

Nelson Spruston

Curriculum Vitae, September 2017

Present Position

Senior Director Scientific Programs; Laboratory Head
Howard Hughes Medical Institute, Janelia Research Campus
19700 Helix Drive, Ashburn, Virginia, USA 20147
Phone: (571) 209-4314; Email: sprustonn@janelia.hhmi.org

Personal Data

Born: May 27, 1963; Vancouver, B.C., Canada
Citizenship: American and Canadian; Family: Married, three children

Research Interests

Synaptic integration, dendritic computation, plasticity, and cellular and circuit organization of the hippocampus.

Education

1981-1985	B.Sc. (Honors), Physiology, University of British Columbia; Vancouver, B.C.
1985-1991	Ph.D., Division of Neuroscience, Baylor College of Medicine; Houston, Texas

Positions

2017-present	Senior Director, Scientific Programs; Laboratory Head HHMI Janelia Research Campus
2011-2017	Scientific Program Director; Laboratory Head HHMI Janelia Research Campus
1995-2011	Department of Neurobiology & Physiology, Northwestern University (1995 Asst. Prof.; 2001 Assc. Prof; 2006 Prof.; 2009 Prof. & Chair)
1991-1995	Postdoctoral Fellow, Department of Cell Physiology Max Planck Institute for Medical Research; Advisor: Prof. Bert Sakmann

Fellowships, Honors, and Awards

2013-present	Fellow of the American Association for the Advancement of Science
2009-2011	Martin J. and Patricia Koldyke Outstanding Teaching Professor
2007-2009	NARSAD Distinguished Investigator Award, Brain and Behavior Res. Found.
1999-2004	NSF Career Award
1998	Klingenstein Fellowship in the Neurosciences
1998	Krieg Cortical Explorer Prize, Cajal Club
1996	Alfred P. Sloan Fellow, Northwestern University
1996	Fellowship Award for the Winter Conference on Brain Research
1994-95	Max-Planck Fellow, Heidelberg, Germany
1992-93	Alexander von Humboldt Fellow, Heidelberg, Germany
1991	Grass Fellow in Neurophysiology, Marine Biological Lab, Woods Hole, MA

1987, 1990	Outstanding Presentation, Neuroscience Symposium, Baylor Col. Medicine
1987	Minoru Suzuki Award for Excellence in Neuroscience, Baylor Col. Medicine
1985	Graduate, First Class, Honors, Dept. Physiology, Univ. British Columbia

Research Funding

2011-present	Spruston lab is exclusively funded by HHMI; Janelia does not allow any funding from outside sources.
2011	“CRCNS: Collaboration on high-resolution maps of synapses on hippocampal neurons”, National Institutes of Health (NINDS R01, PIs: Spruston, Kath, Smith, Remy) – Grant continues to 2014 without Spruston as a collaborator instead of a PI because of HHMI Janelia rules.
2007-2009	NARSAD Distinguished Investigator Award
2003-2011	“Neurobiology of Information Storage” (NIH/NIMH training grant, PI: Routtenberg, Co-Director: Spruston)
2002-2011	“Modeling realistic microcircuits of hippocampal neurons” National Institutes of Health (NINDS R01, PI: Spruston)
1999-2011	Co-Investigator on grants with Disterhoft and Surmeier (15 budget years of support)
1998-2013	NIH National Research Service awards to 4 graduate students and 3 postdocs (>20 budget years of support)
1996-1999	Human Frontiers in Science Program
1996-2011	“Synaptic integration and propagation in CA1 dendrites” National Institutes of Health (NINDS R01, PI: Spruston)

Teaching Activities

1996-09	Instructor (sole), Fundamentals of Neurobiology (undergraduate)
2008	Instructor, Great Experiments in Neurophysiology (graduate)
2001-05	Co-director, Ion Channel Physiology course, Cold Spring Harbor Lab
1999-04	Instructor, Fundamentals of Neuroscience (Cell & Molecular Neuro.)
1987-99	Several other courses (full list available on request)

Committees & Administrative Activities

2011-present	Scientific Program Director, HHMI Janelia Research Campus
2009-2011	Chair, Dept. Neurobiology & Physiology, Northwestern University
1997-2011	Numerous committees at Northwestern (full list available on request)

Advisory Panels and Program Review

2016-present	Scientific Advisory Board, Max Planck Florida Institute, Jupiter, Florida
April 2014	University of Toronto, Faculty of Medicine, Canada
2014-present	Rheinische Friedrich-Wilhelms-Universität Bonn, Germany

Professional Development Workshops

April 2014	Leading Through Communication: The Linkage Communication Clinic, Linkage, Inc.
April 2014	Collaborative Leadership, Glaser & Associates, Inc.
January 2014	Improvisation for Scientists, Alan Alda Center for Communicating Science

Students and Postdocs Supervised

Currently advisor for 6 postdocs at Janelia Research Campus (*full list on request*)

Former students and postdoc (*highlights only*)*

Dan Nicholson, Ph.D.	Postdoc, 2007-2009, currently Associate Prof. at Rush Univ. Medical Center, Chicago, IL, USA
Stefan Remy, M.D.	Postdoc, 2005-07, currently Professor at German Center for Neurodegenerative Diseases, Bonn Germany
Tim Jarsky, Ph.D.	Graduate student, 2001-2006, currently Research Scientist at Allen Institute for Brain Science
Catherine Kaczorowski, Ph.D.	Graduate student, 2001-06, currently Assistant Prof. at The Jackson Laboratory, Bar Harbor, ME, USA
Nace Golding, Ph.D.	Postdoc, 1996-2002, currently Director and Professor at Univ. Texas, Austin, TX, USA
Nathan Staff, M.D., Ph.D.	Graduate student, 1998-2002, currently Neurologist at Mayo Clinic, Rochester, MN, USA

**While at Northwestern University I mentored 17 Postdocs, 15 Graduate Students, and 18 Undergraduates. I actively participated on 22 Thesis Committees at Northwestern, excluding my own students; and was an external member of 4 Thesis Committees at other institutions. A complete list is available upon request.*

Professional Affiliations

1998–present	American Physiological Society
1987–present	Society for Neuroscience

Editorial and Referee Duties

2017-present	Editorial Board, Current Opinion in Neurobiology
2008-present	Associate Editor, Frontiers in Neuroscience
2004-2011	Reviewing Editor, Journal of Physiology
1998-present	Grant review for NIH, NSF, Israeli Science Foundation, Medical Research Council (UK)
1995-present	Reviewer for numerous journals, including Nat. Neuroscience, Neuron, Science, Nature

Invited Talks

1993-present	126 invited seminars (<i>full list available on request</i>)
1995-present	54 invited talks at national and international conferences (<i>full list on request</i>)

Theses

1. **Spruston N.** (1992) Patch-clamp analysis of the passive membrane properties of three classes of hippocampal neurons. Ph.D. dissertation, Baylor College of Medicine.
2. **Spruston, N.** (1985) Purification and characterization of new intestinal smooth muscle contractile peptides. Undergraduate honors thesis, University of British Columbia.

Special Projects

1. Stuart G, **Spruston N**, Häusser M, eds. Dendrites, 3rd edition, Oxford University Press, 2016. (book)
2. Peng H, Hawrylycz M, Roskams J, Hill S, **Spruston N**, Meijering E, Ascoli GA. BigNeuron: large-scale 3D neuron reconstruction from optical microscopy images. Neuron, 87:252-256, 2015.
3. **Spruston N**, Pyramidal neuron. Scholarpedia, 4(5):6130, 2009. (online resource: www.scholarpedia.org/article/Pyramidal_neuron)
4. Stuart G, **Spruston N**, Häusser M, eds. Dendrites, 2nd edition, Oxford University Press, 2008. (book)
5. **Spruston N.** Somato-dendritic Integration: Dendritic Integration”, The New Encyclopedia of Neuroscience, edited by Larry Squire et al, Elsevier, 2008. (electronic resource)
6. Davie JT, Kole MH, Letzkus JJ, Rancz EA, **Spruston N**, Stuart GJ, Häusser M. Dendritic patch-clamp recording. Nature Protocols 1:1235-1247, 2006. (experimental protocol)
7. Stuart G, **Spruston N**, Häusser M, eds. Dendrites, 1st edition, Oxford University Press, 1999. (book)
8. Cline H, **Spruston N**, eds. Dendrites: bringing it all together, Journal of Neurobiology, July, 2005. (special issue)

Reviews, Chapters, and Commentaries

1. Cembrowski MS, **Spruston N.** Illuminating the neuronal architecture underlying context in fear memory. Cell, 167:888-9, 2016.
2. **Spruston N**, Häusser M, Stuart G. Dendritic integration. In: Dendrites, 3rd edition, Stuart G, **Spruston N**, Häusser M, eds. Oxford University Press, pp. 351-398, 2016.
3. Häusser M, **Spruston N**, Stuart G. Conclusion: the future of dendrite research. In: Dendrites, 3rd edition, Stuart G, **Spruston N**, Häusser M, eds. Oxford University Press, pp. 703-707, 2016.
4. Stuart GJ, **Spruston N.** Dendritic integration: 60 years of progress. Nature Neuroscience, 18:1713-1721, 2016.
5. **Spruston N.** Assembling cell ensembles. Cell, 157:1502-1504, 2014.
6. **Spruston N**, Häusser M, Stuart G. Information processing in dendrites and spines. In: Fundamental Neuroscience, Elsevier, 2012.
7. Lisman J, **Spruston N.** Questions about STDP as a general model of synaptic plasticity. Frontiers in Neuroscience, 2:140, 1-5, 2010.
8. **Spruston N**, Cang J. Timing isn't everything. Nature Neuroscience 13:277-279, 2010.
9. **Spruston N**, Johnston D. Out of control in the dendrites. Nature Neuroscience, 11:733-734, 2008.
10. **Spruston N.** Neuroscience: strength in numbers. Nature, 452:420-421, 2008.
11. **Spruston N.** Pyramidal neurons: dendritic structure and synaptic integration. Nature Reviews Neuroscience, 9:206-221, 2008.

12. **Spruston N.** Somato-dendritic Integration: Dendritic Integration” (in-press), The New Encyclopedia of Neuroscience, edited by Larry Squire et al, Elsevier, 2008.
13. **Spruston N**, Häusser M, Stuart G. Dendritic integration. In: Dendrites, 2nd edition, Stuart G, **Spruston N**, Häusser M, eds. Oxford University Press, pp. 351-399, 2008.
14. Häusser M, **Spruston N**, Stuart G. Conclusion: the future of dendrite research. In: Dendrites, 2nd edition, Stuart G, **Spruston N**, Häusser M, eds. Oxford University Press, pp. 551-554, 2008.
15. **Spruston N**, McBain C. Chapter 5: Structural and functional properties of hippocampal neurons. In: The Hippocampus Book, Andersen P, Morris R, Amaral D, Bliss T, O’Keefe J, eds. Oxford University Press, pp. 133-201, 2007.
16. Lisman J, **Spruston N**. Postsynaptic depolarization requirements for LTP and LTD: a critique of spike timing dependent plasticity. Nature Neuroscience, 8:839-841, 2005.
17. Cline H, **Spruston N**. Introduction: Overview of dendrites. Journal of Neurobiology, 64:1-3, 2005.
18. Surmeier DJ, **Spruston N**. Peering into the dendritic machinery of striatal medium spiny neurons. Neuron. 44:401-402, 2004.
19. **Spruston N**, Kath WL. Dendritic arithmetic. Nature Neuroscience, 7:567-569, 2004.
20. **Spruston N**. Branching out: a new idea for dendritic function. Journal of Neurophysiology, 90:2887-2888, 2003
21. **Spruston N**. Axonal gap junctions send ripples through the hippocampus. Neuron 31:669-671, 2001.
22. Häusser M, **Spruston N**, Stuart G. Diversity and dynamics of dendritic signaling. Science, 290:739-744, 2000.
23. **Spruston N**. Distant synapses raise their voices. Nature Neuroscience, 3:849-851, 2000.
24. **Spruston N**, Häusser M, Stuart G. Dendritic integration. In: Dendrites, 1st edition, Stuart G, **Spruston N**, Häusser M, eds. Oxford University Press, pp. 231-270, 1999.
25. Häusser M, **Spruston N**, Stuart G. Conclusion: the future of dendrite research. In: Dendrites, 1st edition, Stuart G, **Spruston N**, Häusser M, eds. Oxford University Press, pp. 365-368, 1999.
26. Mickus T, Jung H, **Spruston N**. Slow sodium channel inactivation in CA1 pyramidal cells. In: Molecular and functional diversity of Ion Channels and Receptors. B. Rudy and P. Seeburg, eds. Annals of the New York Academy of Sciences, 868:97-101, 1999.
27. Traub RD, **Spruston N**, Soltesz I, Konnerth A, Whittington MA, Jefferys JGR. Gamma-frequency oscillations: a neuronal population phenomenon regulated by synaptic and intrinsic cellular processes. Progress in Neurobiology, 55:563-575, 1998.
28. Bulinski JC, Ohm T, Roder H, **Spruston N**, Turner DA, Wheal HV. Changes in dendritic structure and function following hippocampal lesions: correlations with developmental events? Progress in Neurobiology, 55:641-650, 1998.
29. Stuart G, **Spruston N**, Sakmann B, Häusser M. Action potential initiation and backpropagation in neurons of the mammalian central nervous system. Trends in Neurosciences, 20:125-131, 1997.
30. Ferster D, **Spruston N**. Cracking the neuronal code. Science, 270:756–757, 1995.
31. Stuart G, **Spruston N**. Probing dendritic function with patch pipettes. Current Opinion in Neurobiology, 5:389–394, 1995.
32. **Spruston N**, Jaffe DB, Johnston D. Dendritic attenuation of synaptic potentials and currents: the role of passive membrane properties. Trends in Neurosciences, 17:161–166, 1994.

33. Jonas P, **Spruston N**. Mechanisms shaping glutamate-mediated excitatory postsynaptic currents in the CNS. Current Opinion in Neurobiology, 4: 366–372, 1994.
34. Gray R, Fisher R, **Spruston N**, Johnston D. Acutely exposed hippocampal neurons: A preparation for patch clamping neurons from adult hippocampal slices. In: In Vitro Preparations From Vertebrate Nervous Systems. Jahnsen, H. (ed.), John Wiley: England, 3–24, 1990.

Research Publications

1. Cembrowski MS, **Spruston N**. Integrating results across methodologies is essential for producing robust neuronal taxonomies. Neuron, 94:747-751, 2017.
2. Graves AR, Moore SJ, **Spruston N**, Tryba AK, Kaczorowski CC. Brain derived neurotrophic factor differentially modulates excitability of two classes of hippocampal output neurons. Journal of Neurophysiology, 116: 466-71, 2016.
3. Cembrowski MS, Wang L, Sugino K, Shields BC, **Spruston N**. Hipposeq: a comprehensive RNA-seq database of gene expression in hippocampal principal neurons. Elife, 5:e14997, 2016.
4. Bloss EB, Cembrowski MS, Karsh B, Colonell, Fetter R, **Spruston N**. Structured dendritic inhibition supports branch-selective integration in CA1 pyramidal cells. Neuron, 89:1016-1030, 2016.
5. Cembrowski MS, Bachman JL, Wang L, Sugino K, Shields BC, **Spruston N**. Spatial gene expression gradients underlie prominent heterogeneity of CA1 pyramidal neurons. Neuron, 89:351-368, 2016.
6. Kim Y, Hsu CL, Cembrowski MS, Mensh BD, **Spruston N**. Dendritic sodium spikes are required for long-term potentiation at distal synapses on hippocampal pyramidal neurons. eLife, 4:e06414, 2015.
7. Chung S, **Spruston N**, Koh S. Age-dependent changes in intrinsic neuronal excitability in subiculum after status epilepticus. PLoS One, 10(3): e0119411, 2015.
8. Menon V, Musial TF, Liu A, Katz Y, Kath WL, **Spruston N**, Nicholson D. Balanced synaptic impact via distance-dependent synapse distribution and complementary expression of AMPARs and NMDARs in hippocampal dendrites. Neuron, 80: 1451-63, 2013.
9. Sheffield ME, Edgerton G, Heuermann RJ, Deemyad T, Mensh BD, **Spruston N**. Mechanisms of retroaxonal barrage firing in hippocampal interneurons. J Physiol., 591: 4793-805, 2013.
10. Graves AR, Moore SJ, Bloss EB, Mensh BD, Kath WL, **Spruston N**. Hippocampal pyramidal neurons comprise two distinct cell types that are countermodulated by metabotropic receptors. Neuron, 76:776-789, 2012.
11. Harnett MT, Makara JK, **Spruston N**, Kath WL, Magee JC. Synaptic amplification by dendritic spines enhances input cooperativity. Nature, 491:599-602, 2012.
12. Park J, **Spruston N**. Synergistic actions of metabotropic acetylcholine and glutamate receptors on the excitability of hippocampal CA1 pyramidal neurons. Journal of Neuroscience, 32:6081-6091, 2012.
13. Kim Y, **Spruston N**. Target-specific output patterns can be predicted by the distribution of regular-spiking and bursting pyramidal neurons in the subiculum. Hippocampus, 22:693-706, 2012.
14. Sheffield MEJ, Best TK, Mensh BD, Kath WL, **Spruston N**. Slow integration leads to persistent action potential firing in distal axons of coupled interneurons. Nature Neuroscience, 14:200-207, 2010.

15. Park J, Remy S, Varela J, Cooper DC, Chung S, Kang H, Lee J, **Spruston N**. A post-burst afterdepolarization is mediated by group I metabotropic glutamate receptor-dependent upregulation of Ca_v2.3 R-type calcium channels in CA1 pyramidal neurons. PLoS Biology, 8(11): 1-17, 2010.
16. Menon V, **Spruston N**, Kath WL. A state-mutating genetic algorithm to design ion-channel models. Proc. Natl. Acad. Sci. U.S.A., 106:16829-16834, 2009.
17. Katz Y, Menon V, Nicholson D, Geinisman Y, Kath WL, **Spruston N**. Synapse distribution suggests a two-stage model of dendritic integration in CA1 pyramidal neurons. Neuron 63:171-177, 2009.
18. Hardie J, **Spruston N**. Synaptic depolarization is more effective than back-propagating action potentials during Induction of associative long-term potentiation in hippocampal pyramidal neurons. Journal of Neuroscience, 29:3233-3241, 2009.
19. Moore S, Cooper DC, **Spruston N**. Plasticity of burst firing induced by synergistic activation of metabotropic glutamate and acetylcholine receptors. Neuron, 61:287-300, 2009.
20. Rempe M, **Spruston N**, Kath WL, Chopp D. Compartmental neural simulations with spatial adaptivity. Journal of Computational Neuroscience, 25:465-480, 2008.
21. Jarsky T, Mady R, Kennedy B, **Spruston N**. The distribution of bursting neurons in the CA1 region and the subiculum of the rat hippocampus. Journal of Comparative Neurology, 506:535-547, 2008.
22. Katz Y, Kath WL, **Spruston N**, Hasselmo ME. Coincidence detection of place and temporal context in a network model of spiking hippocampal neurons. PLoS Computational Biology, 3:e234-248, 2007.
23. Remy S, **Spruston N**. Dendritic spikes induce single-burst long-term potentiation. Proceedings of the National Academy of Sciences USA, 104:17192-17197, 2007.
24. Metz AE, **Spruston N**, Martina M. Dendritic D-type potassium currents inhibit the spike afterdepolarization in rat hippocampal CA1 pyramidal neurons. Journal of Physiology, 581:175-187, 2007.
25. Kaczorowski CC, Disterhoft JF, **Spruston N**. Stability and plasticity of intrinsic membrane properties in hippocampal CA1 pyramidal neurons: effects of internal anions. Journal of Physiology, 578:799-818, 2007.
26. Nicholson D, Katz Y, Trana R, Kath WL, **Spruston N**, Geinisman Y. Distance-dependent differences in synapse number and AMPA receptor expression in hippocampal CA1 pyramidal neurons. Neuron, 50:431-442, 2006.
27. Jarsky T, Roxin A, Kath WL, **Spruston N**. Conditional dendritic spike propagation following distal synaptic activation of hippocampal CA1 pyramidal neurons. Nature Neuroscience, 8: 1667-1676, 2005.
28. Golding N, Mickus T, Katz Y, Kath WL, **Spruston N**. Factors mediating powerful voltage attenuation along CA1 dendrites, Journal of Physiology, 568:69-82, 2005.
29. Cooper DC, Chung S, **Spruston N**. Output-mode transitions controlled by prolonged inactivation of sodium channels in pyramidal neurons of subiculum. PLoS Biology, 3:1123-1129, 2005.
30. Metz A, Jarsky T, Martina M, **Spruston N**. R-type calcium channels produce an afterdepolarization and bursting in hippocampal CA1 pyramidal neurons. Journal of Neuroscience, 25:5763-5773, 2005.
31. Cooper DC, Moore SJ, Staff NP, **Spruston N**. Psychostimulant-induced plasticity of intrinsic neuronal excitability in ventral subiculum. Journal of Neuroscience, 23:9937-9946, 2003.
32. Staff NP, **Spruston N**. Intracellular correlate of EPSP-spike potentiation in CA1 pyramidal neurons is controlled by GABAergic modulation, Hippocampus, 13:801-805, 2003.

33. Golding N, Staff NP, **Spruston N**. Dendritic spikes as a mechanism for cooperative long-term potentiation. Nature, 418:326-331, 2002.
34. Carr B, Cooper DC, Ulrich SL, Tkatch T, **Spruston N**, Surmeier DJ. Serotonin receptor activation inhibits sodium current and dendritic excitability in prefrontal cortex via a PKC-dependent mechanism. Journal of Neuroscience, 22:6846-6855, 2002.
35. Golding NL, Kath WL, **Spruston N**. Dichotomy of action potential backpropagation in CA1 pyramidal neurons, Journal of Neurophysiology 86:2998-3010, 2001.
36. Jung H, Staff NP, **Spruston N**. Action potential bursting in subicular pyramidal neurons is driven by a calcium tail current. Journal of Neuroscience 21:3312-3321, 2001.
37. Staff NP, Jung H, Thiagarajan T, Yao M, **Spruston N**. Resting and active membrane properties of pyramidal neurons in subiculum and CA1 of rat hippocampus, Journal of Neurophysiology, 84:2398-2408, 2000.
38. Golding NL, Jung H, Mickus T, **Spruston N**. Dendritic calcium spike initiation and repolarization are controlled by distinct potassium channel subtypes in CA1 pyramidal neurons. Journal of Neuroscience, 19:8789-8798, 1999.
39. Mickus T, Jung H, **Spruston N**. Properties of slow, cumulative sodium channel inactivation in rat hippocampal CA1 pyramidal cells. Biophysical Journal, 76:846-860, 1999.
40. Golding NL, **Spruston N**. Dendritic spikes are variable triggers of axonal action potentials in hippocampal CA1 pyramidal neurons. Neuron, 21:1189-1200, 1998.
41. Stuart G, **Spruston N**. Determinants of voltage attenuation in neocortical pyramidal neuron dendrites. Journal of Neuroscience, 18:3501-3510, 1998.
42. Lübke J, Frotscher M, **Spruston N**. Specialized electrophysiological properties of anatomically identified neurons in the hilar region of the rat fascia dentata. Journal of Neurophysiology, 79:1518-1534, 1998.
43. Jung H, Mickus T, **Spruston N**. Prolonged sodium channel inactivation contributes to dendritic action potential attenuation in hippocampal pyramidal neurons. Journal of Neuroscience, 17:6639-6646, 1997.
44. **Spruston N**, Lübke J, Frotscher M. Interneurons in the stratum lucidum of the hippocampus: electrophysiological and morphological characterization. Journal of Comparative Neurology, 385:427-440, 1997.
45. **Spruston N**, Schiller Y, Stuart G, Sakmann B. Activity-dependent action potential invasion into CA1 pyramidal neuron dendrites. Science, 268:297-300, 1995 (see accompanying "Research News" article pp. 200-201, by M. Barinaga).
46. **Spruston N**, Jonas P, Sakmann, B. Dendritic glutamate receptor channels in rat hippocampal CA3 and CA1 pyramidal neurons. Journal of Physiology (Lond.), 482:325-352, 1995.
47. **Spruston N**, Jaffe DB, Williams SW, Johnston D. Voltage- and space-clamp errors associated with measurement of electrotonically remote synaptic events. Journal of Neurophysiology, 70: 781-802, 1993.
48. **Spruston N**, Johnston D. Perforated patch-clamp analysis of the passive membrane properties of three classes of hippocampal neurons. Journal of Neurophysiology, 67: 508-529, 1992.
49. **Spruston N**, Nusbaum M. Cyclic nucleotide-mediated modulation of the pyloric motor pattern in the stomatogastric ganglion of the crab, *Cancer borealis*. Biological Bulletin, 181: 329-330, 1991.

50. McIntosh CH, Dahl MA, Kwok YN, Mutt V, **Spruston N**, Brown JC. Isolation from porcine intestinal extracts of a cholecystinin-like peptide and a peptide with homology to cytochrome oxidase polypeptide VII and chymodenin. Canadian Journal of Physiology and Pharmacology, 66:1407-1414, 1988.