Environmental and Molecular Analysis of a Disease  
Professors Nikolai Kirov and Mary Killilea  
Time and Date: Tuesday 2:00 – 4:45

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Prof. Mary Killilea’s Contact Information  
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Office Hours: Wednesday 11am-noon or by appointment

Course description:  
This is an upper-level undergraduate course that will teach students about the environmental determinants of disease vectors, and the molecular techniques used to measure prevalence of a pathogen in these vectors. Students will partake in a semester long research project on Lyme disease, the most prevalent vector-borne disease in the United States. The aim of the project is to determine the prevalence of Borrelia burgdorferi, the Lyme disease causative agent, in tick populations from New York forests. Students will collect ticks, bring them back to the lab and analyze them for the presence of the Borrelia burgdorferi bacteria. Then collected and analyzed data will be fed into epidemiological models to assess human risk of Lyme disease in the studied areas.

Learning outcomes:  
Upon completion of this course, students will be able to:

• Develop and execute a research project  
• Safely collect field samples of disease vectors  
• Perform quantitative real time PCR to determine the bacterial load of a tick  
• Organize, analyze and present their data

Prerequisites:  
Introduction of Ecology (BIOL-UA 63) or Molecular and Cell Biology I (BIOL-UA 21)

Schedule: The course will meet once a week for 2.5 hours. There will also be one required field trips that will be scheduled outside of the normal class hours.
Grades:
The final grade for the class will be calculated as follows:

- Module One Paper Discussions 15%
- Module One Exam: 25%
- Website Development 20%
- Field Collection 10%
- Lab Preparation 15%
- Presentation of Results 15%

An **unexcused** absence from an exam will be calculated as 0% for that particular test!
If you miss an exam and present a legitimate excuse, a make-up test will be made available to you.
There will be only one opportunity for such an exam; it could be an essay test, and the appropriate
instructors will grade it. This situation will be dealt with partly on an individual basis.

**Required Texts:** There is no required text.

**Course schedule:**

**Module 1:** The first module of the course is designed for students to learn the foundational
material on Lyme disease specifically and Disease Ecology in general. They will be introduced
to the following topics through peer-reviewed literature, textbooks, and in class discussions:

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
</tr>
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<tbody>
<tr>
<td>Sept. 8</td>
<td>Introduction to Lyme disease</td>
</tr>
<tr>
<td>Sept. 15</td>
<td>Ecology of <em>Ixodes scapularis</em></td>
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<tr>
<td>Sept. 22</td>
<td>Methods of collecting environmental samples</td>
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<tr>
<td>Sept. 29</td>
<td>Genomics of <em>B. burgorfergy</em> spirochete</td>
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<tr>
<td>Oct. 6</td>
<td>Methods of detection and quantification of spirochetes in</td>
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<tr>
<td></td>
<td>environmental samples and Website assignment</td>
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<tr>
<td>Oct. 13</td>
<td><strong>No Class Fall Break</strong></td>
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<tr>
<td>Oct. 20</td>
<td>Module 1 Exam</td>
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Readings for Module 1:

- Introduction to Lyme disease

- Ecology of *Ixodes scapularis* and Lyme disease
  - Bunnell et al. 2003
  - Ogden et al. 2004

- Collecting *Ixodes scapularis*
  - Ogden et al. 2016
  - Glass et al. 1994

- Genomics of *B. burgdorferi* spirochete

- Methods of detection and quantification of spirochete in environmental samples.

Assignments for Module 1:

1. Come to class each week having read the articles and prepared to lead a discussion on assigned questions
Module 2: Collection of environmental samples

<table>
<thead>
<tr>
<th>Oct. 23</th>
<th>Field Trip</th>
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<tbody>
<tr>
<td>Oct. 27</td>
<td>No Class On Tuesday</td>
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- Field trips are scheduled for October 23 with a rain date of October 30. This will be an all day trips leaving campus at 8:00 am and returning around 5:00 pm

During field trips, students will collect ticks, identify the species, count them, determine their life cycle stage and freeze them in preparation for the next molecular step.

Note: Professor Killilea is an expert in researching Lyme disease and other tick-borne diseases. She has supervised many undergraduate and professional staff on the safe collection of ticks. Students will be educated about the risks of tick bites and protocols for avoidance and treatment of tick bites. All students will be required to wear white suits to limit their exposure to tick bites, and there will be frequent tick checks.

Assignments for Module 2:
1. Field Data Collection Assignment – A website will be developed to describe what you have learned about Lyme disease risk and tick collection

2. You will collect ticks for Module 3

Module 3:
- November 3 – December 1 Students will learn to isolate DNA from the ticks, quantify it and perform PCR with primers specific for 1-3 *Borrelia* genes. They will next perform quantitative real time PCR with the spirochete positive samples to determine the bacterial load per infected tick. The resulting data will be represented as percentage of infected ticks collected from the studied areas and spirochete genome equivalents per tick.

Readings for Module 3:
- Real time PCR versus regular PCR. Tutorial. Applied Biosystems
- Real time PCR. Application guide. BioRad
Assignments for Module 3:

1. Methods – Before beginning the PCR analysis, all students will be required to read the protocols and be prepared to answer questions at the beginning of lab.

Module 4:

- December 8 and 15 - The data from modules 2 and 3 will be analyzed and visualized

Assignments for Module 4:

1. Final Results – Results produced during Module 3 will be a central part of the development of a webpage that will communicate the final results of the semester long project.

As per the CAS Academic Integrity Policy:

http://cas.nyu.edu/page/academicintegrity

Academic Integrity

As you begin your College career—attending classes, participating in extracurricular activities, performing community service, and thinking about where your academic and career interests lie—it is important to reflect on your role and responsibilities within an academic community.

I. A COMMUNITY OF THE MIND

The College is a "community of the mind." Its students, faculty, and staff all share the goal of pursuing truth through free and open inquiry, and we support one another's endeavors in this regard. As in any community, membership comes with certain rights and responsibilities. Foremost among these is academic integrity. Cheating on an exam, falsifying data, or having someone else write a paper undermines others who are "doing it on their own"; it makes it difficult or impossible to assess fairly a student's interest, aptitude, and achievement; and it diminishes the cheater, depriving him/her of an education. Most importantly, academic dishonesty is a violation of the very principles upon which the academy is founded. Thus, when students enter the College, one of the first things that they are asked to do is to sign a community compact, recognizing these principles of academic integrity. For this reason also, violations of these principles are treated with the utmost seriousness.

"Nothing is more basic to living and working together than trust. Without it, as Thomas Hobbes warned, humanity is reduced to a 'war of all against all.' Trust is the condition of cooperation and of social relationships themselves. We learn as children not to be naively trusting, but instead to watch to see which people and which organizations deserve to be trusted. We are disappointed all too often. Law courts and religions try to make people more
trustworthy. But being the sort of person who can be trusted is still a personal achievement. Trust does not depend on people putting aside their personal benefits, but on people pursuing them in ways that make them dependable partners to others. Thus lovers try to be faithful and friends loyal. Even in competition, trustworthiness is important. Not only are there punishments for those who cheat, but today's competitor may readily become tomorrow's colleague. An institution like a college depends enormously on trust. Students rightly expect professors to teach honestly and not deceive them. Society trusts scientists not to lie about the results of their research. Neither the pursuit of new knowledge nor the effort to preserve and pass on old wisdom can flourish unless we can trust each other to be intellectually honest. —Craig Calhoun, University Professor of the Social Sciences

II. SOME GUIDELINES

Academic honesty means that the work you submit - in whatever form - is original. Students are expected - often required - to build their work on that of other people, just as professional researchers and writers do. Giving credit to someone whose work has helped you is expected; in fact, not to give such credit is a crime. Plagiarism is the severest form of academic fraud. Plagiarism is theft. Obviously, bringing answers into an examination or copying all or part of a paper straight from a book, the Internet, or a fellow student is a violation of this principle. But there are other forms of cheating or plagiarizing which are just as serious, for example:

- presenting an oral report drawn without attribution from other sources (oral or written);
- writing a paragraph which, despite being in different words, expresses someone else's idea without a reference to the source of the idea;
- submitting essentially the same paper in two different courses (unless both instructors have given their permission in advance);
- giving or receiving help on a take-home examination or quiz unless expressly permitted by the instructor (as in collaborative projects);
- presenting as your own a phrase, sentence, or passage from another writer's work without using quotation marks;
- presenting as your own facts, ideas, or written text gathered or downloaded from the Internet;
- submitting another student's work with your name on it;
- purchasing a paper or "research" from a term paper mill;
- "collaborating" between two or more students who then submit the same paper under their individual names.

Term paper mills (web sites and businesses set up to sell papers to students) often claim they are merely offering "information" or "research" to students and that this service is acceptable and allowed throughout the university. THIS IS ABSOLUTELY UNTRUE. If you buy and submit "research," drafts, summaries, abstracts, or final versions of a paper, you are committing plagiarism and are subject to stringent disciplinary action. Since plagiarism is a matter of fact and not intention, it is crucial that you acknowledge every source accurately and completely. If you quote anything from a source, use quotation marks and take down the page number of the quotation to use in your footnote.
When in doubt about whether your acknowledgment is proper and adequate, consult your instructor. Show the instructor your sources and a draft of the paper in which you are using them. The obligation to demonstrate that work is your own rests with you, the student. You are responsible for providing sources, copies of your work, or verification of the date work was completed. While all this looks like a lot to remember, all you need to do is to give credit where it is due, take credit only for your original ideas, and ask your instructor or adviser when in doubt.

Consult the APA, MLA, or Chicago style guides for accepted forms of documentation. You can access these resources, as well as additional information on proper citations on the NYU Libraries Citation Style Guide.

III. PROCEDURES AND SANCTIONS
The penalty for academic dishonesty is severe. The following are the procedures as approved by the Faculty of Arts and Science. See also the College Bulletin.

1. If a student cheats on an examination or in laboratory work or engages in plagiarism, appropriate disciplinary action should be taken. The Department can take the following actions:

   a) The faculty member, with the approval of the Director of Undergraduate Studies (Director), may reduce the student's grade or give the student an F in the course.

   b) If after lowering the grade or assigning an F the department believes a more severe penalty (i.e., probation, suspension, expulsion) is warranted, it can refer the case to the Dean or his/her representative (Associate Dean for Students) for further action.

2. In all cases of either (a) or (b), the Director shall inform the Department Chair of any action in writing and send copies of this letter to the Dean and to the student. The letter shall include the nature of the offense, the penalty, and the right of the student to appeal such penalty. A copy of the letter shall be kept in a confidential chairman's file and not in the student's departmental file. The Dean's office copy shall also be kept in a confidential file. (The Professor and/or the Director is encouraged to meet with the student and discuss the nature of the offense and the action taken.)

3. For cases involving a first offense at New York University, the Dean shall send the student by registered mail a notice that a second offense will result in a one-semester suspension, or a more severe penalty. (The student is also called in to discuss the offense, and review the consequences of the disciplinary action.)

4. For cases involving a second offense, the Dean shall proceed as follows:

   a) Upon receiving a second Director's letter concerning a given student, the Dean shall convene a three-member ad hoc committee, with no member being from the department involved, to examine the evidence. This ad hoc committee shall consider if there are reasonable grounds to believe that cheating/plagiarism has occurred and if so, shall affirm the suspension penalty. It shall report its conclusion to the Dean within three business days.

   b) If the committee affirms the suspension, the Dean shall send the student by registered mail the suspension letter within two business days of receiving the report. The letter shall advise the student of his or her right to appeal. The student shall have two business days from the letter's delivery to request an
appeal of the suspension as provided in Section 5 (below). The suspension shall ordinarily be stayed during the pendency of appeal.

c) If the committee does not affirm the suspension, the report shall be kept on file for a one-year period.

5. The student in all cases has the right to appeal to the Dean. In the event of an appeal, the Dean shall elicit a written complaint from the faculty member and proceed as described above.