

URSULA WILTSHIRE GOODENOUGH

CURRICULUM VITAE

Born: March 16, 1943, New York City

Five children (b. 1970, 1974, 1980, 1982, 1985)

Current Positions:

Professor of Biology Emerita
Department of Biology
Washington University
St. Louis, MO 63130
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Education:

Radcliffe College, 1960-1961, Ann Radcliffe Scholar.
Barnard College, 1961-1963, A.B. cum laude with honors in Zoology,
Phi Beta Kappa, von Wahl Prize in Zoology
Columbia University, 1963-1965, M.A. in Zoology
(Advisor: Professor Lee D. Peachey)
Harvard University, 1965-1969, Ph.D. in Biology
(Thesis Advisor: Professor Keith R. Porter)

Positions Held:

2017- Professor of Biology Emerita, Washington University
1982-2017 Professor of Biology, Washington University
1978-1982 Associate Professor of Biology, Washington University
1976-1978 Associate Professor of Biology, Harvard University
1971-1976 Assistant Professor of Biology, Harvard University
1969-1971 NIH Post-Doctoral Fellow, Harvard University
(sponsor: Professor Lawrence Bogorad)
1964-1969 NIH Pre-Doctoral Fellow, Columbia and Harvard Universities
1963-1964 Eugene Higgins Fellow, Columbia University

Professional Activities:

1978-1982 Member, Molecular Cytology Study Section, NIH
1987-1992 Member, Cell Biology Review Panel, NSF
1979-1983 Associate Editor, Journal of Cell Biology
1994-1998 Associate Editor, Cell Motility and the Cytoskeleton
1997-2000 Associate Editor, Journal of Phycology
1988 Coordinator, Meeting on Cell and Molecular Biology of
Chlamydomonas, Cold Spring Harbor Laboratory
1990 Coordinator, Regional Meeting of the American Society for
Cell Biology, Chicago
1990-1993 Council Member, American Society for Cell Biology (ASCB)
1990-1993 Member, Education Committee, ASCB
1992-1993 Chair, Women in Cell Biology Committee, ASCB
1994-1995 President, ASCB
1994-1995 Member, Future of Space Science Steering Group (FOSS), Space
Studies Board, National Research Council (NRC)
1995-1998 Member, Commission on Life Sciences, NRC

1996-1998 Adjunct Member, Trends in Early Research Careers, Biology Board, NRC
1996-2010 President, Phi Beta Kappa, Washington University chapter
1999-2000 Phi Beta Kappa Visiting Scholar
1999-2002 Board member, Science Writers Fellowship Program, Marine Biological Laboratory
2001-2003 Editor, Eukaryotic Cell
2002 Coordinator, Meeting on Cell and Molecular Biology of *Chlamydomonas*, Vancouver, Canada
2003-2009 Chair, Women in Cell Biology Committee, ASCB
2012 - Editorial Board, Algal Research
2012-2018 Scientific Advisory Committee, Integrated Microbial Diversity, Canadian Institute for Advanced Research

Science Policy:

1992-2009 Member, Public Policy Committee, ASCB
1995-1997 Member, Joint Steering Committee for Public Policy
1993-1995 Chair, NSF and NASA Committees, FASEB Consensus Conferences on Public Policy
1997-1999 Member, FASEB Subcommittee on Ethical Issues of Genetic Research

Washington University:

Teaching:

Biology 334, Introduction to Cell Biology (junior-level)
Biology/Earth and Planetary Sciences/Physics 210, Epic of Evolution (non-science majors)
Biology 4331: Algae: Cell Biology and Molecular Evolution (graduate level)
Biology 5702: Current Approaches in Plant Research (course coordinator)

Administration:

Departmental and University service has included Curriculum Committee (Chair), Microscope Facility (Chair), Space Committee, Chairman's Advisory Committee, Graduate Council, Assembly Series, Committee on Scientific Integrity, Faculty Senate Council, Arts and Sciences Promotion and Tenure Committee, Arts and Sciences Review Committee on Faculty Personnel Procedures, University Academic Freedom and Tenure Hearing Committee, Association of Women Faculty Board, various Search Committees, Plant and Molecular Biosciences Graduate Admissions Committee

Honors

Faculty Teaching Awards, Washington University, 1986 and 1994
Founder's Day Distinguished Faculty Award, Washington University, 1995
Senior Career Recognition Award, American Society for Cell Biology, 1999
Fellow, American Women in Science, 2009
Fellow, American Academy of Arts and Sciences, 2009
Fellow, American Academy of Microbiology, 2013
Fellow, American Society for Cell Biology, 2017
Doctor of Letters *Honoris Causa*, Meadville School of Theology, 2022

Research Interests and Support:

Research has focused on the life cycle of the green alga *Chlamydomonas reinhardtii* using molecular-genetic and ultrastructural analysis. Additional projects have analyzed the ciliary axoneme, the cell walls of various algae, the formation of algal lipid bodies, and the ultrastructure of lichens. The lab has been continuously supported by grants from the NIH, NSF, USDA, and DOE.

Research Articles:

- Johnson (former surname), U.G., and K.R. Porter. 1968. Fine structure of cell division in *Chlamydomonas reinhardi*. Basal bodies and microtubules. *J. Cell Biol.* 38:403-426.
- Goodenough, U.W. and R.P. Levine. 1969. Chloroplast ultrastructure in mutant strains of *Chlamydomonas reinhardi* lacking components of the photosynthetic apparatus. *Plant Physiol.* 44:990-1000.
- Goodenough, U.W., J.J. Armstrong, and R.P. Levine. 1969. Photosynthetic properties of *ac-31*, a mutant strain of *Chlamydomonas reinhardi* devoid of chloroplast membrane stacking. *Plant Physiol.* 44:1001-1012.
- Goodenough, U.W. and R.P. Levine. 1970. Chloroplast structure and function in *ac-20*, a mutant strain of *Chlamydomonas reinhardi*. III. Chloroplast ribosomes and membrane organization. *J. Cell Biol.* 44:547-562.
- Goodenough, U.W. 1970. Chloroplast division and pyrenoid formation in *Chlamydomonas reinhardi*. *J. Phycol.* 6:1-6.
- Goodenough, U.W. and L.A. Staehelin. 1971. Structural differentiation of stacked and unstacked chloroplast membranes: Freeze-etch electron microscopy of wild type and mutant strains of *Chlamydomonas reinhardi*. *J. Cell Biol.* 48:594-619.
- Goodenough, U.W. 1971. The effects of inhibitors of RNA and protein synthesis on chloroplast structure and function in *Chlamydomonas reinhardi*. *J. Cell Biol.* 50:35-49.
- Goodenough, U.W. and R.P. Levine. 1971. The effects of inhibitors of RNA and protein synthesis on the recovery of chloroplast ribosomes, membrane organization and photosynthetic electron transport in the *ac-20* strain of *Chlamydomonas reinhardi*. *J. Cell Biol.* 50:50-62.
- Steinback, K.E. and U.W. Goodenough. 1975. Morphological and photosynthetic properties of digitonin-treated chloroplast membranes from the wild-type and *ac-5* strains of *Chlamydomonas reinhardi*. *Plant Physiol.* 55:863-869.
- Martin, N.C. and U.W. Goodenough. 1975. Gametic differentiation in *Chlamydomonas reinhardi*. I. Production of gametes and their fine structure. *J. Cell Biol.* 67:587-605.
- Bergman, K., U.W. Goodenough, D.A. Goodenough, J. Jawitz, and H. Martin. 1975. Gametic differentiation in *Chlamydomonas reinhardi*. II. Flagellar membranes and the agglutination reaction. *J. Cell Biol.* 67:606-622.
- Goodenough, U.W. and R.L. Weiss. 1975. Gametic differentiation in *Chlamydomonas reinhardi*. III. Cell wall lysis and microfilament-associated mating structure activation in wild-type and mutant strains. *J. Cell Biol.* 67:623-637.
- Goodenough, U.W. and H.S. St. Clair. 1975. Bald-2: A mutation affecting the formation of doublet and triplet sets of microtubules in *Chlamydomonas reinhardi*. *J. Cell Biol.* 66:480-491.
- Goodenough, U.W., C. Hwang, and H. Martin. 1976. Isolation and genetic analysis of mutant strains of *Chlamydomonas reinhardi* defective in gametic differentiation. *Genetics* 82:169-186.
- Martin, N.C., K.S. Chiang, and U.W. Goodenough. 1976. Turnover of chloroplast and cytoplasmic ribosomes during gametogenesis in *Chlamydomonas reinhardi*. *Dev. Biol.* 51:190-201.
- Weiss, R.L., D.A. Goodenough, and U.W. Goodenough. 1977. Membrane particle arrays associated with the basal body and with contractile-vacuole secretion in *Chlamydomonas*. *J. Cell Biol.* 72:133-143.

- Weiss, R.L., D.A. Goodenough, and U.W. Goodenough. 1977. Membrane differentiations at sites specialized for cell fusion. *J. Cell Biol.* 72:144-160.
- Goodenough, U.W. and R.L. Weiss. 1978. Interrelationships between microtubules, a striated fiber, and the gametic mating structure of *Chlamydomonas reinhardi*. *J. Cell Biol.* 76:430-438.
- Minami, S.A. and U.W. Goodenough. 1978. Novel polypeptide synthesis induced by gametic cell fusion in *Chlamydomonas reinhardi*. *J. Cell Biol.* 77:165-181.
- Goodenough, U.W., Hwang, C., and A.J. Warren. 1978. Sex-limited expression of gene loci controlling flagellar membrane agglutination in the *Chlamydomonas* mating reaction. *Genetics* 89:235-243.
- Forest, C., D.A. Goodenough, and U.W. Goodenough. 1978. Flagellar membrane agglutination and sexual signaling in the conditional *gam-1* mutant of *Chlamydomonas*. *J. Cell Biol.* 79:74-84.
- Goodenough, U.W. and D. Jurivich. 1978. Tipping and mating-structure activation induced in *Chlamydomonas* gametes by flagellar-membrane antisera. *J. Cell Biol.* 79:680-693.
- Adair, W.S., D. Jurivich, and U.W. Goodenough. 1978. Localization of cellular antigens in sodium dodecyl sulfate-polyacrylamide gels. *J. Cell Biol.* 79:281-285.
- Mesland, D.A.M., J.L. Hoffman, E. Caligor and U.W. Goodenough. 1980. Flagellar tip activation stimulated by membrane adhesions in *Chlamydomonas* gametes. *J. Cell Biol.* 84:599-617.
- Hoffman, J.L. and U.W. Goodenough. 1980. Experimental dissection of flagellar surface motility in *Chlamydomonas*. *J. Cell Biol.* 86:656-665.
- Hwang, C., B.C. Monk, and U.W. Goodenough. 1981. Linkage of mutations affecting *minus* flagellar membrane agglutinability to the *mt⁻* mating type locus of *Chlamydomonas*. *Genetics* 99:41-47.
- Goodenough, U.W., P.A. Detmers, and C. Hwang. 1982. Activation for cell fusion in *Chlamydomonas*: Analysis of wild-type gametes and non-fusing mutants. *J. Cell Biol.* 42:378-386.
- Adair, W.S., B.C. Monk, R. Cohen, C. Hwang, and U.W. Goodenough. 1982. Sexual agglutinins from the *Chlamydomonas* flagellar membrane: Partial purification and characterization. *J. Biol. Chem.* 257:4593-4602.
- Adair, W.S.* 1982. The spaghetti overlay: Simultaneous screening of multiple polyclonal and monoclonal antibodies by immunautoradiography. *Anal. Biochem.* 125:299-306.
- Goodenough, U.W., and J.E. Heuser. 1982. Substructure of the outer dynein arm. *J. Cell Biol.* 95:798-815.
- Goodenough, U.W. 1983. Motile detergent-extracted cells of *Tetrahymena* and *Chlamydomonas*. *J. Cell Biol.* 96:1610-1621.
- Adair, W.S., C. Hwang, and U.W. Goodenough. 1983. Identification and visualization of the sexual agglutinin from mating-type plus flagellar membranes of *Chlamydomonas*. *Cell* 33:183-193.
- Hourcade, D.* 1983. Marker rescue from bleomycin-treated *Chlamydomonas reinhardi*. *Genetics* 104:391-404.
- Detmers, P., U.W. Goodenough, and J. Condeelis. 1983. Elongation of the fertilization tubule in *Chlamydomonas*: New observations on the core micro-filaments and the effects of transient intracellular signals on their structural integrity. *J. Cell Biol.* 97:522-532.

* Post-doctoral fellows reporting independently executed project in Goodenough lab.

Monk, B.C., W.S. Adair, R.A. Cohen, and U.W. Goodenough. 1983. Topography of *Chlamydomonas*: Fine structure and polypeptide components of the gametic flagellar membrane surface and the cell wall. *Planta* 158:517-533.

Cooper, J.B., W.S. Adair, R.P. Mecham, J.E. Heuser, and U.W. Goodenough. 1983. The *Chlamydomonas* agglutinin is a hydroxyproline-rich glycoprotein. *Proc. Natl. Acad. Sci. USA* 80:5898-5901.

Collin-Osdoby, P., W.S. Adair, and U.W. Goodenough. 1984. *Chlamydomonas* agglutinin conjugated to agarose beads as an in vitro probe of adhesion. *Exp. Cell Res.* 150:282-291.

Goodenough, U.W., and J.E. Heuser. 1984. Structural comparison of purified dynein proteins with in situ dynein arms. *J. Mol. Biol.* 180:1083-1118.

Galloway, R.E., and L.R. Holden.* 1984. Transmission and recombination of chloroplast genes in asexual crosses of *Chlamydomonas reinhardtii* I. Flagellar agglutination prior to fusion does not promote uniparental inheritance or affect recombinant frequencies. *Curr. Genet.* 8:399-405.

Goodenough, U.W., and J.E. Heuser. 1985. Substructure of inner dynein arms, radial spokes, and the central pair/projection complex of cilia and flagella. *J. Cell Biol.* 100:2008-2018.

Goodenough, U.W., W.S. Adair, P. Collin-Osdoby, and J.E. Heuser. 1985. Structure of *Chlamydomonas* agglutinin and related flagellar surface proteins *in situ* and *in vitro*. *J. Cell Biol.* 101:924-942.

Collin-Osdoby, P., and W.S. Adair.* 1985. Characterization of the purified *Chlamydomonas minus* agglutinin. *J. Cell Biol.* 101:1144-1152.

Sale, W.S., U.W. Goodenough, and J.E. Heuser. 1985. The substructure of isolated and in situ outer dynein arms of sea urchin sperm flagella. *J. Cell Biol.* 101:1400-1412.

Galloway, R.E., and U.W. Goodenough. 1985. Genetic analysis of mating locus-linked mutations in *Chlamydomonas reinhardtii*. *Genetics* 111:447-461.

Goodenough, U.W., and J.E. Heuser. 1985. The *Chlamydomonas* cell wall and its constituent proteins analyzed by the quick-freeze deep-etch technique. *J. Cell Biol.* 101:1550-1568.

Goodenough, U.W. 1986. Experimental analysis of the adhesion reaction between isolated *Chlamydomonas* flagella. *Exp. Cell Res.* 166:237-246.

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Goodenough, U.W., B. Gebhart, V. Mermall, D. Mitchell, and J.E. Heuser. 1987. HPLC fractionation of *Chlamydomonas* dynein extracts and characterization of three inner-arm dyneins. *J. Mol. Biol.* 194:481-494.

Ferris, P.J., and U.W. Goodenough. 1987. Transcription of novel genes, including a gene linked to mating-type, induced by *Chlamydomonas* fertilization. *Molec. Cell Biol.* 7:2360-2366.

Pasquale, S.M., and U.W. Goodenough. 1987. Cyclic AMP functions as a primary sexual signal in gametes of *Chlamydomonas reinhardtii*. *J. Cell Biol.* 105:2279-2292.

Adair, W.S., S.A. Steinmetz, D.M. Mattson, U.W. Goodenough, and J.E. Heuser. 1987. Nucleated assembly of *Chlamydomonas* and *Volvox* cell walls. *J. Cell Biol.* 105:2373-2382.

- Goodenough, U.W., and J.E. Heuser. 1988. Molecular organization of cell-wall crystals from *Chlamydomonas reinhardtii* and *Volvox carteri*. J. Cell Sci. 90:717-733.
- Goodenough, U.W., and J.E. Heuser. 1988. Molecular organization of the cell wall and cell-wall crystals from *Chlamydomonas eugametos*. J. Cell Sci. 90:735-750.
- Goodenough, U.W., and J.E. Heuser. 1988. Structure of soluble and *in situ* ciliary dyneins visualized by quick-freeze deep-etch microscopy. In: Cell Movement, Vol. I. The Dynein ATPases. F.D. Warner, P. Satir, and I.R. Gibbons, eds. New York, Alan Liss. pp. 121-140.
- Ferris, P.J.* 1989. Characterization of a *Chlamydomonas* transposon, *Gulliver*, resembling those in higher plants. Genetics 122:363-377.
- Goodenough, U.W. 1989. Cyclic AMP enhances the sexual agglutinability of *Chlamydomonas* flagella. J. Cell Biol. 109:247-252.
- Woessner, J.P., and U.W. Goodenough. 1989. Molecular characterization of a zygote wall protein: an extensin-like molecule in *Chlamydomonas reinhardtii*. The Plant Cell 1:901-911.
- Woessner, J.P., and U.W. Goodenough. 1992. Zygote and vegetative cell wall proteins in *Chlamydomonas reinhardtii* share a common epitope, (Ser Pro)_x. Plant Sciences 83:65-76.
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- Goodenough, U.W. 1993. Tipping of flagellar agglutinins by gametes of *Chlamydomonas reinhardtii*. Cell Motil. Cytoskel. 25:179-189.
- Goodenough, U.W., B. Shames, L. Small, T. Saito, R. C. Crain, M.A. Sanders and J.L. Salisbury. 1993. The role of calcium in the *Chlamydomonas reinhardtii* mating reaction. J. Cell Biol. 121:365-374.
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- Waffenschmidt, S., J.P. Woessner, K. Beer, and U.W. Goodenough. 1993. Evidence that isodityrosine crosslinking mediates the insolubilization of cell-wall HRGPs in *Chlamydomonas*. The Plant Cell 5:809-820.
- Armbrust, E.V., P.J. Ferris, and U.W. Goodenough. 1993. A mating type-linked gene cluster expressed in *Chlamydomonas* participates in the uniparental inheritance of the chloroplast genome. Cell 74:801-811.
- Ferris, P.J., and U.W. Goodenough. 1994. The mating-type locus of *Chlamydomonas reinhardtii* contains highly rearranged DNA sequences. Cell 76:1135-1145.
- Woessner, J.P., A.J. Molendijk, P. van Egmond, F.M. Klis, U.W. Goodenough, and M.A. Haring. 1994. Domain conservation in several volvoclean cell wall proteins. Plant Molec. Biol. 26:947-60.
- Campbell, A.M., H.J. Rayala, and U.W. Goodenough. 1995. The *isol* gene of *Chlamydomonas* is involved in sex determination. Mol. Biol. Cell 6:87-95.
- Ferris, P.J.* 1995. Localization of the *nic-7*, *ac-29*, and *thi-10* genes within the mating-type locus of *Chlamydomonas reinhardtii*. Genetics 141:543-549.
- Armbrust, E.V., A. Ibrahim, and U.W. Goodenough. 1995. A mating type-linked mutation that disrupts the uniparental inheritance of chloroplast DNA also disrupts cell-size control in *Chlamydomonas*. Mol. Biol. Cell 6:1807-1818.

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- Ferris, P.J., and U.W. Goodenough. 1997. Mating type in *Chlamydomonas* is specified by *mid*, the *minus*-dominance gene. *Genetics* 146::859-869.
- Ferris, P.J., C. Pavlovic, S. Fabry, and U.W. Goodenough. 1997. Rapid evolution of sex-related genes in *Chlamydomonas*. *Proc. Natl. Acad. Sci. USA* 94:8634-8639.
- Goodenough, U.W., and J.E. Heuser. 1999. Deep-etch analysis of adhesion complexes between gametic flagellar membranes of *Chlamydomonas reinhardtii* (Chlorophyceae). *J. Phycol.* 35:756-767.
- Suzuki, L., J.P. Woessner, H. Uchida, H. Kuroiwa, Y. Yuasa, S. Waffenschmidt, U. Goodenough, and T. Kuroiwa. 2000. A zygote-specific protein with hydroxyproline-rich glycoprotein domains and lectin-like domains involved in the assembly of the cell wall of *Chlamydomonas reinhardtii* (Chlorophyta). *J. Phycol.* 36:571-583.
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- Umen, J.G., and U. W. Goodenough. 2001. Chloroplast DNA methylation and inheritance in *Chlamydomonas*. *Genes & Development* 15:2585-2597.
- Ferris, P.J., E.V. Armbrust, and U.W. Goodenough. 2002. Genetic structure of the mating-type locus of *Chlamydomonas reinhardtii*. *Genetics* 160:181-200.
- Ferris, P.J., S. Waffenschmidt, J.G. Umen, H. Lin, J-H. Lee, K. Ishida, T. Kubo, J. Lau, and U.W. Goodenough. 2005. *Plus* and *minus* sexual agglutinins from *Chlamydomonas reinhardtii*. *Plant Cell* 17:597-615.
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- Worden, A.Z., J-H. Lee ... (46 authors) ... U.W. Goodenough, Y. Van de Peer, and I.V. Grigoriev. 2009. Green evolution and dynamic adaptations revealed by genomes of the marine picoeukaryotes *Micromonas*. *Science* 324:268-272.
- Wang, Z.T., N. Ullrich, S. Joo, S. Waffenschmidt, and U. Goodenough. 2009. Algal lipid bodies: Stress induction, purification, and biochemical characterization in wild-type and starch-less *Chlamydomonas reinhardtii*. *Eukaryotic Cell* 8:1856-1868.
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Public Outreach: The interface between science and religion (expanded at <https://religious-naturalist-association.org/ursula-goodenough-2/>)

- 1989- Council Member, Institute for Religion in an Age of Science (IRAS)
- 1992-96 President, IRAS
- 1992- Member, Center for Advanced Study in Religion and Science (CASIRAS)
- 1996-98 Member, Advisory Committee, AAAS Program of Dialogue Between Science and Religion
- 1996 IRAS Conference Co-Chair: Epic of Evolution
- 1998 IRAS Conference Co-Chair: Interweaving Art, Science, and Spirituality
- 1998- Editorial Advisory Board, *Zygon: Journal of Religion and Science*
- 2002-06 Vice-President for Development, IRAS
- 2003 IRAS Conference Co-Chair: Ecomorality
- 2006-08 Vice-President for Interdisciplinary Affairs, IRAS
- 2007 IRAS Conference Co-Chair: Emergence: Nature’s Mode of Creativity
- 2009 IRAS Conference Co-Chair: Emergence: Nature’s Mode of Creativity – The Human Dimension
- 2014- Religious Naturalist Association <https://religious-naturalist-association.org>, Co-Founder and President

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