

# TUMOUR-ON-CHIP: CHEMOSENSITIVITY OUTREACH EXPERIMENT

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## THE ACTIVITY

**Biopsies** punched from mini gelatine organs are placed into an oversized **microfluidic device** and supplied with a 'nutrients and drug' mixture. A **colour change** in the biopsy jelly is said to mimic a response of the tumour to chemotherapy (**chemosensitivity**) while no colour change indicates resistance to the drug.

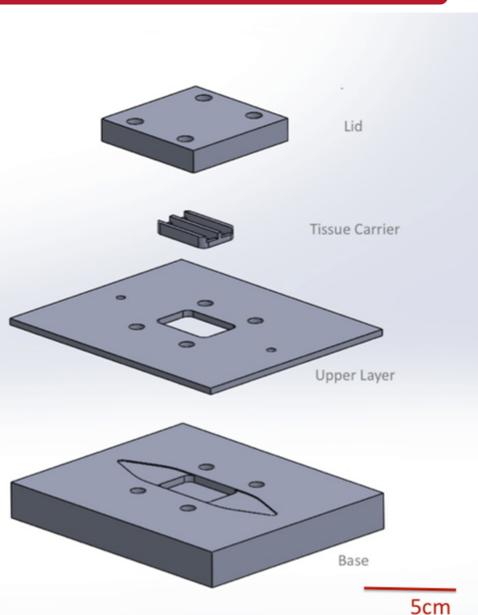


## AIM

To make biomedical microfluidics accessible to school children and the general public by:

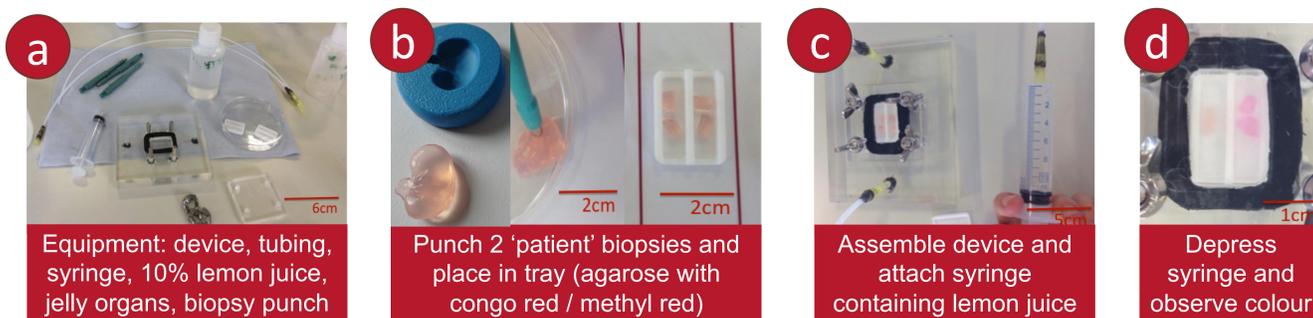
- producing a safe, interactive experiment to explain tumour-on-chip research;
- highlighting the long term applications of the technology.

## THE DEVICE



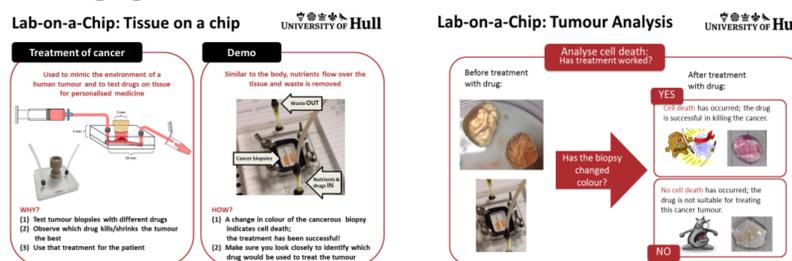
**Fig. 1:** Diagram of the oversized chip device featuring three layers of PMMA layers and a tissue carrier tray made from PTFE. The device is readily assembled and disassembled with a set of four screws and nuts.

## HOW IT WORKS



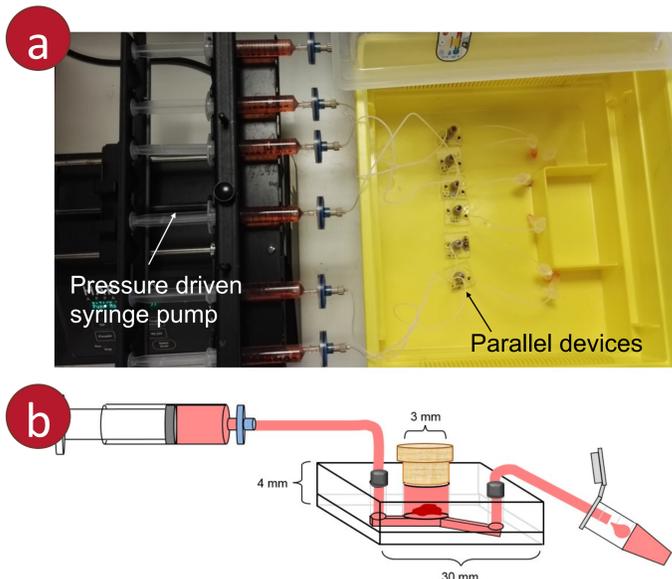
**Fig. 2:** (a) Photograph of utilised equipment. Lemon juice is diluted to 10% with tap water. (b) 2% agarose gel was produced using 1:20 dilutions of indicators (Congo red / Methyl red) in water. Mini-organ moulds are commercially available (Ebay, 7608jacqueline). (c) Tubing was attached to the device and the syringe using pipette tips and epoxy glue. (d) Colour change is observed in the methyl red agarose gel (bright pink) upon flushing with 'drug' solution.

## Additional resources for activity to increase understanding and engagement:



**Fig. 3:** Life size gelatine heart and brain. (Ebay, funtimesfancydress)

## RESEARCH BASIS



**Figure 4:** (a) Photograph of parallel microfluidic tumour-on-chip devices, showing syringes in pressure driven pump. (b) Schematic of a single microfluidic chip maintained at 37°C with constant media influx and simultaneous removal of waste products. Chemotherapeutic drugs (alone or in combination) can be added to the syringe.

The University of Hull has been developing tissue-on-chip technology for several years; maintaining **patient biopsies** facilitates study of the response of the **tumour microenvironment** as a whole. This **ex vivo platform** affords benefits over other methodologies which may only study the response of a single cell type. A further benefit is **reduction in the use of animals** in studies, by directly using human tissue. One of our key research focuses is on **Head and Neck cancers** which see a low overall 5 year survival rate of 40-50% largely due to local recurrence; which is due in part to **treatment resistance**. The maintenance of tumour tissue on chip allows testing of optimal therapies and the monitoring of the tumour response to the therapeutic assault. This technology could provide information on treatments to which patient tumours are most sensitive, moving towards personalised medicine.

**ITAS2016** See Poster T050b (Ruth Bower) and T046b (Charlotte Dyer)

## KEY REFERENCES

- Esfahani MMN, *et al.* Lab-on-a-chip workshop activities for secondary school students. *Biomicrofluidics*. **2016**;10(1):011301.
- Carr SD, *et al.* Analysis of Radiation-Induced Cell Death in Head and Neck Squamous Cell Carcinoma and Rat Liver Maintained in Microfluidic Devices. *Otolaryngology-Head and Neck Surgery*. **2014**;150(1):73-80.
- Sylvester D, *et al.* Development of Microfluidic-based Analytical Methodology for Studying the Effects of Chemotherapy Agents on Cancer Tissue. *Current Analytical Chemistry*. **2013**;9(1):2-8.
- Hattersley SM, *et al.* A Microfluidic System for Testing the Responses of Head and Neck Squamous Cell Carcinoma Tissue Biopsies to Treatment with Chemotherapy Drugs. *Annals of Biomedical Engineering*. **2012**;40(6):1277-88.