

CURRICULUM VITAE

John Patrick Card

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DATE OF BIRTH:

July 3, 1950

EDUCATION:

1979	<u>Ph.D.</u> in Anatomy (Neuroanatomy)	Wayne State University Detroit, Michigan
1975	<u>MS</u> in Biological Sciences	Wright State University Dayton, Ohio
1972	<u>BS</u> in Comprehensive Science	Ashland University Ashland, Ohio

PROFESSIONAL CREDENTIALS:

2008-	Professor Department of Neuroscience, University of Pittsburgh
2004-	Co-Director (with Peter L. Strick, Ph.D.) Center for Neuroanatomy with Neurotropic Viruses University of Pittsburgh
1995-08	Associate Professor with tenure Department of Neuroscience, University of Pittsburgh
1992-95	Associate Professor Department of Neuroscience, University of Pittsburgh Pittsburgh, PA 15217
1990-92	Senior Research Scientist Virology Division, Du Pont Merck Pharmaceutical Co. Wilmington, DE 19880-0228
1985-90	Principal Scientist CNS Research, Central Research and Development Dept. E. I. du Pont de Nemours and Company Wilmington, DE 19880-0400
1982-85	Research Assistant Professor Department of Neurology, SUNY Stony Brook Stony Brook, New York 11790
1979-81	Postdoctoral Fellow SUNY Stony Brook with R. Y. Moore, M.D., Ph.D.

FELLOWSHIPS & SCHOLARSHIPS:

NIH NRSA, University of California @ San Diego	1979-1981
Graduate Professional Scholarship, Wayne State University	1978-1979
Charles B. DeVlieg Fellowship, Wayne State University	1978-1979
Graduate Teaching Assistantship, Wayne State University	1974-1978
General Medical Research Trainee, VA Center, Dayton, Ohio	1973-1974
Faculty Associate, Wright State University	1973-1974
Graduate Teaching Assistantship, Wright State University	1972-1973

MEMBERSHIPS IN PROFESSIONAL SOCIETIES:

Society for Neuroscience
American Association for the Advancement of Science

NATIONAL SERVICE:

Science and Mathematics Advisory Council, Ashland University	1999-present
Society for Neuroscience Program Committee	1999-2001
Co-President, Pittsburgh Chapter, Society for Neuroscience.	1996-1998
NIH; Ad hoc reviewer of RFA No. NIH-NIDCD-92-05 Study Section: “ <i>Transport of Substances in the Olfactory System</i> ”.	2000
NIMH Special Emphasis Panel; Ad hoc reviewer of RFA MH-97-001: “ <i>Innovative Approaches for Microscopic Tract-Tracing</i> ”.	1997
NIMH; Study Section Ad Hoc Reviewer	1997
NSF; Study Section Ad Hoc Reviewer	1997
NIMH; Ad hoc reviewer on Special Emphasis Panel RFA MH-95-003 “ <i>Role of the Blood-Brain-Barrier in HIV Neuropathogenesis</i> ”	1995
NSF; Ad hoc reviewer of REU for Undergraduates RFA	1995
NIH; Visual Sciences C Study Section Ad Hoc Reviewer	1993

UNIVERSITY OF PITTSBURGH SERVICE:

Co-Director, CNUP Graduate Program	2013-
Dietrich School of Arts & Sciences Nominating Committee	2012-2014
Advisory Committee for the Admission of Student Athletes	2011-2014
Director of CNUP Graduate Admissions	2006-2009
University Council on Graduate Studies	2005-2008
Arts and Sciences Undergraduate Council	2004-2007
Provost’s Advisory Council On Instructional Excellence	2004-2007
Co-Director, CNUP Graduate Program	2002-2005
Director of Graduate Studies, Department of Neuroscience	2002-2005
Arts and Sciences Graduate Council	2002-2004
FAS Tenure Council	2001-2004
FAS Tenure Council Selection Committee	2002-2004
Provost’s Committee on University of Pittsburgh Website	2003
IACUC, Committee Member	1995-2000
MD/Ph.D. Selection Committee	2000-2002

TEACHING EXPERIENCE:

Current teaching responsibilities:

- 2004 -** *Functional Neuroanatomy Honors Practicum (NS 1111)*. I assumed responsibility for this course in the Fall of 2004. It is the honors extension of the *Functional Neuroanatomy* course taught by Dr. Susan Sesack. The course has 3 sections; a) laboratory practicum of neuroanatomy, b) analysis of neuroanatomical techniques used to study nervous system organization, and c) critical analysis of contemporary neuroanatomical literature. Each year I have recruited 2 students from the prior class to serve as TAs the subsequent year. I have nominated these individuals for Chancellor's Undergraduate Teaching Fellowships, which have been awarded in every case, except for one, to date. (Typical Enrollment: 16)
- 1992 -** *Graduate Functional Neuroanatomy (NS 2006)*. Course Director through 1998. Since passing on the directorship responsibilities I have continued to lecture annually in the course, principally in the sections on hypothalamus and behavioral state regulation. (Typical Enrollment: 15-30)
- 1995 -** *Functional Organization of Human Nervous System (NS 1032)*. Team-taught with Dr. Robert Y. Moore through 2009 when he retired. I now teach the entire course, which examines the biological basis of nervous system disorders as a foundation for illustrating how different systems function under normal circumstances. (Typical Enrollment: 35)
- 2013 -** *Continuing Experiences in Research (ARTSC 0121)*. Patrick Mullen, Director of Undergraduate Research, recruited me to teach a section of this course. The course is the follow-up to the *First Experiences in Research (FER)* course that places freshmen in research laboratories. As sophomores in this course they learn how to present the research conducted as part of the FER, receive guidance on the preparation of fellowship applications for the Summer Research Program sponsored by the university, and are counseled on effective mechanisms for building credentials in support of applications for postgraduate professional training. (Enrollment: 12)
- 2014 -** *First Experiences in Research (ARTSC 0120)*. Patrick Mullen, Director of Undergraduate Research, recruited me to teach a section of this course this spring. The course is focused upon providing freshmen researchers with insight into the process of scientific method to complement their experience in the laboratory. (Enrollment: 20)

Prior courses at the University of Pittsburgh:

- 1999-2004** *Natural Sciences 1 & 2 (BS 0850)*. Dr. Peter Koehler, Former Dean of Arts & Sciences created this two-term course for non-science majors. Dr. David Pratt recruited I were recruited to teach the sections on biology and chemistry, while Dr. Koehler taught the section on physics. The goal of this team-taught course was to provide an integrated curriculum in the natural sciences for non-science majors who were fulfilling their science course requirements. Toward that end we all attended every lecture throughout the course in an effort to present a cohesive treatment of the different disciplines. University of Pittsburgh. (Typical Enrollment: 50)
- 1997-1999** *Cellular and Molecular Mechanisms of Degeneration (MSCMP 3720)*. I presented lectures on viral-pathogenesis. University of Pittsburgh. (Typical Enrollment: 10)
- 1997** *Glial Cell Function In Health, Disease, and Injury (NS 1045)*. Advanced undergraduate elective that I created and taught for one year. University of Pittsburgh. (Enrollment: 20)

- 1992** *Biological Clocks*. Selected lectures in course created by Dr. Robert Y. Moore. University of Pittsburgh. (*Enrollment: 15*)
- 1992** *Functional Neuroanatomy (BNS 1011)*. Undergraduate course co-taught with Dr. William Cameron. University of Pittsburgh. (*Enrollment: 75*)

TEACHING EXPERIENCE:

Courses taught at other institutions:

- 1991** *Veterinary Neuroanatomy*. Selected lectures and laboratory. University of Pennsylvania. (*Enrollment: 50*)
- 1983-85** *Medical School Neuroanatomy*. SUNY, Stony Brook. (*Typical Enrollment: 50*)
- 1983-84** *Undergraduate Directed Studies in Neurobiology*. SUNY, Stony Brook.
- 1983-85** *Allied Health Neuroanatomy*. SUNY at Stony Brook. (*Typical Enrollment: 35*)
- 1984** *Advanced Graduate Neurobiology*. Co-taught with Dr. Robert Y. Moore. SUNY, Stony Brook. (*Typical Enrollment: 15*)
- 1977-79** *Histology*. Post Baccalaureate Program, Wayne State University (*Typical Enrollment: 12*)
- 1975-79** *Medical School Gross Anatomy*. Wayne State University (*Typical Enrollment: 145*)
- 1973-75** *Allied Health (Nursing) Gross Anatomy*. Wright State University (*Typical Enrollment: 35*)
- 1972-73** *Biology*. Wright State University. (*Enrollment: 20*)

EDITORIAL SERVICE:

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| Encyclopedia of Life Sciences, Scientific Editor | 2002-2004 |
| The Scientific World Journal | 2012-present |

JOURNAL REVIEW: (during the past 10 years)

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|------------------------|----------------------------------|----------------------------|
| Science | Journal of Neuroscience | Journal of Virology |
| Nature | Journal of Comparative Neurology | Molecular Brain Research |
| Cerebral Cortex | Progress in Brain Research | Brain Research |
| PNAS | American Journal of Physiology | Journal of Neurophysiology |
| Neuroscience | Brain Research Reviews | Visual Neuroscience |
| Experimental Neurology | Journal of Biological Rhythms | Brain Research Bulletin |
| Virology | Journal of Neural Transmission | Anatomical Record |
| Neuroscience Letters | Journal of General Virology | European J. Neuroscience |
| J. Neurosci. Methods | Journal of Applied Physiology | PLos One |
| PLos Pathogens | Frontiers in Neuroscience | Brain Structure & Function |

CURRENT GRANT SUPPORT:

NIH. NCRR P40 RR018604: Center for Neuroanatomy with Neurotropic Viruses.
(J. P. Card and P. L. Strick, Co-Directors). 6/1/04-5/31/15.

PENDING GRANT APPLICATIONS:

NIH. RO1 HL093134: C1, RVLM & Cardiovascular Function.
(J. P. Card PI)

NIH. RO1: *Tracing and Monitoring Neural Pathways for Cerebellar Associative Learning.*
(S. Wang, J. P. Card and L. W. Enquist, Co-PIs)

RECENTLY COMPLETED GRANT SUPPORT:

NIH. RO1 HL093134: *C1, RVLM & Cardiovascular Function.*
(J. P. Card PI). 4/1/09-3/31/14.

NSF. IOS-0918867: *Viral Microdissection of Central Circuitry Integrating Autonomic Function.*
(Sved/Card). 8/1/09-7/31/14.

NIH Challenge Grant. RC1NS068414-01: *Viral Brainbow: Tracing Brain Circuits with Connection Order Specificity.*
(Enquist/Card). 9/30/09-8/31/12.

NIH. 5 P50 RR 018604-05: *National Center for Experimental Neuroanatomy with Neurotropic Viruses.*
(Card/Strick). 6/1/04-5/31/09.

MEMBERSHIP ON TRAINING GRANTS:

NIH: Graduate Training Grant. Alan F. Sved, Ph.D., PI.

GRADUATE STUDENT DOCTORAL TRAINING: (at University of Pittsburgh)

Gregory Wojaczynski “*Integrative Circuitry for Associative Learning in the Cerebellum: Role of Nucleus Interpositus*”. In Progress.

Brian J. Jian (Co-Mentored with Bill J. Yates): “*Vestibular Compensation: A Spinovestibular Mediated Process*”. 2004.

Joel Brown (Co-Mentored with Bill J. Yates): “*Neural Substrates of Navigation and Spatial Cognition in the Rat*”. 2004.

Georgina Cano (Co-Mentored with Alan F. Sved): “*Characterization of the CNS Control of Sympathetic Outflow using Viral Transneuronal Tracing*”. 2002.

Faridis Serrano: “*Microglial and Macrophage Responses Associated with the 6-OH-DA-induced Degeneration of the Nigrostriatal Pathway*”. 2001.

GRADUATE STUDENT MASTERS TRAINING:

Rachel S. Fodi “*Characterization of Central Circuits that Influence the Activity of the Locus Coeruleus: Functionally-Defined Segregation of Afferents*”. MS in 2012.

Abhisek Chandan Khandai “*Identity and Organization of Central Neural Circuits Responsible for Feedback Regulation of the Hypothalamic-Pituitary-Adrenal Axis*”. MS in 2012.

James Lois (Co-Mentored with Bill J. Yates): “*Neural Circuits Controlling Diaphragm Function in the Cat Revealed by Transneuronal Tracing*”. MS in 2008.

POSTDOCTORAL TRAINING:

Judith C. Sved, Postdoctoral Fellow; 2005-2008.

Jin-Sang Kim, Ph.D. Postdoctoral Fellow; 1995-1996; currently Assistant Professor at Taegu University, South Korea.

Philip Larsen, Ph.D. Postdoctoral Fellow; 1994-1995; currently Associate Professor at Copenhagen University, Denmark.

RESEARCH FACULTY MENTOR:

Georgina Cano, Ph.D.; 2009 - present.

Kristophor Agassandian, Ph.D.; 2010 - 2013.

UNDERGRADUATE TRAINING (University of Pittsburgh):

Michael Oltman, 2014

Aleksandra Safonova; 2013-

Seth Sheetz. 2013-

Niaz Knah. 2013-2014

Michelle Richard, 2013-2014

Peter Hopkins. 2012-2014

Yizhi (Nick) Li, 2012-2014

Milan Patel, 2011-2013

Tim Ohlsen, 2010-2013

Nyana Baby, 2011-2012

Vivian Allahyari, 2011-2012

Stephanie Taiclet, 2010-2012

Thomas Kessler. 2009-2011

Ashley Ferguson, 2008-2010

Sommer Ebdlahad, 2008-2010

Vedant Desai, 2008-2010

Hosh McCambridge, 2008-2010

Karolina Duskova, 2009-2010

Tshona Corbin, 2007-2008

Colin McCloskey, 2004-2007

Brian Craig, 2004-2007

Carine Bou-Abboud, 2006-2008

Susan Wright, 2008.

Catherine M. Davis (Washington & Jefferson University), 2003

Mary Beth Heaton, 2004-2005

Rebecca Edelmayer, 2002-2003

Elizabeth Juhas, 2002-2003

Maxim Glukhovskoy, 2001-2003

Justin Mazur, 1998-1999

Hani B. Al-Saleh, 1997-1998

LaShay G. Knox, Minority Summer Fellow, 1997

Michael Sapko, Summer Fellow, 1997

Sadiq Syed, 1997-1998

Julia Chosy (Howard Hughes Summer Fellow), 1996

Tariq Syed, 1996-1997

Emad G. Iskandar, 1995-1996, Bradler Award Winner, 1995, 1997

Jehrib Cabarlo, 1995-1996

SELECTED DOMESTIC INVITED LECTURES (*since 1990*):

Thomas Jefferson University, March 2013

Ohio Academy of Science, Keynote Speaker, April 2012

Princeton University, Department of Molecular Biology, May 2011

University of Pittsburgh, Science 2011, October 2011

Oklahoma State University, Department of Pharmacology and Physiology, June 2009

Society for Neuroscience 2007 Meeting, Autonomic Nervous System Social, November 2007
Vanderbilt University, Kennedy Center, June 2007
University of Pittsburgh, Department of Neuroscience, December 2006
University of Pittsburgh, CNBC, February 2006
International Pituitary Congress, Invited Lecture, San Diego, CA, April 2005
Colorado State University, Department of Neurobiology, Spring 2001.
Scripps Institute, Department of Neuropharmacology, May 2000.
West Virginia University, Department of Anatomy, May 2000
Purdue University, Invited Tutorial and Seminar, April 2000.
University of Pittsburgh, Department of Neurobiology, April 2000.
NSF Workshop - Los Angeles, California, Invited Symposium Speaker: "CSF as a Communication Pathway in the Brain". November 1998.
Ohio State University, Invited Symposium Speaker: "Practical Consideration on the Use of Pseudorabies Virus for Transynaptic Analysis". October 1998.
Georgia State University, Invited Symposium Speaker: "Viral Infections in the CNS: Mechanism of Action and Use in Defining Neural Circuits". May 1997.
Howard University, Department of Pharmacology, February 1997.
Harvard University, Department of Genetics, December 1996.
Winter Conference on Brain Research, Panel Organizer; Snowmass, CO, January, 1996.
University of Massachusetts, Department of Neurology, December 1995.
Case Western Reserve University, Department of Neuroscience, April 1995.
SUNY at Stony Brook, Department of Neurobiology & Behavior, November 1993.
University of Virginia Center for Biological Timing, Seminar & New Technologies Tutorial, December 1991.
Cornell University, Department of Neurology & Neuroscience, September 1991.
Michigan State University, Department of Anatomy & Neurobiology, April 1991.
Wayne State University, Department of Anatomy & Cell Biology, April 1991.

INVITED INTERNATIONAL LECTURES (since 1990; declined invitations 2000 - 2012):

University of Calgary, Calgary Canada, June 2013
Gordon Conference on Chronobiology, Barga, Italy, Invited Symposium Speaker.
"The SCN as a Pacemaker". June 1999.
Human Frontiers Conference, Lyon, France, Invited Symposium Speaker.
"Circadian Light Reception and Regulation". May 1996.
University of Copenhagen Panum Institute, Invited Symposium Speaker.
European Pineal Society Colloquium. July 1993.
Concordia University, Montreal, Canada Department of Psychology. March 1992.
Osaka International Symposium on New Functional Aspects of the Suprachiasmatic Nucleus of the Hypothalamus, Invited Speaker; Osaka, Japan, October 1991.

RESEARCH PROGRAM:

My research interests fall into two basic categories. A long-standing focus of the laboratory is definition of the functional organization of neural circuits involved in the control of behavioral state and autonomic function. The primary objective of these studies is to define the synaptic organization and chemical phenotype of the central networks that mediate these essential regulatory functions. Characterization of the plasticity and developmental assembly of these

circuits is a related component of these analyses. The second focus of the laboratory is the development of tools for transneuronal tracing of neural circuits. This effort, which is fundamental to the goals of our investigation of neural circuitry, incorporates a mechanistic approach. It is supported by an NIH center grant (*National Center for Neuroanatomy with Neurotropic Viruses*; Co-Director with Dr. Peter Strick), awarded in 2004 and funded continuously since that time, to establish a state-of-the-art resource for viral transneuronal tracing at the University of Pittsburgh.

Current studies fall into two broad categories. The first focuses upon circuitry through which the brain stem, hypothalamus and limbic forebrain control autonomic function. Toward this end, we have used neurotropic viruses to define the neural circuits that modulate sympathetic and parasympathetic components of the autonomic nervous system. These studies, which examine the central transport of virus from autonomic targets (e.g., stomach, spleen, kidney), have provided important insights into the way in which the nervous system controls autonomic outflow. Nevertheless, the synaptology that permits the central autonomic network to exert integrated regulatory control over autonomic outflow is only understood in general principles. To bring clarity to this issue we have developed novel approaches that permit functional microdissection of the network. These include the use of lentivirus vectors to define the efferent projections of phenotypically defined neurons and conditional replication of pseudorabies virus (PRV). Our conditional expression approach builds upon the proof-of-principle experiments published by DeFalco and colleagues in which a recombinant strain of PRV is dependent upon the presence of the protein cre recombinase (CRE) to become replication competent. Since cre recombinase is not present in the mammalian genome, a means of reliable delivery of the transgene is a rate-limiting step to application of the technology. DeFalco and colleagues generated a transgenic mouse in which CRE was differentially expressed in NPY neurons. Our approach is to develop vectors that deliver CRE to targeted populations of neurons. We have shown that restricted expression of CRE can be achieved in catecholamine neurons by placing CRE expression under the control of a synthetic dopamine-beta-hydroxylase promoter. In developing this vector we incorporated a green fluorescent protein (GFP) reporter gene as a mechanism of unambiguously determining that the CRE transgene was being expressed. An unexpected outcome of this approach was the demonstration that the GFP reporter fills both the somatodendritic and axonal compartments of catecholamine neurons. We exploited this novel finding to define the efferent projections of brainstem catecholamine neurons involved in cardiovascular regulation and are applying it for anterograde tracing of projection fields of other catecholamine neurons. To our knowledge, our studies are the first to exploit the technology for phenotypically-defined characterization of axonal projections. The successful demonstration of the ability to deliver transgenes to targeted populations of neurons has permitted us to combine the targeted delivery of CRE with the use of viruses that require its presence to express conditional reporters, e.g., "Brainbow" recombinants. Proof of principle of this and related approaches were published in 2011 and we are currently applying these technologies to dissect polysynaptic neural networks through which physiology is coordinated with behavioral state.

Our other major focus is to define the functional organization of neural circuitry responsible for associative learning. These studies build upon the initial observation by Ivan Pavlov that mammals have the capacity to establish associates between previously unrelated sensory stimuli if those stimuli are presented repeatedly in close temporal proximity. The cerebellum mediates this learning. Our studies seek to define the role of the deep cerebellar nuclei in this learning process by defining the synaptology of neurons previously shown to be essential for this conditioned learning. We have developed novel recombinants for this purpose and are using them to characterize the functional organization of the circuits.

The collective intent of my research program is to pursue an integrated experimental plan that develops knowledge of the mechanisms of viral invasiveness and then exploits that knowledge for transneuronal analysis of the functional organization of neuronal circuits.

PEER-REVIEWED PUBLICATIONS:

1. Card, J.P., J.A. Mitchell. Surface morphology of ependymal and its specializations in 3rd and 4th ventricles of the rat brain as viewed by SEM. *Micron* 7:309-311, 1976.
2. Card, J.P., J.A. Rafols. Tanycytes of the third ventricle of the neonate rat: A Golgi study. *American Journal of Anatomy* 151:173-190, 1978.
3. Card, J.P., J.A. Mitchell. Scanning electron microscopic observations of supraependymal elements overlying the organum vasculosum of the lamina terminalis of the hamster. *Scanning Electron Microscopy II*:803-809, 1978.
4. Card, J.P., J.A. Mitchell. Electron microscopic demonstration of a supraependymal cluster of neuronal cells and processes in the hamster third ventricle. *Journal of Comparative Neurology* 180:43-58, 1978.
5. Card, J.P., J.A. Mitchell. Nicotine induced alterations of decidualization in the rat. *Biology of Reproduction* 19:326-331, 1978.
6. Mitchell, J.A., J.P. Card. Supraependymal neurons overlying the periventricular region of the third ventricular wall of the guinea pig: A correlative scanning and transmission electron microscopic study. *Anatomical Record* 192:441-457, 1978.
7. Card, J.P., J.A. Mitchell. Further observations on the intraventricular neuronal cluster of the golden hamster brain. *Scanning Electron Microscopy* 3:505-510, 1979.
8. Card, J.P., J.A. Mitchell. Nicotine induced alterations of blastocyst implantation in the rat. *Biology of Reproduction* 20:532-539, 1979.
9. Riley, J.N., J.P. Card, R.Y. Moore. A retinal projection to the lateral hypothalamus in the rat. *Cell and Tissue Research* 214:257-269, 1981.
10. Mitchell, J.A., J.P. Card. Evidence of neurosecretory activity within the intraventricular neuronal complex of the adult hamster. In: *Neurosecretion: Molecules, Cells, and Systems*, (D.S. Farner & K. Lederis, eds), Plenum Publishing Corp., pp. 450-451, 1981.
11. Card, J.P., N. Brecha, H.J. Karten, R.Y. Moore. Immunocytochemical localization of vasoactive intestinal polypeptide containing cells and processes in the suprachiasmatic nucleus of the rat: Light and electron microscopic analysis. *Journal of Neuroscience* 1:1289-1303, 1981.
12. Card, J.P., R.Y. Moore. Ventral lateral geniculate nucleus efferents to the rat suprachiasmatic nucleus exhibit avian pancreatic polypeptide-like immunoreactivity. *Journal of Comparative Neurology* 206:390-396, 1982.
13. Card, J.P., N. Brecha, R.Y. Moore. Immunohistochemical localization of avian pancreatic polypeptide-like immunoreactivity in the rat hypothalamus. *Journal of Comparative Neurology* 217:123-136, 1983.
14. Moore, R.Y., E.L. Gustafson, J.P. Card. Identical immunoreactivity of afferents to the rat suprachiasmatic nucleus with antisera against avian pancreatic polypeptide, molluscan cardioexcitatory peptide and neuropeptide Y. *Cell and Tissue Res* 236:41-46, 1984.
15. Card, J.P. R.Y. Moore. The suprachiasmatic nucleus of the golden hamster: Immunohistochemical analysis of cell and fiber distribution. *Neuroscience* 13:415-431, 1984.
16. Card, J.P., J.N. Riley, R.Y. Moore. The motor trigeminal nucleus of the rat: Analysis of neuronal structure and synaptic organization. *Journal of Comparative Neurology* 250:469-484, 1986.
17. Gustafson, E.L., J.P. Card, R.Y. Moore. Neuropeptide Y localization in the rat amygdaloid complex. *Journal of Comparative Neurology* 251:349-362, 1986.
18. Levine, J.M., J.P. Card. Light and electron microscopic localization of a cell surface antigen (NG2) in the rat cerebellum: Association with smooth protoplasmic astrocytes. *Journal of Neuroscience* 7:2711-2720, 1987.

19. Card, J.P., S. Fitzpatrick-McElligott, I. Gozes, F. Baldino, Jr. Localization of vasopressin, vasoactive intestinal polypeptide, peptide histidine-isoleusine and somatostatin mRNA in rat suprachiasmatic nucleus. *Cell and Tissue Research* 252:71-91, 1988
20. Schwaber, J.S., C. Sternini, N.C. Brecha, W.T. Rogers, J.P. Card. Neurons containing calcitonin gene-related peptide in the parabrachial nucleus project to the central nucleus of the amygdala. *Journal of Comparative Neurology* 270:416-426, 1988.
21. Card, J.P., R.Y. Moore. Neuropeptide Y localization in the rat suprachiasmatic nucleus. *Neuroscience Letters* 88:241-246, 1988.
22. Cassone, V.M., J.C. Speh, J.P. Card, R.Y. Moore. Comparative anatomy of the mammalian hypothalamic suprachiasmatic nucleus. *Journal of Biological Rhythms* 3:71-91, 1988.
23. Siman, R., J.P. Card. Excitatory amino acid neurotoxicity in the hippocampal slice preparation. *Neuroscience* 26:433-447, 1988.
24. Fitzpatrick-McElligott, S., J.P. Card, M.E. Lewis, F. Baldino, Jr. Neuronal localization of prosomatostatin mRNA in rat brain with in situ hybridization histochemistry. *Journal of Comparative Neurology* 273:558-572, 1988.
25. Card, J.P., R.P. Meade, L.G. Davis. Immunocytochemical localization of the precursor protein for beta-amyloid in the rat central nervous system. *Neuron* 1:835-846, 1988.
26. Rinaman, L.M., J. P. Card, J.S. Schwaber, R.R. Miselis. Ultrastructural demonstration of a gastric monosynaptic vagal circuit in the nucleus of the solitary tract in rat. *Journal of Neuroscience* 9:1985-1996, 1989.
27. Baldino, F. Jr., I. Gozes, S. Fitzpatrick-McElligott, J.P. Card. Localization of VIP and PHI-27 messenger RNA in rat thalamic and cortical neurons. *Journal of Molecular Neuroscience* 1:199-207, 1989.
28. Siman, R., J.P. Card, R.B. Nelson, L.G. Davis. Expression of β -amyloid precursor protein in reactive astrocytes following neuronal damage. *Neuron* 3:275-285, 1989.
29. Card, J.P., R.Y. Moore. Organization of lateral geniculate-hypothalamic connections in rat. *Journal of Comparative Neurology* 284:135-147, 1989.
30. Siman, R., J.P. Card, L.G. Davis. Proteolytic processing of beta-amyloid precursor by calpain I. *Journal of Neuroscience* 10:2400-2411, 1990.
31. Card, J.P. L. Rinaman, J.S. Schwaber, R.R. Miselis, M.E. Whealy, A.K. Robbins, L.W. Enquist. Neurotropic properties of pseudorabies virus: uptake and transneuronal passage in the rat central nervous system. *Journal of Neuroscience* 10:1974-1994, 1990.
32. Fitzpatrick-McElligott, S., J.P. Card, T.M. O'Kane, F. Baldino, Jr. Ontogeny of somatostatin mRNA-containing perikarya in the rat central nervous system. *Synapse* 7:123-134, 1991.
33. Whealy, M.E., J.P. Card, R.P. Meade, A.K. Robbins, L.W. Enquist. The effect of Brefeldin A on alpha herpesvirus (PRV) membrane glycosylation and virus egress. *Journal of Virology* 65:1066-1081, 1991.
34. Card, J.P., M.E. Whealy, A.K. Robbins, R.Y. Moore, L.W. Enquist. Two alpha herpesvirus strains are transported differentially in the rodent visual system. *Neuron* 6:957-969, 1991.
35. Sternini, C., J.P. Card. Ultrastructural characteristics of calcitonin gene-related peptide containing fibers and islet cells in the rat pancreas. *Pancreas* 6:375-384, 1991.
36. Card, J.P., M.E. Whealy, A.K. Robbins, L.W. Enquist. Pseudorabies virus envelope glycoprotein gI influences both neurotropism and virulence in the rat visual system. *Journal of Virology* 66:3032-3041, 1992.
37. Nadelhaft, I., P.L. Vera, J.P. Card, R.R. Miselis. Central nervous system neurons labeled following the injection of pseudorabies virus into the rat urinary bladder. *Neuroscience Letters* 143:271-274, 1992.

38. Rinaman, L., J.P. Card, L.W. Enquist. Spatiotemporal response of astrocytes, microglia and macrophages to pseudorabies virus infection of central visual pathways in rat. *Journal of Neuroscience* 13:685-702, 1993.
39. Card, J.P., L. Rinaman, R.B. Lynn, B.-H Lee, R.P. Meade, R.R. Miselis, L.W. Enquist. Pseudorabies virus infection of the rat central nervous system: Ultrastructural characterization of viral replication, transport and pathogenesis. *Journal of Neuroscience* 13:2515-2539, 1993.
40. Whealy, M.E., J.P. Card, A.K. Robbins, J.R. Dubin, H.-J. Rziha, L.W. Enquist. Specific pseudorabies virus infection of the rat visual system requires the gl/gp63 glycoprotein complex. *Journal of Virology* 67:3786-3797, 1993.
41. Moore, R.Y., J.P. Card. The intergeniculate leaflet: An anatomically and functionally distinct subdivision of the lateral geniculate complex. *Journal of Comparative Neurology* 344:403-430, 1994.
42. Enquist, L.W., J.R. Dubin, M.E. Whealy, J.P. Card. Complementation analysis of pseudorabies virus gE and gl mutants in retinal ganglion cell neurotropism. *Journal of Virology* 68:5275-5279, 1994.
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