

# DNA Gets a Newer and Bigger Alphabet

## Scientific Achievement

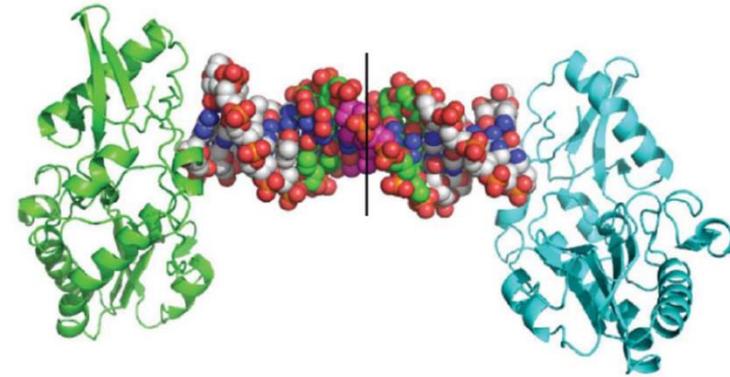
Four new DNA bases were synthesized and combined with the four natural bases to give an expanded genetic Hachimoji alphabet, capable of folding into a standard double helix and producing viable RNA

## Significance and Impact

Synthetic biology has made available a mutable genetic system, built from eight different building blocks, with potential use spanning creating novel proteins to pursuing extra-terrestrial life

## Research Details

- DNA is composed of four natural bases which interact as pairs
- The four new bases (P, B, Z and S) form specific pairs (P:Z and B:S) readily incorporated in DNA's phosphate backbone
- Crystal structures of three 16 base-pair Hachimoji duplexes containing these base pairs were solved to 1.7 Å resolution
- These molecules all form the standard double helix, irrespective of the base-pair identity or sequence
- The Hachimoji DNA can be read by an enzyme which converts it to RNA, the first step in protein synthesis



The crystal structure of a 16-mer Hachimoji DNA comprising Z:P pairs in green and S:B pairs in magenta. The duplex was stabilized as a host-guest complex with two N-terminal fragments from Moloney murine leukemia virus reverse transcriptase (shown as green and cyan ribbons). The asymmetric unit includes one protein molecule and half of the Hachimoji DNA, as indicated by the line. [From Hoshika et al. 2019. Reprinted with permission from AAAS.]

**S. Hoshika, S., et al. 2019. "Hachimoji DNA and RNA: A Genetic System with Eight Building Blocks," *Science* 363(6429), 884-87. DOI: 10.1126/science.aat0971.**

Structural work was performed at  
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