Europe Medical

A Nobel Prize laureate, Jack W. Szostak is Professor of Genetics at Harvard Medical School and Professor of Chemistry and Chemical Biology at Harvard University and is the Alexander Rich Distinguished Investigator at Massachusetts General Hospital. Dr. Szostak grew up in Canada and received a B.Sc. from McGill University and a Ph.D. in biochemistry from Cornell University. He has made pioneering contributions to genetics, including identifying the role of programmed DNA double-strand breaks in meiotic recombination and the discovery of how chromosomes are protected by telomeres. A member of the National Academy of Sciences, Dr. Szostak is now conducting groundbreaking research on the origin of life on Earth.

An Interview with Jack Szostak

You won a Nobel Prize for your work on telomeres. How did you transition from that topic to studying the origin of life?

After working on telomeres and DNA damage repair in yeast, I started to look around for something new to study. At that time, Sid Altman and Tom Cech had just discovered ribozymes, which are RNA molecules that can function as enzyme-like catalysts. I found this really exciting, and so I switched the focus of my lab to RNA biochemistry. At first, we looked at molecular evolution. But it's one thing to study evolution in the lab, where you, the experimenter, control the conditions under which an existing ribozyme can evolve. I started to wonder: How in the first place did RNA form and replicate itself on early Earth? I became more and more interested in that question, and now my whole lab is working on it.

What approaches do you use to study the origin of life?

We're using chemical experiments to try to figure out the conditions under which a primitive cell could form, grow, and divide. Much work from other laboratories has contributed to our current understanding of how the chemical building blocks of biology could have been made on early Earth. This has set the stage for exploring the next question: How did these inanimate chemicals assemble into larger structures and start acting like a living cell?

What hurdles remain to answer this question?

The first living cells must have been extremely simple. But they also must have had some of the universal features of cells today, such as a cell membrane and a genetic material like RNA. We've learned how to assemble cell-like structures with a membrane that surrounds RNA. The membranes of these structures can grow and produce "offspring" similar to themselves. The big remaining hurdle is to discover conditions under which RNA can replicate itself in a way that is compatible with a primitive cell membrane.

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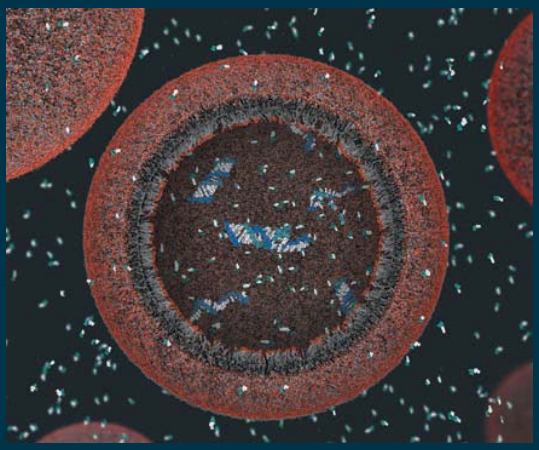
Model of a protocell containing nucleotides and short bits of RNA



What can you learn about present-day cells by studying the origin of life?

All present-day life shares many features, including the same underlying biochemistry. We're trying to find explanations for such shared features. We've learned that the essential role of RNA seems to emerge naturally from chemical conditions like those on early Earth. But questions remain. For example, all cells maintain certain concentration gradients across their membranes, such as higher potassium levels inside the cell than out, and lower sodium levels inside than out. Cells spend a lot of energy maintaining these gradients—why is that? We don't have a good answer for that yet, but we hope to learn more about such puzzling features of life today by studying its origins.

What do you find most rewarding about your job?

I especially enjoy talking with people about new experiments. The lab is filled with talented students and post-docs who have different backgrounds and different scientific interests. Everyone has to learn how to talk with each other. This makes the lab an exciting and fun place where we all are working together to solve a big scientific problem.