Stanford

Justin Du Bois

Henry Dreyfus Professor of Chemistry and Professor, by courtesy, of Chemical and Systems Biology

CONTACT INFORMATION

- **Administrative Contact**

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Bio

BIO

Research and Scholarship

Research in the Du Bois laboratory spans reaction methods development, natural product synthesis, and chemical biology, and draws on expertise in molecular design, molecular recognition, and physical organic chemistry. An outstanding goal of our program has been to develop C–H bond functionalization processes as general methods for organic chemistry, and to demonstrate how such tools can impact the logic of chemical synthesis. A second area of interest focuses on the role of ion channels in electrical conduction and the specific involvement of channel subtypes in the sensation of pain. This work is enabled in part through the advent of small molecule modulators of channel function.

The Du Bois group has described new tactics for the selective conversion of saturated C–H to C–N and C–O bonds. These methods have general utility in synthesis, making possible the single-step incorporation of nitrogen and oxygen functional groups and thus simplifying the process of assembling complex molecules. To date, lab members have employed these versatile oxidation technologies to prepare natural products that include manzacidin A and C, agelastatin, tetrodotoxin, and saxitoxin. Detailed mechanistic studies of metal-catalyzed C–H functionalization reactions are performed in parallel with process development and chemical synthesis. These efforts ultimately give way to advances in catalyst design. A long-standing goal of this program is to identify robust catalyst systems that afford absolute control of reaction selectivity.

In a second program area, the Du Bois group is exploring voltage-gated ion channel structure and function using the tools of chemistry in combination with those of molecular biology, electrophysiology, microscopy and mass spectrometry. Much of this work has focused on studies of eukaryotic Na and Cl ion channels. The Du Bois lab is interested in understanding the biochemical mechanisms that underlie channel subtype regulation and how such processes may be altered following nerve injury. Small molecule toxins serve as lead compounds for the design of isoform-selective channel modulators, affinity reagents, and fluorescence imaging probes. Access to toxins and modified forms thereof (including saxitoxin, gonyautoxin, batrachotoxin, and veratridine) through de novo synthesis drives studies to elucidate toxin-receptor interactions and to develop new pharmacologic tools to study ion channel function in primary cells and murine pain models.

ACADEMIC APPOINTMENTS

- Professor, Chemistry
- Professor (By courtesy), Chemical and Systems Biology
- Member, Bio-X
- Member, Maternal & Child Health Research Institute (MCHRI)
- Faculty Fellow, Sarafan ChEM-H
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Courtesy faculty, Dept. of Chemical and Systems Biology, Stanford University, (2013- present)
- Faculty Affiliate, Stanford Neuroscience Institute, (2013- present)
- Executive Committee Member, Stanford ChEM-H, (2012- present)
- Cofounder, Board Member, SiteOne Therapeutics, Inc, (2011- present)
- Founder, Center for Molecular Analysis and Design at Stanford, (2009- present)
- Founding Member, NSF Center for Selective C–H Functionalization, (2009- present)
- Permanent Member, NIH study section, Synthetic & Biological Chemistry A, (2009-2013)
- Member, Bio-X, (2004- present)
- Member, American Chemical Society, (1992- present)

HONORS AND AWARDS

- John A. and Cynthia Fry Gunn University Fellow in Undergraduate Education, Stanford University (2011–2020)
- Dean’s Award for Distinguished Achievements in Teaching, Stanford University (2008)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Scientist Consultant, Pfizer Inc. (2004 - present)
- Scientist Consultant, Gilead Sciences (2007 - present)
- Founder and Board Member, SiteOne Therapeutics (2010 - present)

PROFESSIONAL EDUCATION

- Postdoc, Massachusetts Institute of Technology , Chemistry (1999)
- PhD, California Institute of Technology , Chemistry (1997)
- BS, University of California, Berkeley , Chemistry (1992)

LINKS

- The Du Bois Laboratory: http://duboislab.stanford.edu/

Teaching

COURSES

2024-25

- Chemical Foundations and 21st Century Problems: CHEM 31E (Aut)
- Structure and Reactivity of Carbon-Based Molecules: CHEM 33 (Win)

2023-24

- The Chemical Principles of Life I: CHEM 141 (Win)
- Understanding the Natural and Unnatural World through Chemistry: CHEM 121 (Aut)

2021-22

- The Chemical Principles of Life I: CHEM 141 (Win)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Casey Chan, Alina Cook, Siyuan Du, Edward Gao, Ryan Golden, Isaac Jackson, Shreya Kishore, Marina Luccioni, Anna Makar-Limanov, Owen McAteer, Camille Petrakian, Nicolas Robalin, Anastasiia Safronova, Lucas Sanchez, Jonathan Yang

Doctoral Dissertation Advisor (AC)

Lawrence Berg, Richard Cardrino, Chris Codogni, Signe Dahlberg-Wright, Aaron Forman, Dayne Goss, Hannah Grupe, Steven Miller, Enrique Moya, Elizabeth Park, Anne Wampler

Publications

PUBLICATIONS

- **Site-selective bromination of sp3 C–H bonds** *Chem.Sci*
  Sathyamoorthi, S., Banerjee, S., Du Bois, J., Burns, N. Z., Zare, R. N.
  2018; 9: 100-104
- **Intermolecular sp3 C-H Amination of Complex Molecules.** *Angewandte Chemie (International ed. in English)*
  Chiappini, N. D., Mack, J. B., Du Bois, J. n.
  2018
- **Ruthenium-Catalyzed C-H Hydroxylation in Aqueous Acid Enables Selective Functionalization of Amine Derivatives.** *Journal of the American Chemical Society*
  Mack, J. B., Gipson, J. D., Du Bois, J., Sigman, M. S.
  2017; 139 (28): 9503-9506
- **Mechanistic analysis of a copper-catalyzed C-H oxidative cyclization of carboxylic acids.** *Chemical science*
  Banerjee, S. n., Sathyamoorthi, S. n., Du Bois, J. n., Zare, R. N.
  2017; 8 (10): 7003–8
- **Copper-Catalyzed Oxidative Cyclization of Carboxylic Acids** *ORGANIC LETTERS*
  Sathyamoorthi, S., Du Bois, J.
  2016; 18 (24): 6308-6311
- **Asymmetric synthesis of batrachotoxin: Enantiomeric toxins show functional divergence against Na-V** *SCIENCE*
  Logan, M. M., Toma, T., Thomas-Tran, R., Du Bois, J.
  2016; 354 (6314): 865-869
- **Manganese(II)/Picolinic Acid Catalyst System for Epoxidation of Olefins** *ORGANIC LETTERS*
  Moretti, R. A., Du Bois, J., Stack, T. D.
  2016; 18 (11): 2528-2531
- **Mutant cycle analysis with modified saxitoxins reveals specific interactions critical to attaining high-affinity inhibition of hNa(V)1.7** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Thomas-Tran, R., Du Bois, J.
  2016; 113 (21): 5856-5861
- **Synthesis of the Paralytic Shellfish Poisons (+)-Gonyautoxin 2, (+)-Gonyautoxin 3, and (+)-11,11-Dihydroxysaxitoxin** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*
  Mulcahy, J. V., Walker, J. R., Merit, J. E., Whitehead, A., Du Bois, J.

2016; 138 (18): 5994-6001

- **Rh2(II,III) Catalysts with Chelating Carboxylate and Carboxamidate Supports: Electronic Structure and Nitrene Transfer Reactivity.** *Journal of the American Chemical Society*
  Varela-Álvarez, A., Yang, T., Jennings, H., Kornecki, K. P., MacMillan, S. N., Lancaster, K. M., Mack, J. B., Du Bois, J., Berry, J. F., Musaev, D. G.
  2016; 138 (7): 2327-2341
- **Inhibition of Sodium Ion Channel Function with Truncated Forms of Batrachotoxin** *ACS Chem. Neurosci.*
  Toma, T., Logan, M. M., Maynard, F., Devlin, A. S., Du Bois, J.
  2016; 7 (10): 1463-1468
- **Saxitoxin.** *Angewandte Chemie (International ed. in English)*
  Thottumkara, A. P., Parsons, W. H., Du Bois, J.
  2014; 53 (23): 5760-5784
- **Organocatalytic C-H hydroxylation with Oxone (R) enabled by an aqueous fluoroalcohol solvent system** *CHEMICAL SCIENCE*
  Adams, A. M., Du Bois, J.
  2014; 5 (2): 656-659
- **Selective Intermolecular Amination of C-H Bonds at Tertiary Carbon Centers** *ANGEWANDTE CHEMIE-INTERNATIONAL EDITION*
  Roizen, J. L., Zalatan, D. N., Du Bois, J.
  2013; 52 (43): 11343-11346
- **Marked difference in saxitoxin and tetrodotoxin affinity for the human nociceptive voltage-gated sodium channel (Nav1.7) [corrected].** *Proceedings of the National Academy of Sciences of the United States of America*
  Walker, J. R., Novick, P. A., Parsons, W. H., McGregor, M., Zablocki, J., Pande, V. S., Du Bois, J.
  2012; 109 (44): 18102-18107
- **Fluorescent Saxitoxins for Live Cell Imaging of Single Voltage-Gated Sodium Ion Channels beyond the Optical Diffraction Limit** *CHEMISTRY & BIOLOGY*
  Ondrus, A. E., Lee, H. D., Iwanaga, S., Parsons, W. H., Andresen, B. M., Moerner, W. E., Du Bois, J.
  2012; 19 (7): 902-912
- **Metal-Catalyzed Nitrogen-Atom Transfer Methods for the Oxidation of Aliphatic C-H Bonds** *ACCOUNTS OF CHEMICAL RESEARCH*
  Roizen, J. L., Harvey, M. E., Du Bois, J.
  2012; 45 (6): 911-922