My laboratory employs diverse interdisciplinary methods of inquiry to understand the relationships among cell shape detection, determination, and maintenance in bacteria. Cell shape plays a critical role in regulating many physiological functions, yet little is known about how the wide variety of cell shapes are determined and maintained. Inside the cell, many proteins organize and segregate, but how they detect and respond to the cellular morphology to end up at the right place at the right time is also largely mysterious. The group uses a combination of analytical, computational, and experimental approaches to probe physical mechanisms of shape-related self-organization in protein networks, membranes, and the cell wall. Current topics of interest are (i) cell-wall biosynthesis, (ii) the regulation and mechanics of cell division, (iii) membrane organization, and (iv) membrane-mediated protein interactions. Ultimately, the manipulation of cell shape may provide a direct tool for engineering complex cellular behaviors.
LINKS

• Laboratory of Cellular Organization: http://whatislife.stanford.edu/

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

We primarily focus on bacteria, in which the exquisite patterning of the interior in both space and time is critical for a wide variety of cellular functions. The wide variety of shapes and sizes that bacteria take on can be used as synthetic environment for studying the establishment of intracellular organization and the cellular response to perturbations in morphology. Ultimately, the manipulation of cell shape may provide a direct tool for engineering complex cellular behaviors.

Currently, we are interested in (i) the role of the cell wall in cell-shape determination, (ii) the regulation and mechanics of the cell cycle and cell division, (iii) the spatial and temporal organization of the membrane, (iv) the role of the membrane in transmembrane-protein interactions and ion channel gating, and (v) collective behavior in bacteria.

Teaching

COURSES

2019-20
• Physical Biology: BIOE 42 (Spr)

2017-18
• Physical Biology: BIOE 42 (Spr)

2016-17
• Advanced Seminar on Prokaryotic Molecular Biology: BIO 346 (Aut)
• Gut Microbiota in Health and Disease: BIOE 221G, MI 221 (Spr)
• Physical Biology of Cells: BIOE 42 (Spr)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)
Katie Bodner, Heejo Choi, Bryan Merrill, Kali Pruss, Tim Schnabel, Will Van Treuren

Postdoctoral Faculty Sponsor
Heidi Arjes, Po-Yi Ho, Manohary Rajendram, Anthony Shiver

Doctoral Dissertation Advisor (AC)
Andres Aranda-Diaz, Esha Atolia, Spencer Cesar, Rebecca Culver, Ben Knapp, Kim Vasquez

Postdoctoral Research Mentor
Heidi Arjes, Manohary Rajendram

Doctoral (Program)
Rafi Ayub, Phillip DiGiacomo, Thomas Lozanoski, Caitlin Maikawa, Taylor Nguyen, Sam Vesuna, Linfeng Yang

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

• Biochemistry (Phd Program)
• Biophysics (Phd Program)
• Microbiology and Immunology (Phd Program)

Publications

PUBLICATIONS

- **Isolation and preparation of bacterial cell walls for Ultra-Performance Liquid Chromatography** in *press, J Vis Exp.*
  Desmarais, S., Cava, F., de Pedro, M., Huang, K. C.

- **The Gut Microbiome: Connecting Spatial Organization to Function** *CELL HOST & MICROBE*
  Tropini, C., Earle, K. A., Huang, K. C., Sonnenburg, J. L.
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- **Coupling between Protein Stability and Catalytic Activity Determines Pathogenicity of G6PD Variants** *CELL REPORTS*
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- **Emergent Phototactic Responses of Cyanobacteria under Complex Light Regimes** *MBIO*
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- **Rapid, precise quantification of bacterial cellular dimensions across a genomic-scale knockout library.** *BMC biology*
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- **GTPase activity-coupled treadmilling of the bacterial tubulin FtsZ organizes septal cell wall synthesis.** *Science*
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- **Strain Library Imaging Protocol for high-throughput, automated single-cell microscopy of large bacterial collections arrayed on multiwell plates.** *Nature protocols*
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- **A Periplasmic Polymer Curves Vibrio cholerae and Promotes Pathogenesis.** *Cell*
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- **Single-molecule imaging reveals modulation of cell wall synthesis dynamics in live bacterial cells** *NATURE COMMUNICATIONS*
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- **FtsZ-Dependent Elongation of a Coccoid Bacterium** *MBIO*
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- **Mechanical Genomics Identifies Diverse Modulators of Bacterial Cell Stiffness.** *Cell systems*
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