

CURRICULUM VITAE

NAME **Kenneth W. Foster**

POSITION Professor of Physics, Syracuse University

EDUCATION

University of Victoria Victoria, Canada	B.Sc.(Hons.) Physics	1965
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California Institute of Technology Pasadena	Ph.D. Biophysics	1972
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PROFESSIONAL EXPERIENCE

1972	Research Fellow in Biology in laboratory of M. Delbrück, California Institute of Technology
1973-1979	Research Associate in laboratory of H.C. Berg, Department of Molecular, Cellular and Developmental Biology, University of Colorado (Boulder)
1978-1979	Lecturer, Department of Molecular, Cellular, and Developmental Biology, University of Colorado (Boulder)
1980-1984	Assistant Professor of Pharmacology, Department of Pharmacology, Mount Sinai School of Medicine, City University of New York.
1984-2003	Associate Professor of Physics (Biophysics Program), Syracuse University.
2004-present	Professor of Physics, Syracuse University

PUBLICATIONS

Papers on the zygomycete *Phycomyces* (a true fungus):

- Bergman, K., Burke, P.V., Cerda-Olmedo, E., David, C.N., Delbrück, M., Foster, K.W., Goodell, E.W., Heisenberg, M., Meissner, G., Zalokar, M., Dennison, D.S. and Shropshire, Jr., W. *Phycomyces*. Bacteriol. Rev. 33:99-157 (1969).
- Foster, K.W. The photoresponses of *Phycomyces*: Analysis using manual techniques and an automatic machine which precisely tracks and measures growth during programmed stimuli. Ph.D. Thesis. California Institute of Technology, Pasadena, CA (1972).
- Foster, K.W. and Lipson, E.D. The light-growth responses of *Phycomyces*. J. Gen. Physiol. 62:590-617 (1973).
- Lipson, E.D., Foster, K.W. and Walsh, M.P. A versatile pseudo-random noise generator. I.E.E.E. Trans. Instr. Measur. 25:112-116 (1976).
- Dennison, D.S. and Foster, K.W. Intracellular rotation and the phototropic response of *Phycomyces*. Biophys. J. 18:103-123 (1977).
- Foster, K.W. Phototropism of coprophilous Zygomycetes. Ann. Rev. Biophys. Bioeng. 6:419- 443 (1977).

Papers on the biological surface activity of materials:

- Nolan, R.P., Langer, A.M. and Foster, K.W. Particle size and chemically-induced variability in the membranolytic activity of quartz: Preliminary observations. In: NATO ASI Series, Vol. G3 "In vitro effects of mineral dusts" Ed. E.G. Beck and J. Bignon, Springer-Verlag, Berlin, Heidelberg, p. 39-50, (1985).
- Nolan, R.P., Langer, A.M., Eskenazi, S., Herson, G.B. and Foster, K.W. Membranolytic activities of quartz standards. Toxic. in Vitro, 1:239-245 (1987).

Papers on the green alga *Chlamydomonas*:

- Foster, K.W., Saranak, J., Patel, N., Zarrilli, G., Okabe, M., Kline, T. and Nakanishi K. A rhodopsin is the functioning photoreceptor for phototaxis unicellular eukaryote *Chlamydomonas*. Nature 311:7567-759 (1984).
- Hegemann, P., Hegemann, U. and Foster, K.W. Reversible bleaching of *Chlamydomonas reinhardtii* rhodopsin *in vivo*. Photochem. Photobiol. 48:123-128 (1988).
- Foster, K.W., Saranak, J., van der Steen, R. and Lugtenburg, J. Retinal in *Chlamydomonas* rhodopsin is in a planar 6-s-*trans* conformation as shown by *in vivo* incorporation of 6-7 locked retinal analogs." ARVO, Sarasota, Florida (1987).
- Foster, K.W., Saranak, J. and Zarrilli, G. Autoregulation of rhodopsin synthesis in *Chlamydomonas reinhardtii*. Proc. Natl. Acad. Sci. U.S.A. 85:6379-6383 (1988).
- Smyth, R.D., Saranak, J. and Foster, K.W. Algal visual systems and their photoreceptor pigments. Prog. Phycol. Res. 6:255-286 (1988).
- Foster, K.W., Saranak, J., Derguini, F., Zarrilli, G.R., Johnson, R., Okabe, M. and Nakanishi, K. Activation of *Chlamydomonas* rhodopsin *in vivo* does not require isomerization of retinal. Biochemistry 28: 819-824 (1989).
- Foster, K.W., Saranak, J., Derguini, F., Jayathirtha Rao, V., Zarrilli, G.R., Okabe, M., Fang, J.-M., Shimizu, N. and Nakanishi, K. Rhodopsin activation: a novel view suggested by *in vivo* *Chlamydomonas* experiments. J. Amer. Chem. Soc. 110:6588- 6589 (1988).
- Foster, K.W., Saranak, J., Derguini, F., and Nakanishi, K. *Chlamydomonas* rhodopsin: Determination of color and mechanism of activation. In: Molecular Physiology of Retinal Proteins (Hara, T. ed.), Yamada Science Foundation, Osaka, Japan, (1988) p. 61-66.
- Petridou, S., Kindle, K., Saranak, J. and Foster, K.W. Rhodopsin regulation of gene expression in *Chlamydomonas reinhardtii*. In: Molecular Physiology of Retinal Proteins, (Hara, T. ed.), Yamada Science Foundation, Osaka, Japan (1988), p. 367- 368.
- Foster, K.W. and Saranak, J. The *Chlamydomonas* (Chlorophyceae) eye as a model of cellular structure, intracellular signaling and rhodopsin activation. In: Algae as Experimental Systems (Coleman, A., Goff, L., and Stein-Taylor, J.R. eds.) (1989), p. 215-230.
- Nakanishi, K., Derguini, F., V. Jayathirtha Rao, Zarrilli, G., Okabe, M., Lien, T., Johnson, R., Foster, K.W. and Saranak, J. Theory of rhodopsin activation: Probable charge redistribution of excited state chromophore. Pure & Appl. Chem. 61:361-364 (1989).
- Saranak, J. and Foster K.W. Activation of *Chlamydomonas* rhodopsin by reducing agents in the dark. 10th International Biophysics Congress Abstracts. (1990) p.482.
- Foster, K.W., Saranak, J. and Dowben, P.A. Spectral sensitivity, structure, and activation of eukaryotic rhodopsins: Activation spectroscopy of rhodopsin analogs in *Chlamydomonas*. J. Photochem. Photobiol. B: Biol. 8:385-408 (1991).

- Derguini, F., Mazur, P., Nakanishi, K., Starace, D.M., Saranak, J. and Foster, K.W. All- *trans*-retinal is the chromophore bound to the photoreceptor of the alga *Chlamydomonas reinhardtii*. Photochem. Photobiol. 54:1017-1021 (1991).
- Saranak, J. and Foster, K.W. The *in vivo* cleavage of carotenoids into retinoids in *Chlamydomonas reinhardtii*. J. Exp. Bot., 45:505-511 (1994).
- Petridou, S., Foster, K. and Kindle, K. Light induces accumulation of isocitrate lyase mRNA in a carotenoid-deficient mutant of *Chlamydomonas reinhardtii*. Plant Molecular Biology 33:381-392 (1997).
- Saranak, J. and Foster, K.W. Reducing Agents and Light Break an S-S Bond Activating Rhodopsin *In Vivo* in *Chlamydomonas*. Biochem. Biophys. Res. Comm. 275:286-291 (2000).
- Josef, K., Saranak, J., and Foster, K.W. An electro-optic monitor of the behavior of *Chlamydomonas reinhardtii* cilia. Cell Motility & Cytoskeleton 61:83-96 (2005).
- Josef, K., Saranak, J., and Foster, K.W. Ciliary behavior of a negatively phototactic *Chlamydomonas reinhardtii*. Cell Motility & Cytoskeleton 61:97-111 (2005).
- Foster, K.W., Josef, K., Saranak, J., and Tuck, N. Dynamics of a sensory signaling network in a unicellular eukaryote. Conf. Proc. IEEE Eng. Med. Biol. Soc. 1, 252–255 (2006).
- Josef, K., Saranak, J., and Foster, K.W. Linear systems analysis of the ciliary steering behavior associated with negative-phototaxis in *Chlamydomonas reinhardtii*. Cell Motility & the Cytoskeleton 63:758-777 (2006).
- Boonyareth, M., Saranak, J., Pinthong, D., Sanvarinda, Y., & Foster, K.W. Roles of cyclic AMP in regulation of phototaxis in *Chlamydomonas reinhardtii*. Biologia 64: 1058—1065, 2009.
- Kenneth W. Foster, Jurepan Saranak, Sonja Krane, Randy L. Johnson, Koji Nakanishi “Evidence from *Chlamydomonas* on the photoactivation of rhodopsins without isomerization of their chromophore”. Chemistry & Biology 18(6), 733–742, 2011.

Papers on phototaxis in general

- Foster, K.W. and Smyth, R.D. Light antennas in phototactic algae. Microbiol. Rev. 44:572- 630 (1980).
- Foster, K.W. (2009). Eye evolution: Two eyes can be better than one. Curr. Biol. 19, R208–R210.
- Blair, Howard A., Jurepan Saranak and Kenneth W. Foster. (2011) "Reverse engineering cellular decisions for hybrid reconfigurable network modeling" in Independent Component Analyses, Wavelets, Neural Networks, Biosystems, and Nanoengineering IX, Harold Szu and Liyi Dai (eds.) Proc. of SPIE Vol. 8058, 80581L, pp. 80581L-1 -- 80581L-14

Papers on other rhodopsins:

- Surya, A., Foster, K.W. and Knox, B.E. Transducin activation by the bovine opsin apoprotein. J. Biol. Chem. 270:5024-5031 (1995).
- Saranak, J. and Foster, K.W. Rhodopsin guides fungal phototaxis. Nature 387:465-466 (1997).
- Saranak, J., and Foster, K.W. The Photoreceptor for Curling Behavior in *Peranema trichophorum* and the Evolution of Eukaryotic Rhodopsin, Eukaryotic Cell (4 (10) 1605-1612 (2005).

Paper on Bioinformatics:

Foster, K.W. Making a Robust Biomolecular Time Scale for Phylogenetic Studies *Protist*, 154, 43–55, (2003)

Invited reviews/chapters

Foster, K.W. Action spectroscopy of photomovement. In: Photomovement, eds. D-P Hader & M. Lebert, *Comprehensive Series in the Photosciences*, 1: pp. 51-115, (2001).

Foster, K.W. Analysis of the Ciliary/Flagellar Beating of *Chlamydomonas*. In “Cilia: Structure and Motility” Stephen M. King and Gregory J. Pazour, editors, *Methods in Cell Biology*, Vol. 91, Academic Press, 2009, p. 173-239.

Foster, K.W., Flagella, Cilia, actin- and centrin-based movement. *In Cell Physiology Sourcebook* 4th ed. Ed. N. Sperelakis, Academic Press, New York, 2012, Chap 47, pp. 823-853.

Selected Abstracts primarily since 1994:

Sullivan, J.M. and Foster, K.W. Light-dependent ion channel activity in *Chlamydomonas*. *Biophys. J.* 51:274a (1987).

Foster, K.W., Rhodopsin activation as seen through the eye of *Chlamydomonas*, *Biophys. J.* 61: 127a (1992).

Foster, K.W. and Saranak, J. A 9-phenyl retinal analog and hexenal appear to normally activate the rhodopsin of *Chlamydomonas*. *Biophys. J.* 61: 527a (1992).

Foster, K.W. and Saranak, J. Primary molecular events in the rhodopsin-like photoreceptors of flagellates. *Photochem. Photobiol.* 57:5S (1993).

Surya, A., Foster, K.W. and Knox, B.E. Transducin activation by the bovine opsin apoprotein. *Biophys. J.* 66: 47a (1994).

Josef, K., Saranak, J. and Foster, K.W. Measurement of signal transduction in *Chlamydomonas reinhardtii*. 34th Northeast Algal Symposium, Woods Hole, MA, (1996).

Josef, K., Saranak, J. and Foster, K.W. Systems analysis of stimulus-dependent ciliary responses of *Chlamydomonas reinhardtii*. 7th Inter. Confer. Cell Molecular Biology of *Chlamydomonas*, Regensburg, Germany (1996).

Guertin, M., Richard, C., Savard, F., Saranak, J. and Foster, K.W. The *Chlamydomonas reinhardtii* LI818 gene identifies a polypeptide related to the fucoxanthin-, chlorophyll a/c binding protein of the chrysophyte *Isochrysis galbana*. 7th Inter. Confer. Cell Molecular Biology of *Chlamydomonas*, Regensburg, Germany (1996).

Foster, K.W. A rhodopsin is the phototaxis receptor of *Allomyces reticulatus*. 35th Northeast Algal Symposium, Woods Hole, MA, (1997).

Foster, K.W. and Saranak, J. Evolution of rhodopsin-based vision: From a gene duplication to human rhodopsin. 8th International Conference on Retinal Proteins. Awaji Island, Japan June 5, 1998.

Foster, K.W. and Güçlü, B. “Development of a unique uniform-time evolutionary tree”. Northeast Algal Symposium, Plymouth, Ma, April 18, 1999.

Foster, K.W. “Energetics of membrane receptors and channels.” Symposium II, The First Bio-Systems Symposium and Workshop, Prince of Songkla University, Hat-Yai, Songkhla, Thailand, July 24-28th, 1999.

- Foster, K.W. "Molecular activation of receptors." Symposium II, The First Bio-Systems Symposium and Workshop, Prince of Songkla University, Hat-Yai, Songkhla, Thailand, July 24-28th, 1999.
- Foster, K.W. "The evolutionary tree of vision is chronicled by a nonlinear biomolecular clock." Ninth International Chlamydomonas Meeting, Amsterdam, Holland, May 22, 2000.
- Foster, K.W. "A nonlinear parallel signal-transduction network in a single cell *in vivo*." The 2nd Bio-systems Symposium and Workshop, Faculty of Science, Khon Kaen University 3-7 July 2000.
- Foster, K.W. "Nonlinear biomolecular clocks and evolutionary trees:" The 2nd Bio-systems Symposium and Workshop, Faculty of Science, Khon Kaen University 3-7 July 2000.
- Foster, K.W. "Nonlinear classification methods as applied to phylogeny and protein structure prediction." The 2nd Bio-systems Symposium and Workshop, Faculty of Science, Khon Kaen University 3-7 July 2000.
- Josef, K., Saranak, J., and Foster, K.W. Motion analysis of the cilia of *Chlamydomonas* in response to phototaxis signals. Tenth International Conference on the Cell and Molecular Biology of *Chlamydomonas*. Vancouver, BC, Canada, June 11-16, 2002.
- Foster, K.W., Josef, K., Korenberg, M.J., Lange, R.J., Liebovitch, L., Lipson, E.D., Mitchell, D., and Saranak, J.. Toward an integrated analysis of biological function within a single cell: the phototaxis system of *Chlamydomonas*. Tenth International Conference on the Cell and Molecular Biology of *Chlamydomonas*. Vancouver, BC, Canada, June 11-16, 2002.
- Lange, R.J., Liebovitch, L.S, Josef, K., and Foster, K.W. The fractal properties of the ciliary stroke pattern of *Chlamydomonas*. Tenth International Conference on the Cell and Molecular Biology of *Chlamydomonas*. Vancouver, BC, Canada, June 11-16, 2002.
- Saranak, J., and Foster, K. Rhodopsin activation in non-animal eukaryotes. 10th International conference on retinal proteins. Seattle, Aug. 20-24, 2002.
- Foster, K., Srinivasan, G. High-speed high-resolution stereo ciliary monitor. The 11th International Conference on the Cell and Molecular Biology of *Chlamydomonas*, Kobe, Japan, May 14, 2004.
- Josef, K., Adulrattananuwat, S., Saranak, J., Foster, K.W. Behavioral response of *Chlamydomonas* cilia to red light. The 11th International Conference on the Cell and Molecular Biology of *Chlamydomonas*, Kobe, Japan, May 11-15, 2004
- Josef, K., Saranak, J., Hawkins, T., Lipson, E., Mitchell, D.R., Kenneth W. Foster, K.W. and Korenberg, M. How phototactic cells decide which way to turn and how cells implement that turn: studied with simultaneous stimulation of the red and green photoreceptors in *Chlamydomonas*. The 11th International Conference on the Cell and Molecular Biology of *Chlamydomonas*, Kobe, Japan, May 12, 2004.
- Foster, K.W. Light-induced charge separation is sufficient *in vivo* to activate eukaryotic rhodopsins provide the chromophores does not block the β -ionone position. 11th Internatioanl Conference on Retinal Proteins. Frauenchiemsee, Germany, June 21-24, 2004.
- K. Foster, J. Vidyadharan and A. Sangani. The hydrodynamics of ciliary beating and phototaxis: What a biologist needs to know. 12th International Conference on the Cell and Molecular Biology of *Chlamydomonas*, Portland, Oregon, May 9-14, 2006.

- S. Amnuanpol and K. Foster. Evidence for the existence of internal processes in *Chlamydomonas* that significantly influence its behavioral response. 12th International Conference on the Cell and Molecular Biology of *Chlamydomonas*, Portland, Oregon, May 9-14, 2006.
- C. Capano, J. Saranak, and K. Foster. Comparison of Bode plots of the electric-current response to modulated light in *Chlamydomonas* with the beat frequency Portland Oregon and stroke velocity responses of the cilia. 12th International Conference on the Cell and Molecular Biology of *Chlamydomonas*, Portland, Oregon, May 9-14, 2006
- Sripanidkulchai, B., Fangkrathok, N., Saranak, J., Foster, K.W. "Effects of purified flavonoids from *Kaempferia parviflora* on mating behavior of *Chlamydomonas reinhardtii*" Japanese Society of Pharmaceutical Science Conference Japan Oct 2007.
- Capano, C. Saranak, J., Foster, K.W. The systems biology of *Chlamydomonas* phototaxis as determined by electric current and ciliary beating. The 13th International Chlamydomonas Conference, Hyères-les Palmiers, France, May 27 to June 1, 2008.
- Srinivasan, G., Adulrattananuwat, S. Foster, N.S., Saranak, J., and Foster, K.W. Automated tracing of the axes of beating *Chlamydomonas* cilia. The 13th International Chlamydomonas Conference, Hyères-les Palmiers, France, May 27 to June 1, 2008.
- Saranak, J., Fangkrathok, N., Sripanidkulchai, B., Foster, K.W. Viagra on *Chlamydomonas* mating. The 13th International Chlamydomonas Conference, Hyères-les Palmiers, France, May 27 to June 1, 2008.
- Saranak, J., Foster, K.W., Boonyareth, M., Pinthong, D., Sanvarinda, Y. cAMP regulation of phototaxis in *Chlamydomonas*. The 13th International Chlamydomonas Conference, Hyères-les Palmiers, France, May 27 to June 1, 2008.
- Foster, K.W., Adulrattananuwat, S., J Saranak, J. The responses of *Chlamydomonas* cilia to green or red light, Congress of the European Society for Photobiology (ESP/eppm), Wroclaw Poland, presented in Photomovements of microorganisms - Chair: Francesco Lenci (Italy). Sept 8, 2009.
- Sangani, Ashok S., Vidyadharan, J. S., Foster, K.W., Higuchi, H. Determination of Active Bending Moments Generated During Ciliary Beating, presented in Complex-Fluid and Bio-Fluid Dynamics I, 2010 AIChE Annual Meeting, Salt Lake City, UT, Nov 9, 2010
- Sitichoke Amnuanpol, Kenneth W. Foster, "Phase-space reconstruction of *Chlamydomonas* ciliary beating" was presented in the 6th annual conference of the Thai Physics society, March 23-26, 2011 at Ambassador City Jomtien Hotel, Pattaya, Chonburi province.
- Sitichoke Amnuanpol, Kenneth W. Foster, "Stability of *Chlamydomonas*'s ciliary beating", Full paper presentation 37th Congress on Science and Technology of Thailand , Oct 12, 2011 at Centara Grand & Bangkok Convention Center, Thailand.
- Ashok S. Sangani, Jyothish S. Vidyadharan, Kenneth W. Foster, "Evaluation of proposed mechanisms for ciliary beating of eukaryotic cells" IUTAM workshop on Mobile Particulate Suspensions in Bangalore, India, Jan 2012.