

# Novel Technology for Detecting Nucleic Acids (*Better tools through Better Chemistry of Materials*)

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## DNA detection

Understand DNA/DNA binding, kinetics *Make DNA detection robust, sensitive* Jonas Boateng, PhD (2012)

## Bioinformatics

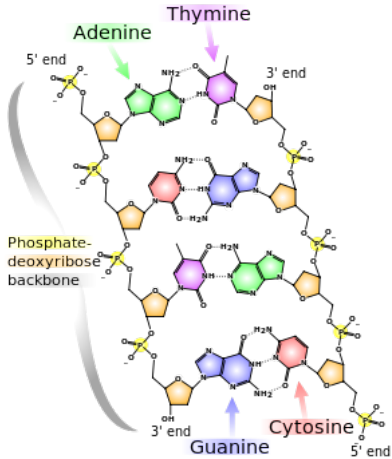
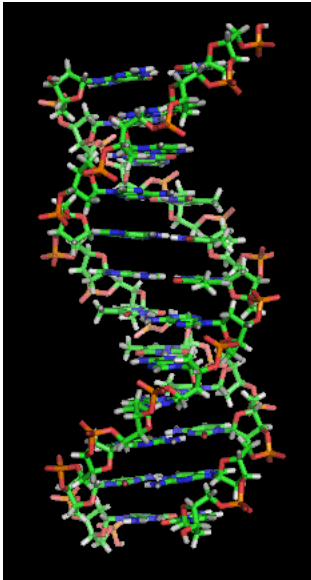
How can we improve database searches through better understanding of protein/DNA/RNA sequences (*on going project, David Cavanaugh*)

## Nucleic Acid Testing

**Principles** Source of infection (nucleic acid, genome) always present and is a necessary condition for pathologies due to infection

**Uniqueness** Unique sequences can be identified once the genome has been sequenced/known for the pathogens (viruses, bacteria, fungi)

**Detection Approach** Design complementary sequence to look for sequences *known* to be present in pathogens (bioinformatics, computer data mining)



## Nucleic Acid Testing

Difficult to detect, low concentrations, amplification needed (of targets or signal)

### Target Amplification

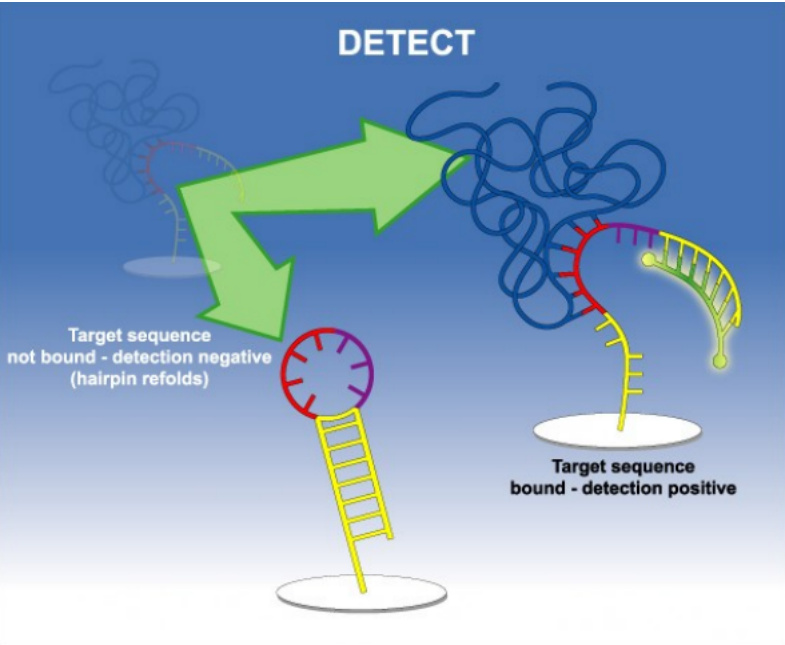
Polymerase Chain Reaction *molecular xeroxing, making multiple identical copies of nucleic acids not robust for clinical applications, lot of work being done*

### Signal Amplification

Gold nanoparticles, Surface Enhancement of fluorescence, vibrational spectra *good, early promise, nothing clinical yet*

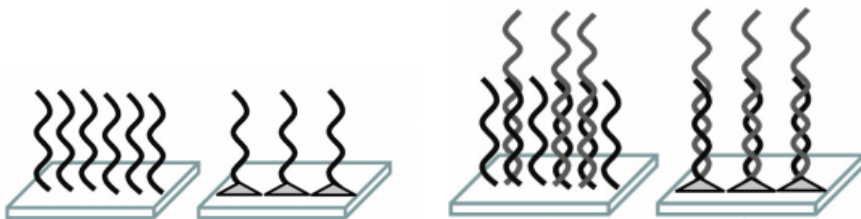
**So, we came up with an idea ...**

# DETECT

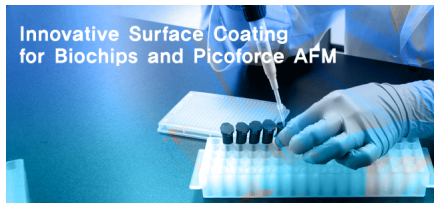


Target sequence  
not bound - detection negative  
(hairpin refolds)

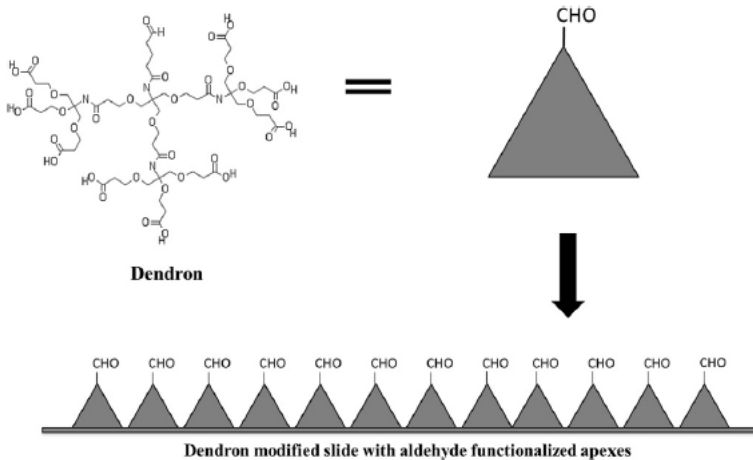
Target sequence  
bound - detection positive

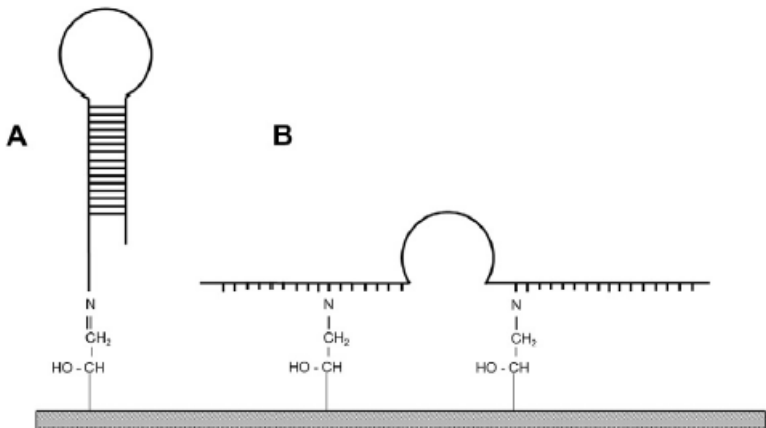


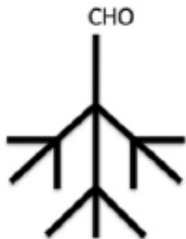
Effect on Surface Chemical Spacing on DNA/DNA binding Biosensors and Bioelectronics, 2011, vol 26, pp 2566-2573



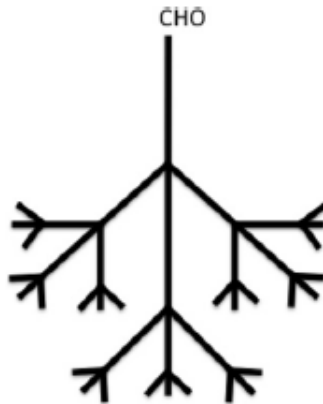




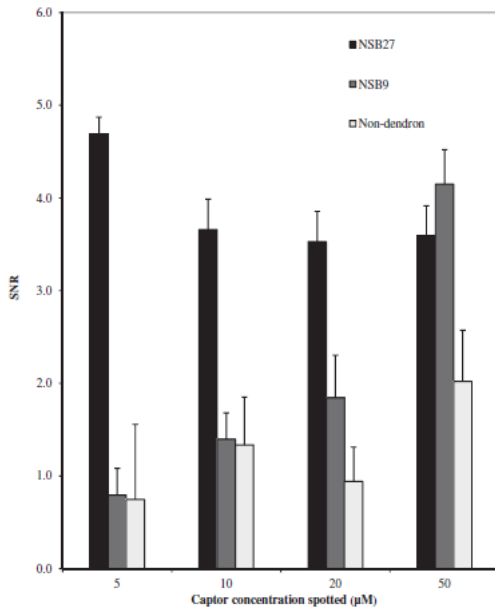


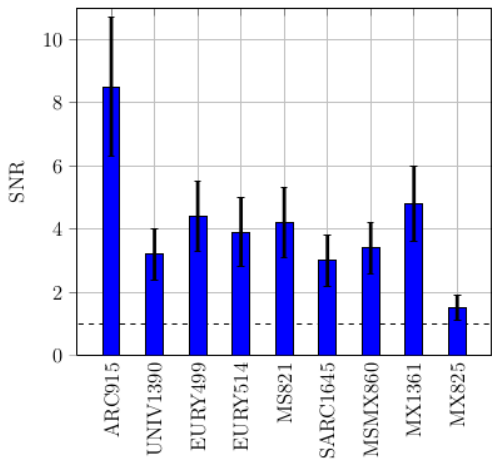


**4nm – NSB9 Dendron**



**7nm – NSB27 Dendron**





## Engineered Surfaces

Spacing of functional groups allows for control of steric hindrance, allows for the lowering of detection limits

## Structure and Function

Designing DNA probes that have specific sequences and structure allows for detecting multiple targets in complex solutions, including for medical diagnostics

THANK  
YOU



Jonas Boateng (MWS Operon), Joel Peek (Microarrays Inc./HudsonAlpha), Robert Zahorchak (HudsonAlpha) (Jeffrey Dowell, Marc Pusey, Joseph Ng)