The Hebrew University of Jerusalem

Syllabus

Cell Biology of host-bacteria lpathogen interaction - 86899

Last update 14-02-2023

HU Credits: 3

Degree/Cycle: 2nd degree (Master)

Responsible Department: Cellular & Developmental Biology

Academic year: 0

Semester: 2nd Semester

Teaching Languages: English

Campus: E. Safra

Course/Module Coordinator: Prof. Benjamin Aroeti

Coordinator Email: aroeti@mail.huji.ac.il

Coordinator Office Hours: By appointment

Teaching Staff:
Prof Ilan Rosenshine,
Prof Benjamin Aroeti

Course/Module description:
The course will discuss the mechanisms by which bacterial pathogens and toxins subvert
their host cells (typically epithelial cells) to establish successful infection. The talks will be focused on
the bacteria-host cell interface, namely, on the mechanisms used by the pathogen to assault its host.
The host's cell response (innate immunity, etc) will also be discussed.
We will emphasize experimental systems used to study bacteria-host interactions (including in our
own laboratories), at both, basic and more applicative (translational) levels. For instance, recent studies suggested
the use of pathogenic bacteria to treat certain human cancers. Interactions with mammalian and plant cells will be discussed.

Course/Module aims:
Understanding the mechanisms by which bacterial pathogens and toxins subvert their host cells and how the latter respond to neutralize them.

Learning outcomes - On successful completion of this module, students should be able to:
Understanding the principles and mechanisms underlying host pathogen interactions.
Critically read and assess scientific work in the field.To get familiar with scientific methodologies aimed at studying the mechanisms of host-pathogen interactions

Attendance requirements(%):
80%

Teaching arrangement and method of instruction: Frontal lectures given by the lecturers; Students will be required to read and analyze scientific works and present them as short frontal talks and/or as a written study.

Course/Module Content:
Bacteria: We will discuss bacterial pathogens that attack their hosts from the

outside, i.e.,
extracellular pathogens, and bacteria that invade their host cells. The following bacteria will be
presented: Enteropathogenic and enterohemorrhagic E. coli (EPEC&EHEC) that attack the human
intestines and cause severe diarrhea in children, and hemorrhagic diarrhea (hemolytic uremic
syndrome), respectively. Salmonella strains, which cause salmonellosis, i.e., food poisoning in
humans cattle and rodents. Shigella dysenteriae, which causes dysentery and Listeria
monocytogenes, which cause listeriosis primarily in pregnant women, newborns, and adults with
weakened immune systems. Helicobacter pylori, causing gastric ulcers, and stomach cancers.
Chlamydia trachomatis, which cause sexually transmitted and respiratory diseases in humans;
Group A streptococcus (GAS), causing severe necrosis of soft tissues, such as the skin.
Bacterial toxins to be discussed are: Anthrax; Shiga; Cholera; Ricin.
Host cell biology: We will cover the following aspects: i). Adherence: Every infection initiates by
pathogen binding to its host plasma membrane. The outstanding strategies used by bacteria to
adhere and colonize their hosts (e.g., type IV pili, tir-intimin interactions, etc) will be covered from the bacterial and host cell perspectives. ii). Delivery of effector molecules: Some Gram negative
pathogens often use the so-called type III secretion system, or injectisome, to deliver proteins from
their cytoplasm into eukaryotic cells. We will discuss the system and its interactions with the host.
iii). Membrane traffic and the cytoskeleton: Pathogenic bacteria and toxins hijack host cell
membrane traffic mechanisms and cytoskeletal elements to achieve successful infection. The
molecular mechanisms underlying these events will be thoroughly discussed. For instance: how (and
why) EPEC and EHEC form actin-rich pedestals in their hosts; how bacterial pathogens, such as
Salmonella and Listerya phagocytose to hide themselves within the host, while avoiding destruction
by immune responses and lysosomal degradation; how and for what purpose bacterial pathogens
reorganize the membrane structure and function of their hosts, e.g., by inducing specialized
membrane domains reminiscent of lipid rafts. iv). Disruption of cell polarity. Special

attention will
be given to the understanding of how bacterial pathogens subvert cell polarity mechanisms to attack
epithelial cells; For example, bacteria of the intestines often hijack the tight junctions to breach the
mucosal barrier. Another example is the ability of some bacterial pathogens to exploit polarized
membrane traffic to deliver secreted toxins and themselves from of external body fluids into the
blood via transcytosis. We will discuss these processes at the molecular and sub-cellular levels. v).
Signal transduction and molecular mimicry. Bacterial pathogens are known to subvert diverse host
cell signaling pathways for their own benefit. Amazingly, some bacteria do not rely on the activity of
their host molecules to induce a specific change. Rather, they introduce their own proteins that
mimic host cell's functions to achieve the effect. Major discoveries of these molecular mimicry
events will be discussed.

Required Reading:
Papers upon teachers' approval

Additional Reading Material:
None

Course/Module evaluation:
End of year written/oral examination 0 %
Presentation 80 %
Participation in Tutorials 20 %
Project work 0 %
Assignments 0 %
Reports 0 %
Research project 0 %
Quizzes 0 %
Other 0 %

Additional information:
The course is limited to 26 students. Preliminary requirement: a cell biology course; A course in Microbiology; classes will be recorded; class attendance via zoom will be enabled for students located in campuses other than the Givat Ram

Campus, namely, mount scopus, agriculture (Rehovot) and Ein Karem (medical school) campuses.