

# Nelson Spruston

Curriculum Vitae, October 2018

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## Present Position

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Senior Director, Scientific Programs; Laboratory Head  
Howard Hughes Medical Institute, Janelia Research Campus  
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[Lab website](#); [Google Scholar](#); [Twitter](#)

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## Personal Data

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

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## Research Interests

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In my laboratory, we use a combination of experimental and computational approaches to study how memories are formed and used to guide animal behavior. Current work is focused on investigating the cell types and synapses in the hippocampus and connected brain regions. Previous work and ongoing interest in the biophysics of synaptic transmission, modulation, and dendritic integration. Broadly interested in neuroscience as it pertains to both healthy brain function and disease.

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## Education

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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

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## Positions

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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
2009-2011	Department Chair, Neurobiology, Northwestern University

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## Current Roles and Responsibilities

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- Supervision of four director-level direct reports covering the following scientific programs:
  - Students & Postdocs
  - Conferences & Workshops
  - Group Leader Recruiting & Review
  - Visiting Scientists
  - Gene Targeting & Transgenics

- Supervision of a research laboratory with seven postdoctoral fellows (see [www.janelia.org/lab/spruston-lab](http://www.janelia.org/lab/spruston-lab))
- Mentoring of ~20 early-career group leaders and ~50 postdoctoral fellows (in various Janelia labs)
- Steering committee member for the following project teams:
  - MouseLight (High-resolution imaging of CNS axons)
  - GENIE (Molecular tools for neuroscience)
  - NeuroSeq (RNA sequencing in ~200 types of CNS neurons; completed)
- Budgetary decision-making (together with the Executive Director)
- Communication with the community of Janelia scientists
- Collaboration on external communications regarding Janelia science

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### **Fellowships, Honors, and Awards**

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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

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### **Research Funding**

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2011-present	Spruston lab is exclusively funded by HHMI; Janelia does not allow any funding from outside sources.
1996-2011	“Synaptic integration and propagation in CA1 dendrites” National Institutes of Health (NINDS R01, PI: Spruston)
2002-2011	“Modeling realistic microcircuits of hippocampal neurons” National Institutes of Health (NINDS R01, PI: Spruston)
2003-2011	“Neurobiology of Information Storage” (NIH/NIMH training grant, PI: Routtenberg, Co-Director: Spruston)
2011-2014	“CRCNS: Collaboration on high-resolution maps of synapses on hippocampal neurons”, National Institutes of Health (NINDS R01, PIs: Spruston, Kath, Smith, Remy; 2012-2014 Spruston was a collaborator instead of a PI because of HHMI/Janelia rules).
2007-2009	NARSAD Distinguished Investigator Award
1999-2011	Co-Investigator on grants with Disterhoft and Surmeier
1998-2013	NIH National Research Service awards to 4 graduate students and 3 postdocs

1996-1999 Human Frontiers in Science Program

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### Teaching

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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)

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### Committees & Administration

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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)

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### Advisory Panels and Program Review

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2016-2018 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

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### Professional Development Workshops

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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

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### Students and Postdocs Supervised

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Currently advisor for 7 postdocs at Janelia Research Campus (*full list on request*)

Former students and postdoc (*highlights only*)\*

Dan Nicholson, Ph.D. Associate Prof. at Rush Univ. Medical Center, Chicago, IL, USA;  
 Spruston lab postdoc, 2007-2009

Stefan Remy, M.D. Professor at German Center for Neurodegenerative Diseases,  
 Bonn Germany; Spruston lab postdoc, 2005-07

Tim Jarsky, Ph.D. Research Scientist at Allen Institute for Brain Science;  
 Spruston lab graduate student, 2001-2006

Catherine Kaczorowski, Ph.D. Associate Prof. and Endowed Chair at The Jackson Laboratory,  
 Bar Harbor, ME, USA; Spruston lab graduate student, 2001-06

Nace Golding, Ph.D. Director and Professor at Univ. Texas, Austin, TX, USA;  
 Spruston lab postdoc, 1996-2002

Nathan Staff, M.D., Ph.D. Neurologist at Mayo Clinic, Rochester, MN, USA;  
 Spruston lab graduate student, 1998-2002

*\*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.*

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### Professional Affiliations

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

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### Editorial and Referee Duties

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2017-present Editorial Board, Current Opinion in Neurobiology  
 2008-2012 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

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### Invited Talks

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1993-present 128 invited seminars (*full list available on request*)  
 1995-present 54 invited talks at national and international conferences (*full list on request*)

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### Theses

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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.
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### Special Projects

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Books and other published resources:

1. Stuart G, **Spruston N**, Häusser M, eds. Dendrites, 3<sup>rd</sup> 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](http://www.scholarpedia.org/article/Pyramidal_neuron))
4. Stuart G, **Spruston N**, Häusser M, eds. Dendrites, 2<sup>nd</sup> 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, 1<sup>st</sup> edition, Oxford University Press, 1999. (book)
8. Cline H, **Spruston N**, eds. Dendrites: bringing it all together, Journal of Neurobiology, July, 2005. (special issue)

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**Reviews, Chapters, and Commentaries**

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Published reviews, etc. (selected from a total of 34):

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, 3<sup>rd</sup> edition, Stuart G, **Spruston N**, Häusser M, eds. Oxford University Press, pp. 351-398, 2016.
3. Stuart GJ, **Spruston N**. Dendritic integration: 60 years of progress. Nature Neuroscience, 18:1713-1721, 2016.
4. **Spruston N**. Assembling cell ensembles. Cell, 157:1502-1504, 2014.
5. **Spruston N**, Häusser M, Stuart G. Information processing in dendrites and spines. In: Fundamental Neuroscience, Elsevier, 2012.
6. Lisman J, **Spruston N**. Questions about STDP as a general model of synaptic plasticity. Frontiers in Neuroscience, 2:140, 1-5, 2010.
7. **Spruston N**. Pyramidal neurons: dendritic structure and synaptic integration. Nature Reviews Neuroscience, 9:206-221, 2008.
8. **Spruston N**. Somato-dendritic Integration: Dendritic Integration” (in-press), The New Encyclopedia of Neuroscience, edited by Larry Squire et al, Elsevier, 2008.
9. **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.
10. Lisman J, **Spruston N**. Postsynaptic depolarization requirements for LTP and LTD: a critique of spike timing dependent plasticity. Nature Neuroscience, 8:839-841, 2005.
11. **Spruston N**, Kath WL. Dendritic arithmetic. Nature Neuroscience, 7:567-569, 2004.
12. **Spruston N**. Branching out: a new idea for dendritic function. Journal of Neurophysiology, 90:2887-2888, 2003
13. **Spruston N**. Axonal gap junctions send ripples through the hippocampus. Neuron 31:669-671, 2001.
14. Häusser M, **Spruston N**, Stuart G. Diversity and dynamics of dendritic signaling. Science, 290:739-744, 2000.
15. **Spruston N**. Distant synapses raise their voices. Nature Neuroscience, 3:849-851, 2000.
16. 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.
17. Ferster D, **Spruston N**. Cracking the neuronal code. Science, 270:756–757, 1995.
18. Stuart G, **Spruston N**. Probing dendritic function with patch pipettes. Current Opinion in Neurobiology, 5:389–394, 1995.
19. **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.
20. Jonas P, **Spruston N**. Mechanisms shaping glutamate-mediated excitatory postsynaptic currents in the CNS. Current Opinion in Neurobiology, 4: 366–372, 1994.

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**Research Preprints**

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Preprints on bioRxiv (either in press, under review, or in preparation for journal publication):

1. Kerlin A, Mohar B, Flickinger D, MacLennan BJ, Davis C, **Spruston N**, Svoboda K. Functional clustering of dendritic activity during decision-making. *bioRxiv*, Oct. 2018, <https://www.biorxiv.org/content/early/2018/10/10/440396>.
2. Jin DZ, Zhao T, Hunt DL, Pearcy R, Hsu CL, **Spruston N**. ShuTu: Open-source software for efficient and accurate reconstruction of dendritic morphology. *bioRxiv*, Nov. 2017, <https://doi.org/10.1101/226548>.
3. Sugino K, Clark E, Schulmann A, Shima Y, Wang L, Hunt DL, Hooks BM, Trankner D, Chandrashekar J, Picard S, Lemire A, **Spruston N**, Hantman A, Nelson S. The transcriptional logic of mammalian neuronal diversity. *bioRxiv*, Nov. 2017, <https://doi.org/10.1101/208355>.

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**Research Publications (selected from a total of 57; full list on [google scholar](#))**

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1. Deemyad T, Lüthi J, **Spruston N**. Astrocytes integrate and drive action potential firing in inhibitory subnetworks Astrocytes integrate and drive neural activity. *Nature Communications*, 9:4336, 2018.
4. Hsu CL, Zhao X, Milstein A, **Spruston N**. Voltage dependence of spatial coding in hippocampal pyramidal neurons mediated by persistent sodium current. *Neuron*, 99:1-16, 2018.
5. Hunt DL, Linaro D, Si B, Romani S, **Spruston N**. A novel pyramidal cell-type triggers sharp-waves in the hippocampus. *Nature Neuroscience*, 21:985-995, 2018.
6. Cembrowski MS, Phillips MG, DiLisio SF, Shields BC, Winnubst J, Chandrashekar J, Bas E, **Spruston N**. Dissociable structural and functional hippocampal outputs via distinct subiculum cell classes. *Cell*, 173:1-13, 2018.
7. Bloss EB, Cembrowski MS, Karsh B, Colonell J, Fetter RD, **Spruston N**. Single excitatory axons form clustered synapses onto CA1 pyramidal cell dendrites. *Nature Neuroscience*, doi:10.1038/s41593-018-0084-6, 2018.
8. Cembrowski MS, **Spruston N**. Integrating results across methodologies is essential for producing robust neuronal taxonomies. *Neuron*, 94:747-751, 2017.
9. 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.
10. 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.
11. 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.
12. 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.
13. 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.
14. Chung S, **Spruston N**, Koh S. Age-dependent changes in intrinsic neuronal excitability in subiculum after status epilepticus. *PLoS One*, 10(3): e0119411, 2015.

15. 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.
16. 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.
17. 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.
18. Harnett MT, Makara JK, **Spruston N**, Kath WL, Magee JC. Synaptic amplification by dendritic spines enhances input cooperativity. Nature, 491:599-602, 2012.
19. 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.
20. 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.
21. 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.
22. 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<sub>v</sub>2.3 R-type calcium channels in CA1 pyramidal neurons. PLoS Biology, 8(11): 1-17, 2010.
23. 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.
24. 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.
25. 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.
26. 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.
27. 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.
28. Remy S, **Spruston N**. Dendritic spikes induce single-burst long-term potentiation. Proceedings of the National Academy of Sciences USA, 104:17192-17197, 2007.
29. 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.
30. 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.
31. 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.

32. 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.
33. 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.
34. 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.
35. 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.
36. Golding N, Staff NP, **Spruston N**. Dendritic spikes as a mechanism for cooperative long-term potentiation. Nature, 418:326-331, 2002.
37. Golding NL, Kath WL, **Spruston N**. Dichotomy of action potential backpropagation in CA1 pyramidal neurons, Journal of Neurophysiology 86:2998-3010, 2001.
38. 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.
39. 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.
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. 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.
43. **Spruston N**, Schiller Y, Stuart G, Sakmann B. Activity-dependent action potential invasion into CA1 pyramidal neuron dendrites. Science, 268:297-300, 1995.
44. **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.
45. **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.
46. **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.