DNA: Not Merely the Secret of Life
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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 design; it is also possible to program 3D 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, as well as nanomechanical devices. We have used this system to self-assemble macroscopic 3D crystals whose structures have been determined by X-ray crystallography. We have also combined 2-state nanomechanical DNA devices with a DNA walker on a DNA origami surface to produce a programmable DNA assembly line.