

**Jeremy Nathans**

**Current Position:**

Professor

Department of Molecular Biology and Genetics

Department of Neuroscience

Samuel Theobald Professor, Wilmer Eye Institute (Department of Ophthalmology)

Johns Hopkins University School of Medicine

Investigator

Howard Hughes Medical Institute

**Personal Data:**

Born July 31, 1958; New York City

Married to Thanh Huynh

Children: Riva (born 7/88) and Rosalie (born 3/94)

**Business Address:**

805 PCTB

Department of Molecular Biology and Genetics

Johns Hopkins University School of Medicine

725 North Wolfe Street

Baltimore, MD 21205

tel: 410-955-4679

FAX: 410-614-0827

e-mail: jnathans@jhmi.edu

**Education:**

Massachusetts Institute of Technology

B.S., Life Sciences

1979

B.S., Chemistry

1979

Stanford University School of Medicine

Ph.D., Biochemistry (with David Hogness)

1985

M.D.

1987

Postdoctoral fellow, Genentech, Inc.

(with Axel Ullrich)

1987

**Professional Experience:**

Assistant Professor, Department of Molecular Biology and Genetics,

Department of Neuroscience, Johns Hopkins University School of Medicine

Assistant Investigator, Howard Hughes Medical Institute

1988–1992

Associate Professor, Department of Molecular Biology and Genetics,

Department of Neuroscience, Johns Hopkins University School of Medicine

Associate Investigator, Howard Hughes Medical Institute

1992-1996

Associate Professor, Department of Ophthalmology

Johns Hopkins University School of Medicine

1993-1996

Professor, Department of Molecular Biology and Genetics, Department of Neuroscience, Department of Ophthalmology Johns Hopkins University School of Medicine	1996-present 1997-present
Investigator, Howard Hughes Medical Institute	

**Advisory and Grant Review Boards (past):**

Scientific Advisory Board, Zanvil Kreiger Mind–Brain Institute, J.H.U.	1991-1992
Scientific Advisory Board, The Ruth and Milton Steinbach Fund	1997-2007
Intramural Program Review Committee, National Eye Institute, N.I.H.	1997-1998
Grant Review Board, McKnight Endowment Fund for Neuroscience	2000-2011
Scientific Advisory Board for Ophthalmology, Novartis	2005-2008
Visiting Committee, Division of Medical Sciences, Harvard Medical School	2006-2010
Grant Review Board, HHMI International Scholars Program	2006, 2011
Scientific Advisory Committee, Machiah Foundation	2009-2011
Grant Review Board, HHMI Professors Program	2010
Scientific Advisory Board, Merck Research Laboratories	1996-1999 and 2008-2013

**Advisory and Grant Review Boards (current):**

Scientific Advisory Board, The Foundation Fighting Blindness	1995-present
Grant Review Board, Life Sciences Research Foundation	2005-present
Advisor, HHMI Janelia Farm Research Campus	2009-present
Grant Review Board, Beckman Initiative for Macular Research	2010-present
Grant Review Board, Klingenstein/Simons Fellowship Awards in Neuroscience	2013-present
Scientific Advisory Board, Blue Cone Monochromacy Families Foundation	2014-present

**Honors and Awards:**

John Asinari Award for undergraduate research in the life sciences, M.I.T.	1978
Alpha Chi Sigma Award for excellence in chemistry, M.I.T.	1979
Newcomb–Cleveland Prize, American Association for the Advancement of Science	1986
Young Scientist Award, Passano Foundation	1987
Initiatives in Research Award, National Academy of Sciences, U.S.A.	1987
Rank Prize in Opto–Electronics, Rank Prize Fund (London)	1988
Wilson S. Stone Memorial Award, M.D. Anderson Cancer Center	1988
Distinguished Young Scientist Award, Maryland Academy of Sciences	1989
Golden Brain Award, Minerva Foundation	1989
Cogan Award, The Association for Research in Vision and Ophthalmology	1992
Alcon Research Institute Award for Vision Research, Alcon Laboratories	1992
Young Investigator Award, Society for Neuroscience	1995
Member, National Academy of Sciences, U.S.A.	1996
Member, American Academy of Arts and Sciences	2000
Teacher of the Year, Graduate Student Association, Johns Hopkins Medical School	2003, 2010
Professor’s Award for Distinction in Teaching in the Basic Sciences, Johns Hopkins Medical School	2004
Golden Apple Award for Teaching Excellence, American Medical Student Association	2004
Champalimaud Award for Vision Research (shared with King-Wai Yau)	2008
Fellow, American Association for the Advancement of Science	2009
Edward Scolnick Prize in Neuroscience, McGovern Institute, MIT	2009
Member, Institute of Medicine, U.S.A.	2011
Albert Muse Prize, The Eye and Ear Foundation of Pittsburgh	2012
Gilman Scholar, Johns Hopkins University	2013
Arthur Kornberg and Paul Berg Lifetime Achievement Award in Biomedical Sciences, Stanford Medical School	2013
Member, American Association of Physicians	2014

**Editorial Positions:**

Associate Editor, Journal of Neuroscience	1991-1996
Editorial Board Member, Proceedings of the National Academy of Sciences, U.S.A.	1999-present
Associate Editor, Proceedings of the National Academy of Sciences, U.S.A.	2005-2006
Board of Reviewing Editors, eLife	2012-present

**Award Committees:**

Award Committee, Passano Award, Passano Foundation	2004-present
Award Committee, Molecular Biology Award, National Academy of Sciences, U.S.A.	2004
Award Committee, Lasker Prizes, Albert and Mary Lasker Foundation	2010-present

**Named or Honorary Lectures:**

Juan March Lecture, Juan March Foundation, Madrid	1991
W.S. Stiles Lecture, University College, London	1992
Walter Sondheim Lecture, Columbus Center, Baltimore	1996
Jack Schultz Memorial Lecture, Fox Chase Cancer Center, Philadelphia	1996
Holiday Lectures (with A. J. Hudspeth), Howard Hughes Medical Institute	1997
Zacharias Dische Memorial Lecture, Columbia University	2001
Stephen M. Schuetze Memorial Lecture, Columbia University	2002
Keynote Lecture, FASEB Meeting – Biology and Chemistry of Vision	2003
Rachford Lecture, Cincinnati Children’s Hospital Research Foundation	2004
Russell DeValois Memorial Lecture, University of California, Berkeley	2007
Laureate Lecture, University of Pittsburgh	2008
Edward Scolnick Prize Lecture in Neuroscience, McGovern Institute, MIT	2009
Gordon Guroff Memorial Lecture, NIH	2009
George Khoury Memorial Lecture, NIH	2010
Friedman Lecture, Mount Sinai Medical School	2012
Muse Prize Lecture, University of Pittsburgh	2012
Marvin Sears Lecture, Yale University	2012
Edward R. and Anne G. Leffler Lecture, Harvard Medical School	2013
Dialogues of Discovery Lecture, Janelia Farm Research Campus, HHMI	2014
The C.H. Li Memorial Lectures, University of California, Berkeley	2014
Randy Chipperfield Memorial Lecture, M.I.T.	2015
Eric Shooter Lecture, Stanford Medical School	2015

**Web materials:**

The Vertebrate Retina (four lectures), iBioSeminars, ASCB/HHMI	2008
Creativity in Science, iBioMagazine, ASCB/HHMI	2011
One Amazing Second in the Life of Your Brain (lecture), iBiology, ASCB/HHMI	2011

**Patents:**

1. United States Patents Nos. 5,693,775 (issued 12/2/97) and 5,872,226 (issued 2/16/99). Fibroblast growth factor homologous factor-1 (FHF-1) and methods of use. Inventors: Nathans, J., Smallwood, P.M., and Macke, J.P.
2. United States Patent No. 5,876,967 (issued 3/2/99). Fibroblast growth factor homologous factor-2 (FHF-2) and methods of use. Inventors: Nathans, J., Smallwood, P.M., and Macke, J.P.
3. United States Patent No. 6,020,189 (issued 2/1/00) Fibroblast growth factor homologous factors (FHF) and methods of use. Inventors: Nathans, J. and Smallwood, P.M.

4. United States Patent No. 6,635,744 (issued 10/21/03) Fibroblast growth factor homologous factor-4 (FHF-4). Inventors: Nathans, J. and Smallwood, P.M.
5. United States Patents Nos. 6,713,300 (issued 3/30/04) and 7,141,420 (issued 11/28/06). Nucleic acid and amino acid sequences for ATP-binding cassette transporter and methods of screening for agents that modify ATP-binding cassette transporter. Inventors: Allikmets, R., Singh, N., Sun, H., Shroyer, N.F., Hutchinson, A., Chidambaram, A., Gerrard, B., Baird, I., Stauffer, D., Peiffer, A., Rattner, A., Smallwood, P., Li, Y., Anderson, K.L., Lewis, R.A., Nathans, J., Leppert, M., Dean, M. and Lupski, J.R.
6. United States Patents No. 8129353 (issued 3/6/12). Methods of gene therapy using nucleic acid sequences for ATP-binding cassette transporter. Inventors: Allikmets, R., Anderson, K.L., Dean, M., Leppert, M., Lewis, R.A., Li, Y., Lupski, J.R., Nathans, J., Rattner, A., Shroyer, N., Singh, N., Smallwood, P., and Sun, H.

**Publications:**

**Research Publications:**

1. Wang, A., Nathans, J., Van Der Marel, G., Van Boom, J.H., and Rich, A. (1978) Molecular structure of a double helical DNA fragment intercalator complex between deoxy CpG and a terpyridine platinum compound. *Nature* 276: 471–474.
2. Kronenberg, H.M., McDevitt, B.E., Majzoub, J.A., Nathans, J., Sharp, P., Potts, J.T., and Rich, A. (1979) Cloning and nucleotide sequence of DNA coding for bovine preproparathyroid hormone. *Proceedings of the National Academy of Sciences USA* 76: 4981–4986.
3. Nathans, J. and Hogness, D.S. (1983) Isolation, sequence analysis, and intron–exon arrangement of the gene encoding bovine rhodopsin. *Cell* 34: 807–814.
4. Nathans, J. and Hogness, D.S. (1984) Isolation and nucleotide sequence of the gene encoding human rhodopsin. *Proceedings of the National Academy of Sciences USA* 81: 4851–4855.
5. Nathans, J., Thomas, D., and Hogness, D.S. (1986) Molecular genetics of human color vision: the genes encoding blue, green, and red pigments. *Science* 232: 193–202.
6. Nathans, J., Piantanida, T.P., Eddy, R.L., Shows, T.B., and Hogness, D.S. (1986) Molecular genetics of inherited variation in human color vision. *Science* 232: 203–210.
7. Vollrath, D., Nathans, J., and Davis, R.W. (1988) Tandem array of human visual pigment genes at Xq28. *Science* 240: 1669–1671.
8. Nathans, J., Weitz, C.J., Agarwal, N., Nir, I., and Papermaster, D.S. (1989) Production of bovine rhodopsin by mammalian cell lines expressing cloned cDNA: spectrophotometry and subcellular localization. *Vision Research* 29: 907–914.
9. Nathans, J., Davenport, C.M., Maumenee, I.H., Lewis, R.A., Hejtmancik, J.F., Litt, M., Lovrien, E., Weleber, R., Bachynski, B., Zwas, F., Klingaman, R., and Fishman, G. (1989) Molecular genetics of human blue cone monochromacy. *Science* 245: 831–838.
10. Nathans, J. (1990) Determinants of visual pigment absorbance: the role of charged amino acids in the putative transmembrane segments. *Biochemistry* 29: 937–942.
11. Nathans, J. (1990) Determinants of visual pigment absorbance: identification of the retinylidene Schiff's base counterion in bovine rhodopsin. *Biochemistry* 29: 9746–9752.

12. Zack, D.J., Bennett, J., Wang, Y., Davenport, C., Klaunberg, B., Gearhart, J., and Nathans, J. (1991) Unusual topography of bovine rhodopsin promoter–lacZ fusion gene expression in transgenic mouse retinas. *Neuron* 6: 187–199.
13. Sung, C.–H., Davenport, C.M., Hennessey, J.C., Maumenee, I.H., Jacobson, S.G., Heckenlively, J.R., Nowakowski, R., Fishman, G., Gouras, P., and Nathans, J. (1991) Rhodopsin mutations in autosomal dominant retinitis pigmentosa. *Proceedings of the National Academy of Sciences USA* 88: 6481–6485.
14. Sung, C.–H., Schneider, B.G., Agarwal, N. Papermaster, D.S., and Nathans, J. (1991) Functional heterogeneity of mutant rhodopsins responsible for autosomal dominant retinitis pigmentosa. *Proceedings of the National Academy of Sciences USA* 88: 8840–8844.
15. Jacobson, S.G., Kemp, C.M., Sung, C.–H., and Nathans, J. (1991) Retinal function and rhodopsin levels in autosomal dominant retinitis pigmentosa with rhodopsin mutations. *American Journal of Ophthalmology* 112: 256–271.
16. Weitz, C.J., Miyake, Y., Shinzato, K., Montag, E., Zrenner, E., Went, L.N., and Nathans, J. (1992) Human tritanopia associated with two amino acid substitutions in the blue–sensitive opsin. *American Journal of Human Genetics* 50: 498–507.
17. Kemp, C.M., Jacobson, S.G., Roman, A.J., Sung, C.–H., and Nathans, J. (1992) Abnormal rod dark adaptation in autosomal dominant retinitis pigmentosa with proline–23–histidine rhodopsin mutation. *American Journal of Ophthalmology* 113: 165–174.
18. Merbs, S.L., and Nathans, J. (1992) Absorption spectra of human cone pigments. *Nature* 356: 433–435.
19. Weitz, C.J., and Nathans, J. (1992) Histidine residues regulate the transition of photoexcited rhodopsin to its active conformation, metarhodopsin II. *Neuron* 8: 465–472.
20. Wang, S.–Z., Adler, R., and Nathans, J. (1992) A visual pigment from chicken that resembles rhodopsin: amino acid sequence, gene structure, and functional expression. *Biochemistry* 31: 3309–3315.
21. Dhallan, R.S., Macke, J., Eddy, R.L., Shows, T.B., Reed, R.R., Yau, K.–W., and Nathans, J. (1992) Human rod photoreceptor cGMP-gated channel: amino acid sequence, gene structure, and functional expression. *Journal of Neuroscience* 12: 3248–3256.
22. Weitz, C.J., Went, L.N., and Nathans, J. (1992) Human tritanopia associated with a third amino acid substitution in the blue sensitive visual pigment gene. *American Journal of Human Genetics* 51: 444–446.
23. Merbs, S.L., and Nathans, J. (1992) Photobleaching difference absorption spectra of human cone pigments: quantitative analysis and comparison to other methods. *Photochemistry and Photobiology* 56: 869–881.
24. Wang, Y., Macke, J. P., Merbs, S. L., Klaunberg, B., Bennett, J., Zack, D., Gearhart, J., and Nathans, J. (1992) A locus control region adjacent to the human red and green pigment genes. *Neuron* 9: 429–440.
25. Merbs, S.L., and Nathans, J. (1992) Absorption spectra of the hybrid pigments responsible for anomalous color vision. *Science* 258: 464–466.

26. Borjigin, J., and Nathans, J. (1993) Bovine pancreatic trypsin inhibitor (BPTI) - trypsin complex as a detection system for recombinant proteins. *Proceedings of the National Academy of Sciences USA* 90: 337-341.
27. Johnson, R.L., Grant, K.B., Zankel, T.C., Boehm, M.F., Merbs, S.L., Nathans, J., and Nakanishi, K. (1993) Cloning and expression of goldfish opsin sequences. *Biochemistry* 32: 208-214.
28. Macke, J.P., Davenport, C.M., Jacobson, S.G., Hennessey, J.C., Gonzalez-Fernandez, F., Conway, B.P., Heckenlively, J., Palmer, R., Maumenee, I.H., Sieving, P., Gouras, P., Good, W., and Nathans, J. (1993) Identification of novel rhodopsin mutations responsible for retinitis pigmentosa: implications for the structure and function of rhodopsin. *American Journal of Human Genetics* 53: 80-89.
29. Macke, J. P., Hu, N., Hu, S., Bailey, M., King, V.L., Brown, T., Hamer, D., and Nathans, J. (1993) Sequence variation in the androgen receptor gene is not a common determinant of male sexual orientation. *American Journal of Human Genetics* 53: 844-852.
30. Merbs, S. L., and Nathans, J. (1993) Role of hydroxyl-bearing amino acids in differentially tuning the absorption spectra of the human red and green cone pigments. *Photochemistry and Photobiology* 58: 706-710.
31. Nathans, J., Maumenee, I.H., Zrenner, E., Sadowski, B., Sharpe, L.T., Lewis, R.A., Hansen, E., Rosenberg, T., Schwartz, M., Heckenlively, J.R., Traboulsi, E., Klingaman, R., Bech-Hansen, N.T., LaRoche, G.R., Pagon, R.A., Murphey, W.H., and Weleber, R.G. (1993) Genetic heterogeneity among blue cone monochromats. *American Journal of Human Genetics* 53: 987-1000.
32. Xiang, M., Zhou, L., Peng, Y.-W., Eddy, R.L., Shows, T.B., and Nathans, J. (1993) Brn-3b: a POU-domain protein expressed in a subset of retinal ganglion cells. *Neuron* 11: 689-701.
33. Sung, C.-H., Davenport, C. M., and Nathans, J. (1993) Rhodopsin mutations responsible for autosomal dominant retinitis pigmentosa: clustering of functional classes along the polypeptide chain. *Journal of Biological Chemistry* 268: 26645-26649.
34. Weitz, C., and Nathans, J. (1993) Rhodopsin activation: the effects on the metarhodopsin I - metarhodopsin II equilibrium of neutralization or introduction of charged amino acids within putative transmembrane segments. *Biochemistry* 32: 14176-14182.
35. Portera-Cailliau, C., Sung, C.-H., Nathans, J., and Adler, R. (1994) Apoptotic photoreceptor cell death in mouse models of retinitis pigmentosa. *Proceedings of the National Academy of Sciences USA* 91: 974-978.
36. Jacobson, S.G., Kemp, C.M., Cideciyan, A.V., Macke, J.P., Sung, C.-H., and Nathans, J. (1994) Phenotypes of stop codon and splice site rhodopsin mutations causing retinitis pigmentosa. *Investigative Ophthalmology and Visual Science* 35: 2521-2534.
37. Chiu, M.I., and Nathans, J. (1994) Blue cones and cone bipolar cells share transcriptional specificity as determined by expression of human blue visual pigment-derived transgenes. *Journal of Neuroscience* 14: 3426-3436.
38. Chiu, M.I., and Nathans, J. (1994) A sequence upstream of the mouse blue visual pigment gene directs blue cone-specific transgene expression in mouse retinas. *Visual Neuroscience* 11: 773-780.

39. Rosas, D.J., Roman, A.J., Weissbrod, P., Macke, J.P., and Nathans, J. (1994) Autosomal dominant retinitis pigmentosa in a large family: a clinical and molecular genetic study. *Investigative Ophthalmology and Visual Science* 35: 3134-3144.
40. Borjigin, J., and Nathans, J. (1994) Insertional mutagenesis as a probe of rhodopsin's topography, stability, and activity. *Journal of Biological Chemistry* 269: 14715-14722.
41. Chiu, M.I., Zack, D.J., Wang, Y. and Nathans, J. (1994) Murine and bovine blue pigment genes: cloning and characterization of two new members of the S family of visual pigments. *Genomics* 21: 440-443.
42. Sung, C.-H., Makino, C., Baylor, D., and Nathans, J. (1994) A rhodopsin gene mutation responsible for autosomal dominant retinitis pigmentosa results in a protein that is defective in localization to the photoreceptor outer segment. *Journal of Neuroscience* 14: 5818-5833.
43. Macke, J.P., Hennessey, J.C., and Nathans, J. (1995) Rhodopsin mutation proline347-to-alanine in a family with autosomal dominant retinitis pigmentosa indicates an important role for proline at position 347. *Human Molecular Genetics* 4: 775-776.
44. Xiang, M., Zhou, L., Macke, J.P., Yoshioka, T., Hendry, S.H.C., Eddy, R.L., Shows, T.B., and Nathans, J. (1995) The Brn-3 family of POU-domain factors: primary structure, binding specificity, and expression in subsets of retinal ganglion cells and somatosensory neurons. *Journal of Neuroscience* 15: 4762-4785.
45. Wang, Y., Macke, J.P., Abella, B.S., Andreasson, K., Worley, P., Gilbert, D.J., Copeland, N.G., Jenkins, N.A., and Nathans, J. (1996) A large family of putative transmembrane receptors homologous to the product of the *Drosophila* tissue polarity gene *frizzled*. *Journal of Biological Chemistry* 271: 4468-4476.
46. Zhou, H., Yoshioka, T., and Nathans, J. (1996) RPF-1: a complex POU-domain gene implicated in the development of retinal ganglion and amacrine cells. *Journal of Neuroscience* 16: 2261-2274.
47. Gan, L., Xiang, M., Zhou, L., Wagner, D.S., Klein, W.H., and Nathans, J. (1996) The POU domain factor Brn-3b is required for the development of a large set of retinal ganglion cells. *Proceedings of the National Academy of Sciences USA* 93: 3920-3925.
48. Xiang, M., Zhou, L., and Nathans, J. (1996) Similarities and differences among inner retinal neurons revealed by the expression of reporter transgenes under the control of Brn-3a, Brn-3b, and Brn-3c promoter sequences. *Visual Neuroscience* 13: 955-962.
49. Bhanot, P., Brink, M., Harryman Samos, C., Hsieh, J.-C., Wang, Y., Macke, J.P., Andrew, D., Nathans, J., and Nusse, R. (1996) A new member of the *frizzled* family from *Drosophila* functions as a Wingless receptor. *Nature* 382: 225-230.
50. Smallwood, P.M., Munoz-Sanjuan, I., Tong, P., Macke, J.P., Hendry, S.H.C., Gilbert, D.J., Copeland, N.G., Jenkins, N.A., and Nathans, J. (1996) Fibroblast growth factor homologous factors (FHF's): new members of the FGF family implicated in nervous system development. *Proceedings of the National Academy of Sciences USA* 93: 9850-9857.
51. Xiang, M., Gan, L., Zhou, L., Klein, W.H., and Nathans, J. (1996) Targeted deletion of the mouse POU domain gene Brn-3a causes a selective loss of neurons in the brainstem and trigeminal ganglion, uncoordinated limb movement, and impaired suckling. *Proceedings of the National Academy of Sciences USA* 93: 11950-11955.

52. Margolis, R.L., Stine, O.C., McInnes, M.G., Ranen, N.G., Rubinsztein, D.C., Leggo, J., Brando, L.V.J., Kidwai, A.S., Loev, S.J., Breschel, T.S., Callahan, C, Simpson, S.G., DePaulo, J.R., McMahon, F.J., Jain, S., Paykel, E.S., Walsh, C., DeLisi, L.E., Crow, T.J., Torrey, E.F., Ashworth, R.G., Macke, J.P., Nathans, J., and Ross, C.A. (1996) cDNA cloning of a human homologue of the *Caenorhabditis elegans* cell fate-determining gene *mab-21*: expression, chromosomal localization and analysis of a highly polymorphic (CAG)<sub>n</sub> trinucleotide repeat. *Human Molecular Genetics* 5: 607-616.
53. Allikmets, R., Singh, N., Sun, H., Shroyer, N.F., Hutchinson, A, Chidambaram, A., Gerrard, B., Baird, I., Stauffer, D., Peiffer, A., Rattner, A., Smallwood, P., Li, Y., Anderson, K.L., Lewis, R.A., Nathans, J., Leppert, M., Dean, M. and Lupski, J.R. (1997) A photoreceptor cell-specific ATP-binding transporter gene (ABCR) is mutated in recessive Stargardt's macular dystrophy. *Nature Genetics* 15: 236-246.
54. He, X., Saint-Jeannet, J.-P., Wang, Y., Nathans, J., Dawid, I., and Varmus, R. (1997) A member of the Frizzled protein family mediating axis induction by Wnt-5A. *Science* 275: 1652-1654.
55. Rattner, A., Hsieh, J.-C., Smallwood, P.M., Debra J. Gilbert, D.J., Copeland, N.G., Jenkins, N.A., and Nathans, J. (1997) A family of secreted proteins containing homology to the cysteine-rich ligand-binding domain of frizzled receptors. *Proceedings of the National Academy of Sciences USA* 94: 2859-2863.
56. Macke, J.P. and Nathans, J. (1997) Individual variation in the size of the human red and green pigment gene array. *Investigative Ophthalmology and Visual Science* 38: 1040-1043.
57. Sun, H., Macke, J.P., and Nathans, J. (1997) Mechanisms of spectral tuning in the mouse green cone pigment. *Proceedings of the National Academy of Sciences USA* 94: 8860-8865.
58. Xiang, M., Gan, L., Li, D., Chen, Z.-Y., Zhou, L., O'Malley, B.W., Klein, W., and Nathans, J. (1997) Essential role of POU-domain factor *Brn-3c* in auditory and vestibular hair cell development. *Proceedings of the National Academy of Sciences USA* 94: 9445-9450.
59. Sun, H., and Nathans, J. (1997) Stargardt's ABCR is localized to the disc membrane of retinal rod outer segments. *Nature Genetics* 17: 15-16.
60. Sun, H., Gilbert, D.J., Copeland, N.G., Jenkins, N.A., and Nathans, J. (1997) Peropsin, a novel visual pigment-like protein located in the apical microvilli of the retinal pigment epithelium. *Proceedings of the National Academy of Sciences USA* 94: 9893-9898.
61. Sherman, P.M., Sun, H., Macke, J.P., Williams, J., Smallwood, P.M., and Nathans, J. (1997) Identification and characterization of a conserved family of protein serine/threonine phosphatases homologous to *Drosophila* retinal degeneration C (*rdgC*). *Proceedings of the National Academy of Sciences USA* 94: 11639-11644.
62. Allikmets, R., Wasserman, W.W., Hutchinson, A., Smallwood, P., Nathans, J., Rogan, P., Schneider, T.D., and Dean, M. (1998) Organization of the ABCR gene: analysis of promoter and splice site mutations. *Gene* 215: 111-122.
63. Soucy, E. Wang, Y., Nirenberg, S., Nathans, J., and Meister, M. (1998) A novel signaling pathway from rod photoreceptors to ganglion cells in mammalian retina. *Neuron* 21: 481-493.
64. Sharpe, L.T., Stockman, A., Jagle, H., Knau, H., Klausen, G., Reitner, A., and Nathans, J. (1998) Red, green, and red-green hybrid pigments in the human retina: correlations between deduced protein



- sequences and psychophysically-measured spectral sensitivities. *Journal of Neuroscience* 18: 10053-10069.
65. Munoz-Sanjuan, I., Simandl, B.K., Fallon, J.F., and Nathans, J. (1999) Expression of chicken fibroblast growth factor homologous factor-1 (FHF-1) and of differentially spliced isoforms of FHF-2 during development and involvement of FHF-2 in chicken limb development. *Development* 126: 409-421.
66. Sun, H., Molday, R. S., and Nathans, J. (1999) Retinal stimulates ATP hydrolysis by purified and reconstituted ABCR, the photoreceptor-specific ABC transporter responsible for Stargardt disease. *Journal of Biological Chemistry* 274: 8269-8281.
67. Stockman, A., Sharpe, L.T., Jagle, H., Knau, H., and Nathans, J. (1999) L, M, and L-M hybrid cone photopigments in man: deriving lambda max's from flicker photometric spectral sensitivities. *Vision Research* 39: 3513-3525.
68. Hsieh, J.-C., Rattner, A., Smallwood, P.M., and Nathans, J. (1999) Biochemical characterization of Wnt-Frizzled interactions using a soluble, biologically active vertebrate Wnt protein. *Proceedings of the National Academy of Sciences USA* 96: 3546-3551.
69. Hsieh, J.-C., Kodjabachian, L., Rebbert, M., Rattner, A., Smallwood, P.M., Harryman Samos, C., Nusse, R., Dawid, I., and Nathans, J. (1999) A new secreted protein that binds to Wnt proteins and inhibits their activities. *Nature* 398: 431-436.
70. Wang, Y., Smallwood, P. M., Cowan, M., Blesh, D., Lawler, A., and Nathans, J. (1999) Mutually exclusive expression of human red and green visual pigment-reporter transgenes occurs at high frequency in murine cone photoreceptors. *Proceedings of the National Academy of Sciences USA* 96: 5251-5256.
71. Bhanot, P., Fish, M., Jemison, J., Nusse, R., Nathans, J., and Cadigan, K.M. (1999) Frizzled and frizzled-2 function as redundant receptors for Wingless during *Drosophila* embryonic development. *Development* 126: 4175-4186.
72. Munoz-Sanjuan, I., Smallwood, P.M., and Nathans, J. (2000) Isoform diversity among fibroblast growth factor homologous factors is generated by alternative promotor usage and differential splicing. *Journal of Biological Chemistry* 275: 2589-2597.
73. Rattner, A., Smallwood, P.M., and Nathans, J. (2000) Identification and characterization of all-trans retinol dehydrogenase from photoreceptor outer segments, the visual cycle enzyme that reduces all-trans retinal to all-trans retinol. *Journal of Biological Chemistry* 275: 11034-11043.
74. Munoz-Sanjuan, I., Fallon, J.F., and Nathans, J. (2000) Expression and regulation of chicken fibroblast growth factor homologous factor (FHF)-4 at the base of the developing limb. *Mechanisms of Development* 95: 101-112.
75. Sun, H., Smallwood, P.M., and Nathans, J. (2000) Biochemical defects in ABCR protein variants associated with human retinopathies. *Nature Genetics* 26: 242-246.
76. Muñoz-Sanjuán, I., Cooper, M.K., Beachy, P.A., Fallon, J.F., and Nathans, J. (2001) Expression and regulation of chicken fibroblast growth factor homologous factor (FHF)-4 during craniofacial morphogenesis. *Developmental Dynamics* 220: 238-245.

77. Sun, H. and Nathans, J. (2001) ABCR, the ATP-binding cassette transporter responsible for Stargardt macular dystrophy, is an efficient target of all-trans retinal-mediated photo-oxidative damage in vitro: implications for retinal disease. *Journal of Biological Chemistry* 276: 11766-11774.
78. Wang, Y., Huso, D., Cahill, H., Ryugo, D., and Nathans, J. (2001) Progressive cerebellar, auditory, and esophageal dysfunction caused by targeted disruption of the frizzled 4 gene, *Journal of Neuroscience* 21: 4761-4771.
79. Ramulu, P., and Nathans, J. (2001) Cellular and subcellular localization, N-terminal acylation, and calcium binding of *Caenorhabditis elegans* protein phosphatase with EF-hands. *Journal of Biological Chemistry* 276: 25127-25135.
80. Dann, C.E., Hsieh, J.-C., Rattner, A., Sharma, D., Nathans, J., and Leahy, D.J. (2001) Insights into Wnt binding and signaling from the structures of two Frizzled cysteine-rich domains. *Nature* 412: 86-90.
81. Ramulu, P., Kennedy, M., Xiong, W., Williams, J., Cowan, M., Blesh, D., Yau K.-W., Hurley, J.B. and Nathans, J. (2001) Normal light response, photoreceptor integrity, and rhodopsin dephosphorylation in mice lacking both protein phosphatases with EF-hands (PPEF-1 and PPEF-2). *Molecular and Cellular Biology* 21: 8605-8614.
82. Simovich, M.J., Miller, B., Ezzeldin, H., Kirkland, B.T., McLeod, G., Fulmer, C., Nathans, J., Jacobson, S.G., and Pittler S.J. (2001) Four novel mutations in the RPE65 gene in patients with Leber congenital amaurosis. *Human Mutation* 18: 164.
83. Rattner, A., Smallwood, P.M., Williams, J., Cooke, C., Savchenko, A., Lyubarsky, A., Pugh, E.N., and Nathans, J. (2001) A novel photoreceptor-specific cadherin is essential for the structural integrity of the outer segment and for photoreceptor survival. *Neuron* 32: 775-786.
84. Smallwood, P.M., Wang, Y., and Nathans, J. (2002) Role of a locus control region in the mutually exclusive expression of human red and green cone pigment genes. *Proceedings of the National Academy of Sciences USA* 99: 1008-1011.
85. Sun, H., Tsunenari, T., Yau, K.-W., and Nathans, J. (2002) The vitelliform macular dystrophy protein defines a new family of chloride channels. *Proceedings of the National Academy of Sciences USA* 99: 4008-4013.
86. Wang, Y., Thekdi, N., Smallwood, P.M., Macke, J.P., and Nathans, J. (2002) Frizzled-3 is required for the development of major fiber tracts in the rostral CNS. *Journal of Neuroscience* 22: 8563-8573.
87. Badea, T., Wang, Y., and Nathans, J. (2003) A noninvasive genetic/pharmacologic strategy for visualizing cell morphology and clonal relationships in the mouse. *Journal of Neuroscience* 23: 2314-2322.
88. Tsunenari, T., Sun, H., Williams, J., Cahill, H., Smallwood, P., Yau K.-W., and Nathans, J. (2003) Structure-function analysis of the bestrophin family of anion channels. *Journal of Biological Chemistry* 278: 41114-41125.
89. Smallwood, P.M., Ölveczky, B.P., Williams, G.L., Jacobs, G.H., Reese, B.E., Meister, M., and Nathans, J. (2003) Genetically engineered mice with a novel class of cone photoreceptors: implications for the evolution of color vision. *Proceedings of the National Academy of Sciences USA* 100: 11706-11711.

90. Parikh, V., Shugart, Y.Y., Doheny, K.F., Zhang, J., Li, L., Williams, J., Hayden, D., Craig, B., Capo, H., Chamblee, D., Chen, C., Collins, M., Dankner, S., Fiergang, D., Guyton, D., Hunter, D., Hutcheon, M., Keys, M., Morrison, N., Munoz, M., Parks, M., Plotsky, D., Protzko, E., Repka, M.X., Sarubbi, M., Schnall, B., Siatkowski, R.M., Traboulsi, E., Waeltermann, J., and Nathans, J. (2003) A strabismus susceptibility locus on chromosome 7p. *Proceedings of the National Academy of Sciences USA* 100:12283-12288.
91. Lyuksyutova, A.I., Lu C.C., Milanesio, N., King, L.A., Guo, N., Wang, Y., Nathans, J., Tessier-Lavigne, M., and Zou, Y. (2003) Anterior-posterior guidance of commissural axons by Wnt-frizzled signaling. *Science* 302: 1984-1988.
92. Xu, Q., Wang, Y., Dabdoub, A., Smallwood, P.M., Williams, J., Woods, C., Kelley, M.W., Jiang, L., Tasman, W., Zhang, K., and Nathans, J. (2004) Vascular development in the retina and inner ear: control by Norrin and Frizzled-4, a high-affinity ligand-receptor pair. *Cell* 116: 883-895.
93. Luo, W., Marsh-Armstrong, N., Rattner, A., and Nathans J. (2004) An outer segment localization signal at the carboxy-terminus of the photoreceptor-specific retinol dehydrogenase. *Journal of Neuroscience* 24: 2623-2632.
94. Luo, W., Williams, J., Smallwood, P.M., Touchman, J.W., Roman, L.M., and Nathans, J. (2004) Proximal and distal sequences control UV cone pigment gene expression in transgenic zebrafish. *Journal of Biological Chemistry* 279: 19286-19293.
95. Guo, N., Hawkins, C., and Nathans, J. (2004) Frizzled6 controls hair patterning in mice. *Proceedings of the National Academy of Sciences USA* 101: 9277-9281.
96. Badea, T., and Nathans, J. (2004) Quantitative analysis of neuronal morphologies in the mouse retina visualized using a genetically directed reporter. *Journal of Comparative Neurology* 480: 331-351.
97. Rattner, A., Chen, J., and Nathans, J. (2004) Proteolytic shedding of the extracellular domain of photoreceptor cadherin: implications for outer segment assembly. *Journal of Biological Chemistry* 279: 42202-42210.
98. Chen, J., Rattner, A., and Nathans, J. (2005) The rod photoreceptor-specific nuclear receptor Nr2e3 represses transcription of multiple cone-specific genes. *Journal of Neuroscience* 25: 118-129.
99. Rattner A., and Nathans J. (2005) The genomic response to retinal disease and injury: evidence for endothelin signaling from photoreceptors to glia. *Journal of Neuroscience* 25: 4540-4549.
100. Wang Y., Zhang J., Mori S., and Nathans J. (2006) Axonal growth and guidance defects in Frizzled3 knockout mice: a comparison of diffusion tensor magnetic resonance imaging, neurofilament staining, and genetically directed cell labeling. *Journal of Neuroscience* 26: 355-364.
101. Wang Y., Guo N., and Nathans J. (2006) The role of Frizzled3 and Frizzled6 in neural tube closure and in the planar polarity of inner ear sensory hair cells. *Journal of Neuroscience* 26: 2147-2156.
102. Chen, J., Rattner, A., and Nathans J. (2006) Effects of L1 retrotransposon insertion on transcript processing, localization, and accumulation: lessons from the retinal degeneration 7 mouse and implications for the genomic ecology of L1 elements. *Human Molecular Genetics* 15: 2146-2156.
103. Tsunenari, T., Nathans, J., and Yau, K.-W. (2006) Calcium-activated chloride currents from human Bestrophin-4 in excised membrane patches. *Journal of General Physiology* 127: 749-754.

104. Wang, Y., Badea, T., and Nathans, J. (2006) Order from disorder: self-organization in mammalian hair patterning. *Proceedings of the National Academy of Sciences USA* 103: 19800-19805.
105. Smallwood, P.M., Williams, J., Xu, Q., Leahy, D.J., and Nathans, J. (2007) Mutational analysis of *Norrin-Frizzled4* recognition. *Journal of Biological Chemistry* 282: 4057-4068.
106. Jacobs, G.H., Williams, G.A., Cahill, H., and Nathans, J. (2007) Emergence of novel color vision in mice engineered to express a human cone photopigment. *Science* 315: 1723-1725.
107. Chen, J. and Nathans, J. (2007) Genetic ablation of cone photoreceptors eliminates retinal folds in the retinal degeneration 7 (*rd7*) mouse. *Investigative Ophthalmology and Visual Science* 48: 2799-2805.
108. Chen, J. and Nathans, J. (2007) Estrogen related receptor beta (*NR3B2*) controls epithelial cell fate and endolymph production by the stria vascularis. *Developmental Cell* 13: 325-337.
109. Cahill, H. and Nathans, J. (2008) The optokinetic reflex as a tool for quantitative analyses of nervous system function in mice: application to genetic and drug-induced variation. *Public Library of Science One* 3: e2055.
110. Liu, C., Wang, Y., Smallwood, P.M., and Nathans, J. (2008) An essential role for *Frizzled5* in neuronal survival in the parafascicular nucleus of the thalamus. *Journal of Neuroscience* 28: 5641-5653.
111. Rattner, A., Toulabi, L., Williams, J., Yu, H., Nathans, J. (2008) The genomic response of the retinal pigment epithelium to light damage and retinal detachment. *Journal of Neuroscience* 28: 9880-9889.
112. Liu, C., and Nathans, J. (2008) An essential role for *Frizzled5* in mammalian ocular development: loss of *Frizzled5* leads to microphthalmia, delayed closure of the optic fissure, persistence of the hyaloid vasculature, and a late retinal degeneration. *Development* 135: 3567-3576.
113. Rotolo, T., Smallwood, P.M., Williams, J., and Nathans, J. (2008) Genetically-directed, cell type-specific sparse labeling for the analysis of neuronal morphology. *Public Library of Science One* 3: e4099.
114. Badea, T.C., Cahill, H., Ecker, J., Hattar, S., and Nathans, J. (2009) Distinct roles of transcription factors *Brn3a* and *Brn3b* in controlling the development, morphology, and function of retinal ganglion cells. *Neuron* 61: 852-864.
115. Ye, X., Wang, Y., Cahill, H., Yu, Y., Badea, T.C., Smallwood, P.M., Peachey, N.S., and Nathans, J. (2009) *Norrin*, *Frizzled4*, and *Lrp5* signaling in endothelial cells controls a genetic program for retinal vascularization. *Cell* 139: 285-298.
116. Badea, T.C., Hua, Z.L., Smallwood, P.M., Williams, J., Rotolo, T., Ye, X., and Nathans, J. (2009) New mouse lines for the analysis of neuronal morphology using *CreER(T)/loxP*-directed sparse labeling. *Public Library of Science One* 16: e7859.
117. Yu, H., Smallwood, P.M., Wang, Y., Vidaltamayo, R., Reed, R., and Nathans, J. (2010) *Frizzled 1* and *frizzled 2* genes function in palate, ventricular septum and neural tube closure: general implications for tissue fusion processes. *Development* 137:3707-3717.
118. Wang, Y., Chang, H., and Nathans, J. (2010) When whorls collide: the development of hair patterns in *frizzled6* mutant mice. *Development* 137: 4091-4099.
119. Ye, X., Smallwood, P., and Nathans, J. (2011) Expression of the Norrie disease gene (*Ndp*) in developing and adult mouse eye, ear, and brain. *Gene Expression Patterns* 11: 151-155.

120. Badea, T., and Nathans, J. (2011) Morphologies of mouse retinal ganglion cells expressing transcription factors Brn3a, Brn3b, and Brn3c: analysis of wild type and mutant cells using genetically-directed sparse labeling. *Vision Research* 51:269-279.
121. Chuang, N., Mori, S., Yamamoto, A., Jiang, H., Ye, X., Xu, X., Richards, L.J., Nathans, J., Miller, M.I., Toga, A.W., Sidman, R.L., and Zhang, J. (2011) An MRI-based atlas and database of the developing mouse brain. *Neuroimage* 54: 80-89.
122. Ye, X., Wang, Y., Rattner, A., and Nathans, J. (2011) Genetic mosaic analysis reveals a major role for frizzled4 and frizzled8 in controlling ureteric growth in the developing kidney. *Development* 138: 1161-1172.
123. Cahill, H., Rattner, A., and Nathans, J. (2011) Preclinical assessment of central nervous system drug action using eye movements in mice. *Journal of Clinical Investigation* 121: 3528-3541.
124. Matsuoka, R.L., Chivatakarn, O., Badea, T.C., Samuels, I.S., Cahill, H., Katayama, K., Kumar, S.R., Suto, F., Chédotal, A., Peachey, N.S., Nathans, J., Yoshida, Y., Giger, R.J., Kolodkin, A.L. (2011) Class 5 transmembrane semaphorins control mammalian inner retinal lamination, neurite arborization, and function. *Neuron* 71: 460-473.
125. Badea, T.C., Williams, J., Smallwood, P., Shi, M., Motajo, O., and Nathans, J. (2012) Combinatorial expression of Brn3 transcription factors in somatosensory neurons: genetic and morphologic analysis. *Journal of Neuroscience* 32: 995-1007.
126. Yu, H., Ye, X., Guo, N. and Nathans, J. (2012) Frizzled2 and Frizzled7 function redundantly in convergent extension and closure of the ventricular septum and palate: evidence for a network of interacting genes. *Development* 139: 4383-4394.
127. Wang, Y., Rattner, A., Zhou, Y., Williams, J., Smallwood, P.M., and Nathans, J. (2012) Norrin/Frizzled4 signaling in retinal vascular development and blood brain barrier plasticity. *Cell* 151: 1332-1344.
128. Wu, H., Williams, J., and Nathans, J. (2012) Morphologic diversity of cutaneous sensory afferents revealed by genetically directed sparse labeling. *eLife* 1: e00181.
129. Chang, H., and Nathans, J. (2013) Responses of hair follicle-associated structures to loss of planar cell polarity signaling. *Proceedings of the National Academy of Sciences USA*, E908-E917.
130. Rattner, A., Yu, H. Williams, J., Smallwood, P.M., and Nathans, J. (2013) Endothelin2 signaling in the neural retina promotes the endothelial tip cell state and inhibits angiogenesis. *Proceedings of the National Academy of Sciences USA* 110: E3830-E3839.
131. Hua, Z.L., Smallwood, P.M., and Nathans, J. (2013) Frizzled3 controls axonal development in distinct populations of cranial and spinal motor neurons. *eLife* 2: e01482.
132. Wu, H., Luo, J, Yu, H., Rattner, A., Mo, A., Smallwood, P.M., Erlanger, B., Wheelan, S.J., and Nathans, J. (2014) Cellular resolution maps of X-chromosome inactivation: implications for neural development, function, and disease. *Neuron* 81: 103-119.
133. Chang, H., Wang, Y., Wu, H., and Nathans, J. (2014) Whole mount imaging of mouse skin and its application to the analysis of hair follicle patterning and sensory axon morphology. *Journal of Visualized Experiments*: e51749.

134. Hua, Z.L., Jeon, S., Caterina, M., and Nathans, J. (2014) Frizzled3 is required for the development of multiple axon tracts in the mouse central nervous system. *Proceedings of the National Academy of Sciences USA* 111: E3005-3014.
135. Wu, H., Williams, J., and Nathans, J. (2014) Complete morphologies of basal forebrain cholinergic neurons in the mouse. *eLife* 3:e02444.
136. Zhou, Y., Wang, Y., Tischfield, M., Williams, J., Smallwood, P.M., Rattner, A., Taketo, M.M., and Nathans, J. (2014) Canonical Wnt signaling components in vascular development and barrier formation. *Journal of Clinical Investigation* 124: 3825-3846.
137. Hua, Z.L., Chang, H., Wang, Y., Smallwood, P.M., and Nathans, J. (2014) Partial interchangeability of Frizzled3 and Frizzled6 in tissue polarity signaling for epithelial orientation and axon growth and guidance. *Development* 141: 3944-3954.
138. Zhou, Y., and Nathans, J. (2014) Gpr124 controls CNS angiogenesis and blood-brain barrier integrity by promoting ligand-specific canonical Wnt signaling. *Developmental Cell* 31: 248-256.
139. Rattner, A., Wang, Y., Zhou, Y., Williams, J., and Nathans, J. (2014) The role of the hypoxia response in shaping retinal vascular development in the absence of Norrin/Frizzled4 signaling. *Investigative Ophthalmology and Visual Science* 55: 8614-8625.
140. Sun, L.O., Brady, C.M., Cahill, H., Al-Khindi, T., Sakuta, H., Dhande, O.S., Noda, M., Huberman, A.D., Nathans, J., and Kolodkin, A.L. (2015) Functional assembly of accessory optic system circuitry critical for compensatory eye movements. *Neuron* 86:971-984
141. Vanhollebeke, B., Stone, O.A., Bostaille, N., Cho, C., Zhou, Y., Maquet, E., Gauquier, A., Cabochette, P., Fukuhara, S., Mochizuki, N., Nathans, J., and Stainier, D.Y. (2015) Tip cell-specific requirement for an atypical Gpr124- and Reck-dependent Wnt/ $\beta$ -catenin pathway during brain angiogenesis. *Elife* 4: e06489.
142. Mo, A., Mukamel, E.A., Davis, F.P., Luo, C., Henry, G.L., Picard, S., Urich, M.A., Nery, J.R., Sejnowski, T.J., Lister, R., Eddy, S.R., Ecker, J.R., and Nathans, J. (2015) Epigenomic Signatures of Neuronal Diversity in the Mammalian Brain. *Neuron* 86:1369-1384.

#### **Review Articles, Book Chapters, and Letters:**

1. Piantanida, T.P., and Nathans, J. (1987) Molecular genetics of human color vision polymorphism. in *Frontiers of Visual Science: Proceedings of the 1985 Symposium*. Washington D.C.: National Academy of Sciences Press. pp 145-149.
2. Nathans, J. (1987) Molecular biology of visual pigments. *Annual Reviews of Neuroscience* 10: 163–194.
3. Nathans, J. (1989) The genes for color vision. *Scientific American* 260: 42–49.
4. Nathans, J. (1990) Protein–chromophore interactions in rhodopsin studied by site–directed mutagenesis. *Cold Spring Harbor Symposium on Quantitative Biology* 55: 621–633.
5. Nathans, J. (1992) Rhodopsin: structure, function, and genetics. *Biochemistry* 31: 4923-4931.

6. Nathans, J., Sung, C.-H., Weitz, C.J., Davenport, C.M., Merbs, S.L., and Wang, Y. (1992) Visual pigments and inherited variation in human vision. *Journal of General Physiology* 47: 110-131.
7. Nathans, J., Merbs, S. L., Sung, C.-H., Weitz, C. J., and Wang, Y. (1992) Molecular genetics of human visual pigments. *Annual Reviews of Genetics* 26: 401-422.
8. Nathans, J. (1994) In the eye of the beholder: visual pigments and inherited variation in human vision. *Cell* 78: 357-360.
9. Jacobson, S.J., Kemp, C., Cideciyan, A.V., and Nathans, J. (1995) Rhodopsin gene mutations causing retinitis pigmentosa: functional phenotypes of codon 23 and codon 135 genotypes. in *Basic and Clinical Perspectives in Vision Research*. (J. Robbins, ed.) New York: Plenum Press. pp 53-62.
10. Xiang, M., Zhou, H., and Nathans, J. (1996) Molecular biology of retinal ganglion cells. *Proceedings of the National Academy of Sciences USA* 93: 596-601.
11. Xiang, M., Gan, L., Li, D., Zhou, L., Chen, Z.-Y., Wagner, D., O'Malley, B.W., Klein, W., and Nathans, J. (1997) Role of the Brn-3 family of POU-domain genes in the development of the auditory/vestibular, somatosensory, and visual systems. *Cold Spring Harbor Symposium on Quantitative Biology* 62: 325-336.
12. Sharpe, L.T., Stockman, A., Jagle, H., and Nathans, J. (1999) Opsin genes, cone photopigments, color vision, and color blindness. in *Color Vision: from Genes to Perception*. (K. Gegenfurtner, and L.T. Sharpe, eds.) Cambridge: Cambridge University Press. pp 3-51.
13. Rattner, A., Sun, H., and Nathans, J. (1999) Molecular genetics of human retinal disease. *Annual Reviews of Genetics* 33: 89-131.
14. Nathans, J. (1999) The evolution and physiology of human color vision: insights from molecular genetic studies of visual pigments. *Neuron* 24: 299-312.
15. Sun, H. and Nathans, J. (2000) ABCR, the rod photoreceptor-specific ABC transporter responsible for Stargardt disease. in *Methods in Enzymology: Vertebrate Phototransduction and the Visual Cycle*, part A (K. Palczewski, ed.) 315: 879-897.
16. Stockman, A., Sharpe, L.T., Merbs, S. L., and Nathans, J. (2000) Spectral sensitivities of human cone pigments determined in vivo and in vitro. in *Methods in Enzymology: Vertebrate Phototransduction and the Visual Cycle*, part B (K. Palczewski, ed.) 316: 626-650.
17. Sun, H., and Nathans, J. (2001) Mechanistic studies of ABCR, the ABC transporter in photoreceptor outer segments responsible for autosomal recessive Stargardt Disease. *Journal of Bioenergetics and Biomembranes* 33: 523-530.
18. Sun, H., and Nathans, J. (2001) The challenge of macular degeneration. *Scientific American* 285: 60-67.
19. Nathans, J. (2005) Written in our genes? *Science* 308: 1742.
20. Rattner, A., and Nathans, J. (2005) An evolutionary perspective on the photoreceptor damage response. *American Journal of Ophthalmology* 141: 558-562.
21. Rattner, A., and Nathans, J. (2006) Macular degeneration: recent advances and therapeutic opportunities. *Nature Reviews of Neuroscience* 7: 860-872.

22. Wang, Y., and Nathans, J. (2007) Tissue/planar cell polarity in vertebrates: new insights and new questions. *Development* 134: 647-658.
23. Jacobs, G.H., and Nathans, J. (2007) Response to comment on “Emergence of novel color vision in mice engineered to express a human cone pigment”. *Science* 318: 196.
24. Badea, T.C, and Nathans, J. (2008) New genetic technologies for studying the morphology, physiology, and development of mouse retinal neurons. In *Eye, Retina, and Visual System of the Mouse* (L.M. Chalupa and R.W. Williams, eds.) Cambridge, MA: MIT Press. pp 593-604.
25. Jacobs, G.H., and Nathans, J. (2009) The evolution of primate color vision. *Scientific American* 300: 40-47.
26. Gleick, P.H., et al. (2010) Climate change and the integrity of science. *Science* 328: 689-690.
27. Ye, X., Wang, Y., and Nathans, J. (2010) The Norrin/Frizzled4 signaling pathway in retinal vascular development and disease. *Trends in Molecular Medicine* 16: 417-425.
28. Nathans, J. (2010) China’s plan flawed but courageous. *Science* 330: 1625.
29. Julius, D. and Nathans, J. (2012) Signaling by Sensory Receptors. In *Perspectives in Signal Transduction*. Series: Cold Spring Harbor Perspectives in Biology 4: a005991.
30. Huang, L., Rattner, A., Liu, H., and Nathans, J. (2013) Tutorial: How to draw the line in biomedical research. *eLife* 2: e00638.