SYNTHETIC BIOLOGY: Reprogramming cells!

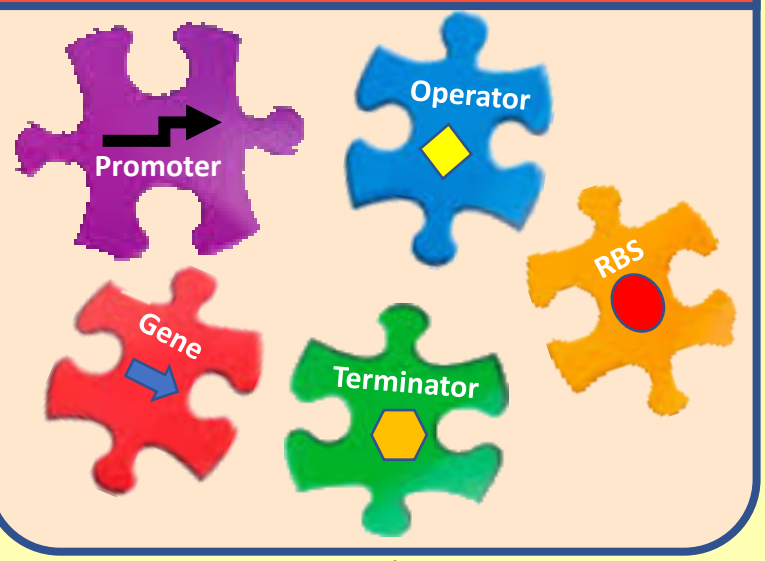
Roshni Shetty, 4th Year, Biological Engineering, Dual Degree, IIT MADRAS

ABSTRACT

Synthetic biology has transformed research initiatives inspired by electronics and software design. Today, we are able to read, edit and write genes and can design new functionalities in living organisms. The goal is to modularize, devise standardized BioBricks such as coding sequences, promoters, ribosomal binding sites and terminators to design, assemble pathways and engineer biological circuits to achieve a predictable output behaviour with a defined input. Successful amplified bio-sensing, timed genetic circuits, oscillators and switches have been designed. However, with the usage of this powerful tool, biosafety is the utmost concern and the consequences of engineering should be clearly predicted. The potential and promise of synthetic biology lies in understanding the comprehensive processes by reflecting on the complexity and specificity!

Are living cells programmable?

Biological circuits can be divded into distinct functional units, called modules.



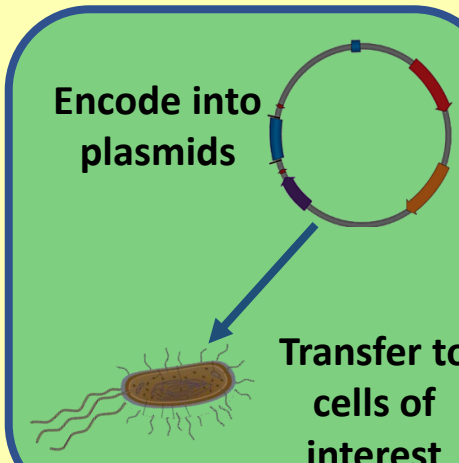
Assemble the parts to design functional circuits!

SYNTHETIC BIOLOGY: Reprogramming cells!

Paving our future and solving challenges!

- Understand biological processes through their reconstruction.
- Facilitate construction of new biological functionalities.
- Synthetic biology the next IT destination! with enormous potential and impact on
- **Healthcare:** Vaccines, pharmaceuticals, gene & cell therapy, diagnostics.
- **Agriculture:** Disease resistance, molecular diagnostics , animal feedstock
- **Environment:** Biosensors, bioremediation, waste treatment
- **Industry:** Biofuels, chemicals, bioenergy, materials

Encode into plasmids



Will it always work? How robust is our system?

"The whole is greater than the sum of its parts."

- The inherent complexity of biological systems, a huge challenge.
- **Rertroactivity**- impedance effects arise on interconnection of components.
- Molecular cross-talk & feedback signals exist.
- What may work in one biological system may not work in another system!
- **BIOSAFETY** is the utmost concern!

REFERENCES: 1. Church GM, Elowitz MB, Smolke CD, Voigt CA, Weiss R. Realizing the potential of synthetic biology. Nat Rev Mol Cell Biol. 2014;15(4):289-294, **2.** Endy, D. Foundations for engineering biology. Nature 438, 449–453 (2005), **3.** Esvelt KM, Wang HH. Genome-scale engineering for systems and synthetic biology. Mol Syst Biol. 2013;9:641., **4.** Purnick, P., Weiss, R. The second wave of synthetic biology: from modules to systems. Nat Rev Mol Cell Biol 10, 410–422 (2009).