Using DNA Origami to Build Nanodevices of the Future

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The Department of Defense allocates time and money to developing biosensors able to detect biological molecules because biological warfare and the spread of disease are concerning vulnerabilities for the military. One particular biosensor, created from DNA, has the capability of targeting drug delivery, detecting biological threats and producing antibodies.

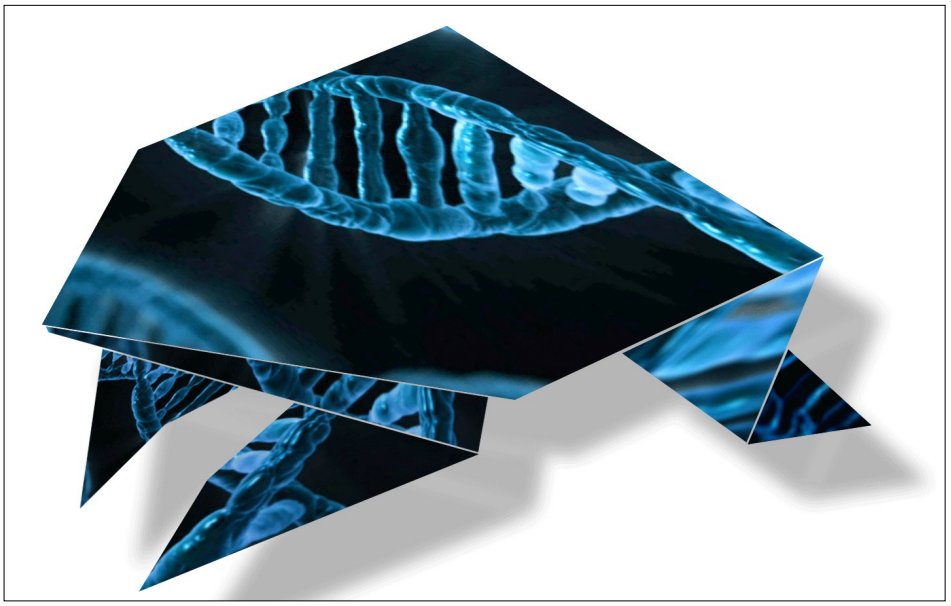
Researchers are using DNA to create self-assembling nanostructures. [1] Similar to how bricks shape buildings, DNA can be manipulated and configured into different shapes. The DNA is specifically coded to form an "origami nanostructure" which is then "folded" into specific 2-D and 3-D forms. [2] A software program then calculates the exact DNA sequence needed for each form. The DNA origami pieces are combined, heated and allowed to form together.

These DNA origami nanostructures create larger structures using a novel approach in which a lipid-bilayer helps the DNA fragments self-assemble. [1] DNA is inherently negatively charged due to the phosphate group that makes up the "backbone" of the DNA. [3] This allows the DNA origami structure to be absorbed into the lipid-bilayer through electrostatic interactions. [2] The structures move freely between the bilayer and are able to form into larger 3-D shapes.

These DNA origami structures can be manipulated to build a variety of nanodevices. One such device is a nanomotor. Nanomotors can be used for targeted drug delivery inside the body and can move on "tracks" created by the DNA origami structures to reach their destinations. [4] DNA origami structures, acting as antibodies, can be made into disease-detecting sensors, which has far reaching military implications. [5]

Dr. Dimitra Stratis-Cullum's program at the U.S. Army Research Laboratory in Adelphi, Md. develops biosensing. [6] Biosensing technology is not currently capable of widespread use outside of a laboratory setting, but Stratis-Cullum believes as technology continues to advance, biosensors can become a viable method to detect biological warfare on a large scale level. In the future, DNA origami could be used to produce antibodies. These antibodies, when integrated with portable devices, can detect diseases such as Ebola, smallpox and anthrax.

Biosensor technology for detection, prevention and treatment is an emerging technology that will not only benefit the warfighter, but also first responders and the general public. The ability to detect biological agents and disease at the cell level will provide preemptive support to medical communities, the DoD and homeland defense. The emergence of handheld devices supporting the effort for next-generation, point-of-care applications enables progress in biological weapons defense, treatment and response.



Researchers are using DNA origami to create self-assembling nanostructures that can be made into biosensors for finding disease and biological warfare agents.

References:

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