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Left-Handed DNA: The Right Way Forward

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Left-Handed DNA May be the Right Way Forward

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Rapid detection of emerging pathogens, environmental monitoring of waterways, and cancer treatments that operate on a cell by cell basis are all technological advances which could be achieved with DNA-based molecular computers. DNA encodes the building blocks of life and researchers have already shown that it can be used as a powerful tool for us to build nanoscale devices that can interact with the molecular world. However, DNA-based molecular devices are susceptible to degradation by natural defense mechanisms called nucleases. This makes operating in the desired biological settings challenging and has thus limited their practical application. My NSF-funded research in Dr. Matthew Lakin's laboratory overcomes this challenge through the use of mirror image “L-DNA” which has a double helix twisting to the left, as opposed to the right-handed twist of natural D-DNA. Since nucleases have evolved to recognize D-DNA, the L-DNA evades detection and thus, is not degraded. We have created a new interface between an L-DNA computing system and natural biology through chimeric DNA molecules. Like the mythological beasts made of different animals in one body, these DNA chimeras are single strands that contain sections of both L- and D-DNA which allow information to be translated from the natural D- molecular world into a robust, mirror L-molecular world where the information can be reliably processed or stored. This research is building a toolkit which scientists could use to detect a precise biological target, such as a specific viral strain or cellular marker, decide what action should be taken using L-DNA devices, and output a detectable signal or autonomously act to diagnose or treat disease within a cell.