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Creation of a novel unnatural base pair system for the expansion of the genetic alphabet toward future biotechnology

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In nature, all organisms store genetic information within sequences consisting of the four standard bases, A, G, C, and T, in nucleic acids. Through the complementarity of the specific A-T and G-C base pairs, the genetic information of DNA is replicated (replication), transcribed to RNA (transcription), and translated into the amino acid sequences of proteins (translation).

If an extra base pair can be added into the genetic information system, the present genetic system expands to one with 6 bases. This artificial expanded system would enable the site-specific incorporation of functional components into nucleic acids and proteins through the genetic information flow-replication, transcription, and translation-mediated by the extra base pair, thus providing novel biotechnology for creating biopolymers with increased functionality. This technology can be achieved by generating extra base pairs with selectivity and efficiency as high as those of the natural base pairs in the biosyntheses of nucleic acids and proteins.

A research group of RIKEN Genomic Sciences Center and the University of Tokyo presented a novel extra base pair, Ds-Pa, which can be practically used in replication and transcription. DNA molecules containing the Ds-Pa pair are amplified by PCR and function as templates for incorporating functional components into RNA. Thus, the Ds-Pa pair system would be a powerful tool for creating nucleic acids useful for therapeutics and diagnosis.

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