Curriculum Vitae

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April 22, 1961; St. Louis, MO

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EDUCATION:

Ph.D. in Cell and Molecular Biology, 1988, St. Louis University, St. Louis, MO
B.S. in Chemistry, 1984, Maryville College, St. Louis, MO

BACKGROUND:

12/07-present	Professor of Cell and Developmental Biology (secondary), Vanderbilt University
9/06-present	Professor of Biological Sciences (primary), Vanderbilt University, Nashville, TN
9/00-8/06	Associate Professor of Biological Sciences, Vanderbilt University, Nashville, TN.
(9/1/00	*Departments of Molecular Biology and Biology merge to form Biological Sciences)*
9/99-8/00	Associate Professor of Molecular Biology, Vanderbilt University, Nashville, TN.
11/92-9/99	Assistant Professor of Molecular Biology, Vanderbilt University, Nashville, TN.
10/91-10/92	American Cancer Society postdoctoral fellow, Howard Hughes Medical Institute, University of California, San Diego, La Jolla, CA, with Dr. Scott Emr
8/89-10/91	American Cancer Society postdoctoral fellow, California Institute of Technology, Pasadena, CA, with Dr. Scott Emr
6/88-7/89	NIH postdoctoral trainee, St. Louis University, St. Louis, MO, with Dr. Arnold Kaplan
8/84-6/88	NIH predoctoral trainee, St. Louis University, St. Louis, MO, with Dr. Arnold Kaplan

HONORS AND AWARDS:

Elected vice-chair of 2017 and chair of the 2019 GRC on Molecular and Cellular Biology of Lipids
Keynote Speaker: GRC on the Molecular and Cellular Biology of Lipids, Waterville Valley, NH (7/26/15).
Department of Biological Sciences Ellen Fanning Mentor of the Year award (2014)
Keynote Speaker: Na^+/K^+ ATPase and Related Transport ATPases meeting, Lunteren, The Netherlands (8/30 – 9/5/14).
National Institutes of Health, MBPP study section regular member. (2010 – 2014)
Vanderbilt University "Chancellor's Award for Research" (2010)
Keynote Speaker: Swiss Yeast Meeting, Fribourg, Switzerland (09/2010).
Vanderbilt University College of Arts and Science "Excellence in Graduate Mentoring" award (2009)
Interdisciplinary Graduate Program "Teacher of the Year" (2004)

National Science Foundation CAREER award, MCB-9600835, Vanderbilt University (9/96 - 8/00)
Phi Beta Kappa, St. Louis University (1988)
Honors graduate magna cum laude, Maryville College, St. Louis, MO (1984)
Award for Excellence in Mathematics/Science, Maryville College, St. Louis, MO (1984)

RESEARCH INTERESTS

All living organisms depend on membranes for survival and my primary research interest is to understand how biological membranes are assembled. Membrane biogenesis is a remarkably complex and dynamic process that requires the temporally and spatially regulated assembly of thousands of different molecules. Our specific focus is on deciphering mechanisms for how cells generate the specific protein and lipid composition of the plasma membrane, and organelles of the secretory and endocytic pathways. A project to explore how vesicular trafficking machinery controls the protein composition of membranes led to our recent discovery that the COPI vesicle coat protein recognizes a polyubiquitin sorting signal important for retrieval of v-SNAREs back to their donor organelle. We discovered several years ago that type IV P-type ATPases (P4-ATPases) play crucial roles in budding transport vesicles from Golgi and endosomal compartments. We went on to show that the P4-ATPases are flippases that pump specific phospholipid species to the cytosolic leaflet, thereby producing asymmetry in lipid composition between the two leaflets. More recent efforts have aimed at understanding *how* the P4-ATPases evolved the ability to recognize and flip different phospholipids, even to the point of mutationally evolving the enzymes to transport novel substrates. We are using these "designer flippases" to probe the specific role of lipid substrates in vesicular transport and membrane remodeling events. Deficiency in P4-ATPase function is linked to a number of human pathologies and we are working to define the molecular basis of these disease associations.

RESEARCH SUPPORT - PENDING GRANTS

Postdoctoral trainee Bartholomew Roland has a K99/R00 application currently under review.

RESEARCH SUPPORT - ACTIVE GRANTS

PI, National Institutes of Health, 1 R01 GM107978-05, 02/01/18 – 01/31/22, $216,600 direct costs per year, $123,255 indirect costs per year, $1,395,420. "P4-ATPase mechanism of phospholipid translocation". Impact score: 20, percentile: 9th

PI, National Institutes of Health, 1 RO1 GM118452-01, 5/01/2016 - 4/30/20, $217,077 direct cost per year, $123,526 indirect cost per year, $1,362,412 total award. "Mechanisms of protein transport between Golgi and endosomes". Impact score: 27, Percentile: 11th

PI, National Institutes of Health, 3R01GM118452-01S1, 5/01/2016 - 4/30/2017, $26,488 Direct costs, 0 Indirect costs, Equipment supplement for "Mechanisms of protein transport between Golgi and endosomes" Role: PI

RESEARCH SUPPORT - PREVIOUS GRANTS

PI, National Institutes of Health, 1 R01 GM107978-01, 9/01/13 – 8/31/17, $190,000 direct costs per year, 100,224 indirect costs in first year, $1,184,851 total award. "P4-ATPase mechanism of phospholipid translocation" (No cost extension to 8/31/18)
PI, National Science Foundation, MCB-1414457, 2/15/14 – 1/31/15, $4000 direct costs

Conference: Southeast Regional Yeast Meeting, March 14 – 16, 2014 at Vanderbilt University

PI, National Institutes of Health, 2 RO1 GM62367-12, 6/1/10 – 5/31/14, $208,166 direct costs per year. $1,277,258 total award. "Drs2p function in clathrin-coated vesicle budding" (1 yr no cost extension to 5/31/15)

PIs Graham and Kenworthy, Vanderbilt Discovery Grant, 5/1/10 – 4/30/13, $95,000 total award "Influence of phospholipid asymmetry on cholesterol dynamics in membranes"

Co-PI, (PI, E. Knapik) National Institutes of Health, 1R01DE018477-01, 8/1/07 – 7/31/11, $250,000 direct costs "Role of the Secretory Pathway in Craniofacial Morphogenesis"

PI, National Institutes of Health, 2 RO1 GM62367-08, 9/1/05 – 8/31/10, $185,000 direct costs per year. $1,121,529 total award. "Drs2p function in clathrin-coated vesicle budding"

PI, National Institutes of Health, 3 RO1 GM62367-05S1, 7/1/06 – 8/31/08, $71,646 total project direct costs. $103,813 total award. Research Supplement to Promote Diversity in Health-Related Research for"Drs2p function in clathrin-coated vesicle budding"

PI, National Science Foundation, MCB0543274, 7/1/06 – 6/31/07, $49,047 direct costs, $75,000 total. "Yeast Auxilin Regulation of Clathrin Dynamics". No cost extension through 6/31/08.

Co-PI, Vanderbilt University Discovery Grant, 5/1/04 – 6/30/06, $50,000 "Conservation of type IV P-type ATPase function in protein trafficking".

PI, National Institutes of Health, 1 RO1 GM62367-01A1, 9/1/01 – 8/31/05, Total budget, $956,386. "Drs2p function in clathrin-coated vesicle budding"

PI, National Institutes of Health, 2 RO1 GM50409-05A1 1/99-12/02 Total budget, $847,305 "Compartmental organization of the yeast Golgi complex".

PI, National Science Foundation CAREER award, MCB-9600835, 9/96 - 8/00, $300,000 "Isolation and characterization of yeast genes that genetically interact with *arf1*"

Co-PI, NSF Multi-User Biological Equipment and Instrumentation Resources. BIR-9419667 1/1/95-12/30/95 $195,837 "Quantitative Biology Core".

PI, National Institutes of Health, RO1 GM50409 1/94-12/98 Total budget, $603,630 "Compartmental organization of the yeast Golgi complex".

PI, University Research Council, Vanderbilt University 1993 $8,590 "Cloning and characterization of genes that encode components of the yeast secretory pathway"

Total support from all grants ~$8,584,500 (2/12/2018)

PUBLICATIONS (descriptions are provided for select publications to highlight significance):

65. Roland, B.P., T. Naito, J.T. Best, C. Arnaiz-Yepez, H. Takatsu, R.Y. Yu, H.-W. Shin, T.R. Graham (2018) Identification and characterization of yeast and human glycosphingolipid flippases. Submitted.

64. Xu, P., H.M. Hankins, C. MacDonald, S.J. Erlinger, M.N. Frazier, N.S. Diab, R.C. Piper, L.P. Jackson, J.A. MacGurn, and T.R. Graham (2017) COPI mediates recycling of an exocytic SNARE by recognition of a ubiquitin sorting signal. Elife 6:e28342

The mechanisms for recycling v-SNAREs from the acceptor compartment where vesicles fuse back to the donor compartment are poorly understood. In addition, roles of the COPI vesicle coat have been controversial for years. The best-defined function for COPI is recycling of proteins from the Golgi back to the ER through recognition of a di-lysine sorting signal. Here we report the discovery that recycling of an exocytic SNARE through the endocytic pathway back to the Golgi requires COPI. Moreover, we show that ubiquitination of the SNARE is required for COPI-dependent recycling, and that COPI directly binds K63-linked polyubiquitin chains. We were also able to devise experiments to

show COPI interaction with ubiquitin is essential in vivo to support SNARE recycling. Thus, we defined a surprising new function for an old coat.

63. van Leeuwen, J., C. Pons, J.C. Mellor, T.N. Yamaguchi, H. Friesen, J. Koschwanez, M.M. Usaj, M. Pechlaner, **M. Takar**, M. Uasj, B. Vandersluis, K. Andrusiak, P. Bansal, A. Baryshnikova, C. Boone, J. Cao, A. Cote, M. Gebbia, G. Horecka, I. Horecka, E. Kuzman, N. Legro, W. Liang, N. van Lieshout, M. McNee, B.J. San-Luis, F. Shaeri, E. Shuteriqi, S. Sun, L. Yang, J.-Y. Youn, M. Yuen, M. Costanzo, A.C. Gingras, P Aloy, C. Oostenbrink, A. Murray, **T.R. Graham**, C.L. Myers, B.J. Andrews, F.P. Roth, and C. Boone. (2016) Exploring genetic suppression interactions on a global scale. Science 354: 599, aag0839 (11 pages)

The Boone laboratory specializes in high throughput genetic interaction studies in yeast and we have collaborated with them several times to define the molecular basis of these interactions. Here, we show mutations in a novel, highly conserved gene called *ANY1* can bypass the essential function of the P4-ATPase Neo1. Our data suggests Any1 is a phospholipid scramblase that partitions the functions of two phospholipid flippases in Golgi membranes.

62. Wu, Y., M. Takar, A.A. Cuentas-Condori and T. R. Graham (2016) Neo1 and phosphatidylethanolamine contribute to vacuole membrane fusion in *Saccharomyces cerevisiae*. Cell. Logistics 6:e1228791 (13 pages)

61. Roland, B.P. and T. R. Graham. (2016) Decoding P4-ATPase substrate interactions. Crit Rev Biochem Mol Biol 51: 513-527

60. Roland, B.P. and T. R. Graham. (2016) Directed evolution of a sphingomyelin flippase reveals mechanisms of substrate backbone discrimination by a P4-ATPase. Proc Natl Acad Sci USA 113:E4460-6.

This manuscript is the most recent in a series of papers (50, 52, 54, 60) where we provide the first mechanistic insight into how P4-ATPases recognize and flip phospholipid. Phospholipid is a highly unusual substrate for a P-type ATPase, which more typically pump cations or heavy metals across membranes. In addition, high-resolution structures of the Na^+/K^+-ATPase and Ca^{++}-ATPase in multiple conformational states have provided exquisite detail into how P-type ATPases recognize and pump cation substrates. How did the P4-ATPases evolve the ability to pump these large amphipathic molecules? The solution to this "giant substrate problem" is that the P4-ATPases are not using the canonical cation-binding pocket in the middle of the membrane domain. Rather, substrate is selected sequentially at two gates at the protein/lipid interface. By mutationally evolving a phosphatidylcholine flippase into a sphingomyelin flippase in this manuscript, we learned what residues are crucial for lipid backbone selection.

59. Takar, M., Y. Wu and T. R. Graham. (2016) The essential Neo1 from budding yeast plays a role in establishing aminophospholipid asymmetry of the plasma membrane. J. Biol. Chem 291:15727-39

58. Hankins, H.M., Y.Y. Sere, N.S. Diab, A.K. Menon, and T.R. Graham. (2015) Phosphatidylserine translocation at the yeast *trans*-Golgi network regulates protein sorting into exocytic vesicles. Mol Biol Cell 26:4674-85

This manuscript and (55) make use of our set of "designer flippases" to identify the trafficking pathways that rely on phosphatidylserine (PS) translocation. It also provides new insight into how "lipid raft"-based protein sorting is regulated by PS and a sterol/phosphoinositide exchange protein.

57. Hankins, H.M., R.D. Baldridge, P. Xu and T.R. Graham. (2015) Role of Flippases, scramblases and lipid transfer proteins in phosphatidylserine subcellular distribution. Traffic. 16:35-47

56. Zhou, X., T.T. Sebastian and T.R. Graham. (2013) Auto-inhibition of Drs2p, a Yeast Phospholipid Flippase, by its Carboxyl-Terminal Tail. J. Biol. Chem. 288:31807-15

55. Xu, P., R.D. Baldridge, R.J. Chi, C.G. Burd and T.R. Graham. (2013) Phosphatidylserine flipping enhances curvature and charge required for vesicular transport. J. Cell Biol. 202:875-86
Here we identify a crucial role for PS flip in vesicular transport between early endosomes and the TGN, and also identify the ArfGAP Gcs1 as an important effector of PS. We also demonstrate that the ArfGAP Lipid Packing Sensor (ALPS) motif in Gcs1 is sensing both the charge and the curvature imparted to the membrane by the PS flippase (Drs2). This work supports our hypothesis that flippases are major drivers of the membrane curvature needed to bud transport vesicles from Golgi and endosomal membranes (see 46 and 31).

54. Baldridge, R.D., P. Xu and T.R. Graham. (2013) Type IV P-type ATPases distinguish mono- versus di-acyl phosphatidylserine using a cytofacial exit gate in the membrane domain. J. Biol. Chem. 288:19516-19527

53. Graham, T.R. (2013) Arl1 gets into the membrane remodeling business with a flippase and ArfGEF. Proc Natl Acad Sci USA, 110:2691-2

52. Baldridge, R.D. and T.R. Graham. (2013) Two gate mechanism for phospholipid selection and transport by P4-ATPases. Proc Natl Acad Sci USA, 110:E358-67

51. Sebastian, T.T., R.D. Baldridge, P. Xu and T.R. Graham. (2012) Phospholipid flippases: building membrane asymmetry and transport vesicles. Bioch. Biophys Acta. 1821(8):1068-77

50. Baldridge, R.D. and T.R. Graham. (2012) Identification of residues defining phospholipid flippase substrate specificity of type IV P-type ATPases. Proc. Natl. Acad. Sci. USA. 109(6):E290-8

49. Brett, C.L., L. Kallay, Z. Hua, R. Green, A. Chyou, Y. Zhang, T.R. Graham, M. Donowitz, R. Rao. (2011) Genome-wide analysis reveals the vacuolar pH-stat of *Saccharomyces cerevisiae*. PLoS One 6:e17619

48. Zhou, X., K. Liu, P. Natarajan, B.-P. Muthusamy and T.R. Graham. (2011) "Coupling Drs2p to phospholipid translocation, membrane asymmetry and vesicle budding" *In Membrane Asymmetry and Transmembrane Motion of Lipids* (eds P. Devaux and A. Herrmann) John Wiley and Sons

47. Graham, T.R. and C.G. Burd. (2011) Coordination of Golgi function by phosphatidylinositol 4-kinases. Trends in Cell Biology 21:113-121

46. Kozlov, M.M. and T.R. Graham (2010) Interplay of proteins and lipids in generating membrane curvature. Curr. Opin. Cell Biol. 4:430-6.

45. Graham, T.R. (2009) Flip-flop season. *In* "Lipid News" section of *ASBMB today*, October issue

44. Natarajan, P., K. Liu, D.V. Patil, C.L. Jackson and T.R. Graham. (2009) Regulation of a Golgi flippase by phosphoinositides and an ArfGEF. Nat Cell Biol. 11: 1421-1426

Phosphatidylinositol-4-phosphate (PI4P) was known to play a crucial role in vesicular transport from the Golgi, but effectors of this signaling lipid were not known at the time. Here, we show that the Drs2 PS flippase is a downstream effector of PI4P. This work, and a subsequent paper (56), also provided the first example for how a P4-ATPase is regulated. The C-terminal, cytosolic tail of Drs2 is an autoinhibitory domain and interactions of this domain with PI4P or an ArfGEF relieve autoinhibition to activate the flippase at the *trans*-Golgi network (TGN).

43. Zhou, X. and T.R. Graham. (2009) Reconstitution of phospholipid translocase activity with purified Drs2p, a type IV P-type ATPase from budding yeast. Proc. Natl. Acad. Sci. USA 106:16586-91

This is one of the most important papers we have published. A phospholipid flippase activity was first described in the red blood cell membrane by the Devaux lab in 1984; however, 25 years of further effort had failed to identify the protein that catalyzed this activity. Work from my lab and others had implicated the P4-ATPases as *potential* phospholipid flippases, but this remained highly controversial. Here we describe the first reconstitution of a phospholipid flippase activity with a purified P4-ATPase. After this publication, the phospholipid flippase activity of P4-ATPases was widely accepted in the field.

42. Muthusamy, B.P., S. Raychaudhuri, P. Natarajan, F. Abe, W.A. Prinz and T.R. Graham. (2009) Control of protein and sterol trafficking by antagonistic activities of a P4-ATPases and oxysterol binding protein homologue. Mol. Biol. Cell. 20: 2920-2931

This manuscript describes the discovery of a homeostatic control feature in membrane remodeling at the TGN. As membrane flows through the secretory pathway, the composition changes dramatically from a sterol-poor ER membrane to a sterol-rich plasma membrane. We found that Drs2 and a sterol transfer proteins (Osh4) negatively regulate each other's activity at the TGN. This is important for proper sorting of exocytic cargo (see 58), budding of clathrin-coated vesicles and the concentration of sterol into vesicles targeted to the plasma membrane.

41. Muthusamy, B.P., P. Natarajan, X. Zhou and T.R. Graham. (2009) Linking phospholipid flippases to vesicle mediated protein transport. Biochem. Biophys. Acta 1791: 612-619

40. Ho CH, Magtanong L, Barker SL, Gresham D, Nishimura S, Natarajan P, Koh JL, Porter J, Gray CA, Andersen RJ, Giaever G, Nislow C, Andrews B, Botstein D, Graham TR, Yoshida M, Boone C. (2009) A molecular barcoded yeast ORF library enables mode-of-action analysis of bioactive compounds. Nat Biotechnol. 27(4):369-77

39. Liu K, K. Surendhran, S.F. Nothwehr, and T.R. Graham. (2008) P4-ATPase Requirement for AP-1/Clathrin Function in Protein Transport from the trans-Golgi Network and Early Endosomes. Mol Biol Cell. 19: 3526 - 3535

In my opinion, this manuscript describes one of our most profound observations. The textbook view of AP-1/clathrin-coated vesicle budding is that the small GTP-binding protein Arf recruits AP-1 and clathrin to the TGN, and that the biophysical properties of the coat itself is sufficient to drive the membrane curvature needed to bud vesicles. However, we demonstrated that acute inactivation of Drs2 (PS flippase) has no effect on the recruitment of Arf, AP-1 and clathrin to the TGN, but vesicle budding appears completely disrupted. We propose that the flippase is an important driver of membrane curvature by a bilayer-couple mechanism. This idea was proposed in my 2004 review article (31, also 46) and was first experimentally supported here and subsequently in (55).

38. Fei, W., G. Alfaro, B.-P. Muthusamy, Z. Klaassen, T.R. Graham, H. Yang, C.T. Beh. (2008) Genome-Wide Analysis of Sterol-Lipid Storage and Trafficking in *Saccharomyces cerevisiae*. Euk. Cell. 7: 401 - 414

37. Liu, K., Z. Hua, J. Nepute and T. R. Graham. (2007) The yeast P4-ATPases Drs2p and Dnf1p are essential cargos of the NPFXD/Sla1p endocytic pathway. Mol Biol Cell, 18: 487-500

36. Hua, Z. and T.R. Graham. (2007) "The Golgi Apparatus" In: *Protein Trafficking, Mechanisms and Regulation*. (editor, N. Segev) Landes Bioscience

35. Chen, S., J. Wang, B.-P. Muthusamy, K. Liu, S. Zare, R.J. Andersen and T.R. Graham. (2006) Roles for the Drs2p-Cdc50p complex in protein transport and phosphatidylserine asymmetry of the yeast plasma membrane. Traffic **7**: 1 - 15

34. Natarajan, P. and T. R. Graham. (2006) Measuring translocation of fluorescent lipid derivatives across yeast Golgi membranes. Methods. **39**:163-8

33. Parsons, A.B., A. Lopez, I.E. Givoni, D.E. Williams, C. Gray, J. Porter, G. Chua, R. Sopko, R. Brost, C.-H. Ho, J. Wang, T. Ketela, C. Brenner, J.A. Brill, G.E. Fernandez, T.C. Lorenz, G.S. Payne, S. Ishihara, Y. Ohya, B. Andrews, T.R. Hughes, B.J. Frey, T.R. Graham, R.J. Andersen, and C. Boone. (2006) Exploring the mode-of-action of bioactive compounds by chemical-genetic profiling in yeast. Cell **126**:611-25

    Our contribution to this paper was to identify PS as the cellular target of papuamide A, an anti-HIV and anti-cancer cell toxin from sea sponges. In addition, we demonstrate the utility of the compound in measuring PS asymmetry of the plasma membrane. This has become a very important tool for studying membrane asymmetry.

32. Xiao, J., L.S. Kim and T.R. Graham. (2006) Dissection of Swa2p/auxilin domain requirements for co-chaperoning Hsp70 clathrin uncoating activity *in vivo*. Mol. Biol. Cell, **17**:3281-90.

31. Graham, T.R. (2004) Flippases and vesicle-mediated protein transport. Trends in Cell Biology **14:** 670 – 677

30. Graham, T. R. (2004) Membrane targeting: Getting Arl to the Golgi. Curr. Biol. **14:** R483 – R485

29. Natarajan, P., J. Wang, Z. Hua, and T.R. Graham. (2004) Drs2p-coupled aminophospholipid translocase activity in yeast Golgi membranes and relationship to in vivo function. Proc. Natl. Acad. Sci., USA **101**: 10614-10619

    This work provided the most compelling evidence to date that the P4-ATPase Drs2 directly catalyzed PS flippase activity in its native Golgi membranes. Previous data from my lab and others using knockout cells supported the hypothesis that P4-ATPases were flippases, but indirect effects were impossible to rule out. This study combined with (43) demonstrated that Drs2 was both necessary and sufficient to catalyze PS flippase activity.

28. Chantalat, S., S.-K. Park, Z. Hua, K. Liu, R. Gobin, A. Peyroche, A. Rambourg, T. R. Graham and C. L. Jackson. (2004) The Arf Activator Gea2p and the P-type ATPase Drs2p Interact at the Golgi in *Saccharomyces cerevisiae*. J. Cell Sci. **117**: 711-722

This paper described the discovery of an interaction between an ArfGEF and a flippase, and that the interaction was somehow important for vesicular transport. We went on to show, surprisingly, that the ArfGEF was stimulating Drs2 flippase activity (44). We also found that the ArfGEF was not sufficient in vitro to activate pure Drs2 (56) and the Lee lab in Taiwan later found that flippase activation required a ternary complex of Drs2-Arl1-Gea2.

27. Chim, N., W.E. Gall, J. Xiao, M.P. Harris, T. R. Graham and Andrzej M. Krezel. (2004) Solution structure of the ubiquitin-binding domain in Swa2p from *Saccharomyces cerevisiae*. Proteins: Structure, Function, and Bioinformatics. **54**: 784-793

26. Hua, Z., and T.R. Graham. (2003) Requirement for Neo1p in retrograde transport from the Golgi complex to the endoplasmic reticulum. Mol. Biol. Cell **14**: 4971 – 4983

25. Hua, Z., P. Fatheddin and T.R. Graham. (2002) An essential subfamily of Drs2p-related P-type ATPases is required for protein trafficking between the Golgi complex and endosomal/vacuolar system. Mol. Biol. Cell **13**: 3162-3177

There are 5 P4-ATPases in budding yeast and 14 members of this protein family in humans. These two papers from Zhoalin Hua (25, 26) present the first analysis of an entire repertoire of these pumps within a species. We have made all possible knockout combinations for the nonessential genes and conditional alleles of the essential *NEO1* gene. We also defined the trafficking pathways where different P4-ATPases acted redundantly and pathways that required solely Drs2 or Neo1. The localization and relative abundance of all 5 members were also defined.

24. Gall, W.E., N.C. Geething, Z. Hua, M.F. Ingram, K. Liu, S. Chen, and T.R. Graham. 2002. Drs2p-dependent formation of exocytic clathrin-coated vesicles *in vivo*. Current Biology **12**: 1623-1627

23. Graham, T.R. and S.F. Nothwehr. 2002. "Protein transport to the yeast vacuole" In: *Protein Targeting, Transport and Translocation*. (ed G. von Heijne and R. Dalbey) Academic Press, London.

22. Gall, W.E., M.A. Higginbotham, C.-Y. Chen, M.F. Ingram, D.M. Cyr and T.R. Graham. 2000. The auxilin-like phosphoprotein Swa2p is required for clathrin function in yeast. Current Biology **10**: 1349-1358

A genetic screen we performed for protein transport factors (15) identified Swa2, which we show in this paper is the yeast ortholog of the clathrin uncoating protein auxilin. Swa2 and auxilin are DnaJ proteins that recruit Hsp70 to clathrin to strip the coat off of clathrin-coated vesicles (CCVs). Auxilin and Hsp70 had been implicated biochemically in uncoating CCVs, but there was no evidence for this function in living cells. We provided the first in vivo data to show that clathrin function is absolutely reliant on auxilin and its ability to stimulate Hsp70 activity (see also 27 and 32).

21. Graham, T. R. 2000. "Metabolic labeling and immunoprecipitation of yeast proteins." In: *Current Protocols in Cell Biology*, Volume 1 (eds. J.S. Bonifacino, M. Dasso, J.B. Harford, J. Lippincott-Schwartz, K.M. Yamada) John Wiley and Sons, New York, NY

20. Brigance, W.T., C. Barlowe and T.R Graham. 2000. Organization of the yeast Golgi complex into at least four functionally distinct compartments. Mol. Biol. Cell **11**: 171-182

19. Hopkins, B. D., K. Sato, A. Nakano and T. Graham. 2000. Introduction of Kex2p cleavage sites in fusion proteins for monitoring localization and transport in the yeast secretory pathway. Meth. in Enzymol. **327**: 107-118

18. Chen, C.-Y., M.F. Ingram, P. Rosal, and T.R. Graham. 1999. Role for Drs2p, a P-type ATPase and potential aminophospholipid translocase, in yeast late Golgi function. J. Cell Biol. **147**: 1223-1236.

This was a landmark paper for my lab and for the field. This is the first report showing that a P4-ATPase (Drs2) is required for vesicle-mediated protein transport from the Golgi complex. This basic observation has been replicated in multiple labs and in multiple organisms, including human cells. There was nothing in the literature to connect a phospholipid pump to the vesicle budding machinery prior to this work.

17. §Gaynor, E. C., §C.-Y. Chen, S. D. Emr, and T. R. Graham. 1998. ARF is required for maintenance of yeast Golgi and endosome structure and function. Mol. Biol. Cell **9**: 653 - 670, § equal contribution

16. Gaynor, E.C., T.R. Graham and S.D. Emr. 1998. COPI in ER/Golgi transport and intra-Golgi transport: do yeast COPs point the way? Bioch. Biophys. Acta **1404**: 33 - 51

15. Chen, C.-Y., and T. R. Graham. 1998. An *arf1Δ* synthetic lethal screen identifies a new clathrin heavy chain conditional allele that perturbs vacuolar protein transport. Genetics **150**: 577 - 589.

To identify new factors involved in vesicular transport from the Golgi, we performed a genetic screen for mutations synthetically lethal with *arf1* (swa mutants). This screen picked up mutations in the clathrin heavy chain gene, *SWA2* (auxilin), *DRS2* (flippase), and *CDC50* (chaperone subunit for Drs2). This paper set the foundation for most of the work subsequently performed in my lab.

14. Reynolds, T.B., B.D. Hopkins, M.R. Lyons and T.R. Graham. 1998. The high osmolarity glycerol response (HOG) MAP kinase pathway controls localization of a yeast Golgi glycosyltransferase. J. Cell Biol. **143**: 935-946.

13. Krasnov, V. and T. R. Graham. 1995. The Golgi complex of *Saccharomyces cerevisiae*. Can. J. Botany **73**: S343-S346

12. Graham, T. R., and V. A. Krasnov. 1995. Sorting of yeast α1,3 mannosyltransferase is mediated by a lumenal domain interaction, and a transmembrane domain signal that can confer clathrin-dependent Golgi localization to a secreted protein. Mol. Biol. Cell **6**: 809-824

11. Graham, T. R. and S. D. Emr. 1994. *SEC18*. In: Guidebook to the Secretory Pathway (J. Rothblatt, P. Novick, and T. Stevens, eds.) Oxford University Press, New York, pp. 132-133

10. Gaynor, E. C., S. te Heesen, T. R. Graham, M. Aebi, and S. D. Emr. 1994. Signal-mediated retrieval of a membrane protein from the Golgi to the ER in yeast. J. Cell Biol. **127**: 653-665

9. Graham, T. R., M. Seeger, V. MacKay, G. S. Payne, and S. D. Emr. 1994. Clathrin-dependent localization of α1,3 mannosyltransferase to the Golgi complex of *Saccharomyces cerevisiae*. J. Cell Biol. **127**: 667-678

8. Graham, T. R., P. Scott, and S. D. Emr. 1993. Brefeldin A reversibly blocks early but not late protein transport steps in the yeast secretory pathway. EMBO J. **12**: 869-877

7. Lacoste, H. C., T. R. Graham, and A. Kaplan. 1992. A sequence in β-hexosaminidase from *Dictyostelium discoideum* required for sorting of proteins to a compartment involved in developmentally induced secretion. J. Biol. Chem. **267**: 5942-5948

6. Robinson, J. S., T. R. Graham, and S. D. Emr. 1991. A putative zinc finger protein, *Saccharomyces cerevisiae* Vps18p, affects late Golgi functions required for vacuolar protein sorting and efficient α-factor prohormone maturation. Mol. Cell. Biol. **12**: 5813-5824

5. Graham, T. R. and S. D. Emr. 1991. Compartmental organization of Golgi-specific protein modification and vacuolar protein sorting events defined in a yeast *sec18* (NSF) mutant. J. Cell Biol. **114:** 207-218

My work as a postdoctoral fellow in Scott Emr's lab demonstrated a role for Sec18/NSF in all vesicular transport steps in the secretory pathway (5). We now know that Sec18/NSF is required to dissociate *cis*-SNARE complexes so v-SNAREs can be recycled. Our work pre-dated the SNARE hypothesis and contributed to idea that SNAREs would be required in all vesicle fusion events. I also defined the influence of brefeldin A (8) on protein trafficking steps in the yeast system and initiated studies on the Golgi to ER retrograde transport of membrane protein bearing a di-lysine sorting motif, which was later shown to be mediated by COPI (10).

4. Vida, T. A., P. K. Herman, S. D. Emr, and T. R. Graham. 1991. Compartmentalized transport, modification and sorting of yeast vacuolar hydrolases. Biomed. Biochim. Acta, **50:** 413-420.

3. Vida, T. A., T. R. Graham, and S. D. Emr. 1990. *In vitro* reconstitution of intercompartmental protein transport to the yeast vacuole. J. Cell Biol. **112:** 2871-2884.

2. Graham, T.R., H. P. Zassenhaus, and A. Kaplan. 1988. Molecular cloning of the cDNA which encodes β-N-acetylhexosaminidase A from *Dictyostelium discoideum*. J. Biol. Chem. **263:** 16823-16829.

My graduate work was focused on determining how lysosomal enzymes reach the lysosome independently of the mannose-6-phosphate receptor. In order to carry out these studies (7), it was necessary to clone the gene encoding a lysosomal enzyme from *Dictyostelium discoideum*, which was known to lack the receptor. Very few molecular reagents were developed for *Dictyostelium* at this time and so this was a ground up project.

1. Cladaras, M. H., T. R. Graham, and A. Kaplan. 1984. Interaction of *Dictyostelium discoideum* α-mannosidase with beef liver phosphomannosyl receptor. Biochem. Biophys. Res. Comm. **116:** 541-546

INVITED LECTURES, SEMINARS & MEETING PRESENTATIONS - Todd R. Graham
(Seminar titles from last five years only)

International Meeting on Lipid Transporters, Kyoto Japan (09/26 – 09/28/18)
Yale University, Dept of Cell Biology (08/22/18) tba
University of Aarhus, Dept of Molecular Biology and Genetics, Aarhus Denmark (06/14/18).
Flippase-gate: Explorations into How Phospholipid Flippases Recognize Substrate.
Washington University, St. Louis, Department of Cell Biology and Physiology (05/02/18). "The Flip Side of Membrane Biology and Protein Trafficking"

St. Louis University, Department of Biochemistry and Molecular Biology (03/19/19). "The Flip Side of Membrane Biology in Health and Disease"

Na^+/K^+ ATPase and Related Transport ATPases meeting, Otsu, Japan (09/24/17-09/29/17). Session Chair and Speaker. "New Substrates and Transport Mechanisms for P4-ATPases".

GRC on Molecular and Cellular Biology of Lipids, Waterville Valley, NH (07/30/17-08/04/17). Vice-Chair and Session Chair.

Genesys Biotechnology Group Distinguished Speaker Series, Hamilton, NJ (10/19/16) "Evolution of Phospholipid Flippase Substrate Specificity"

Mayo Clinic, Department of Biochemistry and Molecular Biology (4/19/16). "The flip side of ubiquitin-dependent protein trafficking".

University of California at San Francisco, Department of Biochemistry and Biophysics, Tetrad Graduate Program (3/8/16). "Flippase-dependent sorting of ubiquitinated cargo by COPI".

National Heart, Lung and Blood Institute (NIH) Cell Biology and Physiology Center (11/19/15). "Flip-flopping on the issue of vesicle mediated protein transport".

Loyola University, Department of Physiology (11/4/15). "Evolution of substrate specificity in a phospholipid pump".

GRC on the Molecular and Cellular Biology of Lipids, Waterville Valley, NH (7/26/15 - 7/31/15). *Invited Keynote Speaker. "Probing how and why P4-ATPases flip phospholipid".

59th Annual Biophysical Society meeting. Baltimore, MD (2/7/15 - 2/11/15). "Control of membrane asymmetry by P4-ATPases".

15th Annual Meeting of the International Union of Biochemistry and Molecular Biology, Taipei, Taiwan (10/21 – 10/26/14). "Roles for Phospholipid Flippases in Membrane Asymmetry and Vesicular Transport".

87th Annual Meeting of the Japanese Biochemical Society. Kyoto, Japan (10/16 – 10/19/14). "Insight into the Phospholipid Flippase Giant Substrate Problem".

University of Kyoto Department of Medical Chemistry, Grad. Sch. Of Medicine, Japan (10/16/14). "Probing how phospholipid flippases produce asymmetric membranes and transport vesicles".

Department of Health Chemistry, Grad. Sch. Of Pharmaceutical Sciences, University of Tokyo, Japan (10/15/14). "Probing how phospholipid flippases produce asymmetric membranes and transport vesicles".

Na^+/K^+ ATPase and Related Transport ATPases meeting, Lunteren, The Netherlands (8/30 – 9/5/14). *Keynote Speaker. "Probing how and why P4-ATPases flip phospholipid across membranes"

GRC on Membrane Transport Proteins, Mount Snow, VT (7/13-7/18/14). "Phospholipid recognition and flip by P4-ATPases"

ASBMB Annual Meeting session on Emerging Topics in Membrane Asymmetry, San Diego, CA (4/26 – 4/30/14), Speaker and Session Chair, "Building asymmetric membranes with P4-ATPases".

Symposium on Cell Signaling and Membrane Traffic, La Jolla, CA (4/26/14). Speaker and Co-organizer with Christopher Burd and Beverly Wendland. "The jagged trail from Sec'zy science to flippin' lipids".

GRC on Protons and Membrane Reactions, Ventura, CA (2/23/14). "Probing the inner workings of phospholipid pumps".

University of Pittsburgh School of Medicine, Molecular Pharmacology Program, Pittsburgh, PA (12/3/13). "The flip-side of protein and lipid trafficking".

University of Michigan Medical Center, Department of Biological Chemistry, Ann Arbor MI (10/22/13). "Pumping out transport vesicles with P4-ATPases".

FASEB conference on Arf and Rab Family G Proteins, Snowmass Village, CO (7/28/13) "Phospholipid flippases: significance others for Arf GEFs and GAPs".

GRC on Molecular and Cellular Biology of Lipids, Waterville Valley, NH (7/21/13). "The flip side of membrane biogenesis: creating asymmetry with P4-ATPases".
University of Alberta, Biochemistry, Edmonton, Canada (6/25/13). "Flip-flopping on the issue of membrane biogenesis"
University of British Columbia, Department of Biochemistry and Molecular Biology, Vancouver, Canada (4/22/2013). "Linking phospholipid flippases to vesicle-mediated protein transport"
Boston University School of Dental Medicine, Molecular and Cell Biology, (11/29/2012).
Tennessee State University, Biological Sciences, MARC Program (11/16/2012).
Belmont University, School of Sciences Colloquium Speaker, Nashville, TN (10/23/2012)
FASEB conference on Phospholipid Metabolism: Disease, Signal Transduction & Membrane Dynamics, Saxtons River, VT (7/2012)
FASEB conference on New Frontiers in Transport ATPases: From Mechanistic to Therapeutic Concepts, Snowmass, CO (6/2012).
2nd Ann. European Symp. on Microbial Lipids, Bern, Switzerland, (5/2012).
Southeast Regional Yeast Meeting, Atlanta, GA (02/2012).
Tennessee State University Biological Sciences, MARC Program (12/2/2011).
ASBMB symposium on Na^+/K^+ ATPase and related P-type ATPases: Structure, Biology and Medicine. Pacific Grove, CA (9/27 – 10/2/2011). "
University of Copenhagen, Plant Biology and Biotechnology, DK (8/12/2011).
GRC on the Cell and Molecular Biology of Lipids, Waterville Valley, NH (07/18/2011)
Ohio State University, Molecular Genetics (3/31/11).
Swiss Yeast Meeting, Fribourg, Switzerland (09/2010). *Invited Keynote Speaker
FASEB meeting on Arf Family G-proteins, Carefree, AZ (08/2010).
Transport ATPases: From Molecules to Maladies, FASEB meeting, Snowmass CO (06/2010).
PepCon 2010, Beijing China (3/21/10) Co-chair of minisymposium on Advances in Protein Molecular and Cell Biology.
Univ of Pennsylvania, Institute for Environmental Medicine (4/3/09).
University of North Carolina, Department of Cell Biology (2/18/09).
Flippase 2008 (meeting), Nov 2 – 7, Ascona, Switzerland
ASBMB conference on Cellular Lipid Transport – Connecting Fundamental Membrane Assembly Processes to Human Disease, Canmore, Alberta Canada (Oct 22 – 26, 2008). Speaker and Co-organizer.
Weill Cornell Medical College, Department of Biochemistry (3/13/08).
Johns Hopkins University School of Public Health, Biochemistry and Molecular Biology (4/2/07).
University of Alabama at Birmingham, Department of Cell Biology (4/16/08)
51st Annual Meeting of the Biophysical Society, Baltimore, MD (3/3 – 3/7, 2007). Speaker and Co-chair of minisymposium on Membrane Transporters and Exchangers
46th Annual Meeting of the ASCB, San Diego, CA (12/9 – 12/13, 2006). Speaker and Co-chair of minisymposium on *Endo- and Exocytosis*
Univ of Tennessee, Biochemistry, Cell and Molecular Biology, Knoxville, TN (10/4/2006).
Tennessee State University, Biological Sciences, MARC Program (10/7/06).
University of Kansas, Department of Molecular Biosciences (11/14/05).
Dartmouth Medical School, Department of Biochemistry (4/8/05).
University of Iowa, Department of Physiology and Biophysics (2/22/05).
Tennessee State University, Biological Sciences, MARC Program (11/12/04).
Indiana University, Department of Chemistry (9/13/04).
NIH, NICHD, Cell Biology and Metabolism Branch (4/2/04).
Western Kentucky University, Department of Biological Sciences (3/5/04).

Tennessee State University, Biological Sciences, MARC Program (4/03).
Tougaloo College, Department of Biology MARC program, (9/03).
Emory University, Department of Physiology (4/03).
Tufts University, Department of Physiology (10/02).
Tennessee State University, Biological Sciences, MARC Program (11/01).
University of Alabama at Birmingham, Department of Cell Biology (1/00).
Albert Einstein College of Med., Dept of Dev. and Mol. Biol., (10/99).
University of Kentucky, Department of Biochemistry (8/99).
Ohio State University, Department of Molecular Genetics (2/99).
Vanderbilt University, Microbiology and Immunology (10/98).
St. Louis University School of Medicine, Department of Biochemistry (12/96).
University of Illinois at Chicago, Department of Biological Sciences (11/96)
Vanderbilt University, Dept of Microbiology and Immunology, (1/93)
Vanderbilt University, Department of Pharmacology (2/93)
Vanderbilt University, Department of Biology (10/93)

ABSTRACTS AND MEETING PRESENTATION BY TRAINEES ('13 - present):
* Selected by meeting organizers for oral presentation.
§ Invited speaker ^undergraduate Presenter

*Roland BP, Naito T, Best JT, Shin H-W, TR Graham (2017) Identification and characterization of yeast and human glycosphingolipid flippases. Southeast Regional Lipid Conference, Cashiers NC

Roland BP and TR Graham (2017) Exofacial membrane composition regulates plasma membrane P4-ATPase activity. Southeast Regional Lipid Conference, Cashiers NC

Roland BP and TR Graham (2017) Identification of P4-ATPases that transport glycosphingolipids. Molecular and Cellular Biology of Lipids GRC, Waterville Valley NH

Roland BP and TR Graham (2017) Identification of P4-ATPases that transport glycosphingolipids. Mechanisms of Membrane Transport GRC, Colby College NH

*Xu, P., Hankins, H., Erlinger, S., Frazier, M., Diab, N., Jackson, L., MacGurn J., and T.R. Graham (2017) An exocytic SNARE's return journey in COPI carrier. *38th Steenbock Symposium-Protein Trafficking in the Secretory Pathway*. Madison, WI June 22-25 (short talk)

§Xu, P., Hankins, H., Macdonald, C., Erlinger, S., Frazier, M., Diab, N., Piper, R., Jackson, L., MacGurn J., and T.R. Graham (2017) A ubiquitin ticket is needed for an exocytic SNARE's return journey in COPI carrier. *EBC 2017 symposium.* Nashville, TN May 15

^*Yu, R and T. R. Graham (2017) Human disease-associated mutations cause a partial loss of function in yeast *DRS2*. Southeast Regional Yeast Meeting, Tuscaloosa, AL

^*Huang,Y., M. Takar, T. R. Graham (2017) Probing the mechanism of phospholipid substrate recognition by the P4-ATPase Neo1. Southeastern Regional Yeast Meeting, Tuscaloosa AL

^*Huang,Y., M. Takar, T. R. Graham (2017) Probing the mechanism of phospholipid substrate recognition by the P4-ATPase Neo1. Gulf Coast Undergraduate Research Symposium, Houston TX

*Takar, M., J. v. Leeuwen, C. Boone and T.R. Graham (2016) Any1 can do it: A novel phospholipid flippase antagonist. Southeast Regional Lipid Conference, Cashiers NC

*Best, J., P. Xu and T.R. Graham (2016) PS-dependent and independent mechanisms of endosomal recycling. Southeast Regional Lipid Conference, Cashiers NC

*Roland, B and T. R. Graham (2016) Identification and characterization of yeast glucosylceramide flippases. Southeast Regional Lipid Conference, Cashiers NC

Takar, M., J. v. Leeuwen, C. Boone and T.R. Graham (2016) Any1 can do it: A novel phospholipid flippase antagonist. GTPases in Trafficking, Autophagy and Disease. West Palm Beach, FL

^*Diab, N., H. Hankins, P. Xu and T.R. Graham (2016) COPI protein sorting at the early endosome is required for induction of stress response pathways converging on Ena1. Southeast Regional Yeast Meeting, Tuscaloosa, AL

Xu, P. MacGurn J. Jackson Lauren and T.R. Graham (2015) COPI sorts ubiquitinated membrane proteins at early endosomes. Poster at Molecular Membrane Biology GRC, Andover, NH Jul 12, 2015

*Takar, M. and T.R. Graham (2015) The Essential Neo1 from Budding Yeast Plays a Role in Establishing Aminophosholipid Asymmetry of the Plasma Membrane. Southeast Regional Lipid Conference, Cashiers, NC 11/13/15

Takar, M and T.R. Graham (2014) The essential yeast type IV P-type ATPase Neo1 plays a role in establishing phosphatidylethanolamine asymmetry of the plasma membrane. ASCB Annual Meeting, Philadelphia, PA

Hankins, H., Y.Y. Sere, A. Menon and T.R. Graham (2014) The role of phosphatidylserine flippase activity in lateral membrane organization. ASCB Annual Meeting, Philadelphia, PA

Christina Snider ^§, Peng Xu and Todd R. Graham (2014) Requirement for Membrane Remodeling in the Budding of AP-1/clathrin-coated vesicles from the Golgi complex. Southeast Regional Yeast Meeting, Nashville, TN (3/14 – 3/16)

Peng Xu and Todd R. Graham (2014) Phosphatidylserine and Phosphatidylinositol 4-phosphate Coordinately Regulate AP-1/clathrin Function in Protein Transport. Southeast Regional Yeast Meeting, Nashville, TN (3/14 – 3/16)

Deanna Tiek ^§, Casey Nielson, Peng Xu and Todd R. Graham. (2014) Genome-wide screen for mutants defective in protein transport from early endosomes to the *trans*-Golgi network. Southeast Regional Yeast Meeting, Nashville, TN (3/14 – 3/16) Best Presenter Award for Tiek

Hannah Hankins and Todd R. Graham (2014) The Role of Budding Yeast Flippase Drs2 in Membrane Organization. Southeast Regional Yeast Meeting, Nashville, TN (3/14 – 3/16)

Hankins, H., L. Theorin, T. Sebastian, T. Pomorski and T.R. Graham (2013) Role of Drs2 in generation of membrane curvature. Poster presentation at the Southeast Regional Yeast Meeting, Birmingham, AL. March 8 – 10.

Takar, M., R.D. Baldridge and T.R. Graham (2013) Probing substrate interaction with type IV P-type ATPases. Poster presentation at the Southeast Regional Yeast Meeting, Birmingham, AL. March 8 – 10.

Xu, P. and T.R. Graham (2013) Recruitment of a membrane curvature sensor to endosomes requires phosphatidylserine translocation by Drs2. Platform presentation at the Southeast Regional Yeast Meeting, Birmingham, AL. March 8 – 10.

TEACHING

CURRENT

Lecturer, 2019 FEBS/EMBO course on Biomembranes. Corsica, France (June 10-20, 2019)

Introduction to Biological Sciences, BSCI1510A, fall '08 – present (21 lectures, ~200 students annually). On scholarly leave in fall of 2018

Introduction to Cell Biology, BSCI2201, Spring '99 – present (21 lectures, ~60 students annually)

Bioregulation I, IGP 300A, Cell Biology Lecturer, Fall '94 – present; (4 - 8 lectures, ~60 students annually)

Chair of IGP Bioregulation I Cell Biology section, Fall '99 – present (organize 18 contact hours),

PREVIOUS

Molecular Membrane Biology, BSCI268, Fall '06

Cell Biology Laboratory, BSCI202, Spring '99 – '06

Cellular Microbiology of the Pathogen-Host interaction, M&IM350, S '01, '02, '03

Microbial Genetics, MB328, Fall '96 -'01
Principles of Genetics, MB210, F '93 - S '97
IGP Bioregulations I, Yeast Genetics Lecturer, F '95 – F '03, F'07
Independent Reading in Molecular Biology, MB282
S '93, R. Ohi; S '94, K. Nagy and J. Kemp; F '94 S. Young; F '98 Ben Johnston; S '01 Mark Harris
Focal Topics in Molecular Biology, MB344, S '96, S '97
Special Topics and Advanced Techniques (BSCI390), Fall Spring and Summer '00-'05
Undergraduate Seminar in Molecular Biology, MB275a S '94
Graduate Seminar in Molecular Biology, MB320 F '94, F '95
Advanced Reading in Molecular Biology, MB385, S '93
Advanced Techniques in Molecular Biology (DNA Cloning and Sequencing Section), MB390 Summer '94

UNDERGRADUATE RESEARCH ADVISEES

Internship in laboratory research, BSCI 280
S '08, Kasey Leach; S'10, Emily Merkel; S'12 Christina Snider, Nicholas Diab, S'14.
Directed Laboratory Research in Molecular Biology, BSCI283
S '93, D. Brower; Summer, '95 V. Snyder; S '97 M. Lyons; F 97 M Higginbotham; F '98 Andy Cook, S '99 M. Williams, F '99 B. Sommerville, F '00 Roxanna Eftkahari, Parvin Fatthedin, S '01 Seema Izfar, F'01 Mark Harris, F'02 Joshua Nepute, S'03 Aisha Jennings, Nick Atria; F '03 Rohini Khatri, Kendall Walters; F '04 Richard Green, Nia Soetandyo, F '05 Leslie Kim; F '06 David Shisler, S '07 Sam Moak, Dustin Patil; S '08 Briana Weiser; F '08 Kasey Leach, S '09 Jason Wen; S '10 Keith Porter; F '10 Emily Merkel, Katherine Roth; F '11 Kathryn Ivy; S'13 Christina Snider; F '13, Deanna Tiek; F'14, Nicholas Diab; F '16 Roger Yu, Yan-Nan Huang.
Independent Laboratory Research in Molecular Biology, BSCI286
F' 93, D. Brower; F' 94, A. Legge and J. Stafford; S '95, S. Young and A. Legge; F '99 M. Williams, S '01 Parvin Fatheddin, S'02 Mark Harris, S '03 Sara Zare; F and S'04 Nick Atria, S '05 Richard Green and Nia Soetandyo; S '06 David Shisler; F '07 Sam Moak, Dustin Patil; F '08 Briana Weiser, S '09 Brianna Weiser, Kasey Leach, F '10 Keith Porter; F '11 Katherine Roth; F'13 Deanna Tiek;F'14 Samuel Erlanger; S'15, F'15, S'16 Nicholas Diab; S '17, Roger Yu, Yan-Nan Huang, F '17 Roger Yu, Yan-Nan Huang.
VUSRP and HHMI summer fellowship students
'93, M. Simmons and D. Brower; '94 J. Stafford; '95 K. Thompson; '96 P. Rosal, '97 M. Lyons and M. Higginbotham, '98 M. Higginbotham and D. Khalatbari, '99 K. Hollister and B. Sommerville; '04 Richard Green (Minority fellowship). Erika Takle (Germs and defense summer fellowship), '11 Kathryn Ivy, '13 Christina Snider, '17, Roger Yu
Honors Research, BSCI296; '95 - '96 A. Mullen; '96 - '97 Peter Rosal ('97 Excellence in Molecular Biology Research Award); '97 - '98 Matthew Lyons; '98 - '99 Megan Higginbotham ('99 Excellence in Molecular Biology Research Award); '00-'01 Nathan Geething ('01 Excellence in Molecular Biology Research Award); '01-'02 Parvin Fatthedin, Seema Izfar; 02-03 Mark Harris; '03-'04 Joshua Nepute ('04 Excellence in Biological Sciences Research Award); '04-05 Rohini Khatri; '05-06 Richard Green and Nia Soetandyo; '06 – 07 Leslie Kim; 07-08 David Shisler; '10-'11, Kasey Leach, Jason Wen; '11-'12 Emily Merkel; '12-'13 Kathryn Ivy, '13-'14 Christina Snider; '15-'16 Samuel Erlinger; '16-'17 Nicholas Diab.
International student: Cayetana Arnaiz from the University Peruana Cayetano Heredia, Peru; part of the Research Experience for Peruvian Undergraduates (REPU) program
High School Students: Indira Bhasvra, J. Court Reese, Leah Kaplan, John Arnold.

FORMER GRADUATE STUDENT ADVISEES

Todd Reynolds (5/94-5/99, Ph.D.) Postdoctoral fellow at MIT with Gerald Fink. Associate Professor, Department of Microbiology, University of Tennessee

Chih-Ying Chen (5/94-5/99, Ph.D.) Postdoctoral fellow at UCSF with Frances Brodsky. Currently working with CA Dept of Public Health.

W. Todd Brigance (5/95-9/00, Ph.D.) Postdoctoral fellow at Johns Hopkins Univ. with Mark Soloski, (Deceased)

B. Diane Hopkins (5/96-8/01, Ph.D.) Assistant Professor at Palm Beach Atlantic College

Walter Gall (5/99-5/02, Ph.D.) 2001 Excellence in Molecular Biology Research Award, Postdoctoral Fellow at UNC with Ted Salmon, CSO Saffron Technology

Zhaolin Hua (5/99-5/03, Ph.D.) 2002 Excellence in Molecular Biology Research Award, Postdoctoral fellow at UC San Francisco with Robert Edwards; Associate Professor, Institute of Biophysics, Chinese Academy of Science

Jing Xiao (4/02-3/07, Ph.D.), Self employed

Ke Liu (4/02-4/07, Ph.D.), Postdoctoral Visiting Fellow, Institute: NIH Chemical Genomics Center, National Human Genome Research Institute with Wei Zheng

A'Drian Pineda (4/05 – 9/08; MS). Research Associate III/MB at the J. Craig Venter Institute.

Weizhen "Maggie" Ying (4/07 – 9/08; MS)

Kavitha Surendhran (4/06-5/09; M.S.)

Baby-Periyanayaki Muthusumy (4/05 - 8/09), Postdoctoral Fellow with Rik Derynck Professor and Vice Chair, Department of Cell and Tissue Biology University of California at San Francisco

Xiaoming Zhou (4/05 - 4/10), Postdoctoral Fellow with Ming Zhou, Department of Molecular Physiology and Biophysics, Columbia University; Assistant Professor at Sichuan University.

Ryan Baldridge (4/08 – 3/13), Postdoctoral Fellow with Tom Rapoport, Dept of Cell Biology and HHMI, Harvard Medical School; Assistant Professor of Biological Chemistry, University of Michigan

Tessy Sebastian (4/08 – 1/16/2014), Regulatory writer at Synchrogenix, a Certara company

Hannah Hankins (5/12 - 3/17/16), Field representative for Zeiss

CURRENT GRADUATE STUDENT ADVISEES

Mehmet Takar (8/12 - present), Jordan T. Best (05/14 - present)

FORMER POSTDOCTORAL ADVISEES

Michael F. Ingram (7/97-6/00), Todd Reynolds (6/99 – 11/99), Walter Gall (5/02-8/02), Jiyi Wang (5/02 – 5/19/2005), Paramasivam Natarajan (8/02 – 3/31/09), Zhaolin Hua (5/03 – 9/03), Yuantai Wu (9/01/13 – 12/30/14)

CURRENT POSTDOCTORAL ADVISEES

Peng Xu (9/01/2010 - present),

Bartholomew Roland (04/01/2014 – present)

THESIS COMMITTEES (Current, **Chair**)

Biological Sciences: Michael Zinda, DeAnne Olsen, Ismael Perez, Sara Perlaky, **Utz Herbig**, Johnathan Ewald, Raymond Sealy, Amy Altman, Yuqi Qiao, **Andrea Patton**, Robert Ott, Nicholas Chim, Jun Li, **Florence Marlow**, Elaine Merrill, Robin Ryther, Jinmin Gu, Vitaly Klimovitch, **Jennifer Ray Panizzi**, Kanika Benton, **Ian Hawkins**, Hong Ji, **Jennifer Osterhage**,

Payal Ray, **Chunyue Yin, Jennelle Talley, Elizabeth Thatcher, Robin Brooks, Ashleigh Long**, Nan Li, Morgan Sammons, **Jenifer Ferguson, Diane Kanter, Vanessa Hobbs, Isi Tolliver, Charlene Hawkins, Neil Dani, Noelle Holmes, Udo Obodo, Nicole Diggins, Mary Lynn Dear,** Will Parkinson, **Nalini Dhingra, Diana Cha, Diana Tafoya Chavez, Dominic Vita, Garrett Warren, Meredith Frazier,** Esther Epum, Roger Burcham, **Scott Hinger**

Micro and Immuno: Chris Mullins, Qing Xu, Michelle Becker, Clint VanValkenburgh, Daniel Ebert, Sean Brock, Haobo Liang, Aaron Derdowski, David Dismuke, Tom Utley, Chris Rold, Fyza Shaikh, Noelle Holmes, Paula Zamora,

Cell and Developmental Biology: Greg Den Haese, Ryomi Ohi, Robert Carnahan, Joe Tasto, Hyunjoo Yoon, Clinton Bartholemew, Joshua Rosenberg, Mi Miao, Abel Alcazar-Roman, Laura Terry, Rachel Roberts, Jonathan Gephart, Paul Miller, Matthew Broadus, Laura Titus, Daniel Levic, Twila Mason, Tyler McCann, Christine Jones, Amanda Lloyd, Zachary Elmore, Amanda Casey, Keyada Frye, Susan Histed, Susan Qualls

Cancer Biology: Permilla Herrell

Pharmacology: Nicole Schramm, Andrea Bauman, Hilary Highfield, Scott Gruver

Neuroscience: Shawn Ferguson, Will Walker, Caleb Doll, Katharine Gurba

Biology, Jiqing Sai

Mol. Phys. & Biophys.: Yu Bai, Jinhui Dong, Courtney Copeland

Pathology: Monica Farkas

Univ. of Alabama at Birmingham, Dept of Cell Biology: Lora Topalof

Dartmouth University, Dept of Biochemistry: Matthew Heidtman

University of Copenhagen, Dept of Plant Biology and Biotechnology (external reader): Susanne Hanisch

University of British Columbia, Dept of Biochemistry and Molecular Biology (external reader): Jonathan Coleman; Lauren Dalton (2016)

University of Alberta, Dept of Biochemistry: Przemyslaw Andrzej Gorski (external reader)

University of Aarhus, Dept of Molecular Biology and Genetics, Jakob Jensen Ulstrup (external reader, 2018)

SERVICE TO THE UNIVERSITY

Interdisciplinary Graduate Program Admissions committee, 9/15 - present
Institutional Committee for Limited Submission Opportunities in the Biomed Sci, ’13 - present
Phi Beta Kappa, Treasurer ’12 – present
Phi Beta Kappa, President ’16 – present
Discovery Proposal review panel ’14 and ’16
New faculty mentor (currently Lauren Jackson, Jared Nordman, Maulik Patel, Jason MacGurn)
Biological Sciences major advisor. Fall '94 - present
Faculty search committee in Biological Sciences: 2 positions - reviewed 500 applicants ‘14-‘15
Faculty search committee in Biological Sciences: Developmental Biology, ’13-‘14
Faculty search committee in Biological Sciences: Biochemistry, ‘12-‘13
Biological Sciences undergraduate curriculum committee, '11-'12, ’14-‘15.
Biological Sciences graduate admissions committee, ’10 - 13
Search committee for the Chair of the Department of Cell and Dev. Biol. (VUMC, '10 - '11)
Curriculum Committee for the Interdisciplinary Graduate Program ('10-'11; ’13-‘15)
Internal Review Committee for the Interdisciplinary Graduate Program. Chair of the Curriculum review group. Designed new curriculum for first year graduate students.
Faculty Senate representative (2009 – 2010)
Biological Sciences Faculty Search committee (2009, 2012)

AXLE curriculum implementation committee, '04 - '14
Advisory Committee on the Health Related Professions. F '94 – '09
Chair of the IGP Internal Review curriculum subcommittee (2009)
Senior Advisory Review Committee (Advisor to A&S Dean on College promotion cases), '07-'08
Director of Graduate Studies, Department of Biological Sciences 2/00 – 8/05
University chemical Safety Committee, F '00 – '05
Chair; Cell Biology faculty search committee (04-05)
Co-organizer of weekly seminar series in the Department of Molecular Biology. F '93 - S '95
Pre-Major Advisor. F'94 – '00
Summer Academic Orientation Advisor. Summer '98
Chair; Molecular Genetic faculty search committee. F '99 – S '00
Organizer of the 2001 Biological Sciences Departmental retreat

SERVICE TO THE PROFESSION

Meeting organization

Elected vice-chair of 2017 and chair of the 2019 GRC on Molecular and Cellular Biology of Lipids.
Session Chair for GRC on the Mechanisms of Membrane Transport, Lewiston, ME (6/28/14 - 7/3/15). (no presentation)
Session Chair for ASBMB Annual Meeting session on Emerging Topics in Membrane Asymmetry, San Diego, CA (4/26 – 4/30/14)
Symposium on Cell Signaling and Membrane Traffic, La Jolla, CA (4/26/14). Co-organizer with Christopher Burd and Beverly Wendland.
21st Annual Southeast Regional Yeast Meeting, Nashville, TN (3/14 – 3/16/14). Co-organizer with Katherine Friedman
16th annual Southeast Regional Yeast Meeting, March 27-29, 2009. Vanderbilt University, Nashville, TN. Co-organizer with Katherine Friedman
ASBMB conference on "Cellular Lipid Transport – Connecting Fundamental Membrane Assembly Processes to Human Disease". Oct 22 – 26, 2008, Canmore, Alberta Canada. Dennis Voelker, Todd Graham and Jean Vance, organizers

Editorial Boards:

Journal of Biological Chemistry (7/1/2015 - 9/30/2020)
Cellular Logistics
Frontiers in Cell and Developmental Biology – Membrane Traffic

Peer Reviewer:

National Institutes of Health, MBPP study section regular member (2009 – 2014)
Site visit and review of the Cell Biology and Metabolism Branch (NICHHD) (11/28 – 11/30, 2006
American Cancer Society (Ad hoc),
National Science Foundation Cellular Organization Advisory Panel Member for the Cell Biology Program (11/1/97 - 10/31/98, 4/02, 5/06)
National Institutes of Health, CDF-4 ad hoc (6/03), Special Emphasis Panel/NRSA ZRG1 F05 (3/06), MBPP ad hoc (6/07, 2/10 and 6/10), CSF ad hoc (10/07), MBPP ad hoc (2/10)
Journals: Journal of Biological Chemistry, Journal of Cell Biology, Genetics, EMBO J, Journal of Cell Science, Molecular Biology of the Cell, Current Biology, Traffic, Eukaryotic Cell, Cell and Molecular Biology, Yeast, Nature reviews, Biochemistry, BBA.
Tenure and promotion review at multiple universities.
Professional Societies:
American Society for Cell Biology (ASCB)

American Society for Biochemistry and Molecular Biology (ASBMB)

CONSULTING

Ono Pharma, USA (4/2015)