Synthetic Biology

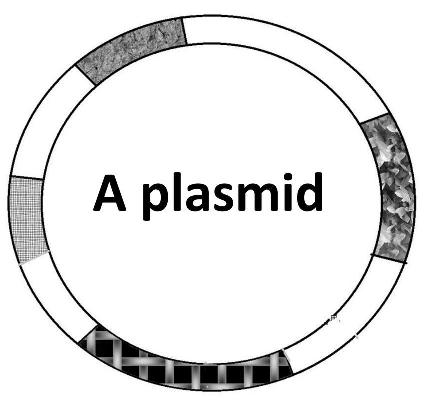
And what we can do with it

So what is Synthetic Biology?

Synthetic biology involves using biology to solve the worlds' problems.

We take useful genes from one organism and insert them into another where their effect can be controlled and optimised to our needs. This doesn't have to be a single gene; we can stick several genes together in order to construct a system which may not necessarily exist in the natural world.

The most common organism we use is E. coli but there is no need to worry! The E. coli we use are of a special strain that can't make you sick, and won't even survive outside a controlled environment for very long.



Bacterial DNA is not quite like our DNA . They have a jumbled circle of DNA, and also have smaller structures called plasmids which can contain other useful genes.

There's already a lot of synthetic biology processes being used. Some examples include:

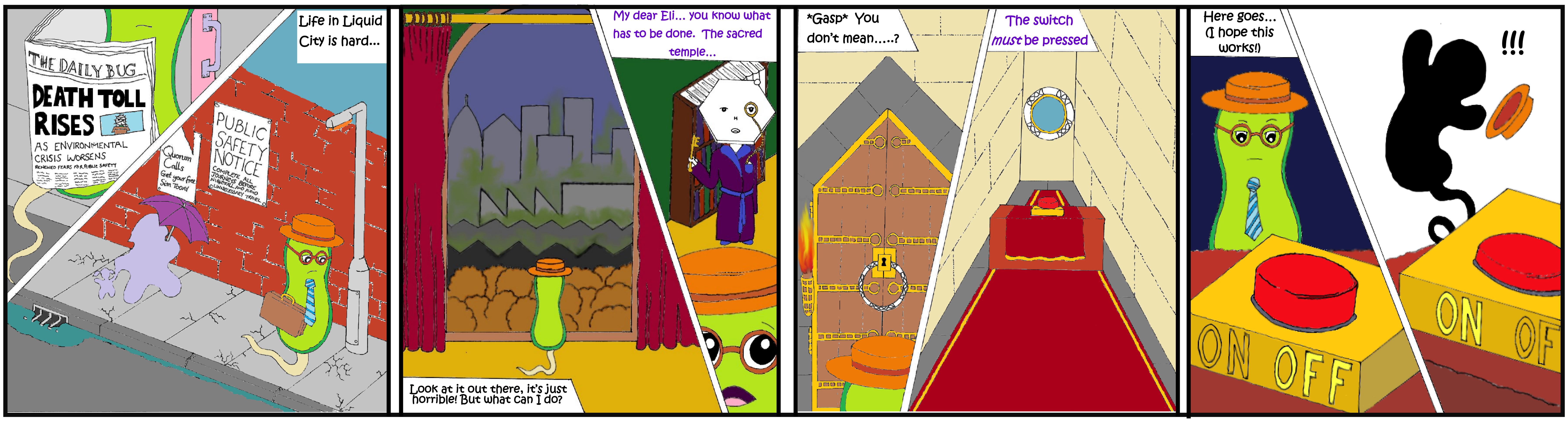
- Insulin production for diabetics –both more efficient and more humane—since the bacteria are producing it, we don't have to take it from other animals.
- Bacteria have been developed that, when supplied with electricity, will covert CO_2 from the air into acetone. Acetone is then easily converted to petrol for global consumption.
- Scientists have developed a synthetic construction from rat heart cells that swims like a jellyfish.

iGEM

We are the Glasgow University iGEM team – but what is iGEM?

Here are some facts:

- It stands for International Genetically Engineered Machine, an organisation dedicated to furthering our advancements in synthetic biology.
- It began in Boston, at the Massachusetts Institute of Technology in 2003, with the first competition taking place in 2004.
- The first competition had just 5 American teams—last year, there were 245 teams from all over the world competing to make the best new synthetic biology system.
- Past projects include arsenic biosensors, toxin removal systems, antihypertensive agents and even a bacterial Minesweeper game!
- The teams are judged on a number of aspects as well as the biology, such as: consideration of ethical implications, public interaction, poster and presentation, the team Wiki page and math modelling and measurement of the system's behaviour.
- iGEM requires these systems to be built from BioBricks - genetic building blocks containing a useful gene(s) that can be placed side by side to create a complete system. There is a huge online registry of these parts that anyone can access.
- iGEM also runs a high school competition - there has never been a Scottish team before, so if you're a high school student or teacher and you think you might be interested, let us know and we can give you some useful contacts!
- This is the 10th anniversary of iGEM, and there are no regional finals. Everyone goes to Boston for a Giant jamboree! We are very proud to be representing Glasgow on a world-wide stage, and we'll do our best to bring home some prizes!



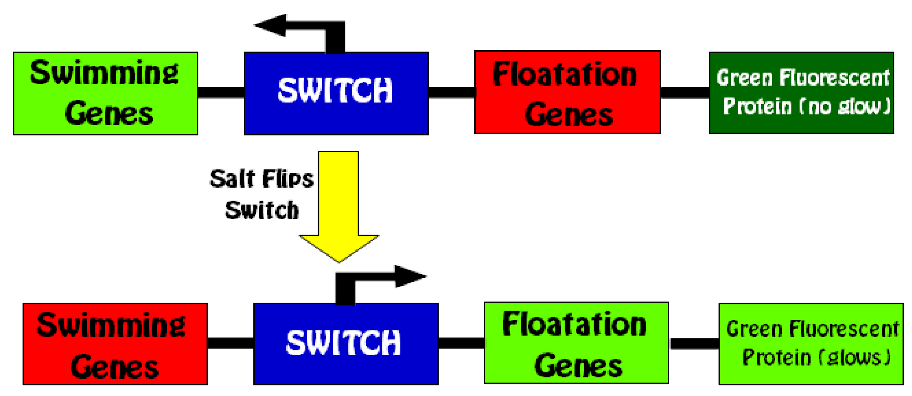
Lack of fresh water for drinking, industry and agriculture is a growing problem in some countries. Water must be obtained through desalination—an expensive and energy intensive process that removes salt from sea or brackish water.

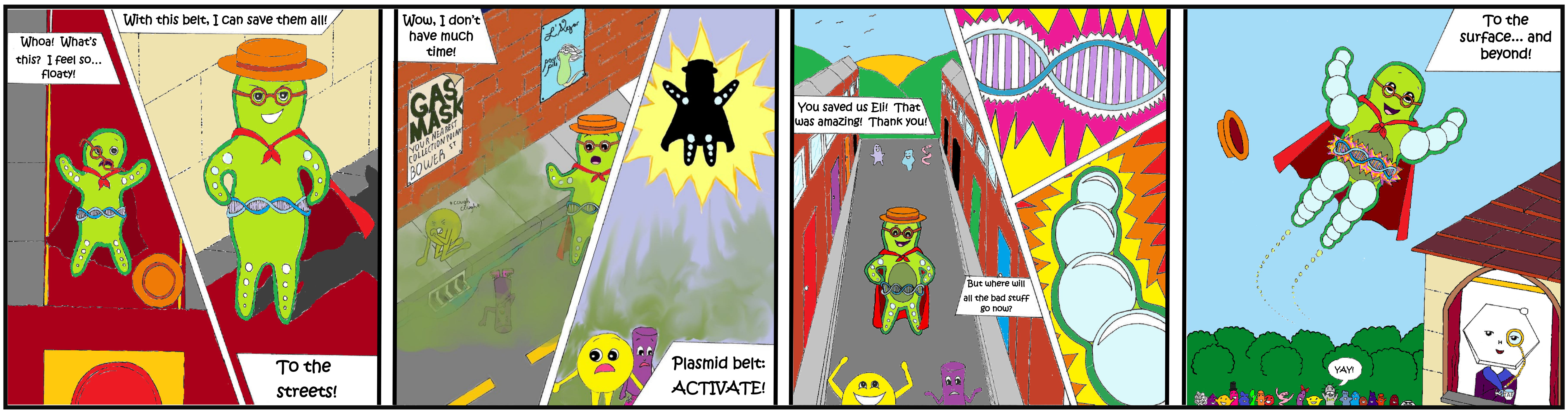
Thermal approaches involve evaporating salt water and then condensing it as purified freshwater, whereas membrane approaches involve forcing the water through various membranes in order to remove the salt.

It would cost an average sized desalination plant £1500-£3100 to fill an Olympic sized pool ($2500m^3$) through thermal methods, or £750 to £2575 using membrane technology.

We propose that bacteria remove the salt. It is our hope that our process will be far less energy Intensive –and thus less expensive.

After collecting enough salt, the *E. coli* would float to the surface for easy collection. But our *E. coli* don't normally have the genes required to float—so we have to supply them on a plasmid ring. The genes will be controlled by a genetic switch, which flips one section of DNA over to activate another piece.





Though the trigger for the genetic switch will be salt, we will use a sugar called arabinose to test the system.

The genes we have added will cause the bacteria to float by producing gas vesicles.

These are hollow structures composed of proteins, more specifically 2 proteins, called GvpA and GvpC. They fill with gas (such as hydrogen, oxygen or carbon dioxide), and act as floatation devices to carry the cell to the surface.

Bacteria often use this system in aquatic environments in order to get nutrients and light from nearer the surface. Because only the bacteria carrying salt will float to the surface, we can easily remove them, and the salt too!

References

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