Inhibitory Synapses in Brain Function and Disorders

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Open at upper undergraduate level only (Elective). Students who have already taken a similar course of mine and graduate students are not allowed. Priority will be given to Neural Science majors who have already completed NEURL-UA 220 Behavioral and Integrative Neuroscience. However, if spaces remain a motivated student without a Neuroscience background will be permitted with the instructor’s permission.

An overview of inhibitory circuits, plasticity and involvement in human disorders will be presented. Whereas greater emphasis will be on synaptic inhibition, discussions will be in context of excitatory synapses, firing properties and discharge patterns, and intrinsic voltage-gated currents. Each lecture will consider issues published in scientific reviews and classic as well as contemporary papers, beginning with overlaying systems level issues and dysfunctions. Cellular, synaptic, and some key intracellular biochemical mechanisms in relation to processing and functional imbalance will be included. Precise content - animal model, human, and brain region - is flexible and will evolve during participation, especially when students choose their own presentations. Therefore, the course structure is not rigid. Discussions will revolve around the following themes.

* GABA<sub>A</sub>, GABA<sub>B</sub> and glycine receptors and their subunit stoichiometry, and complexity in physiology and pharmacology at pre and postsynaptic levels. Heterogeneity of inhibitory interneurons: diversity in their biophysical, structural and synaptic physiology in the medial temporal lobe, cortex, and other areas. Homeostasis of inhibitory transmission and I/E balance during normal processing and behavioral deficits. Role of modulators and dis-inhibition during learning.

* Oscillations and Rhythms: Alpha, gamma and theta band; circadian, circannual, neuroendocrine, and sensorimotor. Role of inhibition in oscillations and propagation of waves.

* Inhibition and disorders: Alzheimer’s, Epilepsy, Presbycussis, ASD, Fragile X, Down, and other.

Students are expected to present and defend classic or recent review or a paper, and present and defend. The first presentation will be of 10 min while the second for ~ 20 min. The 10 min presentation is geared to prepare students for possible formal presentations at professional meetings they may attend. Both presentations should include motivation, specific hypothesis, approach and methods, novelty, major outcome, and potential broader impact to the biomedical community. The two presentations may be independent or interlinked and will be followed by class participation.

*No formal exams.* Grades will be based on students’ own projects and attention. Although class participation is not mandatory, students are strongly encouraged to do so that I get an idea of their thoughts, for enlivening discussion, and some debate in lieu of students’ own interests.

Final grades will be based on the following.

20% → Attendance  
30% → 10 min presentation and 5-10 min defense  
50% → 20 min presentation, defense, and written paper

Written paper will be based on the final presentation or both presentations if they are on the same topic or if they are synergized. The written submission should have your own summary and a critique from an objective standpoint, rather than a rehash of the published paper. The paper may have conceptual figures or some existing figures from the papers, novelty, and impact. The total length should not exceed 4 full pages including figures, legends and some key references.

First Lecture: Monday January 24, 2016  
Spring break March 14 – March 20, 2016  
Last Lecture Monday May 9, 2016

Once a week: Wednesdays: two ~ 70-minute each meetings, 10 min break, between ~ 1 and 3:45p.m. Lecture Hall, 808 Meyer Bldg. Total time commitment per day will be about two and half hours.