

Biol67/Micr167 The Biology of Fungi and Parasites that Cause Disease

To be offered every year

Course Director: Paula Sundstrom, Ph.D.

Prerequisites: BIOL 12 and BIOL 13 and one from among BIOL 40, BIOL 45, or CHEM 41. BIOL 46 and BIOL 42 are both recommended but not required.

Eukaryotic pathogens are among the most important causes of infectious diseases in humans. Fungal pathogens are major causes of opportunistic disease in AIDS patients and other immunosuppressed populations such as transplant and cancer patients. Malaria and other parasites devastate human populations world-wide. The biochemical similarities between mammalian host cells and eukaryotic pathogens limit options for therapeutic strategies, challenge drug discovery efforts and heighten the injurious impact of drug resistant organisms.

The goals of this course are two-fold. The first is to gain knowledge about eukaryotic pathogens that will be useful for designing strategies for disease intervention and prevention; such as identification of pathogen-specific therapeutic targets and understanding the host response to the pathogen. The course will emphasize fungi and will touch upon parasites, integrating aspects of the biology, ecology, genetics, biochemistry, and pathology with molecular analyses of host parasite interactions. The second objective is to understand and interpret data in research articles so as to be able to use this information in answering basic questions about the pathogens and the host immune response. The course will begin with didactic lectures that incorporate data from classic papers that have advanced the field to the current state of the art. Next, contemporary published articles will be covered in class with integration of student participation in the explanation of research data on a variety of pathogens and associated host responses described in the articles. The culmination of these efforts will be an oral and written presentation by each student, that will cover a current area of research on a fungus or parasite or a host immune response. We will focus on research that seeks to identify promising new molecular strategies for fighting diseases caused by eukaryotic pathogens.

Reading materials

The main reading materials will be drawn from the current literature and will be distributed over the Dartmouth Canvas website. Textbooks tend to not cover cutting edge information and are less useful for this course.

For background information students may consult any Medical Microbiology textbook such as Levinson, W. Review of Medical Microbiology and Immunology, Thirteenth Edition. 2014. For parasites, Dickson Despommier's Parasitic Diseases from 2005 is excellent if you can find it however, it appears to be out of print. Schmidt's Foundations of Parasitology is available as an E-Book and is another option. If you have not taken an immunology class, Basic Immunology by AK Abbas and AH Lichtman or other immunology text may also be useful.

Grades

Grades will be based on: 1) two in-class exams consisting of multiple choice and short essay questions based on an assigned manuscript that will be made available at least two days prior to the exam (40%), 2) a report consisting of an oral presentation and a written document (40%) and 3) participation during class sessions and outside of class in working with other students on reports (see below) (20%). The report, which is described in detail below, will be based on a current published journal article or two selected in consultation with the course director. The oral presentation will focus on the data in the manuscript in terms of the purpose of the experiments and interpretation and evaluation of the results. The written report will be based on the same article as the oral presentation and will summarize and evaluate the findings. The written report will include references from relevant background articles leading to the research in the selected article(s), the direction that future research should take, and will explain how the research will benefit human health. The grading of the report will be based on an oral presentation (50%) and on the written document (50%). Grading of participation will depend on a) volunteering to participate in discussion of figures and tables from research articles that will be assigned to individual students prior to class; and b) serving as a consultant to one or two classmates (assigned by the course director).

Attendance policy: Student participation in discussions is central to class progress, and the responsibility for explaining discussion assignments is divided among the class. Absent students cause the other students to shoulder more of the burden in explaining data. Thus, attendance is required. In the case that emergencies or other unavoidable events necessitate missing class, you must obtain permission from Dr. Sundstrom. If you must miss class on short notice, notify Dr. Sundstrom as soon as possible. Unexcused absences will reduce the grade* (see below for notification of absence). Attendance is mandatory for both regular class sessions and scheduled x-hours.

Format of course

The class will meet in timeslot 2A on Tuesdays and Thursdays from 2:00 – 3:50 PM. Two thirds of class time will consist of lectures and discussions. One third of the class time will be devoted to the preparation and presentation of reports.

Background knowledge necessary for understanding material presented in class

The following topics will not be covered in detail. Students will be responsible for reviewing or independently acquiring the information needed to understand the material covered in class.

1. The biochemistry and composition of macromolecules including nucleic acids, proteins, lipids and carbohydrates
2. Basic bacteriology including bacterial structure, methods of classification, mechanisms of gene transfer, the bacterial genome and mechanisms for signal transduction
3. The elements of eukaryotic genomes, their mechanisms of replication, and mechanisms whereby genes are transcribed and translated into proteins
4. Eukaryotic cell structure, mechanisms for secretion of proteins, mechanisms of signal transduction
5. The basic elements of the immune system including types of immune cells and cytokines

Learning outcomes

1. To explain the general characteristics of each eukaryotic pathogen in terms of taxonomy, ecological niche, life-cycles, characteristics of growth, biochemical characteristics, and relationships to bacteria.
2. To describe unknown properties of eukaryotic pathogens that, if answered, could lead to beneficial effects on human health by decreasing the frequency and severity of diseases caused by eukaryotic pathogens.
3. To explain the molecular genetic and biochemical approaches that are currently being used to understand the pathogenesis of diseases caused by eukaryotic pathogens and to apply these approaches in the proposal of research projects that have potential for benefiting human health.

Oral Presentations

From a list provided in class, or choose your own article(s) with permission from the course director, select one or two major papers published within the **last two years** from refereed journals on a current research topic such as:

I Mechanisms of immunity to eukaryotic pathogens

II Defining virulence factors and mechanisms

Adherence of pathogens to host tissues (choose your favorite fungus or parasite)

Mechanisms of entry and survival within human cells (macrophages, endothelial cells, epithelial cells and others)

The biogenesis, molecular composition, and metabolic activity of outer surfaces and cell walls

Resistance to drugs used to treat infections

III Mechanisms of regulation of virulence gene expression

IV Affects of eukaryotic pathogens on mammalian host cells and tissues.

The length of individual presentations will depend on the number of students in the class but will be at least fifteen minutes with three minutes for questions. The report is due one week after the presentation or on the last day of class, whichever is earlier.

Microsoft PowerPoint presentations will be uploaded onto the classroom computer for presentation in class. [Bring your presentation to class on a Flash Drive.](#)

Focus on the figures or tables that contain the major thrust of the paper, i.e. the data that best demonstrate why the article was accepted for publication as original research of high importance. Be ready to explain and answer questions about the methods. Presenters must know how the experiments were performed. A good exercise is to pretend that you are repeating the experiment that led to the generation of the data; describe the steps you would take if you were performing the experiment.

Written Report (due one week after the oral presentation or on the last day of class)

The report should include:

- I Introduction** (1 page). An introduction to the organism and the questions that are being addressed in the manuscript.
Background on the particular topic of the report.
What has been learned about the topic in the last five years? Most importantly, what key findings and health needs have lead to the research described in the paper?
- II Results** (3 pages) Present Data
- List the questions that are being addressed by the research presented.
Describe the specific experiments that were performed? Summarize briefly how they were done. Discuss the controls that were included in the experiments and whether they are adequate for interpreting the data.
- III Discussion** (2 pages) Do the results support the conclusions?
Do the authors note new questions prompted by the research reviewed in section II?
Suggest your own ideas about the directions that this research should take.
How will research on the topic lead to strategies to benefit human health?
- IV Literature cited** (one page) Cite manuscripts required for interpreting the chosen manuscript(s).

The report should be no longer than 10 pages 1.5 times spaced.

*If you cannot attend a class session, you must obtain an excused absence from Dr. Sundstrom as soon as possible. Excused absences are normally granted for personal illness, a national meeting, family wedding, and family emergencies. Excused absences are not granted for participation in extracurricular activities. If you participate in extracurricular activities, you must arrange your schedule to be able to attend class. Excused absences are not granted for class reunions or attendance at on-campus events. You will be responsible for making up the missed material on your own.