ELSC-ICNC Seminar: Carla Shatz

June 2, 2013

On the topic of: "Brain Waves and Synapse Remodeling in the Developing Visual System"

ELSC & ICNC cordially invite you

to the lecture given by:

Carla Shatz
Stanford Bio-X program, School of Medicine, Stanford University - USA

On the topic of:

"Brain Waves and Synapse Remodeling in the Developing Visual System"

The lecture will be held on Sunday, June 2nd, 2013
at 17:00, at ELSC-ICNC: Silverman Bldg., 3rd Wing, 6th Floor, Edmond J. Safra Campus

Light refreshments at 16:45

Abstract:

In the visual system, retinal ganglion cells from each eye connect to LGN neurons in adjacent eye-specific layers. LGN neurons representing each eye, in turn, connect to neurons in layer 4 of primary visual cortex to form the alternating system of ocular dominance (OD) columns that ultimately subserve binocular vision. These connections from retina to lateral geniculate nucleus to primary visual cortex begin to form early in life- in utero in many species and well before the onset of vision. Initially, a basic wiring plan from eye to brain is established using strictly determined axon guidance cues. This period is followed by a prolonged phase of activity-dependent development in which initially diffuse synaptic connections are fine-tuned to yield the highly precise circuits present in the adult brain. For example, initially in development, layer-specific segregation of retinal ganglion cell axons is not present. Eye inputs are intermixed and the adult LGN layering forms subsequently as synapses remodel, with some eliminated and others strengthened and retained. We discovered that during this period of synapse remodeling, the retina generates its own spontaneous activity long before vision starts. Ganglion cells in the eye fire synchronously in "waves" that sweep across retinal domains. (Meister et al, 1991; Feller et al, 1996). This highly correlated retinal activity is relayed to LGN neurons, where it drives cellular mechanisms of Hebbian synaptic plasticity resulting in LTP or LTD depending on timing (Butts et al, 2007). Moreover, these retinal waves are required for ganglion cell axons to segregate into eye-specific layers in the LGN: blocking them prevents segregation, while altering the spatio-temporal pattern of waves perturbs segregation (Penn et al., 1998; Stellwagen and Shatz, 2001). It is as if the eye is running "test patterns" on the brain to check for correct connections weeks before the onset of vision. Thus, the brain internally generates highly coordinated patterns of spontaneously generated neural activity early in development prior to sensory input. Then with further
maturation, sensory input takes over. This tuning process is thought to occur throughout the brain during development, endowing it with a vast capacity to adapt to the environment and also underlying the brain's ability to learn throughout life.