New Molecule-Building Kit “Blows Door Wide Open” for Drug Development

Similar to Legos, TIDA boronates can be assembled into tiny 3D pharmaceuticals—perfect for cancer therapies targeting small molecules.

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For the past 15 years, a group of researchers at the University of Illinois at Urbana-Champaign has been developing chemical building blocks for the synthesis of organic (carbon-based) small molecules. These building blocks, called MIDA boronates, snap together like puzzle pieces and can be assembled into a range of products, from manufacturing materials to food ingredients. The team even created a molecule-building machine to automate the process. As versatile as MIDA boronates are, however, they are much more stable in flat molecules than in 3D space. To advance in the world of chemical synthesis, scientists need Legos, not puzzle pieces.

Enter TIDA boronates: a new kind of chemical building block with built-in 3D structural features. In a paper published in Nature earlier this month, former Damon Runyon-Illini 4000 Fellow Daniel J. Blair, PhD, announced the exciting innovation, which “blows the door wide open” for the assembly of very complex 3D molecules.

With the help of the team’s updated molecule-building machine, TIDA boronates can be assembled into new pharmaceuticals, catalysts that mimic the function of enzymes, diagnostic probes that can identify the presence of a specific molecule or DNA sequence in the cell, and much more.

“Nature is very good at making three-dimensional things a very precise way,” Dr. Blair explains. “A lot of the molecules we use as inspiration for making medicines are natural products. Yet until this point it has been very difficult to capture these structures within modular building blocks. The whole goal is to help more people make more molecules as simply as possible.”

This development has especially exciting implications for cancer treatment, which increasingly relies on small-molecule targeted therapies to block mutant proteins or bolster immune response. When researchers identify a new oncoprotein, for example, they typically invest a great deal of time and effort in developing a small molecule that can inhibit the protein. With the team’s machine and molecular building kits, potential inhibitors can be assembled “with a few keystrokes and clicks” and tweaked one building block at a time. If the widespread use of MIDA boronates is any indication, TIDA boronates will soon be Lego-like not only in their 3D structure but also in their ubiquity.

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