

## CURRICULUM VITAE

### STEPHEN JOSEPH MOORMAN

Business Address/Phone: Robert Wood Johnson Medical School  
Department of Neuroscience and Cell Biology  
675 Hoes Lane  
Piscataway, New Jersey 08854-5635  
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Stephen.Moorman@umdnj.edu (e-mail)

#### **CITIZENSHIP:**

USA

#### **EDUCATION:**

Cornell University	B.S./Biology	1974
S.U.N.Y. Stony Brook	M.S./Anatomy & Phys. Anthropology	1983
Thesis Advisor:	Jack Stern, Ph.D.	
Thesis Title:	Effects of prolonged exercise on muscle activity patterns during human locomotion.	
Colorado State University College of Veterinary Medicine	Ph.D./Anatomy & Neurobiology	1988
Dissertation Advisor:	L. Ray Whalen, DVM, Ph.D.	
Dissertation Title:	Hindlimb reflexes of the rat affected by fetal brainstem tissue implanted in the spinal cord.	

#### **SERVICE EXPERIENCE:**

US Air Force, Honorable Discharge 1976

#### **POSTGRADUATE EDUCATION:**

Neuroscience Short Course on Motor Control, 1985  
Woods Hole Digital Image Processing Course, 1988  
Teaching Survival Skills and Ethics to Emerging Scientists  
NIH Sponsored Workshop, 1995  
Research!America Keys to Advocacy Workshop, 2000

#### **HONORS AND AWARDS:**

UMDNJ Master Educator	2008-present
Harvard-Macy Medical Education Fellow	2004-2008
Harvard-Macy Institute Program for Health Science Educators	
NASA Center for Advanced Studies in Space Life Sciences Woods Hole Marine Biological Laboratory "Scholar in Residence"	Summer, 2003
American Association of Anatomists Young Anatomist Publication Award	2003
Research!America Science Advocacy Fellow	2000-2003
NASA NeuroLab Space Shuttle Science Mission Astronaut Payload Specialist Nominee	1995

**HONORS AND AWARDS (cont.):**

Woods Hole Marine Biological Laboratory  
Young Investigator Fellowship Summer, 1991  
Stephen Kuffler Fellowship Summer, 1994  
Air Force ROTC Scholarship 1973 - 1975

**PROFESSIONAL EXPERIENCE:**

Department of Neuroscience and Cell Biology Present:  
Robert Wood Johnson Medical School Associate Professor  
675 Hoes Lane  
Piscataway, New Jersey 08854-5635

Department of Anatomy 1998-2002  
School of Medicine Assistant Professor  
Case Western Reserve University Director, Functional Genomics Lab  
10900 Euclid Ave. CWRU Center for Zebrafish Research  
Cleveland, OH 44106-4930

UNT Health Science Center at Fort Worth  
3500 Camp Bowie Blvd.  
Fort Worth, TX 76107-2699

Department of Anatomy and Cell Biology 1993 - 1998: Assistant Professor  
and North Texas Eye Research Institute  
Physician Assistant Program 1995 - 1997: Acting Academic Coordinator  
Fort Worth Zebrafish Research Facility 1997 - 1998: Director

The Marine Biological Laboratory 1991 - present  
Woods Hole, MA 02543 Principal Investigator

Toxicology Program 1992 - 1993  
Neurotoxicology Research Lab Assistant Research Scientist  
University of Michigan  
Ann Arbor, MI 48109-2029

Department of Biology 1988 - 1992  
University of Michigan Postdoctoral Fellow  
Ann Arbor, MI 48109 Mentor: Richard I. Hume, Ph.D.

Front Range Community College 1987 - 1988  
Westminster, CO Instructor of Anatomy

American Univ. Caribbean 1981 - 1982  
Plymouth, Montserrat Instructor of Anatomy  
British West Indies

Dept. of Neuro. & Behavior 1975 - 1976  
Cornell University Histology Res. Asst.  
Ithaca, NY Ron Hoy's lab

**RESEARCH SUPPORT:**

**CURRENT:**

2009-2014 NIH/NICHD "Primary cilia regulate transcriptional noise" (pending)  
2004-2009 NIH/NCRR (#RR017441) "The zebrafish atlas" (\$185,000, fy07)  
2007-2008 UMDNJ Educational Technology Grant Program: "Informatics approach to student assessment" (\$20,000)

**RESEARCH SUPPORT (cont.)**

**PREVIOUS:**

- 2006-2007 UMDNJ Educational Technology Grant Program: "Gross Anatomy Dissection DVDs" (\$17,700)  
2002-2007 NASA #NAG2-1591 "Effects of microgravity on gene expression"  
2002-2008 NIH/NIDCD – "Zebrafish otic tissue for cDNA libraries" (contract)  
2000-2004 NASA – #NCC2-1204  
"Effects of microgravity during the critical period of zebrafish vestibular development" Flight Experiment  
1999-2003 NASA – #NAG2-1356:  
"Effects of Microgravity on Zebrafish Vestibular development"  
1998-2001 NIH/NIDCD - Minority Fellowship to support Rodolfo Cordova  
Administrative Supplement to parent Grant (DC03531)  
1997-2002 NIH/NIDCD - #DC03531  
"Is development of the equilibrium receptor system dependent on gravity."  
1995-1998 American Paralysis Association  
"Cell-cell interactions that limit regeneration after spinal cord injuries."  
1996-1997 Fight For Sight  
"Regeneration of retinal ganglion cell axons in the optic nerve."  
1994-1995 UNT Health Science Center Faculty Research Award  
"Mechanisms that limit remyelination in Multiple Sclerosis"  
1993-1994 UNT Health Science Center Faculty Research Award  
"Oligodendrocyte interactions during development."  
1990-1991 American Paralysis Association  
"In vitro analysis of cellular mechanisms regulating spinal cord regeneration."

**INVITED PRESENTATIONS:**

- 2006 Dalhousie University School of Medicine: Invited Speaker  
2003 Marine Biological Laboratory at Woods Hole, Center for Advanced Studies in Space Life Sciences: Invited Speaker  
2003 Mid-Atlantic Regional Zebrafish Meeting: Invited Speaker  
2001 Robert Wood Johnson Medical School, Department of Neuroscience and Cell Biology: Invited Speaker  
2001 University of Maryland, Department of Biology: Invited Speaker  
2000 Cleveland Clinic, Department of Molecular Biology: Invited Speaker  
2000 NASA, Life Sciences Research Seminar Series: Invited Speaker  
1999 Case Western Reserve University, Department of Neurosciences: Invited Speaker  
1999 NIH, Joint NIH – NASA workshop: Invited Speaker  
1998 Medical College of Virginia, Department of Anatomy: Invited Speaker  
1997 Case Western Reserve University, Department of Anatomy: Invited Speaker.  
1997 Baylor University Dental School, Department of Anatomy: Invited Speaker.  
1996 Division of Biology and Marine Resources, Marine Biomedical Institute, UTMB-Galveston: Invited Speaker.  
1995 2nd International Conference on Cellular and Molecular Mechanisms of Regeneration and Functional Repair in the CNS, Osnabruk, Germany: Invited Speaker.  
1994 National Multiple Sclerosis Society Research and Treatment Update: Invited Speaker.  
1993 52nd Society for Developmental Biology Meetings: Invited Speaker.  
1993 2nd International Locus Coeruleus Symposium: Invited Speaker.  
1992 Winter Conference on Brain Research, Steamboat Springs, Colorado: Invited Speaker.  
1991 IBRO Meeting Satellite Symposium on Spinal Cord Development, Plasticity and Regeneration: Invited speaker.

### **INTERNATIONAL SERVICE**

- 2004-2007 Grant Reviewer for Canadian Space Agency  
2007 Grant Reviewer for Netherlands Organisation for Scientific Research

### **NATIONAL SERVICE**

- 2007-2010 FASEB Research Conferences Advisory Committee (AAA representative)  
2004-2008 New Jersey Academy of Science – NewsLetter Editor  
2004-2007 American Association of Anatomists Research Meetings Outreach Grant Committee  
2004-2008 Board of Reviewers, *The Anatomical Record*  
2001-2008 American Association of Anatomists, Experimental Biology Meeting Program Committee: Member  
2005-2007 Grant Reviewer for NASA Institute for Advanced Concepts.  
2006-2007 Manuscript reviewer for *Medical Education*  
2005 NIH/NCRR study section: Ad Hoc Member  
2005 American Society for Neurochemistry Annual Meeting workshop: “Zebrafish as a Model for Development and Disease.” Workshop organizer  
2004 Manuscript reviewer for *Developmental Dynamics*  
2004 Manuscript reviewer for *Advances in Space Research*  
2004 FASEB Symposium: “Gravitational force and gene expression.” Symposium Organizer  
2004 American Society for Neurochemistry annual meeting, Local Host Committee  
2003-2005 NASA Developmental Biology Study Section  
2003 NASA Fundamental Space Biology Roadmap Workshop - Planning Committee  
2003 Zebrafish Mini-Meeting sponsored by the American Association of Anatomists as part of FASEB (EB-2003): Meeting Coordinator  
2002-2003 American Association of Anatomists, Nominating Committee: Member  
2002 FASEB Symposium: “Imaging techniques in live embryos.” Symposium organizer  
2001 Manuscript reviewer for *Journal of Experimental Biology*  
2001 Grant Reviewer for U. S. Civilian Research and Development Foundation for the independent States of the former Soviet Union  
2001 Manuscript Reviewer for *Genesis: The Journal of Genetics and Development*  
2001 Zebrafish Mini-Meeting sponsored by the American Association of Anatomists as part of FASEB (EB-2001): Meeting Coordinator  
2001 Grant Reviewer for NASA 2000 NASA Astrobiology Study Section: Sub-panel Chair.  
2000 FASEB Symposium: “Development of the sensory systems in zebrafish.” Symposium organizer  
2000 Manuscript Reviewer for *Transgenic Research*  
2000 Manuscript Reviewer for *Journal of Neurobiology*  
1999-2000 NASA ad hoc Peer Review Group: Chair  
1999-2003 Zebrafish Anatomical Dictionary Work-group: Co-Coordinator of atlas of anatomy of adult zebrafish.  
1999 Joint NIH – NASA workshop: “Role of transgenic and knockout studies in understanding sensory-motor performance in altered gravitational environments.”  
1999 NASA workshop: “Microgravity’s effects on biological systems and behavior: an integrative approach.  
1998-2005 Grant Reviewer for NSF

**UNIVERSITY SERVICE:**

Robert Wood Johnson Medical School

- 2007-2010 RWJMS Curriculum Committee
- 2007-2010 RWJMS Research Committee
- 2005-2008 Institutional Animal Care and Use Committee
- 2007 Physiology Interactive, Team-Learning Small-Group – Technology Coordinator
- 2004 K-12 Educational Programs Task Force
- 2002 Strategic Planning Committee

Case Western Reserve University

- 2001-2002 Provost's Taskforce on CWRU-Cleveland Municipal School District Collaboration: Advisor
- 2000-2002 Center for Science and Mathematics Education Advisory Board: Member
- 2000-2002 Search Committee for permanent Anatomy Chairman
- 2000-2002 Visual Sciences Training Program: Mentor
- 1999-2002 Biomedical Sciences Training Program: Mentor
- 1999-2002 Developmental Biology Training Program: Mentor
- 1999-2002 Anatomy Department Graduate Executive Committee

UNT-Health Science Center

- 1997-1998 University Task Force to review Medical Student Mentorship Program
- 1997-1998 Departmental Research Committee
- 1996-1999 Institutional Animal Care and Use Committee
- 1995-1998 Departmental Space Committee (chair)
- 1994-1998 University Curriculum Reform Subcommittee
- 1994-1998 University Library/Biomedical Communications Committee
- 1993-1998 Departmental Computer Committee (chair)
- 1996-1997 Departmental Academic Affairs Committee
- 1995-1997 Acting Academic Coordinator, PA Program
- 1994-1996 Department Academic Affairs Committee (ad hoc)
- 1994-1996 University Curriculum Committee
- 1993-1995 Departmental Graduate Affairs Committee
- 1993-1995 Departmental Seminar Committee

Colorado State University

- 1985-1986 Presidents Special University Review and Redirection, Academic Support Committee
- 1983-1985 University Committee on Budgets and Financial Planning

Cornell

- 1971-1974 University Sports Advisory Committee

**COMMUNITY SERVICE:**

- 2007 Siemens National High School Math, Science, and Technology Competition, Judge
- 2005-2008 North Jersey Regional Science Fair, Zoology Category Chair & ISEF panel
- 2004-2008 Hillsborough High School – guest lecturer
- 2005 Rutgers – Cook College Cooperative Education Program - Mentor
- 2002-2006 Franklin Township Soccer Club, Coach
- 2001 Catholic Diocese of Cleveland, Mini-Science Convention, Invited Speaker
- 2000-2002 JASON Project MC and presenter
- 1999-2000 9<sup>th</sup> grade Anatomy Instructor for Cleveland Learning Co-op.
- 1998-1999 Coordinator of Partnership Program with Dunbar 6th Grade School, FWISD
- 1997-1998 49<sup>th</sup> International Science and Engineering Fair, Zoology Category Co-Chair
- 1997-1998 State Employee Charitable Campaign Committee, departmental representative
- 1995-1997 Fort Worth Regional Science Fair, Judge
- 1994-1995 State Employee Charitable Campaign Committee, departmental representative
- 1989-1992 Scene Designer, University of Michigan Gilbert and Sullivan Society

COMMUNITY SERVICE (cont.)

1981-1982 Advisor to Montserrat Government, for Caribbean Festival of the Arts  
1974-1976 Technical Theatre Director, Cornell Savoyards

**POSTDOCTORAL FELLOWS:**

Naoko Shimada, Ph.D.; 2003-2006  
Ilona Gillette-Ferguson, Ph.D.; 2001-2002

**GRADUATE STUDENTS:**

Liang Han, Ph.D. Candidate, UMDNJ/RWJMS  
Jiaping Gu, Ph.D. Candidate, UMDNJ/RWJMS  
Zhexing Wen, Ph.D. Candidate, UMDNJ/RWJMS  
Jedd Hillegass, Ph.D. Rutgers University, 2008  
Suzanna Lesko, Ph.D., University of Utah, 2007  
Sarah Davies, M.S., CWRU 2002  
Hassan Shaibah, M.S., CWRU 2002  
Nicolle Conway, DO/Ph.D. UNT Health Science Center, 2001  
Martha E. Stokely, Ph.D., UNT Health Science Center, 2002

**MEDICAL STUDENT SUMMER RESEARCH PROGRAM:**

Alyson Feigenbaum, RWJMS  
Gbolabo Sokunbi, RWJMS  
David Gendelberg

**RUTGERS CO-OP STUDENTS:**

Megan Clayton

**UNDERGRAD SUMMER STUDENTS:**

Ardon Shorr, Oberlin College  
Chris Caravanos, Boston College  
Lauren Stutzbach, Bard College  
Caitlin Oksienik, Lehigh University  
Sophie Chen, Rutgers  
Meghal Desai, Rutgers  
Jesse Hoff, Rutgers  
Gabriel Wagner, CWRU  
Rajen U. Desai, Stanford  
Ellen Kardas, MIT  
Rodolfo Cordova, now a graduate student at UNT Health Science Center  
Joseph E. Anwah, Virginia Military Institute  
Seema Lakdawala, now a graduate student at MIT  
Thomas Collins, Virginia Military Institute

**HIGH SCHOOL STUDENTS:**

Students in North Side High School of Medical Professions Program, Ft. Worth, TX:

Rodolfo Cordova	Mary Cao	Sara Godoy
Joshua Slater	Anita Elizondo	
Charlotte Burress	Neil Desai	
Seema Lakdawala	Sarah Johnson	

**HIGH SCHOOL STUDENTS (cont.)**

Students at Beaumont Academy, Cleveland Heights, OH:  
Kelly Peppard Betty Elee

Home schooled students, Cleveland Learning Coop:  
Rebekah Danner Shafeeqa Ismael  
Robin Woods Kalanit Horwitz

Students at Franklin Township High School  
Steven Blanks

**JUNIOR FACULTY MENTORED:**

Neeraj Agarwal, Ph.D.  
Associate Professor  
Department of Anatomy and Cell Biology  
UNT Health Science Center at Fort Worth

Gjumrakch Aliev, M.D., Ph.D.  
Research Assistant Professor  
Department of Anatomy  
Case Western Reserve University

Sharon Coles (deceased)  
Assistant Professor  
Division of Biomedical Sciences  
University of South Dakota

Jay Hove, Ph.D.  
Assistant Professor  
Genomics Research Institute  
University of Cincinnati

**SABBATICAL TRAINEES:**

Robert Gould, Ph.D.  
NYS Institute for Basic Research in Developmental Disabilities  
1050 Forest Hill Rd.  
Staten Island, NY 10314

**COLLABORATORS:**

Dr. Roger P. Croll  
Professor and Graduate Coordinator  
Department of Physiology & Biophysics  
Dalhousie University  
5859 University Avenue  
Halifax, Nova Scotia

Bruce Riley, Ph.D.  
Assistant Professor  
Department of Biology  
Texas A&M University  
College Station, TX 77843-3258

Melitta Schachner  
Zentrum für Molekulare Neurobiologie  
Universitaet Hamburg  
Falkenried 94  
20251 Hamburg  
Germany

Keith Cheng, Ph.D.  
Associate Professor of Pathology  
The Jake Gittlen Cancer Res. Inst.  
Penn State College of Medicine  
500 University Drive, Room C7804  
Hershey, PA 17033

Jeffery Laskin, Ph.D.  
Professor  
Department of Toxicology  
RWJMS/UMDNJ

**PROFESSIONAL MEMBERSHIPS:**

American Association of Anatomists  
Society for Neuroscience  
American Society for Gravitational and Space Biology  
American Society for Neurochemistry  
American Association for Advancement of Science

**PUBLICATIONS:**

1. **Moorman, S.J.**, L.R. Whalen, and H.O. Nornes (1990): A neurotransmitter specific functional recovery mediated by fetal implants in the lesioned spinal cord of the rat. *Brain Res.* 508:194-198
2. **Moorman, S.J.** and R.I. Hume (1990): Growth cones of chick sympathetic preganglionic neurons *in vitro* interact with other neurons in a cell-specific manner. *J. Neurosci.* 10:3158-3163
3. **Moorman, S.J.** and L.R. Whalen (1991): Fetal implants in the lesioned spinal cord of the rat. *Methods in Neurosciences* 7:300-304
4. Nornes, H.O., **S.J. Moorman**, A.R. Mihajlov, B.E. Pulford and L.R. Whalen (1992): Intraspinal transplants of catecholamine containing cells and fetal spinal cord and iris tissues in the adult rat. *Advances in Neurology* 59:185-197
5. **Moorman, S.J.**, and L.R. Whalen (1993): A model system to determine the effects of specific neurotransmitters on segmental reflexes in the spinal cord of the rat. *J. Neurosci. Meth.* 46:73-81
6. **Moorman, S.J.**, and R.I. Hume (1993): Omega-conotoxin prevents myelin-evoked growth cone collapse in neonatal-rat brainstem neurons *in-vitro*. *J. Neurosci.* 13:4727-4736
7. **Moorman, S.J.** and R.I. Hume (1994): Contact with myelin *in-vitro* evokes a release of calcium from internal stores in neonatal rat oligodendrocytes. *GLIA* 10:202-210
8. **Moorman, S.J.** and R.I. Hume (1994): Locus Coeruleus Growth Cones and Spinal Cord Regeneration. *Brain Research Bulletin* 35:419-422
9. Gould, R.M., A.M. Fannon, and **S.J. Moorman** (1995): Neural cells from dogfish embryos express the same subtype-specific antigens as mammalian neural cells *in vivo* and *in vitro*. *GLIA* 15:401-418
10. **Moorman, S.J.** (1996): The inhibition of motility that results from contact between oligodendrocytes *in vitro* can be blocked by pertussis toxin. *GLIA* 16:257-265
11. **Moorman, S.J.** (1996): Does myelin limit regeneration and remyelination? in: *Molecular Signaling and Regulation in Glial Cells: A Key to Remyelination and Functional Repair*, G. Jeserich, H.H. Althaus, C. Richter-Landsberg, R. Heumann eds. Springer Verlag, Heidelberg. pp.243-254
12. Sims, J.A. and **S.J. Moorman** (1996): The role of the iliolumbar ligament in low back pain. *Medical Hypotheses* 46:511-515
13. **Moorman, S.J.** and R.M. Gould (1997): Differentiating oligodendrocytes inhibit neuronal growth cone motility in different ways. *J. Neurosci. Res.* 50:791-797
14. **Moorman, S.J.**, C. Burrell, R. Cordova, and J. Slater (1999) Stimulus dependence of the development of the zebrafish (*Danio rerio*) vestibular system. *J Neurobiology* 38:247-258
15. Riley, B. and **S.J. Moorman** (2000) Development of utricular otoliths, but not saccular otoliths, is necessary for vestibular function and survival in zebrafish. *J. Neurobiology* 43:329-337
16. **Moorman, S.J.** (2000) Anatomical nomenclature for zebrafish. *Zebrafish Science Monitor* 7(1)7-8 (electronic publication: [http://zfinfo.org/zf\\_info/monitor/vol7.1/vol7.1.pdf](http://zfinfo.org/zf_info/monitor/vol7.1/vol7.1.pdf))
17. **Moorman, S.J.** (2001) Development of the sensory systems in Zebrafish. *ILAR J* 42:292-298

18. **Moorman, S.J.**, R. Cordova, and S.A. Davies (2002) A Critical Period for functional development of the zebrafish (*Danio rerio*) vestibular system. *Developmental Dynamics* 223:285-291.
19. Gillette-Ferguson, I., D.G. Ferguson, K.D. Poss and **S.J. Moorman** (2003) Changes in gravitational force induce alterations in gene expression that can be monitored in the live, developing zebrafish heart. *Advances in Space Research* 32:1641-1646
20. Shimada, N., G. Sokunbi, and **S.J. Moorman** (2005) Changes in gravitational force affect gene expression in developing organ systems at different developmental times. *BMC Developmental Biology* 2005, 5:10.
21. Shimada, N. and **S.J. Moorman** (2006) Changes in gravitational force cause changes in gene expression in the lens of developing zebrafish. *Developmental Dynamics* 235:2686-2694
22. Sive, H., T. Mueller, M.F. Wullmann, J.Y. Kuwada, **S.J. Moorman** and M.A. Haendel, (2006) ZFIN Anatomy Working Group: Nervous System. Manually curated data
23. Kwak, S.J., S. Vemaraju, **S.J. Moorman**, D. Zeddies, A.N. Popper and B.B. Riley (2006) Zebrafish *pax5* specifically regulates development of the utricular macula and vestibular function. *Developmental Dynamics* 235:3026-3038
24. **Moorman, S.J.** (2006) Prof-in-a-Box: using internet-videoconferencing to assist students in the gross anatomy laboratory. *BMC Medical Education* 6:55
25. Chen, X., **S.J. Moorman**, K.N. Wallace, M. Pack, and M.A. Haendel, (2007) ZFIN Anatomy Working Group: Digestive System. Manually curated data.
26. **Moorman, S.J.**, N. Shimada, G. Sokunbi, and C. Pfirrmann (2007) Simulated–microgravity induced changes in gene expression in zebrafish embryos suggest that the primary cilium is involved in gravity transduction. *Gravitational and Space Biology* 20:79-86
27. **Moorman, S.J.** and A.Z. Shorr (2008) The primary cilium as a gravity sensor and a regulator of transcriptional noise. *Developmental Dynamics* 237:1955-1959
28. Shorr, A.Z and **S.J. Moorman** (2008) The Moon’s gravitational pull affects gene expression on Earth. *Development, manuscript submitted*
29. Lindsey, B.W., T.C. Dumbarton, **S.J. Moorman**, F.M. Smith and R.P. Croll (2008) Effects of Simulated Microgravity on Swimbladder Development in the Zebrafish (*Danio rerio*). Manuscript in preparation
30. **Moorman, S.J.**, N. Shimada, G Sokunbi, and R.S. Nowakowski (2008) Gravitational force stabilizes gene expression levels during development. Manuscript in preparation
31. **Moorman, S.J.**, C. Oliensik, S. Chen, and M.R. Clayton (2008) Changes in gravitational force affect Ets transcription factor *fli1* expression in developing blood vessels at different developmental times. Manuscript in preparation

### **ABSTRACTS:**

1. **Moorman, S.J.** and J.G. Fleagle (1980): The nasal fossa in extinct Strepsirhines. Abstract in *Proceedings of American Assoc. of Physical Anthropologists*.
2. **Moorman, S.J.**, L.R. Whalen, and H.O. Nornes (1987): Studies of hindlimb reflexes in the adult rat: A non-invasive test of the central excitatory state of the spinal cord. Abstract in *Proceedings of Society for Neurosciences*, vol 13.
3. **Moorman, S.J.**, L.R. Whalen, and H.O. Nornes (1988): Hindlimb reflexes affected by fetal brainstem tissue implanted in the spinal cord of the rat. Abstract in *Proceedings of Society for Neurosciences*, vol. 14.
4. **Moorman, S.J.** and R.I. Hume (1989): Time-lapse observation of neurite growth by

- sympathetic preganglionic neurons *in vitro*. Abstract in Proceedings of Society for Neurosciences, vol. 15.
5. **Moorman, S.J.** and R.I. Hume (1990): Cell-specific Growth cone behaviors suggestive of pathway and target recognition. Development and Plasticity of the Spinal Cord Conference, Ohio State University.
  6. **Moorman, S.J.** and R.I. Hume (1991): Three cell-specific growth cone behaviors suggestive of pathway and target recognition *in vitro*. Proceedings of I.B.R.O. Satellite Symposium on Spinal cord development, plasticity and regeneration.
  7. **Moorman, S.J.** and R.I. Hume (1991): An increase in internal free calcium concentration coincides with two different growth cone behaviors. Abstract in Proceedings of Society for Neurosciences, vol 17.
  8. **Moorman, S.J.**, and R.I. Hume (1992): Contact with myelin causes a release of calcium from internal stores in oligodendrocytes. Abstract in Proceedings of Society for Neurosciences, vol 18.
  9. Gould, R.M. and **S.J. Moorman** (1995): Culturing neural cells from dogfish embryos. Journal of Neurochemistry, vol 65 supplement 1
  10. **Moorman, S.J.** (1995): Pertussis toxin blocks the effects of contact between oligodendrocytes *in vitro*. Abstract in Proceedings of Society for Neurosciences, vol 21.
  11. Stokely, M.E. and **S.J. Moorman** (1996) Retina trophically supports oligodendrocytes from the optic nerve *in vitro*. Abstract in Proceedings of Society for Neurosciences, vol 22.
  12. **Moorman, S.J.** and R.M. Gould (1996) Maturing oligodendrocytes inhibit neuronal growth cone motility in different ways. Abstract in Proceedings of Society for Neurosciences, vol 22.
  13. **Moorman, S.J.**, C. Burrell, R. Cordova , and J. Slater (1997) Development of the zebrafish vestibular system depends on normal gravity. Abstract in Proceedings of Society for Neurosciences, vol 23.
  14. Agarwal, N., R. Krishnamoorthy, N. Desai and **S.J. Moorman** (1998) Changes in gravitational force induce changes in gene expression in the zebrafish vestibular system. Cold Spring Harbor Zebrafish Development & Genetics Symposium
  15. **Moorman, S.J.**, C. Burrell, R. Cordova , and J. Slater (1998) Development of the zebrafish vestibular system depends on normal gravity. Cold Spring Harbor Zebrafish Development & Genetics Symposium
  16. **Moorman, S.J.**, R. Krishnamoorthy, N. Desai. S. Lakdawala, and N. Agarwal (1999) Changes in gravitational force induce changes in gene expression in the developing zebrafish vestibular system. Abstract in Proceedings of Society for Neurosciences, vol 25.
  17. Cheng, K.C., **S.J. Moorman**, F.J. Verbeek, L.G. Beckwith, and J.L. Moore (2000) Development of a reference atlas of anatomy and histology for the adult zebrafish (*Danio rerio*). Cold Spring Harbor Zebrafish Development & Genetics Symposium, Special Genomics Session
  18. **Moorman, S.J.**, R. Cordova, and S.A. Davies (2000) A critical period for vestibular development in zebrafish (*danio rerio*). Gravitational and Space Biology Bulletin 14:22
  19. Gillette-Ferguson, I., D.G. Ferguson, and **S.J. Moorman** (2001) Microgravity induced changes of gene expression in the developing zebrafish heart. Gravitational and Space Biology Bulletin 15:
  20. Lesko, S.E. and **S.J. Moorman** (2002) Diencephalic neurons transiently project to the inner ear in the developing zebrafish. 5<sup>th</sup> International Zebrafish Development and Genetics Meeting

21. **Moorman, S.J.** (2003) Simulated-microgravity causes changes in heat shock protein expression in zebrafish embryos. *Gravitational and Space Biology Bulletin* 17:57
22. **Moorman, S.J.**, J.K. Hoff, and G. Sokunbi (2004) Changes in gravitational force induce changes in gene expression in the developing zebrafish heart. *FASEB J*
23. Kwak, S., **Moorman, S.J.** and Riley, B. (2004) Pax5 regulates neuroblasts production in the inner ear and is specifically required for vestibular function. 6<sup>th</sup> International Zebrafish Development and Genetics Meeting, p 109
24. Cheng, K.C. and **Moorman, S.J.** (2004) A lifespan virtual atlas of the zebrafish as a starting point for systems morphogenetics. 6<sup>th</sup> International Zebrafish Development and Genetics Meeting, p 178
25. Shimada, N. and **Moorman, S.J.** (2005) Effects of microgravity on *hsp-70* gene expression in developing lens. *FASEB J.* 491.4
26. Wentz, C.A., Chen, T., Cheng, A.M., Mest, J., Sabaliauskas, N., Sidor, A., Zhao, W., Canfield, V., **Moorman, S.J.**, and Cheng, K.C. (2005) A virtual life-span atlas of the zebrafish: A platform for cross-phylogenetic integration. *FASEB J* 491.9
27. Shimada N. and **Moorman S. J.** (2005) Effects of altered-gravity on *hsp70* gene expression in developing lens. *Gravitational and Space Biology Bulletin* 18
28. **Moorman, S.J.**, Clayton, M.R., Oksienik, C., Chen S. (2005) Changes in gravitational force affect gene expression in developing blood vessels. *Gravitational and Space Biology Bulletin* 18
29. **Moorman, S.J.** (2006) Prof-in-a-Box: using internet-videoconferencing to assist students in the gross anatomy lab. *FASEB J* 492
30. Copper, J., Canada, B., Foutz, C., Gershenson, J., Mest, J., Sabaliauskas, N., Sidor, A., Zhao, W., Canfield, V, **Moorman, S.J.**, Cheng, K.C. (2006) A Virtual Life-Span Atlas of the Zebrafish: A Catalyst for Systems Morphogenetic Integration. 7<sup>th</sup> International Zebrafish Development and Genetics Meeting, p 311
31. **Moorman, S.J.** and N. Shimada (2006) Simulated–microgravity induced changes in gene expression in zebrafish embryos suggest that the primary cilium is involved in gravity transduction. *Gravitational and Space Biology Bulletin* 20:43
32. **Moorman, S.J.** (2007) Informatics approach to student assessment. *FASEB J* 319.1
33. Shorr, A.Z and **S.J. Moorman** (2008) The primary cilium is a gravity sensor. *FASEB J*
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## **RESEARCH INTERESTS:**

### *Fundamental Biology*

A cell's ability to tightly regulate gene expression levels is a key component of cell fate specification during development, especially in the context of morphogen concentration gradients. Developmentally, if there is a change in the cell's ability to tightly regulate gene expression levels there might be a change in either the number of cells specified or in the spatial restriction of cells specified by a specific morphogen concentration. In the adult, cells need to continue to tightly regulate their gene expression levels to maintain the phenotypic integrity of different cell and tissue types. If mature cells lose the ability to tightly regulate their gene expression levels, as expression levels become more variable the probability of a cell becoming metastatic would increase. We propose that the primary cilium is actively involved in stabilizing gene expression levels during development and in adults.

The primary cilium is a phylogenetically old, recently rediscovered, nearly ubiquitous, cell organelle that serves specific sensory functions on specific cell types. The primary cilium plays a key role in a number of well-studied molecular pathways, including WNT and Hh pathways, and primary cilium defects are known to play central roles in the etiology of a growing number of diseases. Despite the near ubiquitous nature of the primary cilium, no single function shared by all cells has been identified for the primary cilium. We have already shown that the primary cilium transduces the cyclic nature of the Earth's gravitational field due to the Sun and Moon into cyclic changes in the stochastic nature of gene expression in Rohon-Beard neurons in the developing zebrafish spinal cord. Regulating the stochastic nature of gene expression is a potential ubiquitous function of the primary cilium. This is the focus of my current research.

### *Anatomical Genomics*

The characterization of mutations affecting organs and tissues and the study of tumors and malformations of zebrafish will require a uniform nomenclature for the adult zebrafish. As an outcome of a recent NIH meeting about the generation of an anatomical dictionary for the zebrafish, we established a collaboration with investigators at Penn State to generate high quality digital images for print, and web and DVD-based atlases of anatomy of the adult zebrafish. In addition, we have begun work on methods to create a digital multidimensional atlas of gene expression patterns during zebrafish development that can be used for teaching embryology/development and for molecular biology research. One of the most difficult concepts for a student to understand in vertebrate development is how specific structures change shape over time. In the field of molecular biology a similar problem is encountered in trying to visualize gene expression patterns and how these patterns change over time during development. This visualization of gene expression patterns is one aspect of functional genomics. This aspect of functional genomics is gaining prominence because the value of gene expression data will be derived from understanding not only the spatial and temporal expression patterns of individual genes, but also how these patterns relate to the spatial and temporal expression patterns of other genes. The long-range goal for this project is to use state-of-the-art computer technology to produce a 4D-embryo, a database of digital 3D images of specific anatomical systems changing over time during development.

## **MEDICAL EDUCATION RESEARCH**

### *Technology:*

We have a problem in gross anatomy: Within the next decade, there will be a critical national shortage of PhD-level faculty trained to teach gross anatomy- the way we teach will have to change. Effective use of educational theory and distance-learning technologies to provide lectures (delivered by geographically dispersed faculty) to students at numerous schools is one way to continue to provide medical students with instruction in gross anatomy when this shortage becomes reality. However, the optimal learning environment for gross anatomy is the dissection laboratory where students learn to recognize anatomical structures and their relationships *in situ*. To date, no one has demonstrated that it is possible to use distance-learning technologies to provide instruction in a dissection laboratory setting. Historically, this laboratory dissection experience has been supervised and guided by trained faculty in a setting with a significantly lower faculty-student ratio (1:20 at the home school) than that for the lectures (1:170 at the same school). In the dissection lab, the faculty serve as a resource to (1) answer questions, (2) help students identify structures, and (3) perform aspects of the dissections for the students when warranted. When the faculty shortage materializes, the quality of the laboratory experience will suffer as the faculty-student ratio in the dissection lab shifts toward that of the lecture.

I have developed a Prof-in-a-Box system with three components: (1) a secure server to ‘host’ a videoconference; (2) a trained anatomist in his/her office with a computer and video camera; (3) a computer with two video cameras adjacent to a cadaver in the dissection lab. This system uses iChat-AV software to allow the anatomist to see the students and the dissection via the cameras in the lab. The camera in the faculty office allows the students to see the faculty member, providing a more personal aspect to the interaction. The software allows the students and the faculty member to interact via live audio and video providing an environment where questions can be asked and answered and anatomical structures can be identified ‘at a distance’. At least two of the three functions (1 & 2) of a faculty member in the dissection lab can be performed ‘at a distance’ using the Prof-in-a-box system. Using the Prof-in-a-Box, the number of faculty needed “on-site” can be reduced to the number needed to perform the third function in the dissection lab. This could result in a geographically dispersed faculty able to provide both the lecture and laboratory experience for the students at numerous medical schools.

### *Assessment:*

In American medical schools the predominant mode of assessment in the preclinical curriculum is through multiple-choice exams. Each student receives a grade on an exam and some indications of which specific questions were answered correctly and which were answered incorrectly. Using gross anatomy as a beta-test course, we are creating an assessment software package that provides feedback with respect to specific strengths and weaknesses by topic, organ system, region of the body, etc. This assessment tool makes use of an anatomy ontology database created for the genomics community for annotating genomic data. This database contains all of the hierarchical relationships between structures that are necessary to construct genomic network inter-relationships. By mapping anatomical terms from exams back to the ontology, a numerical score can be created that represents the frequency of shared nodes in the ontology. These frequencies are direct indications of strengths and weaknesses based on performance on the exam. In addition to providing student feedback, the same ontological approach can be used to analyze the exam itself to provide faculty feedback about the distribution of topics actually being tested. Using this ontological assessment strategy, students can be given the feedback necessary to address their weaknesses in anatomical knowledge in order to improve performance on future exams. In principle, this strategy can be applied to any discipline once discipline-specific ontologies are created. In fact, many of these ontologies have already been created as part of the Unified Medical Language System at the National Library of Medicine.

**TEACHING EXPERIENCE**

Undergraduate Allied Health Gross Anatomy S.U.N.Y. Stony Brook	Teaching Assistant	1978
Medical Gross Anatomy S.U.N.Y. Stony Brook	Teaching Assistant	1979 - 1980
Medical Gross Anatomy Amer. Univ. of Carib.	Instructor	1981 - 1982
Medical Embryology Amer. Univ. of Carib.	Instructor	1981 - 1982
Undergraduate Allied Health Human Anatomy C.S.U.	Teaching Assistant	1983 - 1984 & 1987
Undergraduate Domestic Animal Anatomy/Physiology C.S.U.	Teaching Assistant	1985 & 1987
Undergraduate Anatomy/Physiology Front Range Community College	Instructor	1987 - 1988
Introduction to Toxicology The University of Michigan	Instructor	1993
Medical Gross Anatomy UNT Health Science Center at Fort Worth	Lecturer	1993 - 1998
Medical Embryology UNT Health Science Center at Fort Worth (Merged with Medical Gross in 1997)	Lecturer	1993 - 1996
Cell and Molecular Biology I UNT Health Science Center at Fort Worth	Lecturer	1994 - 1998
Survival Skills and Ethics for Emerging Scientists UNT Health Science Center at Fort Worth	Lecturer	1996 - 1998
Physician Assistant Anatomy UNT Health Science Center at Fort Worth	Course Director Lecturer	1997 1997 - 1998
Human Embryology Case Western Reserve University	Course Director	1999 - 2002
Scientific Presentations Case Western Reserve University	Course Director	1999 - 2002
Medical Curriculum Case Western Reserve University	Embryology Lecturer	1999 - 2002
Surgical Anatomy Case Western Reserve University	Embryology Lecturer	1999 - 2002
Life and Living in Space Marine Biological Laboratory at Woods Hole	Lecturer	2003
Research training for Astronaut/Scientists Marine Biological Laboratory at Woods Hole	Co-Course Director	2004
Gross and Developmental Anatomy Robert Wood Johnson Medical School	Lecturer WebCT designer	2002 - present 2007 - 2008