Departments of Physics and Biology
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DNA Bendability: The Role of DNA Mechanics in Biology

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Abstract: DNA is commonly thought of as the repository of genetic information. However, an equally important function of DNA is its role in controlling the access to that information. One way DNA sequence controls access to genetic information is through its affect on DNA bendability. DNA bending comes at a cost in free energy, and the chemical properties of the DNA sequence affect the bendability of DNA. Sharply bent DNA structures are present in diverse biological processes, yet we lack a detailed understanding of both the kinetics and thermodynamics of DNA bending. My current research explores how the chemical properties of DNA determine its physical properties. One aspect of this research investigates how quickly DNA can form sharply bent structures. Our results show that current polymer models of DNA underestimate how fast DNA can bend and how sensitive DNA bendability is to cation concentration. A second aspect of this work investigates how the chemical properties of DNA modulate DNA structure. Our results show that simple changes involving a few atoms can have large effects on the structure and mechanical properties of DNA. Together these data suggest that our understanding of the physical properties of DNA is far from complete.

Biography: Dan Grilley earned a B.A. in physics from St. Olaf College in 1998, and Ph.D. in Biophysics from Johns Hopkins University in 2005. During his graduate work he utilized experimental and theoretical techniques to investigate how electrostatic interactions influence RNA folding. His interests in nucleic acid physical chemistry lead him to an American Heart Association Postdoctoral Fellowship in Dr. Widom's lab at Northwestern University. His long-term goal is to integrate the structure and physical properties of both DNA and its complexes with their function in gene regulation, and ultimately use this understanding to predict gene regulation.