

# Reading resources for 7.61 Graduate Cell Biology, Fall 2006

## 7.61 Receptors (Lectures 1 & 3)

### Required Reading for "Receptors" and "G-protein Signaling":

Lodish 5th edition:

General: Chapter 13

Binding properties: p. 533-539

Purification: p. 539-541

Alberts et al (4rd ed.): Chapter 15

### **Additional References (not required):**

#### **Scatchard analysis of binding and data analysis:**

Leatherbarrow, R. J. "Using linear and non-linear regression to fit biochemical data" TIBS 15:455-458 (1990).

Lierler, K. "Misuse of nonlinear Scatchard plots" TIBS 14:314-317 (1989).

D. A. Lauffenburger and J. J. Linderman "Receptors: Models for binding, trafficking, and signaling" Oxford University Press Oxford NY, 1993

GraphPad Prism software, <http://www.graphpad.com/welcome.htm> also *Intuitive Biostatistics* H. Motulsky, Publisher: Oxford University Press, New York, 1995 ISBN: 0-19-50-8607-4

#### **Multiligand Receptors:** J. Clin. Investigation Perspectives series, fall 2001, Series Introduction:

Krieger M, Stern DM. Multiligand receptors and human disease. J Clin Invest. 2001 Sep;108(5):645-7.

#### **Receptor Purification:**

Reeves, P. J., Thurmond, R. L., and Khorana, H. G. (1996) *Proc Natl Acad Sci U S A* **93**, 11487-92

Chelikani P, Reeves PJ, Rajbhandary UL, Khorana HG. The synthesis and high-level expression of a beta2-adrenergic receptor gene in a tetracycline-inducible stable mammalian cell line. *Protein Sci.* 2006 Jun;15(6):1433-40.

Reeves PJ, Callewaert N, Contreras R, Khorana HG. Structure and function in rhodopsin: high-level expression of rhodopsin with restricted and homogeneous N-glycosylation by a tetracycline-inducible N-acetylglucosaminyltransferase I-negative HEK293S stable mammalian cell line. *Proc Natl Acad Sci U S A.* 2002 Oct 15;99(21):13419-24.

Liu B, Krieger M. Highly purified scavenger receptor class B, type I reconstituted into phosphatidylcholine /cholesterol liposomes mediates high affinity HDL binding and selective lipid uptake. *J Biol Chem.* 2002 Jul 10 [epub ahead of print] (2002)

#### **G-protein coupled receptors:**

Reiter E, Lefkowitz RJ. GRKs and beta-arrestins: roles in receptor silencing, trafficking and signaling. *Trends Endocrinol Metab.* 2006 May-Jun;17(4):159-65..

Rajagopal K, Lefkowitz RJ, Rockman HA. When 7 transmembrane receptors are not G protein-coupled receptors. *J Clin Invest.* 2005 Nov;115(11):2971-4..

Shenoy SK, Lefkowitz RJ. Seven-transmembrane receptor signaling through beta-arrestin. *Sci STKE.* 2005 Nov 1;2005(308):cm10..

Lefkowitz RJ, Shenoy SK. Transduction of receptor signals by beta-arrestins. *Science.* 2005 Apr 22;308(5721):512-7..

Lefkowitz RJ. Historical review: a brief history and personal retrospective of seven-transmembrane receptors. *Trends Pharmacol Sci.* 2004 Aug;25(8):413-22 [http://www.sciencedirect.com/science?\\_ob=ArticleURL&\\_udi=B6T1K-4CS4N42-1&\\_user=501045&\\_coverDate=08%2F31%2F2004&\\_alid=201961659&\\_rdoc=1&\\_fmt=full&\\_orig=search&\\_qd=1&\\_cdi=4893&\\_sort=d&\\_docanchor=&\\_view=c&\\_acct=C000022659&\\_version=1&\\_urlVersion=0&\\_userid=501045&\\_md5=9b87f7bd1905e7818e5080a9189e6d9f&\\_artImgPref=F](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6T1K-4CS4N42-1&_user=501045&_coverDate=08%2F31%2F2004&_alid=201961659&_rdoc=1&_fmt=full&_orig=search&_qd=1&_cdi=4893&_sort=d&_docanchor=&_view=c&_acct=C000022659&_version=1&_urlVersion=0&_userid=501045&_md5=9b87f7bd1905e7818e5080a9189e6d9f&_artImgPref=F)

Lefkowitz RJ, Whalen EJ. beta-arrestins: traffic cops of cell signaling. *Curr Opin Cell Biol.* 2004 Apr;16(2):162-8

[http://www.sciencedirect.com/science?\\_ob=ArticleURL&\\_udi=B6VVRW-4BJ2FV9-1&\\_coverDate=04%2F30%2F2004&\\_alid=201964332&\\_rdoc=1&\\_fmt=&\\_orig=search&\\_qd=1&\\_cdi=6245&\\_sort=d&\\_view=c&\\_acct=C000022659&\\_version=1&\\_urlVersion=0&\\_userid=501045&\\_md5=f9b03dece3f0ebbd4e6ef2f1129dda7b](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VVRW-4BJ2FV9-1&_coverDate=04%2F30%2F2004&_alid=201964332&_rdoc=1&_fmt=&_orig=search&_qd=1&_cdi=6245&_sort=d&_view=c&_acct=C000022659&_version=1&_urlVersion=0&_userid=501045&_md5=f9b03dece3f0ebbd4e6ef2f1129dda7b)

Gainetdinov RR, Premont RT, Bohn LM, Lefkowitz RJ, Caron MG. Desensitization of G protein-coupled receptors and neuronal functions. *Annu Rev Neurosci.* 2004;27:107-44.

[http://arjournals.annualreviews.org/doi/full/10.1146/annurev.neuro.27.070203.144206;jsessionid=jaO\\_tuGqnEF8](http://arjournals.annualreviews.org/doi/full/10.1146/annurev.neuro.27.070203.144206;jsessionid=jaO_tuGqnEF8)

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- Robert J. Lefkowitz A Magnificent Time With the "Magnificent Seven" Transmembrane Spanning Receptors *Circ Res* 2003 92: 342 – 344 History of BAR discoveries in Lefkowitz lab
- Klabunde T, Hessler G. Drug design strategies for targeting G-protein-coupled receptors. *Chembiochem.* 2002 Oct 4;3(10):928-44. <http://www3.interscience.wiley.com/cgi-bin/fulltext/99015697/HTMLSTART>
- Kristen L. Pierce, Richard T. Premont & Robert J. Lefkowitz *Nature Reviews Molecular Cell Biology* 3, 639-650 (2002); Signalling SEVEN-TRANSMEMBRANE RECEPTORS [http://www.nature.com/cgi-taf/DynaPage.taf?file=/nrm/journal/v3/n9/full/nrm908\\_fs.html](http://www.nature.com/cgi-taf/DynaPage.taf?file=/nrm/journal/v3/n9/full/nrm908_fs.html)
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- C. D. Strader, M. R. Candelore, W. S. Hill, I. S. Sigal, R. A. F. Dixon (1989) Identification of two serine residues involved in Agonist activation of the  $\beta$ -Adrenergic Receptor. *J. Biol. Chem.* 264: 13572-13578.
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#### **Nuclear Receptor superfamily:**

- Barish GD, Narkar VA, Evans RM. PPAR delta: a dagger in the heart of the metabolic syndrome. *J Clin Invest.* 2006 Mar;116(3):590-7.
- Evans RM. 2003 Keio Medical Science Prize commemorative lecture. PPARs and the complex journey to obesity. *Keio J Med.* 2004 Jun;53(2):53-8.
- Olefsky JM. *J Biol Chem.* 2001 Oct 5;276(40):36863-4. Epub 2001 Jul 17. Nuclear receptor minireview series.
- Folkertsma S, van Noort P, Van Durme J, Joosten HJ, Bettler E, Fleuren W, Oliveira L, Horn F, de Vlieg J, Vriend G. A family-based approach reveals the function of residues in the nuclear receptor ligand-binding domain. *J Mol Biol.* 2004 Aug 6;341(2):321-35. [http://www.sciencedirect.com.libproxy.mit.edu/science?\\_ob=ArticleURL&\\_udi=B6WK7-4CP4M85-D&\\_user=501045&\\_handle=B-WA-A-W-WY-MSAYWA-UUW-AUEYUYBDCU-AUECZZVCCU-ZWDVUEEUW-WY-U&\\_fmt=full&\\_coverDate=08%2F06%2F2004&\\_rdoc=1&\\_orig=browse&\\_srch=%23toc%236899%232004%23996589997%23512113!&\\_cdi=6899&view=c&\\_acct=C000022659&\\_version=1&\\_urlVersion=0&\\_userid=501045&md5=1ab21ac8fa754ee6ba2a21cda910153e&artImgPref=F](http://www.sciencedirect.com.libproxy.mit.edu/science?_ob=ArticleURL&_udi=B6WK7-4CP4M85-D&_user=501045&_handle=B-WA-A-W-WY-MSAYWA-UUW-AUEYUYBDCU-AUECZZVCCU-ZWDVUEEUW-WY-U&_fmt=full&_coverDate=08%2F06%2F2004&_rdoc=1&_orig=browse&_srch=%23toc%236899%232004%23996589997%23512113!&_cdi=6899&view=c&_acct=C000022659&_version=1&_urlVersion=0&_userid=501045&md5=1ab21ac8fa754ee6ba2a21cda910153e&artImgPref=F)
- Julie M. Hall, John F. Couse, and Kenneth S. Korach J. The Multifaceted Mechanisms of Estradiol and Estrogen Receptor Signaling *Biol. Chem.*, Vol. 276, Issue 40, 36869-36872, October 5, 2001

#### **Crystal structures:**

- Palczewski K, Kumasaka T, Hori T, Behnke CA, Motoshima H, Fox BA, Le Trong I, Teller DC, Okada T, Stenkamp RE, Yamamoto M, Miyano M. Crystal structure of rhodopsin: A G protein-coupled receptor. *Science.* 289(5480):739-45. (2000)
- Henry R. Bourne and Elaine C. Meng Rhodopsin Sees the Light *Science* 289: 733-734 (2000)
- Werner Kuhlbrandt, Bacteriorhodopsin -- the movie *Nature* 406 (6796) Page 569 - 570 (2000)
- Subramaniam S, Henderson R. Molecular mechanism of vectorial proton translocation by bacteriorhodopsin. *Nature.*;406(6796):653-7 (2000)
- Hans Jurgen Sass, Georg Buldt, Ralf Gessenich, Dominic Hehn, Dirk Neff, Ramona Schlesinger, Joel Berendzen, Pal Ormos, Structural alterations for proton translocation in the M state of wild-type bacteriorhodopsin *Nature* 406 (6796) 649 - 653 (2000)
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- De Vos, A. M., Ultsch, M. and Kossiakoff, A.A. "Human Growth Hormone and Extracellular Domain of its Receptor: Crystal Structure of the Complex" *Science* 255 306-312 (1992).
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- Y. Kimura et al "Surface of bacteriorhodopsin revealed by high-resolution electron crystallography" *Nature* 389:206-211.

#### **Mutagenesis studies of Growth Hormone and its receptor by Wells and colleagues:**

- Cunningham, B. C. and J. A. Wells. "Comparison of a Structural and a Functional Epitope" *J. Mol. Biol.* 234: 554-563 (1993) - (also see accompanying article 564-578)
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### **Additional References, mainly for G-protein and other signaling:**

Excellent older reviews:

- A. G. Gilman (1987) *Ann. Rev. Biochem.* 56: 615-649, or  
 L. Stryer and H. Bourne (1986) *Ann. Rev. Cell Biol.* 2: 391-419  
 J. W. Putney et. al. (1989) *FASEB J.* 3: 1899-1905

#### **other reviews of $\beta$ -adrenergic system and G proteins:**

- Lee S. Weinstein, Shuhua Yu, and Carolyn A. Ecelbarger Variable imprinting of the heterotrimeric G protein Gs -subunit within different segments of the nephron *AJP - Renal* 2000 278: F507-F514.
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- Henry R Bourne "How receptors talk to trimeric G proteins." *Current Opinion in Cell Biology* 1997, 9: 134-142.
- Michael R Koelle: A new family of G-protein regulators – the RGS proteins *Current Opinion in Cell Biology* 1997 9: 143-147.
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