A TECHNOLOGY TO HELP DEVELOPING COUNTRIES: CAPILLARY-DRIVEN MICROFLUIDICS FOR STAND ALONE POINT-OF-CARE (POC) DEVICES

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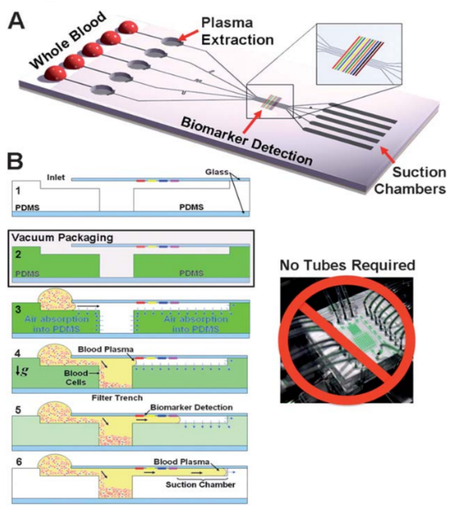
We can create flow in microfluidic channels without the need of auxiliary pumps and bulky laboratory equipment. The capillary action will trigger a flow and drive the liquid in a controlled, predictable manner. Such capillary action occurs because of adhesive forces, acting on the boundary between solid and liquid, but also because of the surface tension of the liquid. You can experiment with the flows in porous materials, such as paper, and in hydrophilic micro channels.

CAPILLARY-DRIVEN FLOW AND PAPER

- Lateral flow in paper is at the pivot of point-of-care diagnostic devices, which are extremely important for testing outside of laboratories.
- Controlling the flow through porous materials, such as paper provides control over contact times and gradient formation.
- Pumps and auxiliary equipment can be prohibitively expensive and become a limiting factor for environments with limited resources.

Image from a field laboratory (New York Times, Sep. 12, 2011).



Self-priming, self-contained, tether-free SIMBAS device (University of California, Berkeley)

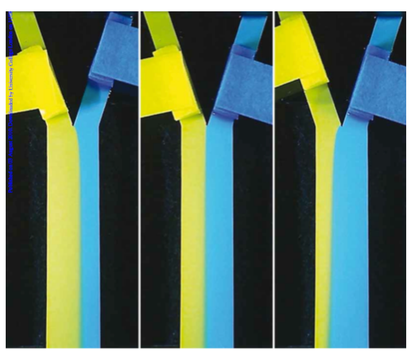
TUNING THE SURFACE PROPERTIES WITH PLASMA

Corona is a visible electrical discharge which occurs when high voltage, high frequency electrical potential is applied to a small diameter electrode in a relatively close proximity to an electrical ground. The resulting electrical discharge is known as "Corona Discharge." This corona discharge will cause partial ionization of the surrounding atmosphere and can be used for surface modification. (*from DYNE Technology*)

EXPERIMENT 1: PAPER MICROFLUIDICS

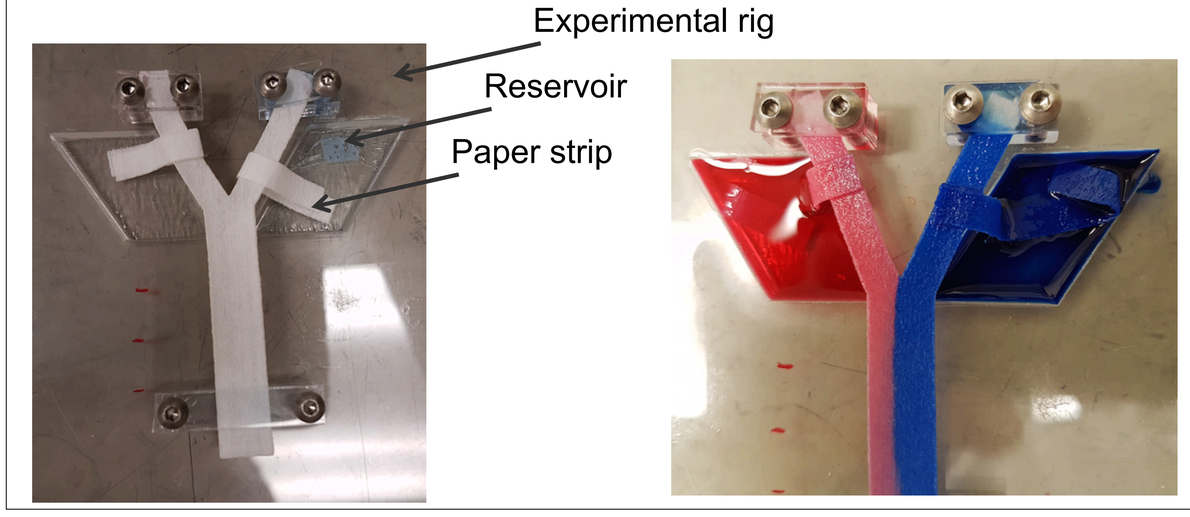
Lateral fluid flow in a Y-shaped paper strip is controlled by varying the contact points which is useful for building gradients and defining contact times.

JOIN US AND GIVE IT A TRY!



Osborn et al., *Lab Chip*, 2010, **10**, 2659-65

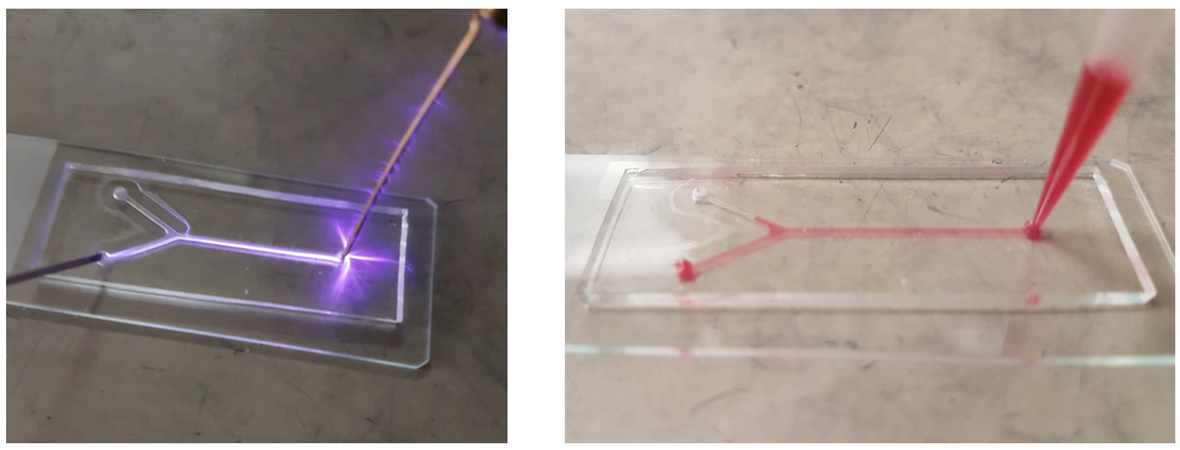
- Work in teams.
- Fill both reservoirs of the experimental rig with water and water with dye.
- Soak the two short strips of paper into the reservoirs with liquid.
- Slide the short paper strips up or down the Y-junction to move the water-dye interface in the middle.



EXPERIMENT 2: PLASMA GUN CHANNEL TREATMENT

Oxygen plasma creates active radicals from the molecules in the Air which render the polymer surface hydrophilic.

A closed Y-shaped channel is made in resin (PDMS) which is naturally hydrophobic as it has a large (>60°) contact angle with water. You get to render the surface hydrophilic using a plasma gun and test the flow in the channel.



- To direct the corona discharge a metal wire is placed into an inlet.
- The plasma gun is placed at the outlet of the channel.
- Next, the plasma gun is switched on and the channel is treated for 1 minute.
- A pipette tip full of liquid is carefully placed at the inlet.
- If the treatment was successful you should see the liquid streaming though the treated part of the channel only.

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