BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Bruce, Barry D.

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Postelle Distinguished Professor, Associate Head and Director of Graduate Studies

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	END DATE MM/YYYY	FIELD OF STUDY
University of California at Santa Cruz, Santa Cruz, CA	BS	12/1979	Double Major: Chemistry and Biology
University of Massachusetts at Amherst, Amherst, MA	MS	06/1982	Biochemistry/Biophysics
University of California at Berkeley, Berkeley, CA	PHD	12/1989	Molecular Plant Biology
University of Wisconsin at Madison, Madison, WI	Postdoctoral Fellow	12/1993	NSF Postdoctoral Fellowship in Plant Biology

A. Personal Statement

Chloroplast biogenesis and protein import: I have a long-standing interest in on the biogenesis of organelles and in particular the family of organelles specific to plants, known as plastids. This family includes a divers set of organelles that perform an extensive set of biochemical reactions including the process of photosynthesis, which takes place in chloroplasts. This diverse metabolic activity is the enabled via the import of several thousand nuclear encoded proteins from the cytosol. This targeting and import process is critical to many if not most of the key metabolic processes associated with plants. We are specifically interested in how chloroplast destined precursors are targeted, recognized and translocated into the plastid via two translocons, TIC and TOC, that are found in the chloroplast inner and outer envelope membranes, respectively. This process is mediated by selective recognition of the transit peptide by one or more of the TOC components. We are working to explain the biochemistry and biophysics of how these proteins are translocated across the plastid membranes.

Applied photosynthesis: A second area of research is how we may exploit the ultra efficient process of solar energy capture and conversion of natural photosynthesis into hybrid devices that will provide either direct photovoltaic electricity or be stored in some form of fuel such as molecular hydrogen. To date we have help design build and characterize novel: 1) luminescent solar concentrators, 2) hybrid Bio-organic thin-film photovoltaic devices, 3) hydride bio-inorganic photovoltaic devices, and 4) bio-Pt hydrogen evolving nanoparticles.

1. Nguyen K, Bruce BD. Growing green electricity: progress and strategies for use of photosystem I for sustainable photovoltaic energy conversion. Biochim Biophys Acta. 2014 Sep;1837(9):1553-66. PubMed PMID: 24388916.
2. Baker DR, Manocchi AK, Lamicq ML, Li M, Nguyen K, Sumner JJ, Bruce BD, Lundgren CA. Comparative photoactivity and stability of isolated cyanobacterial monomeric and trimeric Photosystem I. J Phys Chem B. 2014 Mar 13;118(10):2703-11. PubMed PMID: 24547776.
3. Mershin A, Matsumoto K, Kaiser L, Yu D, Vaughn M, Nazeeruddin MK, Bruce BD, Graetzel M, Zhang S. Self-assembled photosystem-I biophotovoltaics on nanostructured TiO(2)and ZnO. Sci Rep. 2012;2:234. PubMed Central PMCID: PMC3270499.

4. Iwuchukwu IJ, Vaughn M, Myers N, O'Neill H, Frymier P, Bruce BD. Self-organized photosynthetic nanoparticle for cell-free hydrogen production. Nat Nanotechnol. 2010 Jan;5(1):73-9. PubMed PMID: 19898496.

B. Positions, Scientific Appointments and Honors

Positions and Scientific Appointments

2019 -	Postelle Distinguished Professor, Associate Head and Director of Graduate Studies , Biochemistry and Cellular and Molecular Biology Department, University of Tennessee at Knoxville, Knoxville, TN
2015 - 2016	Program Director, NSF State-Wide EPSCoR (TN-SCORE), University of Tennessee at Knoxville, Knoxville, TN
2007 - 2019	Professor, Department of Biochemistry and Cellular and Molecular Biology And Department of Microbiology , University of Tennessee at Knoxville, Knoxville, TN
2001 - 2006	Associate Professor, Biochemistry and Cellular and Molecular Biology Department, University of Tennessee at Knoxville, Knoxville, TN
1994 - 2000	Assistant Professor, Biochemistry Department, University of Tennessee at Knoxville, Knoxville, TN

C. Contribution to Science

1. Applied photosynthesis: A second area of research is how we may exploit the ultra efficient process of solar energy capture and conversion of natural photosynthesis into hybrid devices that will provide either direct photovoltaic electricity or be stored in some form of fuel such as molecular hydrogen. To date we have help design build and characterize novel: 1) luminescent solar concentrators, 2) hybrid Bio-organic thin-film photovoltaic devices, 3) hydride bio-inorganic photovoltaic devices, and 4) bio-Pt hydrogen evolving nanoparticles. This is a filed that I helped pioneer and was recognized by Forbes Magazine as a revolutionary (https://www.forbes.com/2007/05/23/barry-bruce-photosynthesis-tech-cx_07rev_de_0524bruce.html#2e6ede384c3b)

    a. Nguyen K, Bruce BD. Growing green electricity: progress and strategies for use of photosystem I for sustainable photovoltaic energy conversion. Biochim Biophys Acta. 2014 Sep;1837(9):1553-66. PubMed PMID: 24388916.
    b. Baker DR, Manocchi AK, Lamicq ML, Li M, Nguyen K, Sumner JJ, Bruce BD, Lundgren CA. Comparative photoactivity and stability of isolated cyanobacterial monomeric and trimeric Photosystem I. J Phys Chem B. 2014 Mar 13;118(10):2703-11. PubMed PMID: 24547776.
    c. Mershin A, Matsumoto K, Kaiser L, Yu D, Vaughn M, Nazeeruddin MK, Bruce BD, Graetzel M, Zhang S. Self-assembled photosystem-I biophotovoltaics on nanostructured TiO(2)and ZnO. Sci Rep. 2012;2:234. PubMed Central PMCID: PMC3270499.
    d. Iwuchukwu IJ, Vaughn M, Myers N, O'Neill H, Frymier P, Bruce BD. Self-organized photosynthetic nanoparticle for cell-free hydrogen production. Nat Nanotechnol. 2010 Jan;5(1):73-9. PubMed PMID: 19898496.

2. hloroplast biogenesis and protein import: I have a long-standing interest in on the biogenesis of organelles and in particular the family of organelles specific to plants, known as plastids. This family includes a divers set of organelles that perform an extensive set of biochemical reactions including the process of photosynthesis, which takes place in chloroplasts. This diverse metabolic activity is the enabled via the import of several thousand nuclear encoded proteins from the cytosol. This targeting and import process is critical to many if not most of the key metabolic processes associated with plants. We are specifically interested in how chloroplast destined precursors are targeted, recognized and translocated into the plastid via two translocons, TIC and TOC, that are found in the chloroplast inner and outer envelope membranes, respectively. This process is mediated by selective recognition

of the transit peptide by one or more of the TOC components. We are working to explain the biochemistry and biophysics of how these proteins are translocated across the plastid membranes.

a. Davis MM, Lamichhane R, Bruce BD. Elucidating Protein Translocon Dynamics with Single-Molecule Precision. Trends Cell Biol. 2021 Jul;31(7):569-583. PubMed PMID: 33865650.
b. Chotewutmontri P, Holbrook K, Bruce BD. Plastid Protein Targeting: Preprotein Recognition and Translocation. Int Rev Cell Mol Biol. 2017;330:227-294. PubMed PMID: 28215533.
c. Holbrook K, Subramanian C, Chotewutmontri P, Reddick LE, Wright S, Zhang H, Moncrief L, Bruce BD. Functional Analysis of Semi-conserved Transit Peptide Motifs and Mechanistic Implications in Precursor Targeting and Recognition. Mol Plant. 2016 Sep 6;9(9):1286-1301. PubMed PMID: 27378725.
d. Chotewutmontri P, Bruce BD. Non-native, N-terminal Hsp70 molecular motor recognition elements in transit peptides support plastid protein translocation. J Biol Chem. 2015 Mar 20;290(12):7602-21. PubMed Central PMCID: PMC4367265.

3. This work advances our understanding of the structural basis of the tetrameric form of PSI in thermophilic non-heterocyst-forming cyanobacterium by elucidating the structure of TS-821 by cryo-EM. Structure analysis visualizes the dimer-of-dimers formation, defines the correlation between the structural changes in PsaL subunit and the variations in the oligomeric state, and describes the structural relationship between the novel tetrameric PSI orga- nization and the known trimeric one. Our study allows not only a direct comparison of the TS-821 PSI tetramer with previous trimeric PSI crystal structures from T.e. BP-1 and Syn PCC 6803, but also enables the first comparison of tetrameric PSI structures within thermophilic and mesophilic cyanobacteria. Finally, the bioinformatics analysis revealed multiple conserved regions of PsaL of TS-821 that are potentially critical for PSI oligomerization.

a. Semchonok D, Mondal J, Cooper C, Schlum K, Li M, Amin M, Sorzano C, Ramírez-Aportela E, Kastritis P, Boekema E, Guskov A, Bruce B. Cryo-EM structure of a tetrameric photosystem I from Chroococcidiopsis TS-821, a thermophilic, unicellular, non-heterocyst-forming cyanobacterium. Plant Communications. 2022 January; 3(1):100248-. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2590346221001541 DOI: 10.1016/j.xplc.2021.100248
b. Li M, Calteau A, Semchonok DA, Witt TA, Nguyen JT, Sassoon N, Boekema EJ, Whitelegge J, Gugger M, Bruce BD. Physiological and evolutionary implications of tetrameric photosystem I in cyanobacteria. Nat Plants. 2019 Dec;5(12):1309-1319. PubMed PMID: 31819227.
c. Semchonok DA, Li M, Bruce BD, Oostergetel GT, Boekema EJ. Cryo-EM structure of a tetrameric cyanobacterial photosystem I complex reveals novel subunit interactions. Biochim Biophys Acta. 2016 Sep;1857(9):1619-1626. PubMed PMID: 27392600.
d. Li M, Semchonok DA, Boekema EJ, Bruce BD. Characterization and evolution of tetrameric photosystem I from the thermophilic cyanobacterium Chroococcidiopsis sp TS-821. Plant Cell. 2014 Mar;26(3):1230-45. PubMed Central PMCID: PMC4001380.

4. The field of detergent-free, integral membrane protein isolation using styrene−maleic acid copolymers (SMAs) has grown rapidly over the last decade. SMAs have enabled the isolation of membrane proteins and their surrounding lipids into discrete styrene−maleic acid lipid particles (SMALPs). Compared to proteins isolated via detergent-facilitated extraction, integral membrane proteins incorporated into SMALPs have been proposed to retain a more native conformation and have enabled researchers to probe their structures using techniques like cryogenic electron microscopy (Cryo-EM). As this field continues to advance, a better understanding of how structural alterations of the SMA copolymer scaffold impact the protein extraction process will be required to design next-generation SMA copolymers and derivatives thereof. This goal will be aided by in-depth SMA structure-property relationship studies and mechanistic investigations.

a. Phan MD, Korotych OI, Brady NG, Davis MM, Satija SK, Ankner JF, Bruce BD. X-ray and Neutron Reflectivity Studies of Styrene-Maleic Acid Copolymer Interactions with Galactolipid-Containing Monolayers. Langmuir. 2020 Apr 14;36(14):3970-3980. PubMed PMID: 32207953.
b. Cherepanov DA, Brady NG, Shelaev IV, Nguyen J, Gostev FE, Mamedov MD, Nadtochenko VA, Bruce BD. PSI-SMALP, a Detergent-free Cyanobacterial Photosystem I, Reveals Faster Femtosecond Photochemistry. Biophys J. 2020 Jan 21;118(2):337-351. PubMed Central PMCID: PMC6976803.
c. Korotych O, Mondal J, Gattás-Asfura K, Hendricks J, Bruce B. Evaluation of commercially available styrene-co-maleic acid polymers for the extraction of membrane proteins from spinach chloroplast thylakoids. European Polymer Journal. 2019 May; 114:485-500. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0014305718311698 DOI: 10.1016/j.eurpolymj.2018.10.035
d. Brady N, Qian S, Bruce B. Analysis of styrene maleic acid alternating copolymer supramolecular assemblies in solution by small angle X-ray scattering. European Polymer Journal. 2019 February; 111:178-184. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0014305718311583 DOI: 10.1016/j.eurpolymj.2018.11.034