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1966	B.S. Biochemistry, University of Chicago, Chicago, IL
1970	Ph.D., Department of Crystallography, University of Pittsburgh, Pittsburgh, PA
1970-1972	Research Associate in Molecular Graphics, Columbia University, New York, NY
1972-1977	Damon Runyon and NIH Postdoctoral Fellow, Massachusetts Institute of Technology, Cambridge, MA
1977-1988	Department of Biological Sciences, State University of New York - Albany, Albany, NY
1988	Professor, Department of Chemistry, New York University, New York, NY

Honors

1995	Feynman Prize in Nanotechnology
1997	Discover award in Emerging Technology

DNA Nanotechnology

Nanotechnology is broadly defined as the science of creating and developing well-structured materials and their components. DNA-based nanotechnology employs branched motifs to these ends. This effort has been quite successful, because these unusual motifs of DNA present an extremely favorable construction medium: The sticky-ended association of DNA molecules occurs with high specificity and diversity, and it results in the formation of B-DNA, whose structure is well known. The use of stable branched DNA molecules permits one to make stick-figures and topological targets. We have used this strategy in the past to construct covalently closed DNA polyhedra and knots.

Borromean rings are a series of linked cyclic molecules with a special topological property: If a single one of them is broken, the entire assemblage falls apart. They offer a particularly intriguing topology for bringing a number of species to a given locus and then dispersing them. We have built a prototype set of Borromean rings from DNA by mixing B-DNA and Z-DNA in a specific fashion.

In a second use of Z-DNA, we have constructed a DNA nanomechanical device. The device consists of two DNA double crossover (DX) molecules connected by a piece of DNA that can be converted to Z-DNA. DX molecules contain two DNA double helices with parallel axes linked by Holliday-like crossovers. Atoms move between 20 Å and 60 Å when the device undergoes the transition.

A central goal of DNA nanotechnology is the deliberate construction of periodic matter by self-assembly. We have constructed 2-dimensional DNA arrays in three different motifs. In the first motif, we have used DX molecules with sticky ends that have been designed to tile the plane. Our arrays are typically about a micron in size. It is possible to decorate the simple DX molecule with DNA hairpins that protrude from the plane of the 2-D array; these hairpins act as topographic labels that are visible when the array is visualized by atomic force microscopy (AFM). We can change the pattern produced by these labels at will, just by changing the sticky ends. We can also modify the pattern after assembly. In a similar fashion, we have used triple crossover (TX) molecules decorated in the same fashion to produce patterns in 2D crystals. These TX molecules contain three coplanar helical domains linked in the same fashion as DX molecules. Rotation of TX molecules leads to different patterns in the AFM. In addition, we have generated arrays from parallelograms predicated on Holliday junction analogs. These parallelograms contain cavities whose sizes can be tuned by design.