

**PubH 6162**  
**Biomarkers**  
**Fall 2017**

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**Credits:** 2  
**Meeting Days:** Mondays  
**Meeting Time:** 5:45 pm – 7:40 pm  
**Meeting Place:** Amundson 104  
**Instructors:** Irina Stepanov  
**Office Address:** 2-140 CCRB  
**Office Phone:** 612-624-4998  
**Fax:** 612-624-3869  
**E-mail:** [stepa011@umn.edu](mailto:stepa011@umn.edu)  
**Office Hours:** by appointment

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**I. Course Description**

Biomarkers are invaluable tools in identifying and preventing human disease. Due to significant concerns over the risk of human exposure to airborne pollutants, persistent organic pollutants, heavy metals, and other environmental agents, the potential of molecular markers is especially high in identifying susceptible individuals and preventing environmentally-induced disease. This course will introduce the concept and the tools in molecular biomarker research, including biomarkers of chemical exposures, genetic toxicity markers, genomics-based biomarkers of susceptibility, and organ and systems biomarkers. The progression of biomarker development and application from the laboratory environment to the clinical or population-based settings and to the development of public health policies and interventions will be discussed. The course includes writing a research proposal.

**II. Course Prerequisites**

Introductory courses in toxicology and exposure analysis recommended (PubH 6103, PubH 6104 or equivalent) or instructor consent.

**III. Course Goals and Objectives**

**General goal.** The goal of this course is to introduce students to the value and challenges of using biomarker applications in research and intervention activities pertinent to environmental health, and to provide a view of emerging trends and technologies in the evolving field of biomarker discovery.

**Specific objectives.** Upon completion of this course students should be able to:

Recognize the diversity of biomarker types and applications, as well as the variety of cutting-edge analytical techniques used for their identification and measurement.

Describe the biological meaning of various types of biomarkers and their utility in addressing specific public health issues.

Design a biomarker-based study that coherently incorporates methodological, ethical, and communication considerations.

Analyze biomarker data and interpret their meaning to public health on population and individual levels.

Communicate the results and the meaning of biomarker measurements to various audiences.

**IV. Methods of Instruction and Work Expectations**

This course includes lectures, directed readings, in-class exercises and discussions, and writing and presenting a course project. The lectures will be given to introduce basic concepts and will be followed by seminars to practice application of the gained knowledge and to discuss assigned readings. The course project will include writing a biomarker-based research proposal (3-5 pages) and a discussion of proposals written by all students. Students are expected to attend all of the classes.

**V. Course Text and Readings**

This course is based on the practical aspects of current biomarker applications. Most readings will include recent research papers and reviews of works that are focused on current issues in human health and use state-of-the art technologies. Copies of, or web links to, research papers, reviews, and book chapters will be provided on the Moodle site (<https://moodle.umn.edu/>).

Recommended general reading:

*Casarett and Doull's Toxicology. The Basic Science of Poisons* by Curtis D. Klaasen. This reference book is useful for reviewing toxicology concepts. This reference is available online through the University of Minnesota Biomedical Library: <http://www.knovel.com/knovel2/Toc.jsp?BookID=95>

*Molecular, clinical and environmental toxicology. Volume 3, Environmental toxicology.* Luch, A., Editor. Basel; New York: Springer, 2012. This volume contains two chapters on biomarker application in toxicology and risk assessment. Free access online through University Libraries.

*Biomarkers and human biomonitoring.* Knudsen, Lisbeth E.; Merlo, Domenico Franco.; Royal Society of Chemistry (Great Britain). Cambridge : RSC Pub., 2012. This reference discusses biomarkers of exposure to environmental toxicants and provides examples of biomarker-based studies. Available at UM TC Bio-Medical Library (WA670 B615 2012 )

*Biomarkers and occupational health. Progress and perspectives.* Mendelsohn, M.L., Peeters, J.P., Normandy, M.J., Eds. Washington, D.C.: Joseph Henry Press 1995. Available at UM TC Bio-Medical Library (WA400 B6155 1994)

**Examples of journals for the course project literature search (online access through UMN library)**

- Cancer Epidemiology Biomarkers & Prevention
- Chemical Research in Toxicology
- Biomarkers
- Environmental perspectives
- Chemico-Biological Interactions
- Regulatory Toxicology and Pharmacology

**VI. Course Outline/Weekly Schedule**

Lecture: Topic	Specific learning points or activities
Lecture 1: Introduction to the course	<ul style="list-style-type: none"> <li>• Overview of the course structure and explanation of the course project</li> <li>• Definitions, classifications, and characteristics of biomarkers.</li> </ul>

Lecture 2: Biomarkers of exposure (Part 1)	<ul style="list-style-type: none"> <li>• Development and application of biomarkers of exposure</li> <li>• Discussion of assigned reading</li> </ul>
Lecture 3: Biomarkers of exposure (Part 2)	<ul style="list-style-type: none"> <li>• Biomarkers of common toxicants and carcinogens</li> <li>• Discussion of assigned papers</li> </ul>
Lecture 4: Presentation of selected topics for proposals	<ul style="list-style-type: none"> <li>• Each students presents their idea in 2-3 slides</li> <li>• Discussion and feedback</li> </ul>
Lecture 5: Genetic toxicity markers	<ul style="list-style-type: none"> <li>• The concept and the biological significance of DNA adducts</li> <li>• Issues around DNA adduct discovery and analysis in humans</li> <li>• Methodologies for DNA adduct analyses</li> </ul>
Lecture 6: Biomarkers of genetic susceptibility	<ul style="list-style-type: none"> <li>• Effects of genetic variations on toxicant metabolism, biomarker levels, and susceptibility to disease</li> <li>• Complexity of genomic data, analyses and interpretation</li> </ul>
Lecture 7: Organ and systems biomarkers (Part 1)	<ul style="list-style-type: none"> <li>• Inflammatory and immune markers: circulating markers and DNA adducts</li> <li>• Issues related to sample collection and processing</li> <li>• Limitations of inflammatory and immune marker measurements and interpretation</li> </ul>
Lecture 8: Organ and systems biomarkers (Part 2)	<ul style="list-style-type: none"> <li>• Epigenetic markers</li> <li>• Effect of chemical exposures and other environmental stressors on DNA methylation</li> <li>• Methodologies for the analysis of DNA methylation and histone modifications</li> </ul>
<b><u>Draft proposals due</u></b>	
Lecture 9: Biomarker discovery	<ul style="list-style-type: none"> <li>• Guest lecture (omics research)</li> </ul>
Lecture 10: Ethical and data protection issues in biomarker research	<ul style="list-style-type: none"> <li>• Subject recruitment and informed consent</li> <li>• Blinded approach to biomarker analyses</li> <li>• Biomarker feedback</li> </ul>
Lecture 11: Communication considerations	<ul style="list-style-type: none"> <li>• Communication of complex and incomplete scientific data to stakeholders</li> </ul>
<b><u>Final proposals due</u></b>	
Lecture 12: Biomarkers in public health policies and interventions	<ul style="list-style-type: none"> <li>• Examples of the impact of biomarker research and findings on policy development</li> </ul>
<b><u>Critique assignment</u></b>	
Lecture 13: Guest lecture	<ul style="list-style-type: none"> <li>• Example of biomarker-based research at the U of M</li> </ul>
Lecture 14: Proposal presentation	<ul style="list-style-type: none"> <li>• Discussion and critique of proposals</li> </ul>

## VII. Evaluation and Grading

Grading percentages will be based on total performance on the assignments. Course grades will be determined by the following:

- Class attendance and assigned readings and classroom activities (35%)

The purpose of these activities is to involve students in active learning process and to apply the gained knowledge to the analysis of case studies.

Students will read assigned research papers and prepare for class presentation by writing a brief summary, focusing on the critique of issues relevant to the specific course topic (as indicated by the instructor). Points will be awarded for clearly and concisely addressing the major strengths and weaknesses of the reviewed research study.

Classroom exercises will include group discussions, small group projects, quizzes, and minute papers. For selected activities, students will be required to upload their reports on Moodle site (<https://moodle.umn.edu/>). Points will be awarded for active participation and turning in completed written assignments.

- Course Project (50%)

Students will design a biomarker-based study in the form of a research proposal. The proposal will follow the format outlined by the instructor, which will be close to the NIH proposal format. The proposals will be 6 pages maximum (excluding the 1-page Specific Aims page), and will coherently incorporate a statement of specific aims, significance of the problem, study design and methodology, and a discussion of potential limitations and solutions. Students will work on individual parts of the proposal over the course of the semester. Each proposal will be graded according to the rubric which will be provided by the instructor.

- Critique of the course project (15%)

Each student will prepare a written critique of proposals prepared by other students (as assigned by the instructor). This will be the final assignment. Students will have two weeks to complete this assignment and will follow rubrics provided by the instructor. Points will be awarded for clearly and concisely addressing the major strengths and weaknesses of the reviewed proposal.

After completion of this assignment, each project will be discussed in class in a study section format.

Letter grades and associated points are awarded in this course as follows below, and will appear on the student's official transcript.

The University utilizes plus and minus grading on a 4.000 cumulative grade point scale in accordance with the following:

A	4.000 - Represents achievement that is outstanding relative to the level necessary to meet course requirements
A-	3.667
B+	3.333
B	3.000 - Represents achievement that is significantly above the level necessary to meet course requirements
B-	2.667
C+	2.333
C	2.000 - Represents achievement that meets the course requirements in every respect
C-	1.667
D+	1.333
D	1.000 - Represents achievement that is worthy of credit even though it fails to meet fully the course requirements
S	Represents achievement that is satisfactory, which is equivalent to a C- or better.

**For additional information, please refer to:**

<http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html>.

### **Course Evaluation**

The SPH will collect student course evaluations electronically using a software system called CoursEval: [www.sph.umn.edu/courseval](http://www.sph.umn.edu/courseval). The system will send email notifications to students when they can access and complete their course evaluations. Students who complete their course evaluations promptly will be able to access their final grades just as soon as the faculty member renders the grade in SPHGrades: [www.sph.umn.edu/grades](http://www.sph.umn.edu/grades). All students will have access to their final grades through OneStop two weeks after the last day of the semester regardless of whether they completed their course evaluation or not. Student feedback on course content and faculty teaching skills are an important means for improving our work. Please take the time to complete a course evaluation for each of the courses for which you are

registered.

### **Incomplete Contracts**

A grade of incomplete "I" shall be assigned at the discretion of the instructor when, due to extraordinary circumstances (e.g., documented illness or hospitalization, death in family, etc.), the student was prevented from completing the work of the course on time. The assignment of an "I" requires that a contract be initiated and completed by the student before the last official day of class, and signed by both the student and instructor. If an incomplete is deemed appropriate by the instructor, the student in consultation with the instructor, will specify the time and manner in which the student will complete course requirements. Extension for completion of the work will not exceed one year (or earlier if designated by the student's college). For more information and to initiate an incomplete contract, students should go to SPHGrades at: [www.sph.umn.edu/grades](http://www.sph.umn.edu/grades).

### **University of Minnesota Uniform Grading and Transcript Policy**

A link to the policy can be found at [onestop.umn.edu](http://onestop.umn.edu).

## **VIII. Other Course Information and Policies**

### **Grade Option Change** (if applicable):

For full-semester courses, students may change their grade option, if applicable, through the second week of the semester. Grade option change deadlines for other terms (i.e. summer and half-semester courses) can be found at [onestop.umn.edu](http://onestop.umn.edu).

### **Course Withdrawal:**

Students should refer to the Refund and Drop/Add Deadlines for the particular term at [onestop.umn.edu](http://onestop.umn.edu) for information and deadlines for withdrawing from a course. As a courtesy, students should notify their instructor and, if applicable, advisor of their intent to withdraw.

Students wishing to withdraw from a course after the noted final deadline for a particular term must contact the School of Public Health Office of Admissions and Student Resources at [sph-ssc@umn.edu](mailto:sph-ssc@umn.edu) for further information.

### **Student Conduct Code:**

The University seeks an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves the educational mission of the University. Similarly, the University seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community.

As a student at the University you are expected adhere to Board of Regents Policy: *Student Conduct Code*.

To review the Student Conduct Code, please see:

[http://regents.umn.edu/sites/default/files/policies/Student\\_Conduct\\_Code.pdf](http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf).

Note that the conduct code specifically addresses disruptive classroom conduct, which means "engaging in behavior that substantially or repeatedly interrupts either the instructor's ability to teach or student learning. The classroom extends to any setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities."

### **Use of Personal Electronic Devices in the Classroom:**

Using personal electronic devices in the classroom setting can hinder instruction and learning, not only for the student using the device but also for other students in the class. To this end, the University establishes the right of each faculty member to determine if and how personal electronic devices are allowed to be used in the classroom. For complete information, please reference:

<http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html>.

### **Scholastic Dishonesty:**

You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code:

[http://regents.umn.edu/sites/default/files/policies/Student\\_Conduct\\_Code.pdf](http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf)) If it is determined that a

student has cheated, he or she may be given an "F" or an "N" for the course, and may face additional sanctions from the University. For additional information, please see:

<http://policy.umn.edu/Policies/Education/Education/INSTRUCTORRESP.html>.

The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: <http://www1.umn.edu/oscai/integrity/student/index.html>. If you have additional questions, please clarify with your instructor for the course. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class-e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam.

#### **Makeup Work for Legitimate Absences:**

Students will not be penalized for absence during the semester due to unavoidable or legitimate circumstances. Such circumstances include verified illness, participation in intercollegiate athletic events, subpoenas, jury duty, military service, bereavement, and religious observances. Such circumstances do not include voting in local, state, or national elections. For complete information, please see:

<http://policy.umn.edu/Policies/Education/Education/MAKEUPWORK.html>.

#### **Appropriate Student Use of Class Notes and Course Materials:**

Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community. For additional information, please see: <http://policy.umn.edu/Policies/Education/Education/STUDENTRESP.html>.

#### **Sexual Harassment:**

"Sexual harassment" means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behavior is not acceptable in the University setting. For additional information, please consult Board of Regents Policy:

<http://regents.umn.edu/sites/default/files/policies/SexHarassment.pdf>

#### **Equity, Diversity, Equal Opportunity, and Affirmative Action:**

The University will provide equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy:

[http://regents.umn.edu/sites/default/files/policies/Equity\\_Diversity\\_EO\\_AA.pdf](http://regents.umn.edu/sites/default/files/policies/Equity_Diversity_EO_AA.pdf).

#### **Disability Accommodations:**

The University of Minnesota is committed to providing equitable access to learning opportunities for all students. The Disability Resource Center Student Services is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations.

If you have, or think you may have, a disability (e.g., mental health, attentional, learning, chronic health, sensory, or physical), please contact DRC at 612-626-1333 or [drc@umn.edu](mailto:drc@umn.edu) to arrange a confidential discussion regarding equitable access and reasonable accommodations.

If you are registered with DS and have a current letter requesting reasonable accommodations, please contact your instructor as early in the semester as possible to discuss how the accommodations will be applied in the course.

For more information, please see the DS website, <https://diversity.umn.edu/disability/>.

#### **Mental Health and Stress Management:**

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 and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: <http://www.mentalhealth.umn.edu>.

**The Office of Student Affairs at the University of Minnesota:**

The Office for Student Affairs provides services, programs, and facilities that advance student success, inspire students to make life-long positive contributions to society, promote an inclusive environment, and enrich the University of Minnesota community.

Units within the Office for Student Affairs include, the Aurora Center for Advocacy & Education, Boynton Health Service, Central Career Initiatives (CCE, CDes, CFANS), Leadership Education and Development – Undergraduate Programs (LEAD-UP), the Office for Fraternity and Sorority Life, the Office for Student Conduct and Academic Integrity, the Office for Student Engagement, the Parent Program, Recreational Sports, Student and Community Relations, the Student Conflict Resolution Center, the Student Parent HELP Center, Student Unions & Activities, University Counseling & Consulting Services, and University Student Legal Service.

For more information, please see the Office of Student Affairs at <http://www.osa.umn.edu/index.html>.

**Academic Freedom and Responsibility: for courses that do not involve students in research:**

Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.\*

**OR:****Academic Freedom and Responsibility, for courses that involve students in research**

Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom and conduct relevant research. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.\*

When conducting research, pertinent institutional approvals must be obtained and the research must be consistent with University policies.

Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help. Contact the instructor, the Department Chair, your adviser, the associate dean of the college, (Dr Kristin Anderson, SPH Dean of Student Affairs), or the Vice Provost for Faculty and Academic Affairs in the Office of the Provost.

*\* Language adapted from the American Association of University Professors "Joint Statement on Rights and Freedoms of Students".*

**Student Academic Success Services (SASS): <http://www.sass.umn.edu>:**

Students who wish to improve their academic performance may find assistance from Student Academic Support Services. While tutoring and advising are not offered, SASS provides resources such as individual consultations, workshops, and self-help materials.

*Template update 9/2014*