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
258 Cunz Hall
1841 Neil Avenue
Office phone: 247-4942
Office hours: Call for appointment

Dr. Knobloch
434 Cunz Hall
1841 Neil Avenue
Office phone: 292-4168
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 as URL links or PDF files within Carmen.

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


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:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Completion of Safety Modules</td>
<td>5%</td>
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<tr>
<td>Laboratory Notebook:</td>
<td>20%</td>
</tr>
<tr>
<td>Quizzes: (8 @ 2.5%)</td>
<td>20%</td>
</tr>
<tr>
<td>qRT-PCR Individual Project</td>
<td>30%</td>
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<tr>
<td>Participation:</td>
<td>5%</td>
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<tr>
<td>Final Exam (cumulative)</td>
<td>20%</td>
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</table>
The following system will serve as a guide for the assignment of final grades.

<table>
<thead>
<tr>
<th>Final Percentage</th>
<th>Grade</th>
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<tbody>
<tr>
<td>94-100</td>
<td>A</td>
</tr>
<tr>
<td>90-93</td>
<td>A-</td>
</tr>
<tr>
<td>87-89</td>
<td>B+</td>
</tr>
<tr>
<td>84-86</td>
<td>B</td>
</tr>
<tr>
<td>80-83</td>
<td>B-</td>
</tr>
<tr>
<td>77-79</td>
<td>C+</td>
</tr>
<tr>
<td>74-76</td>
<td>C</td>
</tr>
<tr>
<td>70-73</td>
<td>C-</td>
</tr>
<tr>
<td>60-69</td>
<td>D</td>
</tr>
<tr>
<td>&lt;60</td>
<td>E</td>
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**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 Youkin 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

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Day</th>
<th>Topic/Activity</th>
<th>Instructor</th>
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</table>
| 1    | February   | TH  | Introduction to the course  
Lecture 1: Institutional Biosafety and Laboratory Safety Policies  
Lab 1: Complete | Weghorst |
|      | 27         |     |                 |              |
| 2    | March      | TU  | Quiz 1: EH&S Research and Safety Online Training Certificates  
Lecture 2: Cell Culture  
Lab 2: Cell Culture | Knobloch  
March 3 |     |     |                 |              |
| 3    | March      | TH  | Quiz 2: Cell Culture  
Lecture 3: DNA and RNA.  
Lab 3: DNA and RNA Isolation | Knobloch  
March 5 |     |     |                 |              |
| 4    | March      | TU  | Quiz 3: DNA and RNA  
Lecture 4: Polymerase Chain Reaction (PCR).  
Lab 4-1: Endpoint PCR | Weghorst  
March 17 |     |     |                 |              |
|      | March      | TH  | Lab 4-2: Gel Electrophoresis and Interpretation  
Quiz 4: Polymerase Chain Reaction (PCR).  
Lecture 5: DNA Methylation Detection Techniques | Weghorst  
March 19 |     |     |                 | Song         |
| 5    | March      | TU  | Lab 5: DNA Methylation Detection Techniques | Song  
March 24 |     |     |                 |              |
|      | March      | TH  | Quiz 5: DNA Methylation Detection Techniques  
Lecture 6: Gene-Environment Interactions Single Nucleotide Polymorphism (SNP) Analysis  
Lab 6-1: SNP Assay Setup | Knobloch  
March 26 |     |     |                 |              |
| 6    | March      | TU  | Lab 6-2: SNP Analysis  
Lecture 7: Real-time PCR | Knobloch  
March 31 |     |     |                 |              |
|      | April      | TH  | Quiz 6: “SNP Analysis”  
Lab 7-1: qPCR Setup | Oghumu  
April 2 |     |     |                 |              |
| 7    | April      | TU  | Lab 7-2: qPCR Analysis Discussion | Knobloch  
April 7 |     |     |                 |              |
|      | April      | TH  | Quiz 7: qPCR Analysis  
Review: Laboratory Notebook Review | Knobloch  
April 9 |     |     |                 | Weghorst     |
| 8    | April      | TU  | Lecture 8: qRT-PCR Data Analysis Methods | Pennell  
April 14 |     |     |                 |              |
|      | April      | TH  | Quiz 8: qRT-PCR Data Analysis Methods  
Lab 8: qRT-PCR Individual Project | Knobloch  
April 16 |     |     |                 | Weghorst     |
|      | April      | TU  | Final Exam: 2:00pm – 3:45pm: Room 430 Cunz | Weghorst  
April 28 |     |     |                 |              |
## Alignment of Course Topics, Assignments, Course Learning Objectives, and Core/Specialization Competencies

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
<th>Assignments</th>
<th>Aligned Course Learning Objectives</th>
<th>All Graduate Degree Foundational Public Health Knowledge Objectives</th>
<th>MPH: Foundational Competencies</th>
<th>MPH: Specialization in EHS</th>
<th>MS: Specialization in Environmental Public Health</th>
<th>PhD: Specialization in Environmental Public Health</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Institutional Biosafety and Laboratory Safety Policies</td>
<td>Quiz; in lab assignments</td>
<td>1,3</td>
<td>6,7,8</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>2</td>
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<tr>
<td>2</td>
<td>Sterile Technique &amp; Cell Culture; DNA and RNA; DNA and RNA Isolation</td>
<td>Quizzes; in lab assignments</td>
<td>1,2,3,4</td>
<td>6,7,8</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Spring Break</td>
<td>None</td>
<td>1,2,3,4</td>
<td>6,7,8</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>2</td>
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<tr>
<td>4</td>
<td>Polymerase Chain Reaction (PCR), Endpoint PCR; Gel Electrophoresis and Interpretation; DNA Methylation</td>
<td>Quizzes; in lab assignments</td>
<td>1,2,3,4</td>
<td>6,7,8</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>2</td>
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<tr>
<td>5</td>
<td>DNA Methylation Detection Techniques; Gene-Environment Interactions Single Nucleotide Polymorphism (SNP) Analysis;</td>
<td>Quizzes; in lab assignments</td>
<td>1,2,3,4</td>
<td>6,7,8</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>2</td>
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<tr>
<td>6</td>
<td>SNP Analysis; qPCR Analysis; Laboratory Notebook Review</td>
<td>Quizzes; in lab assignments</td>
<td>1,2,3,4</td>
<td>6,7,8</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>2</td>
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<tr>
<td>7</td>
<td>qRT-PCR Data Analysis Methods; qRT-PCR Individual Project</td>
<td>Quizzes; in lab assignments, Individual project</td>
<td>1,2,3,4</td>
<td>6,7,8</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>2</td>
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Notes:
- **Week 5** includes a Spring Break. 
- Assignments are listed as follows: Quiz; in lab assignments.
- Course Learning Objectives are aligned as follows:
  - **1,3,4**: MPH: Foundational Competencies
  - **6,7,8**: All Graduate Degree Foundational Public Health Knowledge Objectives
- Specialization Competencies are aligned as follows:
  - **2,3**: MPH: Specialization in EHS
  - **2,3,7**: MS: Specialization in Environmental Public Health
  - **2**: PhD: Specialization in Environmental Public Health
Alignment of Course Topics, Assignments, Course Learning Objectives, and Core/Specialization Competencies