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Hosted by the Department of Chemical Engineering

## Research Seminar

### Nanomaterials Enable Delivery of Genetic Material Without Transgene Integration in Plants

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**Abstract:** Genetic engineering of plants is at the core of sustainability efforts, natural product synthesis, and agricultural crop engineering. Plant bioengineering requires delivery of biomolecules for genetic or post-transcriptional manipulation of plants, however, current delivery methods either suffer from host range limitations, low transformation efficiencies, tissue regenerability issues, tissue damage, or unavoidable DNA integration into the host genome. Here, we elucidate particle transport in plant tissues and demonstrate efficient diffusion-based biomolecule delivery several plant species with a suite of pristine and chemically-functionalized high aspect ratio nanomaterials [1]. Efficient DNA delivery and strong protein expression without transgene integration is accomplished in mature *Nicotiana benthamiana*, *Eruca sativa* (arugula), *Triticum aestivum* (wheat) and *Gossypium hirsutum* (cotton) leaves and arugula protoplasts [2]. Notably, we demonstrate that transgene expression is transient and devoid of transgene integration into the plant host genome, of potential utility for easing regulatory oversight of transformed crops as genetically modified organisms (GMOs) [3, 4]. We also demonstrate nanoparticle-based delivery of small interfering RNA (siRNA) to mature *Nicotiana benthamiana* leaves with over 95% gene silencing efficiency [5] and use DNA origami and gold nanoparticles to elucidate force-independent transport phenomena of nanoparticles to the plant cell wall [6, 7]. We find that nanomaterials both facilitate biomolecule transport into plant cells, while also protecting polynucleotides from nuclease degradation. Lastly, we demonstrate non-biostic protein delivery in plants with newly-discovered cell penetrating peptides towards DNA-free genome editing [8]. Our work provides a tool for species-independent, targeted, and passive delivery of genetic material, without transgene integration, into plant cells for diverse plant biotechnology applications.

**Biography:** Markita Landry is an associate professor in the department of Chemical and Biomolecular Engineering at the University of California, Berkeley. She received a B.S. in Chemistry and a B.A. in Physics from the University of North Carolina at Chapel Hill, a Ph.D. in Chemical Physics and a Certificate in Business Administration from the University of Illinois at Urbana-Champaign and completed an NSF postdoctoral fellowship in Chemical Engineering at the Massachusetts Institute of Technology. Her current research centers on the development of synthetic nanoparticle-polymer conjugates for imaging neuromodulation in the brain, to study lipid nanoparticle-cell membrane interactions, and for the delivery of genetic materials into plants. Markita is a member of the scientific advisory boards and a consultant for several major agricultural companies, and co-founder and CSO of Biophilia Genetics. She is a recent recipient of over 40 career awards, including awards from the Burroughs Wellcome Fund, the Schmidt Foundation, the McKnight Foundation, DARPA Young Investigator program, Beckman Young Investigator program, Howard Hughes Medical Institute, NSF CAREER award, is a Sloan Research Fellow, an FFAR New Innovator, and is a Chan-Zuckerberg Biohub Investigator.