Education

Cellular Engineering is an emerging, interdisciplinary field requiring, not only knowledge and skills in the domain of cell and molecular biology, but also physics (in order to test and understand how forces influence cellular structure and function across scales) and computational thinking (for harnessing the power of cells, to develop powerful predictive models of cellular structure and function, and to leverage machine learning to accelerate research progress).

Training center members and other students in this interdisciplinary approach is the overarching education goal of the CCC. Developing a scientific workforce that is fluent across disciplines so that individuals can identify creative ways to model phenomena, test hypotheses, and design novel solutions to problems is seen as critical to our ability to solve these global problems. The Center for Cellular Construction is pioneering a model for educating students to conduct Convergence Research [1] while simultaneously, through the research conducted in the Center, we are working to both Understand the Rules of Life [2], and then apply our knowledge of these rules to develop innovative solutions to problems facing our world.

Center Educational Offerings:

Graduate Education [3]

Undergraduate Education [4]

High School Education [5]

Information for Prospective Postdocs [6]

Framework for Cellular Engineering Education

Cellular engineering education is informed by a framework to guide the development of curriculum across a wide range of levels – from work with the public, K-12 teachers and students, undergraduate, graduate students, and postdoctoral fellows. The framework has three core components, briefly outlined below:

Cell are Machines that Can be Engineered

A central tenet of the Center for Cellular Construction is that cells are biological machines that can be engineered to solve important problems facing the world. To fully unlock the power of cells as an engineering platform, researchers need to understand the Rules of Life that govern
cellular structure and the assembly of multi-cellular structures. Similarly, research will further elucidate how the structure of cellular components impacts function.

An Engineering Approach to Biological Problems

Engineering is an inherently quantitative discipline, while traditionally biology relies on highly qualitative results. A large part of creating the discipline of cellular engineering will rely on creating more quantitative methods for use in biology. Those trained in biology must be taught to think like an engineer, and those trained as engineers must gain a deep understanding underlying biology so that they can properly utilize their problem-solving skillset. This necessitates developing novel approaches to preparing trainees.

Engineering Complex Systems Requires Working Across Interfaces

Because biology is highly nonlinear, dynamic, and noisy, cellular engineers need to think differently about how to design biological machines, with an emphasis on ways to select from among many possible designs using high throughput methods and machine learning.

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Links
[3] https://ccc.ucsf.edu/graduate-education
[6] https://ccc.ucsf.edu/prospective-postdocs