1. Name, position, academic department (s)

Anita L. Zimmerman, Ph.D.
Professor of Medical Science
Molecular Pharmacology, Physiology & Biotechnology

2. Home address

87 Bay Road
Barrington, RI 02806

3. Education

1978 A.B. Zoology, University of California, Berkeley, California.

1982 Ph.D., Physiology and Biophysics, University of Miami Medical School, Miami, Florida; thesis: Kinetics of Intracellular and Cell-to-cell Diffusion of Fluorescent Tracers.

4. Professional appointments

1974-1977 Staff Research Associate, University of California Medical Center, San Francisco and the Lawrence Livermore Laboratory, Livermore, California.

1983-1987 Postdoctoral Fellow/Research Associate, Department of Neurobiology, Stanford Medical Center, Stanford, California.

1987-1994 Assistant Professor of Medical Science, Section of Physiology, Brown University, Providence, Rhode Island.

1994-2005 Associate Professor of Medical Science (tenured), Molecular Pharmacology, Physiology & Biotechnology, Brown University, Providence, Rhode Island.

1994-1995 Visiting Scientist, on sabbatic leave in the Department of Physiology & Biophysics, University of Washington, Seattle, Washington. September, 1994 - June, 1995.

2005-present Professor of Medical Science (tenured), Molecular Pharmacology, Physiology & Biotechnology, Brown University, Providence, Rhode Island.

5. Completed Research, Scholarship and/or Creative Work:

a. chapters in books

Zimmerman, A.L. Cyclic nucleotide gated ion channels. **In**: Cell Physiology Source Book: A Molecular Approach. N. Sperelakis, editor. Academic Press (chapter 36 in 1st edition, 1995; chapter 46 in 2nd edition, 1998; chapter 47 in 3rd edition, 2001).

Zimmerman, A.L. Visual transduction. **In**: Cell Physiology Source Book: A Molecular Approach.

N. Sperelakis, editor. Academic Press (chapter 37 in 1st edition, 1995; chapter 47 in 2nd edition, 1998; chapter 48 in 3rd edition, 2001).

b. refereed journal articles

Zimmerman, A.L., King, E.B., Barrett, D.L. and Petrakis, N.L. The incidence and significance of intracytoplasmic calcifications in nipple aspirate specimens. *Acta Cytol*. **21:** 685-692 (1977).

Jensen, R.H., Bigbee, W.L., Zimmerman, A.L. and King, E.B. Plasminogen activator as a diagnostic marker for preneoplastic cells in human gynecologic specimens. *Acta Cytol*. **23:** 105 (1979).

Schwarzmann, G., Weigandt, H., Rose, B., Zimmerman, A.L., Ben-Haim, D. and Loewenstein, W.R. Diameter of the cell-to-cell junctional membrane channels as probed with neutral molecules. *Science* **213:** 551-553 (1981).

Tedeschi, B., Wilson, D.L., Zimmerman, A.L. and Perry, G.W. Are axonally transported proteins released from sciatic nerves? *Brain Research* **211:** 175-178 (1981).

Zimmerman, A.L. and Rose, B. Permeability properties of cell-to-cell channels: Kinetics of fluorescent tracer diffusion through a cell junction. *J. Membrane Biol*. **84:** 269-283 (1985).

Zimmerman, A.L., Yamanaka, G., Eckstein, F., Baylor, D.A. and Stryer, L. Interaction of hydrolysis-resistant analogs of cyclic GMP with the phosphodiesterase and light-sensitive channel of retinal rod outer segments. *Proc. Natl. Acad. Sci. USA* **82:** 8813-8817 (1985).

Zimmerman, A.L. and Baylor, D.A. The cyclic GMP-sensitive conductance of retinal rods consists of aqueous pores. *Nature* **321:** 70-72 (1986).

Karpen, J.W., Zimmerman, A.L., Stryer, L. and Baylor, D.A. Gating kinetics of the cyclic-GMP-activated channel of retinal rods: flash photolysis and voltage-jump studies. *Proc. Natl. Acad. Sci. USA*. **85:** 1287-1291 (1988).

Zimmerman, A.L., Karpen, J.W. and Baylor, D.A. Hindered diffusion in excised membrane patches from retinal rod outer segments. *Biophys. J*. **54:** 351-355 (1988).

Zimmerman, A.L., Karpen, J.W., Kantrowitz-Gordon, S., Tsai, C-S. S., Baylor, D.A. and Stryer, L. Workings of the cGMP-activated channels of retinal rods. *Neuroscience Research*, Suppl. 12, S165 - S174 (1990).

Zimmerman, A.L. and Baylor, D.A. Cation interactions within the cyclic GMP-activated channel of retinal rods from the tiger salamander. *J.Physiol*. **449**: 759-783 (1992).

Gordon, S.E., Brautigan, D.L. and Zimmerman, A.L. Protein phosphatases modulate the apparent agonist affinity of the light-regulated ion channel in retinal rods. *Neuron* 9: 739-748 (1992).

Gordon, S.E., Downing-Park, J. and Zimmerman, A.L. Modulation of the cGMP-gated ion channel in frog rods by calmodulin and an endogenous inhibitory factor. *J. Physiol*. **486**: 533-546 (1995).

Gordon, S.E., Downing-Park, J., Tam, B. and Zimmerman, A.L. Diacylglycerol analogs inhibit the rod cGMP-gated channel by a phosphorylation-independent mechanism. *Biophys. J.* **69**: 409-417 (1995).

Zimmerman, A.L. Cyclic nucleotide-gated channels. *Current Opinion in Neurobiology* **5**: 296-303 (1995).

Crary, J.I., Gordon, S.E. and Zimmerman, A.L. Perfusion system components release agents that distort functional properties of rod cyclic nucleotide-gated ion channels. *Visual Neuroscience* **15**: 1189-1193 (1998).

Crary, J.I., Dean, D.M., Nguitragool, W., Kurshan, Peri T. and Zimmerman, A.L. Mechanism of Inhibition of Cyclic Nucleotide-Gated Ion Channels by Diacylglycerol. *J. Gen. Physiol.* **116**: 755-768 (2000).

Crary, J.I., Dean, D.M., Maroof, F. and Zimmerman, A.L. Mutation of a single residue in the S2-S3 loop of CNG channels alters the gating properties and sensitivity to inhibitors. *J. Gen. Physiol.* **116**: 769-779 (2000).

Dean, D.M., Nguitragool, W., Miri, A., McCabe, S.L. and Zimmerman, A.L. All-*trans*-retinal shuts down rod cyclic nucleotide-gated ion channels: a novel role for photoreceptor retinoids in the response to bright light? *Proc. Natl. Acad. Sci. USA* **99**: 8372-8377 (2002).

Zimmerman, A.L. Two B or not two B? Questioning the rotational symmetry of tetrameric ion channels. *Neuron* **36**: 997-999 (2002). This was an invited, but peer-reviewed, minireview.

McCabe, S.L., Pelosi, D.M., Tetreault, M., Miri, A., Nguitragool, W., Kovithvathanaphong, P., Mahajan, R. and Zimmerman, A.L. All-*trans*-retinal is a closed-state inhibitor of rod cyclic nucleotide-gated ion channels. *J. Gen. Physiol.* **123**: 521-531 (2004).

Zimmerman, A.L. Capturing ion channel gating: a little salt on the tail does the trick. *J. Gen. Physiol.* **124**: 627-629 (2004). Invited paper, but reviewed.

Yeh, J.I., Zimmt, M. B., and Zimmerman, A. L. Nanowiring of a Redox Enzyme by Metallized Peptides. Rapid communication, *Biosensors & Bioelectronics* **21**: 973-978 (2005).

Horrigan, D.M., Tetreault, M.L., Tsomaia, N., Vasileiou, C., Borhan, B., Mierke, D.F., Crouch, R.K. and Zimmerman, A.L. Defining the retinoid binding site in the rod cyclic nucleotide-gated channel. *J. Gen. Physiol.* **126**: 453-460 (2005).

Tetreault, M.L., Henry, D., Horrigan, D.M., Matthews, G. and Zimmerman, A.L. Characterization of a novel cyclic nucleotide-gated channel from zebrafish brain. *Biochem. Biophys. Res. Comm.* **348**: 441-449 (2006).

Tetreault, M.L., Horrigan, D.M., Kim, J.A. and Zimmerman, A.L. Retinoids restore normal cGMP sensitivity of mutant ion channels associated with cone dystrophy. Acceptable with minor revision *Molecular Vision* (2006).

He, Q., Alexeev, D., Estevez, M.E., McCabe, S.L., Calvert, P.D., Ong, D.E., Cornwall, M.C., Zimmerman, A.L. and Makino, C.L. Cyclic nucleotide-gated ion channels in rod photoreceptors are protected from retinoid inhibition. In press, *J. Gen. Physiol.* (2006).

Zimmerman, A.L. The sweet smell of success: conclusive evidence that cyclic AMP hydrolysis does not trigger fast adaptation in olfactory receptor cells. *J. Gen. Physiol.* **128**: 149-151 (2006). Invited paper, but reviewed.

Isayama, T., Chen, Y., McCabe, S. L., DeGrip, W. J., Zimmerman, A. L., Ma, J.-X., Crouch, R. K., Makino, C. L. Differences in the pharmacological activation of visual opsins support the existence of a second retinoid-binding site. *In preparation.*

c. non-refereed journal articles

King, E.B., Zimmerman, A.L., Barrett, D.L., Petrakis, N.L. and King, M.C. Cytopathology of abnormal mammary duct epithelium. **In:** Proceedings of the Third International Symposium on Detection and Prevention of Cancer. New York, April 29, 1976.

Karpen, J.W., Zimmerman, A.L., Stryer, L., and Baylor, D.A. Molecular mechanics of the cyclic GMP-activated channel of retinal rods. **In:** Cold Spring Harbor Symposium on Quantitative Biology, Vol. 53 (1988).

d. abstracts

King, E.B., Zimmerman, A.L., Barrett, D.L. and Petrakis, N.L. Cytopathology of duct epithelial abnormalities in the breast. *Acta Cytol. Abstr.* **19:** 586 (1975).

Zimmerman, A.L. and Rose, B. Kinetics of intracellular and cell-to cell (transjunctional) diffusion of fluorescent tracers. *Biophys. J.* **37:** 286a (1982).

Zimmerman, A.L. and Rose, B. Analysis of cell-to-cell diffusion kinetics: changes in junctional permeability without accompanying changes in selectivity. *Biophys. J.* **41:** 216a (1983).

Zimmerman, A.L. and Baylor, D.A. Electrical properties of the light-sensitive conductance of salamander retinal rods. *Biophys. J.* **47:** 357a (1985).

Zimmerman, A.L. and Baylor, D.A. Gating and conduction in the light-sensitive channels of retinal rods. *Biophys. J.* **49:** 408a (1986).

Zimmerman, A.L. and Baylor, D.A. Interactions of Cations with the cyclic GMP-sensitive channel of retinal rods. *Biophys. J.* **51:** 17a (1987).

Karpen, J.W., Zimmerman, A.L., Stryer, L. and Baylor, D.A. Gating kinetics of the cGMP-activated channel of retinal rods. *Biophys. J.* **53:** 37a (1988).

Zimmerman, A.L. and Baylor, D.A. Ionic permeation in the cGMP-activated channel of retinal rods. *Biophys. J.* **53:** 472a (1988).

Kantrowitz-Gordon, S.E. and Zimmerman, A.L. Long-term changes in the cGMP-activated conductance in excised patches from rod outer segments. *Biophys. J.* **59:** 533a (1991).

Gordon, S.E. and Zimmerman, A.L. An increase in cyclic GMP sensitivity of rod outer segment channels following patch excision is reversibly blocked by a phosphatase inhibitor. *Invest. Ophthal. Vis. Sci.* **33:** 1104 (1992).

Gordon, S.E. and Zimmerman, A.L. Diacylglycerol analogs suppress the cyclic GMP-activated conductance in rod outer segment patches in the absence of ATP. *Biophys. J.* **64:** A217 (1993).

Zimmerman, A.L. and Gordon, S.E. Phosphorylation-independent suppression of the cyclic GMP-activated conductance in rod outer segment patches by diacylglycerol analogs. *Invest. Ophthal. Vis. Sci.* **34:** 1068 (1993).

Gordon, S.E. and Zimmerman, A.L. Modulation of the rod cGMP-gated ion channel by calmodulin and an endogenous factor distinct from calmodulin. *Biophys. J.* **66:** 355a (1994).

Gordon, S.E., Crary, J.I. and Zimmerman, A.L. Do perfusion-related conditions contribute to the apparent differences between cloned and native cyclic nucleotide-gated channels? *Biophys. J.* **74**: A385 (1998).

Crary, J.I., Maroof, F. and Zimmerman, A.L. Differential Inhibition of olfactory and rod cyclic nucleotide-gated channels by diacylglycerol. *Biophys. J.* **76**: A349 (1999).

Zimmerman, A.L., Crary, J.I. and Maroof, F. Degree of inhibition of different cyclic nucleotide-gated ion channels by diacylglycerol does not merely depend on efficacy of channel opening. *Invest. Ophthal. Vis. Sci.* **40:** 1258 (1999).

Crary, J.I., Dean, D.M. and Zimmerman, A.L. A point mutation in olfactory CNG channels dramatically increases inhibition by diacylglycerol. *Biophys. J.* **78**: 148A (2000).

Crary, J.I., Dean, D.M., Nguitragool, W. and Zimmerman, A.L. A point mutation in the S2-S3 loop of the olfactory cyclic nucleotide-gated ion channel alters its sensitivity to agonists, voltage and inhibitors *J. Gen. Physiol.* **116**(1):10A (2000).

Zimmerman, A. L. and Dean, D. All-*trans* retinal and all-*trans* retinol inhibit cloned wild-type rod cyclic nucleotide-gated ion channels. *Invest. Ophthal. Vis. Sci.* **42:** 1995 (2001).

Nguitragool, W., Miri, A., McCabe, S.L., Dean, D.M. and Zimmerman, A.L. Retinoids shut down rod cyclic nucleotide-gated ion channels. *Biophys. J.* **82**: 277A (2002).

McCabe, S.L., Pelosi, D.M., Miri, A., Nguitragool, W., Kovithvathanaphong, P., Mahajan, R. and Zimmerman, A.L. Inhibition of cyclic nucleotide-gated (CNG) channels by all-*trans*-retinal. *Biophys. J.* **84**: 400A (2003).

McCabe, S.L., Calvert, P., Makino, C.L. and Zimmerman, A.L. Is retinoid inhibition of photoreceptor cyclic nucleotide-gated (CNG) channels physiologically relevant? *Biophys. J.* **86**: 292A (2004).

Pelosi, D.M., Tetreault, M.L., McCabe, S.L. and Zimmerman, A.L. All-trans-retinal is a closed-state inhibitor of rod cyclic nucleotide-gated (CNG) channels. *Biophys. J.* **86**: 292-293A (2004).

McCabe, S.L., He, Q., Calvert, P.D., Makino, C.L. and Zimmerman, A.L. Retinoid inhibition of cyclic nucleotide-gated (CNG) channels in isolated photoreceptors. *Biophys. J.* **88**: 508A (2005).

Tetreault, M.L., Rothschild, J. and Zimmerman, A.L. All-trans-retinal inhibits CNG channels but not Shaker channels. *Biophys. J.* **88**: 295A (2005).

Horrigan, D.M., Tetreault, M.L., Tsomaia, N., Vasileiou, C., Borhan, B., Mierke, D.F., Crouch, R.K. and Zimmerman, A.L. Defining the retinoid binding site in the rod CNG (CNGA1) channel. *Biophys. J.* **90**: 1214A (2006).

Tetreault, M.L., Henry, D., Matthews, G.G. and Zimmerman, A.L. Characterization of a Novel Cyclic Nucleotide-gated Channel from Zebrafish Brain. *Biophys. J.* **90**: 51A (2006).

e. invited lectures

i. invited research seminars

1986 Minisymposium on "Internal Transmitter Mechanisms in Retinal Rods", Biophysical Society Annual Meeting, San Francisco, California, February 9-13.

1987 Massachusetts General Hospital, Department of Neurology, Boston, Massachusetts, February 5.

Brandeis University, Graduate Department of Biochemistry, Waltham, Massachusetts, February 10.

FASEB meeting on the "Biology and Chemistry of Vision", Copper Mountain, Colorado, July 26-31.

University of North Carolina Medical School, Department of Pharmacology, Chapel Hill, North Carolina, October 13.

Harvard Medical School, Department of Neurobiology, Boston, Massachusetts, December 14.

1989 University of Connecticut School of Medicine, Department of Physiology, Farmington, Connecticut, March 16.

Taniguchi Foundation International Symposium on Molecular Mechanisms of Sensory Transduction, Katata, Japan, November 27 - December 1. One of nineteen participants (one of six from the U.S.A.).

1990 University of Massachusetts at Amherst, Department of Zoology, March 9.

Rush University, Physiology Department, Chicago, Illinois, November 5.

1991 University of California at San Francisco, Department of Ophthalmology, March 1.

Brown University, Neurosciences Graduate Seminar Series, October 31.

State University of New York at Stony Brook, Department of Neurobiology, November 19.

Harvard Medical School, Department of Neurobiology, Boston, Massachusetts, December 10.

1992 University of Washington, Department of Physiology & Biophysics, Seattle, Washington, January 9.

Stanford University Medical School, Department of Neurobiology, Stanford, California, January 13.

University of California, Department of Animal Physiology, Davis, California, January 14.

California Institute of Technology, Division of Biology, Pasadena, California, January 15.

Harvard Medical School, Department of Ophthalmology, Massachusetts Eye & Ear Hospital, Boston, Massachusetts, December 11.

1993 University of Miami Medical School, Department of Physiology & Biophysics, Miami, Florida, February 11.

Harvard Medical School, Department of Neurobiology, Boston, Massachusetts, February 25.

FASEB meeting on the "Biology and Chemistry of Vision", Copper Mountain, Colorado, June 20-25.

Marine Biological Laboratory, Woods Hole, Massachusetts, November 10.

Division of Renal Diseases, Rhode Island Hospital, November 19.

1998 Smith-Kettlewell Research Institute, San Francisco, California, January.

1999 SISSA International School for Advanced Studies, Trieste, Italy, November 5.

2000 Department of Physiology & Biophysics, University of Washington, Seattle, January 27.

Department of Neurobiology, Stanford University Medical School, Stanford, January 29.

Chair, Symposium on "Sensational Molecules: Mechanisms of Sensory Transduction", Annual Biophysical Society meeting, New Orleans, Louisiana, February 16.

2001 Columbia University, Molecular Biophysics Seminar on "Gating and Modulation of Cyclic Nucleotide-gated Ion Channels", May 4.

2002 Harvard Medical School, Ophthalmology, Boston, Massachusetts, November 15.

2003 Department of Physiology & Pharmacology, Oregon Health & Science University, Portland, Oregon, April 24.

Neuroscience Graduate Program, University of California, San Francisco, April 25.

MRC Laboratory of Molecular Biology, Cambridge, England, November 17.

Institut für Biologische Informationsverarbeitung, Jülich, Germany, November 18.

International School for Advanced Studies (SISSA), Trieste, Italy, November 21.

2004 Department of Biochemistry and Molecular Biology, University of New Hampshire, Durham, April 9.

Department of Physiology & Biophysics, Boston University School of Medicine, November 2.

2005 FASEB Summer Research Conference on the Biology and Chemistry of Vision, June 19.

ii. invited guest lectures in courses

1979-1981 Graduate teaching assistant for mammalian physiology and cell physiology/biophysics for first-year medical students and graduate students at the University of Miami Medical School.

1983-1984 Teaching assistant for an introductory neurobiology course for first-year medical students at Stanford University Medical School.

1987 Guest lecturer in a graduate level course in membrane biophysics (BI 265) at Brown University.

1987, 1991, 1993 Guest lecturer in a graduate level course in cellular neurophysiology (Neurobiology 220) at Harvard Medical School, Department of Neurobiology. Lectures on visual transduction.

1990, 1993, Guest lecturer in the Neurobiology course of the Boston University

1996, 1997, 1998	Marine Program at the Marine Biological Laboratory in Woods Hole, Massachusetts. Lectures on G-proteins, visual transduction and cyclic nucleotide-gated ion channels.
1990-1993	Guest lecturer in a graduate level course on sensory transduction (Biology 222) at Harvard University, Department of Cellular & Developmental Biology.
1992, 1996, 2001	Lecturer in an introductory physiology course at Pfizer.
1996, 1999	Guest lecturer for the Neurobiology summer course at the Marine Biological Laboratory in Woods Hole, Massachusetts. Lectures on cyclic nucleotide gated ion channels.
2002	Guest lecturer in BN 102 (Principles of Neurobiology), Brown University.
	Guest lecturer in BN 110 (Cell Physiology & Biophysics), Brown University (Julie Kauer was course director).
	Guest lecturer in BI 217 (Receptors, Channels & Signalling), Brown University.
2003	Guest lecturer in sensory physiology, SISSA, Trieste, Italy, November 24.
	Guest lecturer in visual transduction, SISSA, Trieste, Italy, November 25.
2004	Guest lecturer in BI 127/227 (Advanced Biochemistry), Brown University.
2005, 2006	Guest lecturer in BI 194/PH 199 (Selected Topics in Molecular Biophysics), Brown University.
	Guest lecturer in BN 203 (Cellular Neuroscience), Brown University.

6. Research in progress

Research in our laboratory is in the area of molecular & cellular neurobiology, with an emphasis on the function, structure and regulation of ion channels and the mechanisms of visual transduction. Essentially every function in the body is controlled by the activity of ion channels -- membrane proteins that change their conformation in response to chemical and electrical signals, allowing specific ions to enter or exit cells as needed. Ion channels are critically involved in functions as diverse as nerve impulses in the brain, the beating of the heart, visual perception, muscle contraction, learning and memory, and embryonic development. They are also the targets of many drugs, such as those used to treat pain and heart disease, and genetic defects in ion channels can cause devastating diseases, such as cystic fibrosis. Our current work centers on ion channels that are opened by direct interaction with cyclic nucleotides (e.g., cyclic AMP & cyclic GMP) and by changes in membrane voltage. Since these ion channels contain pores that allow the passage of Ca^{2+} and Na^{+} into cells,

their activity affects membrane voltage and the intracellular concentration of Ca^{2+}, both of which are vital regulators of cell function.

We study the molecular mechanisms by which these channels undergo conformational changes and are regulated by intracellular factors, such as calcium binding proteins and phosphorylation enzymes, as well as by external agents such as local anesthetics. Much of our current research centers on the control of ion channel function by derivatives of Vitamin A (retinoids), like all-*trans* retinal which is critically involved in the first stages of vision. Our experimental techniques include patch clamp and artificial bilayer (electrophysiological) methods, molecular biology (including site-directed mutagenesis), biochemistry and computational studies. For most projects, we study cloned channels heterologously expressed in *Xenopus* (frog) oocytes, but we also study purified channels inserted into artificial bilayers, as well as native channels in photoreceptors (rod and cone cells) to study the role of channel modulation in vision and retinal disease.

We also evaluate derivatives of Vitamin A that may be useful in treating degenerative diseases of the retina that cause blindness. These derivatives regulate the sensitivity of cyclic nucleotide-gated ion channels to cyclic GMP without affecting other members of the enzyme cascade involved in visual transduction. By specifically targeting the channels, these agents may be able to counteract the problems created by genetic defects that lead to abnormal levels of cyclic GMP (e.g, in some forms of retinitis pigmentosa) or hyperactive channels (e.g., in some forms of cone dystrophy).

7. Service

a. service to Brown

1990-1994	Sophomore advisor
1990-2/2006	Biology concentration advisor, with typically 10 to 20 students per class.
1993	Member, Neuroscience faculty search committee.
1999	Member, faculty search committee, Molecular Pharmacology, Physiology & Biotechnology
	Member, Provost search committee
1999-2005	Member, Institutional Animal Care and Use Committee (IACUC).
2001-3/2006	Member, Graduate Program Committee, Molecular Pharmacology & Physiology
2002-2004	Associate Director, Brown University MD/PhD program
2002-3/2006	Co-director, Graduate Program, Molecular Pharmacology & Physiology
2002-present	Member, Financial Aid Planning Committee, Brown University Medical School
2004-3/2006	Member, Brown Medical School Curriculum Committee

2005-present Director, Brown University MD/PhD program

b. service to the scientific profession

i. grant review service

1988 Ad Hoc reviewer for Alberta Heritage Foundation for Medical Research (Canada).

1990 Ad Hoc reviewer for the Medical Research Council of Canada.

1991 Ad Hoc reviewer for the Visual Sciences B Study Section (AHR-S1) of the National Eye Institute, NIH.

1993-1994 Member, NIH Behavior & Neurosciences Study Section 1, until its dissolution.

1994 Ad Hoc reviewer for the Visual Sciences A Study Section and for the Visual Sciences C Study Section, National Eye Institute, NIH.

1996 Ad Hoc reviewer for a Special Emphasis Panel for the Visual Sciences A Study Section, National Eye Institute, NIH.

2005 Ad Hoc reviewer for the Retinal Studies Special Emphasis Panel, NIH.

2005-present One of two Brown Medical School representatives to the Group in Graduate Research, Education and Training of the Association of American Medical Colleges (AAMC).

ii. Editorial boards, journal review service

2006-present Member, Editorial Board, *Journal of General Physiology*

1987-present, ad hoc reviewer for the following journals:

American Journal of Physiology
Biochemistry
Biophysical Journal
Biochimica et Biophysica Acta
Current Pharmaceutical Design
European Journal of Physiology
Journal of Experimental Biology
Journal of Experimental Zoology
Journal of General Physiology
Journal of Membrane Biology
Journal of Neurophysiology
Journal of Neuroscience
Journal of Physiology (London)
Neuron
Proc. Natl. Acad. Sci.
Proceedings of the Royal Society
Science
Visual Neuroscience

iii. society offices

1998-2001 Elected Member of the General Council of the Biophysical Society

Member, Committee on Biophysical Discussions.

1998-2001 Elected Member of Council for the Society of General Physiology.

1998-present Member, Biophysical Society Public Affairs Committee

iv. society memberships:

American Association for the Advancement of Science
Association for Research in Vision and Ophthalmology
Biophysical Society
Society of General Physiologists
Society for Neuroscience

c. service to the community

1991 Speaker at the New England Biology Teachers' Conference, presenting current topics in neurobiology to high school biology teachers.

1999 Workshop on "From Genetic Engineering to Bioelectricity: Making Frog Eggs Work for Us" in "Discovering Biotechnology Day", sponsored at Brown by Johns Hopkins University Institute for Academic Advancement of Youth.

2001 Speaker at the Barrington High School Career Day workshop, spring, 2001.

8. Academic honors, research grants, fellowships, honorary societies

Current and pending grants:

1988-2007 Current: NIH research grant, R01 EY07774 (National Eye Institute), "Properties of light-modulated ion channels in the retina."

2007-2012 Pending: NIH research grant, 1R01 NS058890-01 (National Institute of Mental Health, National Institute of Neurological Disorders and Stroke), "Properties of brain cyclic nucleotide-gated ion channels."

Past grants, awards and honors:

2002 and 2004-2006 Dean's Teaching Excellence Award for outstanding teaching in the first-year medical physiology course (BI 117) presented by the Brown Medical School.

1983-1985 NIH training grant award, #NS-07158, for postdoctoral research.

1997-1999 RI American Heart, "Modulation of ion channels in the sino-atrial node of the heart."

1998 Salomon Faculty Research Award, "Molecular mechanism of modulation of cyclic

nucleotide-gated ion channels by Ca^{2+}/calmodulin."

1998 Rhode Island Foundation Research Grant, "Molecular mechanism of modulation of cyclic nucleotide-gated ion channels by Ca^{2+}/calmodulin."

9. Teaching (last three years)

Course director and lecturer in a cell physiology/biophysics course (BI 110) for upper level undergraduates and graduate students. Taught every other spring. Enrollment 30 students (limited enrollment).

Lecturer on general/cellular physiology in a mammalian physiology course (BI 117) for first-year medical students and graduate students. Taught every fall, until 2006. Enrollment limited to 80 students.

Lecturer and course director for an introductory physiology course (BI 80) for undergraduates. Taught every other spring, alternately with BI 110. Enrollment about 120-150 students. I also give a few lectures in this course when it is directed by Don Jackson in alternate years.

Occasional guest lectures in other Brown courses (see guest lectures list above).

Thesis advisor for two Ph.D. students; advisor for one postdoctoral research associate, three rotation graduate students, six undergraduate research assistants and one visiting summer student from Tougaloo College. Thesis committee member for four Ph.D. students, in addition to my own two graduate students.

Lecturer in BI 364, Integrated Medical Sciences, Section 1: Scientific Foundations of Medicine. Taught every fall to the first-year medical school class. Replaces my teaching in BI 117, which ended Fall of 2005.

Lecturer in BI 217, core course to be started this fall for the graduate program in Molecular Pharmacology and Physiology.

10. Date of the preparation of the document: September 18, 2006.