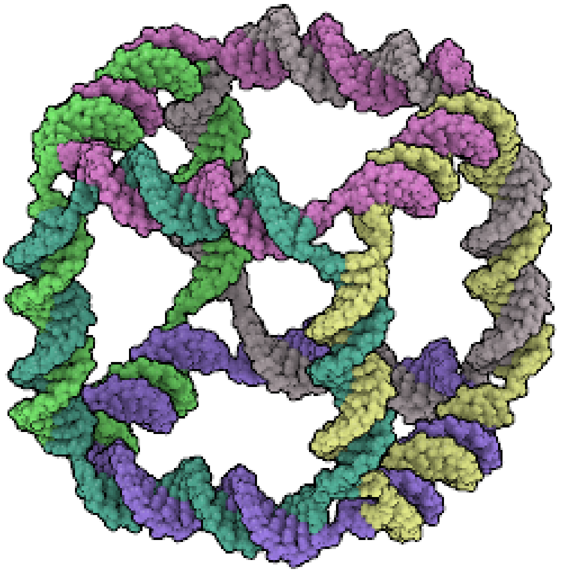
AUSTRALIA'S INNOVATIVE UNIVERSITY

Macquarie University

Faculty of Science

Colloquium

DNA: Not Merely the Secret of Life



Nadrian C. Seeman

Department of Chemistry, New York University, USA

Friday 2-3 pm Nov 28th, E6A 102

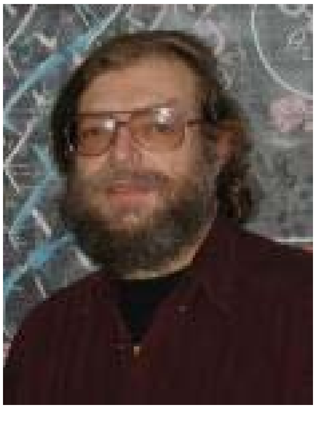
Followed by Tea & Discussion

This Faculty-wide Colloquia series is hosted by the Dean of the Faculty of Science. This event is open to all within the Faculty and externally. The series aims to strengthen research collaborations and communicate with the broader community, both internally and externally to the Faculty of Science.

Abstract

DNA is well-known as the genetic material of living organisms. Its most prominent feature is that it contains information that enables it to replicate itself. This information is contained in the well-known Watson-Crick base pairing interactions, adenine with thymine and guanine with cytosine The double helical structure that results from this complementarity has become a cultural icon of our era. To produce species more diverse than the DNA double helix, we use the notion of reciprocal exchange, which leads to branched molecules. The topologies of these species are readily programmed through sequence selection; in many cases, it is also possible to program their structures. Branched species can be connected to one another using the same interactions that genetic engineers use to produce their constructs, cohesion by molecules tailed in complementary single-stranded overhangs, known as 'sticky ends Such sticky-ended cohesion is used to produce N-connected objects and lattices. We have been working since the early 1980's to combine these DNA motifs to produce target species. From branched junctions, we have used ligation to construct DNA stick-polyhedra and topological targets, such as Borromean rings. Nanorobotics is a key area of application and a bipedal walker has been built. A central goal of DNA nanotechnology is the self-assembly of periodic matter. We have constructed 2-dimensional DNA arrays from many different motifs. We can produce specific designed patterns visible in the AFM. Recently, we have used DNA scaffolding to organize active DNA components, as well as other materials. Active DNA components include DNAzymes and DNA nanomechanical devices; both are active when incorporated in 2D DNA lattices. We have used pairs of PX-based devices to capture a variety of different targets. Multi-tile DNA arrays have also been used to organize gold nanoparticles in specific arrangements. Recently, we have self-assembled a 3D crystalline array and have solved its crystal structure.

BioPic



Nadrian C. Seeman was born in Chicago in 1945. Following a BS in biochemistry from the University of Chicago, he received his Ph.D. in biological crystallography from the University of Pittsburgh in 1970. His postdoctoral training, at Columbia and MIT, emphasized nucleic acid crystallography. He obtained his first independent position at SUNY/Albany, where his frustrations with the macromolecular crystallization experiment and his awareness of the fatal series--no crystals, no crystallography, no crystallographer--led him to the campus pub one day in the fall of 1980. There, he realized that the similarity between 6-arm DNA branched junctions and the flying fish in the periodic array of Escher's 'Depth' might lead to a rational approach to the organization of matter on the nanometer scale, particularly crystallization. Ever since, he has been trying to implement this approach and its spin-offs, such as nanorobotics and the organization of nanoelectronics; since 1988 he has worked at New York University. When told in the mid-1980's that he was doing nanotechnology, his response was similar to that of M. Jourdain, the title character of Moliere's Bourgeois Gentilehomme, who was delighted to discover that he had been speaking prose all his life. He has won the Sidhu Award, the Feynman Prize, the Emerging Technologies Award and the Tulip Award in DNA Computing. Further information is available at http://seemanlab4.chem.nyu.edu