BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
Peter A. Friedman	Professor and Vice Chair of Pharmacology & Chemical Biology
eRA COMMONS USER NAME	
PAFriedman	

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	YEAR(s)	FIELD OF STUDY
Syracuse University, Syracuse, NY	A.B.	1970	Biology
SUNY Upstate Medical Center, Syracuse, NY	Ph.D.	1975	Pharmacology
University of Lausanne, Switzerland	Postdoc	1975-1977	Pharmacology
Cornell University Medical College, NY, NY	Fellow	1977-1980	Membrane Biophysics
Dartmouth College	A.M.	1992	*ad eundem*
Institut für Pharmakologie, Würzburg, Germany	Sabbatical	2005-2006	Molecular Pharmacology

A. Positions and Honors.

1979-1984	Assistant Professor of Internal Medicine, Univ. of Texas Medical School, Houston, TX
1984-1986	Assistant Professor of Pharmacology, Dartmouth Medical School, Hanover, NH
1986-1991	Associate Professor of Pharmacology, Dartmouth Medical School, Hanover, NH
1991-1998	Professor of Pharmacology (tenured), Dartmouth Medical School, Hanover, NH
1994-1998	Interim Chair, Department of Pharmacology, Dartmouth Medical School, Hanover, NH
1998-	Professor of Pharmacology (tenured), Univ. Pittsburgh School Medicine, PA
2004-2006	Interim Chair, Department of Pharmacology, Univ. Pittsburgh School Med., PA
2005-2006	Visiting Professor, Institut für Pharmakologie, University of Würzburg, Germany
2009-	Vice Chair for Academic Affairs, Department of Pharmacology & Chemical Biology

Honors and Awards (selected or current)

1983-1988	Established Investigator, American Heart Association
1999-2001	Board of Directors, Advances in Mineral Metabolism
1995-2001	Assoc. Editor. Am. J. Physiology - Renal Physiology
2000-2004	Editorial Board, Endocrinology
2003-2007	Editorial Board, Am. J. Physiology - Renal Physiology
2003	Gordon Conference, Bones & Teeth
2005	British Endocrine Society Invited Speaker
2005, 2008	University of Pittsburgh Innovator Award

Public/Professional National Advisory Committees (selected or current)

2001-2003	NIH, Oral Biology and Medicine B Study Section, Regular Member
2004-2007	Awards Committee, American Physiological Society. Chair, 2005-2007
2006-2010	Journal of Bone and Mineral Research, Editorial Board
2010-2014	NIH, Molecular and Cellular Endocrinology Study Section, Regular Member
2012-2014	European Journal of Molecular Biology, Editorial Board
2013-2016	American Society for Bone and Mineral Research, Publications Committee
2013-	F1000 Prime Faculty of 1000

B. Selected peer-reviewed publications (last 10 years)

1. Ba J and Friedman PA. CaSR regulation of renal mineral ion transport. *Cell Calcium* 35: 229-237, 2004.
2. Friedman PA. PTH revisited. *Kidney Int* 66: S1-S7, 2004.
3. Friedman PA and Ba J. PTH receptor activation but not internalization is required for MAPK stimulation. *J Bone Miner Res* Submitted, 2004.
4. Friedman PA and Berndt WO. Diuretic drugs. In: *Modern Pharmacology with Clinical Applications* (6 ed.), edited by Craig CR and Stitzel RE. Philadelphia: Lippincott Williams & Wilkins, 2004, p. 239-255.
5. Magyar CE, Sneddon WB, Bisello A, and Friedman PA. PTH(7-34) downregulates the PTH1 receptor by a ubiquitin-sensitive pathway. *J Bone Miner Res* 19: 174-175, 2004.
6. Sneddon WB, Bisello A, Magyar CE, Willick GE, Syme CA, Galbiati F, and Friedman PA. Ligand-selective

dissociation of activation and internalization of the parathyroid hormone receptor. Conditional efficacy of PTH peptide fragments. *Endocrinology* 145: 2815-2823, 2004.
7. Friedman PA. Agents affecting mineral ion homeostasis and bone turnover. In: *Goodman & Gilman's The Pharmacological Basis of Therapeutics* (11 ed.), edited by Brunton LL, Lazo JS and Parker KL, 2005, p. 1647-1679.
8. Friedman PA. Regulating PTH responses in the kidney. *Endocrine Abstracts* 9: S10, 2005.
9. Sneddon WB, Wang B, and Friedman PA. NHERF1/EBP50 and NHERF2/E3KARP regulate PTH1R endocytosis. *J Bone Miner Res* 20: S433, 2005.
10. Syme CA, Friedman PA, and Bisello A. Parathyroid hormone receptor trafficking contributes to the activation of extracellular signal-regulated kinases but is not required for regulation of cAMP signaling. *J Biol Chem* 280: 11281-11288, 2005.
11. Wang B, Sneddon WB, Yang Y, and Friedman PA. NHERF1 switches extracellular signal-regulated kinase signaling by the PTH receptor. *J Bone Miner Res* 20: S41, 2005.
12. Friedman PA and Goodman WG. PTH(1-84) / PTH(7-84): a balance of power. *Am J Physiol Renal Physiol* 290: F975-F984, 2006.
13. Sneddon W and Friedman PA. Differential Beta-Arrestin-Dependent Hormone-Stimulated MAP Kinase Activation and PTH1R Internalization. *J Bone Miner Res* 21 Suppl. 1: S120, 2006.
14. Weinman EJ, Hall RA, Friedman PA, Liu-Chen LY, and Shenolikar S. The association of NHERF adaptor proteins with G protein-coupled receptors and receptor tyrosine kinases. *Annu Rev Physiol* 68: 491-505, 2006.
15. Sneddon WB and Friedman PA. ß-arrestin-dependent parathyroid hormone-stimulated ERK activation and PTH1R internalization. *Endocrinology* 148: 4073-4079, 2007.
16. Sneddon WB, Yang Y, Ba J, Harinstein L, and Friedman PA. Extracellular signal-regulated kinase activation by parathyroid hormone in distal tubule cells. *Am J Physiol Renal Physiol* 292: F1028-F1034, 2007.
17. Srinivasan R, Huang S, Chaudhry S, Sculptoreanu A, Krisky D, Cascio M, Friedman PA, deGroat WC, Wolfe D, and Glorioso J. An HSV vector system for selection of ligand-gated ion channel modulators. *Nature Methods* 4: 733-739, 2007.
18. Vasavada R, Wang L, Fujinaka Y, Takane K, Rosa TC, Mellado-Gil JM, Friedman PA, and Garcia-Ocana A. Protein kinase C-ζ activation markedly enhances ß-cell proliferation: an essential role in growth factor-mediated ß-cell mitogenesis. *Diabetes* 56: 2732-2743, 2007.
19. Wang B, Bisello A, Yang Y, Romero GG, and Friedman PA. NHERF1 regulates parathyroid hormone receptor membrane retention without affecting recycling. *J Biol Chem* 282: 36214-36222, 2007.
20. Wheeler DG, Sneddon WB, Wang B, Friedman PA, and Romero G. NHERF-1 and the cytoskeleton regulate the traffic and membrane dynamics of G protein-coupled receptors. *J Biol Chem* 282: 25076-25087, 2007.
21. Bisello A and Friedman PA. PTH and PTHrP Actions on Kidney and Bone. In: *Principles of Bone Biology* (3 ed.), edited by Bilezikian JP, Raisz LG and Martin TJ, 2008, p. 665-712.
22. Bushinsky DA and Friedman PA. Calcium Nephrolithiasis. In: *Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism* (7 ed.), edited by Rosen CJ. Washington, DC: American Society for Bone and Mineral Research, 2008, p. 460-464.
23. Friedman PA. Renal calcium metabolism. In: *Seldin and Giebisch's The Kidney: Physiology and Pathophysiology* (4 ed.), edited by Alpern RJ and Hebert SC. San Diego: Elsevier, 2008, p. 1851-1890.
24. Friedman PA. Diuretic drugs. In: *Craig and Stitzel's Modern Pharmacology* (7 ed.), edited by Fink LWH and Woodfork KA. Philadelphia: Lippincott Williams & Wilkins, 2008, p. 239-255.
25. Friedman PA, Kim YK, Yang Y, and Wang B. Regulated desensitization of the parathyroid hormone receptor by NHERF1. *Keystone Symposium on G Protein-Coupled Receptors*, 2008.
26. Sebastian EM, Suva LJ, and Friedman PA. Differential effects of intermittent PTH(1-34) and PTH(7-34) on bone microarchitecture and aortic calcification in experimental renal failure. *Bone* 43: 1022-1030, 2008.
27. Wang B, Yang Y, and Friedman PA. Na/H Exchange regulator factor 1, a novel Akt-associating protein, regulates extracellular signal-related signaling through a B-Raf-mediated pathway. *Mol Biol Cell* 19: 1637-1645, 2008.
28. Wheeler D, Garrido JL, Bisello A, Kim YK, Friedman PA, and Romero G. Regulation of PTH1R dynamics, traffic and signaling by the Na^+/H^+ exchanger regulatory factor-1 (NHERF1) in rat osteosarcoma ROS 17/28 cells. *Mol Endocrinol* 22: 1163-1170, 2008.
29. Bernardo JF, Magyar CE, Sneddon WB, and Friedman PA. Impaired renal calcium absorption in mice

lacking calcium channel ß$_3$ subunits. *Can J Physiol Pharmacol* 87: 522-530, 2009.
30. Friedman PA. Molecular Biology of Parathyroid Hormone. In: *Textbook of Nephro-Endocrinology: Hormones and the Kidney*, edited by Singh AK and Williams GH. San Diego: Elsevier, 2009, p. 95-104.
31. Gamba G and Friedman PA. Thick ascending limb: the Na^+:K^+:2Cl^- cotransporter, NKCC2, and the calcium-sensing receptor, CaSR. *Pflugers Arch* 458: 61-76, 2009.
32. Garrido JL, Wheeler D, Vega LL, Friedman PA, and Romero G. Role of phospholipase D in parathyroid hormone receptor type 1 signaling and trafficking. *Mol Endocrinol* 23: 2048-2059, 2009.
33. Wang B, Yang Y, Abou-Samra AB, and Friedman PA. NHERF1 regulates parathyroid hormone receptor desensitization; interference with ß-arrestin binding. *Mol Pharmacol* 75: 1189-1197, 2009.
34. Friedman PA. Safety Update for Osteoporosis Drugs, Bisphosphonates, and Atypical Fractures. In: *Goodman & Gilman's The Pharmacological Basis of Therapeutics*, edited by Brunton LL, Lazo JS and Parker KL, 2010.
35. Klenk C, Vetter T, Zurn A, Vilardaga JP, Friedman PA, Wang B, and Lohse MJ. NHERF1, ß-arrestin, and the parathyroid hormone receptor form a ternary signaling complex. *J Biol Chem* 285: 30355-30362, 2010.
36. Romero G, Sneddon WB, Yang Y, Wheeler D, Blair HC, and Friedman PA. Parathyroid hormone receptor directly interacts with dishevelled to regulate β-catenin signaling and osteoclastogenesis. *J Biol Chem* 285: 14756-14763, 2010.
37. Wang B, Ardura JA, Romero G, Yang Y, Hall RA, and Friedman PA. Na/H exchanger regulatory factors control PTH receptor signaling by differential activation of Gα protein subunits. *J Biol Chem* 285: 26976-26986, 2010.
38. Alonso V, Ardura JA, Wang B, Sneddon WB, and Friedman PA. A naturally occurring isoform inhibits parathyroid hormone receptor trafficking and signaling. *J Bone Miner Res* 26: 143-155, 2011.
39. Alonso V, Magyar CE, Wang B, Bisello A, and Friedman PA. Ubiquitination–deubiquitination balance dictates ligand-stimulated PTHR sorting. *J Bone Miner Res* 26: 2923-2934, 2011.
40. Ardura JA and Friedman PA. Regulation of G protein-coupled receptor function by Na^+/H^+ exchange regulatory factors. *Pharmacol Rev* 63: 882-900, 2011.
41. Ardura JA, Watkins SC, Vilardaga JP, and Friedman PA. Dynamic Na^+-H^+ exchanger regulatory factor-1 association and dissociation regulate PTH receptor trafficking at membrane microdomains. *J Biol Chem* 286: 35061-35070, 2011.
42. Blair HC, Robinson LJ, Huang CL, Sun L, Friedman PA, Schlesinger PH, and Zaidi M. Calcium and bone disease. *Biofactors* 37: 159-167, 2011.
43. Friedman PA. Agents affecting mineral ion homeostasis and bone turnover. In: *Goodman & Gilman's The Pharmacological Basis of Therapeutics* (12 ed.), edited by Brunton LL, Chabner B and Knollmann B. New York: McGraw Hill, 2011, p. 1275-1306.
44. Friedman PA and Brunton LL. Updated Vitamin D and Calcium Recommendations (Update). In: *Goodman & Gilman's The Pharmacological Basis of Therapeutics* (11 ed.), edited by Brunton LL, Lazo JS and Parker KL, 2011.
45. Liu L, Schlesinger PH, Slack NM, Friedman PA, and Blair HC. High capacity Na^+/H^+ exchange activity in mineralizing osteoblasts. *J Cell Physiol* 226: 1702-1712, 2011.
46. Romero G, Von Zastrow M, and Friedman PA. Role of PDZ proteins in regulating trafficking, signaling, and function of GPCRs. Means, motif, and opportunity. *Adv Pharmacol* 62: 279-314, 2011.
47. Vilardaga JP, Romero G, Friedman PA, and Gardella TJ. Molecular basis of parathyroid hormone receptor signaling and trafficking: a family B GPCR paradigm. *Cell Mol Life Sci* 68: 1-13, 2011.
48. Wheeler DS, Barrick SR, Grubisha M, Brufsky AM, Friedman PA, and Romero G. Direct interaction between NHERF1 and Frizzled regulates β-catenin signaling *Oncogene* 30: 32-42, 2011.
49. Friedman PA. Physiological Actions of PTH II: Renal Actions. In: *The Parathyroids* (Third ed.), edited by Bilezikian JP, Marcus R, Silverberg SJ, Marcocci C, Levine MA and Potts JT, Jr.: Elsevier, 2013.
50. Friedman PA. Shedding some (sun)light on calcium and vitamin D. In: *Goodman & Gilman's The Pharmacological Basis of Therapeutics* (12 ed.), edited by Brunton LL, Chabner BA and Knollmann BC. New York: McGraw-Hill, 2013.
51. Bernardo JF and Friedman PA. Renal Calcium Metabolism. In: *Seldin and Giebisch's The Kidney: Physiology and Pathophysiology*, edited by Alpern RJ, Caplan MJ and Moe OW. San Diego: Academic Press, 2013, p. 2225-2247.
52. Alonso V and Friedman PA. Ubiquitination-regulated G protein-coupled receptor signaling and trafficking. *Mol Endocrinol* 27: 558-572, 2013.
53. Wang B and Friedman PA. Regulation of GPCR Signaling by NHERF1. *Int J Endocrinol*, 2013.

54. Wang B, Yang Y, Liu L, Blair HC, and Friedman PA. NHERF1 regulation of PTH-dependent bimodal Pi transport in osteoblasts. *Bone* 52: 268-277, 2013.
55. Loughran PA, Stolz DB, Barrick SR, Wheeler DS, Friedman PA, Rachubinski RA, Watkins SC, and Billiar TR. PEX7 and EBP50 target iNOS to the peroxisome in hepatocytes. *Nitric Oxide* 31: 9-19, 2013.
56. Friedman PA and Bushinsky DA. Renal tubular physiology of calcium excretion. In: *Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism* (8 ed.), edited by Rosen CJ. Washington, DC: John Wiley & Sons, Inc., 2013, p. 845-855.
57. Mamonova T, Bisello A, and Friedman PA. Modeling and experimental study of NHERF1 PDZ domain specificity. *Biophys J* 106: 661a-662a, 2014.

C. Research Support

Current:

R01 DK054171-27-31 (PI)	05/01/12–04/30/16	3.0 mos
PTH Receptor: Posttranslational Modification and Recycling in Bone The major goals of this project are to: 1) characterize novel PTHR post-translational modifications, their mechanism of action, and effect on receptor fate; and 2) elucidate the mechanism by which cytoplasmic trans-acting chaperones facilitate PTHR recycling.		

R01 DK069998 (PI)	2/01/11–1/31/15	3.0 mos
EBP50 Regulation of PTH Receptor in Bone The major goals of this project are to: 1) characterize EBP50 conformations and dimerization; 2) define post-translational modifications of EBP50 that determine its function; and 3) delineate the direct effects of EBP50 on bone.		

R01 DK087688 (Co-I)	5/01/10–4/30/15	1.2 mos
Sustained cAMP signals triggered by internalized PTH receptor: new consequences for cell signaling The major goals of this project are to: 1) determine the mechanisms of sustained cAMP responses triggered by the PTHR; and 2) define the consequences of sustained cAMP levels for cell signaling.		

Pending:

Grant No.	Grant Title	Role in Project and Percentage of Effort	Years Inclusive	Source
1R01HD076248-01A1 (3%)	PMCA2 Regulates Mammary Gland Involution	Co.I., 10	4/01/14 - 3/31/19	NIH