PSYCH 46 / BIO 49: CELLULAR AND MOLECULAR NEUROSCIENCE

SPRING 2017

COURSE DESCRIPTION

This course focuses on cellular and molecular mechanisms that underlie the development and function of the nervous system. This includes aspects of gene expression (transcription, mRNA metabolism) and cell biology (cellular transport and cytoskeleton, cell cycle, signal transduction, signaling pathways) as they pertain to neurons and glia. Lectures supplemented by in-class discussion of primary research articles will also serve as an introduction to microscopic, electrophysiological, molecular biological, and genetic techniques, as well as to the animal models used to study the nervous system and the molecular and cellular alterations that occur during a variety of neurological disorders.

CLASS MEETING TIME AND LOCATION

This class meets MWF from 11:30am - 12:35pm in Room B03 of the Moore building, with lectures and/or optional review sessions held during some of the X hours (Tuesdays 12:15 pm-1:05pm). Class begins on March 27th and ends with the last exam on June 2nd. There is no class on Memorial Day (May 29th).

INSTRUCTORS

Robert A. Maue, Ph.D.
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Geisel School of Medicine at Dartmouth
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COURSE MATERIALS / RESOURCES

Textbooks: There is no single textbook for this course. Instead, information is drawn from research articles, reviews and a number of well-regarded neuroscience textbooks (listed below). While some of these books may be on reserve, the corresponding reading from them will be on the Blackboard site. Letter(s) preceding the title of the textbook correspond to the abbreviations used in the syllabus.

(SRH) Development of the Nervous System. 3rd Edition. (D.H. **Sanes,** T. A. **Reh**, W.A. **Harris**). Academic Press. New York. 2012.

(B) Neuroscience- Exploring the Brain. 3rd Edition. (Eds. M. F. **Bear**, B. W. Connors, M. A. Paradiso). Lippincott, Williams, and Wilkins. New York. 2007.

(P) Neuroscience. 3rd Edition. (Eds. D. **Purves**, G. J. Augustine, D. Fitzpatrick, W. C. Hall, A. LaMantia, J. O. McNamara, S. M. Williams). Sinauer. Sunderland, Massachusetts. 2004.

(N) From Neuron to Brain. 4th Edition. (Eds. J.G. **Nicholls**, A. R. Martin, B.G. Wallace, and P.A. Fuchs). Sinauer. Sunderland, Massachusetts. 2001.

(P/L) Principles of Neural Development. (Eds. D. **Purves** and J. W. **Lichtman**). Sinauer. Sunderland, Massachusetts. 1992.

(S) Basic Neurochemistry. 6th Edition. (Eds. G. J. **Siegel**, B. W. Agranoff, R. W. Albers, S. K. Fischer, M. D. Uhler). Lippincott-Raven. New York. 1999.

(LK) The Neuron – Cell and Molecular Biology. 2rd Edition. (Eds. I.B. **Levitan** and L. K. **Kaczmarek**). Oxford Univ Press. 1997.

(K) Cellular and Molecular Biology. 3rd Edition. (Ed. G. **Karp**). Wiley and Sons. New York. 2002.

(L) Molecular and Cellular Biology. 4th Edition. (Eds. H. **Lodish**, A. Berk, S. L. Zipusrsky, P. Matsudaira, D. Baltimore, J. Darnell). W. H. Freeman 2000.

(C) What's Wrong With My Mouse? J. N. **Crawley**. Wiley-Liss. New York. 2000.

Canvas: The Canvas site for this course will include Powerpoint slides, accompanying reading material, and primary research articles. Note, for the first time the site will also include ECHO360 video recordings of all of the lectures and X-hrs.

PBS 46 / Bio 49 Study Group: For those interested, the Academic Skills Center can help students develop a Study Group. Contact the Skills Center for details.

EVALUATION

Three "in class", written exams will be given (the last exam is NOT cumulative). Grades will be determined by the percentage of the total points possible (300), and not on a curve (the entire class could receive an A, an E, or anything in between). While 90% or above will definitely be an "A" and more than 60% will be required to pass the course, the grades associated with the remainder of the scores may be adjusted slightly depending upon the overall difficulty of the exams. *Typical (but not necessarily final)* percentages and corresponding grades are: ≥90 (A); 86-89 (A-/B+); 80-85 (B); 76-79 (B-/C+); 70-75 (C); 66-69 (C-); 61-65 (D); ≤60 (E).

HONOR PRINCIPLE

During this course it is expected that students will abide by the Honor Principle. The Dartmouth College Student Handbook (page iii) states "Fundamental to the principle of independent learning are the requirements of honesty and integrity in the performance of academic assignments, both in the classroom and outside. Dartmouth operates on the principle of academic honor, without proctoring of examinations. Students who submit work which is not their own or who commit other acts of academic dishonesty forfeit the opportunity to continue at Dartmouth." If you have any questions regarding this during the course, please contact Dr. Maue.

STUDENT ACCCOMODATION

DISABILITIES

Students with disabilities, including invisible disabilities such as chronic illnesses and learning disabilities, are encouraged to arrange for accommodations that might be helpful to them. Please meet with Dr. Maue or Dr. Hoppa as soon as possible, preferably during the first week of class, to discuss possible accommodations. All discussions will be confidential, although the Academic Skills Center may be consulted to verify the documentation of the disability.

RELIGIOUS OBSERVANCES

Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that poses a conflict with your participation in the course, please contact Dr. Maue or Dr. Hoppa as soon as possible, preferably before the end of the second week of the term, to discuss appropriate accommodations. All discussions will be confidential.

EXTRACURRICULAR COMMITMENTS

Students with extracurricular activities that will cause them to miss class should plan on discussing this with Dr. Maue or Dr. Hoppa as soon as possible, and in cases where appropriate, provide a letter from their Coach or the Director of their activity confirming when the conflict will occur. Students should bring any issues like these to the attention of Dr. Maue or Dr. Hoppa as soon as possible during the term, particularly if it involves missing a scheduled exam. In terms of the material, the slides for the lectures will be on the course Canvas site and all lectures are video recorded and the videos put on the Canvas site using the ECHO360 feature. Note, the earlier the conflict is brought to the attention of the instructors, the more time there is to make arrangements, and therefore the greater the chance that arrangements can and will be made (conversely, last minute, “day before” notifications are not conducive to alternative arrangements being made).

COURSE SYLLABUS

DATE	TOPIC	READING GENERAL	READING SPECIFIC
	I. NEURONAL DEVELOPMENT		
M 3/27	Neural induction during embryogenesis		P/L 11-17 P 501-511 SRH 1:1-16
Tu 3/28			
W 3/29	Neuronal proliferation and migration	L496-498 L524-525	B 691-695 P 517-518 SRH 3:49-55 SRH 3:58-66 SRH 3:67-73
F 3/31	Differentiation and compartmentation: More transcriptional programs and soluble factors	K 521-541	P/L 33-43 P 512-515 SRH 1:1-16 SRH 2:23-28 SRH 4:87-90
M 4/3	Mechanisms governing axon outgrowth	S 139-147	N 499-507 SRH 5:105-
Tu 4/4			
W 4/5	Neuronal polarity and mechanisms of transport		Craig (1994) P 548 S 565-585
F 4/7	Establishing neural connections – synapse formation		P/L 205-228 Li and Sheng (2003) SRH 7: 214- SRH 8: 223- SRH 9:255-
	II. NEURONAL SIGNALING MECHANISMS		
M 4/10	Neurotrophins and other trophic factors	L 872-875	P 549-555 N 513 SRH 7:171-
Tu 4/11	Dynamics of calcium signaling		S 453-468
W 4/12	Discussion of research paper#1: Primary neuron culture for nerve growth and axon guidance studies in Zebrafish(*Danio rerio*),Chen, Lee, H., Henle, SJ, Cheever, TR, Ekker (2013). PLos One 3:1-10.		Chen (2013)
F 4/14	Review		

M 4/17	**EXAM I**	
Tu 4/18		
W 4/19	G protein-mediated signaling pathways	S 401-412
F 4/21	Introduction to molecular properties of ion channels	Clapham (1997) Clapham (2002)
M 4/24	Action potentials revisited: molecular aspects of voltage-gated channels	P 69-85 Miller (2003)
Tu 4/25	Discussion of research paper #2: Restoration of inactivation in mutants of shaker K channels by a peptide derived from ShB Science 250: 568-571.	Zagotta (1990)
W 4/26	Synaptic channels: ligand gated ion channels and gap junctions	P 133-147
F 4/28	Synaptic function	P 103-124
M 5/1	Molecular mechanisms of Ca2+-dependent vesicle fusion	Mellman (2013) Sudhof (2013)
Tu 5/2	Synaptic plasticity	P 575-598
W 5/3	Neural circuits: plasticity and rhythmic behavior	N 550-66 IK 451-65
F 5/5	Review	
M 5/8	**EXAM II**	
	III. MOLECULAR INSIGHTS AND APPROACHES TO NEUROLOGICAL DISORDERS	
Tu 5/9		
W 5/10	Animal models in neuroscience research	N 292-6 P 576
F 5/12	Animal models in neuroscience research: Mouse technology	C 9-23 C 227-232 L 284-286

M 5/15	Cellular and molecular aspects of Alzheimer's disease: plaques, tangles, and transport	S 949-965	P 750-751 B 36-37 Mattson (2004) Huang and Mucke (2012)
Tu 5/16	CNS and Immune System Interactions		
W 5/17	Parkinson's disease - dynamics of protein aggregation	K 545-546 P 426-430	Dauer (2003)
F 5/19	Huntington's disease and tri-nucleotide repeat disorders	P 426-430 L 259	K 418-419 Gatchel (2005)
M 5/22	Fragile X Syndrome: The morphology and mRNA of mental retardation	B 43-44 P 590-91	Bagni and Greenough (2005) Calabrese (2006)
Tu 5/23	Discussion of research paper #3: In vitro differentiation of human neural progenitor cells into striatal GABAergic neurons (2015) Li, L., Yuan, J., Sander , Golas, M. Stem Cell Trans Med 4:775-788.		Li (2015)
W 5/24	Autism spectrum disorders: Searching for the genetic basis of disease		Pardo (2007) Garber (2007) McNeil (2009)
F 5/26	Developing molecular therapies for CNS disorders	L 199-204	Cyranoski (2015) Ledford (2015) Hayden (2016)
M 5/29	Memorial Day (NO CLASS)		
Tu 5/30	Review		
W 5/31	NO CLASS		
F 6/2	**EXAM III** (scheduled for 8-11 am)		