Introduction

Examples of controversial art abound: Andy Warhol's soup cans, Mark Rothko's panels of color….even Monet's impressionist sunrise, a painting that can now be counted among the most highly valued in the world. When they appeared, these works were met with skepticism and passionate criticism. Over time they have proven to be meaningful expressions that inspire and inform other artistic efforts.

"Image removed due to copyright reasons."

Andy Warhol's Campbell's Soup Can

"Image removed due to copyright reasons."

Mark Rothko's panels of color

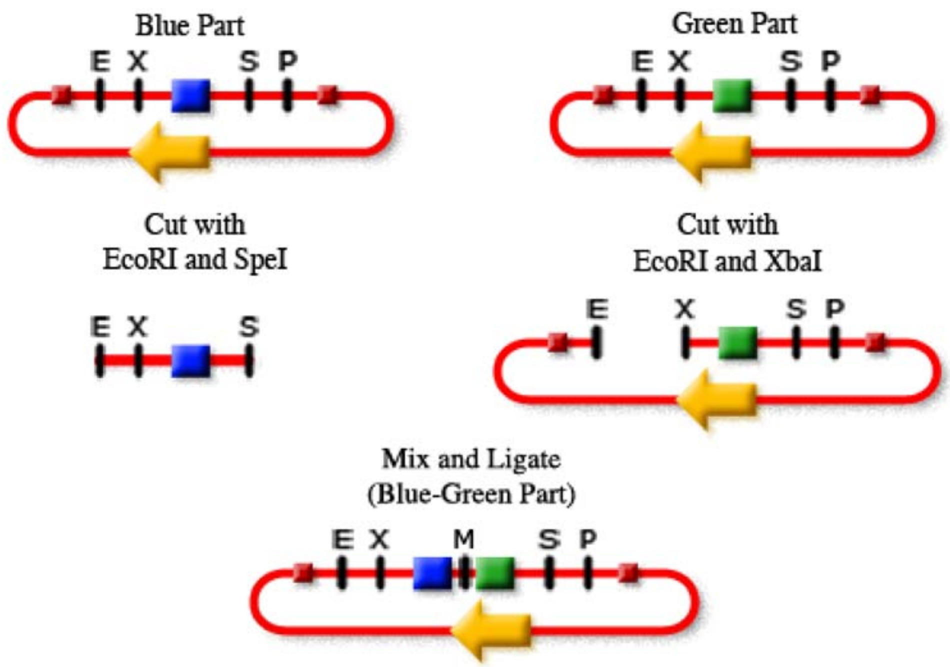
"Image removed due to copyright reasons."

Elowitz and Leibler, Nature, 2000

Discovery science is driven by a desire to understand, describe and sometimes improve the living world. Research is celebrated if it reveals some fundamental truth, if it connects facts in surprising ways, or if it harnesses the machinery of living organisms to meet a generally agreed upon goal. A particular set of discoveries may inspire and inform future work, and it's essential that any reported data be reproducible by others. However, scientific advances are not evaluated on their artistic merit; arguably they could be. Like art, there is no requirement that science be performed in standard ways or with established protocols, beyond what is enforced as ethical and safe practices. Each scientist brings their own touches and experiences to their work doing even commonplace experiments in their own fashion. In this way, art and science are similarly personal endeavors, doing what it takes to meet an immediate end and not prioritizing the means.

There is a cost to this approach. In general, considerable efforts underlie scientific discoveries. The "repressilator" plasmid shown above took years to design, build and test by one of the world's foremost biophysicists. Still more effort would be required to modify it significantly in the service of new questions. Science, when pursued as an artistic effort, constrains and slows others who might want to capitalize and build on a given system. Perhaps some uniformity would make each person's work more generally useful, but how can biology be "standardized" given the diversity of the living world and the range of approaches to understanding it?

Standardizing DNA manipulations might be a good place to start. If everyone would invariably include or exclude particular sequence features and use only DNA fragments with standard junctions (i.e. restriction enzyme recognition sites), then fragments could be mixed and matched as easily as LEGOs™. Plasmid construction with standardized DNA parts could be quick and reliable, giving DNA builders more time and more variations to try. The Registry of Standard Biological Parts has developed one way to try this (there are many other ways possible), standardizing the flanking sequences of every part in their Registry and developing method for assembling parts that facilitates building with DNA. [1]



Standard assembly of BioBricks

Knight, T., Idempotent Vector Design for Standard Assembly of Biobricks. Unpublished, MIT 2001.

The details of the standard assembly will be addressed during today's lab, when you will plan the assembly steps for the protein generator that you designed and specified last time. Standard DNA assembly is just one example of a helpful foundational technology for engineering biological systems. Other standards that we'll consider during this experimental module include standards for operating conditions, characterization of parts and rules for composition. With these goals in mind, you'll begin characterizing the bacterial photography system, measuring its output (beta-galactosidase) under standard operating conditions and then testing the "biofilm's" resolution by taking a picture.