

## **Background for Richard D. Cummings, Ph.D. (2019)**

Dr. Cummings is a pioneer in the area of structure and recognition of glycoconjugates in biological processes and roles of glycoconjugates in disease. Through his wide-ranging publications in glycosciences, review articles and books, and world-wide speeches and lectures to highlight glycosciences to diverse audiences, he has made a major impact on the elevation and recognition of the field. His research has been at the forefront of translational glycobiology and helped to develop world-wide appreciation for glycoscience-based drugs. His work is focused on understanding the structures and functions of complex carbohydrates and their roles in diverse pathways, including development, hemostasis, hematopoiesis, inflammatory conditions, cancer, infections, and immune interactions. His work has led to new treatments for disease and new ways to manipulate cellular glycomes.

Cummings is the S. Daniel Abraham Endowed Professor of Surgery in Beth Israel Deaconess Medical Center (BIDMC) and Harvard Medical School. He is also the founder and Director of the Harvard Medical School Center for Glycoscience, and Director of the National Center for Functional Glycomics. Cummings holds other leadership roles in the Department of Surgery and at BIDMC being Vice-Chair of Basic and Translational Research, Chair of the Research Council, Associate Director for Drug Discovery and Translational Research, and the Scientific Director of the Feihe Nutrition Laboratory at BIDMC. Cummings is also the Director of the Cancer Glycomics Program within the Cancer Research Institute at BIDMC.

Cummings received his B.S. degree in biology/chemistry from the University of Montevallo (1974), and his Ph.D. from The Johns Hopkins University (1980). He conducted post-doctoral training in hematology and oncology with Dr. Stuart Kornfeld at the Washington University School of Medicine in St. Louis (1983). He began his academic career at the University of Georgia (1983) in the Department of Biochemistry and Molecular Biology, rising to Professor in 1992. While there he was also an Associate Director of the Complex Carbohydrate Research Center. In 1992 he moved to the University of Oklahoma Health Sciences Center in Oklahoma City to hold the Ed Miller Endowed Chair in Biochemistry and Molecular Biology, and the George Lynn Cross Research Professorship. He subsequently moved in 2006 to Emory University School of Medicine where he was Chair of the Department of Biochemistry until 2015. At both Oklahoma and Emory, Cummings founded Glycomics Centers to foster the interactions of glycoscience with medicine. In 2015 Cummings moved to Harvard Medical School and the Department of Surgery at BIDMC, where he founded the Harvard Medical School Center for Glycoscience, that serves as the hub for a wide array of medically-related glycoscience studies in the Boston area and beyond. Since 1983 Cummings has trained over 30 Ph.D. and Master's Degree students in glycosciences, many of whom are leaders in academia and industry. He has also trained over 60 post-doctoral fellows in the field, along with dozens of undergraduate students and fellows.

Cummings' honors include election as a Fellow of the American Association for the Advancement of Science (2014), the recent IGO Award (2019) from the International Glycoconjugate Organization in honor of exceptional contributions to the field of Glycobiology, the Karl Meyer Award from the Society for Glycobiology (2006), election as Chair of the International Consortium for Functional Glycomics (2012-Present), and election as President of the Society for Glycobiology (2001). Cummings has published over 300 peer-reviewed articles and has 30 patents, numerous books, including being a co-editor of the textbook *Essentials of Glycobiology*, now in its 3<sup>rd</sup> Edition (he was also the illustrator for all Editions of that book), and has co-edited other books in glycoscience including *Handbook of Glycomics* and *Galectins – Methods and Protocols*. Cummings is also helping to lead the Human Glycome Project, a world-wide effort to sequence the human glycome. He is also the co-founder of several biotechnology companies, including Selexys Pharmaceuticals, Inc., founded in 2002, which was purchased for \$665million by Novartis in 2016, based on development of a humanized antibody to block P-selectin function to treat Sickle Cell Disease. Cummings also co-founded Tetherex Pharmaceuticals, Inc., founded in 2014, which recently raised \$50million to conduct phase II clinical studies on a humanized antibody to block selectin and ligand functions in inflammatory diseases, including Crohn's Disease and venous thromboembolism.



**Richard D. Cummings, Ph.D.**  
The S. Daniel Abraham Endowed  
Professor of Surgery,  
Beth Israel Deaconess Medical  
Center and Harvard Medical School

*Some Highlighted Publications from over 300 from the Cummings Lab (Cummings as Senior Author)*

1. Ju T and Cummings RD (2002) A Unique Molecular Chaperone *Cosmc* Required for Activity of the Mammalian Core-1  $\beta$ 3-Galactosyltransferase. ***Proc. Natl. Acad. Sci. USA* 99(26):16613-8.**
2. Ju T and Cummings RD (2005) Protein Glycosylation: Chaperone Mutation in Tn Syndrome. ***Nature* 437:1252.**
3. Xia B, Kawar ZS, Ju T, Sachdev GP, and Cummings RD (2005) Versatile Derivatization of Glycans for Glycomic Analysis. ***Nature Methods* 2:845-50**
4. Stowell SR, Arthur CM, Dias-Baruffi M, Rodrigues LC, Gourdiine JP, Heimburg-Molinario J, Ju T, Molinaro RJ, Rivera-Marrero C, Xia B, Smith DF & Cummings RD (2010) Innate Immune Lectins Kill Bacteria Expressing Blood Group Antigen. ***Nature Med.* 16(3):295-301.**
5. Wang Y, Ju T, Ding X, Wang W, Laszik Z, Perry J, Archer D, Xia L, & Cummings RD. (2010) Disrupted Expression of the ER Molecular Chaperone *Cosmc* in Mice Results in Embryonic Lethality and Altered Protein Glycosylation. ***Proc. Natl. Acad. Sci. USA* 107(20):9228-33**
6. Song X, Lasanajak Y, Xia B, Thielens NM, Air GM, Tappert MM, \*Cummings RD, & \*Smith DF (2011) Shotgun Glycomics: A Microarray Strategy for Functional Glycomics. ***Nature Methods.* 8(1):85-90 (\*Co-Senior)**
7. Wang Y, Jobe SM, Ding X, Choo H, Archer D, Mi R, Ju T, & Cummings RD. (2012) Platelet Biogenesis and Functions Require Correct Protein O-glycosylation. ***Proc. Natl. Acad. Sci. USA.* 109(40):16143-8.**
8. Stowell SR, Arthur CM, McBride R, Berger O, Razi N, Heimburg-Molinario J, Rodrigues LC, Gourdiine J-P, Noll AJ, von Gunten S, Smith DF, Knirel Y, Paulson JC & Cummings RD (2014) Microbial Glycan Microarray Defines Key Features of Host-Microbial Interactions. ***Nature Chem Biol.* 10(6):470-6**
9. Byrd-Leotis L, Liu R, Bradley K, Lasanajak Y, Cummings SF, Song X, Heimburg-Molinario J, Galloway SE, Culhane MR, Smith DF, Steinhauer DA & Cummings RD (2014) Shotgun Glycomics of Pig Lung Identified Natural Endogenous Receptors for Influenza Viruses. ***Proc. Natl. Acad. Sci. USA.* 111(22):E2241-50.**
10. Kudelka MR, Antonopoulos A, Wang Y, Duong DM, Song X, Seyfried NT, Dell A Haslam SM, Cummings RD, and Ju T (2016) Cellular O-Glycome Reporter/Amplification (CORA) to Explore O-Glycans in Living Cells. ***Nature Methods* 13(1):81-6**
11. Kudelka MR, Hinrichs B, Darby T, Moreno CS, Nishio H, Cutler CE, Wang J, Wu H, Zeng J, Wang Y, Ju T, Stowell SR, Nusrat A, Jones RM, Neish AS, and Cummings RD (2016) *Cosmc* is an X-linked Inflammatory Bowel Disease Risk Gene that Spatially Regulates Gut Microbiota and Contributes to Sex-specific Risk. ***Proc. Natl. Acad. Sci. USA.* 113(51):14787-14792 [PMC5187739](https://pubmed.ncbi.nlm.nih.gov/27111111/)**
12. Song X, Ju H, Lasanajak Y, Smith DF, and Cummings RD (2016) Oxidative Release of Natural Glycans for Functional Glycomics. ***Nature Methods* 13(6):528-34.**
13. Byrd-Leotis L, Jia N, Dutta S, Trost JF, Gao C, Cummings SF, Braulke T, Müller-Loennies S, Heimburg-Molarino J, Steinhauer DA and Cummings RD (2019) Influenza Binds Phosphorylated Glycans from Human Lung, ***Science Advances, In Press.***

14. Gao C, Hanes MS, Byrd-Leotis LA, Wei M, Jia N, Kardish RJ, McKittrick T, Steinhauer DA, and Cummings RD (2019) Unique Binding Specificities of Proteins Towards Isomeric Asparagine-linked Glycans, ***Cell Chemical Biology***, *In Press*.

*Some Additional Highlighted Publications Papers (Cummings as co-Author)*

15. Condac E, Silasi-Mansat R, Kosanke S, Schoeb T, Towner R, Lupu F, Cummings RD, & Hinsdale ME (2007) Polycystic Disease Caused by Deficiency in Xylosyltransferase II, an Initiating Enzyme of Glycosaminoglycan Biosynthesis ***Proc. Natl Acad. Sci. U.S.A.*** **104(22)**:9416-21
16. Hu L, Ramani S, Czako R, Sankaran B, Yu Y, Smith DF, Cummings RD, Estes MK, and Prasad BVV (2015) Structural Basis of Glycan Specificity in Neonate-Specific Bovine-Human Reassortant Rotavirus. ***Nature Commun.*** **6**:8346.
17. Krishnamurthy VR, Sardar MYR, Yu Y, Song X, Haller C, Dai E, Wang X, Hanjaya-Putra D, Sun L, Morikis V, Simon SI, Woods R, Cummings RD, and Chaikof EL (2015) Glycopeptide Analogues of PSGL-1 Inhibit P-selectin Function *in Vitro* and *In Vivo*. ***Nature Commun.*** **6**:6387. PMC4423566
18. Wesener DA, Wangkanont K, McBride R, Song X, Kraft MB, Hodges HL, Zarling LC, Splain RA, Smith DF, Cummings RD, Paulson JC, Forest KT, and Kiessling LL (2015) Recognition of Microbial Glycans by Human Intelectin. ***Nature Structural & Molecular Biology.*** **22(8)**:603-10
19. Purohit S, Li T, Guan W, Song X, Song J, Tian Y, Li L, Sharma A, Dun B, Mysona D, Ghamande S, Rungruang B, Cummings RD, Wang PG, and She J-X (2017) Multiplex glycan bead array: a high throughput and high content platform for glycan binding proteins. ***Nat. Commun.*** **9(1)**:258.