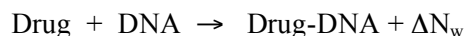
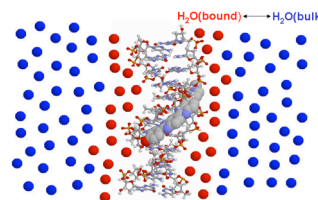


Dr. Jeff Petty Research Projects

Hydration Changes for DNA-Drug Interactions

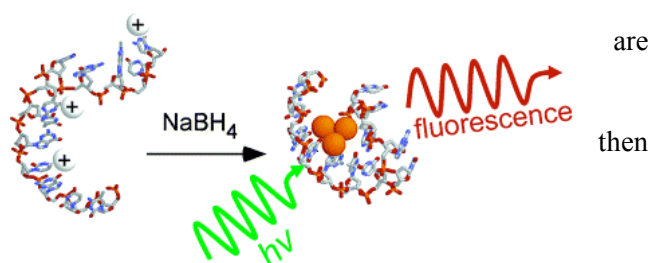
With the sequence of the human genome determined, efforts to rationally design a new generation of gene-specific drugs now have new impetus. We are considering the role of water in this recognition process. A description of the role of water begins with its recognition as a participant in the reaction:



where DNA represents the binding site for the drug, Drug-DNA is the complex, and ΔN_w is the number of water molecules exchanged with the solvent. Our previous studies have indicated a relationship between minor groove binding and hydration changes. We discovered the surprising result that the complex acquires water relative to the reactants. This summer, we are continuing these studies to identify how the structure of the drug and the sequence of the DNA influence the participation of water in the reaction. We are using fluorescence spectroscopy to measure how water influences the equilibrium constants for the reactions.

DNA-Based Nanomaterials

We are investigating how the structures of biological macromolecules can be used to form new materials of interest in nanotechnology. Control of the size, shape, and arrangement of nanoparticles is needed to utilize their optical, electronic, and catalytic properties. To accomplish this goal, we use DNA molecules to form small (1 – 10 atoms) metal nanoclusters of silver. DNA-bound silver ions are reduced to form metal atoms and the atoms coalesce to form the nanoclusters. This summer, we are investigating how the sequence of DNA influences the formation of the nanoclusters. We are using optical spectroscopies to characterize the nanoclusters.



DNA Structures and Neurological Diseases

To understand the genetic origin of diseases, a significant challenge is to understand how sequence dictates the types of DNA structures that form. For example, repeated base sequences comprise a significant proportion of the DNA of humans, and repeated trinucleotide sequences are the causative agents in a number of neurodegenerative diseases. These sequences favor the formation of intramolecular hairpins during replication and influence the length of progeny DNA strands. This summer, we will evaluate the energetics of trinucleotide repeat hairpins in cell-like environments. The available volume of a cell is significantly reduced due to large macromolecules such as proteins and nucleic acids, and this crowded environment has a profound effect on the rates and favorability of reactions such as folding. The thermal denaturation studies will be conducted using absorbance spectroscopy.

