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GENETICS

Synthetic biology: applications come of age

Ahmad S. Khalil and James J. Collins

Synthetic biology is bringing together engineers and biologists to design and build novel biomolecular components, networks and pathways and to use these constructs to rewire and reprogram organisms. These re-engineered organisms will change our lives over the coming years, leading to cheaper drugs, 'green' means to fuel our cars and targeted therapies for attacking 'superbugs' and diseases such as cancer. The *de novo* engineering of genetic circuits, biological modules and synthetic pathways is beginning to address these crucial problems and is being used in related practical applications¹.





Synthetic signal processing

Protein scaffolds, which serve as natural signal processing hubs, can be purposefully engineered to tune the output response of cells to environmental or internal signals. In the example shown, a synthetic protein scaffold was used to physically recruit positive and negative modulators of a MAP kinase pathway to enable new and desired circuit responses (for example, accelerated, delayed or ultrasensitive responses)⁸.

Biosensing

Cells have evolved a myriad of regulatory circuits — from transcriptional to post-translational — for sensing and responding to diverse environmental signals. Synthetic biology aims to re-engineer these circuits and circuit components to bring about novel sensory functions and to process the upstream signals in predictive ways for mobilizing appropriate cellular responses.



Synthetic sensing

cellular optical sensors. Harnessing and re-engineering cyanobacterial- and plant-derived photoreceptive domains has unlocked a variety of light-sensitive applications, including Escherichia coli-based image-edge detection⁶ (left) and optical control of mammalian cell processes⁷ (right). In the latter example, the optical control of cell motility was demonstrated by focusing red light on a small portion of the cell (circle). As a result, protein domains that modify induce the local extrusion of lamellipodia in live cells.



Pharmaceutical

biology strategies.

assays using synthetic

drug production

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Gene RNAi target

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