

BGGN 246 B: Advanced Biology of Sleep Oscillations

Instructor: Terry Sejnowski (UCSD/Salk)

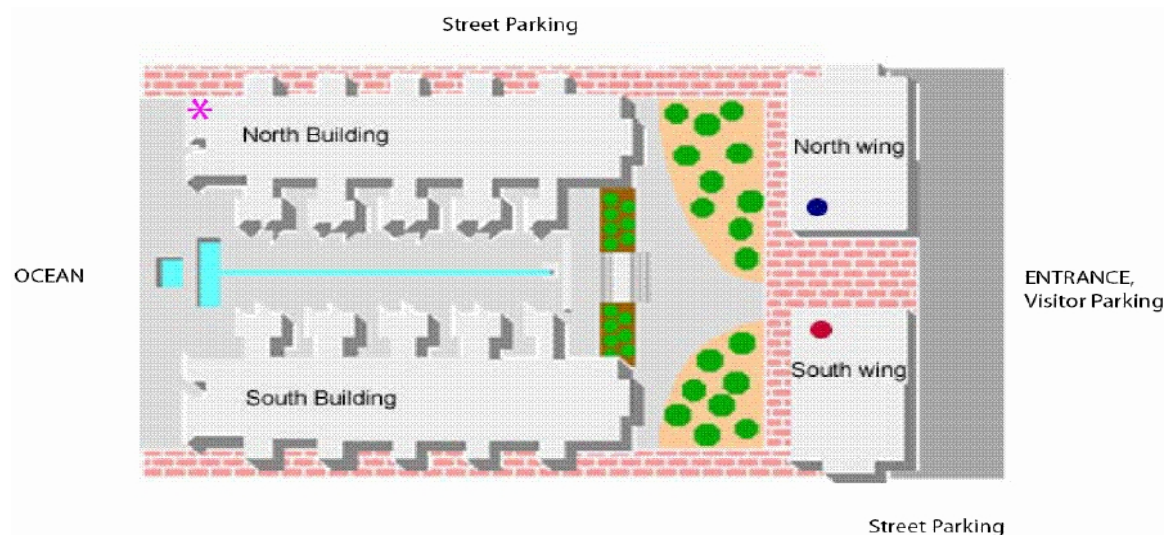
Teaching Assistant: Philip Low (UCSD/Salk)

This intensive course will focus on reading both the landmark as well as some of the most recent significant papers in the field of sleep research. We will approach the topic from cellular, cognitive, comparative, endocrine, medical, neuroethological and computational vantage points and will discuss tools used to model and quantify sleep data, such as nonlinear dynamics and unsupervised EEG analysis. The functional significance of individual sleep stages will receive particular emphasis. This course will meet once a week for 2 hours and will focus on presentations by students and guest speakers. Students will also be required to write an essay in which they will be asked to propose an original hypothesis in the field of sleep research as well as a way to test the latter.

BGGN 246B is a graduate course in the Biology and Neurosciences departments but graduate and upper division undergraduate students from all departments are invited to sign up for the course or to audit it. Faculty and postdocs from all departments are welcome to sit in on lectures.

The class will be taught on Wednesdays from 5-7 PM in the HHMI Conference Room at the Salk Institute.

Please direct inquiries about the course to philip@salk.edu



***HHMI Conference Room, 4th floor,
1 floor above the library which is on the
courtyard level.
Call 858-531-4490 if you cannot find it.**

Optional textbooks:

Sleep and Wakefulness.
Kleitman, N. The University of Chicago Press, Chicago, 1963
The Neural Control of Sleep and Waking
Siegel, J. Springer, 2002
Brain Control of Wakefulness and Sleep
Steriade, M and McCarley, R. Springer, 2005
Thalamocortical Assemblies
Destexhe, A and Sejnowski, T. Oxford University Press, USA, 2001
All I Want Is a Good Night's Sleep
Ancoli-Israel, S. C.V. Mosby, 1996
Principles and Practice of Sleep Medicine, 4th edition
Kryger, M (ed.), Roth, T (ed.), Dement, W (ed.) Saunders/Elsevier, 2005
Dreaming
Hobson, JA. Oxford University Press, USA, 2004
Secrets of Sleep
Borbely, A. Basic Books, 1988.
Pharmacology of Sleep
Kales, A (ed.), Springer, 1995.
A Universe of Consciousness
Edelman, GM and Tononi, G. Basic Books, 2001
Sleep Deprivation: Clinical Issues, Pharmacology, and Sleep Loss
Effects.
Kushida C, editor. New York: Marcel Dekker; 2005.

Topics:

- I. April 5th. Circadian Rhythms.
5:30-6:30 PM. Satchin Panda (Salk)
6:30-7:30 PM. David Welsh (TSRI)

Synchronization and maintenance of timekeeping in suprachiasmatic circadian clock cells by neuropeptidergic signaling.
Maywood ES et al. *Curr Biol*. 2006 Mar 21;16(6):599-605.

A clockwork web: circadian timing in brain and periphery, in health and disease.
Hastings MH, Reddy AB, Maywood ES. *Nat Rev Neurosci*. 2003 Aug;4(8):649-61.

Strange vision: ganglion cells as circadian photoreceptors.
Berson DM. *Trends Neurosci*. 2003 Jun;26(6):314-20.

Bioluminescence Imaging of Individual Fibroblasts Reveals Persistent, Independently Phased Circadian Rhythms of Clock Gene Expression
Welsh D et al. *Curr Biol*. 2004 Dec 29;14(24):2289-95.

Physiology. Biological clocks coordinately keep life on time.
Gillette MU, Sejnowski TJ. *Science*. 2005 Aug 19;309(5738):1196-8.

Illumination of the melanopsin signaling pathway.
Panda S, Nayak SK, Campo B, Walker JR, Hogenesch JB, Jegla T.
Science 2005 Jan 28;307(5709):600-4.

II. April 12th. Hypocretins and HPA axis regulation during sleep.
5:00-6:00 PM. Luis de Lecea (Stanford)
6:00-7:00 PM. Student presentations: Chris Robinson (UCSD)
& Justin Brady (UCSD).

The hypocretins: setting the arousal threshold.
Sutcliffe, J.G., de Lecea, L. *Nat Rev Neurosci*. 2002 May;3(5):339-49.

Hypocretin (orexin): role in normal behavior and neuropathology.
Siegel JM. *Annu Rev Psychol*. 2004;55:125-48.

Lesions of the suprachiasmatic nucleus eliminate the daily rhythm of
hypocretin-1 release.
Zhang S et al. *Sleep*. 2004 Jun 15;27(4):619-27.

The role of hypocretins (orexins) in sleep regulation and narcolepsy.
Taheri S, Zeitzer JM, Mignot E. *Annu Rev Neurosci*. 2002;25:283-313.

III. April 19th. EEG I: Sleep.
5:00 -7:00 PM. Philip Low (Salk)

Limitations of Rechtschaffen and Kales.
Himanen SL, Hasan J. *Sleep Med Rev*. 2000 Apr;4(2):149-167.

Automated sleep staging in rat with a standard spreadsheet.
Costa-Miserachs D, Portell-Cortes I, Torras-Garcia M, Morgado-Bernal I.
J Neurosci Methods. 2003 Nov 30;130(1):93-101.

Global forebrain dynamics predict rat behavioral states and their
transitions.
Gervasoni D, Lin SC, Ribeiro S, Soares ES, Pantoja J, Nicolelis MA.
J Neurosci. 2004 Dec 8;24(49):11137-47.

Supplementary Reading (optional):

Hans Berger: from psychic energy to the EEG.
Millett D. *Perspect Biol Med*. 2001 Fall;44(4):522-42. Optional

Regularly occurring periods of eye motility, and concomitant phenomena, during sleep.
Aserinsky & Kleitman. *Science*. 1953 Sep 4;118(3062):273-4.

IV. April 26th. Thalamocortical Oscillations & EEG II:
Drowsiness.

5:00 - 6:00 PM. Maxim Bazhenov (Salk)

6:00 - 7:00 PM Scott Makeig (UCSD)

Thalamocortical oscillations in the sleeping and aroused brain.
Steriade M, McCormick DA, Sejnowski TJ.
Science. 1993 Oct 29;262(5134):679-85.

Origin of slow cortical oscillations in deafferented cortical slabs.
Timofeev I, Grenier F, Bazhenov M, Sejnowski TJ, Steriade M.
Cereb Cortex. 2000 Dec;10(12):1185-99.

Model of thalamocortical slow-wave sleep oscillations and transitions to activated States.

Bazhenov M, Timofeev I, Steriade M, Sejnowski TJ.
J Neurosci. 2002 Oct 1;22(19):8691-704.

Tonic, phasic, and transient EEG correlates of auditory awareness in drowsiness.

Makeig S, Jung TP. *Brain Res Cogn Brain Res*. 1996 Jul;4(1):15-25.

V. May 3rd. Clinical Disorders and sleep.

5:00 - 6:00 PM. Sonia Ancoli-Israel (UCSD - VA)

6:00 - 7:00 PM. Student Presentations: Sarah Israel (UCSD) & Issa Rammal (UCSD)

Insomnia in Primary Care:
Overcoming Diagnostic and Treatment Barriers
Postgraduate Medicine. McGraw-Hill, 2004

Insomnia.

Sateia MJ, Nowell PD. *Lancet*. 2004 Nov 27-Dec 3;364(9449):1959-73.

Sleep-disordered breathing and cardiovascular disease.
Phillips B. Sleep Med Rev. 2005 Apr;9(2):131-40.

Treatment of chronic insomnia. An American Academy of Sleep
Medicine review.
Morin,C.M. et al. Nonpharmacologic Sleep 22:1134-56, 1999.

NIH State of the Science Conference Statement on Insomnia.
Manifestations and Management of Chronic Insomnia in Adults June
13-15, 2005.
Sleep 28:1049-1058, 2005.

Sleep deprivation and clinical performance.
Weinger MB, Ancoli-Israel S. JAMA. 2002 Feb 27;287(8):955-7.

Supplementary Reading (optional):

Epidemiology of insomnia: what we know and what we still need to
learn.
Ohayon, M.M. Sleep Medicine Reviews 6:97-111, 2002.

What are the contributing factors for insomnia in the general
population?
Ohayon,M.M. and Roth,T. J Psychosomatic. Res 51:745-755, 2001.

Assessment and diagnosis of insomnia in non-pharmacological
intervention studies.
Martin JL, Ancoli-Israel S. Sleep Med Rev. 2002 Oct;6(5):379-406.

Derivation of research diagnostic criteria for insomnia: report of an
American Academy of Sleep Medicine Work Group.
Edinger JD et al. Sleep. 2004 Dec 15;27(8):1567-96.

Sleep disorders in Alzheimer's disease and other dementias.
Bliwise DL. Clin Cornerstone. 2004;6 Suppl 1A:S16-28.

- VI. May 10th. Sleep deprivation I. A Clinical Perspective.
5:00 - 6:00 PM. Daniel Kripke (UCSD)
6:00 - 7:00 PM. Student Presentations: Brad Aimone (Salk) &
Sabrina Xiang (UCSD)

Do we sleep too much?

Kripke DF. *Sleep*. 2004 Feb 1;27(1):13-4.

No association of sleep with total daily physical activity in normal sleepers.

Youngstedt SD, Perlis ML, O'Brien PM et al. *Physiology & Behavior* 2003;78:395-401.

Long sleep and mortality: rationale for sleep restriction.

Youngstedt SD, Kripke DF. *Sleep Medicine Reviews* 2004;8:159-74.

Supplementary Reading (optional):

Functional imaging of the sleeping brain: review of findings and implications for the study of insomnia.

Drummond SP, Smith MT, Orff HJ, Chengazi V, Perlis ML. *Sleep Med Rev*. 2004 Jun;8(3):227-42.

Altered brain response to verbal learning following sleep deprivation.

Drummond SP, Brown GG, Gillin JC, Stricker JL, Wong EC, Buxton RB. *Nature*. 2000 Feb 10;403(6770):655-7.

Sleep deprivation as a model experimental antidepressant treatment: findings from functional brain imaging.

Gillin JC, Buchsbaum M, Wu J, Clark C, Bunney W Jr. *Depress Anxiety*. 2001;14(1):37-49.

Different effects of phenelzine treatment on EEG topography in waking and sleep in depressed patients.

Landolt HP, Gillin JC. *Neuropsychopharmacology*. 2002 Sep;27(3):462-9.

VII. May 17th. Sleep deprivation II.

5:00 - 6:00 PM. Ralph Greenspan (NSI)

6:00 - 7:00 PM. Student presentations: Sarah Israel (UCSD) & Issa Rammal (UCSD)

Sleep and Wakefulness.

Kleitman, N. The University of Chicago Press, Chicago, 1963, pp. 215-229.

Sleep deprivation in the rat: X. Integration and discussion of the findings. 1989. (reprint)

Rechtschaffen A et al. *Sleep*. 2002 Feb 1;25(1):68-87.

Stress response genes protect against lethal effects of sleep deprivation in *Drosophila*.

Shaw PJ, Tononi G, Greenspan RJ, Robinson DF.
Nature. 2002 May 16;417(6886):287-91.

Supplementary Reading (optional) :

Unihemispheric enhancement of delta power in human frontal sleep EEG by prolonged wakefulness.

Achermann P, Finelli LA, Borbely AA. Brain Res. 2001 Sep 21;913(2):220-3.

Sleep deprivation reduces proliferation of cells in the dentate gyrus of the hippocampus in rats.

Guzman-Marin et al. J Physiol. 2003 Jun 1;549(Pt 2):563-71.

Sleep deprivation impairs long-term potentiation in rat hippocampal slices.

Campbell IG, Guinan MJ, Horowitz JM.
J Neurophysiol. 2002 Aug;88(2):1073-6.

Sleep deprivation causes behavioral, synaptic, and membrane excitability alterations in hippocampal neurons.

McDermott CM, LaHoste GJ, Chen C, Musto A, Bazan NG, Magee JC.
J Neurosci. 2003 Oct 22;23(29):9687-95.

Sleep: suppression of rapid eye movement phase in the cat after electroconvulsive shock.

Cohen HB, Dement WC. Science. 1966 Oct 21;154(747):396-8.

Sleep deprivation in the rat: an update of the 1989 paper.

Rechtschaffen A, Bergmann BM. Sleep. 2002 Feb 1;25(1):18-24.

Uncoupling of brain activity from movement defines arousal States in *Drosophila*.

van Swinderen B, Nitz DA, Greenspan RJ.
CurrBiol. 2004 Jan 20;14(2):81-7.

VIII. May 24th. Off-line Processing I. Psychophysics.

5:00 - 6:00 PM. Sara Mednick (Salk)

6:00 - 7:00 PM. Student presentations: Sabrina Xiang (UCSD)
& Justin Brady (UCSD)

The restorative effect of naps on perceptual deterioration.
Mednick SC et al. Nat Neurosci. 2002 Jul;5(7):677-81.

Sleep-dependent learning: a nap is as good as a night.
Mednick S, Nakayama K, Stickgold R. Nat Neurosci. 2003 Jul;6(7):697-8.

Dependence on REM sleep of overnight improvement of a perceptual skill.
Karni A et al. Science. 1994 Jul 29;265(5172):679-82.

Consolidation during sleep of perceptual learning of spoken language.
Fenn KM, Nusbaum HC, Margoliash D.
Nature. 2003 Oct 9;425(6958):614-6.

Sleep-dependent memory consolidation.
Stickgold R. Nature 2005 Oct 27;437(7063):1272-78.

Sleep, learning, and dreams: off-line memory reprocessing.
Stickgold R, Hobson JA, Fosse R, Fosse M.
Science. 2001 Nov 2;294(5544):1052-7.

Replaying the game: hypnagogic images in normals and amnesics.
Stickgold et al. Science. 2000 Oct 13;290(5490):350-3.

Motor memory consolidation in sleep shapes more effective neuronal representations.
Fischer S, Nitschke MF, Melchert UH, Erdmann C, Born J.
J Neurosci. 2005 Dec 7;25(49):11248-55.

- IX. May 31st. Off-line Processing II. Network Dynamics.
5:00-7:00 PM. Student presentations: Brad Aimone (Salk),
Chris Robinson (UCSD) & Eviatar Yemini (UCSD).

Temporally structured replay of awake hippocampal ensemble activity during rapid eye movement sleep.
Louie K, Wilson MA. Neuron. 2001 Jan;29(1):145-56.

Reactivation of hippocampal ensemble memories during sleep.
Wilson MA, McNaughton BL. Science. 1994 Jul 29;265(5172):676-9.

Song replay during sleep and computational rules for sensorimotor vocal learning.
Dave AS, Margoliash D. Science. 2000 Oct 27;290(5492):812-6.

Replay and time compression of recurring spike sequences in the hippocampus.

Nadasdy Z, Hirase H, Czurko A, Csicsvari J, Buzsaki G.
J Neurosci. 1999 Nov 1;19(21):9497-507.

X. June 7th. Why Do We Sleep?
5:00 - 7:00 PM. Jerome Siegel (UCLA).

Clues to the functions of mammalian sleep.
Siegel JM. Nature 2005 Oct 27;437(7063):1264-71.

The function of dream sleep.
Crick F, Mitchison G. Nature. 1983 Jul 14-20;304(5922):111-4.

The REM sleep-memory consolidation hypothesis.
Siegel JM. Science. 2001 Nov 2;294(5544):1058-63.

Paradoxical sleep as a programming system.
Jouvet M. J Sleep Res. 1998;7 Suppl 1:1-5.

Why do we sleep?
Sejnowski TJ, Destexhe A.
Brain Res. 2000 Dec 15;886(1-2):208-223.

Slow-wave sleep, acetylcholine, and memory consolidation.
Power AE. Proc Natl Acad Sci U S A. 2004 Feb 17;101(7):1795-6.

Local sleep and learning.
Huber R, Ghilardi MF, Massimini M, Tononi G.
Nature. 2004 Jul 1;430(6995):78-81.

Supplementary Reading (optional):

Freud returns? Like a bad dream.
Hobson JA. Sci Am. 2004 May;290(5):89.

Sleep forms memory for finger skills.
Fischer S, Hallschmid M, Elsner AL, Born J.
Proc Natl Acad Sci U S A. 2002 Sep 3;99(18):11987-91.

Sleep EEG in mice that are deficient in the potassium channel subunit K.v.3.2.

Vyazovskiy et al. Brain Res. 2002 Aug 30;947(2):204-11.

Symposium: Normal and abnormal REM sleep regulation: The importance of REM sleep for brain maturation.

Mirmiran M, Van Someren E. J Sleep Res. 1993 Dec;2(4):188-192.

Practice with sleep makes perfect: sleep-dependent motor skill learning.

Walker MP, Brakefield T, Morgan A, Hobson JA, Stickgold R.

Neuron. 2002 Jul 3;35(1):205-11.

Low acetylcholine during slow-wave sleep is critical for declarative memory consolidation.

Gais S, Born J.

Proc Natl Acad Sci U S A. 2004 Feb 17;101(7):2140-4.

The sleep slow oscillation as a traveling wave.

Massimini et al.

J Neurosci. 2004 Aug 4;24(31):6862-70.

The evolutionary biology of self-deception, laughter, dreaming and depression: some clues from anosognosia.

Ramachandran VS.

Med Hypotheses. 1996 Nov;47(5):347-62.