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.
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

2022-23
• Physical Biology: BIOE 42 (Spr)

2021-22
• Physical Biology: BIOE 42 (Spr)

2020-21
• Physical Biology: BIOE 42 (Spr)

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

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)
Skye Glenn, Thomas Lozanoski, Bryan Merrill, Yashna Thappeta, Daniel Wong, Bokai Zhu

Postdoctoral Faculty Sponsor
Po-Yi Ho, Jaime Lopez, Saria McKeithen-Mead

Doctoral Dissertation Advisor (AC)
Siranush Babakhanova, Rebecca Culver, Ben Knapp, Taylor Nguyen, Rachel Porter, Jiawei Sun

Master's Program Advisor
William Wang

Undergraduate Major Advisor
Sydney Steele

Doctoral (Program)
Nora Enright, Ian Ho, Thomas Lozanoski, Taylor Nguyen, Heena Saqib
GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

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

Publications

PUBLICATIONS

- Pictures of Tongues Sticking Out. *Trends in endocrinology and metabolism: TEM*
  Shi, H., Huang, K. C.
  2020

- Colons or semi-colons: punctuating the regional variation of intestinal microbial-immune interactions. *Nature reviews. Gastroenterology & hepatology*
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  Koyama, L. A., Aranda-Diaz, A. n., Su, Y. H., Balachandra, S. n., Martin, J. L., Ludington, W. B., Huang, K. C., O’Brien, L. E.
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- Bellymount enables longitudinal, intravital imaging of abdominal organs and the gut microbiota in adult Drosophila *PLOS BIOLOGY*
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  Arjes, H. A., Vo, L. n., Dunn, C. M., Willis, L. a., DeRosa, C. A., Fraser, C. L., Kearns, D. B., Huang, K. C.
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  Khare, S., Hsin, J., Sorto, N. A., Nepomuceno, G. M., Shaw, J. T., Shi, H., Huang, K.
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- Decoupling of Rates of Protein Synthesis from Cell Expansion Leads to Supergrowth. *Cell systems*
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