MVP Core
CAMB 706
Fall Semester 2019

Course Directors and Contact Info:

Matthew Weitzman, Colket 4050, 267-425-2068, weitzmanm@email.chop.edu
Sunny Shin, Johnson Pavilion 201B, 215-746-8410, sunshin@pennmedicine.upenn.edu

Section Directors

Bacteriology I & II : Sunny Shin/Jay Zhu
Virology I : Matthew Weitzman/Jianxin You

Description

The MVP Core class provides CAMB-MVP students with key fundamental knowledge of Bacteriology, Virology, and Parasitology. The course runs through the Fall and Spring for first year CAMB-MVP students. The course starts with 3 overview lectures and is then organized into three sections that cover principles of Bacteriology, Virology, and Parasitology.

Prerequisites

None

Enrollment criteria

Required for all first year CAMB-MVP students. Non CAMB-MVP students by permission of course directors.

Schedule

MWF, 2:30-3:30

Location

209 Johnson

Format

• Lecture
• Discussion - Themed lecture sets with intermittent journal article discussion groups

Student assignments

Midterm/final exam for each subsection
Journal article presentation within each subsection
Syllabus

Grading Criteria:

- 50% Exam based (in class or take home, varies by section leaders)
- 40% presentation based
- 10% participation based (participation in discussions, asking questions during lecture, etc.)

Course Goals

Students who complete this course successfully will have gained:

- A broad introduction to host-pathogen interactions
- A survey of bacteriology, virology and parasitology with emphasis on common and distinct themes
- Ability to analyze relevant primary articles in-depth

Guidelines/Expectations for Student Paper Presentations

Students not assigned to present:

Read the paper well in advance of the presentation day.

1. Come prepared to participate actively in the discussion with at least two questions or observations about approaches or interpretations by the authors.

Student assigned to present:

1. Meet the faculty mentor for the paper well in advance of the presentation to go over expectations and discuss the background for the paper. It is your responsibility to establish contact with the faculty member.
2. Format will be a journal club style presentation via PowerPoint and should contain the following elements:
   A. A brief presentation of the background of the research including rationale and key previous findings upon which it is based,
   B. A presentation of key findings in the most important figures (ie. not necessarily all of them!),
   C. A critical review of the major findings and interpretations and
   D. A critique of the significance of the paper overall.
3. Meet with the faculty mentor for the paper soon after your presentation for feedback.

Faculty Mentor:

Faculty mentors are encouraged to give brief comments at the end of the presentation session about where the paper fits into the general thrust of research in their field.
Syllabus

Course Directors
Matthew Weitzman, Ph.D.
Professor of Pathology & Laboratory Med
4050 Colket Translational Research Building
The Children's Hospital of Philadelphia
3501 Civic Center Blvd
Philadelphia, PA 19104
Office: 267-425-2068
Email: weitzmanm@email.chop.edu

Sunny Shin, Ph.D.
Associate Professor of Microbiology
Perelman School of Medicine
3610 Hamilton Walk
201B Johnson Pavilion
Philadelphia, PA 19104
Office: 215-746-8410
Email: sunshin@pennmedicine.upenn.edu

Bacteriology Section
Sunny Shin, Ph.D.
Email: sunshin@pennmedicine.upenn.edu

Virology Section
Matthew Weitzman, Ph.D.
Email: weitzmanm@email.chop.edu

Jay Zhu, Ph.D.
Email: junzhu@pennmedicine.upenn.edu

Parasitology Section
Sparky Lok, Ph.D.
Email: jlok@vet.upenn.edu

Jianxin You, Ph.D.
Email: jianyou@pennmedicine.upenn.edu

Chris Hunter, Ph.D.
Email: chunter@vet.upenn.edu

Assistants
Kate Wurges
Office: 267-426-8150
Email: wurgesk@email.chop.edu

Laurie Zimmerman
Office: 215-573-2596
Email: zimml@pennmedicine.upenn.edu
# Syllabus

**CAMB 706 – Bacteriology Session I & II**  
**Course Directors: Sunny Shin & Jay Zhu**  
MWF, 2:30-3:30  209 Johnson

<table>
<thead>
<tr>
<th>DATE</th>
<th>DAY</th>
<th>TITLE</th>
<th>LECTURER/PRESENTER</th>
<th>EMAIL</th>
</tr>
</thead>
</table>
| 9/6/2019 | F   | Intro: Course Layout  
Intro: Pathogen Genomes                                                  | Drs. Weitzman & Shin  
Dr. Bushman                                    | weitzmanm@email.chop.edu  
sunshin@pennmedicine.upenn.edu  
bushman@pennmedicine.upenn.edu                  |
| 9/9/2019 | M   | Intro: Concepts of Host-Pathogen Interactions                         | Dr. Hunter                          | chunter@vet.upenn.edu                       |
| 9/13/2019 | W   | Intro: Host Immune Responses to Pathogens                             | Dr. Scott                            | pscott@vet.upenn.edu                        |
| 9/13/2019 | F   | Bacterial Basics, Global Microbiome, Nucleic Acid Management in Prokaryotes | Dr. Bushman                         | bushman@pennmedicine.upenn.edu              |
| 9/16/2019 | M   | Antibiotic Resistance                                                | Dr. Planet                           | planetp@email.chop.edu                      |
| 9/18/2019 | W   | Student Paper Presentation                                           | Dr. Bittinger                        | bittingerk@email.chop.edu                   |
| 9/20/2019 | F   | Principles of Bacterial Pathogenesis                                 | Dr. Brodsky                          | brodsky@vet.upenn.edu                       |
| 9/23/2019 | M   | Strategies for Bacterial Adhesion and Invasion                       | Dr. Brodsky                          | brodsky@vet.upenn.edu                       |
| 9/25/2019 | W   | Student Paper Presentation                                           | Dr. Brodsky                          | ibrodsky@vet.upenn.edu                      |
| 9/27/2019 | F   | Bacterial cell-cell interactions                                      | Dr. Zhu                              | junzhu@pennmedicine.upenn.edu               |
| 9/30/2019 | M   | Student Paper Presentation                                           | Dr. Zhu                              | junzhu@pennmedicine.upenn.edu               |
| 10/2/2019 | W   | Signal transduction in bacteria                                       | Dr. Goulian                          | goulian@sas.upenn.edu                       |
| 10/3/2019 | Th  | Microbiome Symposium                                                 |                                     |                                            |
| 10/4/2019 | F   | Signal transduction in bacteria                                       | Dr. Goulian                          | goulian@sas.upenn.edu                       |
| 10/7/2019 | M   | Student Paper Presentation                                           | Dr. Zhu                              | junzhu@pennmedicine.upenn.edu               |
| 10/9/2019 | W   | Vertebrate microbial communities in health and disease                | Dr. Levy                             | maayanle@pennmedicine.upenn.edu             |
| 10/11/2019 | F   |                                                                      |                                     |                                            |
| 10/14/2019 | M   | Vertebrate microbial communities in health and disease                | Dr. Thaiss                           | thaiss@pennmedicine.upenn.edu               |
| 10/16/2019 | W   | Student Paper Presentation                                           | Drs. Levy & Thaiss                   | maayanle@pennmedicine.upenn.edu  
thaiss@pennmedicine.upenn.edu                |
| 10/18/2019 | F   | Intracellular bacteria                                               | Dr. Shin                             | sunshin@pennmedicine.upenn.edu              |
| 10/21/2019 | M   | Intracellular bacteria                                               | Dr. Shin                             | sunshin@pennmedicine.upenn.edu              |
| 10/23/2019 | W   | Student Paper Presentation                                           | Dr. Shin                             | sunshin@pennmedicine.upenn.edu              |
| 10/25/2019 | F   | Gram-positive bacteria and toxins                                     | Dr. Zackular                         | Joseph.Zackular@pennmedicine.upenn.edu      |
| 10/27/2019 | F   | Student Paper Presentation                                           | Dr. Brodsky                          | ibrodsky@vet.upenn.edu                      |

**Microbiome Symposium**  
10/4/2019  F  Signal transduction in bacteria  
10/7/2019  M  Student Paper Presentation  
10/9/2019  W  Vertebrate microbial communities in health and disease  
10/11/2019  F  

**CAMB Symposium**  
10/14/2019  M  Vertebrate microbial communities in health and disease  
10/16/2019  W  Student Paper Presentation  
10/18/2019  F  Intracellular bacteria  
10/21/2019  M  Intracellular bacteria  
10/23/2019  W  Student Paper Presentation  
10/25/2019  F  Gram-positive bacteria and toxins
### Syllabus

<table>
<thead>
<tr>
<th>DATE</th>
<th>DAY</th>
<th>TITLE</th>
<th>LECTURER/ PRESENTER</th>
<th>EMAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/28/2019</td>
<td>M</td>
<td>Immunity to bacteria</td>
<td>Dr. Abt</td>
<td><a href="mailto:Michael.Abt@pennmedicine.upenn.edu">Michael.Abt@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td>10/30/2019</td>
<td>W</td>
<td>Student Paper Presentation</td>
<td>Drs. Abt &amp; Zackular</td>
<td><a href="mailto:Michael.Abt@pennmedicine.upenn.edu">Michael.Abt@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><a href="mailto:Joseph.Zackular@pennmedicine.upenn.edu">Joseph.Zackular@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td>11/1/2019</td>
<td>F</td>
<td>Phage</td>
<td>Dr. Bushman</td>
<td><a href="mailto:bushman@pennmedicine.upenn.edu">bushman@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td>11/4/2019</td>
<td>M</td>
<td>Student Paper Presentation</td>
<td>Dr. Bushman</td>
<td><a href="mailto:bushman@pennmedicine.upenn.edu">bushman@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td>11/11/2019</td>
<td>M</td>
<td></td>
<td></td>
<td>Bacteriology Final due</td>
</tr>
<tr>
<td>11/1/2019</td>
<td>W</td>
<td>Viral structure and diversity</td>
<td>Dr. Bushman</td>
<td><a href="mailto:bushman@pennmedicine.upenn.edu">bushman@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td>11/13/2019</td>
<td>W</td>
<td>Viral structure and diversity</td>
<td>Dr. Bushman</td>
<td><a href="mailto:bushman@pennmedicine.upenn.edu">bushman@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td>11/15/2019</td>
<td>F</td>
<td>Student Paper Discussion</td>
<td>Dr. Bushman</td>
<td><a href="mailto:bushman@pennmedicine.upenn.edu">bushman@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Schooley et al., Development and Use of Personalized Bacteriophage-Based Therapeutic Cocktails To Treat a Patient with a Disseminated Resistant Acinetobacter baumannii Infection. <em>Antimicrob Agents Chemother.</em> 2017 Sep 22;61(10).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/18/2019</td>
<td>M</td>
<td>Virus receptors</td>
<td>Dr. Bates</td>
<td><a href="mailto:pbates@mail.med.upenn.edu">pbates@mail.med.upenn.edu</a></td>
</tr>
<tr>
<td>11/20/2019</td>
<td>W</td>
<td>Virus entry</td>
<td>Dr. Bates</td>
<td><a href="mailto:pbates@mail.med.upenn.edu">pbates@mail.med.upenn.edu</a></td>
</tr>
<tr>
<td>11/22/2019</td>
<td>F</td>
<td>Student Paper Discussion</td>
<td>Dr. Bates</td>
<td><a href="mailto:pbates@mail.med.upenn.edu">pbates@mail.med.upenn.edu</a></td>
</tr>
<tr>
<td>11/25/2019</td>
<td>M</td>
<td>Retrovirus replication</td>
<td>Dr. Collman</td>
<td><a href="mailto:collmanr@pennmedicine.upenn.edu">collmanr@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td>11/27/2019</td>
<td>W</td>
<td>Thanksgiving Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/29/2019</td>
<td>F</td>
<td>Thanksgiving Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/2/2019</td>
<td>M</td>
<td>Retrovirus pathogenesis</td>
<td>Dr. Collman</td>
<td><a href="mailto:collmanr@pennmedicine.upenn.edu">collmanr@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td>12/4/2019</td>
<td>W</td>
<td>Student Paper Discussion</td>
<td>Kellie Jurado</td>
<td><a href="mailto:Kellie.Jurado@pennmedicine.upenn.edu">Kellie.Jurado@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td>12/6/2019</td>
<td>F</td>
<td>RNA virus replication strategies</td>
<td>??</td>
<td>??</td>
</tr>
<tr>
<td>12/9/2019</td>
<td>M</td>
<td>Flu &amp; RNA virus pathogenesis</td>
<td>Dr. Hensley</td>
<td><a href="mailto:hensley@pennmedicine.upenn.edu">hensley@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td>12/11/2019</td>
<td>W</td>
<td>Student Paper Discussion</td>
<td>Dr. Hoxie</td>
<td><a href="mailto:hoxie@pennmedicine.upenn.edu">hoxie@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td>12/18/2019</td>
<td>W</td>
<td>Virology Midterm Due</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**CAMB 706 – Virology Session I**

Course Directors: Jianxin You and Matthew Weitzman

MWF, 2:30-3:30  209 Johnson
Syllabus
Syllabus

Introductions

9/5/18  Course Layout & Intro: Pathogen Genomes
9/7/18  Intro: Concepts of Host-Pathogen Interactions
9/10/18 Intro: Host Immune Responses to Pathogens

Bacteriology I

9/12/18  Bacterial Basics, Global Microbiome, Nucleic Acid Management in Prokaryotes (Bushman)
- Principles of pathogenesis
- Pathogen genomes
- Effects of host-microbe competition on host genomes
- Studying microbial genomes by whole genome synthesis

9/14/18  Antibiotic Resistance (Planet)
9/17/18  Principles of Bacterial Pathogenesis (Brodsky)
9/19/18  Discussion (Abt & Bittinger)
9/21/18  Strategies for Bacterial Adhesion and Invasion (Schifferli)
- Function of fimbrial adhesins
- Structure and biogenesis of Gram -/+ bacterial fimbriae
- Non-fimbrial adhesins: OMPs & T5SS
- Examples of adhesin-expressing host surface colonizers
- EPEC delivers a receptor to host cells for its adhesin

9/24/18  Strategies for Bacterial Adhesion and Invasion (Schifferli)
- Bacterial tools for the zipper and trigger mechanisms of host cell invasion
- Salmonella, its T3SS & effectors & its OMPs/invasins for host cell uptake
- Yersinia sp. that use an invasin for host-cell uptake
- Listeria monocytogenes, a cell & cell-to-cell invader

9/26/18  Presentation (Schifferli)
9/28/18  Bacterial cell-cell interactions (Zhu)
10/1/18  Presentation (Zhu)
10/3/17  Signal transduction in bacteria (Goulian)
Syllabus

- Definition and diversity of two-component systems
- Basic Reactions
- Histidine Kinases
- Response regulators
- Specificity and Cross-talk

10/5/18 CAMB Symposium

Bacteriology II

10/8/18 Signal Transduction in Bacteria (Goulian)

- Two canonical examples of two-component signaling:
  - porin regulation
  - chemotaxis

10/10/18 Presentation (Zhu)

10/12/18 Vertebrate microbial communities in health and disease (Grice)

- Overview of the human microbiome, techniques, & practicalities
- What is the human microbiome?
- How do we study the microbiome?
- 16S rRNA gene sequencing
- Metrics and bioinformatics
- Controls
- Metagenomic shotgun sequencing
- Beyond bacteria: Eukaryotic and viral members of the microbiome

10/15/18 Vertebrate microbial communities in health and disease (Grice)

- Microbiome roles in health and disease
- The NIH Human Microbiome Project
- The microbiota of different body sites and functional roles in health and disease
- Gastrointestinal tract
- Skin
- Vagina
- Oral Cavity
- Microbiome-based therapeutics: probiotics, prebiotics, and transplantation

10/17/18 Presentation (Grice)

10/19/18 Intracellular bacteria (Shin)

- General strategies used by intracellular pathogens
- Escape from the phagosome- Listeria, Shigella
Syllabus

- Arrest normal phagosome maturation- Salmonella, Mycobacteria
- Unique ER-derived compartment- Legionella
- Acidic lysosomal compartment- Coxiella

10/22/18  Intracellular bacteria (Shin)

- Innate immune recognition
- IFNg defense and evasion- Chlamydia
- Evasion of host cell apoptosis- Coxiella
- Pyroptosis and inflammation- Salmonella
- Autophagy- Shigella and Listeria
- Inhibition of immune signaling- many pathogens
- Endosymbiotic bacteria

10/24/18  Presentation (Shin)

10/26/18  Clinical Microbiology (Graf)

- Principles of Clinical/Diagnostic Microbiology
- Structure of the Clinical Laboratory
- Regulatory aspects of Clinical Lab Medicine
- Methods to culture organisms from various anatomical sites
- Methods to identify organisms to species level
- Methods for determining antibiotic resistance in clinical isolates
- Recent advances in diagnostic microbiology
- Sequencing and MALDI-TOF Mass Spectrometry
- Case studies: Practical examples of diagnostic dilemmas and the role of the laboratory in diagnosis

10/29/18  Clinical Lab Tour (Graf)

10/31/18  Phage (Bushman)

- Phage history
- Global Virome
- Phage Phylogeny
- Clinical Consequences
- Phage T4
- Phage lambda
- Phage therapy

11/5/18  Presentation (Bushman)

11/8/18  Penn-CHOP Microbiome Symposium

11/12/18  Bacteriology Final Due
Virology I

11/12/18  Viral structure and diversity (Bushman)
- Methods: negative staining, cryo-EM, X-ray crystallography, NMR, mixed methods
- Genetic economy-> symmetry
- Helical symmetry
- Icosahedral symmetry
- Relationship between structure and route of transmission

11/14/18  Viral structure and diversity (Bushman)
- Introduction: viral diversity
- The human virome
- Metagenomics and virus hunting

11/16/18  Paper Discussion

11/19/18  Virus receptors (Bates)
- What is a virus particle?
- General problems in virus replication
- Virus attachment
- Internalization and fusion strategies

11/21/18  Thanksgiving Break

11/23/18  Thanksgiving Break

11/26/18  Virus entry (Bates)
- Metastable virion entry
- Stepwise dis-assembly
- Signaling in viral entry
- Viral receptor identification and analysis

11/28/18  Retrovirus replication (Collman)
- Introduction
  - The retrovirus family
  - Shared and unique genetic features
- Replication cycle
  - Entry
  - Reverse Transcription
  - Nuclear migration & Integration
  - Regulation of gene expression & protein expression
  - Assembly & release
- Interaction with host proteins
  - Intrinsic host defense
  - HIV auxiliary genes
11/30/18  **Retrovirus pathogenesis (Collman)**
- Introduction
  - Overview
  - Endogenous retroviruses
- Oncoretroviral Pathogenesis
  - Non-acute transforming viruses: Insertional oncogenesis
  - Acute transforming virus: V-Onc carrying viruses
  - Trans-activating oncoviruses
- Lentiviruses (other than immunodeficiency viruses)
- Immunodeficiency virus pathogenesis
  - Transmission & acute infection
  - Viral dynamics and chronic disease
  - Mechanisms of immunopathogenesis
  - Viral & host determinants of disease
  - HIV as a zoonosis

12/3/18  **Paper Discussion**

12/5/18  **Paper Discussion**

12/7/18  **RNA virus replication strategies (Weiss)**
- Groups of RNA viruses-positive and negative strand viruses-compare virions and genomes
- Viral structural proteins-Virus life cycle
- RNA transcription and replication strategies
- Protein expression, polyprotein processing, frame shifting
- Expression and function of viral accessory proteins
- Recombination and reassortment
- Reverse genetics

12/10/18  **Flu & RNA virus pathogenesis (Hensley)**
- Introduction to influenza virus
  - Viral lifecycle
  - Pathogenesis
  - Epidemiology
- Immune escape
  - Influenza virus antibodies
  - Antigenic shift
  - Antigenic drift
- Evasion of anti-virals
- Influenza virus versus other RNA viruses (measles as an example)

12/12/18  **Paper Discussion**

12/19/18  **Midterm Due**