

Bi 23 Tutorials 1 - 3: Winter Term (2023-24)

1. Human Memory

(3 units)

Memory is at the core of the human experience and our identities. But what is memory? How accurate and stable is our memory and can we improve it? As an invisible process of great interest, for much of history it has been approached from philosophical and artistic investigation. Modern empirical research into memory spans many disciplines from molecular manipulations to computational modeling. As we can't cover the full scope, this tutorial will be a survey of topics in human memory from the neurobiological and psychological view that can serve as an introduction or appreciation for the topic. Possible topics may include photographic memory, repressed memory, traumatic memory, false memories, cultural memory, sleep and memory.

Organizational Meeting on Friday, January 5th at 4 PM, 322 CNRB

Tutor: Kevin Mei., kmei@caltech.edu

CNS Graduate Student, Perona Lab

2. Building the Brain from scratch: Brain Organoids

(3 units)

Brain organoids, often referred to as “mini-brains” or “brain-in-a-dish”, are miniature three-dimensional structures that are generated from stem cells. These structures are a game-changer in neuroscience owing to their ability to mimic some of the characteristics of a developing brain, including the capacity to generate different types of brain cells and form basic neural connections. Such organoids are an important tool for studying brain development and disease such as neurodevelopmental disorders that are otherwise too complex to be studied in two-dimensional and/or non-mammalian models.

In this tutorial, we will first cover an overview of 1) the basic elements of brain organoid technology, followed by detailed analysis of 2) case studies of key advancements in the field over the past decade, ending with discussions on the 3) limitations of existing techniques and brainstorming ideas on 4) alternative approaches and future prospects of this technology. By the end of this tutorial, students will have a holistic understanding of the past and present advancements, along with ideas for the future of the brain organoid field.

Organizational Meeting on Friday, January 5th at 4 PM, on Zoom

Tutor: Dr. Pallavi Panda, ppanda@caltech.edu

BBE Postdoc, Glover/Zernicka-Goetz Labs

3. Rhythms of the Brain and Body: An Exploration of the Neural Basis for Animal Dance and Communication

(3 units)

Dance, a non-verbal language communicating emotion and narrative, is often seen as a uniquely human form of expression. However, coordinated rhythmic body movements for communication exist across the animal kingdom. From honeybees using the waggle dance to convey the location of food, to birds of paradise showcasing intricate mating rituals for courtship, dance and rhythmic movement function as ancient forms of communication, fostering social bonds. This interdisciplinary tutorial delves into the realm of animal communication through dance, blending insights from neuroscience and the performing arts. Students will learn how the central nervous system integrates information for coordinated movement, posture, and balance, as well as the sensory cues and brain-body interactions that drive behavior. Furthermore, students will explore how dance and theater concepts can both inform and be informed by the study of animal behavior, aided by modern tools for quantifying animal pose and movement. Through discussions, guest lectures, movement exercises, and collaborative projects, this course seeks to unite scientific and artistic perspectives to illuminate the neural and behavioral underpinnings of dance.

Organizational Meeting on Wednesday, January 3rd at 4 PM, on Zoom

Tutor: Dr. Jess Kanwal, jkanwal@caltech.edu

BBE Postdoc, Parker Lab