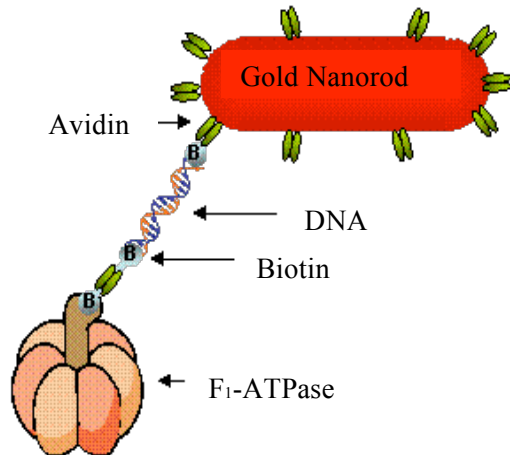


## Putting a New Spin on DNA for Health and Security Applications



**Putting A New Spin on DNA Detection:** Target DNA forms part of a molecular tether between a tiny, nano-motor (named F1-ATPase, bottom left) and microscopic gold material – the gold nanorod. When a single molecule of a specific target DNA is added, the whirling, nano-sized complex emits a pulsing red signal that can be detected.

A growing health care concern of recent years has been the emergence of microbes that are increasingly resistant to the traditional first-line of defense, antibiotics. Our society also faces the risk of newly evolved infectious diseases such as SARS, avian flu, or threats to national security from bioterrorism. In today's global economy and transportation sector, these threats can rapidly spread across borders and continents as the dangerous microbes hitch a ride with human activity and travel.

Now, to mitigate the threat from infectious pathogens, scientists at Arizona State University (ASU) are using the ultimate biological detective, DNA, to develop new devices that can rapidly detect the microbial threats to human health and national security. With a \$281,000 Innovation Investment Award from Science Foundation Arizona, lead scientist Dr. Wayne Frasch and his co-workers at ASU have laid the groundwork for nanotechnology-based biosensors that can sniff out even trace amounts of microbial DNA.

One such biosensor is a small, portable "lab on a chip." This device could thwart bioterrorism threats like anthrax and revolutionize health screenings for diseases caused by antibiotic resistant *Staphylococcus aureus*, and even be applied to identifying the DNA defects linked to cancer.

A tissue-box-sized prototype of a DNA detector is currently in development utilizing the biosensor device. It uses nanotechnology based on the world's tiniest rotary motor: a biological, spinning top-shaped engine called F1-ATPase. This molecule is one of nature's nano-sized molecular motors, acting like a rotary engine to generate torque and make ATP (Adenosine Triphosphate), the energy currency of every cell. The tiny, spinning F1-ATPase motor can detect minute amounts of DNA, even down to the level of single DNA molecules, far exceeding the detection limits of conventional DNA technology. Such a detection instrument would also be faster, cheaper and more portable than current technology.

The ASU team envisions that the device would be routinely used in health care clinics and to screen luggage passing through airport security checkpoints leading to substantial commercialization potential. Sampling would be as simple as taking a swab from an infected wound, or a piece of baggage, dissolving it into a solution and placing a drop on a slide containing the nanoparts to do the DNA detective work. Red blinking signals emitted by rotating nanorods would let a computer know there's trouble, literally, in a flash.

With support from Science Foundation Arizona, the team is transferring the work from the bench to biotech development by establishing a local company to manufacture the DNA detection device. The project has also attracted the interest of investors and enabled the ASU team to extend the technology platform to perform protein detection at the single molecule level, an important step in understanding human health and disease.



**No assembly required:** DNA samples collected from patients can be added to a microscope slide. On the slide, the nanoparts can rapidly self-assemble to detect the DNA of the patient. A portable microscope identifies the number of nanoparticles as various colored dots.