

From Kibbutz Fishponds to The Nobel Prize: Taking Molecular Functions into Cyberspace

Presented by:

Dr. Arieh Warshel Distinguished Professor of Chemistry, USC Fellow of the National Academy of Sciences Nobel Laureate in Chemistry

Abstract:

The talk will cover Dr. Arieh Warshel's life experiences. Warshel grew up in Kibbutz Sde Nahum, a communal agricultural farm in northern Israel. Warshel's research has often been ahead of his time, considered outside the box. Here is a man, a great innovator, that often sees connections that are not immediately obvious to others. This has also led to significant resistance to his ideas, although they have been eventually embraced by the broader community. The talk will include anecdotes about his family, upbringing, early education, and military service in the Israeli army. He will also cover his training at undergraduate (Technion) and graduate (Weizmann Institute of Science) levels, which has led him to study a wide-range of organic and biological systems from β -cyclodextrin to large enzymatic systems as F-ATPase. During his studies at the Weizmann Institute using a computer named "Golem," Warshel, together with Lifson (his Ph.D. mentor) and Michael Levitt, developed the consistent force field theory (CFF) that set the path for biomolecular simulations, that are standard approaches/tools today. While at Weizmann, Professor Warshel began a fruitful collaboration with Levitt (currently at Stanford). That collaboration led to a landmark simulation of protein folding. It also led to sharing the Nobel Prize with Levitt and Martin Karplus in 2013. Warshel's rich academic career at USC since 1976 has revolved around understanding the importance of electrostatic effects in enzyme catalysis.





Arieh Warshel

Arieh Warshel was born to a Jewish family in 1940 in kibbutz Sde Nahum, Mandatory Palestine. He served in the Israeli Armored Corps. After serving the Israeli Army (final rank Captain), he attended the Technion, Haifa, where he received his BSc degree in chemistry, Summa Cum Laude, in 1966. Subsequently, he earned both M.Sc. and Ph.D. degrees in Chemical Physics (in 1967 and 1969, respectively), with Shneior Lifson at Weizmann Institute of Science, Israel. After his doctoral studies, he did postdoctoral work at Harvard University until 1972, and from 1972 to 1976 he returned to the Weizmann Institute and worked for the Laboratory of Molecular Biology, Cambridge, England. He joined the faculty of the Department of Chemistry at USC in 1976 and has been there ever since.

Arieh Warshel is well-known for his work on computational biochemistry and biophysics and in particular for pioneering computer simulations of the functions of biological systems, and for developing what is known today as Computational Enzymology. For his outstanding work, he shared the 2013 Nobel Prize in Chemistry with Martin Karplus of Harvard University and Michael Levitt of Stanford University. What Warshel and Karplus and Levitt, achieved – beginning in the late 1960s when computers were still very primitive – was the creation of computer programs that describe the action of proteins and other biological molecules by "multiscale models." Such models describe the most important parts of the molecular system in more detail than the surroundings. For example, in exploring the way enzymes work, the programs describe the reacting bonds quantum mechanically and the surroundings by classical molecular mechanics. Such models can simulate how enzymes control key biological processes and how a drug molecule targets a protein in the body. Scientists can now let computers perform most of the work in predicting chemical processes in very large systems, saving extensive resources used in conventional laboratory experiments. Warshel's pioneering work has led to the ability to describe and understand the action of molecular machines, the activation of ion channels, and the ability to model electron and proton transport in biology, as well as to gain insight on other key biological processes.