Stanford

Christopher M. Dundas

Postdoctoral Scholar, Biology

Bio

BIO

Christopher Dundas received his B.S. in Chemical Engineering ('15) with a minor in Biotechnology at the University at Buffalo. He received his Ph.D. in Chemical Engineering ('20) at the University of Texas at Austin, under the guidance of Dr. Benjamin (Keith) Keitz. During his doctoral training, Christopher studied and engineered electroactive soil bacteria – a unique class of microbes that can directly convert carbon sources into electrical energy. Using techniques in materials science and synthetic biology, he demonstrated that bacterial electron transfer can control the formation of a variety of functional organic and inorganic materials. At UT Austin, Christopher also developed genetic tools that increase the programmability and responsiveness of bioelectrical behavior.

At Stanford, Christopher is using bacterial/plant synthetic biology to uncover how plants transfer carbon from roots to soil and aid terrestrial carbon sequestration.

HONORS AND AWARDS

- TomKat Center Postdoctoral Fellowship in Sustainable Energy, TomKat Center (2021-2023)
- NSF Graduate Research Fellowship (Honorable Mention), National Science Foundation (2015)
- Barry M. Goldwater Scholarship, Goldwater Foundation (2013-2015)

PROFESSIONAL EDUCATION

- Postdoctoral Fellow, Stanford University , Biology (2021)
- Postdoctoral Fellow, University of Texas at Austin , Chemical Engineering (2020)
- Ph.D., University of Texas at Austin , Chemical Engineering (2020)
- B.S., University at Buffalo , Chemical Engineering (2015)

STANFORD ADVISORS

- Jose Dinneny, Postdoctoral Faculty Sponsor

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Soil can have an enormous impact on climate change mitigation, as atmospheric CO2 is captured and stored in large quantities by soil organic matter. Plants mediate carbon sequestration by transferring aboveground photosynthesis products to belowground roots. This carbon is stabilized into soil pools by root growth/biomass turnover, exudation of organic compounds, and metabolization by soil microbes. Crops bioengineered to increase soil carbon input could boost net CO2 capture and improve agricultural productivity (e.g., via elevated water and nutrient availability). However, genetic engineering targets that control carbon exchange from roots to soil remain poorly defined. Since carbon distribution within plants is controlled by sugar metabolization and transport, genes that alter these processes may also regulate carbon input to root-proximal soil (i.e., the rhizosphere). At Stanford, Christopher will study how these genes affect soil carbon input by Setaria viridis, a model energy grass that is a promising sustainable fuel source. Leveraging high throughput root imaging technology and genetic circuit design, he will construct root-associating bacterial strains and transgenic Setaria that allow researchers to measure/modulate sugar flux from root systems. These living sensors/actuators will be used to determine genetic design rules of soil carbon input at the root-rhizosphere interface. Results will inform engineering of biofertilizer bacteria and functional plant genes that can increase carbon release into soils by other food- and energy-relevant crops.

Publications

PUBLICATIONS

- **Molecular Engineering of Hydrogels for Rapid Water Disinfection and Sustainable Solar Vapor Generation.** *Advanced materials (Deerfield Beach, Fla.)*
  Guo, Y., Dundas, C. M., Zhou, X., Johnston, K. P., Yu, G.
  2021: e2102994
- **The role of chemotaxis and efflux pumps on nitrate reduction in the toxic regions of a ciprofloxacin concentration gradient** *ISME JOURNAL*
  Alcalde, R. E., Dundas, C. M., Dong, Y., Sanford, R. A., Keitz, B., Fouke, B. W., Werth, C. J.
  2021
- **Tuning Extracellular Electron Transfer by Shewanella oneidensis Using Transcriptional Logic Gates** *ACS SYNTHETIC BIOLOGY*
  Dundas, C. M., Walker, D. F., Keitz, B. K.
  2020; 9 (9): 2301-2315
- **Genetic Control of Radical Cross-linking in a Semisynthetic Hydrogel** *ACS BIOMATERIALS SCIENCE & ENGINEERING*
  Graham, A. J., Dundas, C. M., Hillsley, A., Kasprak, D. S., Rosales, A. M., Keitz, B. K.
  2020; 6 (3): 1375-1386
- **Microbial reduction of metal-organic frameworks enables synergistic chromium removal** *NATURE COMMUNICATIONS*
  Springthorpe, S. K., Dundas, C. M., Keitz, B. K.
  2019; 10: 5212
- **Extracellular Electron Transfer by Shewanella oneidensis Controls Palladium Nanoparticle Phenotype** *ACS SYNTHETIC BIOLOGY*
  Dundas, C. M., Graham, A. J., Romanovicz, D. K., Keitz, B. K.
  2018; 7 (12): 2726-2736
- **Shewanella oneidensis as a living electrode for controlled radical polymerization** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
  Fan, G., Dundas, C. M., Graham, A. J., Lynd, N. A., Keitz, B. K.
  2018; 115 (18): 4559-4564
- **Super-resolution imaging of synaptic and Extra-synaptic AMPA receptors with different-sized fluorescent probes** *ELIFE*
  Lee, S., Jin, C., Cai, E., Ge, P., Ishitsuka, Y., Teng, K., de Thomaz, A. A., Nall, D., Baday, M., Jeyifous, O., Demonte, D., Dundas, C. M., Park, et al
  2017; 6
- **Expression and purification of soluble monomeric streptavidin in Escherichia coli** *APPLIED MICROBIOLOGY AND BIOTECHNOLOGY*
  Demonte, D., Dundas, C. M., Park, S.
  2014; 98 (14): 6285-6295
- **Streptavidin-biotin technology: improvements and innovations in chemical and biological applications** *APPLIED MICROBIOLOGY AND BIOTECHNOLOGY*
  Dundas, C. M., Demonte, D., Park, S.
  2013; 97 (21): 9343-9353