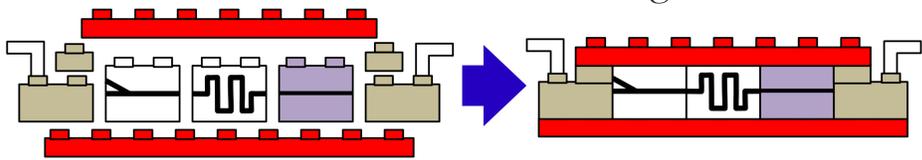


## The concept: brick by brick

(1) A microfluidic system with many interchangeable 'brick' pieces allows it to be assembled and changed easily. Its function is determined by the bricks that are chosen and the way they are arranged.



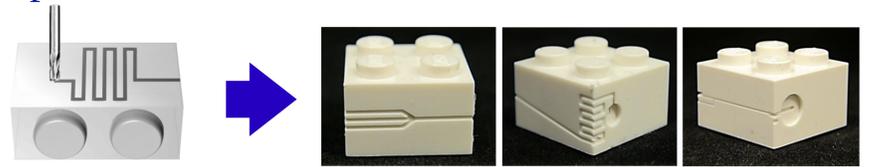
Lego® Bricks



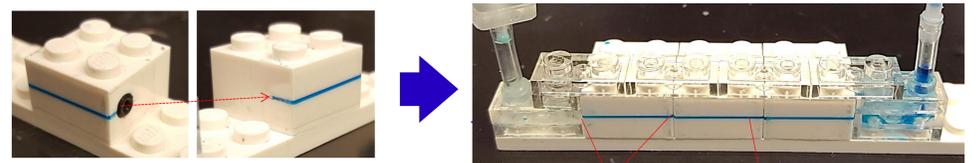
Modified 'bricks' snap together to make a modular microfluidic system.

## How the bricks work

Off-the-shelf Lego bricks were modified to direct the flow of fluid. An O-ring seals between bricks when they are placed down.



A cutting tool removes material from a brick surface. Here are bricks for flow focusing, mixing, and joining two fluids.



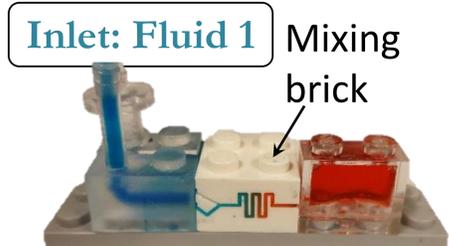
Inlet O-ring Fluid Outlet

Small O-rings are compressed to reversibly seal between bricks, forming a closed system.

## Designing a fluid mixing system

(2) Students build their own system to mix fluids, and observe what happens when they choose different bricks for a variable "?" position.

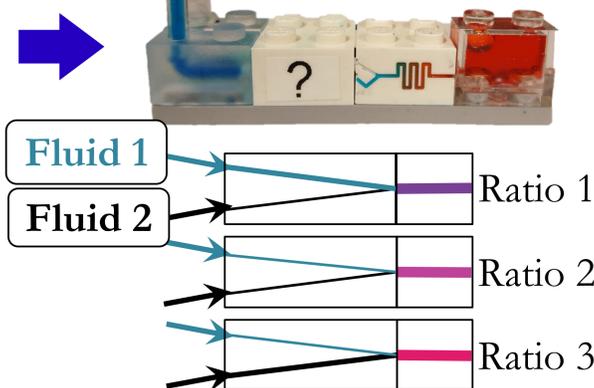
(3) Different choices of bricks will change the geometry of the fluid path, and with a single pressure source this results in a different mixing ratio of two fluids and a different end colour that reveals the pH of the final solution.



Inlet: Fluid 1 Mixing brick  
Inlet: Fluid 2 Product

Fluid 1: water with a pH indicator (cabbage juice)

Fluid 2: Lemon juice, a source of citric acid



pH color scale, indicated by cabbage juice concentrate:

Lemon juice 2 3 4 5 6 7 Water

## Why do we do this? Connection to research.

- Fluids can be combined in a specific ratio to make a certain product.
- For example, we can use this method to add a treatment chemical to water at the right level to make it safe to drink.

## How?

- Students get into groups and build a microfluidic network with different bricks.
- Students change the system by swapping bricks, and this makes different reaction products. What colours can they make? How do the bricks influence the final colour?

## Learning goals

Every microfluidic system begins with a design. This activity introduces students to the general process of designing a microfluidic system and the concept of microfluidic functions, and allows them to build and test ideas in a playful setting.