

## BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2. Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME Sean J. Morrison		POSITION TITLE Director of Children's Research Institute; Professor of Pediatrics; HHMI Investigator	
eRA COMMONS USER NAME Gandym			
EDUCATION/TRAINING <i>(Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.)</i>			
INSTITUTION AND LOCATION	DEGREE <i>(if applicable)</i>	YEAR(s)	FIELD OF STUDY
Dalhousie University, Halifax, Canada	BSc	1986-1991	Biology and Chemistry
Stanford University, Palo Alto, CA	Ph.D.	1991-1996	Immunology
California Institute of Technology, Pasadena, CA	Fellow	1996-1999	Neurobiology

### **A. Research and Professional Experience**

1986 - 1990	President and Director of Endogro Systems Inc.
1991 - 1996	Graduate student in the laboratory of Dr. Irving L. Weissman, Stanford University
1996 - 1999	Postdoctoral scholar in the lab of Dr. David J. Anderson, Caltech
1999 - 2004	Assistant Professor, Department of Internal Medicine, University of Michigan
2000 - present	Investigator, Howard Hughes Medical Institute
2004 - 2008	Associate Professor, Department of Internal Medicine, University of Michigan
2005 - 2011	Director, University of Michigan Center for Stem Cell Biology
2005 - 2011	Henry Sewall Professor of Medicine, University of Michigan
2008 - 2011	Professor, Department of Internal Medicine, University of Michigan
2008 - 2011	Research Professor, Life Sciences Institute, University of Michigan
2011 - present	Director, Children's Research Institute, University of Texas Southwestern Medical Center
2011 - present	Professor, Children's Research Institute, UT Southwestern Medical Center
2011 - present	Mary McDermott Cook Chair in Pediatric Genetics, Department of Pediatrics, UTSW
2016 - present	Kathryne and Gene Bishop Distinguished Chair in Pediatric Research

### **Honors and Awards**

1986	Young Canadians Award for Excellence in Science
1991	Dalhousie University Medal in Biology
1991	Natural Sciences and Engineering Research Council 1967 Scholarship (declined)
1991-1996	Howard Hughes Institute Predoctoral Fellowship in Biological Sciences
1996-1998	Natural Sciences and Engineering Research Council Postdoctoral Fellowship
1997-1998	American Cancer Society, California Division Junior Postdoctoral Fellowship
1999	American Cancer Society, California Division Senior Postdoctoral Fellowship
2000-2003	Searle Scholar
2002	Named to TR100 list: MIT Technology Review Magazine's list of 100 young innovators
2003	Wired Magazine Rave Award for Science
2003	Presidential Early Career Award for Scientists & Engineers, White House
2004	Dean's Award for Basic Science, University of Michigan Medical School
2006	Detroit News Michiganian of the Year
2007	Pfizer Young Michigan Biomedical Investigator of the Year Award
2007	McCulloch and Till Award, International Society for Hematology & Stem Cells
2008	American Association of Anatomists Harland Winfield Mossman Award
2009	MERIT Award, National Institute on Aging, National Institutes of Health
2012	Roy M. Huffington Distinguished Lecture, Baylor College of Medicine
2015	President, International Society for Stem Cell Research
2016	Keynote Address, Keystone Symposium on Stem Cells and Cancer

## **Editorial Boards**

2003- 2009	Stem Cells
2006–2015	Faculty of 1000, Section Head “Stem cells & Regeneration”
2006–present	Cell Stem Cell
2010–present	Journal of Experimental Medicine
2011–present	EMBO Journal
2011–present	Current Opinion in Cell Biology
2012–present	Cancer Cell
2012–present	eLife (Senior Editor)
2012–present	EMBO Reports
2012–present	Stem Cell Reports
2014-present	Cancer Discovery

## **B. Selected Peer-Reviewed Publications (Partial Listing – 61 of 108 peer-reviewed publications):**

1. Morrison, S.J., and I.L. Weissman. 1994 The long term repopulating subset of hematopoietic stem cells is deterministic and isolatable by phenotype. **Immunity** 1:661-673.
2. Morrison, S.J., H.D. Hemmati, A.M. Wandycz, and I.L. Weissman. 1995. The purification and characterization of fetal liver hematopoietic stem cells. **Proc. Natl. Acad. Sci. USA** 92:10302-10306. PMC40784
3. Morrison, S.J., A.M. Wandycz, K. Akashi, A. Globerson, and I.L. Weissman. 1996. The aging of hematopoietic stem cells. **Nature Medicine** 2:1011-1016.
4. Morrison, S.J., N.M. Shah, and D.J. Anderson. 1997. Regulatory mechanisms in stem cell biology. **Cell** 88:287-298.
5. Morrison, S.J., P.M. White, C. Zock, and D.J. Anderson. 1999. Prospective identification, isolation by flow cytometry and in vivo self-renewal of multipotent mammalian neural stem cells. **Cell** 96:737-749.
6. Morrison, S.J., S.E. Perez, J.M. Verdi, C. Hicks, G. Weinmaster, D.J. Anderson. 2000. Notch activation instructs rapid glial differentiation by multipotent neural crest stem cells. **Cell** 101:499-510
7. Reya, T.,\* Morrison, S.J.,\* Clarke, M.F. and Weissman, I.L. 2001. Stem cells, cancer, and cancer stem cells. **Nature** 414:105-111. \* These two authors contributed equally
8. Bixby, S., G.M.. Kruger, J.T. Mosher, N. Joseph, and S.J. Morrison. 2002. Cell-intrinsic differences between neural stem cells from different regions of the peripheral nervous system regulate the generation of neural diversity. **Neuron** 35:643-656.
9. Kruger, G.M., J. Mosher, S. Bixby, N. Joseph, T. Iwashita, and S.J. Morrison. 2002. Neural crest stem cells persist in the adult gut but undergo perinatal changes in self-renewal potential, neuronal subtype potential, and responsiveness to lineage determination factors. **Neuron** 35:657-669. PMC2728576
10. Al-Hajj, M., M.S. Wicha, A. Benito-Hernandez, S.J. Morrison, and M.F. Clarke. 2003. Prospective identification of tumorigenic breast cancer cells. **Proc. Natl. Acad. Sci. USA** 100:3983-3988. PMC153034
11. Park, I-K, Q. Dalong, M. Kiel, M.W. Becker, M. Pihalja, I.L. Weissman, S.J. Morrison, and M.F. Clarke. 2003. Bmi-1 is required for maintenance of adult self-renewing haematopoietic stem cells. **Nature** 423:302-305.
12. Iwashita, T., G.M. Kruger, R. Pardal, M.J. Kiel, and S.J. Morrison. 2003. Hirschsprung disease is linked to defects in neural crest stem cell function. **Science** 301:972-976. PMC2614078
13. Molofsky, A.V., R. Pardal, T. Iwashita, I-K. Park, M.F. Clarke, and S.J. Morrison. 2003. *Bmi-1* dependence distinguishes stem cell self-renewal from restricted progenitor proliferation. **Nature** 425:962-967. PMC2614897
14. Alvarez-Dolado, M., R. Pardal, J.M. Garcia-Verdugo, J.R. Fike, H.O. Lee, K. Pfeffer, C. Lois, S.J. Morrison and A. Alvarez-Buylla. 2003. Fusion of bone-marrow-derived cells with Purkinje neurons, cardiomyocytes and hepatocytes. **Nature** 425:968-973.
15. Pardal, R., M.F. Clarke, and S.J. Morrison. 2003. Applying the principles of stem cell biology to cancer. **Nature Reviews Cancer** 3:895-902.
16. Kruger G.M., Mosher, J.T., Y.H. Tsai, K.J. Yeater, T. Iwashita, C. E. Gariepy and S.J. Morrison. 2003. Temporally distinct requirements for endothelin receptor B in the generation and migration of gut neural

crest stem cells. **Neuron** 40:917-929.

17. Molofsky, A.V., S. He, M. Bydon, S.J. Morrison, and R. Pardal. 2005. Bmi-1 promotes neural stem cell self-renewal and neural development but not mouse growth and survival by repressing the p16<sup>Ink4a</sup> and p19<sup>Arf</sup> senescence pathways. **Genes & Development** 19:1432-1437. PMC1151659
18. Kiel, M.J., O.H. Yilmaz, T. Iwashita, O.H. Yilmaz, C. Terhorst, and S.J. Morrison. 2005. SLAM family receptors distinguish hematopoietic stem and progenitor cells and reveal endothelial niches for stem cells. **Cell** 121:1109-1121.
19. Yilmaz, O.H., R. Valdez, B. Theisen, W. Guo, D. Ferguson, H. Wu, S.J. Morrison. 2006. Pten dependence distinguishes haematopoietic stem cells from leukaemia-initiating cells. **Nature** 441:475-482.
20. Morrison, S. J., J. Kimble. 2006. Asymmetric and symmetric stem-cell divisions in development and cancer. **Nature** 441:1068-1074.
21. Molofsky, A.V., S.G. Slutsky, N.M. Joseph, S. He, R. Pardal, J. Krishnamurthy, N. Sharpless and S.J. Morrison. 2006. Increasing *Ink4a* expression decreases forebrain progenitor function and neurogenesis during ageing. **Nature** 443:448-452. PMC2586960
22. Kim, I., T.L. Saunders, and S.J. Morrison. 2007. Sox17 dependence distinguishes the transcriptional regulation of fetal from adult hematopoietic stem cells. **Cell** 130:470-483. PMC2577201
23. Kiel, M., G.L. Radice and S.J. Morrison. 2007. Lack of evidence that hematopoietic stem cells depend on N-cadherin-mediated adhesion to osteoblasts for their maintenance. **Cell Stem Cell** 1:204-217.
24. Kiel, M., S. He, R. Ashkenazi, S.N. Gentry, M. Teta, J.A. Kushner, T.L. Jackson and S.J. Morrison. 2007. Hematopoietic stem cells do not asymmetrically segregate chromosomes or retain bromodeoxyuridine. **Nature** 449:238-242. PMC2633872
25. Joseph, N.M., J.T. Mosher, J. Buchstaller, P. Snider, P.E. McKeever, M. Lim, S. J. Conway, L.F. Parada, Y. Zhu, and S.J. Morrison. 2008. The loss of Nf1 transiently promotes self-renewal but not tumorigenesis by neural crest stem cells. **Cancer Cell** 13: 129-140. PMC2566828
26. Morrison, S.J. and A. Spradling. 2008. Stem Cells and Niches: Mechanisms that promote stem cell maintenance throughout life. **Cell** 132: 598-611.
27. Kiel, M.J. and S.J. Morrison. 2008. Uncertainty in the niches that maintain haematopoietic stem cells. **Nature Reviews Immunology** 8: 290-301.
28. Kiel M.J., O.H. Yilmaz, and S.J. Morrison. 2008. CD150- cells are transiently reconstituting multipotent progenitors with little or no stem cell activity. **Blood** 111: 4413-4. PMC2293285
29. Nishino, J., I. Kim, K. Chada, and S.J. Morrison. 2008. Hmga2 promotes neural stem cell self-renewal in young, but not old, mice by reducing p16<sup>Ink4a</sup> and p16<sup>Arf</sup> expression. **Cell** 135: 227-239. PMC2582221
30. Quintana, E., M. Shackleton, M. Sabel, D.Fullen, T.M. Johnson, and S.J. Morrison. 2008. Efficient tumor formation by single human melanoma cells. **Nature** 456:593-598. PMC2597380
31. Kiel M.J., M. Acar, G.L. Radice and S.J. Morrison. 2008. Hematopoietic stem cells do not depend on N-cadherin to regulate their maintenance. **Cell Stem Cell** 4:170-179. PMC2681089
32. Shackleton, M., E. Quintana, E. Fearon and S.J. Morrison. 2009. Heterogeneity in cancer: cancer stem cells versus clonal evolution. **Cell** 138: 822-829.
33. He, S., D. Nakada and S.J. Morrison. 2009. Mechanisms of stem cell self-renewal. **Annual Review of Cell and Developmental Biology** 25: 16.1-16.30.
34. Quintana, E., M. Shackleton, D.R. Fullen, M.S. Sabel, T.M. Johnson and S.J. Morrison. 2010. Phenotypic heterogeneity among tumorigenic melanoma cells from patients that is reversible and not hierarchally organized. **Cancer Cell** 18: 510-523. PMC3031091
35. Lee, J.Y., D. Nakada, O.H. Yilmaz, Z. Tothova, N.M. Joseph, M.S. Lim, D.G. Gilliland and S.J. Morrison. 2010. mTOR activation induces tumor suppressors that inhibit leukemogenesis and deplete hematopoietic stem cells after *Pten* deletion. **Cell Stem Cell** 7: 593-605. PMC2995996
36. Chuikov, S., B.P. Levi, M.L. Smith and S.J. Morrison. 2010. Prdm16 promotes stem cell maintenance in multiple tissues, partly by regulating oxidative stress. **Nature Cell Biology** 12: 999-1006. PMC2948585
37. Nakada, D., T.L. Saunders and S.J. Morrison. 2010. Lkb1 regulates cell cycle and energy metabolism in haematopoietic stem cells. **Nature** 468: 653-658. PMC3059717
38. Nakada, D., B.P. Levi, and S.J. Morrison. 2011. Integrating physiological regulation with stem cell and tissue homeostasis. **Neuron** 70:703-18

39. He, S., I. Kim, M.S. Lim, and S.J. Morrison. 2011. Sox17 expression confers self-renewal potential and fetal stem cell characteristics upon adult hematopoietic progenitors. **Genes & Development** 25:1613-1627. PMC3182027
40. Joseph, N.M., S. He, E. Quintana, Y-G. Kim, G. Núñez, and S.J. Morrison. 2011. Enteric glia are multipotent in culture but primarily form glia in the adult rodent gut. **Journal of Clinical Investigation** 121:3398-3411. PMC3163971
41. Buchstaller, J., P.E. McKeever, and S.J. Morrison. 2012. Tumorigenic Cells Are Common in Mouse MPNSTs but Their Frequency Depends upon Tumor Genotype and Assay Conditions. **Cancer Cell** 21:240-252. PMC3285409
42. Magee, J.A., E. Piskounova and S.J. Morrison. 2012. Cancer Stem Cells: Impact, Heterogeneity, and Uncertainty. **Cancer Cell** 21:283-296.
43. Ding, L., T.L. Saunders, G. Enikolopov, and S.J. Morrison. 2012. Endothelial and perivascular cells maintain hematopoietic stem cells. **Nature** 481:457-462. PMC3270376
44. Magee, J.A., T. Ikenoue, D. Nakada, J.Y. Lee, K.-L. Guan, and S.J. Morrison. 2012. Temporal changes in PTEN and mTORC2 regulation of hematopoietic stem cell self-renewal and leukemia suppression. **Cell Stem Cell** 11:415-428. PMC3447536
45. Quintana, E., E. Piskounova, M. Shackleton, D. Weinberg, U. Eskiocak, D.R. Fullen, T.M., and S.J. Morrison. 2012. Human melanoma metastasis in NSG mice correlates with clinical outcome in patients. **Science Translational Medicine** 4,159ra149
46. Signer, R.A. and S.J. Morrison. 2013. Mechanisms that regulate stem cell aging and life span. **Cell Stem Cell** 12:152-65. PMC3641677
47. Ding, L. and S.J. Morrison. 2013. Haematopoietic stem cells and early lymphoid progenitors occupy distinct bone marrow niches. **Nature** 495:231-235. PMC3600153
48. Meacham, C.E., and S.J. Morrison. 2013. Tumor heterogeneity and cancer cell plasticity. **Nature** 501:328- 337. PMID24048065
49. Li, Q., N. Bohin, T. Wen, V. Ng, J. Magee, S.C. Chen, K. Shannon, and S.J. Morrison. 2013. Oncogenic Nras has bimodal effects on stem cells that sustainably increase competitiveness. **Nature** 504:143-147. PMID24284627
50. Morrison, S.J., and D.T. Scadden. 2014. The bone marrow niche for haematopoietic stem cells. **Nature** 505:327-334. PMID22429631
51. Nakada, D., H. Oguro, B. Levi, N. Ryan, A. Kitano, Y. Saitoh, M. Takeichi, G. Wendt, and S.J. Morrison. 2014. Oestrogen increases haematopoietic stem-cell self-renewal in females and during pregnancy. **Nature** 505:555-558. PMID24451543
52. Signer, R.A.J., J.A. Magee, A. Salic, S.J. Morrison. 2014. Haematopoietic stem cells require a highly regulate protein synthesis rate. **Nature** 509:49-54. PMID24670665
53. Mich, J.K., R.A.J. Signer, D. Nakada, A. Pineda, R.J. Burgess, T.Y. Vue, J.E. Johnson, S.J. Morrison. 2014. Prospective identification of functionally distinct stem cells and neurosphere-initiating cells in adult mouse forebrain. **eLIFE** 10.7554/eLife.02669
54. Zhou, B.O., R. Yue, M. M. Murphy, J.G. Peyer, S.J. Morrison. 2014. Leptin-receptor-expressing mesenchymal stromal cells represent the main source of bone formed by adult bone marrow. **Cell Stem Cell** 15:154-168. PMID 24953181
55. Buszczak, M., R.A.J. Signer, S.J. Morrison. 2014. Cellular differences in protein synthesis regulate tissue homeostasis. **Cell In Press**
56. Zhou, B., L. Ding, S.J. Morrison. 2015. Hematopoietic stem and progenitor cells regulate the regeneration of their niche by secreting Angiopoietin-1. **eLIFE** 10.7554/eLife.05521. PMC4411515
57. Acar, M., K.S. Kocherlakota, M.M. Murphy, J.G. Peyer, H. Oguro, C.N. Inra, C.J. Jaiyeola, Z. Zhao, K. Luby-Phelps and S.J. Morrison. 2015. Deep imaging of bone marrow shows non-dividing stem cells are mainly perisinusoidal. **Nature** 526:126-130. PMID26416744
58. Piskounova, E., M. Agathocleous, Z. Hu, S. Mann, Z. Zhao, A.M. Leitch, T.M. Johnson, R.J. DeBerardinis and S.J. Morrison. 2015. Reversible metabolic changes in human melanoma cells enable distant metastasis. **Nature** 527:186-191. PMC 4644103
59. Inra, C., B.O. Zhou, M. Acar, M.M. Murphy, Z. Zhao and S.J. Morrison. 2015. A perisinusoidal niche for extramedullary hematopoiesis in the spleen. **Nature** 527:466-471. PMID26570997

60. Yue, R., B.O. Zhou, I.S. Shimada, Z. Zhao and S.J. Morrison. 2016. Leptin receptor promotes adipogenesis and reduces osteogenesis by regulating mesenchymal stromal cells in adult bone marrow. **Cell Stem Cell** 18:782-796. PMC4127103
61. Yue, R., B.O. Zhou and S.J. Morrison. 2016. Clec11a/Ostelectin is an osteogenic growth factor that promotes the maintenance of the adult skeleton. **eLIFE** 10.7554/eLife.18782 PMID 27976999