**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.

For most sections there are Khan Academy resources to watch for the background material as a refresher or for more detailed background information. These are *optional* and just to help fill any gaps in my lectures and/or your previous classes.

**Session 1: Introduction and Genetic Disorders**

* Course Introduction, expectations, and worldwide impacts of different diseases
* Central Dogma of Biology, mutations, proteins, and genetics

**Session 2: Genetic Disorders**

* 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
* **Extra background resources**
  + Bond line structures: <https://www.khanacademy.org/science/organic-chemistry/gen-chem-review/bond-line-structures/v/bond-line-structures-new>
  + Electronegativity and polarity: <https://www.khanacademy.org/science/organic-chemistry/gen-chem-review/electronegativity-polarity/v/electronegativity-and-chemical-bonds>

**Session 3: Cell Biology and Nutritional Diseases**

* Cell structure and organelles
  + **Extra background resources:** <https://www.khanacademy.org/science/high-school-biology/hs-cells/hs-eukaryotic-cell-structures/v/organelles-in-eukaryotic-cells>
* Fats, Sugars, and Proteins as energy sources
* Protein cofactors: Vitamins and Minerals
* Case Study 1: Obesity and associated conditions
* Case Study 2: Rickets
* Case Study 3: Iron deficiency

**Session 4: Immune System and Infectious Diseases-Viruses and Prion Diseases**

* Basic Immunology: Adaptive and Innate Immunity
  + **Extra background resources:** <https://www.khanacademy.org/science/high-school-biology/hs-human-body-systems/hs-the-immune-system/v/types-of-immune-responses-innate-and-adaptive-humoral-vs-cell-mediated>
* Introduction to Viruses and vaccines
* Case Study 1: HIV
* Case Study 2: COVID-19
* Introduction to Prions
* Case Study 3: Alzheimer’s
* Tree of life: How related are bacteria, various eukaryotes, and archaea?
* Bacteria as pathogens and commensal organisms
* Antimicrobials and Drug resistance

**Session 5: Infectious Diseases-Bacteria, Fungus, and Parasites and Anatomy/Physiology/Body Systems**

* Case Study 1: Tuberculosis
* Case Study 2: C. difficil Infection
* Case Study 3: Malaria
* Tissue and organ structures
* Circulatory System
* Nervous System Overview
* Endocrine System
* Lymphatic System
* **Extra Background Resources:** <https://www.khanacademy.org/science/high-school-biology/hs-human-body-systems>
  + Not all of the information from this Khan Academy unit will be covered but it gives a nice background on organ systems.

**Session 6: Physiological Diseases**

* Case Study 1: Heart Disease and blood clots
* Cancer: Stages, formation, and somatic mutation
* Case Study 2: Lung Cancer
* Case Study 3: TBA but likely multiple sclerosis (MS)
* Case Study 4: Diabetes (Endocrine system)
* Case Study 5: Depression and Reuptake inhibitors