

DESIGNING SYNTHETIC CELLS

Remember Jacques Loeb? Before 1900, he was studying biological processes in order to control life. He sought to engineer life to make it behave how he wanted. Today, researchers in engineering and biology lead the way in the quest to synthesize cells to do what we want.

Loeb said in 1902 in *McClure's* magazine:

"I wanted to take life in my hands and play with it, I wanted to handle it in my laboratory as I would any other chemical reaction – to start it, stop it, vary it, study it under every condition, to direct it at my will!"

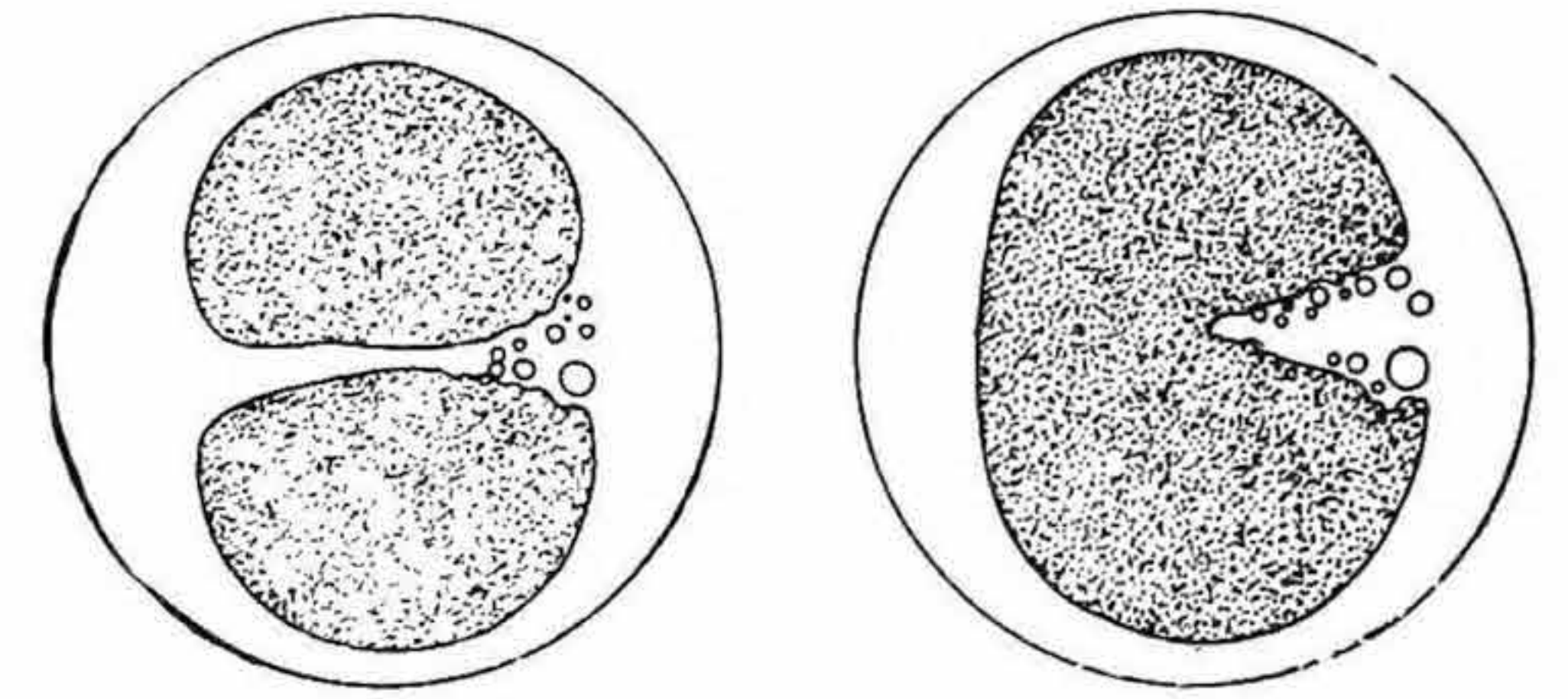


Fig. 21

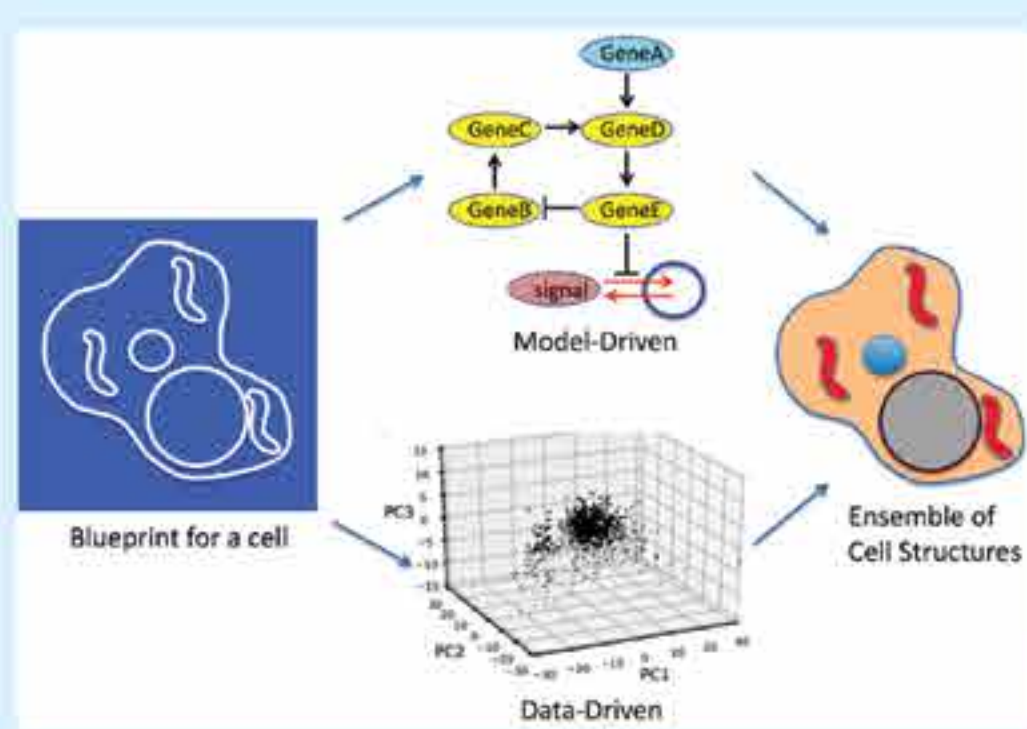
Fig. 22

Sea urchin egg cells dividing in response to an artificial membrane
Loeb 1913

Since 1902, researchers have developed many new tools and methods to synthesize cells. But just as there is no single right way to visualize a cell, there is no single right synthetic cell. Researchers design their cells based on the questions they want to ask and answer.

They are asking questions like:

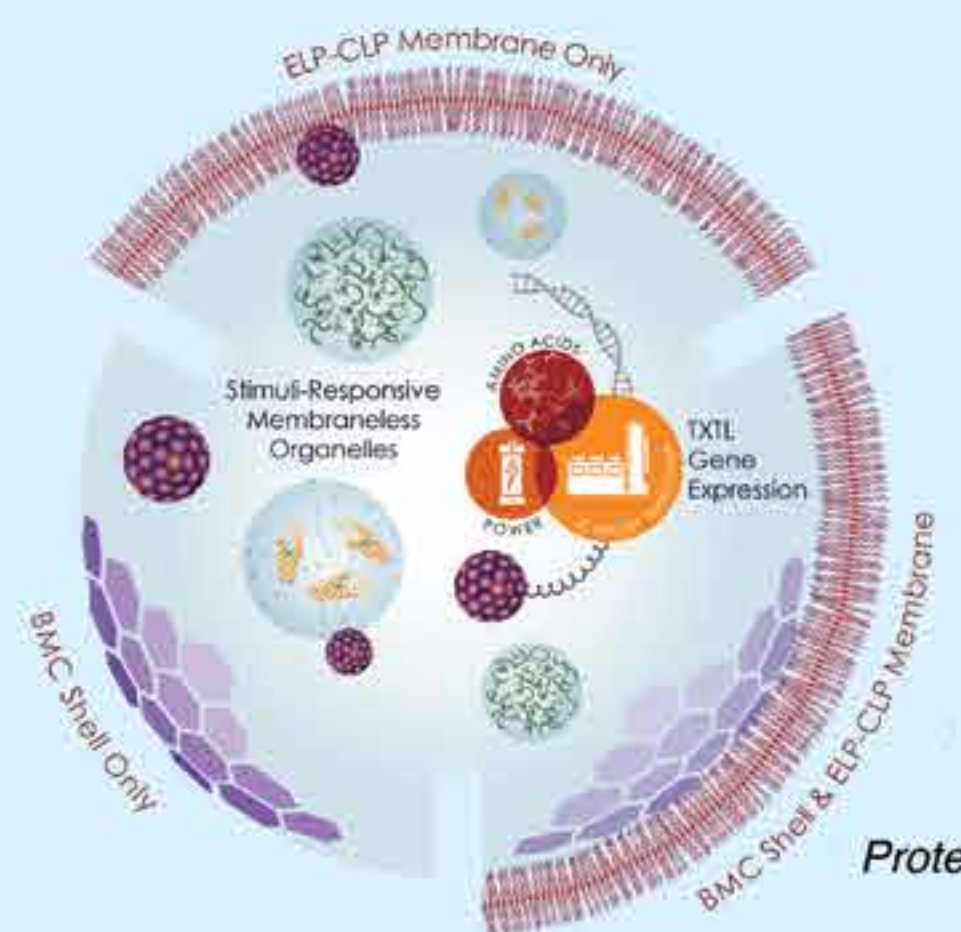
Can we redesign the structure of cells?



Center for Cellular Construction 2021

At the Center for Cellular Construction, researchers start with a cell blueprint based on a list of desired features of drawings. Then, they use models or data to predict what kinds of genetic molecular changes are needed to achieve that blueprint in a final synthesized cell.

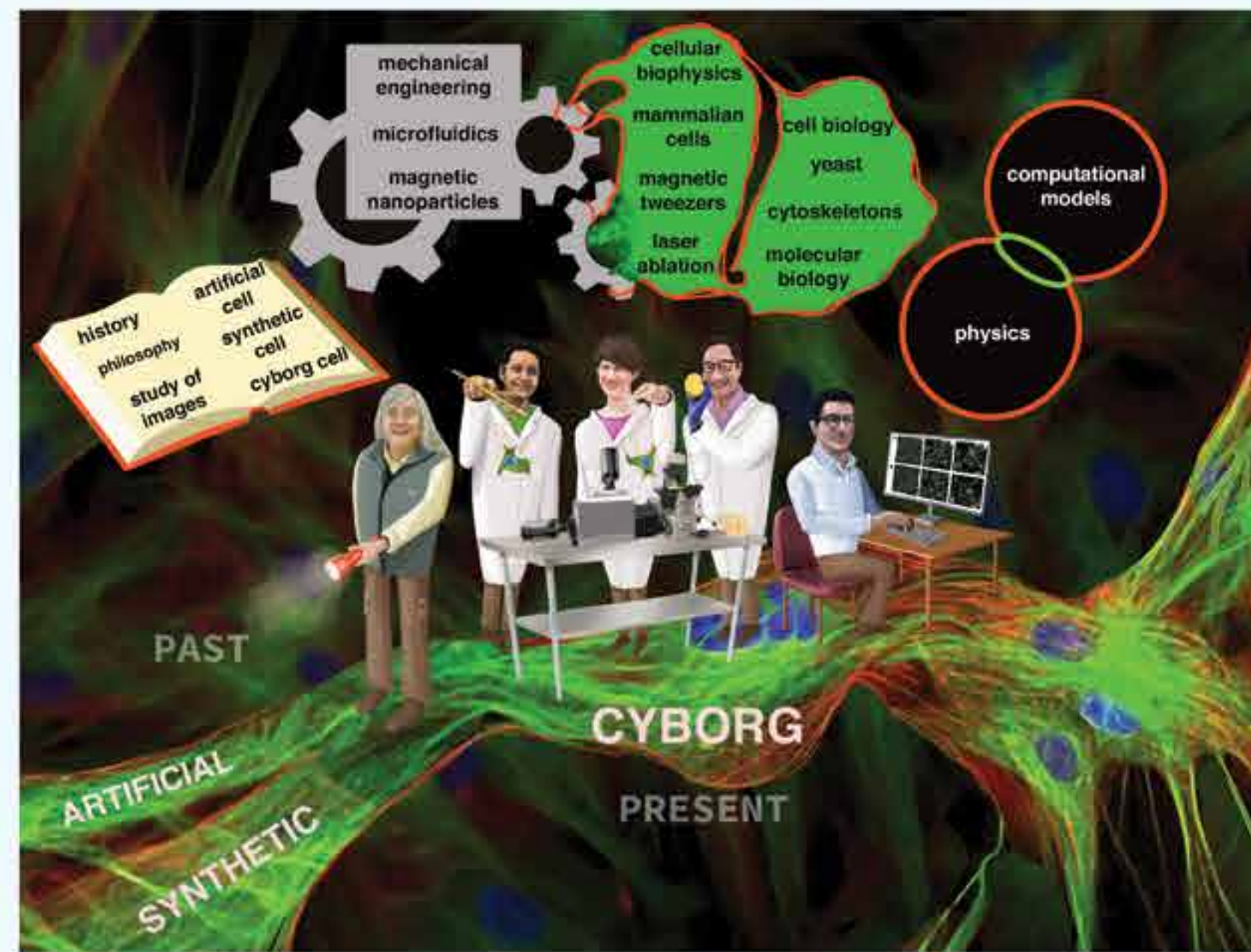
Can we build cells with different materials?



ProteoCell Team

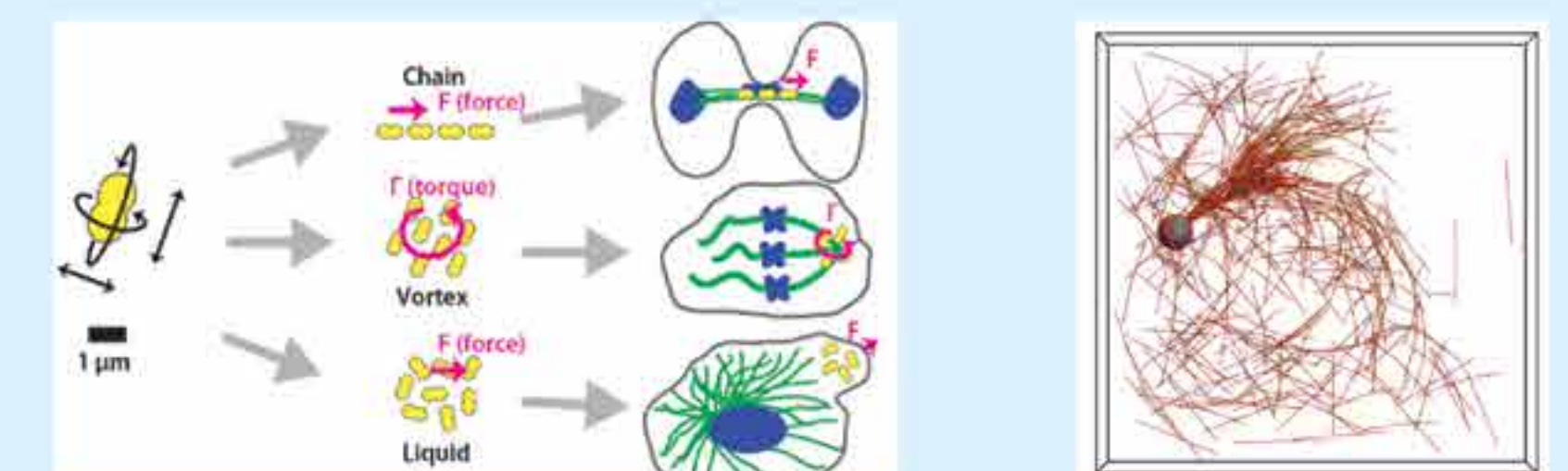
The membranes of cells and their organelles are primarily made of lipids. The ProteoCell Team uses alternative biological materials, like proteins and peptides, to build synthetic compartments.

Guerrero 2021



Researchers from many different disciplines make up these groups. Cell biologists, computational modelers, engineers, physicists, sociologists, historians, and more are designing synthetic cells together to investigate basic rules of life. The diversity of perspectives and methods enables them to explore many possibilities.

Can we engineer cell parts to make cells move in ways that we want?

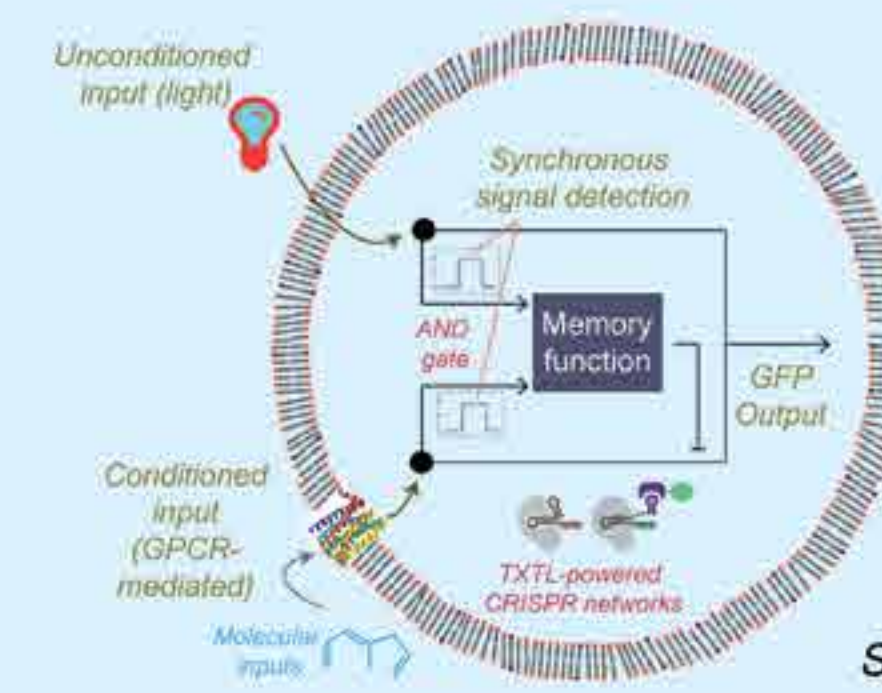


Cyborg Cell group 2021

Floyd and Dinner 2021

The Cyborg Cell group attempts to introduce materials that can be externally controlled, such as magnets, into cells to direct cellular structures and achieve new functions.

Can we give synthetic cells memory?



SynCell group 2021

The SynCell Learning group aims to "program" a synthetic cell to perform associative learning tasks, like Pavlovian conditioning: in this case, learning to "salivate" (produce GFP) in response to a "bell" (blue light) after repeated pairing of the "bell" with a chemical input.

...and more!

Microscopy is integral to designing synthetic cells. It has shown us cells and what is inside them. It has raised many questions about how these living units work in themselves and in organisms. Images made with microscopes help us share what we see as evidence of what is there and what it's doing.

How, then, do images help us imagine synthetic cells?