

LSBS 52410 Actions and Application of Toxins  
W6W7 (Weds 14:20 -16:00) 2021 Spring semester  
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Living organisms, including microbes, plants and animals can produce pathological and/or deadly toxins for defense and prey. Understanding the action mechanisms of these toxins could not only shed light on the physiological processes of life on earth, but also allow the development of drugs and medicine for the emerging diseases such as the recent Covid-19 pandemics. As the actions of toxins to its targets, in many senses, are similar to the development of weapons in wars, they could also be considered as evolutionary products critical for the survival of living organisms. For instance, venoms enable the animals to explore new ecological habitats and to adapt to distinct niches. In nature, venoms are used primarily for predation, digestion and defense. Thus, animal venoms are composed of various pharmacologically active toxins. Since in conflicts between humans and the toxin producing organisms, such as those well documented in contagious diseases and snakebite, often cause sufferings and deaths to humans, it is important to understand the mechanisms and application of these toxins in the context of medicine and biodiscovery.

In this course, we will address the compositions, general mechanisms and applications of venoms, natural and microbial toxins. The following topics will be covered: (1) how venoms and toxins are produced and delivered, (2) how venoms and toxins work, and (3) how our bodies react to the effects of venoms and toxins. Finally, the bio-technological and biomedical applications of the toxins will also be discussed by considering the biodiversity of toxins. In order to achieve the aim, we will spend 1/3 of the lecture hours to review the basics of action mechanism of toxins, another 1/3 to update the progress in the field based on the review articles during the last decade and finally, the last 1/3 to guide students reading the state of the art publications in the field of Toxin biology.

Grade: 30% Report and/or Examination, 30% Oral Presentation, 40% Exercise

1. *Venom: the secrets of nature's deadliest weapon (2017)*  
by Ronald Jenner & Eivind Undheim, Smithsonian Books
2. *Venom Genomics and Proteomics (2016)*  
Edited by JJ Calvete in *Toxinology*
3. *Essential of Glycobiology 3<sup>rd</sup> Edition*  
Edited by A Varki, Cold Spring Harbor Lab.
4. Assigned reading and presentation on current review and articles

## Tentative Agenda

February 24. Let's begin with Coronavirus and snake venom toxins

### Part I: Toxin delivery

- March 3 Hijacking cell's machinery & Immune system
- March 10 Protein injection system of Bacteria and other microbials
- March 17 Production and delivery system of animal venoms
- March 24 Composition and diversity of venom

### Part II: Find the target first

- March 31 Lipid & carbohydrate mediated toxin action: Ricin, Cholera Toxin
- April 7 Proteins targets: Ion Channel, Integrin, ECM & Cytoskeleton
- April 14 Membrane pore formation
- April 21 Common tissue/organ targets of venom
- April 28 Midterm Examination

### Part III: Host Pathogen response and treatment

- May 5 Innate and Adaptive immune System
- May 12 Macrophages and Leukocytes
- May 19 Microenvironment remodeling
- May 26 Toxicokinetics and toxicopharmacodynamics
- June 2 Treatment of envenomation

### Part IV: Toxin evolution & Applications

- June 9 Proteomics and Genomics
- June 16 Accelerating evolution for Toxins as Biological weapon
- June 23 Final Examination