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Education

Anatomy Masters Surgical Anatomy Cadaver Workshop, Larkin Health Sciences Institute, 2014
Postdoctoral Fellow, Neuroscience, University of Pennsylvania, 2006-2010
Ph.D., Neuroscience, Tulane University, 2006
B.A., Psychology, University of Maryland Baltimore County, 1997

Faculty Positions Held

2016 – present Assistant Professor
College of Psychology, Department of Psychology and Neuroscience,
Nova Southeastern University, Ft. Lauderdale, FL.

2010 – 2016 Assistant Professor
Halmos College of Natural Sciences and Oceanography, Department of
Biology, Nova Southeastern University, Ft. Lauderdale, FL.

Research Experience

08/10-present Assistant Professor: Nova Southeastern University.
Research: (1) Neurogenesis in adult fish brain as an early indicator of pollution-induced neurotoxicity, (2) The effects of selective agonism of angiotensin II AT1 and AT2 receptors on neuronal differentiation and proliferation in human derived neural stem cells, and (3) Examining re-purposed FDA-approved drugs in an *in vitro* model of Alzheimer's disease.

05/08-07/10 Postdoctoral Fellow: Department of Neuroscience.
University of Pennsylvania. Advisor: Dr. Matthew B. Dalva.
Research: Investigated the role of the tyrosine kinase receptor, EphB2, on proliferation and migration in endogenous neural progenitor cells.

04/06-04/08 Postdoctoral Fellow: Department of Neuroscience.
University of Pennsylvania. Advisor: Dr. Philip G. Haydon.
Research: Investigated the role of IP₃ signaling on the proliferation and differentiation of neural progenitor cells *in vitro* and *in vivo*.

08/00-04/06 Graduate Student: Neuroscience Program, Center for Gene Therapy.
Tulane University. Advisor: Dr. Darwin J. Prockop.
Research: (1) Examined neurotrophic factor secretion from mesenchymal stem cells *in vitro* and following implantation into the hippocampus of mice, (2)

Examined the interaction between implanted mesenchymal stem cells and endogenous neural stem cells in the hippocampus of mice, and (3) Isolated and characterized a novel p75NTR expressing stem cell *in vitro* and following implantation into the hippocampus of mice. (4) Examined erythropoietin expression during hypoxia in hippocampal slices.

08/98-06/00 Graduate Student: Department of Psychology.
Florida Atlantic University. Advisor: Dr. David L. Wolgin.
Research: Examined the role of instrumental learning in tolerance to cathinone hypophagia.

03/97-08/98 Research Assistant: Gerontology Research Center, Lab of Cellular and Molecular Biology, Molecular Physiology and Genetics Section.
N.I.A., N.I.H. Advisor: Dr. Donald K. Ingram.
Research: (1) Examined dopamine-induced DNA damage and apoptosis on striatal neurons, (2) Examined the involvement of dopamine D2 receptor in complex maze learning and acetylcholine release in ventral hippocampus, and (3) Examined age related sensitivity to increased brain and plasma TNF-alpha levels.

Teaching Experience

08/10-present Assistant Professor: Nova Southeastern University.
Introduction to Behavioral Neuroscience/Lab (NEUR 2500)
Neuroanatomy (NEUR 2600)
Methods in Behavioral Neuroscience/Lab (NEUR 2700)
Developmental Neuroscience (NEUR 3100)
Neurobiology of Disease (NEUR 4100)
Neurobiology (BIOL 4200)
Anatomy and Physiology I/Lab (BIOL 3320)
Anatomy and Physiology II/Lab (BIOL 3330)
Cell and Molecular Biology (BIOL 4340)
Directed Independent Study (BIOL 4990 and NEUR 4990)

01/09-04/09 Visiting Scholar: Department of Biology, Lincoln University.
Molecular Basis of Human Disease (Bio 495). Course Description: The course was designed to (1) highlight the impact of basic science on medicine, and (2) introduce students to several biomedical disciplines as they relate to the origin, pathology, and treatment of human disease.

09/08-05/09 Visiting Scholar: Department of Biology, Rutgers-Camden, The State University of New Jersey.
(1) General Biology (BIO 101). Course Description: The course was designed to introduce students to biological topics in: The cell, animal diversity, and animal form and function.
(2) Molecular Basis of Human Disease (BIO 496/596). Course Description: The course was designed to (1) highlight the impact of basic science on medicine,

and (2) introduce students to several biomedical disciplines as they relate to the origin, pathology, and treatment of human disease.

- 01/08-04/08 Visiting Assistant Professor: Department of Biology, Haverford College. Laboratory in Biochemistry and Molecular Biology (BIOLH300/CHEMH300). Course Description: The course introduced students to the application of modern experimental approaches in the study of biological questions. Detailed instruction was accomplished through the use of various techniques to address student-derived hypotheses based on the co-culturing of astrocytes with neural progenitor cells, such as cell culture, RNA and protein isolation, RT-PCR, Western blot, cell labeling, immunofluorescence, and ELISA.
- 02/07-05/08 Scientist: iPRAXIS (NSF funded organization to foster and develop interest in science. Developed curricula, trained students and scientists, and mentored middle and high school students).
- 09/07-12/07 Course Instructor: Department of Neuroscience. University of Pennsylvania. Neuroscience in Practice (INSC 572). Imaging section. Detailed instruction in confocal microscopy was accomplished through the use of specimens, microscopy, and audio/visual aids.
- 01/01-05/01 Graduate Student: Neuroscience Program. Advanced Neuroanatomy (ANAT 719). Course Description: The course was designed to teach students anatomical structures as applied to function and the deficits resulting from neurological disorders. Detailed instruction in human and rodent neuroanatomy was accomplished through the use of specimens, microscopy, and audio/visual aids.
- 08/98-12/98 Teaching Assistant: Department of Psychology. Research Methods in Psychology (PSY 3213). Course Description: The course was designed to teach students the basic principles of scientific psychology and how to write research papers according to the current guidelines of the American Psychological Association.

Grants and Fellowships

- Department of Education Subcontract 05/2017-05/2000
\$40,000, P031c160143 (P.I. Belmont: NSU P.I. Tartar)
STEM EngInE (Educate, Intern and Employ) Research mentor.
- N.S.U.'s President's Faculty and Research Development Grant 07/01/17-06/30/18
\$10,000.
PFRDG: The goal of this proposal is to examine the effects of angiotensin II and dopamine 4 receptor interaction in neurons from ADHD rats.

N.S.U.'s President's Faculty and Research Development Grant \$10,000. PFRDG: The goal of this proposal is to examine how redox-based epigenetic changes contribute to defining neuronal stem cell fate	07/01/17-06/30/18
President's ExEL Fund \$2,547.00 Genetic Investigations for Undergraduate Studies	07/01/17-06/30/18
Department of Defense Equipment Grant \$489,902., W911NF-14-1-0070 (Contributor, PI: Dr. Robert Smith) The goal this proposal was to acquire equipment to be used to advance research, teaching, and outreach.	2014-2015
N.S.U.'s President's Faculty and Research Development Grant \$10,000. PFRDG: The goal of this proposal is to examine the effects of selective agonism of angiotensin II AT1 and AT2 receptors on neuronal differentiation and proliferation in human derived neural stem cells.	07/01/14-06/30/15
Farquhar College of Arts and Sciences Dean's Mini-Grant \$1,500. Dean's Mini-Grant: The goal of this proposal is to examine the effects of learning and memory and neurogenesis in the common octopus (<i>Octopus Vulgaris</i>). Several strategies are being used to examine the proliferation, migration, integration, and cell death of neural stem/progenitor cells including EdU incorporation assays, immunofluorescence, TUNEL assays, Western blotting, and microscopy to examine concomitant changes in neurogenesis and learning and memory. Preliminary data demonstrate the first evidence of neurogenesis in the octopus.	10/10/13-10/09/14
N.S.U.'s President's Faculty and Research Development Grant \$10,000. PFRDG: The goal of this proposal was to examine factors that regulate neurogenesis in the adult Mayan Cichlid brain. Several strategies were used to examine the proliferation, migration, integration and cell death of neural stem/progenitor cells including EdU incorporation assays, immunofluorescence, TUNEL assays, Western blotting, and microscopy to identify the vascular niche and migratory routes of neural stem/progenitor cells. Preliminary data demonstrate neural progenitor cells migrate along blood vessels prior to undergoing maturation.	07/01/13-06/30/14
Beta Beta Beta Research Foundation Award \$750. Beta Beta Beta Biological Society Research Foundation Award: The goal of this proposal was to establish a model of neurogenesis using the adult Mayan Cichlid fish brain. Several strategies were used to examine the birth, migration, maturation, and cell death of new brain cells including EdU incorporation assays, immunofluorescence, and microscopy. Results demonstrated neurogenesis occurs in multiple brain regions. Ongoing studies are quantifying the cell-cycle kinetics and rates of migration, integration, cell-type specific maturation, and cell death across the various neurogenic regions.	10/20/12-10/20/13

Farquhar College of Arts and Sciences Dean's Mini-Grant
\$1,500.

10/10/12-10/09/13

Dean's Mini-Grant: The goal of this proposal was to examine neurogenesis in the adult Mayan Cichlid brain. Several strategies were used to examine the proliferation, migration, integration and cell death of neural stem/progenitor cells including EdU incorporation assays, immunofluorescence, TUNEL assays, Western blotting, and microscopy to identify the vascular niche and migratory routes of neural stem/progenitor cells. Preliminary data demonstrate multiple neurogenic nuclei in the adult brain.

Alavi-Dabiri Postdoctoral Fellowship Award
\$6,500.

07/01/09-06/30/10

Abass Alavi Endowed Postdoctoral Fellowship: The goal of this proposal was to test the hypothesis that disrupting EphB2/ephrin-B signaling alters migration of adult neural progenitor cells. Several strategies were used to examine the role of EphB2/ephrin-B signaling on the migration of neural progenitor cells including shRNA-mediated knockdown of EphB2, EphB2 knockout mice, Cre/lox-mediated knockout of ephrin-B1, and shRNA-mediated knockdown of ephrin-B2. Immunofluorescence, Western blotting, and BrdU incorporation assays were used to assess the effects of disrupted EphB2/ephrin-B expression *in vitro* and *in vivo*. Preliminary data demonstrate a role for EphB/ephrin-B interactions in the directed migration of progenitors and suggest that cell-to-cell interactions between progenitors and ensheathing astrocytes are critical for proper migration.

T-32 NIH/NINDS Postdoctoral Award

05/01/07-04/31/10

Training Program in Neurodevelopmental Disabilities: The goal of this proposal was to test the hypothesis that IP₃, a critical second messenger, regulates neural progenitor cell (NPC) proliferation, differentiation, and survival *in vitro* and *in vivo*, as well as following transplantation into the nervous system. Several strategies were used to examine IP₃-mediated regulation of NPC fate including membrane-permeant IP₃ analogs, pharmacological inhibition of the IP₃ receptor, and overexpression of IP₃ 5-phosphatase. Immunofluorescence, calcium imaging, and 2-photon *in vivo* imaging were used to assess functional changes *in vitro* and integration *in vivo* following transplantation into the central nervous system. Results demonstrated that (1) attenuation of IP₃ signaling inhibited cell proliferation without inducing cell death, (2) overexpression of IP₃ 5-phosphatase promoted differentiation of NPCs into astrocytes *in vitro* and *in vivo*, (3) NPCs functionally engrafted and expressed neural markers following implantation into the central nervous system of mice.

HMI Postdoctoral Teaching Fellowship

01/20/08-03/02/08

Haverford College Teaching Fellowship Award. The goal of this fellowship was to develop and implement a laboratory course in biochemistry and molecular biology using modern experimental approaches in the study of interesting biological questions. To advance the clinical utility of stem cells and our understanding of how immature transplanted cells would develop in the mature brain, I developed a module that focused on examining the ability of mouse post-natal cortical astrocytes to influence the development of cortical neural progenitor cells.

Louisiana Board of Regents Fellowship
Regents predoctoral scholarship.

08/00-06/04

Awards and Honors

Travel Award, American Junior Academy of Science and AAAS meeting, 2015.
Beta Beta Beta Biological Society Research Foundation Award, 2012.
Interviewed by *Science* magazine for being the first postdoctoral fellow to complete the N.I.H. IRACDA program at the University of Pennsylvania, 2012
Recognized as a Faculty Mentor at the Leadership Roundtable Scholars Reception, N.S.U., 2011.
Alavi-Dabiri Postdoctoral Fellowship Award, 2009
Selected for Building Future Faculty Program at North Carolina State University, 2009.
Penn-PORT Teaching and Research Fellowship, Univ. of Pennsylvania Institutional Research and Academic Career Development Award, 2008.
HHMI Postdoctoral Teaching Fellowship, Haverford College, 2008.
Training Program in Neurodevelopmental Disabilities Award, 2007.
Feature Article for Neuroscience, PNAS, 102(50), 18171-6.
Travel Award, International Society for Cellular Therapy, 2005.
Gene Therapy Research Award, 2005.
Louisiana Board of Regents Fellowship, 2000-2004.
Travel Award, American Society for Neural Transplantation and Repair, 2003.
Honorary Membership, American Society for Neural Transplantation and Repair, 2003.
Predoctoral N.I.H. Intramural Research Award, 1997-98.

Committee Service

Behavioral Neuroscience Major Internal Review Committee	2018
Behavioral Neuroscience Faculty Search Committee	2017
Behavioral Neuroscience Training Program Committee	2015-current
Human Anatomy and Physiology Society Southern Regional Conference Committee	2016
TEDxNSU Organizing Committee	2012-current
Biology Faculty Search Committee	2012-13, 2015
Biology Curriculum Committee	2010-2016
Brain Awareness Committee	2010-current

Other Scholarship

American STEM Institute, Technical Review Board Member	2018-current
Thesis committee member, Ritishka Kapoor	2018
Thesis committee member, Sarah Marie Lyle	2016
Developmental Disabilities workshop, Instructor: Dr. Tyler Reimschisel	2016
Narcolepsy workshop, Instructors: Dr. Julie Flygare and Jose Ray	2015
Physician to Patient Club	2018-current
Neuroscience Club Faculty Advisor	2018-current
Pre-Physician Assistant Faculty Advisor	2013-current
Delta Epsilon Mu, Inc. – Alpha Xi Chapter	2017-current
NSU Aim-High Summer Camp Instructor	2016-current
College of Psychology Behavioral Neuroscience Camp	2013, 2016-current
NSU Undergraduate Student Symposium Judge	2018
NSU Undergraduate Student Symposium Faculty Advisor	2012-2016

Beta Beta Beta Biological Society Research Foundation Faculty Advisor 2012-2015
Science Alive Volunteer 2011-16

Memberships

Human Anatomy and Physiology Society	2017-current
Psi Chi National Honor Society	1998-current
Society for Neuroscience	1999-current
Beta Beta Beta Biological Honors Society	2012-current
American Society for Neural Transplantation and Repair	2003-2010
Society for Developmental Biology	2008-2010

Skills and Techniques

Laboratory: Isolation and purification of mesenchymal stem cells, neural stem cells, astrocytes, and neurons, cell culture, calcium imaging, siRNA/shRNA transfection/transduction, EdU and BrdU incorporation assays, stereotaxic surgery, cannulation techniques (intracranial, intraoral), perfusions, cryostat and microtome sectioning, histology, confocal microscopy, 2-photon microscopy, RNA/DNA/Protein isolation, PCR, RT-PCR, real-time RT-PCR, Western blotting, ELISAs, and TUNEL assays.

Computer: Microsoft Word, Excel, Powerpoint, Adobe Photoshop, ImageJ and MetaMorph.

Languages: English and moderate Spanish (spoken fair, comprehension excellent).

Peer Reviewer

Frontiers in Neuroscience
Neurochemistry International

Presentations

- 6/17 "The history and promise of neuroscience." Human Anatomy and Physiology National Conference, Salt Lake City, Utah.
- 10/16 Keynote speaker: "The history and promise of neuroscience." Human Anatomy and Physiology Society Regional Meeting.
- 2/15 "Current topics in neural stem cell research." Miami Dade College STEMversations Series.
- 2/14 "The effects of selective agonism of angiotensin II AT1 and AT2 receptors on neuronal differentiation and proliferation in human derived neural stem cells." Florida International University.
- 10/13 "Neurogenesis in the adult brain of the Mayan Cichlid and Octopus Vulgaris," Chemistry Club Science Week, Nova Southeastern University, Ft. Lauderdale, FL.
- 6/12 Speaker/Panelist, 2012 National Institutional Research and Academic Career Development Award Conference, University of Pennsylvania.

- 5/12 "Neurogenesis in adult fish brain as an early indicator of pollution-induced neurotoxicity," Enterprise Development Corporation BioTech: 11th Annual Life Science Conference.
- 4/12 "Establishing a model of neurogenesis in the Mayan Cichlid," 11th Annual Undergraduate Student Symposium, Nova Southeastern University, Ft. Lauderdale, FL.
- 3/12 "Brains on my mind," TEDxNSU: The Inspiring Brain, Nova Southeastern University, Ft. Lauderdale, FL. <http://www.youtube.com/watch?v=8FXWuvZ49p4>
- 10/11 "Creating a Model of Neurogenesis in Fish as an Early Indicator of Neurotoxicity," Chemistry Club, Nova Southeastern University, Ft. Lauderdale, FL.
- 10/11 "Understanding the Admissions Process for Post-Baccalaureate Programs, Medical School, and Graduate School," MAPS Club, Nova Southeastern University, Ft. Lauderdale, FL.
- 9/11 "Understanding the Admissions Process for Post-Baccalaureate Programs, Medical School, and Graduate School," Neuroscience Club, Nova Southeastern University, Ft. Lauderdale, FL.
- 11/10 "The Effects of Sleep Deprivation on Learning and Memory," Neuroscience Club, Nova Southeastern University, Ft. Lauderdale, FL.
- 03/10 "Harnessing the Power of Stem Cells to Treat Diseases of the Brain," Brain Awareness Week Lecture Series, Nova Southeastern University, Ft. Lauderdale, FL.
- 07/09 "Disruption of EphB2/ephrin-B signaling alters migration of neural progenitor cells." Department of Biology, Haverford College, Haverford, PA.
- 04/08 "IP₃ signaling regulates the proliferation and differentiation of cortical neural progenitor cells." Department of Biology, Rutgers-Camden, Camden, NJ.
- 04/08 "Cortical astrocytes regulate the differentiation of cortical neural progenitor cells." Department of Biology, Rutgers-Camden, Camden, NJ.
- 02/08 "IP₃ signaling regulates the proliferation and differentiation of cortical neural progenitor cells." Department of Biology, Haverford College, Haverford, PA.

Poster Presentations

Jessica Garcia*, Weston He*, James R. Munoz. (2017). Examining the role of blood vessels in neural progenitor cell migration, Association of Southeastern Biologists Conference, Montgomery, Alabama.

(* denotes undergraduate student)

Jessica Garcia*, Weston He*, James R. Munoz. (2016). Examining the role of blood vessels in neural progenitor cell migration, STEM Research Symposium, MDC School of Science, Miami, FL.

(* denotes undergraduate student)

Leena Couling, Nadia Siddiqi*, James R. Munoz, and Robert C. Speth. (2016). Alterations in doublecortin expression in human neural stem cells in response to angiotensinergic stimulation in proliferation and differentiation conditions, Experimental Biology, April 2-6, San Diego.

(* denotes undergraduate student)

Nadia Siddiqi*, Leena Couling, James R. Munoz, and Robert C. Speth. (2016). Increased proliferation of human neural stem cells following selective agonism of angiotensin II AT1 receptor. Life Sciences South Florida STEM Undergraduate Research Symposium.

(* denotes undergraduate student)

Leena Couling, Nadia Siddiqi*, James R. Munoz, and Robert C. Speth. (2016). Alterations in doublecortin expression in human neural stem cells in response to angiotensinergic stimulation in proliferation and differentiation conditions, HPD Research Day.

(* denotes undergraduate student)

Brigitte Blanco*, Puja Patel*, Sujay Kamisetty*, Nadia Siddiqi*, Malav Trivedi, James R. Munoz, and Robert C. Speth. (2015). Stimulation of AT2 angiotensin II receptor subtype increases neural stem cell proliferation, Society for Neuroscience, October 17-21, Chicago.

(* denotes undergraduate student)

Brigitte Blanco*, Puja Patel*, Sujay Kamisetty*, Nadia Siddiqi*, Malav Trivedi, James R. Munoz, and Robert C. Speth. (2015). Neural stem cell proliferation, differentiation, and survival in response to AT1 and AT2 angiotensin II receptor-specific agonism, American Junior Academy of Science and AAAS meeting.

(* denotes undergraduate student)

Zara Khan* and James R. Munoz. (2015). Examining migration of neural stem cells in the adult Mayan Cichlid brain, FIU McNair Scholars Research Conference.

(* denotes undergraduate student)

Brigitte Blanco*, Puja Patel*, Sujay Kamisetty*, Nadia Siddiqi*, Malav Trivedi, James R. Munoz, and Robert C. Speth. (2015). Neural stem cell proliferation, differentiation, and survival in response to AT1 and AT2 angiotensin II receptor-specific agonism, SYNAPSE Meeting of the Palm Beach Chapter of Society for Neuroscience, Max Plank Institute.

(* denotes undergraduate student)

Zara Khan*, Ahmed Ali*, Jonathan P. Romanes*, Sameed Ashfaq*, and James R. Munoz. (2014). Examining migration of neural stem cells in the adult Mayan Cichlid brain, SYNAPSE Meeting of the Palm Beach Chapter of Society for Neuroscience, Florida Atlantic University. (* denotes undergraduate student)

Zara Khan*, Ahmed Ali*, Jonathan P. Romanes*, Sameed Ashfaq*, and James R. Munoz. (2014). Examining migration of neural stem cells in the adult Mayan Cichlid brain, Life Sciences South Florida STEM Undergraduate Research Symposium, Miami Dade College. (* denotes undergraduate student)

Ahmed Ali*, Sameed Ashfaq*, William Kotkin*, Kelsey E. Bragg*, and James R. Munoz. (2013). Neural stem cells proliferate in vascular niches in the adult Mayan Cichlid brain, Enterprise Development Corporation BioTech: 12th Annual Life Science Conference. (* denotes undergraduate student)

Publications (Peer-reviewed journals):

Zhou, W. *, **Munoz, J.R.*** (* = equally contributing authors), Rao, V., and Dalva, M.B. (2017). Control of neural stem cell migration through EphB and ephrin-B mediated motility and repulsion in the adult brain. In revision for resubmission to Neuron.

Halassa, M.M., Florian, C., Fellin, T., **Munoz, J.R.**, Abel, T., Frank, M.G., and Haydon, P.G. (2009). Astrocytic modulation of sleep homeostasis and cognitive consequences of sleep loss. Neuron, 61: 1-7.

Bakondi, B., Shimada, I.S., Perry, A., **Munoz, J.R.**, Ylostalo, J., Howard, A.B., Gregory, C.A., and Spees, J.L. (2009). CD133 identifies a human bone marrow stem/progenitor cell sub-population with a repertoire of secreted factors that protect against stroke. Molecular Therapy, 17(11): 1938-47.

Wolgin, D.L. and **Munoz, J.R.** (2006). Role of instrumental learning in tolerance to cathinone hypophagia. Behav. Neurosci., 120(2): 362-70.

Lee, R.H., Hsu, S.C., **Munoz, J.**, Jung, J.S., Lee, N.R., Pochampally, R., and Prockop, D.J. (2006). A subset of human rapidly self-renewing marrow stromal cells preferentially engraft in mice. Blood, 107(5): 2153-61.

Munoz, J.R., Stoutenger, B.R., Robinson, A.P., Spees, J.L., and Prockop, D.J. (2005). Human stem/progenitor cells from bone marrow promote neurogenesis of endogenous neural stem cells in the hippocampus of mice. Proc. Natl. Acad. Sci. U S A., 102(50): 18171-76.

Gregory, C.A., Gunn, W.G., Reyes, E., Smolarz, A.J., **Munoz, J.R.**, Spees, J.L., and Prockop, D.J. (2005). How Wnt signaling affects bone repair by mesenchymal stem cells from the bone marrow. Ann. N.Y. Acad. Sci., 1049: 1-10.

Umegaki, H., **Munoz, J.**, Meyer, R.C., Spangler, E.L., Yoshimura, J., Ikari, H., Iguchi, A.I., and Ingram, D.K. (2001). Involvement of dopamine D2 receptor in complex maze learning and acetylcholine release in ventral hippocampus of rats. Neuroscience, 103(1): 27-33.

Kalehua, A.N., Taub, D.D., Baskar, P.V., Hengemihle, J., **Munoz, J.**, Trambadia, M., Speer, D.L., DeSimoni, M.G., and Ingram, D.K. (2000). Aged mice exhibit greater mortality concomitant to increased brain and plasma TNF-alpha levels following intracerebroventricular injection of lipopolysaccharide. *Gerontology*, 46(3): 115-28.

Luo, Y., Hattori, A., **Munoz, J.**, Qin, Z.H., and Roth, G.S. (1999). Intrastriatal dopamine injection induces apoptosis through oxidation-involved activation of transcription factors AP-1 and NF-kappaB in rats. *Mol. Pharmacol.*, 56(2): 254-64.

Hattori, A., Luo, Y., Umegaki, H., **Munoz, J.**, and Roth, G.S. (1998). Intrastriatal injection of dopamine results in DNA damage and apoptosis in rats. *Neuroreport*, 9(11): 2569-72.

Research References

Darwin J. Prockop, MD., Ph.D., Former Director, Center for Gene Therapy, Tulane University Health Sciences Center, Current Director, Institute of Regenerative Medicine, Texas A&M Health Sciences Center College of Medicine, 5701 Airport Road, Module C, Temple, TX 76502
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Teaching References

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