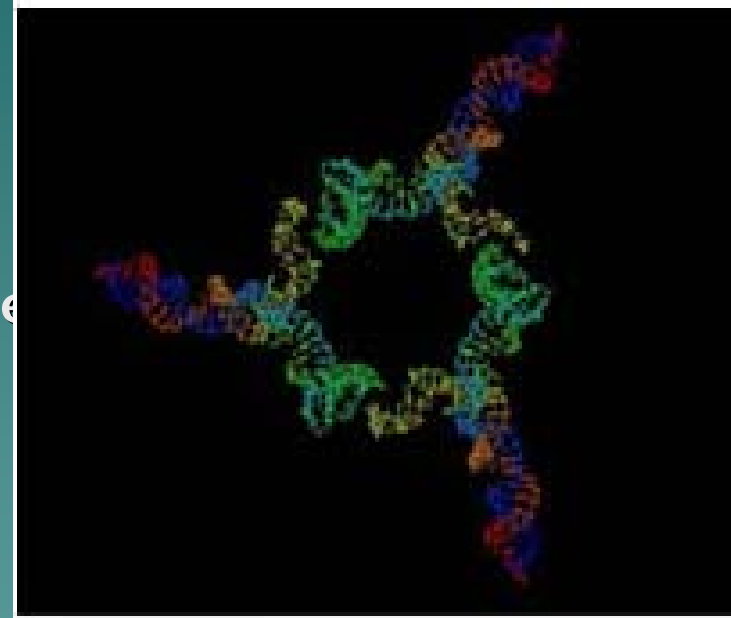


RNA Nanotechnology

Purdue study: RNA “motor” transports DNA

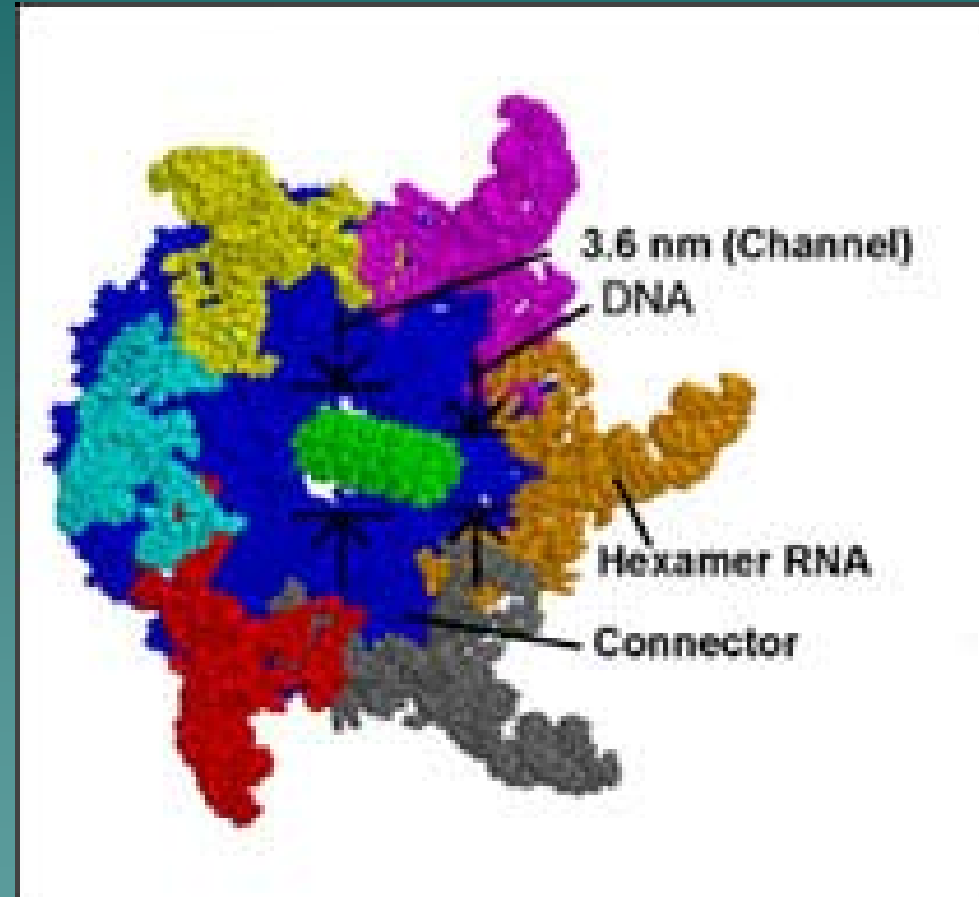
Purdue Scientists Treat Cancer with RNA Nanotechnology

- ◆ Purdue University's researchers developed some of their RNA-manipulation techniques in 2003 by building an [RNA nanomotor](#).
- ◆ The team sorted through a variety of RNA forms that have shown promise for disease treatment and found three that could perform each of the desired tasks.
- ◆ One example is "small interfering RNA," or siRNA, which deactivates certain genes in cells.
- ◆ The others are RNA aptamers, which bind to cancer cell surface markers, and
- ◆ ribozymes, which can be designed to degrade specific RNA in cancer cells or viruses.



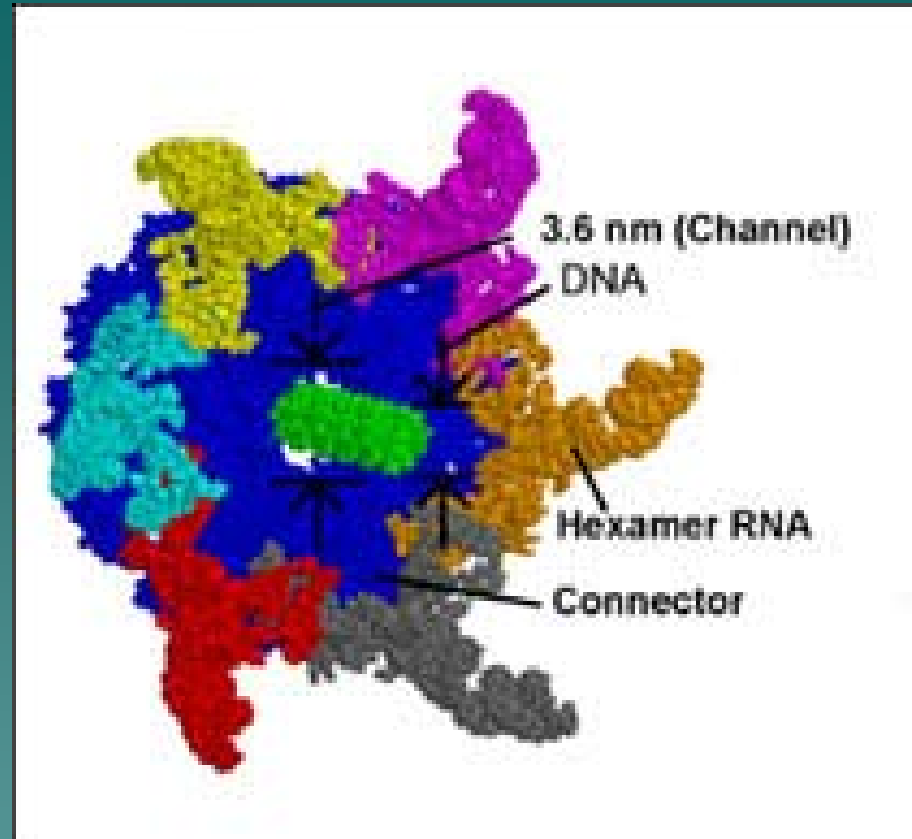
The nanoparticles have already proven effective against cancer growth in living mice as well as lab-grown human nasopharyngeal carcinoma and breast cancer cells. [Shu, D., Moll, W.-D., Deng, Z., Mao, C., and Guo, P. (2004). *Nano Lett.* 4:1717–1724]

- ◆ In 1987, Guo discovered this "transporting" RNA species and provided the first evidence that RNA played a role in packaging DNA in Phi 29. This new type of RNA was dubbed "pRNA" for "packaging" RNA.
- ◆ Subsequent reports by Guo and others have since established the presence and molecular structure of pRNA.



- ◆ Guo says that Bacteriophage Phi 29 is typical of double-stranded DNA viruses in that its genetic material is packaged into its protein shell, or capsid, during maturation.
- ◆ "All linear double-stranded DNA viruses, including herpes viruses, adenoviruses, pox viruses and the double-stranded DNA bacteriophages, package their genomic DNA into a pre-formed protein shell," he says. "What makes Phi 29 unique is that it is the first virus to be reported to use RNA as a component of the transportation machine to drive this process."

- ◆ Peixuan Guo, professor of molecular virology at Purdue University, has found that a virus known as Bacteriophage Phi 29 uses six RNAs strung together in the shape of a hexagon to create a motor that transports DNA in the virus.
- ◆ Guo's findings represent the first example of a hexagonal-shaped RNA complex. It is also the first example of transportation vehicles using RNA as building blocks.
- ◆ The motor measures about 25 nanometers long, which is less than one hundredth the size of a red blood cell. It is made from six strands of RNA surrounding a center strand of DNA. In the presence of ATP, the RNA strands push the DNA axle in succession, spinning it around.



This produces 50 to 60 piconewtons, or trillionths of a newton of force. A falling apple exerts about one newton of force.

The successful use of small RNA for therapeutic purposes requires a safe and efficient delivery system capable of targeting specific cells. These protein-free 25-nm nanoparticles will allow for repeated and longterm administration escaping immunoresponse and avoid the short retention time of smaller molecules and the undeliverability of larger molecules.

