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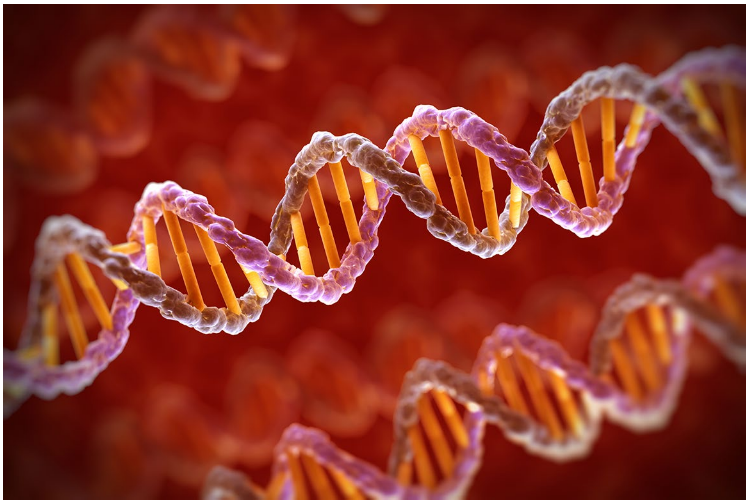

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BIOPHYSICS

DNA's crooked path

In the cell, DNA bends and stretches, making it possible to pack metre-scale DNA into micrometre-scale chromosomes. On long length scales, DNA is well understood as a polymer with a persistence length of around 50 nm, that is, DNA can be modelled as a chain of 50 nm flexible rods. However, on short length scales, this picture breaks down — for example, chromosome formation requires DNA to wind around histone octamers that have a radius of just 4 nm, much shorter than its persistence length. Now, writing in *Physical Review Letters*, Alberto Marín-González and co-workers report on simulations showing that the DNA sequence can be used to predict the short-scale flexibility of the molecule.

In sequences of a few base pairs, the base pair centres veer away from a straight line connecting one end of the sequence to the other, on a scale of a few nanometres. The deviation is sequence-dependent, and Marín-González and colleagues quantify it with a "crookedness parameter". They used molecular dynamics simulations to study how DNA sequences with 18 base pairs deform under small constant forces. The dominant contribution to the stretching stiffness of the DNA does not come from the cost of separating consecutive base pairs, but instead from the cost of reducing crookedness. Sequences that are less crooked have larger stretching stiffness.

The relationship between crookedness and the cost of straightening the DNA is fitted well by a phenomenological model. This makes it possible to predict the short-scale stretching stiffness of DNA from its equilibrium structure, which can be obtained using techniques such as nuclear magnetic resonance or crystallography. Intriguingly, the length scale of crookedness is comparable to the size of histone octamers, suggesting that DNA may take advantage of crookedness to conform to those structures. In addition, certain DNA sequences are known to resist wrapping around histone octamers; some of these sequences were found in the simulations to have low crookedness and correspondingly high stretching stiffness.

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ORIGINAL ARTICLE Marín-González, A. et al. DNA crookedness regulates DNA mechanical properties at short length scales. *Phys. Rev. Lett.* https://journals.aps.org/prl/accepted/3407eY5eF9f12268572c65406f0f994c378f8dfce (2018)