APPH 6211 Systems Physiology I: Cellular mechanisms of plasticity

Fall 2013
MWF 1-2, Instr Ctr 115

Instructor:
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On-campus office hour: tbd

Objective: To provide a solid foundation in the cellular mechanisms of adaptation, communication, and homeostasis. The emphasis is on understanding how cellular and molecular processes are modulated by the environment to alter cell function.

Text: Pollard & Earnshaw **Cell Biology,** ISBN 978-1416022558
Supplemental readings from literature

Web: http://www.ap.gatech.edu/Burkholder/6211/

Useful supplements: Boron & Boulpaep, **Medical Physiology**; Silverthorn, **Human Physiology**

Topical Outline

Synthetic mechanisms (Aug 19- Sep 13)
- DNA (PE 12-14, 40-42)
- RNA (PE 15-16, BB 5)
- Protein (PE 17-18, 20-21)

Sensory mechanisms (Sep 16-Oct 11)
- Chemistry/allostery
- Receptors (PE 24 BB 4)
- Channels (PE 7-11 BB 3)

Control mechanisms (Oct 14-Nov 8)
- Ion balance (PE 11 BB 3,7)
- 2nd messengers (PE 26 BB 4)
- Post-translational modification (PE 25, 27)

Cellular systems (Nov 11-Dec 6)
- ATP synthesis (PE 19)
- Cell growth (PE 40-41)
- Cell division (PE 42-46)
- Cell motility (PE 33-39)
- Neural pattern generators (BB 11-14)

Evaluation:

70% exams (4, tenatively Sep 13, Oct 11, Nov 8, Dec 11)
30% project

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Synthetic mechanisms

Week	Topic	Reading
1	DNA structure and replication	• Text Ch 12-14, 40-42
2	RNA structure and transcription	• Text Ch 15-16 • Venters, B.J. and Pugh, B.F., 2009. How eukaryotic genes are transcribed. Crit Rev Biochem Mol Biol 44, 117-41.
3	Protein structure and translation Labor Day	• Text ch 3, 17, 20 • Preiss, T. and Hentze. (2003). Starting the protein synthesis machine: eukaryotic translation initiation. Bioessays 25, 1201-11. • Wilkie, *et al*. (2003). Regulation of mRNA translation by 5'- and 3'-UTR-binding factors. Trends in Biochemical Sciences 28, 182-8.
4	Protein modification & trafficking	• Text ch 20-21 • Resh, (1996). Regulation of cellular signalling by fatty acid acylation and prenylation of signal transduction proteins. Cell Signaling 8, 403-12.

Sensory mechanisms

Week	Topic	Reading
5	Chemistry/allostery	• Nalivaeva and Turner (2001). Post-translational modifications of proteins: acetylcholinesterase as a model system. Proteomics 1, 735-47.
6	Receptors	• Text ch 24 • Boron & Boulpaep ch 4 • MBOC ch 15
7	Receptors and channels	• Text ch 24, 7-11 • Boron & Boulpaep ch 3
8	Channels	• Text ch 7-11 • Bezanilla, F. (2005). Voltage-gated ion channels. IEEE Transactions on Nanobioscience 4, 34-48. • tbd – ideally something like Principles of Neural Science ch 6-9

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Control mechanisms

Week	Topic	Reading
9	Ion balance Fall Break	• Text ch 8-11 • Boron & Boulpaep ch 3,7 • http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=cooper.section.1986 • Wen *et al*. (2004). A CaMKII/calcineurin switch controls the direction of Ca(2+)-dependent growth cone guidance. Neuron 43, 835-46.
10	2nd Messengers	• Text Ch 26 • Serhan, C.N., *et al.*, (1996). Lipid mediator networks in cell signaling: update and impact of cytokines. FASEB J 10, 1147-58.
11	2nd Messengers Post-translational modification	• Text ch 25-27 • Pearson, *et al*.. (2001). Mitogen-activated protein (MAP) kinase pathways: regulation and physiological functions. Endocrine Reviews 22, 153-83.
12	Proteolysis	• Text ch 23

Cellular systems

Week	Topic	Reading
13	ATP Synthesis	• Text ch 19
14	Cell growth Thanksgiving	• Text ch 40-41
15	Cell division Cell motility	• Text ch 33-46
16	Neural pattern generation	• Boron & Boulpaep ch 11-14 • Kandel & Schwartz, ch 63