Professor sheds light on DNA mechanisms

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By manipulating individual atoms in DNA and forming unique molecules, a Georgia State University researcher hopes to open new avenues in research towards better understanding the mechanisms of DNA replication and transcription, and perhaps leading to new treatments for diseases.

Chemistry and chemical biology professor Zhen Huang and his lab were able, for the first time, to manipulate methyl and phosphate groups of molecules in DNA that has been altered to contain selenium in order to bring them close enough together to form hydrogen bonds.

Such interactions may reduce the energy needed for a process called DNA duplex separation, thereby playing a role in the unwinding of DNA, which must happen in order for the genetic code to be copied and transcribed during cell replication and transcription. The research also helps to explain how energy is used in the process, Huang said.

“Assume that you want to do something, like to move an object from downstairs to upstairs, or building a pyramid where heavy blocks have to be transported,” Huang said. “You need lots of energy for these processes.

“If you need lots of energy, it will be a slow process or become inhibited because it consumes too much energy.”

With DNA in humans, the genome is comprised of about 3 billion base pairs, which are part of DNA's “ladder” in the double helix which forms

the code that causes certain genetic traits. If it takes a lot of energy to unwind DNA in order to duplicate, the process is slowed. On the other hand, if cellular dividing is too fast, DNA isn't copied properly with full length, which causes unhealthy cells to be formed.

New research directions may open from the study, which could also have practical implications, Huang said, such as better understanding how RNA, which is involved in protein synthesis, is transcribed and works.

If scientists know the shape and structure of DNA and RNA, scientists can design drugs to bind to the molecules in question — inhibiting the expression and progression of a disease, thus killing it off — whether it's cancer, HIV or any other viruses.

The research appears in the June 8, 2009 edition of Chemical & Engineering News and in the June 2009 edition of Organic Letters.

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