1

Molecular Biology

To understand Synthetic Biology, first we must understand the molecular processes that are essential to all life.

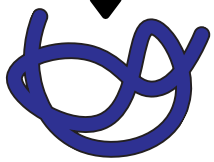
DNA
holds all the information about how an organism will look and function.

Transcription: copying information from DNA to RNA

RNA
passes this information along to later make proteins

Translation: transformation of RNA into protein by **Ribosomes** (Protein Factories)

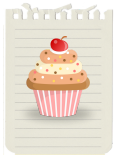
Protein
are the building blocks of life



Think of it like this:

DNA is the recipe book

RNA is the order to the kitchen



Protein is the food

2

Parts

DNA stores information and important sequences control these processes. These **parts** of DNA with special functions are represented below:

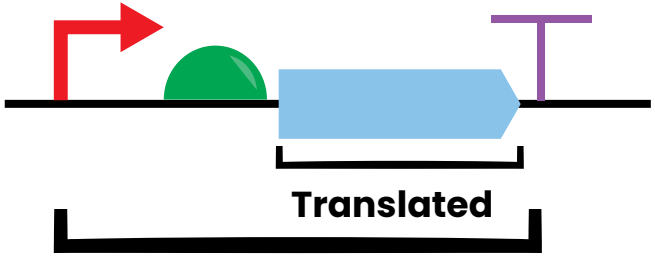
Gene: A DNA sequence with instructions to make a protein

Promoter: A DNA sequence in front of the gene that **starts transcription**

Terminator: A sequence after a gene that **stops transcription**

Ribosome Binding Site: A sequence that **starts RNA translation**

These parts work together like batteries and switches in electrical circuits...

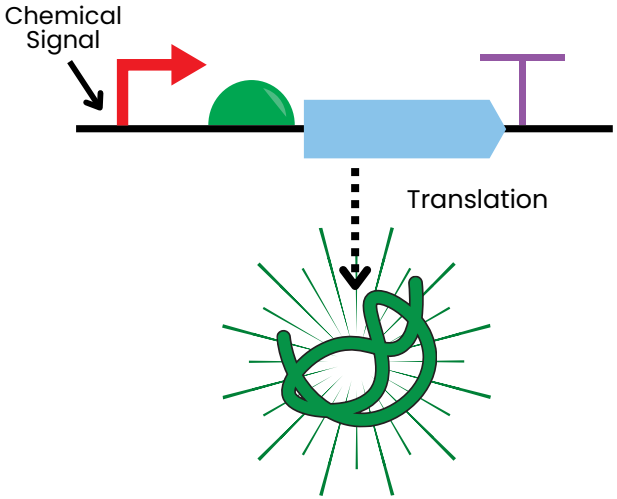


...switching genes on and off like lightbulbs!

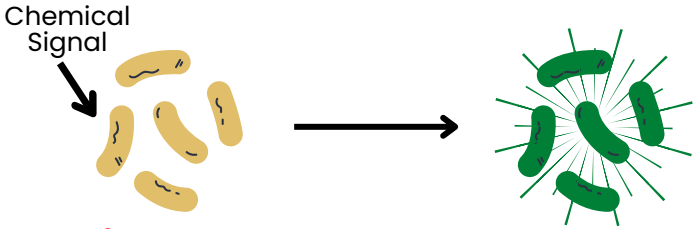
3

Synthetic Biology

In Synthetic Biology we rearrange these parts to give organisms new functions. For example, we can make a **biosensor** by modifying bacteria to detect a certain chemical.



Here, the **promoter** starts **transcription** in the presence of a specific chemical.
The gene is then **translated** into a protein that emits light:

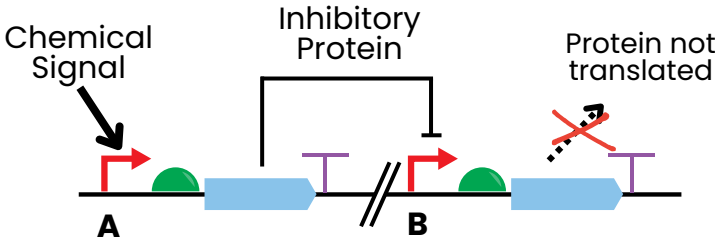


We can then use the bacteria to investigate harmful compounds in water and soil.

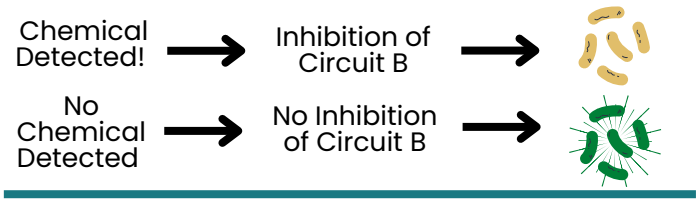
Genetic Circuits

Like a computer processing complex inputs, if we arrange these **genetic circuits** correctly, we can get our organism to respond differently to its environment.

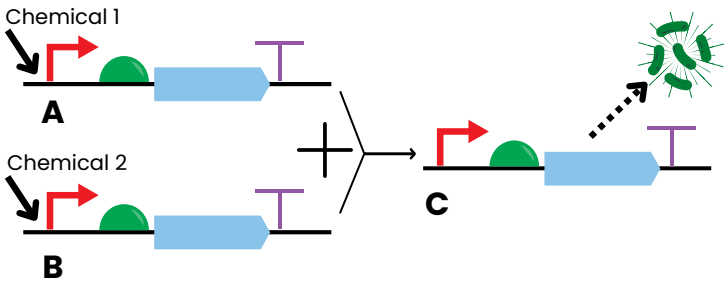
Instead of glowing when it detects a harmful chemical, what if we wanted our bacteria to detect the **absence** of an important chemical?



We can link two circuits together! Follow the logic below:



What if chemical 1 was only harmful in the presence of chemical 2? How could we make our bacteria glow only when both are present?

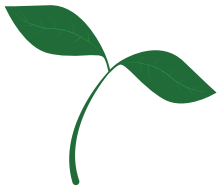


We can feed inputs from two circuits into a third! But in real Synthetic Biology, there are many answers.

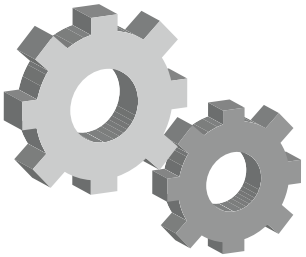
The World is Yours

These circuits can be mixed and matched with incredible results and endless applications!
Some include:

Diagnostics: Making biosensors to detect diseases in humans and plants earlier and cheaper than current tests.



Environment: Engineering plants to absorb toxic material from soil to clean up e.g. industrial spills.



Manufacturing: Engineering microorganisms to efficiently produce medication, detergents, biofuels and even plastics!

Building on decades of genetic research and new technologies, Synthetic Biology has the potential to change the world.

What will **you** build?

UNIVERSITY OF BATH

iGEM

Synthetic Biology

A Technical Guide