CURRICULUM VITAE
PAUL H. YANCEY, Ph.D.

Professor of Biology
Carl E. Peterson Endowed Chair of Sciences
Whitman College, Walla Walla WA 99362 U.S.A.
(509) 527-5498; Fax -5904; yancey@whitman.edu

EDUCATION AND DEGREES

1978	**Scripps Institution of Oceanography, University of California at San Diego** **Ph.D.**, Marine Biology (Physiology/Biochemistry; mentor George Somero)
1973	**California Institute of Technology** **B.S.**, Biology, with Honors

PROFESSIONAL EXPERIENCE AND FELLOWSHIPS

1997-present	**Carl E. Peterson Endowed Chair of Sciences**, Whitman College
2009-2011	Special Volunteer, Nat'l Inst. Health, Laboratory of Kidney & Electrolyte Metabolism
1981/86/92-	Assistant, Associate, and Full **Professor of Biology**, Whitman College
Summer 2004	Invited Pauley Summer Program fellow at Hawai'i Inst. Marine Biology, Coconut I, Oahu HI
Fall 2003	Visiting Scientist, Hopkins Marine Station and Monterey Bay Aquarium Research Institute
1999-02	**Chair** of Basic Sciences and Mathematics Division, Whitman College
1999-01	Director of Howard Hughes Medical Institute Grant to Whitman College
Fall 1998	University of Otago Postgraduate Medical Society Visiting Professorship, New Zealand
Summer 1998	Visiting Professor, Louisiana State University Biological Sciences
Summer 1994	William Evans Visiting Fellowship, University of Otago, Dunedin, New Zealand
Summer1990	Pew Summer Research Fellowship, Mt. Desert Island Biological Lab., Maine
1988-1991	**Chair** of Biology Department, Whitman College
1987-1988	Visiting Research Scientist, National Institutes of Health
Summer 1985	Visiting Research Associate, Oregon State University
Summer 1984	Visiting Scholar, Scripps Institution of Oceanography
1978-1980	NATO **Postdoctoral** and Leverhulme Fellowships, Physiology, University of St. Andrews
1977-78	Carl Hubbs-Seaworld Fellowship for graduate work at Scripps Inst. Oceanography
1973	California State Graduate Fellowship for graduate work at Scripps
1973-1978	Research Assistant with Drs. G.N. Somero, J.R. Beers, D. Epel, T.J. Chow, Scripps Inst.
1971-1973	Research Assistant with Drs. E.H. Davidson, B. Hough, Calif. Institute of Technology

ACADEMIC AWARDS and other DISTINCTIONS

2003	G. Thomas Edwards Award for **Excellence in Teaching and Scholarship** (Whitman College)
2002	Whitman College **Alumni Association Award** for distinguished service
1997	Designated as the first **Carl E. Peterson Endowed Chair of Sciences** (renewed in 2004, 2009)
1994	Dr. A. E. Lange Award for **Teaching Excellence in Science** (Whitman College)
1993	Washington State Region IV Higher Education **Science Teacher of the Year**
1992	Recognition (by the Institute for Scientific Information, Inc.) of our 1982 Science paper (see Publications) as a **Science Citation Classic** (now > 2000 citations). Noted in Current Contents as the 2nd-most cited paper in all sciences with co-author from a liberal arts college, 1982-1992.
1988	Paul Garrett Fellowship (Whitman College) for excellence in teaching and research
1979	Eckart Dissertation Prize, Scripps Institution of Oceanography, $1000 + travel: Award for **best doctoral thesis** of 1978-79, based on originality and significance of research and clarity of writing

PROFESSIONAL SOCIETIES & SERVICE

Member: Amer. Physiol. Soc (APS).; Sigma Xi, the Scientific Research Honor Soc.; Soc. Integr. Compar. Biol. (SICB); Council on Undergraduate Research (CUR)

Offices held:

2012	Nominating Committee of Comparative Section of Soc. Integr. Compar. Biol.
2006-07	Co-Chair of 2007 **Gordon Research Conference on Cellular Osmoregulation** (elected); conference, for which I raised most of the funding (NIH, Monsanto) in Aussois, **France**
2004-06	Secretary, SICB, Div. Compar. Biochem. Physiol. (by national election)

1999-02 Vice-President and Secretary of local Sigma Xi chapter
1995-16 Institutional Liaison for Council on Undergraduate Research
1992-94 Member, Electorate Nominating Committee, AAAS (by national election)

GRANTS

2015-17 **BBSRC (Biotechnology and Biological Sciences Research Council)** UK, international **collaborator** on grant to Dr Gordon Cramb, University of St. Andrews, Scotland, "Hypoxanthine metabolism in salmon: roles in osmoregulation and the innate immune response," 2015-17.

2014-15 **Schmidt Ocean Institute** grant: "*Studying the Ecology and Geology of the Mariana Trench – The Deepest Place on Earth*." **Co-P.I**. on this grant led by Jeffrey Drazen and Patty Fryer of U. Hawai'i. SOI lets researchers use their ship *Falkor* for free.

2011-15 **National Science Foundation** grant (BioOce; $93,000 for my part): "*Collaborative Research: Controls on Hadal Megafaunal Community Structure: A Systematic Examination of Pressure, Food Supply, and Topography*." **Co-P.I**. with Timothy Shank, Woods Hole, and Jeffrey Drazen, U. Hawai'i; ecology and physiology of life in the deepest ocean trenches, using the *Nereus* ROV; with several UK/New Zealand biologists, Nat'l Geographic Society and James Cameron's DEEPSEA CHALLENGE team as collaborators.

2012-14 **NERC** (**Nat'l Envir. Research Council) UK,** international **collaborator** on grant to Gordon Cramb, U. St. Andrews, Scotland: "*Inositol Metabolism in Euryhaline Fish and Effects of Pesticides*"; environmental effects on inositol and other osmolytes of European eels, salmon, tilapia; travel and supply funds for me at about $3500/year

2011-15 **Danisco-Dupont** grants: "*Effect of Betaine Supplementation on Brain-Cell Osmotic Balance and Potentiation*." **Co-P.I.** with Leena Knight, Whitman, in collaboration with Drs Stuart Craig and Kirsti Tiihonen, Danisco; testing an osmolyte-based sports-drink additive on memory functions and osmotic stress in neurons.

2009 **National Science Foundation-R.O.A**. grant (BioOce; $36,797): "*An Absence Of Sharks In The Abyss: Ecological Or Physiological Limitations?*" Research on metabolic and pressure adaptations with Jeffrey Drazen, U. Hawai'i

2007 **National Institutes of Health** grant ($8000) to support **Gordon Research Conference** (above)

2004 **Keck Foundation**-Whitman grant for summer research on deep-sea pressure adaptations

1982-11 11 **Sally Ann Abshire and Perry** (internal college) Awards (1985, '86, '90, '94, '96, '99, '00, '03, '06, '07, '11), including funds for about 30 undergraduates and me to participate in deep-sea research expeditions, including robotic submersibles, the *Alvin* submersible.

1999-01 **M. J. Murdock Charitable Trust** Life Sciences Grant ($28,000): "*Effects of Organic Osmolytes from Deep-Sea Animals on Perturbations by Hydrostatic Pressure*." **P.I.**

1996-01 **Howard Hughes Medical Institute** grant: Assisted committee in obtaining funds for summer research (beginning 1997) and adding multimedia and project-learning to curriculum

1995-97 **M. J. Murdock Charitable Trust** grant: Assisted committee in obtaining funds for sophomores and juniors to work summers on- and off-campus. Awarded to Whitman Science Division, 3 years. Summers 1995, 1996: $26,000 total grants from this for me and 7 students

1992-94 **M. J. Murdock Charitable Trust** Award of **Research Corporation**: **Partners-in-Science** grant ($13,000, 2 summers for high school teacher in my lab): "*Effects of aldose reductase inhibitor on renal osmoregulation in galactosemic (diabetic-like) rats*"

1991-94 **M.J. Murdock Charitable Trust** grant: Assisted committee in obtaining $400,000 for3 years for Whitman Science Division; 1992-4: $11,000 grants for me and two students every summer

1991 **National Science Foundation** grant: Assisted committee in obtaining "*Computer Based Science Laboratory*" funding for Whitman Science Division ($64,000)

1988-93 **Howard Hughes Medical Institute** grant. Assisted committee in obtaining funds for Biology and Chemistry Departments; $400,000, 5 years. Summers 1989-93: $7,000 grants from this for me and two students every summer

1987-88 **National Institutes of Health** Intergovernmental Personnel Act research award ($11,000): "*Organic osmolytes in mammalian kidneys: contents, effects on cultured cells, role in diabetes*." For sabbatical work at NIH's Laboratory of Kidney & Electrolyte Metabolism

1986 **Research Corporation-Hewlett Foundation** Grant ($7600, 1 summer, including stipend for one student): "*Organic osmolytes in kidneys of desert rodents*"; **P.I.**

1985 **National Science Foundation-R.O.A.** (Regulatory Biology) DCB-8544475, at Oregon State University with Dr. J. Siebenaller: "*Biochemical adaptation to the deep sea"*

1984 **Sigma Xi** Grant-in-Aid of Research: "*Myosin content of muscles in mesopelagic fishes having reduced protein contents*"; **P.I.**

1971 **National Science Foundation** Undergraduate Research Grant at Caltech (2 months)

INVITED PRESENTATIONS

May 2015 Oregon Inst. Marine Biol.: "*Life in the Trenches: How do Animals Cope under High Pressure? A Report from the HADES Project*"

Jan. 2015 Scripps Inst. Oceanography: "*Life under Pressure: How Deep Can Fish Go?*"

May 2011 Canadian Soc. Zoology, Ottawa: "*Small nitrogenous solutes in deep-sea animals: counteracting hydrostatic pressure and detoxifying hydrogen sulphide*"

1982-2011 Invited departmental seminars: Washington State, Portland State, Walla Walla, Louisiana State, and San Francisco State Universities; University of British Columbia; Nat'l. Inst. Health

July 2008 **Plenary** opening talk International Congress of Fish Biology, Portland, OR: "*Trimethylamine oxide as a protein stabilizer in elasmobranch and deep-sea fishes*"

Oct. 2006 APS Comparative Physiology Meeting, Virginia Beach: "*Cytoprotective roles of compatible and counteracting solutes*"

Sept. 2006 4th International Conf. on High Pressure Bioscience and Biotechnology, Tsukuba, **Japan**: "*Adaptations to pressure in protein structure and organic osmolytes in deep-sea animals*"

Apr. 2006 Annual Mead-Johnson Clinical Scholars' Program, Sedona, AZ: Two talks on osmolyte research

Aug. 2004 VI International Congress on Biology of Fish, Manaus, **Brazil**: "*Trimethylamine oxide as an organic osmolyte in deep-sea fishes: correlations with depth and stabilization of proteins under pressure.*"

June 2004 Pauley Summer Program at Hawai'i Inst. Marine Biology, Coconut Island (Oahu): "*Organic osmolytes and related solutes in animals from hydrothermal vents and cold seeps*" and "*Organic osmolytes from sharks to deep-sea fishes to the mammalian kidney*"

Aug. 2003 **Keynote** opening talk, **Gordon Conference** on Cellular Osmoregulation, Rogers Williams Univ., Rhode Island: "*Lessons from nature: protecting proteins with osmolytes in habitat stresses from the Dead Sea to the deep-sea*."

July 2002 V International Congress on Biology of Fish, Vancouver, **Canada**: "*Nitrogenous solutes as pressure-counteracting osmolytes in deep-sea fishes.*"

July 2000 Protein Stability Conference, Breckenridge CO: "'*Deep insights' into properties of stabilizing osmolytes: counteraction of hydrostatic pressure effects on proteins*."

Apr. 2000 Exper. Biol. 2000, San Diego: "*Osmolytes and pressure effects in deep-sea animals*."

Jan. 2000 **Keynote** opening talk, SICB Symposium on Osmoregulation, Atlanta: "*Water stress and proteins*."

July 1999 Internatl. Conf. High Pressure Sci. & Tech., Honolulu: "*Effects of osmolytes of deep-sea animals on enzyme function and stability under high hydrostatic pressure*."

Nov. 1998 **Keynote** talks, University of Otago, **Dunedin, NZ**: "*Organic osmolytes from the deep sea to mammalian development*" and "*Water stress from the deep sea to medicine: role of organic osmolytes.*"

Oct. 1996 **Keynote** talk, XII Intern. Congress of Eye Research, **Yokohama, Japan**: "*Compensatory changes in rat renal and lenticular osmolytes induced by polyol perturbations*."

July 1994 University of Otago Medical School, **Dunedin, New Zealand**: "*Living with water stress: organic osmolytes from sharks to humans*" and "*Water and osmolytes*."

Apr. 1992 FASEB92, Anaheim, CA: "*Evolutionary significance of organic osmolytes in marine organisms and mammalian kidneys*."

Sept. 1990 10th Internat'l Conf. on Comp. Physio., **Crans-sur-Sierre, Switzerland**: "*Compatible and counteracting aspects of organic osmolytes in mammalian kidney cells in vivo and in vitro*."

June 1988 Workshop on Cell Volume Regulation, Buffalo: "*Organic solutes in volume regulation*."

Aug. 1984 1st International Congress of Comparative Physiology and Biochemistry, **Liege, Belgium**: "*Organic osmotic effectors in cartilaginous fishes*."

Jan. 1983 Winter Conference on Brain Research, Keystone, CO: "*Organic osmolytes in water regulation within the central nervous system*."

RESEARCH

Details at people.whitman.edu/~yancey

CURRENT and RECENT WORK: *Occurrences and Roles of ORGANIC OSMOLYTES*

1) **Organic osmolytes as piezolytes = PRESSURE counteractants in deep-sea animals**; collaboration with: i) Jeffrey Drazen, Mackenzie Gerringer, Univ. Hawai'i; Tim Shank, Woods Hole; Alan Jamieson, U. Aberdeen; A. Rowden, NIWA New Zealand; Doug Bartlett, Scripps Inst. Oceanography & James Cameron's *DEEPSEA CHALLENGE* project -- **HADES Project (www.whoi.edu/hades)**
   ii)
2) **Organic osmolytes** as **cytoprotectants** against **temperature, sulfide** in **hydrothermal-vent and hydrocarbon-seep** animals. Collaboration with Ray Lee, WSU; Peter Gurguis, Harvard U., Lisa Levin, Scripps.

#1,2 involve many **research cruises** on the R/Vs *Wecoma, Pt. Sur, K-O-K* with trawl nets*, Pt. Lobos* with ROV *Ventana*; R/V *Atlantis* with HOV ***Alvin*****;** R/V *Thompson* with landers and hROV ***Nereus;*** R/Vs ***Falkor*** and **Shinyo-maru** with landers.

3) **Organic osmolytes in corals**: (i) osmotic composition in Hawai'an coral larvae and adults, and potential use in cryopreservation of larvae (to create a "gene bank" of endangered species), in collaboration with Mary Hagedorn, Smithsonian Inst./Univ. Hawai'i; (ii) adaptations of corals in low-salinity acidic waters of Yucatan *ojos*, in collaboration with Elizabeth Derse and Adina Payton, UCSC; and Mario Rebolledo-Vieyra and Laura Hernandez, Centro de Investigacion Cientifica de Yucatan.
4) **Organic osmolytes in mammals/humans:** Renal osmolytes in (i) cystic fibrosis and (ii) CLN3 disease, with M. Howard and W. Welch, UCSF, and Colleen Stein, U. Iowa. (iii) **Betaine as a sports drink**: effect on neurons in exercise-like conditions, with Leena Knight, Whitman Coll., Stuart Craig, Danisco/DuPont
5) **Organic osmolytes in farmed salmon and [endangered] European eels:** with Gordon Cramb, University of St Andrews.

PUBLICATIONS

[undergraduate co-authors indicated by *]

TEXTBOOKS

ANIMAL PHYSIOLOGY: FROM GENES TO ORGANISM BY LAURALEE SHERWOOD, HILLAR KLANDORF (WEST VIRGINIA UNIVERSITY), AND PAUL H. YANCEY (WHITMAN COLLEGE); Cengage;. 2005; 2013 2nd edition.

BIOLOGY: THE DYNAMIC SCIENCE **BY RUSSELL ET AL.;** Thomson/Brooks-Cole; 2008. Author of four "Unanswered Questions" box features (authors of which are shown with pictures and short biographies).

RESEARCH ARTICLES and REVIEWS

1. **Hough, B.R., P.H. Yancey*, E.H. Davidson** (1973). Persistence of maternal RNA in *Engystomops* embryos. *J. Exp. Zool.* **185**: 357-368
2. **Somero, G.N., T.J. Chow, P.H. Yancey, C.B. Snyder** (1977). Lead accumulation rates in tissues of the estuarine teleost Gillichthys mirabilis: salinity and temperature effects. *Arch. Envir. Contam. Toxicol*. **6**: 337-346
3. **Somero, G.N., P.H. Yancey, T.J. Chow, C.B. Snyder** (1977). Lead effects on tissue and whole organism respiration of the estuarine teleost Gillichthys mirabilis. *Arch. Envir. Contam. Toxicol.* **6**: 346-354
4. **Yancey, P.H., G.N. Somero** (1978). Temperature dependence of intracellular pH: its role in the conservation of pyruvate apparent Km values of vertebrate lactate dehydrogenases. *J. Comp. Physiol.* **125**: 129-134
5. **Yancey, P.H., G.N. Somero** (1978). Urea-requiring lactate dehydrogenases of marine elasmobranch fishes. *J. Comp. Physiol*. **125**: 135-141
6. **Somero, G.N., P.H. Yancey** (1978). Evolutionary adaptations of K_m and k_{cat} values: fitting the enzyme to its environment through modifications in the amino acid sequences and changes in the solute environment of the cytosol. *Symp. Biol. Hungar.* **21**: 249-276
7. **Yancey, P.H., G.N. Somero** (1979). Counteraction of urea destabilization of protein structure by methylamine osmoregulatory compounds of elasmobranch fishes. *Biochem. J.* **182**: 317-323
8. **Yancey, P.H., G.N. Somero** (1980). Methylamine osmoregulatory compounds in elasmobranch fishes reverse urea inhibition of enzymes. *J. Exp. Zool.* **212**: 205-213
9. **Altringham, J.D., J.A. Johnston, P.H. Yancey** (1980). A sensitive positional feedback transducer for

investigating the force-velocity relationship of actomyosin threads. *J. Physiol.* **9/12**: 17P-18P
10. **Altringham, J.D., P.H. Yancey, I.A. Johnston** (1980). Limitations in the use of actomyosin threads as model contractile systems. *Nature* **287**: 338-340
11. **Altringham, J.D., P.H. Yancey, I.A. Johnston** (1982). The effects of osmoregulatory solutes on tension generation by dogfish skinned muscle fibres. *J. Exp. Zool.* **96**: 443-445
12. **Yancey, P.H., I.A. Johnston** (1982). Effect of electrical stimulation and exercise on the phosphorylation state of myosin light chains from fish skeletal muscle. *Pflugers Archiv.* **393**: 334-339
13. **Yancey, P.H., M.E. Clark, S.C. Hand, R.D. Bowlus, G.N. Somero** (1982). Living with water stress: evolution of osmolyte systems. *Science* **217**: 1214-1222. **I.S.I. CITATION CLASSIC** (>2000 citations)
14. **Siebenaller, J.F., P.H. Yancey** (1984). The protein composition of white skeletal muscle from mesopelagic fishes having different water and protein contents. *Mar. Biol.* **78**: 129-137
15. **Yancey, P.H**. (1985). Organic osmotic effectors in cartilaginous fishes. IN: *Transport Processes, Iono- and Osmoregulation* (R. Gilles, M. Gilles-Ballien, eds), pp 424-436; Berlin: Springer-Verlag
16. **Yancey, P.H., J.F. Siebenaller** (1987). Coenzyme binding ability of homologs of M_4-lactate dehydrogenase in temperature adaptation. *Biochim. Biophys. Acta* **924**: 483-491.
17. **Yancey, P.H**. (1988). Osmotic effectors in kidneys of xeric and mesic rodents: cortico-medullary distributions and changes with water availability. *J. Comp. Physiol.* **158B**: 369-380
18. **Wolff, S., P.H. Yancey, T.S. Stanton, R. Balaban** (1989). A simple HPLC method for quantitating the major organic solutes of the renal medulla. *Amer. J. Physiol.* **256**: F954-956
19. **Yancey, P.H., M.B. Burg** (1989). Distributions of major organic osmolytes in rabbit kidneys in diuresis and antidiuresis. *Amer. J. Physiol.* **257**: F602-607
20. **Yancey, P.H., R. Lawrence-Berrey*, M. D. Douglas*** (1989). Adaptations in mesopelagic fishes. I. Buoyant glycosaminoglycan layers in species without diel vertical migrations. *Mar. Biol.* **103**: 453-459
21. **Yancey, P.H., M.B. Burg, S.M. Bagnasco** (1990). Effects of NaCl, glucose and aldose reductase inhibitors on cloning efficiency of renal cells. *Amer. J. Physiol.* **258**: C156-163
22. **Yancey, P.H., M.B. Burg** (1990). Counteracting effects of urea and betaine on colony-forming efficiency of mammalian cells in culture. *Amer. J. Physiol.* **258**: R198-204
23. **Yancey, P.H., R.G. Haner*, T. Freudenberger*** (1990). Effects of an aldose reductase inhibitor on osmotic effectors in rat renal medulla. *Amer. J. Physiol.* **259**: F733-F738
24. **Yancey, P.H., J. Ruble*, J.D. Valentich** (1991). Effect of chloride secretagogues on cyclic AMP formation in cultured shark (*Squalus acanthias*) rectal gland epithelial cells. *Bull. Mt. Des. I. Biol. Lab.***13**: 51-52
25. **Yancey, P.H.** (1992) Compatible and counteracting aspects of organic osmolytes in mammalian kidney cells in vivo and in vitro. In: *Water and Life: A Comparative Analysis of Water Relationships at the Organismic, Cellular, and Molecular Levels*; Somero, G.N., C.B. Osmond, C.L. Bolis (eds); Springer-Verlag
26. **Peterson*, D.P., K.M. Murphy*, R. Ursino*, K. Streeter*, P.H. Yancey** (1992). Effects of dietary protein and salt on rat renal osmolytes: co-variation in urea and GPC contents. *Amer. J. Physiol.* **263**: F594-F600
27. **Yancey, P.H., T. Kulongoski*, M.D. Usibelli*, R. Lawrence-Berrey*, A. Pedersen*** (1992). Adaptations in mesopelagic fishes. II. Protein contents of various muscles and actomyosin contents and structure of swimming muscle. *Comp. Biochem. Physiol.* **103B**: 691-697
28. **Edmands*, S., P.H. Yancey** (1992). Effects on rat renal osmolytes of extended treatment with an aldose reductase inhibitor. *Comp. Biochem. Physiol.* **103C**: 499-502
29. **Yancey, P.H.** (1994). Compatible and counteracting solutes. In: *Cellular and Molecular Physiology of Cell Volume Regulation*, Strange, K. (ed.), CRC Press, Boca Raton; pp. 81-109
30. **Edmands*, S.D., K.S. Hughs*, S. Lee*, S.D. Meyer*, E. Saari, P.H. Yancey** (1995). Time-dependent aspects of osmolyte changes in rat kidney, urine, blood and lens with sorbinil and galactose feeding. *Kidney Int.* **48**: 344-353
31. **Trachtman, H., P.H. Yancey, S.R. Gullans** (1995). Cerebral cell volume regulation during hypernatremia in developing rats. *Brain Res.* **693**: 155-62
32. **Somero, G.N., P.H. Yancey** (1997). Osmolytes and cell volume regulation: physiological and evolutionary principles. In: *Handbook of Physiology*, *Sec. 14;* Hoffman, J. F, J.D. Jamieson (eds). Oxford University Press
33. **Fuery, C.J., P.V. Attwood, P.C. Withers, P.H. Yancey, J. Baldwin, M. Guppy** (1997). Effects of urea

on M4-lactate dehydrogenase from elasmobranchs and urea-accumulating Australian desert frogs. *Comp. Biochem. Physiol.* **117B**: 143-150

34. **Gillett*, M.B., J.R. Suko*, F.O. Santoso*, P.H. Yancey** (1997). Elevated levels of trimethylamine oxide in muscles of deep-sea gadiform teleosts: a high-pressure adaptation? *J. Exp. Zool.* **279**: 386-391 (Rapid Communication)
35. **Bedford, J.J., J.L. Harper, J.P. Leader, P.H. Yancey, R.A.J. Smith** (1998). Tissue composition of the elephant fish, *Callorhyncus milli:* Betaine is the principal counteracting osmolyte. *Comp. Biochem. Physiol.* **119B**: 521-526
36. **Kelly*, R.H., P.H. Yancey** (1999). High contents of trimethylamine oxide correlating with depth in deep-sea teleost fishes, skates, and decapod crustaceans. *Biol. Bull.* **196**:18-25
37. **Rohr*, J.M., T. Hong*, S. Truong*, P.H. Yancey** (1999). Effects of ascorbic acid, aminoguanidine, sorbinil and zopolrestat on sorbitol and betaine contents in cultured rat renal cells. *Exp. Biol. Online* **4**:3; http://link.springer.de/link/service/journals/00898/bibs/9004001/90040003.htm
38. **Yancey, P.H., J.F. Siebenaller** (1999). Trimethylamine oxide stabilizes teleost and mammalian lactate dehydrogenases against inactivation by hydrostatic pressure and trypsinolysis. *J. Exp. Biol.* **202**:3597-3603. Featured in *Science News*.
39. **Miller*, T.J., R.D. Hanson*, P.H. Yancey** (2000). Developmental changes in organic osmolytes in prenatal and postnatal rat tissues. *Compar. Biochem. Physiol.* **125**: 45-56.
40. **Yancey, P.H., R.H. Kelly*, A.L. Fyfe-Johnson*, M.T. Auñón*, V.P. Walker*, J. F. Siebenaller** (2000). Effects of osmolytes of deep-sea animals on enzyme function and stability under high hydrostatic pressure. In: *Science and Technology of High Pressure: Proceedings of AIRAPT-17* (Manghnani, M.H., W.J. Nellis, M.T. Nicol, eds). Universities Press, Hyderabad, India,, pp 328-30.
41. **Yin, M., H.R. Palmer, A.L. Fyfe-Johnson*, J.J. Bedford, R.A. Smith, P.H. Yancey** (2000). Hypotaurine, N-methyltaurine, taurine, and glycine betaine as dominant osmolytes of vestimentiferan tubeworms from hydrothermal vents and cold seeps. *Phys. Biochem. Zool.* **73**: 629-637.
42. **Yancey, P.H., A.L. Fyfe-Johnson*, R.H. Kelly*, V.P. Walker*, M.T. Auñón*** (2001). Trimethylamine oxide counteracts effects of hydrostatic pressure on proteins of deep-sea teleosts. *J. Exp. Zool*. **289**: 172-176.
43. **Yancey, P.H**. (2001). Nitrogenous solutes as osmolytes. *Fish Physiology* Vol. 20: *Nitrogen Excretion* (P. Wright, P. Anderson, eds). Academic Press, pp 309-341 (invited chapter).
44. **Yancey, P.H.** (2001). Protein, osmolytes and water stress. *Amer. Zool*. **41:** 699-709.
45. **Leader, J.P., J. Schofield, P.H. Yancey, J.J. Bedford** (2002). The effects of hypoosmotic infusion on the composition of renal tissue of the Australian brush-tailed possum *Trichosurus vulpecula. Comp. Biochem. Physiol*. **132B**: 645-652.
46. **Yancey, P.H., W. Blake*, J. Conley*** (2002). Unusual organic osmolytes in deep-sea animals: Adaptations to hydrostatic pressure and other perturbants. *Comp. Biochem. Physiol.* **133A**: 667-676
47. **Fiess*, J.C., J.R. Hom*, H.A. Hudson*, C. Kato, P.H. Yancey** (2002). Phosphodiester amine, taurine and derivatives, and other osmolytes in vesicomyid bivalves: correlations with depth and symbiont metabolism. *Cahiers Biol. Mar.* **43**: 337-340.
48. **Yancey, P.H., W. Blake*, J. Conley*, R.H. Kelly*** (2002). Nitrogenous solutes as protein-stabilizing osmolytes: counteracting the destabilizing effects of hydrostatic pressure in deepsea fish. *Proceedings of the 2002 International Congress on Fish Biology* (Wright, P., D. MacKinlay, eds). Amer. Fisheries Society.
49. **Yancey, P.H.** (2003). Proteins and counteracting osmolytes. *Biologist* **50**: 126-131 (invited review).
50. **Howard, M., H. Fischer, J. Roux, B.C. Santos, S.R. Gullans, P.H. Yancey, W.J. Welch** (2003). Mammalian osmolytes and s-nitrosoglutathione promote ΔF508 cystic fibrosis transmembrane conductance regulator (CFTR) protein maturation and function. *J. Biol. Chem*. **278**: 35159-35167.
51. **Steele, S.L., P.H. Yancey, P.A. Wright** (2004). Dogmas and controversies in the handling of nitrogenous wastes: Osmoregulation during early embryonic development in the marine little skate *Raja erinacea*; response to changes in external salinity. *J. Exp. Biol.* **207**: 2021-2031.
52. **Yancey P.H., M.D. Rhea*, K.M. Kemp, D.M. Bailey** (2004). Trimethylamine oxide, betaine and other osmolytes in deep-sea animals: depth trends and effects on enzymes under hydrostatic pressure. *Cell. Molec. Biol*. **50:** 371-376.
53. **Yancey, P.H.** (2004). Compatible and counteracting solutes: protecting cells from the Dead Sea to the deep sea. *Science Progress* **87:** 1-24.

54. **Steele, S.L., P.H. Yancey, P.A. Wright** (2005). The little skate *Raja erinacea* exhibits an extrahepatic ornithine urea cycle in the muscle and modulates nitrogen metabolism during low-salinity challenge. *Physiol. Biochem. Zool.* **78**: 216-226.
55. **Yancey, P.H.** (2005). Organic osmolytes as compatible, metabolic, and counteracting cytoprotectants in high osmolarity and other stresses. *J. Exp. Biol*. **208**: 2819-2830.
56. **Rosenberg*, N.K., R.W. Lee, P.H. Yancey** (2006). High contents of hypotaurine and thiotaurine in hydrothermal-vent gastropods without thiotrophic endosymbionts. *J. Exp. Zool.* **305A**: 655-662.
57. **Brand*, G.L., R.V. Horak*, N. LeBris, S.K. Goffredi, S.L. Carney, B. Govenar, P.H. Yancey** (2007). Hypotaurine and thiotaurine as indicators of sulfide exposure in bivalves and vestimentiferans from hydrothermal vents and cold seeps. *Mar. Ecol.* **28**: 208-218.
58. **Samerotte*, A.L., J.C. Drazen, G.L. Brand*, B.A. Seibel, P.H. Yancey** (2007). Correlation of trimethylamine oxide and habitat depth within and among species of teleost fishes: An analysis of causation. *Phys. Biochem. Zool*. **80**: 197-208.
59. **Fiess, J.C., A. Kunkel-Patterson*, L. Mathias*, L.G. Riley, P.H. Yancey, T. Hirano, E.G. Grau**. (2007). Effect of environmental salinity and temperature on osmoregulatory ability, organic osmolytes, and plasma hormone profiles in the Mozambique tilapia (*Oreochromis mossambicus*). *Comp. Physiol. Biochem*. **146A**: 252-264.
60. **Yancey, P.H**. (2007). Adaptations to hydrostatic pressure in protein structure and organic osmolytes in deep-sea animals. *High Press. Biosci. Biotech.* **1:** 90-95 (proceedings of a 2006 conference).
61. **Yancey, P.H., J. Ishikawa*, B. Meyer*, P. Girguis, R. Lee** (2009). Hypotaurine and thiotaurine in polychaetes without endosymbionts from hydrothermal vents: correlation with sulfide exposure. *J. Exp. Zool*. **311A**:439-447.
62. **Hagedorn, M., V.L. Carter, S. Ly*, R.A. Andrell*, P.H. Yancey, J.A. Leong, F.W. Kleinhans (**2010). Analysis of internal osmolality in developing coral larvae, *Fungia scutaria*. *Phys. Biochem. Zool.* **83**:157-166
63. **Yancey, P.H., M. Heppenstall*, S. Ly*, R.M. Andrell*, R.D. Gates, V.L. Carter, M. Hagedorn (**2010). Betaines and dimethylsulfoniopropionate (DMSP) as major osmolytes in Cnidaria with endosymbiotic dinoflagellates. *Phys. Biochem. Zool.* **83**: 167-173
64. **Herr, J.E., T.M. Winegard, M.J. O'Donnell, P.H. Yancey, and D.S. Fudge (**2010). Stabilization and swelling of hagfish slime mucin vesicles. *J. Exp. Biol*. **213**: 1092-1099. Featured in *Science News*.
65. **Stein, C.S., P.H. Yancey, I. Martins, R.D. Sigmund, J.B. Stokes, B.L. Davidson (**2010). Osmoregulation of CLN3 in the renal medulla. *Am. J. Physiol. Cell Physiol.* **298**: C1388-C1400
66. **Laxson*, C., N. E. Condon, J. C. Drazen, and P.H. Yancey** (2011). Decreasing urea:methylamine ratios with depth in Chondrichthyes: A physiological depth limit? *Physio. Biochem. Zool.* **84**:494-505.
67. **Jamieson, A., and P.H. Yancey** (2012). On the validity of the *Trieste* flatfish: dispelling the myth. *Biol. Bull*. **222**:171-175 – Editors' Pick COVER STORY http://www.biolbull.org/content/222/3.cover-expansion
68. **Kalujnaia, S., S. Gellatly, N. Hazon, A. Villaseñor*, P.H. Yancey and G. Cramb** (2013). Tissue distribution of inositol monophosphatase (IMPA) isoforms in two euryhaline teleosts, the European eel (*Anguilla anguilla*) and the Nile tilapia (*Orechromis niloticus*); the effects of SW-acclimation on isoform expression and inositol production. *Amer. J. Physiol*. 305:R369-R384.
69. **Yancey, P.H., M. Gerringer*, A.A. Rowden, J.C. Drazen, A. Jamieson** (2014). Marine fish may be biochemically constrained from inhabiting the deepest ocean depths. *Proc. Natl. Acad. Sci. USA* 111:4461-4465.
70. **Hagedorn, M., V. Carter, N. Zuchowicz, M. Phillips, C. Penfield, B. Shamenek, E.A. Vallen, F.W. Kleinhans, K. Peterson*, M. White*, P.H. Yancey** (2015). Trehalose is a chemical attractant in the establishment of coral symbiosis. ***PLoS ONE*** 10.1371/journal.pone.0117087.
71. **Ichino, M C., M.R Clark, J.C. Drazen, A. Jamieson, D.O.B. Jones, A.A. Rowden, T.M. Shank, P.H. Yancey and H.A. Ruhl** (2015). The distribution of benthic biomass in hadal trenches: a modelling approach to investigate the effect of vertical and lateral organic matter transport to the seafloor. *Deep-Sea Res. I.* 100:21-33.
72. **Yancey, P.H, and J.F. Siebenaller** (2015). Co-evolution of proteins and solutions: protein adaptation versus cytoprotective micromolecules and their roles in marine organisms. *J. Exp. Biol*. 218:1880-1896.
73. **Yancey, P.H** (2015). Organic osmolytes in elasmobranchs. IN: ***Fish Physiology*** (R.E. Shadwick, A.P. Farrell, C.J. Brauner, eds), Vol. 34B (pp 221-277). Academic Press.

74. **Divino, J.N., M. Monette, S.D. McCormick, P.H. Yancey, K.G. Flannery*, M.A. Bell, F.A. von Hippel, and E.T. Schultz** (2016). Osmoregulatory physiology and rapid evolution of salinity tolerance in a recently introduced lake population of Threespine Stickleback. *Evol. Ecol. Res.* 17:179-201.
75. **Linley, T., M. Gerringer, P.H. Yancey, J.C. Drazen, C. Weinstock*, A. Jamieson** (2016). Fishes of the hadal zone including new species, *in situ* observations and depth records of Liparidae. *Deep-Sea Res. I*, 114: 99-110.
76. **Mills S., Leduc D., Drazen J. C., Yancey P., Jamieson A. J., Clark M. R., Rowden A. A., Mayor D. J., Piertney S., Heyl T., Bartlett D., Bourque J., Cho W., Demopoulos A., Fryer P., Gerringer M., Grammatopoulou E., Herrera S., Ichino M., Lecroq B., Linley T. D., Meyer K., Nunnally C., Ruhl H., Wallace* G., Young C. and Shank T. M.** (2016). 10,000 m under the sea: an overview of the HADES expedition to Kermadec Trench. IN: B. Golder and A. Connell (Eds.) Proceedings of Kermadec–Discoveries and Connections (pp 36–38). The Pew Charitable Trusts.
77. **Gerringer, M.E., Drazen, J.C., Yancey**, P.H. (2017). Metabolic enzyme activities of abyssal and hadal fishes: pressure effects and a re-evaluation of depth-related changes. *Deep-Sea Res. I* 125: 135–146.
78. **Knight, L. S., Q. Piibe*, C. Perkins*, I. Lambie*, and P.H. Yancey** (2017)**.** Betaine in the brain: characterization of betaine uptake, its influence on other osmolytes and its potential role in neuroprotection from osmotic stress. ***Neurochem. Res.*** In press.

OTHER ARTICLES

79. **Weiler, C.S., P.H. Yancey** (1989). Dual-career couples and science: opportunities, challenges and strategies. *Oceanography* **2**: 28-31.
80. **Weiler, C.S., P.H. Yancey** (1992). Dual-career couples and academic science. *J. Coll. Sci. Teach.* **21**: 217-222.
81. **Yancey, P.H.** (1993). Micromolecules that help macromolecules in dehydration [commentary written for I.S.I. Citation Classic® recognition]. *Curr. Contents Life Sci.* **36**: 9.
82. **Sandquist, J., L. Romberg, P. Yancey** (2013). Life as a professor at a small liberal arts college. *Mol. Biol. Cell* **24**: 3285-3291

PUBLISHED ABSTRACTS from presented talks and posters

1. **Yancey, P.H., W. Bement*, M. Maier*** (1985). Temperature, pH and pressure effects on lactate dehydrogenases of vertically migrating midwater fishes. *Amer. Zool.* **25**: 19A.
2. **Yancey, P.H., R.G. Haner*, T. Freudenberger*** (1990). Effects of an aldose reductase inhibitor on osmotic effectors in rat renal medulla. *Proc. Soc. Exp. Bio. Med.*, March: 238
3. **Walsh*, L.P., P.H. Yancey** (1994). Hyperthermic and hypertonic shock induce HSP70 accumulation and thermotolerance but not osmotic tolerance in cultured mammalian renal cells. *The Physiologist* **37**: A98
4. **Yancey, P.H., R. Won*, E. Saari** (1995). Applications of a rapid HPLC method for osmolyte analysis: major compatible solutes in analgesic-stressed mammalian renal cells and summer- and winter-stressed desert sagebrush. *Phys. Zool.* **68**: 175. At IUBS/CBP Conference, Birmingham, **England**
5. **Yancey, P.H., S.D. Meyer*, S.Y. Lee*, T.A. Hong*, S. Truong*** (1996). Compensatory changes in rat renal and lenticular osmolytes induced by polyol perturbations. *Exp. Eye Res.* **63**: S188. Invited talk, Congress of Eye Research, Yokohama, **Japan**
6. **Gillett*, M.B., J.R. Suko*, F.O. Santoso*, P.H. Yancey** (1996). Elevated levels of trimethylamine oxide in muscles of deep-sea teleosts. *Amer. Zool.* **36**: 35A
7. **Kelly*, R.H., M.G. Gillett*, P.H. Yancey** (1997). High levels of trimethylamine oxide in muscles of deep-sea fishes, squid and shrimp. *Amer. Zool.* **37**: 144A
8. **Fyfe-Johnson*, A.L., P.H. Yancey** (1998). Pressure inhibition of deep-sea grenadier lactate dehydrogenase and counteractions by trimethylamine oxide. *Amer. Zool.* **38**: 120A
9. **Yancey, P.H.** Water stress and proteins (1999). *Amer. Zool.* **39**: 6A--invited SICB talk
10. **Yin, M., H.R. Palmer, J.J. Bedford, A. Fyfe-Johnson*, F. Santoso*, J. Suko*, P.H. Yancey** (1999). Unusual osmolytes in deep-sea vestimentiferans, gastropods, and echinoderms. *Amer. Zool.* **39**: 65A
11. **Yancey, P., M. Gillett*, R. Kelly*, A. Fyfe-Johnson*, M. Auñón*, V. Walker*, J. Siebenaller** (2000). Co-evolution of deep-sea proteins and osmolytes: trimethylamine N-oxide counteracts inhibition by hydrostatic pressure. *FASEB J.* **14:** A440
12. **Yin, M., P.H Yancey**. Methylamine osmolytes dominate in deep-sea polychaetes, pycnogonids, and octopods (2000). *Amer. Zool.* **40**: 1269
13. **Fiess*. J.C., J.R. Hom*, H.A. Hudson*, C. Kato, P.H. Yancey** (2001). Depth correlations of organic

osmolytes in foot and mantle tissues of vesicomyid bivalves. *Amer. Zool*. **41**:1442

14. **Hudson*, H.A., J.R. Hom*, J.C.Fiess*, C. Kato, P.H. Yancey** (2001). Correlations of hypotaurine and thiotaurine contents with sulfide metabolism in gills of vesicomyid bivalves. *Amer. Zool*. **41**:1476
15. **Steele, S., P.H. Yancey, P.A. Wright** (2002). Osmoregulation and nitrogen excretion in the embryonic little skate *Raja erinacea*. *Proc. 2002 Internatl. Congr. Fish Biology;* Conference in Vancouver **Canada**
16. **Yancey, P.H., J.C. Fiess*, H.A. Hudson*, J.R. Hom*, C. Kato** (2002). Phosphoserine and other unusual osmolytes in deep-sea vesicomyid bivalves: correlations with depth. *The Physiologist* **45**:370.
17. **Steele, S.L., Yancey, P.H., Wright, P.A**. (2002). Osmoregulation and nitrogen excretion in the embryonic little skate (*Raja erinacea)*. *Integr. Comp. Biol*. **42**:1318
18. **Rosenberg*, N.B., R.W. Lee, P.H. Yancey** (2003). Adaptation to environmental stresses with osmolytes: possible roles for betaine, hypotaurine and thiotaurine in gastropods from hydrothermal vents. *Comp. Biochem. Physiol.* **134**: S120. At ICCPB in Mt. Buller, **Australia**
19. **Yancey, P.H**. (2003). Unusual organic osmolytes in deep-sea animals as adaptations to symbiont metabolism and hydrostatic pressure. *Comp. Biochem. Physiol.* **134**: S117.
20. **Steele, S.L., Yancey, P.H., Wright, P.A**. (2003). Mechanisms of osmotic regulation in a marine elasmobranch in response to dilute seawater: a developmental perspective. *Comp. Biochem. Physiol*. **134A**:S11. International Fish Biology Congress, Vancouver **Canada**
21. **Horak*, R.V., N.K. Rosenberg*, H.A. Hudson*, R. Lee, P.H. Yancey** (2003). Occurrence of thiotaurine and hypotaurine in hydrothermal vents and cold seep species without endosymbionts. *Integr. Comp. Biol.* **43**: 1043.
22. **Yancey, P.H., A.L. Samerotte*, G.L. Brand*, J.C. Drazen** (2004). Increasing contents of TMAO with depth within species as well as among species of teleost fish. *Integr. Comp. Biol.* **44**: 669.
23. **Kunkel-Patterson*, A., J.C. Fiess; L. Mathias*; L. Riley; A. Samerotte*; T. Hirano; P.H. Yancey** (2005). Effects of salinity and temperature on organic osmolytes in tilapia. *Integr. Comp. Biol.* **45**: 1156.
24. **Yancey, P.H.** (2006). Cytoprotective roles of compatible and counteracting solutes. *The Physiologist* **49**: C1-40.

Selected Unpublished ABSTRACTS from Presentations (printed in meeting bulletins only)

Other *international* presentations (Japan, England, Australia, Switzerland, Canada, France) *published* and/or *invited* above

- **Yancey, P.H., S. Edmands*, K. Seekamp*, R. Haner*** (1991). Organic osmolyte regulation in rodent kidneys subjected to various perturbations. *3rd Internatl. Cong. Comp. Physiol. Biochem*., Tokyo, **Japan**
- **Rohr*, J.M., P.H. Yancey** (1997). Effects of aldose reductase inhibitors, ascorbic acid and amino-guanidine on sorbitol contents in primary renal cultures. Poster at the *33rd Internat'l Cong. Physiol. Sci.*, St. Petersburg, **Russia**, June 30-July 5.
- **Walker*, V., M. Auñon*, P.H. Yancey** (2000). Effects of osmolytes of deep-sea animals on enzyme function and stability under high hydrostatic pressure. Council on Undergraduate Research **Posters-On-The-Hill Meeting**, **Washington DC:** selected competitively as one of only 60 from the whole country. We listened to talks by a congressman and other officials on science funding; met with congressional aides for Senator Patty Murray and congressmen from the students' home districts (Oregon, Colorado): Ron Wyden, Gordon Smith, and others (to discuss research funding). We presented our work at a poster session, in which several NSF and NASA officials and congressional aides specifically went over our poster in detail.
- **Yancey, P.H., W. Blake*, J. Conley* (**2001). Protective properties of organic osmolytes in deep-sea fish and vestimentiferans. Talk at *How Animals Work Conference*, Chobe Nat'l Park, **Botswana**, Aug. 18-24.
- **Fiess*, J., J.R. Hom*, H.A. Hudson*, P.H. Yancey** (2001). Phosphodiester amine, taurine and derivatives, and other osmolytes in vesicomyid bivalves from cold seeps: correlations with depth and symbiont metabolism. At 2nd Internat'l Symposium Hydrothermal Vents Cold Seeps , Brest, **France**
- **Yancey, P.H.** (2004). Trimethylamine oxide as an organic osmolyte in deep-sea fishes: Correlations with depth and stabilization of proteins under pressure**.** *Internat'l Cong. Biology Fish Biology,* Aug 1-5, Manaus, **Brazil**
- **Brand*, G.L., R.V. Horak*, N. LeBris, S.K. Goffredi, S.L. Carney, B. Govenar, P.H. Yancey** (2005). Hypotaurine and thiotaurine as indicators of sulfide exposure in bivalves and vestimentiferans from hydrothermal vents and cold seeps (2005). 3rd Internat'l Symp. Hydrothermal Vents Cold Seeps, La Jolla
- **Laxson*, C.J., N. Condon, J.C. Drazen, P.H. Yancey** (2010). Decreasing urea:methylamine ratios with depth in chondrichthyan fishes: a physiological depth limit? *12th Internat'l Symp. Deep-sea Biology,* Reykjavik, **Iceland** June 5-11

- **Chavez*, K., R.G. Waller, P.H. Yancey.** Organic Osmolytes in Deep-sea Corals. *12th Internat'l Symp. Deep-sea Biology,* Reykjavik, **Iceland** June 5-10.
- **Gerringer*, M.,** A**. Jamieson, A. Rowden, J. Drazen, P.H. Yancey** (2012). High trimethylamine oxide contents in hadal snailfish (Liparidae) indicate a depth limit for teleost fishes. *13th Internat'l Symp. Deep-sea Biology,* Wellington, **New Zealand**, Dec. 2-7.
- **Downing*, A.B., G.T. Wallace*, C.L.Weinstock*, P.H. Yancey** (2015) Trimethylamine oxide, scyllo-inositol and other potential piezolytes (pressure counteractants) correlating with depth in hadal fishes and amphipods. *14th Internat'l Symp. Deep-sea Biology,* Aveiro, **Portugal**, Aug. 30-Sept. 4.

INTERNET Materials

- **Yancey, P.H**. (1999). Self-test questions on the **website** for the 1999 edition of *Marine Biology* by Castro and Huber (a major college text by McGraw Hill). Posted on the web in 6/99.
- **Yancey, P.H.** (1997-present). people.whitman.edu/~yancey/deepsea.html: **Educational DEEP-SEA WEB SITE** designed in 1997, and continuously updated with new deep-sea research. It is cited in at least 3 marine science texts, and is used by many people around the world; I receive many emails each week from a variety of sources, e.g., reporters, writers, students, teachers seeking information on the deep sea. In 2002, the site was was selected by the Nat'l Sci. Teachers Assoc., under strict NSF guidelines, as an online science resource for K-12 and higher education. In 2011, the Marine Education Society of Australasia adopted my entire site (embedded in their site: http://www.mesa.edu.au/deep_sea/biblioPY.asp)
- **DIRECTOR OF DEEP SEA for MARINEBIO.ORG** (2011-present): http://marinebio.org/oceans/deep/ Appointed to this position by David Campbell, webmaster of this growing new site dedicated to "sharing the wonders of the ocean realm to inspire science education, marine conservation, research, and a sea ethic." Duties are to manage the deep-sea page of this site and advise on other features of the entire site. I wrote a long overview of deep-sea biology, which has received many positive comments online by users.