

## Programmable cell-free circuitry with genelets

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SYNTHETIC biochemical circuits both provide an opportunity for embedding control logic within chemical systems for technological applications and provide a platform for probing our understanding of general principles for biochemical circuits. We have developed a general approach to the construction of in vitro biochemical circuits based on the transcription and degradation of RNA molecules. Consisting of just DNA templates (“genelets”) and two essential enzymes, arbitrary circuits can be systematically constructed, displaying a rich variety of dynamical and computational behavior. We have experimentally demonstrated individual transcriptional switches, two distinct bistable networks, and several oscillating circuits. In doing so, we have encountered a number of unexpected difficulties – deviations from ideal circuit behavior – that help frame the critical question of how to design and analyze biochemical systems.