduates mentor and provide hands on science experiences for upper level elementary school students using the established BioEYES curriculum
Semester Credit Hours/Units Fixed: 1

Offering Information

Length Of Course 14 Week
Flexibly Scheduled Course Never
Does any section of this course have a distance education component? No
Grading Basis Satisfactory/Unsatisfactory
Repeatable Yes
Allow Multiple Enrollments in Term No
Max Credit Hours/Units Allowed 3
Max Completions Allowed 3
Course Components Workshop
Grade Roster Component Workshop
Credit Available by Exam No
Admission Condition Course No
Off Campus Never
Campus of Offering Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites BIOL 1113 and an upper division course in Molecular Genetics (MOLGEN 4500 or 4606) or another major (MICRO 4000, EEOB 4210, BIOCHEM 4511), or permission of instructor.
Exclusions
Electronically Enforced Yes

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code 26.0804
Subsidy Level Baccalaureate Course

Intended Rank

Sophomore, Junior, Senior

Requirement/Elective Designation

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- Upon course completion students will effectively manage active learning activities
implement an effective hands-on curricula
interact positively with elementary students/teachers
design hands-on science activities for elementary classes

Content Topic List

- Content knowledge and practical skills
Zebrafish development and husbandry
Genetics
Personal growth and responsibility
Leadership skills
Teaching experience
Community service
Contribute to public understanding of science
- No

Sought Concurrence

Attachments

- AMACHER_BioEYES Syllabus_REV2_Submit.docx: Syllabus
(Syllabus. Owner: Cole, Susan Elizabeth)
- AMACHER_S-Designation-Request-Form.docx: Service learning designation request form
(Other Supporting Documentation. Owner: Cole, Susan Elizabeth)
- Bioeyes - Cover letter.docx
(Cover Letter. Owner: Cole, Susan Elizabeth)
- Molgen Curricular Map 2022.docx: Updated curricular map
(Other Supporting Documentation. Owner: Cole, Susan Elizabeth)

Comments

- If this new course will be able to count in your major (even as an elective), please upload an updated curriculum map for the major. (If it won't count in the major, please just indicate so in a note.) Many thanks. *(by Vankeerbergen, Bernadette Chantal on 01/24/2023 08:23 AM)*

COURSE REQUEST
4581S - Status: PENDING

Last Updated: Vankeerbergen, Bernadette
Chantal
02/15/2023

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Cole, Susan Elizabeth	01/23/2023 05:37 PM	Submitted for Approval
Approved	Cole, Susan Elizabeth	01/23/2023 05:37 PM	Unit Approval
Revision Requested	Vankeerbergen, Bernadette Chantal	01/24/2023 08:23 AM	College Approval
Submitted	Cole, Susan Elizabeth	02/06/2023 09:03 AM	Submitted for Approval
Approved	Cole, Susan Elizabeth	02/06/2023 09:03 AM	Unit Approval
Approved	Vankeerbergen, Bernadette Chantal	02/15/2023 02:35 PM	College Approval
Pending Approval	Jenkins, Mary Ellen Bigler Hanlin, Deborah Kay Hilty, Michael Vankeerbergen, Bernadette Chantal Steele, Rachel Lea	02/15/2023 02:35 PM	ASCCAO Approval



THE OHIO STATE UNIVERSITY

Department of Molecular Genetics

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January 23, 2023

Andrew Martin
Associate Dean for Undergraduate Education
College of Arts and Sciences
114 University Hall, 230 North Oval Mall,
Columbus, OH 43210

Dear Dr. Martin

We are delighted to submit this proposal for a service learning course to be entitled “BioEYES: Hands-on STEM learning with zebrafish in Columbus Public Elementary Schools” offered through the Department of Molecular Genetics.

This course is based upon “Project BioEYES”, a successful international teaching curriculum initially developed in 2002, that has reached >150,000 students and >1,000 teachers across the globe. The Ohio State University is a recognized BioEYES partner site (<https://www.bioeyes.org/partner-sites>), that operates as a partnership between Columbus public elementary schools and BioEYES-trained OSU scientists. The instructor, Dr. Sharon Amacher, has worked with her, co-PI Dr. Uyen Tram and with undergraduate and graduate student volunteers to offer the BioEYES curriculum in Columbus since 2019. Since 2019, every upper elementary student at Cranbrook and Barrington elementary schools has participated in the program. Last year, as part of a funded BETHA proposal, four undergraduates formally “piloted” the service-learning course; our course application and syllabus reflects their comments and suggestions about how to effectively run the program as a service-learning course.

OSU students enrolled in this course will help teach the BioEYES curriculum in the elementary school classroom, assisting students with hands-on activities and actively engaging with them as they make observations and generate hypotheses. Students enrolled in this course will learn how to (1) effectively manage a classroom during active learning, (2) design an effective and exciting hands-on curriculum, and (3) interact positively with upper elementary students and their teachers. We anticipate that this course will be attractive for a wide variety of students at OSU, including those who intend to teach STEM coursework at the K-5 level and students who wish to engage in community

Please let us know if you need any further information,

Susan Cole
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Department of Molecular Genetics
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Sharon Amacher
Professor and Vice Chair for Research
Department of Molecular Genetics
Professor, Department of Biological Chemistry and Pharmacology
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MOLGEN 4581S

**“BioEYES: Hands-on STEM learning with zebrafish in Columbus Public Elementary Schools”
Autumn Semester, Service Learning Course, 1 credit**

Instructor

Professor Sharon Amacher, trained BioEYES educator
125A Rightmire Hall (west campus)
Phone: (614) 292-1277; Email: amacher.6@osu.edu
Office Hours: TBD

Course Coordinator

Dr. Uyen Tram, trained BioEYES educator
Email: tram.1@osu.edu

Meeting Days and Times and Location

Orientation and hands-on training sessions will take place during the first two weeks of class. The first week session will be a self-paced (approximately 3-hour) review of online material. The second week session will be an in-person ~3-hour hands-on training session held at time to be arranged that work best with student schedules (possibly in the evening and or on weekends). Elementary school visits will take place in-person at local Columbus elementary schools, including Cranbrook Elementary and Barrington Elementary. School visits occur Mondays, Tuesdays, and Fridays (and occasional Wednesdays and Thursdays) and last ~3 hours (2 classroom periods/session). Visits are available at variable times during the day between mid-morning to mid-afternoon. Meeting times are thus variable and depend upon the school visit schedule. Students will select 4 school visits (8 classrooms) throughout the semester that work with their schedule. Transportation to the elementary schools will be provided.

Format of Instruction

This is service-learning course. There is an average of 3 contact hours per week. Most course activities will involve engaging with upper elementary students in the classroom. Students will select 4 school visits (8 classrooms total) throughout the semester that work with their course schedule. In addition to school visits, students will participate in orientation, hands-on training, 1-2 preparatory sessions, and 1 wrap-up session. There is one assignment.

Description of the course

The hands-on science experience provided for upper elementary students in this course is based upon “Project BioEYES”, a successful international teaching curriculum that was initially developed in 2002, that has reached >150,000 students and >1,000 teachers across the globe. The Ohio State University is a recognized BioEYES partner site (<https://www.bioeyes.org/partner-sites>). The Columbus BioEYES program operates as a partnership between Columbus public elementary schools and BioEYES-trained OSU scientists. The program brings a week-long, hands-on science experience into elementary school classrooms; to date, OSU BioEYES has reached 631 upper elementary students in 29 classrooms at 2 different Columbus public schools (Autumn semesters 2019, 2021, and 2022). OSU students enrolled in this course will help teach the BioEYES curriculum in the elementary school classroom, assisting students with hands-on activities and actively engaging with them as they make observations and generate hypotheses. Students enrolled in this course will learn how to (1) effectively manage a classroom during active learning, (2) design an effective and exciting hands-on curriculum, and (3) interact positively with upper elementary students and their teachers. As a final assignment, students will design and demonstrate a genetics or genomics hands-on activity for the class.

Prerequisites

This course is open to all science and/or science education majors. Prerequisites are BIOL 1113 and an upper division course in Molecular Genetics (MOLGEN 4500 or 4606) or another major (MICRO 4000, EEOB 4210, BIOCHEM 4511), or permission of instructor. All students who are interested in biology and are eager to learn how to communicate biological concepts to elementary school students are welcome.

Required texts and course materials

There is no required textbook. All course materials will be provided at the orientation meeting or posted on the course CarmenCanvas site.

Assignments and Examinations

There are no examinations in this course. The majority of the coursework is to participate in 4 elementary school visits (2 classrooms per visit) for a total of 8 classroom sessions. There is one course assignment (a final project). The course assignment involves designing a hands-on activity for elementary school students that expands upon what they have learned in BioEYES or covers a new topic in genetics and/or genomics. The student will turn in a 1-page description, video, or powerpoint/keynote presentation and demonstrate their activity at our final wrap-up session. These student-designed projects may be incorporated into spring semester BioEYES festivals (where the elementary students whose classrooms we visited come to OSU for a field trip to do additional hands-on science activities), or other outreach programs (OSU WestFest Science and Technology Festival, COSI Big Science Festival, etc.). Students who have taken this course are welcome (but not expected) to participate in outreach activities in future semesters.

Grading Information and Grading Scale

This course is graded S/U. A student will receive an S grade for satisfactory completion of required classroom visits and the one assignment. The course is repeatable up to a maximum of 3 credit hours.

Scheduling of course meetings and assignment due dates

Hands-on training session: The hands-on training session will take place during the second week of class at a time that works for all students enrolled in the course. This may be an evening or weekend. We will set the date and time during the first week of class.

Classroom Visits: Every year the classroom visit schedule is different, so we do not have fixed visit dates and times until the beginning of the semester. Mondays, Tuesdays, and Fridays are BioEYES educator-led days and thus are the days where we will visit classrooms to lead the program. Teachers also often request our presence on Wednesdays and Thursdays, the classroom teacher-led days of the program. The activities performed each day are different, so students are encouraged to participate on different days if their schedule allows.

Hands-on Science Activity assignment: This assignment will be due during the last week of instruction or during finals week at a time that works for all students enrolled in the course. This may be an evening or weekend. We will decide the date and time during the first week of class.

Course Attendance Policy

Students are expected to attend the classroom visit sessions for which they sign up. They should select sessions that do not conflict with their courses, extracurricular activities, or observed religious holidays. In the case of illness, the student should contact the instructor as soon as possible to select another session or arrange another way to make up the missed visit (e.g., participate in extra preparatory sessions).

Week-by-week Course Outline

Week 1: 3-hour self-paced review of (1) the BioEYES website (<https://www.bioeyes.org>), including video tutorials of BioEYES activities (<https://www.bioeyes.org/refreshers>), (2) the BioEYES teacher manual, and (3) a short video by the instructor describing the activities performed each day over the course of the week-long classroom experiment.

Week 2: 3-hour session with the instructor and course coordinator to tour the zebrafish facility, perform hands-on activities, discuss effective elementary classroom teaching techniques, review the BioEYES student journal activities, and ask questions.

Weeks 3-13: Visit 8 classrooms (2 classrooms per session) in 4 different school visits. You may spread these visits throughout the semester. Participate in 2 preparatory sessions to assist preparation of materials needed for the classroom activities.

Week 14: Turn in your assignment and present your hands-on activity to the class.

COVID-19 policies

The COVID-19 pandemic is still present. Current expectations can be found at the Safe and Healthy Buckeyes site (<https://safeandhealthy.osu.edu>). If you are ill, or have been asked to self-isolate or quarantine, please do not attend class. If this comes up for you, please contact the instructors as soon as practical to work out how to complete course material. Public health declarations may require us to make changes in our class plans which will be communicated via CarmenCanvas.

Course Continuity Plan during short-term campus closures

Should in-person classes be canceled, we will also cancel elementary school visits. We share updates via CarmenCanvas.

Academic Integrity

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct: <http://studentlife.osu.edu/csc/>.

Disability services

The University strives to make all learning experiences as accessible as possible. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's request process, managed by Student Life Disability Services. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let us know immediately so that we can privately discuss options. To establish reasonable accommodations, we may request that

you register with Student Life Disability Services. After registration, make arrangements with us as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Religious Accommodations

Our inclusive environment allows for religious expression. Students requesting accommodations based on faith, religious or a spiritual belief system in regard to examinations, other academic requirements or absences, are required to provide the instructor with written notice of specific dates for which the student requests alternative accommodations at the earliest possible date. For more information about religious accommodations at Ohio State, visit odi.osu.edu/religious-accommodations.

Diversity, Equity, and Inclusion

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

Mental Health Statement

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling [614-292-5766](tel:614-292-5766). CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at [614-292-5766](tel:614-292-5766) and 24 hour emergency help is also available 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

Service-Learning Designation Request Form

(Note: This version of the S-Designation Request Form will only be used to determine assignment of the S-designation for submitted courses. If you would like to seek approval for the GE Open Option as well as the S-designation, please contact the Service-Learning Initiative at slearning@osu.edu.)

- | | | |
|---|-----|--------------------------|
| 1. Has this class previously received an S-Designation? | Yes | <input type="radio"/> No |
| 2. Is this class always taught with a service-learning component? | Yes | <input type="radio"/> No |

(if no, please provide details)

This is a new course offering. OSU is a BioEYES partner site (<https://www.bioeyes.org/partner-sites>). The Columbus BioEYES program operates as a partnership between Columbus public elementary schools and two BioEYES trained scientists, OSU Professor Sharon Amacher and scientist Dr. Uyen Tram. The program brings a week-long, hands-on science experience into elementary school classrooms; to date, BioEYES has reached **631** 4th and 5th grade students in 29 classrooms at 2 different Columbus public schools (Autumn semesters 2019, 2021, and 2022). Classroom visits are led by Drs. Amacher and Tram, with OSU undergraduate and graduate student volunteers (when available). We are submitting a Course Request form to establish BioEYES as a service-learning course.

An effective service-learning course should include the following core premises:

- Connection to academic learning
- Analysis of connection between academic content and service
- Mutual benefit for all involved
- Student preparation and support
- Plan for evaluation
- Plan for sustainability

COURSE CONTENT/PLANNING

3. Please describe the planned service activities to be performed by students in this course. The students in this course are trained in the Project BioEYES curriculum and hands-on activities. Students accompany the BioEYES instructors on elementary classroom visits and engage with the children as they complete the activities. They lead some activities, like fish embryo collection and microscopy activities. They also engage with the classroom teachers. They perform some of the preparatory visits to ready the materials for the classroom. Finally, they design an additional, age-appropriate hands-on activity on a genetic/genomic topic that extends or complements the BioEYES curriculum.

4. Please describe how the planned service activities reflect priorities and stated goals/needs of the community partner(s)?

The Project BioEYES (<https://www.bioeyes.org>) curriculum was initially offered in 2002 and has been evolving since. The main goals of the program are to (1) provide an exciting hands-on,

week-long science experience for K-12 students (we focus on 4th and 5th grades), (2) collaborate with and empower teachers so that after two years they can offer the curriculum semi-independently or independently, and (3) provide a curriculum that complements National Science Standards, thus covers age-appropriate required content in a fun and exciting way.

5. Service-Learning activities are all based on an agreement between three parties each of whom has specific goals/expectations/responsibilities that are necessary to make it an effective service-learning experience.

Please describe goals/expectations/responsibilities for:

a) Faculty

The faculty instructor is responsible for: (a) leading all undergraduate student and teacher training sessions, (b) providing classroom materials (including live animals) required for the experience, (c) preparing materials with undergraduates for the classroom activities, (d) providing and/or arranging transportation to and from elementary schools, (e) maintaining an approved IACUC animal protocol, (f) acting as the lead instructor during the Monday, Tuesday, and Friday classroom visits, assisted by the course coordinator and the enrolled undergraduates, (g) obtaining general feedback from enrolled students to improve the experience in future years, and (h) communicating with the BioEYES central office to obtain aggregate pre- and post-survey data to inform our effectiveness. The course coordinator, when available, assists with c, d, f, and h. The course coordinator is the person who visits the classroom (accompanied by undergraduates), if requested by the classroom teacher, on Wednesdays and Thursdays, which are the classroom teacher-led instruction days.

b) Students

The enrolled students are responsible for: (a) becoming familiar with the BioEYES curriculum (initially at a basic level; students will learn the curriculum more deeply over the semester), (b) being an effective and respectful science ambassador in the community, and (c) learning how to interact effectively with elementary school students and teachers in an active learning classroom. An important goal is that students will feel comfortable and confident engaging with non-scientists and children about basic science after completing the course. The students will demonstrate this ability by designing a final project where they create their own hands-on science activity for upper elementary students.

c) The community partner(s)

The elementary school community partners benefit in several ways. First, the students undertake a fun and exciting hands-on curriculum early in their school years that affects their attitudes about science and science careers. We have provided the program (with undergraduate student volunteers) for 3 years (in 2019, 2020, and 2022) and BioEYES pre- and post-survey analyses reveal that the experience significantly and positively changed attitudes about science and science careers (data available upon request). Second, the BioEYES program is unique from other programs in that it empowers teachers to learn and present the material independently (or semi-independently) after 2 years in the program. Third, the BioEYES program benefits school administration because it provides curriculum that

complements National Science Standards, thus covers age-appropriate required content in a fun and exciting way. Fourth, the program allows upper elementary students to engage with college students who are excited about science in a substantive way, with a goal of encouraging them to consider attending college.

6. Please describe your plans for sustainability and departmental support for offering this service-learning course on a continuing basis.

We have offered the BioEYES program in Columbus since 2019, with the instructor and course coordinator volunteering their time as service and are dedicated to continuing and growing the program to additional Columbus City Schools. Since 2019, every upper elementary student at Cranbrook and Barrington elementary schools has participated in the program. We have been fortunate to have undergraduate and graduate students participate as volunteers. Last year, as part of our funded BETHA proposal, we recruited 4 undergraduates to essentially “pilot” the service-learning course; our course application and syllabus reflects their comments and suggestions about how to effectively run the program as a service-learning course. The Molecular Genetics department is also committed to the success of the program. The department has loaned microscopes and provided materials for classroom visits and has agreed to continue this commitment in the future. Our funded BETHA proposal (July 2022 – June 2024) also covers the salary of the course coordinator to assure smooth implementation of the program as a service-learning course. The BETHA proposal has funded the purchase of additional microscopes, which will allow us to expand to new schools (as classroom teachers become trained and can offer the program independently with materials loaned from us).

COURSE GOALS

7. How does the service activity connect with the academic content of the course and how is this content in turn enhanced by the service component of the course?

The service activity and academic content are intertwined. The educational content of the BioEYES curriculum will teach or reinforce key science concepts (the scientific method, the use of model systems, the function of various organ systems, basic genetic concepts, etc.) that an undergraduate interested in biology or teaching biology should know. The service component of the course allows the student to effectively and enthusiastically teach that content to upper elementary students. By reiterating this process, the students learn the material and how to teach the material effectively.

8. In addition to course-specific student learning goals, the following general Expected Learning Outcomes are defined for students in Service-Learning courses:

- Students make connections between concepts and skills learned in an academic setting and community-based work
 - Students demonstrate an understanding of the issues, resources, assets, and cultures of the community in which they are working.
 - Students evaluate the impacts of the service learning activity.
- a) What processes are in place to allow students to reflect on and make connections between concepts and skills learned in an academic setting and community-

based work

At the end of the course, we will hold a final wrap-in session during which students will share the skills they have learned over the course of the semester, compare experiences in different schools, and complete a short in-class response to assess their learning. At the wrap-up session, they will also demonstrate a hands-on science activity (that takes 5-15 minutes to complete) they have designed that extends or complements the BioEYES curriculum, to demonstrate that they have learned to effectively engage with students at an age-appropriate level.

- b) What aspects of the course ensure that the students learn about the issues, resources, assets, and cultures of the community in which they are working.

Unfortunately, resources at Columbus area public schools are strikingly different (iPads for every student at one, not enough pencils at the other). Most undergraduates in the class will experience classrooms in different schools, and if not, we will discuss issues, resources, assets, and cultures of each school community at our final wrap-up session.

- c) How does the course promote reflection on and evaluation of the impacts of the service-learning activity.

As part of our partnership with BioEYES, the national office provides and analyzes pre- and post-surveys to assess the concepts learned and attitude shifts of the elementary school students who have participated in the program. They share this anonymized, aggregate data with us and we will share this data with the students in the course. Undergraduates who complete the service-learning course are invited (but not expected) to participate in Spring semester BioEYES festival, where we bring the elementary students who participated in the fall BioEYES to OSU on a field trip to participate in additional hands-on science activities that reinforce and extend what they learned in BioEYES, which will include some of the activities that the enrolled undergraduates designed for their final project. We will also likely use their designed activities in our other outreach efforts, including WestFest Science and Technology Festival and COSI Big Science Festival; again, we always recruit undergraduate volunteers for these outreach activities.

Measuring student learning outcomes can take many different approaches. For example, you may measure student success in achieving identified outcomes through written-papers, embedded test questions, pre and post-tests, reflection journals, discussions, successful completion of a specified product, focus groups, interviews, and observations.

9. Please describe how student learning, with respect to the goals in #8 above, will be assessed in this course.

During the final wrap-up session, we will assess student general outcomes through active discussion and an in-class survey. The final project will also be evaluated by the instructor, course coordinator, and peers to assess content, ease of "hands-on" performance, and age-appropriateness. We will actively discuss each project and provide constructive comments on how the activity could be improved and/or modified for the intended (as well as different) audiences.

Molecular Genetics Curricular map and goals

<i>Course Number</i>	<i>Course Title</i>	<i>Credit Hours</i>	<i>Role in Major/MS degree</i>	<i>UG Program Learning Goals</i>	<i>MS Program Learning Goals</i>
Biochem 4511	Introduction to Biological Chemistry	4	core (BS)	1*, 2*, 3*, 4*, 5*	NA
MOLGEN 2220H	Intro to Molecular Life Sciences: Research Opportunities and Career Options	1	Elective (BS)	1, 2	NA
MOLGEN 3300	General Plant Biology	3	Elective (BS)	1*, 2*	NA
MOLGEN 3436	Introductory Plant Physiology	3	Elective (BS)	1*, 2*	NA
MOLGEN 4503	Molecular Genetics Writing Project	1	Elective (BS)	6**, 7**, 8**	NA
MOLGEN 4581S	BioEYES: Hands-on STEM learning with zebrafish in Columbus Public Elementary Schools	1	Elective (BS)	6**, 7**	NA
MOLGEN 4591S	DNA Fingerprinting Workshops in Columbus Public Schools	1	Elective (BS)	6**, 7**	NA
MOLGEN 4606	Molecular Genetics	4	core (BS)	1*, 2*, 3*, 4*, 5*	NA
MOLGEN 4703	Human Genetics	3	Elective (BS)	2**, 3**, 4**, 8*	NA
MOLGEN 4998	Undergraduate Research in Molecular Genetics	1 to 3	Elective (BS)	3**, 4**, 5**, 6**, 7**, 8**	NA
MOLGEN 4998H	Undergraduate Research in Molecular Genetics	1 to 3	Elective (BS)	3**, 4**, 5**, 6**, 7**, 8**	NA
MOLGEN 4999	Thesis Research in Molecular Genetics	1 to 3	Elective (BS)	3**, 4**, 5**, 6**, 7**, 8**	NA
MOLGEN 4999H	Thesis Research in Molecular Genetics	1 to 3	Elective (BS)	3**, 4**, 5**, 6**, 7**, 8**	NA
MOLGEN 5193	Individual Studies	1 to 3	Elective (BS), Elective MS Plan A, core MS Plan B	6**, 7**, 8**	2-A, 3-A
MOLGEN 5194	Group Studies	1 to 3	elective BS and MS	2**, 8**	2-A
MOLGEN 5300	Cancer Genetics	3	elective BS and MS	2**, 3**, 4**, 8**	1-I
MOLGEN 5601	Eukaryotic Molecular Genetics Lab	3 or 4	core (BS) elective (MS)	2*, 3*, 4*, 5*, 6*, 7*	1-I, 3-A
MOLGEN 5602	Eukaryotic Cell and Developmental Laboratory	3 or 4	core (BS) elective (MS)	2*, 3*, 4*, 5*, 6*, 7*	1-I, 3-A

MOLGEN 5607	Cell Biology	3	core (BS) elective (MS)	1*, 2*, 3*, 4*, 5*	1-B
MOLGEN 5607E	Cell Biology	4	core (BS) elective (MS)	1*, 2*, 3*, 4*, 5*, 6*	NA
MOLGEN 5608	Genes and Development	3	core (BS) elective (MS)	1*, 2*, 3*, 4*, 5*	1-B
MOLGEN 5608E	Genes and Development	4	core (BS) elective (MS)	1*, 2*, 3*, 4*, 5*, 6*	1-B
MOLGEN 5623	Genetics and Genomics	2	elective BS and MS	2**, 3**, 4**, 8**	1-I, 3-A
MOLGEN 5630	Plant Physiology	3	elective BS and MS	2**, 3**, 4**, 8**	1-I
MOLGEN 5632	Insect Molecular Genetics	2	elective BS and MS	2**, 3**, 4**, 8**	1-I
MOLGEN 5643	Plant Anatomy	3	elective BS and MS	2**, 3**, 4**, 6**, 7*, 8**	1-I
MOLGEN 5645	Quantitative, Population, and Evolutionary Genetics	2	core (BS) elective (MS)	1*, 2*, 3*, 4*, 5*	1-B
MOLGEN 5650	Analysis and Interpretation of Biological Data	3	elective BS and MS	3**, 5**	1-I
MOLGEN 5695	Frontiers in in Life Sciences Research: Genomics, Proteomics and Bioethics	1	elective BS and MS	2**, 3**, 4**, 8**	1-I
MOLGEN 5700	Systems of Genetic Analysis	3	elective BS and MS	2**, 3**, 4**, 8**	1-I
MOLGEN 5701	DNA Transactions and Gene Regulation	4	elective BS and MS	2**, 3**, 4**, 8**	1-I
MOLGEN 5705	Advances in Cell Biology	2	elective BS and MS	2**, 3**, 4**, 8**	1-I
MOLGEN 5715	Developmental Genetics	2	elective BS and MS	2**, 3**, 4**, 8**	1-I
MOLGEN 5733	Advanced Human Genetics	2	elective BS and MS	2**, 3**, 4**, 8**	1-I
MOLGEN 5735	Plant Biochemistry	3	elective BS and MS	2**, 3**, 4**, 8**	1-I
MOLGEN 5795	Special Topics in Molecular Genetics	1 to 3	elective BS and MS	2**, 3**, 4**, 8**	1-I
MOLGEN 5796	Current Topics in Signal Transduction	1 to 2	elective BS and MS	2**, 3**, 4**, 8**	1-I
MOLGEN	Study at a Foreign	1 to 3	elective BS	6*, 7*, 8*	1-B

5797	Institution		and MS		
MOLGEN 5798	Study Tour: Domestic	1 to 3	elective BS and MS	6*, 7*, 8*	1-B
MOLGEN 5800	Organelle Biology	2	elective BS and MS	2**, 3**, 4**, 8**	1-I
MOLGEN 7600	First-Year Student Orientation	1	required (MS)	NA	1-B
MOLGEN 7741	Molecular Virology and Pathogenesis of Viruses	5	elective (MS)	NA	1-A
MOLGEN 7999	Thesis Research	1-12	required (planA) elective (planB)	NA	2A, 3A
MOLGEN 7807	Gene Expression: Post- Transcriptional Control	3	elective (MS)	NA	1-A 3-A

Undergraduate Major Learning Goals

(no asterisk = beginner's level; * = intermediate level; ** = advanced level)

1. Undergraduate Molecular Genetics majors acquire a basic mastery of fundamental concepts of biology, chemistry, mathematics, physics, and the scientific method.
2. Undergraduate Molecular Genetics majors acquire a basic mastery of fundamental areas of molecular genetics, including transmission genetics, the central dogma of molecular biology, regulation of gene expression, quantitative and population genetics, genomics, recombinant DNA and biotechnology, and cell and developmental biology.
3. Undergraduate Molecular Genetics majors develop analytical and problem solving skills in areas of genetics and molecular biology.
4. Undergraduate Molecular Genetics majors acquire a basic mastery of experimental techniques and approaches used in genetics and molecular biology.
5. Undergraduate Molecular Genetics majors acquire a basic mastery of data analysis and statistical approaches used in genetics and molecular biology.
6. Undergraduate Molecular Genetics majors effectively communicate their understanding of genetics and molecular biology both orally and in writing.
7. Undergraduate majors participate in academic research and/or outreach activities that are consistent with their interests and postgraduate plans.
8. Undergraduate majors acquire expertise relevant to their chosen area of specialization.

MS Learning goals

(B- beginning, I = Intermediate, A= Advanced)

1. Demonstrate a broad base of knowledge in several areas, including genetics, cell biology, and developmental biology. Goal is partially achieved by requiring one course in each pillar above.
2. Demonstrate a deep understanding of an area of special interest.
3. Effectively communicate research findings via oral and written presentations to specialized scientific and general audiences.