Syllabus

MVP Core
CAMB 706
Fall Semester 2021

Course Directors and Contact Info:
Sunny Shin, Johnson Pavilion 201B, 215-746-8410, sunshin@pennmedicine.upenn.edu
Boris Striepen, Hill Pavilion, 215-573-9167, striepen@vet.upenn.edu
Jianxin You, Johnson Pavilion 201C, 215-573-6781, jianyou@vet.upenn.edu

Section Directors
Bacteriology I & II : Sunny Shin/Jay Zhu
Virology I : Jianxin You/Elizabeth White

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, 1:45-2:345
Location
Johnson Pavilion 209

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

Grading Criteria:
Syllabus

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 (modified for virtual presentation)

Students not assigned to present:
1. Read the paper well in advance of the presentation day.
2. Email to the assigned faculty member a specific question about the science presented in the paper that can become part of the discussion
3. Come prepared to participate actively in the discussion with observations and answers to questions about approaches or interpretations by the authors.

Students (2-3 selected for each paper) 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 (i.e. not necessarily all of them!)
   C. A critical review of the major findings and interpretations
   D. A critique of the significance of the paper overall.
3. Meet with the faculty mentor for the paper immediately after your presentation for feedback.

Faculty Mentor:
1. The assigned faculty member will meet with presenters prior to the presentations.
2. 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

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Perelman School of Medicine
3610 Hamilton Walk
201C Johnson Pavilion
Philadelphia, PA 19104
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Email: jianyou@pennmedicine.upenn.edu

Bacteriology Section

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

Virology Section

Elizabeth White, Ph.D.
Email: eawhite@pennmedicine.upenn.edu

Parasitology Section

Michael Povelones, Ph.D.
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Boris Striepen, Ph.D.
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School of Veterinary Medicine
380 South University Avenue
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Jay Zhu, Ph.D.
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Jianxin You, Ph.D.
Email: jianyou@pennmedicine.upenn.edu

Boris Striepen, Ph.D.
Email: striepen@vet.upenn.edu
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<tr>
<th>DATE</th>
<th>DAY</th>
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<th>LECTURER/ PRESENTER</th>
<th>EMAIL</th>
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</thead>
<tbody>
<tr>
<td>9/8/2021</td>
<td>W</td>
<td>Intro: Course Layout</td>
<td>Drs. Shin, Striepen, You Dr. Bushman</td>
<td><a href="mailto:sunshin@pennmedicine.upenn.edu">sunshin@pennmedicine.upenn.edu</a> <a href="mailto:striepen@vet.upenn.edu">striepen@vet.upenn.edu</a> <a href="mailto:you@pennmedicine.upenn.edu">you@pennmedicine.upenn.edu</a> <a href="mailto:bushman@pennmedicine.upenn.edu">bushman@pennmedicine.upenn.edu</a></td>
</tr>
<tr>
<td>9/10/2021</td>
<td>F</td>
<td>Intro: Concepts of Host-Pathogen Interactions</td>
<td>Dr. Striepen</td>
<td><a href="mailto:striepen@vet.upenn.edu">striepen@vet.upenn.edu</a></td>
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<tr>
<td>9/13/2021</td>
<td>M</td>
<td>Intro: Host Immune Responses to Pathogens</td>
<td>Dr. Scott</td>
<td><a href="mailto:pscott@vet.upenn.edu">pscott@vet.upenn.edu</a></td>
</tr>
<tr>
<td>9/15/2021</td>
<td>W</td>
<td>Bacterial Basics, Global Microbiome, Nucleic Acid Management in Prokaryotes</td>
<td>Dr. Bushman</td>
<td><a href="mailto:bushman@pennmedicine.upenn.edu">bushman@pennmedicine.upenn.edu</a></td>
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<tr>
<td>9/17/2021</td>
<td>F</td>
<td>Antibiotic Resistance</td>
<td>Dr. Planet</td>
<td><a href="mailto:planetp@email.chop.edu">planetp@email.chop.edu</a></td>
</tr>
<tr>
<td>9/20/2021</td>
<td>M</td>
<td>Student Paper Presentation</td>
<td>Dr. Bittinger</td>
<td><a href="mailto:bittingerk@email.chop.edu">bittingerk@email.chop.edu</a></td>
</tr>
<tr>
<td>9/22/2021</td>
<td>W</td>
<td>Principles of Bacterial Pathogenesis</td>
<td>Dr. Brodsky</td>
<td><a href="mailto:ibrodsky@vet.upenn.edu">ibrodsky@vet.upenn.edu</a></td>
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<tr>
<td>9/24/2021</td>
<td>F</td>
<td>Strategies for Bacterial Adhesion and Invasion</td>
<td>Dr. Brodsky</td>
<td><a href="mailto:ibrodsky@vet.upenn.edu">ibrodsky@vet.upenn.edu</a></td>
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<tr>
<td>9/29/2021</td>
<td>W</td>
<td>Bacterial cell-cell interactions</td>
<td>Dr. Zhu</td>
<td><a href="mailto:junzhu@pennmedicine.upenn.edu">junzhu@pennmedicine.upenn.edu</a></td>
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<tr>
<td>10/1/2021</td>
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<td>Student Paper Presentation</td>
<td>Dr. Zhu</td>
<td><a href="mailto:junzhu@pennmedicine.upenn.edu">junzhu@pennmedicine.upenn.edu</a></td>
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<tr>
<td>10/4/2021</td>
<td>M</td>
<td>Signal transduction in bacteria</td>
<td>Dr. Goulian</td>
<td><a href="mailto:goulian@sas.upenn.edu">goulian@sas.upenn.edu</a></td>
</tr>
<tr>
<td>10/6/2021</td>
<td>W</td>
<td>Signal transduction in bacteria</td>
<td>Dr. Goulian</td>
<td><a href="mailto:goulian@sas.upenn.edu">goulian@sas.upenn.edu</a></td>
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<tr>
<td>10/8/2021</td>
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<td>Student Paper Presentation</td>
<td>Dr. Zhu</td>
<td><a href="mailto:junzhu@pennmedicine.upenn.edu">junzhu@pennmedicine.upenn.edu</a></td>
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<tr>
<td>10/11/2021</td>
<td>M</td>
<td>Vertebrate microbial communities in health and disease</td>
<td>Dr. Levy</td>
<td><a href="mailto:maayanle@pennmedicine.upenn.edu">maayanle@pennmedicine.upenn.edu</a></td>
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<tr>
<td>10/13/2021</td>
<td>W</td>
<td>Vertebrate microbial communities in health and disease</td>
<td>Dr. Thaiass</td>
<td><a href="mailto:thaiss@pennmedicine.upenn.edu">thaiss@pennmedicine.upenn.edu</a></td>
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<tr>
<td>10/15/2021</td>
<td>F</td>
<td>Student Paper Presentation</td>
<td>Drs. Levy &amp; Thaiass</td>
<td><a href="mailto:maayanle@pennmedicine.upenn.edu">maayanle@pennmedicine.upenn.edu</a> <a href="mailto:thaiss@pennmedicine.upenn.edu">thaiss@pennmedicine.upenn.edu</a></td>
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<tr>
<td>10/18/2021</td>
<td>M</td>
<td>Intracellular bacteria</td>
<td>Dr. Shin</td>
<td><a href="mailto:sunshin@pennmedicine.upenn.edu">sunshin@pennmedicine.upenn.edu</a></td>
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<td>10/20/2021</td>
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<td>Intracellular bacteria</td>
<td>Dr. Shin</td>
<td><a href="mailto:sunshin@pennmedicine.upenn.edu">sunshin@pennmedicine.upenn.edu</a></td>
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<td>10/22/2021</td>
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<td>CAMB Symposium</td>
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<tr>
<td>10/25/2021</td>
<td>M</td>
<td>Student Paper Presentation</td>
<td>Dr. Shin</td>
<td><a href="mailto:sunshin@pennmedicine.upenn.edu">sunshin@pennmedicine.upenn.edu</a></td>
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<tr>
<td>10/27/2021</td>
<td>W</td>
<td>Gram-positive bacteria and toxins</td>
<td>Dr. Zackular</td>
<td><a href="mailto:Joseph.Zackular@pennmedicine.upenn.edu">Joseph.Zackular@pennmedicine.upenn.edu</a></td>
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## Syllabus

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<tr>
<td>10/29/2021</td>
<td>F</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>
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<tr>
<td>11/1/2021</td>
<td>M</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> <a href="mailto:Joseph.Zackular@pennmedicine.upenn.edu">Joseph.Zackular@pennmedicine.upenn.edu</a></td>
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<tr>
<td>11/3/2021</td>
<td>W</td>
<td>Phage</td>
<td>Dr. Bushman</td>
<td><a href="mailto:bushman@pennmedicine.upenn.edu">bushman@pennmedicine.upenn.edu</a></td>
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<td>11/5/2021</td>
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<td>Student Paper Presentation</td>
<td>Dr. Bushman</td>
<td><a href="mailto:bushman@pennmedicine.upenn.edu">bushman@pennmedicine.upenn.edu</a></td>
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<tr>
<td>11/12/2021</td>
<td>F</td>
<td>Bacteriology Final due</td>
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### CAMB 706 – Virology Session I

**Course Directors: Jianxin You and Elizabeth White**

MWF, 1:45-2:45pm  
Johnson Pavilion 209

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<tr>
<td>11/12/2021</td>
<td>F</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>
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<td>11/17/2021</td>
<td>W</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>11/19/2021</td>
<td>F</td>
<td>Virus receptors</td>
<td>Dr. Bates</td>
<td><a href="mailto:pbates@pennmedicine.upenn.edu">pbates@pennmedicine.upenn.edu</a></td>
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<tr>
<td>11/22/2021</td>
<td>M</td>
<td>Virus entry</td>
<td>Dr. Bates</td>
<td><a href="mailto:pbates@pennmedicine.upenn.edu">pbates@pennmedicine.upenn.edu</a></td>
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<tr>
<td>11/24/2021</td>
<td>W</td>
<td>Thanksgiving Break</td>
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<td>11/29/2021</td>
<td>M</td>
<td>Student Paper Discussion</td>
<td>Dr. Bates</td>
<td><a href="mailto:pbates@pennmedicine.upenn.edu">pbates@pennmedicine.upenn.edu</a></td>
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<tr>
<td>12/1/2021</td>
<td>W</td>
<td>Retrovirus replication</td>
<td>Dr. Collman</td>
<td><a href="mailto:collmanr@pennmedicine.upenn.edu">collmanr@pennmedicine.upenn.edu</a></td>
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<tr>
<td>12/3/2021</td>
<td>F</td>
<td>Retrovirus pathogenesis</td>
<td>Dr. Collman</td>
<td><a href="mailto:collmanr@pennmedicine.upenn.edu">collmanr@pennmedicine.upenn.edu</a></td>
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<tr>
<td>12/6/2021</td>
<td>M</td>
<td>Student Paper Discussion</td>
<td>Dr. Jurado</td>
<td><a href="mailto:Kellie.Jurado@pennmedicine.upenn.edu">Kellie.Jurado@pennmedicine.upenn.edu</a></td>
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<tr>
<td>12/8/2021</td>
<td>W</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>
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<tr>
<td>12/10/2021</td>
<td>F</td>
<td>RNA virus replication strategies</td>
<td>Dr. Cherry</td>
<td><a href="mailto:cherrys@pennmedicine.upenn.edu">cherrys@pennmedicine.upenn.edu</a></td>
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<td>Student Paper Discussion</td>
<td>Dr. Hoxie</td>
<td><a href="mailto:hoxie@pennmedicine.upenn.edu">hoxie@pennmedicine.upenn.edu</a></td>
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<tr>
<td>12/20/2021</td>
<td>M</td>
<td>Virology Midterm Due</td>
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Introductions

9/8/21 Course Layout & Intro: Pathogen Genomes (Bushman)
- Principles of pathogenesis
- Microbial and host genomes
- Effects of host-microbe competition on the genomes of each

9/10/21 Intro: Concepts of Host-Pathogen Interactions (Streipen)

9/13/21 Intro: Host Immune Responses to Pathogens (Scott)

Bacteriology I

9/15/21 Bacterial Basics, Nucleic Acid Management in Prokaryotes (Bushman)
- Bacterial phylogeny
- Bacteria nucleic acid management

9/17/21 Antibiotic Resistance (Planet)

9/20/21 Paper Discussion (Bittinger)

9/22/21 Principles of Bacterial Pathogenesis (Brodsky)

9/24/21 Strategies for Bacterial Adhesion and Invasion (Brodsky)

9/27/21 Paper Discussion (Brodsky)

9/29/21 Bacterial cell-cell interactions (Zhu)

10/1/21 Paper Discussion (Zhu)

10/4/21 Signal transduction in bacteria (Goulian)
- Definition and diversity of two-component systems
- Basic Reactions
- Histidine Kinases
- Response regulators
- Specificity and Cross-talk

10/6/21 Signal Transduction in Bacteria (Goulian)
- Two canonical examples of two-component signaling:
  - porin regulation
  - chemotaxis
10/8/21 Paper Discussion (Zhu)

**Bacteriology II**

10/11/21 Vertebrate microbial communities in health and disease (Levy)

10/13/21 Bacteriology Midterm Due; Vertebrate microbial communities in health and disease (Thaiss)

10/15/21 Paper Discussion (Levy and Thaiss)

10/18/21 Intracellular bacteria (Shin)

- General strategies used by intracellular pathogens
- Escape from the phagosome- Listeria, Shigella
- Arrest normal phagosome maturation- Salmonella, Mycobacteria
- Unique ER-derived compartment- Legionella
- Acidic lysosomal compartment- Coxiella

10/20/21 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

10/22/21 CAMB Symposium

10/25/21 Paper Discussion (Shin)

10/27/21 Gram positive bacteria and toxins (Zackular)

10/29/21 Immunity to bacteria (Abt)

11/1/21 Paper Discussion (Abt and Zackular)

11/3/21 Phage (Bushman)

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

11/5/21  Paper Discussion (Bushman)


11/12/21  Bacteriology Final Due
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Virology I

11/12/21  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

11/15/21  Viral structure and diversity (Bushman)
- Introduction: viral diversity
- The human virome
- Metagenomics and virus hunting

11/17/21  Paper Discussion (Bushman)
Schooley et al., Development and Use of Personalized Bacteriophage-Based Therapeutic Cocktails To Treat a Patient with a Disseminated Resistant Acinetobacter baumannii Infection. Antimicrob Agents Chemother. 2017 Sep 22;61(10).

11/19/21  Virus receptors (Bates)
- What is a virus particle?
- General problems in virus replication
- Virus attachment
- Internalization and fusion strategies

11/22/21  Virus entry (Bates)
- Metastable virion entry
- Stepwise dis-assembly
- Signaling in viral entry
- Viral receptor identification and analysis

11/24/21  Thanksgiving Break
11/26/21  Thanksgiving Break
11/29/21  Paper Discussion (Bates)

12/1/21  Retrovirus replication (Collman)
- Introduction
  - The retrovirus family
  - Shared and unique genetic features
- Replication cycle
  - Entry
  - Reverse Transcription
  - Nuclear migration & Integration
Syllabus

- Regulation of gene expression & protein expression
- Assembly & release
- Interaction with host proteins
  - Intrinsic host defense
  - HIV auxiliary genes

12/3/21 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

12/6/21 Paper Discussion (Jurado)

12/8/21 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)

12/10/21 RNA virus replication strategies (Cherry)

12/13/21 Paper Discussion (Hoxie)

12/20/21 Virology Midterm Due