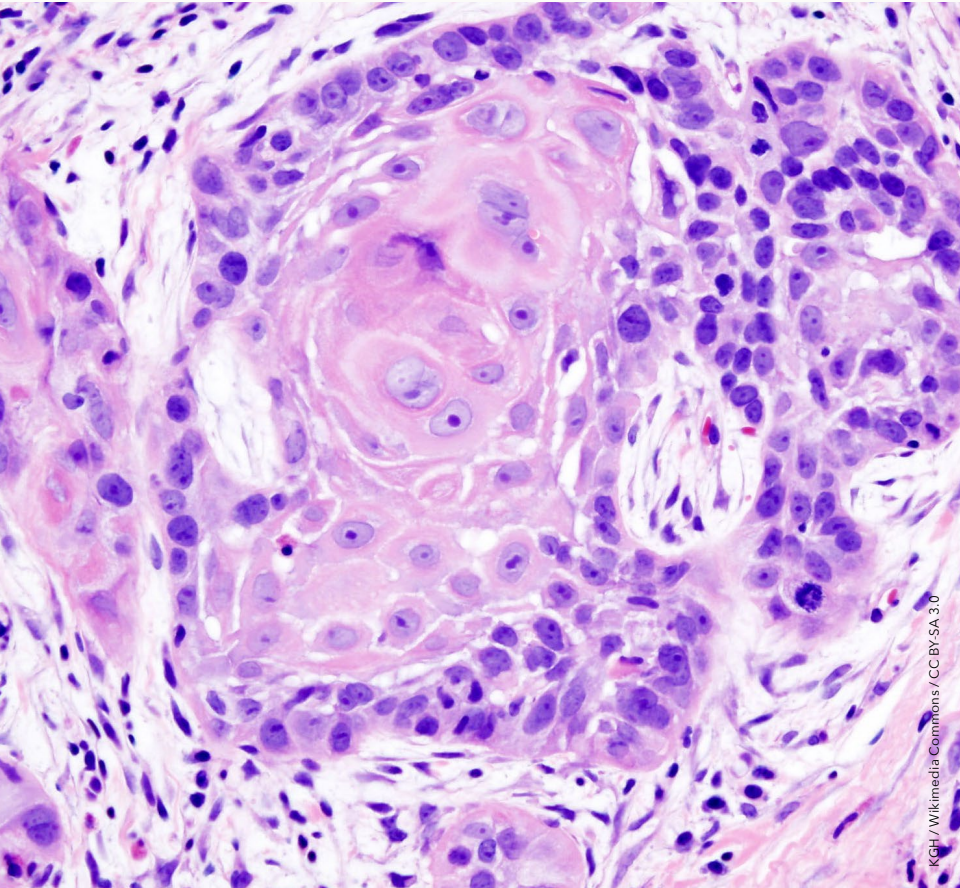


Can you design a biological cell to...

# Treat cancer?



Can you design a biological cell to...

# Treat cancer?

## What's the challenge?

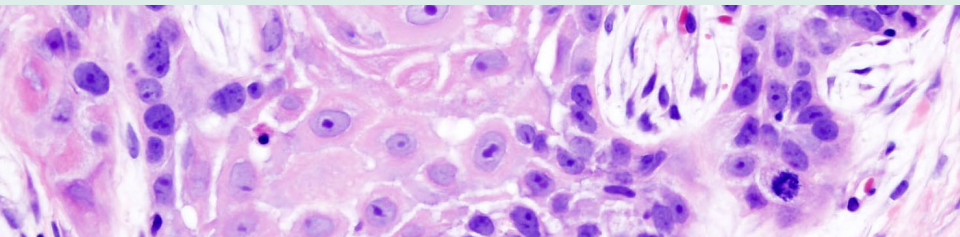
Existing cancer treatments such as chemotherapy and radiation damage healthy cells as well as cancer cells. More targeted approaches could reduce side effects.

## Possible synthetic biology solution:

Design a cell to **move** around, **sense** cancer cells, and **communicate** back and forth with other engineered cells to cause the cancer cells to **self-destruct**.

### WHAT'S HAPPENING IN REAL LIFE?

Scientists are working on developing engineered cells that detect and destroy some kinds of cancer. Like tiny *biocomputers*, they use logic to recognize cancer cells and force them to self-destruct, leaving healthy cells alone. Scientists are working to develop this system further so that some day it can be tested in animals.



Can you design a biological cell to...

# Produce a drug to treat malaria?



Can you design a biological cell to...

## Produce a drug to treat malaria?

### What's the challenge?

Malaria is a disease that affects over 200 million people every year, mostly children. Drug therapies that use *artemisinin* are highly effective, but this chemical comes from a plant and is difficult to produce.

### Possible synthetic biology solution:

Design a cell that can **produce** an antimalarial drug, will **start and stop** production as needed, and includes a safety **control**.

### WHAT'S HAPPENING IN REAL LIFE?

Scientists have engineered yeast to produce *artemisinic acid*, the key ingredient for making antimalarial medications. In 2014, a pharmaceutical company derived artemisinin-based medications produced by yeast.



*Can you design a biological cell to...*

# **Make renewable plastic?**





*Can you design a biological cell to...*

# Make renewable plastic?

## What's the challenge?

Acrylic is a family of plastic materials used to make many things, including paint, adhesives, and detergents. Currently, acrylic is made from petroleum, using a production process that consumes lots of energy.

## Possible synthetic biology solution:

Design a cell that can **produce** a synthetic acrylic plastic, can **start and stop** production as needed, and includes a safety **control**.

### WHAT'S HAPPENING IN REAL LIFE?

Scientists have engineered a strain of yeast to make sugar into *acrylic acid*. Companies are trying to scale up this process, making biosynthetic plastic commercially available. If bio-based acrylic were widely used, it could reduce the amount of energy and oil used to produce plastics.



Can you design a biological cell to...

# Locate environmental toxins?



*Can you design a biological cell to...*

# Locate environmental toxins?

## **What's the challenge?**

Toxic chemicals in the environment are dangerous for humans, plants, and animals. These toxins are often difficult to find and remove.

## **Possible synthetic biology solution:**

Design a cell with a **sensor** that can detect toxins in the environment, will **produce** a signal when it's working, and includes a safety **control**.

## **WHAT'S HAPPENING IN REAL LIFE?**

Scientists are engineering bacteria to help find environmental pollution. Some researchers are working on whole-cell biosensors that send out a glowing signal in the presence of toxins such as arsenic and mercury.





Can you design a biological cell to...

# Make synthetic blood?



*Can you design a biological cell to...*

# Make synthetic blood?

## What's the challenge?

Hospitals around the world are often in short supply of blood that can be used in patients during surgery or after a trauma. In addition, the blood banks that supply hospitals have difficulty getting donations of rare blood types.

## Possible synthetic biology solution:

Design a cell that can **produce** a blood substitute, will **start and stop** production as needed, and includes a safety **control**.

### WHAT'S HAPPENING IN REAL LIFE?

Researchers are trying to produce a safe and effective blood alternative. This artificial blood could be given to any patient in need, regardless of blood type. Patients needing surgery or those suffering from injury, bleeding, or disease would benefit from having a guaranteed supply of blood on hand for transfusion.

