

PUBHEHS 8340
Molecular Techniques for Environmental Health Sciences
3 Credits Hours
Spring Semester 2020; 2nd Session

Course Directors: Christopher M. Weghorst, PhD
Professor
Division of Environmental Health Sciences

Thomas J. Knobloch, PhD
Adjunct Assistant Professor
Division of Environmental Health Sciences

Office Locations:	Dr. Weghorst	Dr. Knobloch
	258 Cunz Hall	434 Cunz Hall
	1841 Neil Avenue	1841 Neil Avenue
	Office phone: 247-4942	Office phone: 292-4168
	Office hours: Call for appointment	Office hours: Call for appointment

Meeting Time and Place:
Tuesdays and Thursdays
12:30 p.m. – 3:20 p.m.
Room 430 Cunz Hall

*Note: In addition to the scheduled class times, students can expect to spend up to 8-10 hours per week in out-of-class time preparing for class and completing assignments.

Additional Course Faculty:

Min-Ae Song, PhD	Assistant Professor, COPH, EHS	380C Cunz Hall
Steve Oghumu, PhD	Assistant Professor, COM, Dept. of Pathology	337 Hamilton Hall
Michael Pennell, PhD	Associate Professor, COPH, BIOSTATS	246 Cunz Hall

Teaching Assistant:

Chieh-Ming Wu EHS Doctoral Student wu.1615@osu.edu 400 Cunz Hall

Course Description:

This course provides students with a practical introduction to a variety of molecular techniques, as applied to the study of living systems at the molecular level. It is designed to offer novice students an opportunity to understand the fundamental principles of modern molecular techniques, as well as actively participate in their application to specific research problems through the combination of both theory and laboratory experiences. Specific techniques include sterile technique, tissue culture, DNA and RNA isolation, PCR, Real-Time qPCR and analysis, and bioinformatics.

Prerequisites:

Completion of a series of pertinent safety training modules during week 1 that are provided online through The Ohio State University Office of Environmental Health and Safety [<https://ehs.osu.edu/research-biosafety-training>]. Implementation of this safety feature, while legally mandated, also serves to enhance the academic experience of our students and prepares students to recognize regulatory aspects of research operations at OSU and elsewhere.

Course Learning Objectives: Following the completion of this course, students will be able to:

1. Describe the general concepts of the institutional biosafety and laboratory safety policies;
2. Summarize and describe the important theoretical concepts, technical steps, and practical applications related to the molecular techniques studied;
3. Discuss the critical features related to the accurate recording and preserving details of an experimental protocol;
4. Create and properly maintain a research laboratory notebook.

Applicable Foundational Public Health Knowledge Objectives:

- Explain the critical importance of evidence in advancing public health knowledge (#6)
- Explain effects of environmental factors on a population's health (#7)
- Explain biological and genetic factors that affect a population's health (#8)

Applicable MPH Degree Foundational Competencies:

- Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software, as appropriate (#3)
- Interpret results of data analysis for public health research, policy or practice (#4)

Applicable MPH Degree: EHS Specialization Competencies

- outline the health challenges that natural and anthropogenic contaminants in the environment can pose to population health (#2);
- identify and explain individual (e.g., genetic, physiologic and psychosocial) and community (e.g., social, built, economic, race) susceptibility factors that heighten the risk for populations for adverse health outcomes from environmental hazards (#4);
- explain exposure and the underlying mechanisms of toxicity and infectivity resulting from chemical, biological and physical agents (#6).

Applicable MS Degree: EHS Specialization Competencies

- Synthesize literature in student's area of specialization relative to their thesis topic and its importance for public health (#2);
- Apply relevant theories and conceptual models to inform and ground research design and interpretation (#3);
- Explain individual and community susceptibility and vulnerability factors that heighten the risk for populations for adverse health outcomes from environmental hazards (#7).

Applicable PhD Degree: EHS Specialization Competencies

- Synthesize and critique existing literature in student's area of specialization to identify gaps in the evidence base and justify their importance for public health (#2);
- Apply relevant theories and conceptual models to inform and ground research design and interpretation (#3).

Textbook and Reference Materials:

While no specific textbook is required for the course, several molecular biology and laboratory reference materials will be utilized. These reference materials are listed below and are available without cost either within the Weghorst Laboratory for your review or via the Internet. Specific readings drawn from the reference materials will be provided to students to as URL links or PDF files within Carmen.

1. **At the Bench: A Laboratory Navigator, Updated Edition** (2005)

ISBN 978-087969708-2) by Kathy Barker

A research laboratory filled with competent, busy people entirely familiar with its arcane customs and practices is a daunting place for newcomers. Kathy Barker knows this world. She was a technician, an undergraduate, then a graduate student at the University of Massachusetts, and as a postdoctoral fellow and assistant professor at Rockefeller University, she was a mentor to grad students, physicians in training, technicians, and research nurses. From this rich experience, she has written *At the Bench*, a unique handbook for living and working in the laboratory. Much more than a simple primer or lab manual, this book is an essential aid to understanding: (i) how research groups work at a human level—and how to fit in, (ii) what equipment is essential, and how to use it properly, (iii) how to get started and get organized, (iv) how to set up an experiment, (v) how to handle and use data and reference sources, (vi) how to present yourself and your results—in print and in person.

2. **Internet-based Resources:**

National Center for Biotechnology Information (NCBI) Bookshelf

(<http://www.ncbi.nlm.nih.gov/sites/entrez?db=Books&itool=toolbar>)

Human Molecular Genetics 2. Tom Strachan and Andrew P. Read. New York and London: Garland Science, c1999.

(<http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=hmg.TOC&depth=2>)

GENES IX. Benjamin Lewin. Jones and Bartlett Publishers, Burlington, MA, c2013.

(<http://biology.jbpub.com/book/genes/index.cfm>)

Molecular Biology of the Cell. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter. New York and London: Garland Science, c2002.

(<http://www.ncbi.nlm.nih.gov/books/bv.fcgi?call=bv.View..ShowTOC&rid=mboc4.TOC&depth=10>)

Molecular Cell Biology. Harvey Lodish, Arnold Berk, S. Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James E. Darnell. New York: W. H. Freeman & Co., c1999.

(<http://www.ncbi.nlm.nih.gov/books/bv.fcgi?call=bv.View..ShowTOC&rid=mcb.TOC&depth=10>)

The NCBI Handbook. J. McEntyre and J. Ostell, eds. Bethesda (MD): National Library of Medicine (US), NCBI; 2002–2005.

(<http://www.ncbi.nlm.nih.gov/books/bv.fcgi?call=bv.View..ShowTOC&rid=handbook.TOC&depth=10>)

The NCBI Style Guide [Internet]. Beck, Belinda. Bethesda (MD): National Library of Medicine (US), NCBI; 2004.

(<http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=styleguide>)

Priorities in Health. Dean T. Jamison, Joel G. Breman, Anthony R. Measham, George Alleyne, Mariam Claeson, David B. Evans, Prabhat Jha, Anne Mills, and Philip Musgrove, eds. Washington (DC): IBRD/The World Bank; 2006

<http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=pih.TOC&depth=2>)

**U.S. Department of Health and Human Services (HHS) – National Institutes of Health (NIH)
– National Institute of Environmental Health Sciences (NIEHS)**

<http://www.niehs.nih.gov/>)

Resources for Scientists

<http://www.niehs.nih.gov/research/resources/index.cfm>)

Environmental Genome Project

<http://egp.gs.washington.edu/>)

3. Selected primary and review articles from the current literature as necessary and assigned.
4. The Weghorst Laboratory-specific Lecture Notes and Laboratory Standard Operating Procedures (SOPs).

CONDUCT OF COURSE

Format: The course will include both in class/laboratory sessions and out-of-class/distance learning sessions focused on specific molecular biology techniques.

Student Responsibilities: You are expected to be prepared for and participate in the class/laboratory sessions. In each of the sessions, we will be discussing the readings assigned for that day. Read the assigned readings prior to the class and come prepared to discuss them.

Attendance:

It is expected that students will attend ALL lectures and laboratory sessions. Failure to do so could reduce the likelihood of completion of certain components of the final project, resulting in an “Incomplete” as well as affect the participation portion of their grade.

Safety: Laboratory operations involve the use of hazardous chemicals and equipment, which may pose health hazards and physical hazards to laboratory personnel. These hazards can be managed or minimized through appropriate facilities, protocols and knowledgeable personnel, the foundations of practicing safe science. Regulations that address these issues are intended to formalize existing protocols and training practices. Thus, prior to participating in any activities within the EHS laboratories, all students will be required to take a series of pertinent safety training modules provided online through The Ohio State University Office of Environmental Health and Safety [<https://www.ehs.ohio-state.edu/secure/>]. Implementation of this safety feature, while legally mandated, also serves to enhance the academic experience of our students and prepares students to recognize regulatory aspects of research operations at OSU and elsewhere.

Laboratory Fees: There are no fees associated with the purchasing of laboratory supplies utilized in this course. All required materials, supplies and equipment will be provided by Dr. Weghorst and the Division of EHS.

Assignments and Grading:

Completion of Safety Modules	5%
Laboratory Notebook:	20%
Quizzes: (8 @ 2.5%)	20%
qRT-PCR Individual Project	30%
Participation:	5%
Final Exam (cumulative)	20%

The following system will serve as a guide for the assignment of final grades.

Final Percentage	Grade
94-100	A
90-93	A-
87-89	B+
84-86	B
80-83	B-
77-79	C+
74-76	C
70-73	C-
60-69	D
<60	E

Incompletes:

Any student who for any reason is given a grade of Incomplete (I) will automatically lose one letter grade of the final grade. For example, if you are given a mark of Incomplete, and then successfully complete the course requirements, and you have done B+ work, you will receive a final grade of C+.

Office of Student Life: Disability Services

Any student who feels s/he may need an accommodation based on the impact of a disability should contact me privately to discuss your specific needs. Please contact the Office of Student Life: Disability Services at 614-292-3307 in Room 098 Baker Hall 113 W. 12th Ave. to coordinate reasonable accommodations for students with documented disabilities(<http://slds.osu.edu/>).

Mental Health Services

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 <https://ccs.osu.edu/> or calling 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 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273-TALK or at suicidepreventionlifeline.org.

Academic Integrity

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University, the College of Public Health, and the Committee on Academic Misconduct (COAM) expect that all students have read and understood the University's *Code of Student Conduct* and the School's *Student Handbook*, and that all students will complete all academic and scholarly assignments with fairness and honesty. The *Code of Student Conduct* and other information on

academic integrity and academic misconduct can be found at the COAM web pages (<http://oaa.osu.edu/coam/home.html>). Students must recognize that failure to follow the rules and guidelines established in the University's *Code of Student Conduct*, the *Student Handbook*, and in the syllabi for their courses may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the University, or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Please note that the use of material from the Internet without appropriate acknowledgement and complete citation is plagiarism just as it would be if the source were printed material. Further examples are found in the *Student Handbook*. Ignorance of the *Code of Student Conduct* and the *Student Handbook* is never considered an "excuse" for academic misconduct.

If I suspect a student of academic misconduct in a course, I am obligated by University Rules to report these suspicions to the University's Committee on Academic Misconduct. If COAM determines that the student has violated the University's *Code of Student Conduct* (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in the course and suspension or dismissal from the University. If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Course Schedule
PUBHEHS 8340: Molecular Techniques for Environmental Health Sciences
Spring Semester 2020; Second Session
3 Credit Hours

Meeting Times: Tuesdays and Thursdays; 12:30 p.m. to 3:20 p.m.; Room 430 Cunz Hall

Week	Date	Day	Topic/Activity	Instructor
1	February 27	TH	Introduction to the course Lecture 1: Institutional Biosafety and Laboratory Safety Policies Lab 1: Complete	Weghorst
2	March 3	TU	Quiz 1: EH&S Research and Safety Online Training Certificates Lecture 2: Cell Culture Lab 2: Cell Culture	Knobloch
	March 5	TH	Quiz 2: Cell Culture Lecture 3: DNA and RNA. Lab 3: DNA and RNA Isolation	Knobloch
3	March 10	TU	SPRING BREAK – NO CLASS	
	March 12	TH	SPRING BREAK – NO CLASS	
4	March 17	TU	Quiz 3: DNA and RNA Lecture 4: Polymerase Chain Reaction (PCR). Lab 4-1: Endpoint PCR	Weghorst
	March 19	TH	Lab 4-2: Gel Electrophoresis and Interpretation Quiz 4: Polymerase Chain Reaction (PCR). Lecture 5: DNA Methylation Detection Techniques	Weghorst Song
5	March 24	TU	Lab 5: DNA Methylation Detection Techniques	Song
	March 26	TH	Quiz 5: DNA Methylation Detection Techniques Lecture 6: Gene-Environment Interactions Single Nucleotide Polymorphism (SNP) Analysis Lab 6-1: SNP Assay Setup	Knobloch
6	March 31	TU	Lab 6-2: SNP Analysis Lecture 7: Real-time PCR	Knobloch
	April 2	TH	Quiz 6: “SNP Analysis” Lab 7-1: qPCR Setup	Oghumu
7	April 7	TU	Lab 7-2: qPCR Analysis Discussion	Knobloch
	April 9	TH	Quiz 7: qPCR Analysis Review: Laboratory Notebook Review	Knobloch Weghorst
8	April 14	TU	Lecture 8: qRT-PCR Data Analysis Methods	Pennell
	April 16	TH	Quiz 8: qRT-PCR Data Analysis Methods Lab 8: qRT-PCR Individual Project	Knobloch Weghorst
	April 28	TU	Final Exam: 2:00pm – 3:45pm: Room 430 Cunz	Weghorst

Alignment of Course Topics, Assignments, Course Learning Objectives, and Core/Specialization Competencies

Week	1	2	3	4	5	6	7	8
Topics	Institutional Biosafety and Laboratory Safety Policies	Sterile Technique & Cell Culture; DNA and RNA; DNA and RNA Isolation	Spring Break	Polymerase Chain Reaction (PCR). Endpoint PCR; Gel Electrophoresis and Interpretation; DNA Methylation	DNA Methylation Detection Techniques; Gene-Environment Interactions Single Nucleotide Polymorphism (SNP) Analysis;	SNP Analysis; qPCR Setup;	qPCR Analysis Discussion; Laboratory Notebook Review	qRT-PCR Data Analysis Methods; qRT-PCR Individual Project
Assignments	Quiz; in lab assignments	Quizzes; In lab assignments	None	Quizzes; In lab assignments	Quizzes; In lab assignments	Quizzes; In lab assignments	Quizzes; In lab assignments	Quizzes; In lab assignments; Individual project
Aligned Course Learning Objectives	1,3	1,2,3,4	None	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
All Graduate Degree Foundational Public Health Knowledge Objectives	6,7,8	6,7,8	None	6,7,8	6,7,8	6,7,8	6,7,8	6,7,8
MPH: Foundational Competencies	4	4	None	4	4	4	4	3,4
MPH: Specialization in EHS	6	4,6	None	4,6	4,6	6	6	
MS: Specialization in Environmental Public Health	2	2,3,7	None	2,3,7	2,3,7	2,3,7	2,3,7	2,3,7
PhD: Specialization in Environmental Public Health	2	2,3	None	2,3	2,3	2,3	2,3	2,3

Alignment of Course Topics, Assignments, Course Learning Objectives, and Core/Specialization Competencies