



FUNDAMENTALS OF IMMUNOLOGY

Seminar Leader: **Ashwin Skelly**

House Leader: **Ai Yamasaki**

Course Description

This course will give students an overview of immunology, focusing on the mechanisms by which the human body protects itself from disease and infection. Understanding immunology is the key to unlocking the mysteries behind health and disease, and is relevant to the lives of everyone in the world. In this seminar, we will explore how the body detects foreign substances, and how it tailors its response based on the identity and localization of the pathogen. Together, we will answer questions like “how do vaccines work?”, “how do people get allergies?”, and “how does the body know to attack certain things and not others?” Understanding these concepts will allow us to analyze the broad range of possible conditions that result from the misregulation of a healthy immune system. We can also begin to brainstorm how to approach the current outbreaks of deadly viruses such as HIV/AIDS and Ebola. This course is open to all students, regardless of their science background, who are interested in discovering the intense battle waged every day between their bodies and pathogens.

Schedule

Day 1: *Introduction to Immunology*

Today’s objective is to explore the body’s basic immune mechanisms, and to understand what goes on during an infection. We will discuss the two major components of the human immune system (innate and adaptive immunity), and how they complement one another in detecting and clearing infections. We will also touch upon how the body differentiates between different types of pathogens and how it tailors its response accordingly. Today we will do an experiment in which we extract and visualize strawberry DNA!

Day 2: *Allergies & Autoimmunity*

Yesterday we learned about the body’s incredibly diverse and complex defense mechanisms against disease; today we will look at what happens when these mechanisms do not function properly. We will discuss the immunological basis of allergies and asthma, and current treatments. We will also talk about autoimmune diseases (that is, what happens when your body mistakes its own cells for foreign pathogens), and will end with a discussion about blood type. Today’s experiment will be DNA extraction from our own cheek cells!

Day 3: *HIV/AIDS*

Today we will take a detailed look at the epidemiology and biology of the Human Immunodeficiency Virus (HIV). We will discuss the disease’s origins, the current epidemic, and modes of transmission. The virus life cycle will also be studied, including



its methods of entry and replication. We will close with a discussion of current treatment options and why it has proven so difficult to design a vaccine against this deadly disease.

Day 4: Vaccines

Today we will look at the history and theory of vaccines. We will explore the evolution of immunization over time, as well as the pros and cons of the various types of vaccines. We will study the influenza vaccine in detail. For example, why do you need to be re-vaccinated every year to prevent influenza, whereas you only need one dose to prevent other diseases? Finally, we will discuss recent disease eradication attempts via vaccination, and why they succeeded or failed.

Final Exercise

Each student will give a short research presentation on a topic in immunology (outlined below). Points to address include:

If you choose a disease:

- History/epidemiology of the disease
- Basic scientific mechanism of disease
- Relevance to modern world

If you choose a scientist:

- Brief biography of scientist
- Most important experiment
- Contribution to modern immunology/medicine

Presentations will be given orally, and should last 3-5 minutes. There is no need to submit a written copy of your report. Be prepared to ask and answer questions! :)

Topics: Choose 3 topics from those provided below, rank them in order of interest to you, and email them to Ashwin (ashwinskelly@college.harvard.edu) by **July 10th**. In the email, please include a short description of your scientific background (i.e. “studying to be a biologist” or “took introductory high school biology course”)

- Influenza インフルエンザ
- Ebola エボラ
- Edward Jenner エドワード・ジェンナー (免疫学の父)
- Louis Pasteur ルイ・パスツール (ワクチン)
- Ilya (Elie) Metchnikoff イリヤ・メチニコフ (白血球の食作用)



Pre Assignments and Reading List

Required:

- “免疫とは” http://www.jsi-men-eki.org/general/qa_pdf/hirano.pdf
- “免疫の仕組み（自然免疫と獲得免疫” ”
http://www.jsi-men-eki.org/general/qa_pdf/koyasu.pdf
- “アレルギーとは？” http://www.jsi-men-eki.org/general/qa_pdf/nakanishi.pdf
- “Today’s HIV/AIDS Epidemic”
<http://www.cdc.gov/nchhstp/newsroom/docs/HIVFactSheets/TodaysEpidemic-508.pdf>
- Vocabulary list (compiled by Ashwin Skelly & Ai Yamasaki)

Recommended (*not* required):

- Excerpt from Chapter 1 (Properties and Overview of Immune Responses) of Cellular and Molecular Immunology (Abbas et al.)

Message from the House Leader

Hi everyone! My name is Ai Yamasaki, and I graduated from Tufts University in Boston last spring with a degree in biology. Also, I have just recently been accepted to medical school in Michigan, where I will be matriculating this fall! Similarly to Ashwin, I enjoy a studying a variety of other disciplines, such as the history of medicine, Japanese and Chinese language, ballroom dancing, drawing, and cooking. I am very much looking forward to exploring the world of immunology with you all this summer. It is easy to take the immune system for granted in our everyday life. However, it is a complex and fascinating system that, despite all of the groundbreaking discoveries already made, is still full of profound mysteries. Feel free to send me a message with any questions, comments, or just to say hello :)

Message from the Seminar Leader

Hello students! My name is Ashwin Skelly, and I just finished my sophomore year at Harvard University. I’m studying chemistry, but am interested in tons of other areas (including medicine, Spanish, Japanese, Taekwondo, and music). I’ve been playing violin for eleven years, piano for nine, and am a huge fan of classical and K-pop music! I’m very excited to get to know you all this summer, and to begin unraveling the mysteries of the immune system together. It’s a fascinating field that is relevant to everyone, since it is the basis for all health and disease. Please feel free to reach out with any questions or concerns (or anything else – J-pop recommendations are much appreciated).