New DNA-peptide molecules developed

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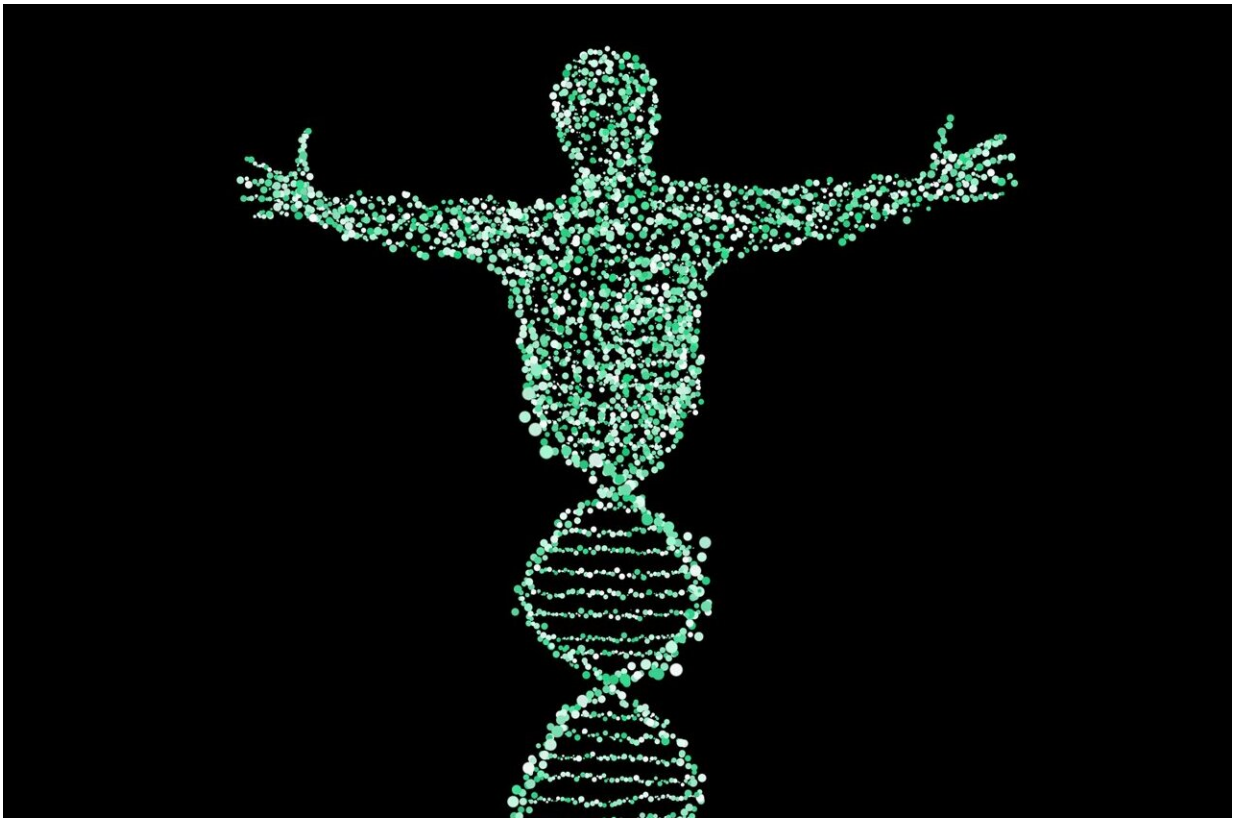

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When scientists discovered DNA and learned how to control it, not only science but society was revolutionized. Today, researchers and the medical industry routinely create artificial DNA structures for many purposes, including diagnosis and treatment of diseases.

Now an international research team reports the creation of a powerful supermolecule they describe as a marriage between DNA and peptides.

The work is published in *Nature Communications*. Authors are from University of Southern Denmark (Denmark), Kent State University (U.S.), Copenhagen University (Denmark), Oxford University (UK) and ATDBio (UK). Lead authors are Chenguang Lou, associate professor, University of Southern Denmark and Hanbin Mao, professor, Kent State University, U.S..

Next generation of nanotechnology

DNA is an important biomolecule, and so are peptides; peptide structures are used, among other things, to create artificial proteins and nanostructures.

"If you combine these two, as we have, you get a very powerful molecular tool, that may lead to the next generation of nanotechnology; it may allow us to make more advanced nanostructures, for example, for detecting diseases," says corresponding author Chenguang Lou, associate professor at Department of Physics, Chemistry and Pharmacy, University of Southern Denmark.

The cause of Alzheimer's

According to the researchers, this marriage of peptides to DNA can be used to create artificial protein that are more stable and thus more reliable to work with than natural proteins, which are vulnerable to heat, ultraviolet radiation and chemical reagents.

"Our next step will be to investigate whether it can be used to explain the cause of Alzheimer's disease, in which malfunctional peptides are

culprits," says corresponding author Hanbin Mao, professor at Chemistry and Biochemistry, Kent State University.

The research work reports the mechanical properties of a new structure composed of three-stranded DNA structures and three-stranded peptide structures. It may sound simple, but it is far from.

Left and right in nature

It is rare that DNA and peptide structures are chemically linked like this new structure. In nature, they often behave like cats and dogs, though some key interactions are essential to any living organisms. One possible reason for this is their so-called chirality, sometimes also described as "handedness."

All biological structures, from molecules to the human body, have a fixed chirality; think of the heart, which is positioned in the left side of our body. DNA is always right-handed and peptides are always left-handed, so trying to combine them is a highly challenging task.

Changing left to right

"Imagine you want to stack your two hands by matching each finger while both palms face the same direction. You will find out it is impossible to do it. You can only do this if you can trick your two hands into having the same chirality," says Hanbin Mao.

This is what the research team has done: tricked the chirality. They have changed the peptide chirality from left to right so it fits with the chirality of the DNA and works with it instead of repelling it.

"This is the first study to show that the chirality of DNA and peptide

structures can communicate and interact when their handedness is changed," says Chenguang Lou.

The researchers also provide an answer to why the biological world is chiral: "The answer is energy: The chiral world requires the lowest energy to maintain; therefore, it is most stable," says Hanbin Mao. In other words, nature will always seek to spend as little energy as possible.

More information: Chirality transmission in macromolecular domains, *Nature Communications* (2022). DOI: 10.1038/s41467-021-27708-4

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