Article 2: An Environmentally Responsive Reciprocal Replicating Network

Robertson, C. C.; Mackenzie, H. W.; Kosikova, T.; Philp, D. An EnvironmentalReciprocal Replicating Network. *Journal of the American Chemical Society* **2018**, *140* (22), 6832–6841. https://doi.org/10.1021/jacs.7b13576.

Figure 1

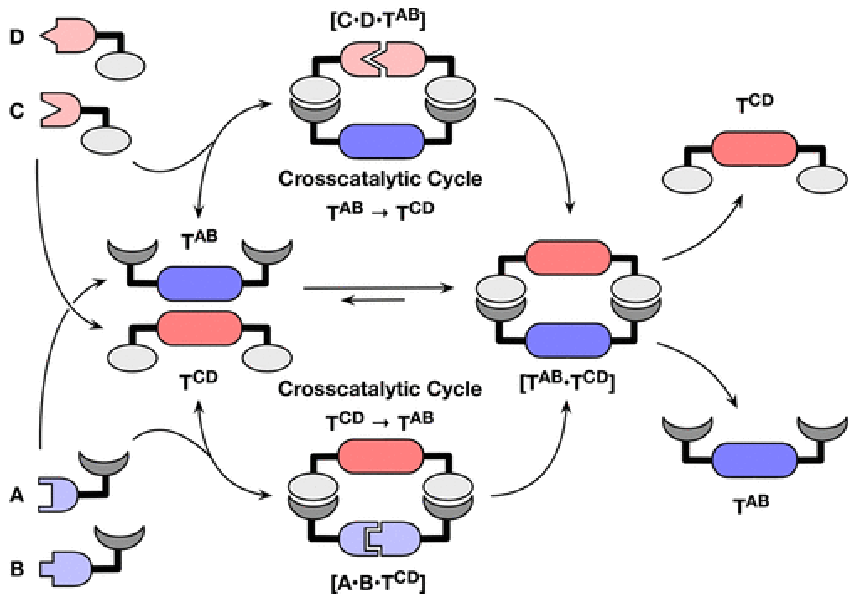

Figure 1 depicts a reciprocal replicating system with two templates, TAB and TCD, formed through reactions between components A and B and C and D. These templates catalyze each other's formation: TAB promotes the creation of TCD and vice versa, through ternary complexes ([A•B•TCD] and [C•D•TAB]). This forms a reciprocal replication cycle where the templates dissociate and return to their starting points to repeat the process. The system's complexity can increase if the reactions between the components are not chemically orthogonal, allowing for additional replication cycles and the formation of self-complementary templates.

Synopsis

The article "An Environmentally Responsive Reciprocal Replicating Network" by Craig C. Robertson, Harold W. Mackenzie, Tamara Kosikova, and Douglas Philp, published in the Journal of the American Chemical Society, introduces a chemical system that mimics certain behaviors of biological networks. This system is designed to respond to environmental changes, similar to how living organisms adapt to their surroundings.

In this study, the researchers developed a system comprising four basic chemical building blocks, labeled A, B, C, and D. These blocks can pair up in two specific ways:

Pair 1: A combines with B through a reaction called 1,3-dipolar cycloaddition.

Pair 2: C combines with D via a condensation reaction.

When these pairs form, they create two distinct compounds: A–B and C–D. A unique feature of this system is that each compound helps the formation of the other, creating a self-sustaining cycle where A–B promotes the creation of C–D, and C–D promotes the creation of A–B.

A key aspect of this system is its ability to change behavior based on the acidity or basicity (pH) of the environment:

Acidic Conditions: When the environment is more acidic, the condensation reaction is favored, leading to an increase in the C–D compound.

Basic Conditions: In a more basic environment, the 1,3-dipolar cycloaddition is favored, resulting in more of the A–B compound.

This means that by simply changing the pH, one can control which compound is more prevalent in the system.

Figure 1 in the article visually represents this system. It shows the structures of the four building blocks (A, B, C, and D) and illustrates how they pair up to form the compounds A–B and C–D. The figure also depicts the reciprocal relationship, highlighting how each compound facilitates the formation of the other and indicates how changes in pH influence these reactions.

This study demonstrates the possibility of creating chemical networks that can adapt to environmental changes, similar to biological systems. Such adaptable chemical systems could have applications in developing smart materials that respond to their environment or in advancing our understanding of self-replicating and catalytic processes in chemistry.

In summary, the article presents a significant advancement in chemistry by designing a system where simple chemical building blocks interact in a self-sustaining and environmentally responsive manner. This work bridges concepts from chemistry and biology, opening pathways for future research into adaptive and self-replicating chemical systems.