**Mechanisms of Disease Syllabus: HSSP Summer 2020**

**Overview:** In this 6-session course we will look at the biochemical mechanisms that give rise to different diseases. We will cover the 4 main types of disease: Nutritional diseases, Genetic Diseases, Infectious Diseases, and Physiological Diseases and cover significant examples like malnutrition, Sickle Cell Anemia, Tuberculosis, and Cancer respectively. For each disease and example, we will go into specific biochemical interactions and how they affect an individual as a whole. Students will be expected to think critically about possible and current treatments. We will also touch on active areas of research for the examples covered.

**Format:** All lectures will be held on Zoom. Students will be expected to participate in polls/comprehension questions.

**Prerequisites:** High school level Biology or consent of instructor. Some Chemistry knowledge is also expected. This does not have to be a formal Chemistry course but students should be familiar with bonds, elements, charges, and hydrophobicity. Many high school biology courses go over basic biochemistry which should be sufficient. If you are worried about your Chemistry or Biology background, this module (<https://www.khanacademy.org/science/ap-biology/chemistry-of-life>) on Khan Academy is great preparation for the course.

**Session 1: Introduction and Genetic Disorders**

* Course Introduction, expectations, and worldwide impacts of different diseases
* Central Dogma of Biology, mutations, proteins, and genetics
* How do mutations give rise to dysfunctional proteins and genetic disorders?
* Case Study: Sickle Cell Anemia
* Case Study: Huntington's disease

**Session 2: Cell Biology and Nutritional Diseases**

* Cell structure and organelles
* Fats, Sugars, and Proteins as energy sources
* Case Study 1: Obesity and associated conditions
* Protein cofactors: Vitamins and Minerals
* Case Study 2: Rickets
* Case Study 3: Iron deficiency

**Session 3: Immune System and Infectious Diseases-Viruses and Prion Diseases**

* Basic Immunology: Adaptive and Innate Immunity
* Introduction to Viruses
* Case Study 1: HIV
* Case Study 2: Flu or COVID-19
* Introduction to Prions
* Case Study 3: Mad Cow Disease

**Session 4: Taxonomy and Infectious Diseases-Bacteria, Fungus, and Parasites**

* Tree of life: How related are bacteria, various eukaryotes, and archaea?
* Bacteria as pathogens and commensal organisms
* Antimicrobials and Drug resistance
* Case Study 1: Tuberculosis
* Case Study 2: C. difficil Infection
* Eukaryotic Pathogens
* Case Study 3: Malaria

**Session 5: Anatomy/Physiology and Physiological Diseases-Big Killers Heart Disease and Cancer**

* Tissue and organ structures
* Circulatory System
* Case Study 1: Heart Disease and blood clots
* Cancer: Stages, formation, and somatic mutation
* Case Study 2: Lung Cancer

**Session 6: Signaling and Physiological Diseases-Neurological and hormonal diseases**

* Nervous System Overview
* Case Study 1: TBA but likely multiple sclerosis (MS)
* Endocrine System
* Case Study 2: Diabetes
* Lymphatic System and Psychiatric Diseases
* Case Study 3: Depression and Reuptake inhibitors