Stanford

Christopher O. Barnes

Assistant Professor of Biology and, by courtesy, of Structural Biology

Bio

BIO

Christopher Barnes, PhD is an Assistant Professor of Biology and Sarafan ChEM-H Institute Scholar whose research leverages interdisciplinary approaches to address fundamental principles of viral-host interactions for therapeutic benefit. Before arriving at Stanford, Dr. Barnes earned degrees in Psychology (BA) and Chemistry (BS, MA) from the University of North Carolina at Chapel Hill (G. Pielak), and completed his Ph.D. thesis at the University of Pittsburgh (G. Calero). Following this training, he completed postdoctoral research at the California Institute of Technology, where he combined biophysical methods with in vivo approaches to understand how viruses such as HIV-1 and SARS-CoV-2 infect host cells and elicit specific humoral immune responses (P. Bjorkman). Over the course of the COVID-19 pandemic, he has made significant contributions to our understanding of antibody-spike interactions through in-depth structural analysis that detail the specificities and mechanisms of how monoclonal neutralizing antibodies bind spike to prevent infection. His work in structure-guided approaches to the treatment of infectious disease has earned him several awards, including recognition as a Rita Allen Foundation Scholar, an HHMI Hanna H. Gray Fellow, and appointment as a Chan Zuckerberg Biohub investigator. Now, the Barnes laboratory investigates viral-host interactions and translates knowledge of the structural correlates of antibody-mediated neutralization of viruses into the rational development of highly protective antibodies. The long-term goal of this work will be structure-based design of potent and stable immunogens for vaccination against emerging and re-emerging zoonotic viruses.

ACADEMIC APPOINTMENTS

- Assistant Professor, Biology
- Assistant Professor (By courtesy), Structural Biology
- Member, Bio-X
- Institute Scholar, Sarafan ChEM-H

HONORS AND AWARDS

- Freeman Hrabowski Scholar, Howard Hughes Medical Institute (2026)
- Young Investigator Award, The Protein Society (2025)
- Early Career ASPIRE Award, American Association of Immunologists (2025)
- Early Independent Career Award, The Biophysical Society (2025)
- 50 Scientists that Inspire, Cell Press (2024)
- Scholar, Pew Biomedical Scholars Program (2023)
- Scholar, The Rita Allen Foundation (2022)
- Investigator, Chan Zuckerberg Biohub (2021)

- Hanna Gray Fellow, Howard Hughes Medical Institute (2017)
- Postdoctoral Enrichment Program Fellow, Burroughs Wellcome Fund (2017)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, American Association of Immunologists (2023 - present)
- Member, Biophysical Society (2019 - present)

PROFESSIONAL EDUCATION

- Postdoctoral training, California Institute of Technology , Structural Biology and Immunology (2021)
- Ph.D, University of Pittsburgh , Molecular Pharmacology (2016)
- MA, University of North Carolina - Chapel Hill , Chemistry (2010)
- BS, University of North Carolina - Chapel Hill , Chemistry (2008)
- BA, University of North Carolina - Chapel Hill , Psychology (2008)

PATENTS

- Christopher Barnes, Gary Pielak, Naima Sharaf, Greg Young, Fred Pinero, Lisa Charlton, Christopher Seagle. "United States Patent 8,773,130 Device for Particulate NMR Samples in a Fluid and Related Methods", The University of North Carolina at Chapel Hill, Jul 8, 2014

LINKS

- Barnes Lab Website: https://www.thebarneslab.com/

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Research in our lab is aimed at defining the structural correlates of broad and potent antibody-mediated neutralization of viruses. We combine biophysical and structural methods (e.g., cryo-EM), protein engineering, and in vivo approaches to understand how enveloped viruses infect host cells and elicit antigen-specific immune responses. We are particularly interested in the co-evolution of HIV-1 and broadly-neutralizing IgG antibodies (bNAbs), which may hold the key to the development of an effective HIV-1 vaccine. In addition, we are investigating antibody responses to SARS-CoV-2 and related zoonotic coronaviruses (CoV), with the related goal of developing broadly-protective immunotherapies and vaccines against variants of concern and emerging CoV threats.

HIV-1; SARS-CoV-2; coronaviruses; cryo-EM; crystallography; vaccines; directed evolution

Teaching

COURSES

2025-26

- Visualizing Biomolecules: BIO 218 (Aut)
- Visualizing Biomolecules Lab: BIO 218A (Aut)

2024-25

- Frontiers in Biology: BIO 301 (Aut)
- Visualizing Biomolecules: BIO 218 (Aut)

2023-24

- Frontiers in Biology: BIO 301 (Aut, Win)

- Visualizing Biomolecules: BIO 218, CHEM 287 (Aut)

2022-23

- Frontiers in Biology: BIO 301 (Aut, Win)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Eliel Akinbami, Rebekah Costello, Nana Akua Duah, Desmond Edwards, Sipei Fu, Dominic Pham, Andrew Reiter, Arvie Violette, Izumi de los Rios Kobara

Postdoctoral Faculty Sponsor

Daniel Hoces Burga, Maria Juarez, Okikiola Olajide, My Kim Tran, Sheena Vasquez

Doctoral Dissertation Advisor (AC)

Josh Carter, Zaria Contejean, Ipsita Krishnamurthy, Adonis Rubio, AbuBakr Sangare

Doctoral Dissertation Co-Advisor (AC)

Joseph Noh

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Biology (School of Humanities and Sciences) (Phd Program)
- Biophysics (Phd Program)
- Immunology (Phd Program)
- Structural Biology (Phd Program)

Publications

PUBLICATIONS

- **Analysis of West Nile disease convalescents identifies human monoclonal antibodies protective against West Nile and related orthoflaviviruses.** *Immunity*
  Cervantes Rincón, T., Frckova, T., Contejean, Z. I., Cantergiani, J., Groen, K., Cena, B., Moro, S. G., Bianchini, F., Simonelli, L., Jarrossay, D., Tosolini, S., Kuratli, R., Robinson, et al
  2026

- **Oriented Multivalent Display Drives Consistent Serum Immunodominance to the Ebola Virus Glycoprotein.** *ACS central science*
  Zheng, C., Rubio, A. A., Vasquez, S., Pham, D., Pan, Z., Barnes, C. O., Kim, P. S.
  2026; 12 (1): 100-110

- **Human Coronavirus HKU1 Neutralizing Monoclonal Antibodies Target Diverse Epitopes Within and Around the TMPRSS2 Receptor Binding Site.** *bioRxiv : the preprint server for biology*
  Wang, L., Joseph, J., Vasquez, S., Wrapp, D., Sheahan, T. P., Dzuvor, C. K., Rosen, O., Kirchdoerfer, R. N., Abiona, O. M., Hammond, C., Shi, W., Moak, S. P., Kong, et al
  2025

- **Structure-guided design of native-like HIV Env Single Chain Trimers for enhanced stability, immunogenicity, and versatile vaccine delivery.** *bioRxiv : the preprint server for biology*
  Li, X., Krishnamurthy, I., Mishra, N., James, N. E., Chowdhury, R. R., Callaghan, S., Somanathan, A., Avillion, G., Amereh, K., Sekar, T., Oberoi, P., Zhu, Y., Torres, et al
  2025

- **Sustained Vaccine Exposure Elicits More Rapid, Consistent, and Broad Humoral Immune Responses to Multivalent Influenza Vaccines.** *Advanced science (Weinheim, Baden-Wurttemberg, Germany)*
  Saouaf, O. M., Ou, B. S., Song, Y. E., Carter, J. J., Yan, J., Jons, C. K., Barnes, C. O., Appel, E. A.
  2025: e2404498

- **Bispecific antibodies targeting the N-terminal and receptor binding domains potently neutralize SARS-CoV-2 variants of concern.** *Science translational medicine*
  Rubio, A. A., Baharani, V. A., Dadonaite, B., Parada, M., Abernathy, M. E., Wang, Z., Lee, Y. E., Eso, M. R., Phung, J., Ramos, I., Chen, T., El Nesr, G., Bloom, et al
  2025; 17 (788): eadq5720

- **Discovery and engineering of the antibody response to a prominent skin commensal.** *Nature*
  Bousbaine, D., Bauman, K. D., Chen, Y. E., Lalgudi, P. V., Nguyen, T. T., Swenson, J. M., Yu, V. K., Tsang, E., Conlan, S., Li, D. B., Jbara, A., Zhao, A., Naziripour, et al
  2024

- **Structural basis of transcription: RNA polymerase II substrate binding and metal coordination using a free-electron laser.** *Proceedings of the National Academy of Sciences of the United States of America*
  Lin, G., Barnes, C. O., Weiss, S., Dutagaci, B., Qiu, C., Feig, M., Song, J., Lyubimov, A., Cohen, A. E., Kaplan, C. D., Calero, G.
  2024; 121 (36): e2318527121

- **Vaccine design via antigen reorientation.** *Nature chemical biology*
  Xu, D., Carter, J. J., Li, C., Utz, A., Weidenbacher, P. A., Tang, S., Sanyal, M., Pulendran, B., Barnes, C. O., Kim, P. S.
  2024

- **Structural basis of transcription: RNA Polymerase II substrate binding and metal coordination at 3.0 A using a free-electron laser.** *bioRxiv : the preprint server for biology*
  Lin, G., Barnes, C. O., Weiss, S., Dutagaci, B., Qiu, C., Feig, M., Song, J., Lyubimov, A., Cohen, A. E., Kaplan, C. D., Calero, G.
  2023

- **Juneteenth in STEMM and the barriers to equitable science.** *Cell*
  Mays, A., Byars-Winston, A., Hinton, A., Marshall, A. G., Kirabo, A., August, A., Marlin, B. J., Riggs, B., Tolbert, B., Wanjalla, C., Womack, C., Evans, C. S., Barnes, et al
  2023; 186 (12): 2510-2517

- **Pan-sarbecovirus prophylaxis with human anti-ACE2 monoclonal antibodies.** *Nature microbiology*
  Zhang, F., Jenkins, J., de Carvalho, R. V., Nakandakari-Higa, S., Chen, T., Abernathy, M. E., Baharani, V. A., Nyakatura, E. K., Andrew, D., Lebedeva, I. V., Lorenz, I. C., Hoffmann, H. H., Rice, et al
  2023

- **Human neutralizing antibodies to cold linear epitopes and subdomain 1 of the SARS-CoV-2 spike glycoprotein.** *Science immunology*
  Bianchini, F., Crivelli, V., Abernathy, M. E., Guerra, C., Palus, M., Muri, J., Marcotte, H., Piralla, A., Pedotti, M., De Gasparo, R., Simonelli, L., Matkovic, M., Toscano, et al
  2023: eade0958

- **Human neutralizing antibodies to cold linear epitopes and to subdomain 1 of SARS-CoV-2.** *bioRxiv : the preprint server for biology*
  Bianchini, F., Crivelli, V., Abernathy, M. E., Guerra, C., Palus, M., Muri, J., Marcotte, H., Piralla, A., Pedotti, M., De Gasparo, R., Simonelli, L., Matkovic, M., Toscano, et al
  2022

- **HIV-1 CD4-binding site germline antibody-Env structures inform vaccine design.** *Nature communications*
  Dam, K. A., Barnes, C. O., Gristick, H. B., Schoofs, T., Gnanapragasam, P. N., Nussenzweig, M. C., Bjorkman, P. J.
  2022; 13 (1): 6123

- **A naturally arising broad and potent CD4-binding site antibody with low somatic mutation** *SCIENCE ADVANCES*
  Barnes, C. O., Schoofs, T., Gnanapragasam, P. N. P., Golijanin, J., Huey-Tubman, K. E., Gruell, H., Schommers, P., Suh-Toma, N., Lee, Y., Lorenzi, J., Piechocka-Trocha, A., Scheid, J. F., Jr, et al
  2022; 8 (32): eabp8155

- **Antibody-mediated neutralization of SARS-CoV-2.** *Immunity*
  Gruell, H., Vanshylla, K., Weber, T., Barnes, C. O., Kreer, C., Klein, F.
  2022

- **Analysis of memory B cells identifies conserved neutralizing epitopes on the N-terminal domain of variant SARS-Cov-2 spike proteins.** *Immunity*

Wang, Z., Muecksch, F., Cho, A., Gaebler, C., Hoffmann, H., Ramos, V., Zong, S., Cipolla, M., Johnson, B., Schmidt, F., DaSilva, J., Bednarski, E., Ben Tanfous, et al

2022

- **Structural insights into antibody-mediated neutralization of SARS-CoV-2**

  Barnes, C., Scheid, J. F., Eraslan, B., Hudak, A., Muecksch, F., Weisblum, Y., Bjorkman, P. J., Xavier, R. J.

  OXFORD UNIV PRESS INC.2021: 1696-1697

- **Sequential immunization of macaques elicits heterologous neutralizing antibodies targeting the V3-glycan patch of HIV-1 Env** *SCIENCE TRANSLATIONAL MEDICINE*

  Escolano, A., Gristick, H. B., Gautam, R., DeLaitsch, A. T., Abernathy, M. E., Yang, Z., Wang, H., Hoffmann, M. A. G., Nishimura, Y., Wang, Z., Koranda, N., Kakutani, L. M., Gao, et al

  2021; 13 (621): eabk1533

- **Broad cross-reactivity across sarbecoviruses exhibited by a subset of COVID-19 donor-derived neutralizing antibodies** *CELL REPORTS*

  Jette, C. A., Cohen, A. A., Gnanapragasam, P. N. P., Muecksch, F., Lee, Y. E., Huey-Tubman, K. E., Schmidt, F., Hatziioannou, T., Bieniasz, P. D., Nussenzweig, M. C., West, A. P., Keeffe, J. R., Bjorkman, et al

  2021; 36 (13)

- **Naturally enhanced neutralizing breadth against SARS-CoV-2 one year after infection.** *Nature*

  Wang, Z., Muecksch, F., Schaefer-Babajew, D., Finkin, S., Viant, C., Gaebler, C., Hoffmann, H. H., Barnes, C. O., Cipolla, M., Ramos, V., Oliveira, T. Y., Cho, A., Schmidt, et al

  2021

- **B cell genomics behind cross-neutralization of SARS-CoV-2 variants and SARS-CoV.** *Cell*

  Scheid, J. F., Barnes, C. O., Eraslan, B., Hudak, A., Keeffe, J. R., Cosimi, L. A., Brown, E. M., Muecksch, F., Weisblum, Y., Zhang, S., Delorey, T., Woolley, A. E., Ghantous, et al

  2021; 184 (12): 3205-3221.e24

- **mRNA vaccine-elicited antibodies to SARS-CoV-2 and circulating variants.** *Nature*

  Wang, Z., Schmidt, F., Weisblum, Y., Muecksch, F., Barnes, C. O., Finkin, S., Schaefer-Babajew, D., Cipolla, M., Gaebler, C., Lieberman, J. A., Oliveira, T. Y., Yang, Z., Abernathy, et al

  2021; 592 (7855): 616-622

- **Mosaic nanoparticles elicit cross-reactive immune responses to zoonotic coronaviruses in mice.** *Science (New York, N.Y.)*

  Cohen, A. A., Gnanapragasam, P. N., Lee, Y. E., Hoffman, P. R., Ou, S., Kakutani, L. M., Keeffe, J. R., Wu, H. J., Howarth, M., West, A. P., Barnes, C. O., Nussenzweig, M. C., Bjorkman, et al

  2021; 371 (6530): 735-741

- **De novo design of potent and resilient hACE2 decoys to neutralize SARS-CoV-2.** *Science (New York, N.Y.)*

  Linsky, T. W., Vergara, R., Codina, N., Nelson, J. W., Walker, M. J., Su, W., Barnes, C. O., Hsiang, T. Y., Esser-Nobis, K., Yu, K., Reneer, Z. B., Hou, Y. J., Priya, et al

  2020; 370 (6521): 1208-1214

- **SARS-CoV-2 neutralizing antibody structures inform therapeutic strategies.** *Nature*

  Barnes, C. O., Jette, C. A., Abernathy, M. E., Dam, K. A., Esswein, S. R., Gristick, H. B., Malyutin, A. G., Sharaf, N. G., Huey-Tubman, K. E., Lee, Y. E., Robbiani, D. F., Nussenzweig, M. C., West, et al

  2020; 588 (7839): 682-687

- **A broadly neutralizing macaque monoclonal antibody against the HIV-1 V3-Glycan patch.** *eLife*

  Wang, Z., Barnes, C. O., Gautam, R., Cetrulo Lorenzi, J. C., Mayer, C. T., Oliveira, T. Y., Ramos, V., Cipolla, M., Gordon, K. M., Gristick, H. B., West, A. P., Nishimura, Y., Raina, et al

  2020; 9

- **Structures of Human Antibodies Bound to SARS-CoV-2 Spike Reveal Common Epitopes and Recurrent Features of Antibodies.** *Cell*

  Barnes, C. O., West, A. P., Huey-Tubman, K. E., Hoffmann, M. A., Sharaf, N. G., Hoffman, P. R., Koranda, N., Gristick, H. B., Gaebler, C., Muecksch, F., Lorenzi, J. C., Finkin, S., Hägglöf, et al

  2020; 182 (4): 828-842.e16

- **Convergent antibody responses to SARS-CoV-2 in convalescent individuals.** *Nature*

  Robbiani, D. F., Gaebler, C., Muecksch, F., Lorenzi, J. C., Wang, Z., Cho, A., Agudelo, M., Barnes, C. O., Gazumyan, A., Finkin, S., Hägglöf, T., Oliveira, T. Y., Viant, et al

2020; 584 (7821): 437-442

- **Broad and Potent Neutralizing Antibodies Recognize the Silent Face of the HIV Envelope.** *Immunity*
  Schoofs, T., Barnes, C. O., Suh-Toma, N., Golijanin, J., Schommers, P., Gruell, H., West, A. P., Bach, F., Lee, Y. E., Nogueira, L., Georgiev, I. S., Bailer, R. T., Czartoski, et al
  2019; 50 (6): 1513-1529.e9

- **Immunization expands B cells specific to HIV-1 V3 glycan in mice and macaques.** *Nature*
  Escolano, A., Gristick, H. B., Abernathy, M. E., Merkenschlager, J., Gautam, R., Oliveira, T. Y., Pai, J., West, A. P., Barnes, C. O., Cohen, A. A., Wang, H., Golijanin, J., Yost, et al
  2019; 570 (7762): 468-473

- **The crystal structure of dGTPase reveals the molecular basis of dGTP selectivity** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Barnes, C. O., Wu, Y., Song, J., Lin, G., Baxter, E. L., Brewster, A. S., Nagarajan, V., Holmes, A., Soltis, S., Sauter, N. K., Ahn, J., Cohen, A. E., Calero, et al
  2019; 116 (19): 9333-9339

- **Partially Open HIV-1 Envelope Structures Exhibit Conformational Changes Relevant for Coreceptor Binding and Fusion.** *Cell host & microbe*
  Wang, H., Barnes, C. O., Yang, Z., Nussenzweig, M. C., Bjorkman, P. J.
  2018; 24 (4): 579-592.e4

- **Structural characterization of a highly-potent V3-glycan broadly neutralizing antibody bound to natively-glycosylated HIV-1 envelope** *NATURE COMMUNICATIONS*
  Barnes, C. O., Gristick, H. B., Freund, N. T., Escolano, A., Lyubimov, A. Y., Hartweger, H., West, A. P., Cohen, A. E., Nussenzweig, M. C., Bjorkman, P. J.
  2018; 9: 1251

- **The DDB1-DCAF1-Vpr-UNG2 crystal structure reveals how HIV-1 Vpr steers human UNG2 toward destruction** *NATURE STRUCTURAL & MOLECULAR BIOLOGY*
  Wu, Y., Zhou, X., Barnes, C. O., DeLucia, M., Cohen, A. E., Gronenborn, A. M., Ahn, J., Calero, G.
  2016; 23 (10): 933-940

- **Assessment of microcrystal quality by transmission electron microscopy for efficient serial femtosecond crystallography** *ARCHIVES OF BIOCHEMISTRY AND BIOPHYSICS*
  Barnes, C. O., Kovaleva, E. G., Fu, X., Stevenson, H. P., Brewster, A. S., Deponte, D. P., Baxter, E. L., Cohen, A. E., Calero, G.
  2016; 602: 61-68

- **Transmission electron microscopy for the evaluation and optimization of crystal growth** *ACTA CRYSTALLOGRAPHICA SECTION D-STRUCTURAL BIOLOGY*
  Stevenson, H. P., Lin, G., Barnes, C. O., Sutkeviciute, I., Krzysiak, T., Weiss, S. C., Reynolds, S., Wu, Y., Nagarajan, V., Makhov, A. M., Lawrence, R., Lamm, E., Clark, et al
  2016; 72: 603-615

- **High-density grids for efficient data collection from multiple crystals.** *Acta crystallographica. Section D, Structural biology*
  Baxter, E. L., Aguila, L., Alonso-Mori, R., Barnes, C. O., Bonagura, C. A., Brehmer, W., Brunger, A. T., Calero, G., Caradoc-Davies, T. T., Chatterjee, R., DeGrado, W. F., Fraser, J. S., Ibrahim, et al
  2016; 72: 2-11

- **Crystal Structure of a Transcribing RNA Polymerase II Complex Reveals a Complete Transcription Bubble** *MOLECULAR CELL*
  Barnes, C. O., Calero, M., Malik, I., Graham, B. W., Spahr, H., Lin, G., Cohen, A. E., Brown, I. S., Zhang, Q., Pullara, F., Trakselis, M. A., Kaplan, C. D., Calero, et al
  2015; 59 (2): 258–69

- **Goniometer-based femtosecond crystallography with X-ray free electron lasers** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Cohen, A. E., Soltis, S. M., Gonzalez, A., Aguila, L., Alonso-Mori, R., Barnes, C. O., Baxter, E. L., Brehmer, W., Brewster, A. S., Brunger, A. T., Calero, G., Chang, J. F., Chollet, et al
  2014; 111 (48): 17122-17127

- **Use of transmission electron microscopy to identify nanocrystals of challenging protein targets** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*

Stevenson, H. P., Makhov, A. M., Calero, M., Edwards, A. L., Zeldin, O. B., Mathews, I. I., Lin, G., Barnes, C. O., Santamaria, H., Ross, T. M., Soltis, S. M., Khosla, C., Nagarajan, et al
2014; 111 (23): 8470-8475