Living cells and creatures are characterized by their ability to respond dynamically and in complex ways to physical and chemical stimuli. To fabricate systems and devices that exhibit similar stimulus-induced behavior, it is necessary to build and integrate reliable nanoscale sensors, processors, and actuators. Structural DNA nanotechnology has shown that DNA self-assembly allows spatial addressability and resolution at a scale not achievable by conventional top-down patterning, and can easily interface with other nanoscale materials. Now, dynamic DNA nanotechnology affords precise temporal and logical control over binding, self-assembly, and reconfiguration events. Consequently, nucleic acids have become leading nanoscale materials.

In this presentation, I will talk about our steady progress in building nucleic acid sensors, processors, and actuators towards the goal of a synthetic chemotactic nucleic acid device. Along the way, we have also worked on integrating our results with other technologies for applications such as improved PCR specificity, reduced bleaching in super-resolution optical microscopy, and quorum-gated drug release.