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Scaling Up Bioimaging with Microfluidic Chips Workshop 2025 - Session 1

Asst. Prof. Dr. Tobias Wenzel
twitter: @MakerTobey @WenzelLab

Outline

- LIBRE hub
- Open Source Hardware and the Wenzel Lab
- Our microfluidics resources potentially relevant to you
- The scope of this remote workshop

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Latin American Hub for Bioimaging through Open Hardware (LIBRE hub)

Chan Zuckerberg Initiative

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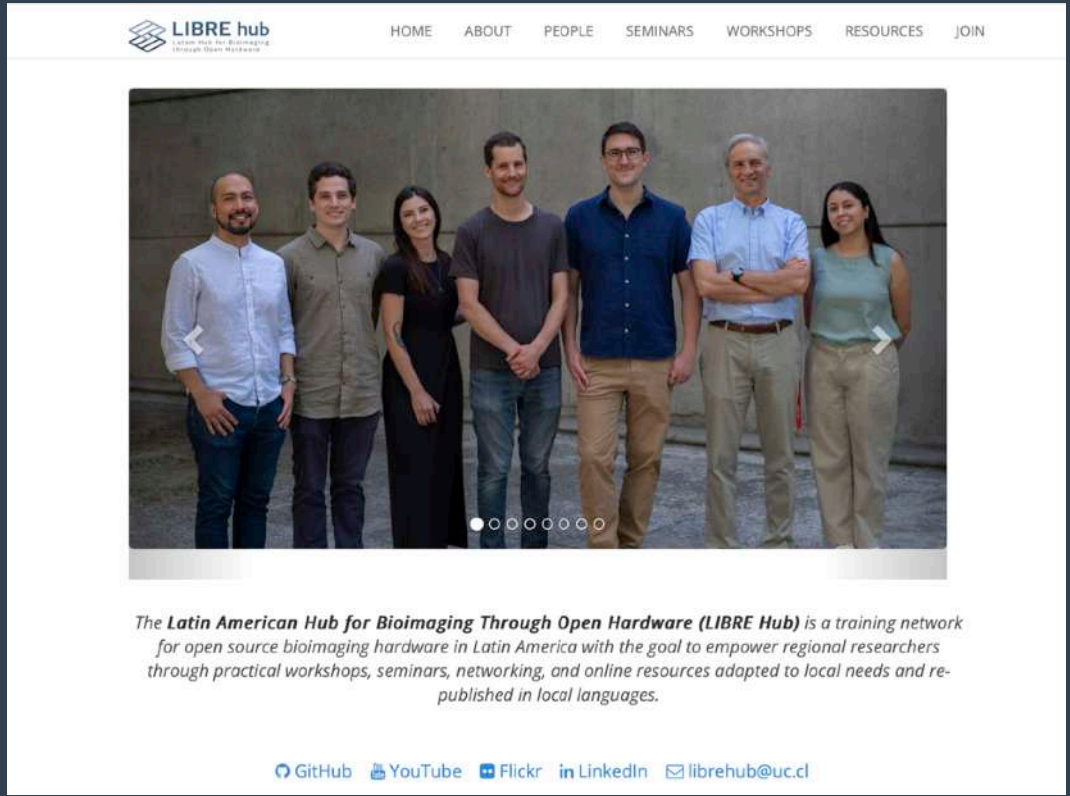
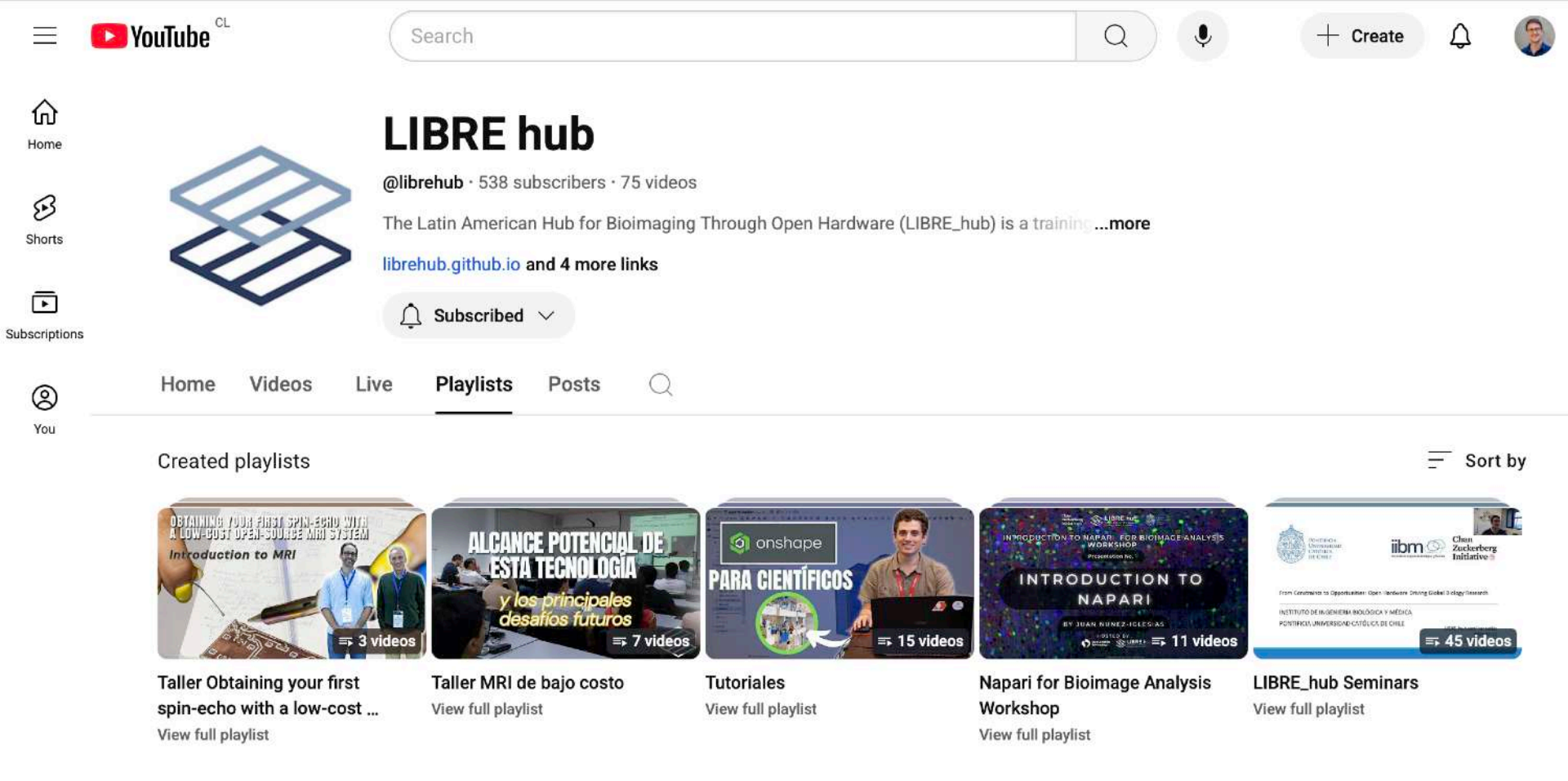
- Tobias Wenzel #OpenHardware
- Pablo Irarrázaval #openMRI
- Vicente Parot #compMicroscopy

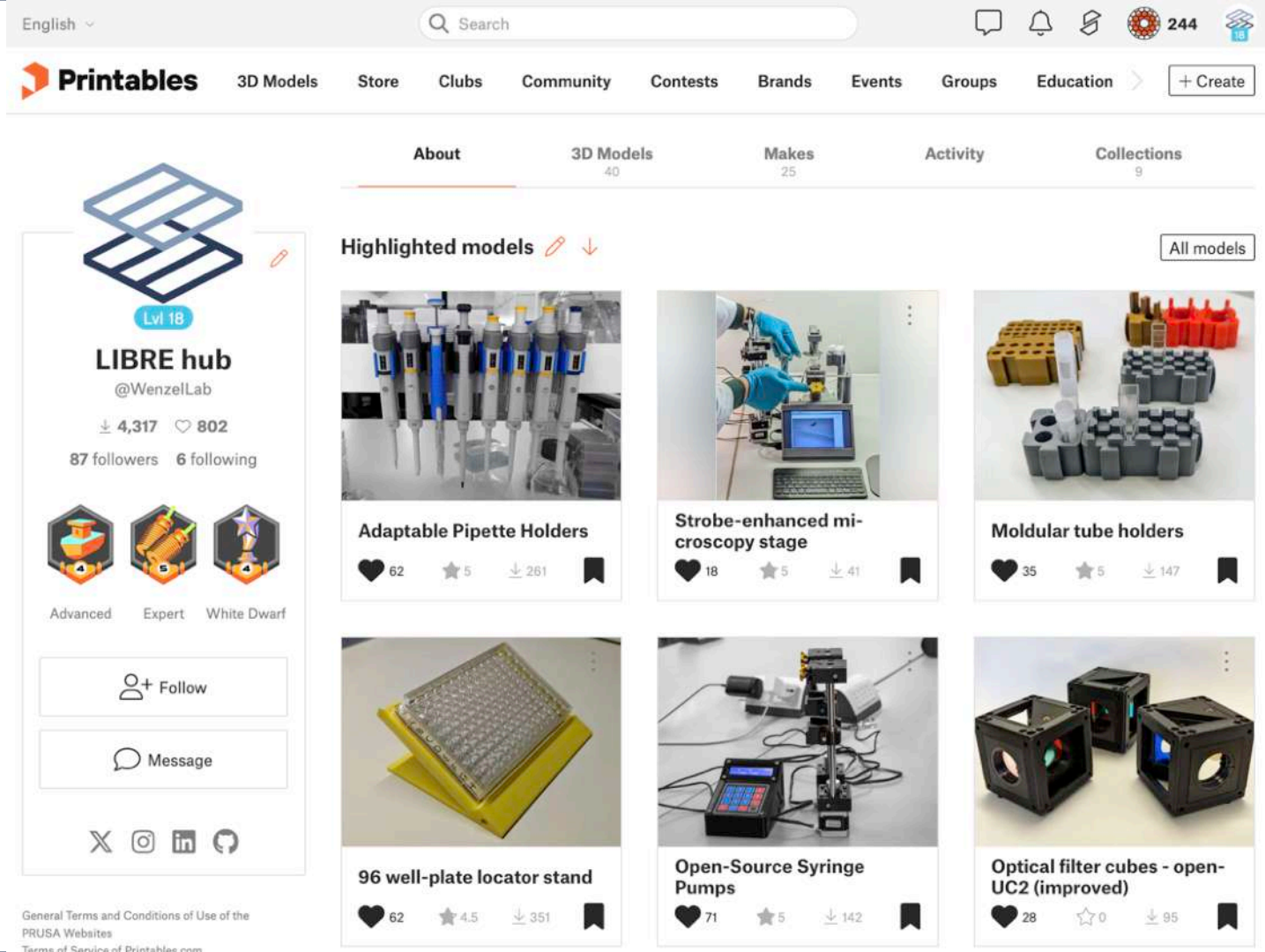


Dec.2021-Nov2025

Building a LatAm science maker community



We can help you share your designs!



LIBRE hub

Initiative to further Open Source Hardware based Bioimaging in Latin America - CZI funded; check also: https://github.com/wenzel-lab

Unfollow

26 followers · Chile · https://librehub.github.io · company/librehub · @librehub · https://chanzuckerberg.com/imagin... · @WenzelLab

librehub@uc.cl

Popular repositories

napari-LatAm-workshop-2023 — Public

Napari training material for a workshop by the CZI funded initiatives LIBRE hub, Napari, and several amazing volunteers

Shell · ☆ 10 · 6

Advanced-Scientific-Computing-Using-Julia — Public

Julia is a modern programming language, ideal for scientific computing, designed for fast, extensible, and reproducible code. In this two-day workshop, you'll get hands-on: start with a practical e...

HTML · ☆ 8 · 1

MRI-processing-2023 — Public

Webpage of the workshop "MRI: Processing your Data"

HTML · ☆ 4 · 3

LIBREhub.github.io — Public

This is repository for LIBRE hub project web page. We use Jekyll to run our GitHub page.

HTML · ☆ 3 · 1

fiber-coupled-laser-illumination — Public

Modular fiber-coupled laser illumination

gitbuilding-for-beginners — Public

Forked from biodotpe/gitbuilding-for-beginners

View as: Public

You are viewing the README and pinned repositories as a public user.

You can create a README file or pin repositories visible to anyone.

Get started with tasks that most successful organizations complete.

Discussions

Set up discussions to engage with your community!

Turn on discussions

People

Wenzel Lab

Wenzel Lab at IIBM, Universidad Católica de Chile, check also: https://github.com/LIBREhub

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23 followers · Santiago, Chile · https://wenzel-lab.github.io/en/ · @WenzelLab · wenzellab · company/92802424

https://www.printables.com/@Wenz...

Popular repositories

droplet-sorter-master — Public

Master repository that documents how the different parts come together of the open source hardware Fluorescence Activated (Microfluidic) Droplet Sorter (FADS).

☆ 14

modular-microfluidics-workstation-controller — Public

Repository for the development of the modular parts of a free and open source microfluidic workstation.

G-code ☆ 9 2

droplet-sorting-FPGA-controller — Public

IT setup for realtime analysis of microfluidic droplets with FPGA board (RedPitaya) based on python pyprl library

Python ☆ 8

syringe-pumps-and-controller — Public

Design of 3d printable syringe pumps and dual controller.

JavaScript ☆ 5 2

high-voltage-pulse-generator — Public

Custom electronics solution for microfluidic droplet sorting pulses

flow-microscopy-platform — Public

Our open hardware flow microscopy platform is a more comprehensive version of our strobe-enhanced microscopy stage design, including the

View as: Public

You are viewing the README and pinned repositories as a public user.

You can create a README file or pin repositories visible to anyone.

Get started with tasks that most successful organizations complete.

Discussions

Set up discussions to engage with your community!

Turn on discussions

People

Detailed documentation and open license

Strobe-enhanced microscopy stage

by Pierre Padilla-Huamantinco, Matías Hurtado-Labarca, and Tobias Wenzel
Latin American Hub for Bioimaging Through Open Hardware (LIBRE hub)

Strobe-enhanced microscopy stage

Build the 3-level microscopy stage

Print the plastic parts

Laser cut the acrylic parts

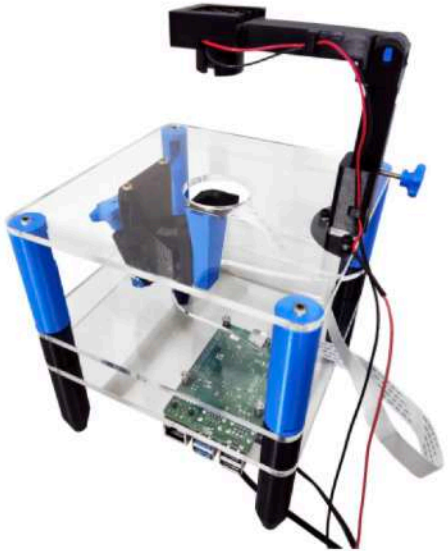
Assemble the focus mechanism

Assemble the basics optics module

Attach parts to the top plate

Attach parts to the

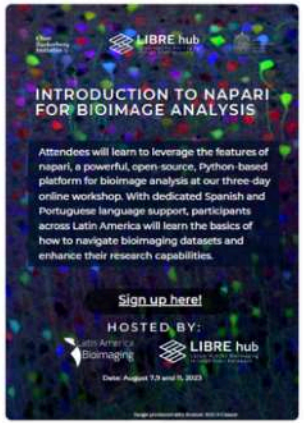
3-level microscopy stage

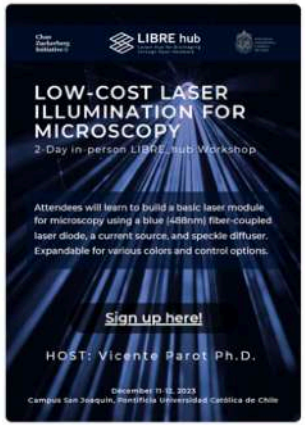


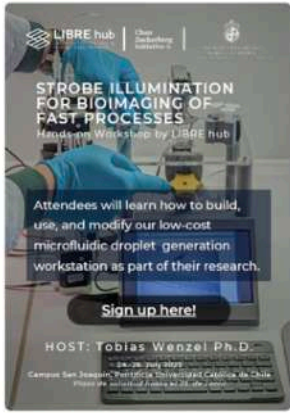
Before you start building the station, you will need to source all the components listed in our bill of materials (HTML, CSV), which is given on the next page.

Instructions

Workshops for Latin America







Open Source Hardware and the Wenzel Lab

Asst. Prof. Dr. Tobias Wenzel

Open Source Hardware

Open source hardware is hardware whose design is made publicly available so that anyone can study, modify, distribute, make, and sell the design or hardware based on that design. (…) [OSHWA]

Why Open Instrumentation?

- Accessing advanced biomedical methods
- Build creative tools that address new custom problems
- Reduction of cost
- Maintaining the equipment in-house
- Easy to automate and work with useful data formats
- Better collaborations - reproducibility, user lead dev.

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OPEN ACCESS

ESSAY

Open hardware: From DIY trend to global transformation in access to laboratory equipment

Tobias Wenzel

Published: January 17, 2023 • https://doi.org/10.1371/journal.pbio.3001931

67 Save | 52 Citation | 10,099 View | 140 Share

Abstract

Introduction

Conclusions

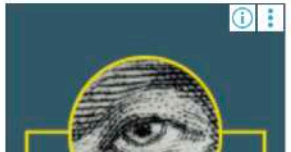
Acknowledgments

References

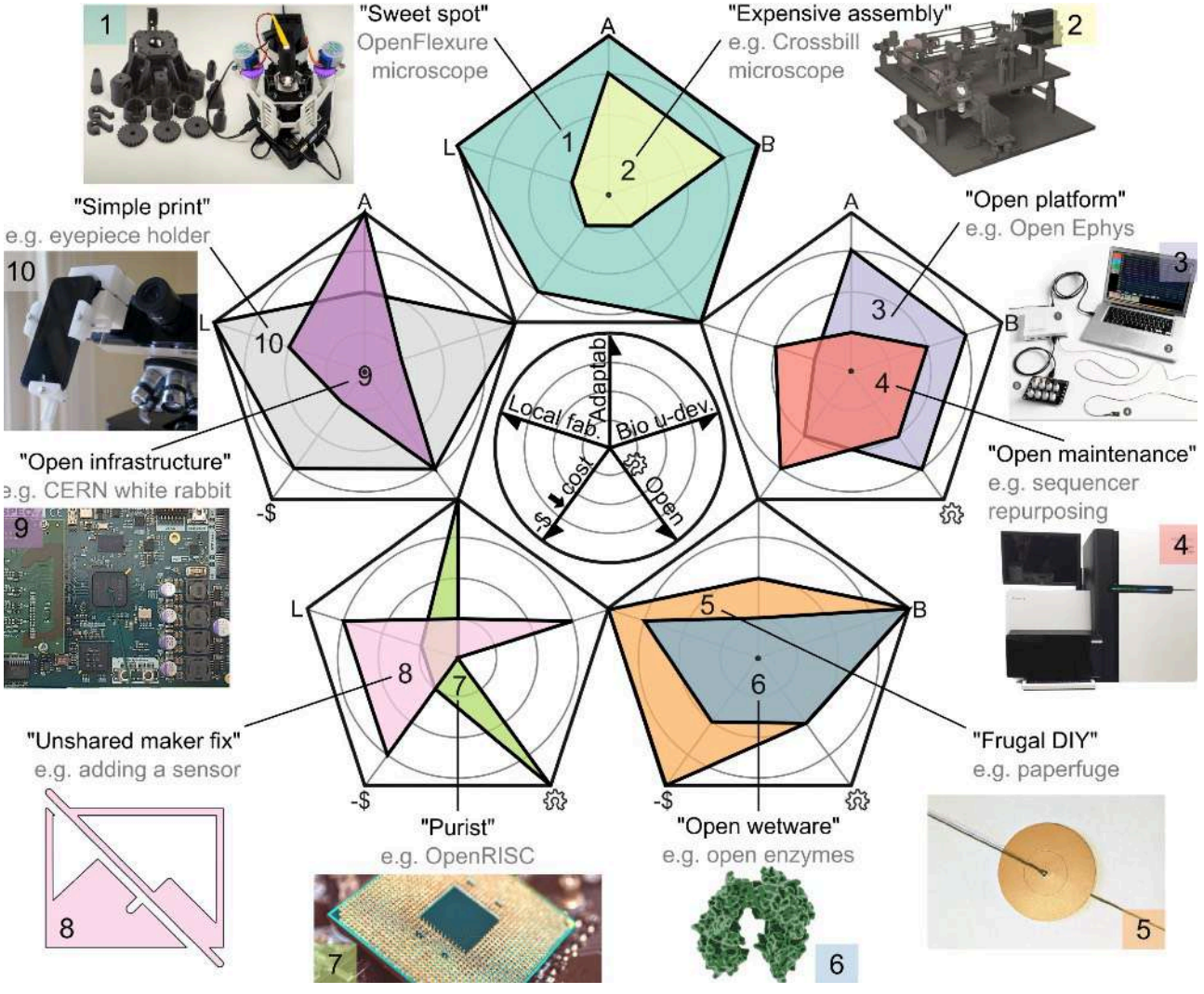
Abstract

Open hardware solutions are increasingly being chosen by researchers as a strategy to improve access to technology for cutting-edge biology research. The use of DIY technology is already widespread, particularly in countries with limited access to science funding, and is catalyzing the development of open-source technologies. Beyond financial accessibility, open hardware can be transformational for the access of laboratories to equipment by reducing dependence on import logistics and enabling direct knowledge transfer. Central drivers to the adoption of appropriate open-source technologies in biology laboratories around the world are

ADVERTISEMENT



Types of Open Hardware



01/2023
Open hardware: From DIY trend to global transformation in access to laboratory equipment.
T. Wenzel

Open Hardware industry examples

Table 1. Examples of open hardware companies relevant for biology laboratories.

Company name	Field or product	Link
Tindie	Online marketplace for open electronics and hardware products. Sales platform for makers and small businesses	https://www.tindie.com/
SparkFun	Designs, manufactures, and sells open microcontroller development boards and breakout boards	https://www.sparkfun.com/
Seeed Studio	Integrated platform for creating hardware solutions for IoT, AI, and Edge	https://www.seeedstudio.com/
Sci-Bots	Dropbot, digital microfluidic control system	https://sci-bots.com/
Sanworks	Automated systems for neuroscience research	https://sanworks.io/
Safecast	Crowdsourced environmental data with open hardware, originally radiation in Japan now also air quality globally	https://safecast.org/
Red Pitaya	FPGA-powered boards as multifunction laboratory and engineering instrument	https://redpitaya.com/
Public Lab	Community science tools for environmental monitoring	https://www.publiclab.org/
Prometheus Science	Open hardware for biology consulting	https://prometheus-science.com/
Precious Plastic	Plastic recycling equipment	https://preciousplastic.com/
OpenTrons	Pipetting robot and addons	https://opentrons.com/
OpenQCM	Quartz Crystal Microbalance, e.g., for protein affinity measurements at molecular resolution	https://openqcm.com/
OpenFlexure Industries	Manufactures the openflexure microscope and openflexure block stage	https://openflexure.com/
Open Ephys	Electrophysiology laboratory tools	https://open-ephys.org/
OpenBCI	Brain–computer interface platform	https://openbci.com/
Open Acoustic Devices	Designs supports and deploys acoustic hardware and software for environmental and wildlife monitoring projects, audio moth	https://www.openacousticdevices.info/
Olimex	Developer and provider for development tools for embedded market, including non-open boards	https://www.olimex.com/
neurogig	Instruments for neurophysiology laboratories	https://neurogig.com/
Kitspace	Share and order electronic projects with the automatic component shopping list generator for github projects	https://kitspace.org/
IORodeo	Designing and selling biolab hardware, now mainly potentiostats	https://iorodeo.com/
Elphel	Imaging hardware and software	https://www.elphel.com/
Beneficial Bio	Network of social enterprises for biolabs	https://beneficial.bio/
BeagleBoard	BeagleBone computers	https://beagleboard.org/
Backyard Brains	Demonstration instruments for neuroscience education	https://backyardbrains.com/
Arduino	Designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices	https://www.arduino.cc/
Apertus	AXIOM cameras	https://www.apertus.org/axiom
Adafruit	Designs, manufactures, and sells a number of electronics products, electronics components, tools, and accessories	https://www.adafruit.com/
3D printer providers such as Prusa (Prusa Research), LulzBot (FAME 3D), Voron, Rostock Max (seemecnc)	Providers of open source commercial 3D printers	https://www.prusa3d.com https://lulzbot.com https://vorondesign.com https://www.seemecnc.com

https://doi.org/10.1371/journal.pbio.3001931.t001

Source: Our publication in PLOS Bio 2023:
Open hardware: From DIY trend to global transformation in access to laboratory equipment. T. Wenzel

Community values

GOSH Manifesto

Deutsch | English | Español | Français | Português | 中文 | বাংলা | 日本語

The Global Open Science Hardware (GOSH) movement seeks to reduce barriers between diverse creators and users of scientific tools to support the pursuit and growth of knowledge. These are our principles:

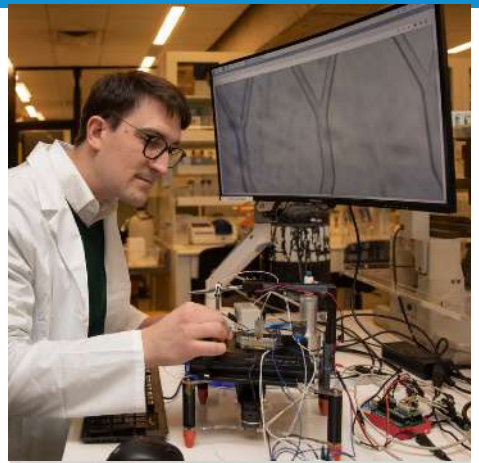
10	**Javier Serrano**	Spain	CERN
9	**Bengt Sjölén**	Sweden	independent
8	**Tobias Wenzel**	Germany	University of Cambridge
7	**Richard Bowman**	UK	University of Cambridge
6	**Kshitiz Khanal**	Nepal	Open Knowledge Nepal
5	**Rafael Pezzi**	Brazil	Centro de Tecnologia Acadêmica IF/UFRGS and ALICE/CERN
4	**Puneet Kishor**	USA	independent
3	**Mikael Fernstrom**	Ireland	University of Limerick
2	**Greg Austic**	USA	PhotosynQ
1	**Max Liboiron**	Canada	Civic Laboratory for Environmental Action Research (CLEAR)

Undersigned

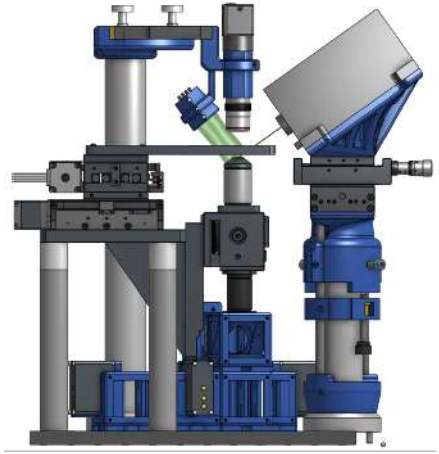
- GOSH is accessible
- GOSH makes science better
- GOSH is ethical
- GOSH changes the culture of science
- GOSH democratizes science
- GOSH has no high priests
- GOSH empowers people
- GOSH has no black boxes
- GOSH is impactful tools
- GOSH allows multiple futures for science

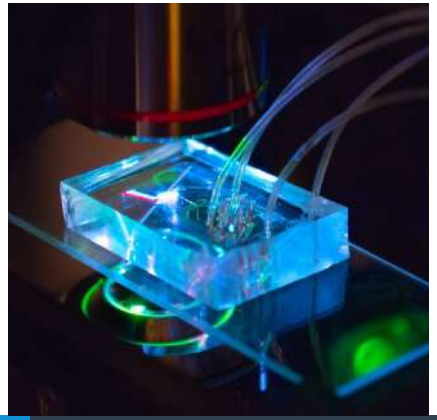
Developing instruments for high-throughput biomedical analysis

Advanced fluid handling platforms

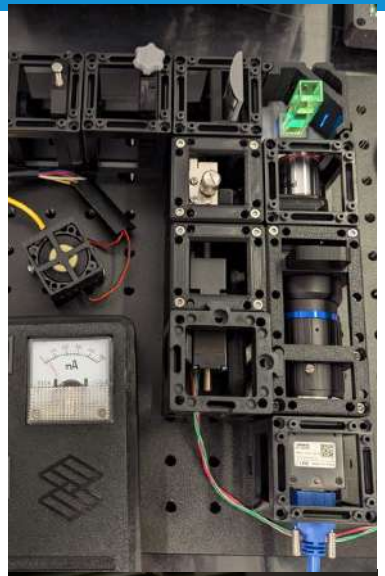


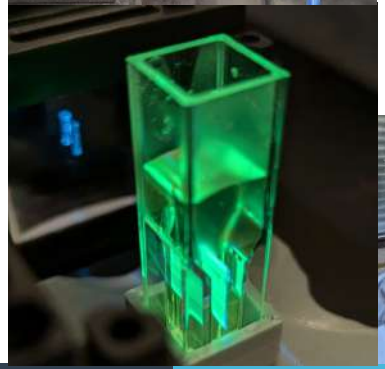
First droplet sorting cytometer in Latin America





Low-cost light sheet microscope

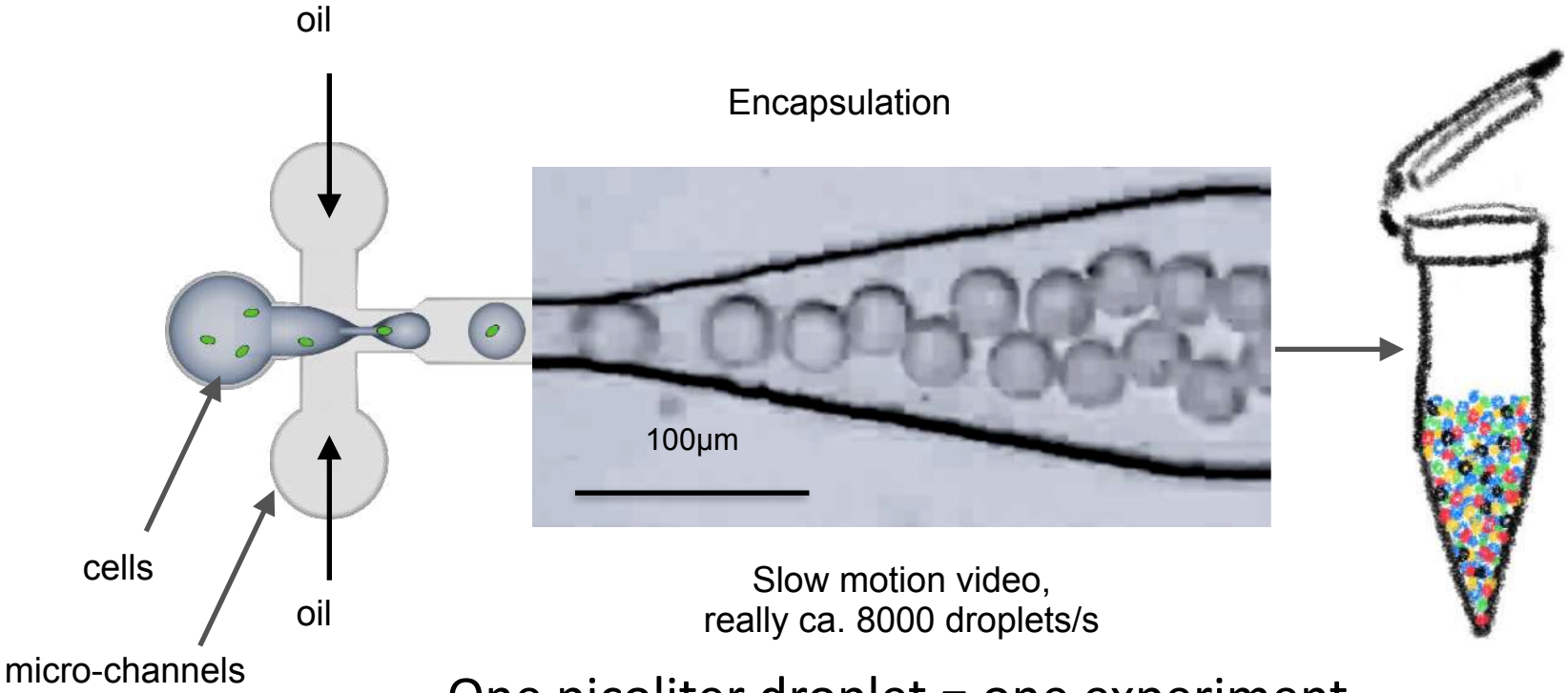




Advanced Microscopy

Trainings

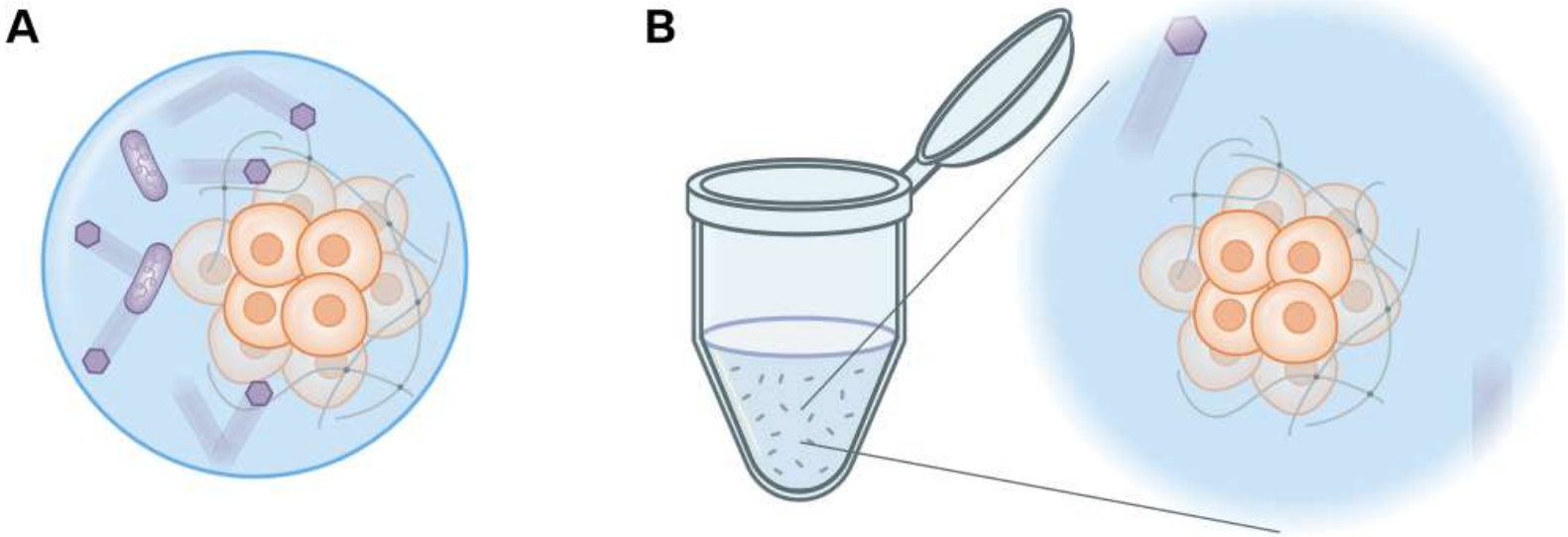
Microfluidic droplets - record-keeping high-throughput



One picoliter droplet = one experiment

millions per hour

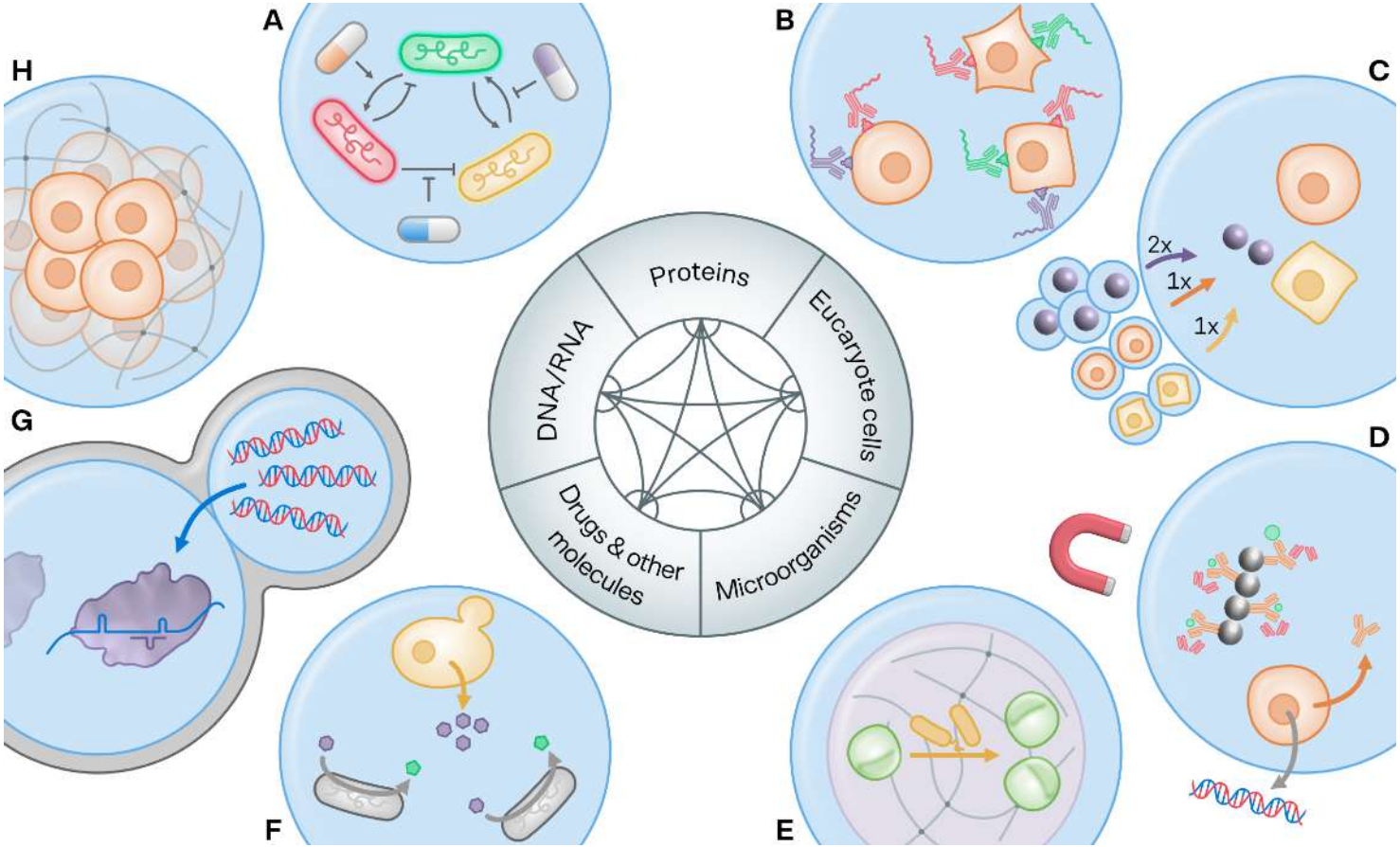
Interactions are best studied in droplets



Variation of:

Leveraging interactions in microfluidic droplets for enhanced biotechnology screens
C. Vitalis & T. Wenzel
Current Opinion in Biotechnology, 2023/08

Many interactions can be studied in droplets!



Leveraging interactions in microfluidic droplets for enhanced biotechnology screens
C. Vitalis & T. Wenzel
Current Opinion in Biotechnology, 2023/08

Tobias Wenzel -
Microfluidics for controlled organoid tissue engineering

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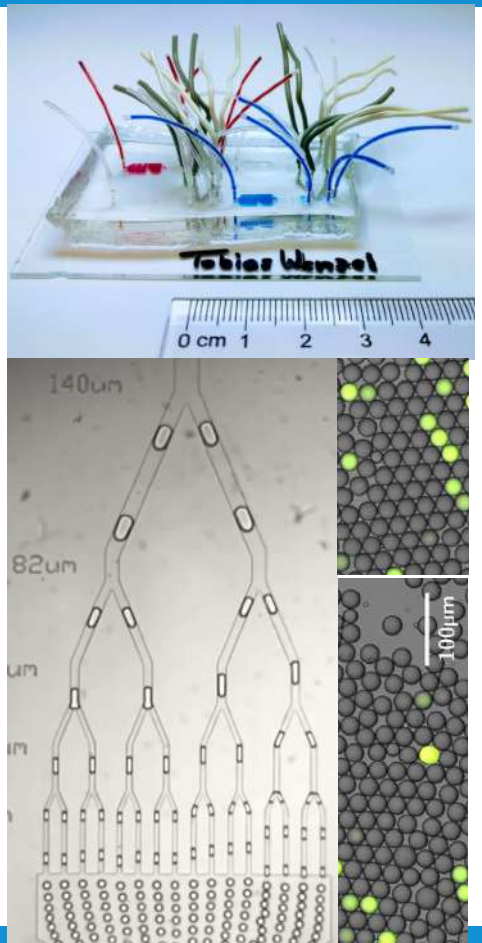
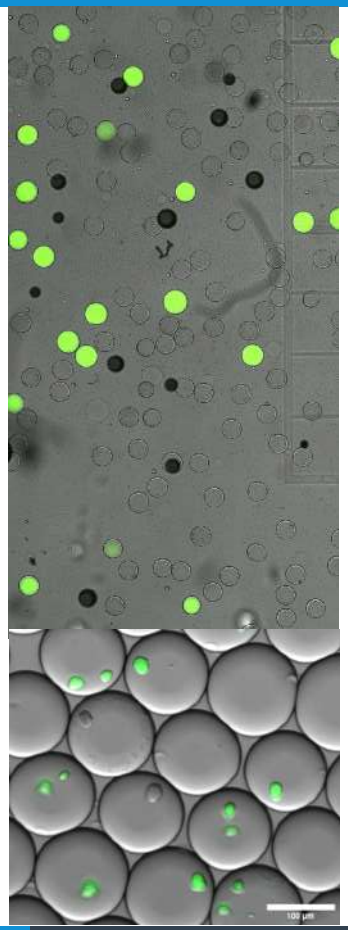
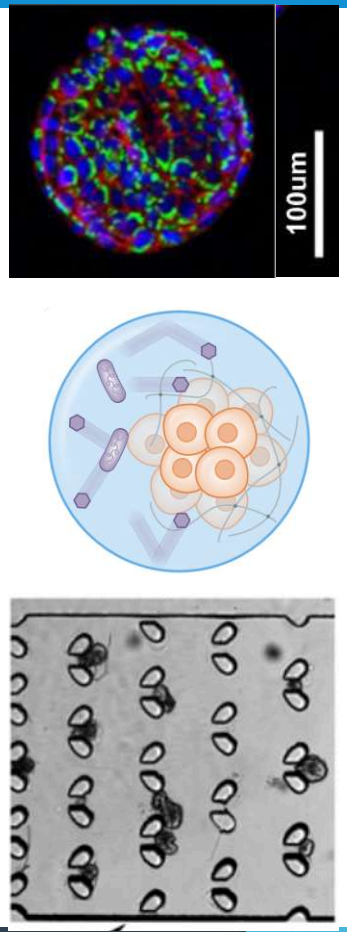
Millions of microfluidic droplets per experiment



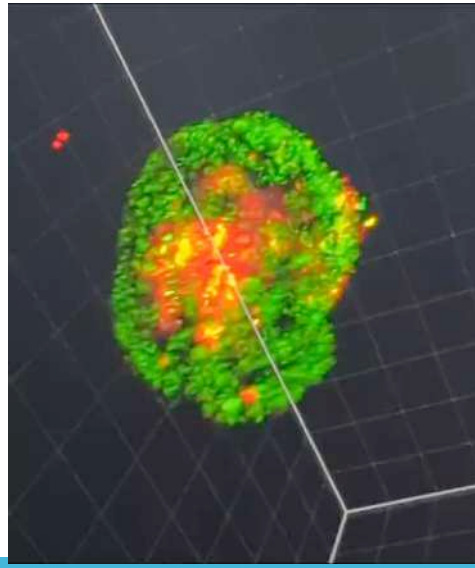
Single-cell analysis and single genomes



Gastric and intestinal organoid culture



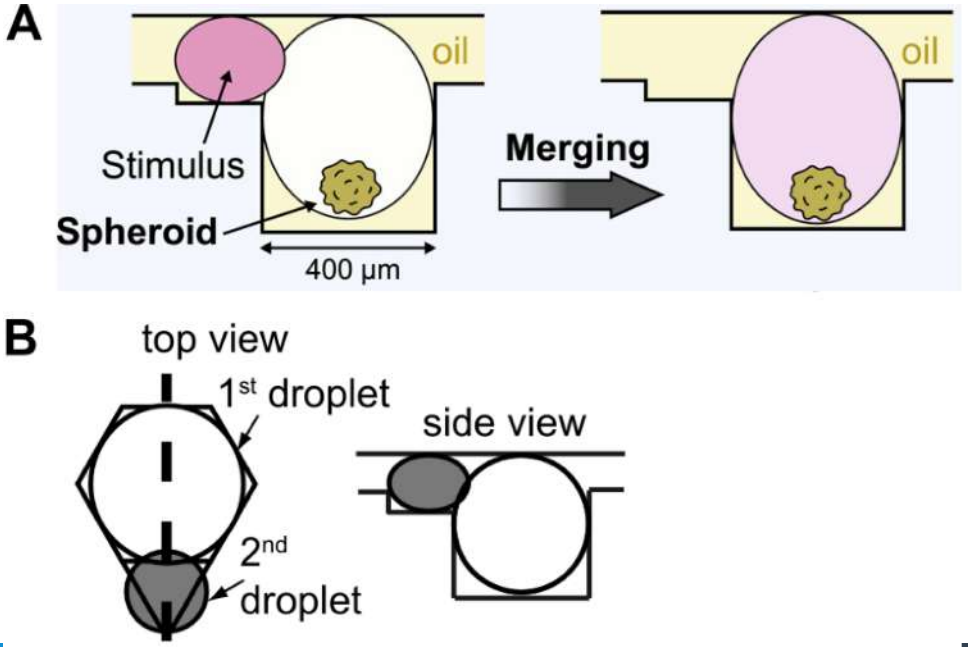
Organoid 3D-imaging

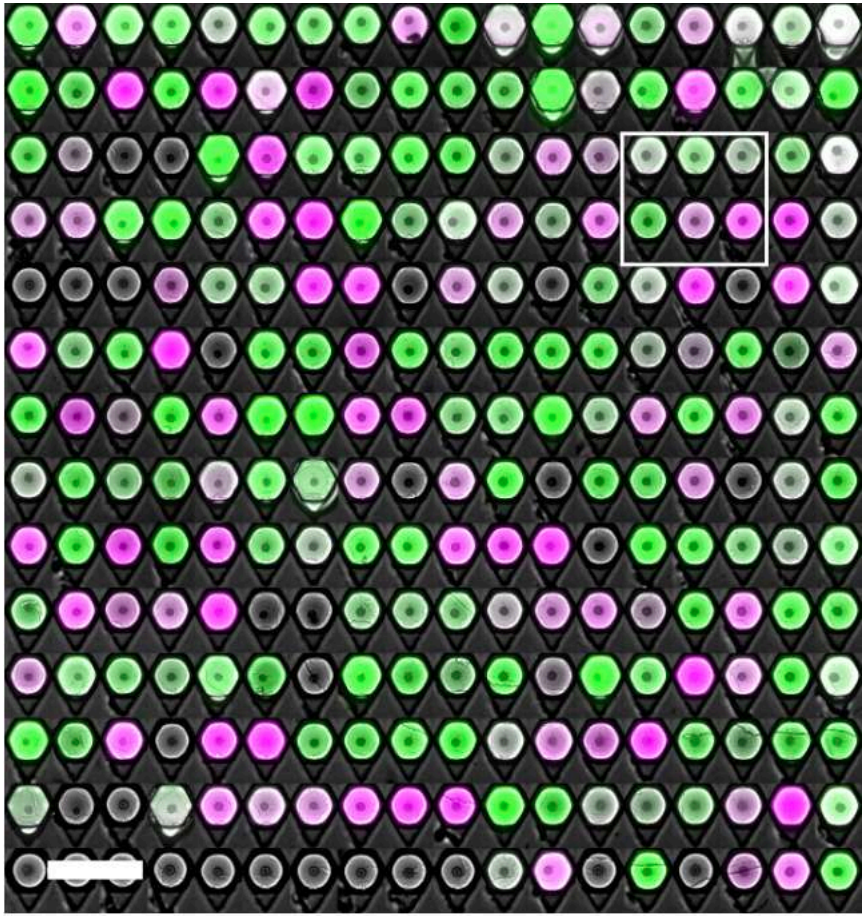


intestinal enteroids." *Biomicrofluidics* 8.2 (2014)

Bioimaging in droplets for organoids and interactions

- **High throughput analysis of host-pathogen interactions in droplets**





Tomasi et al. (Cell Reports. 2020)

Our microfluidics resources potentially relevant to you

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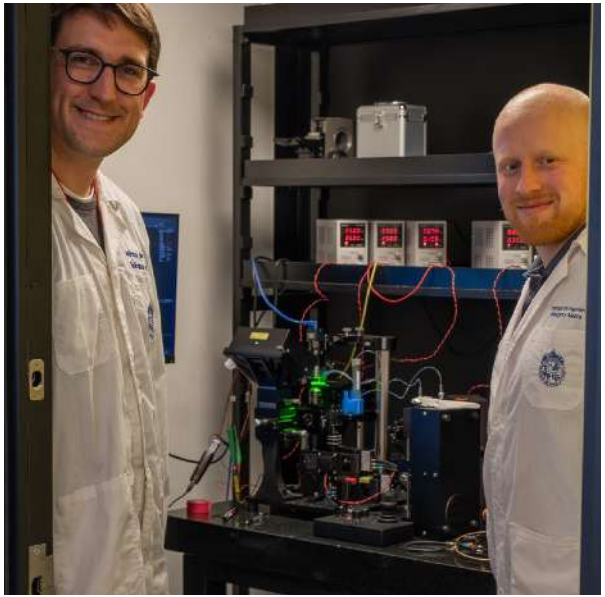
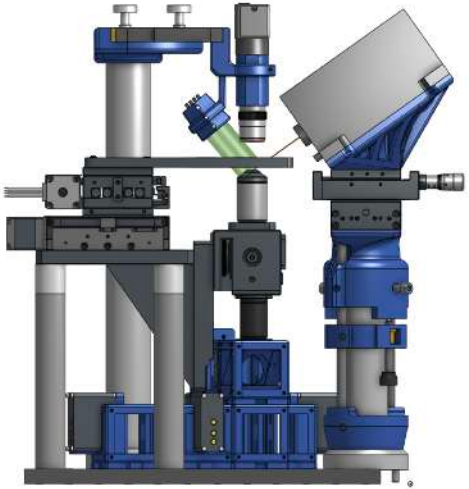
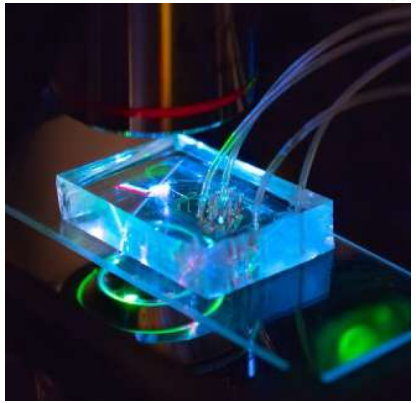
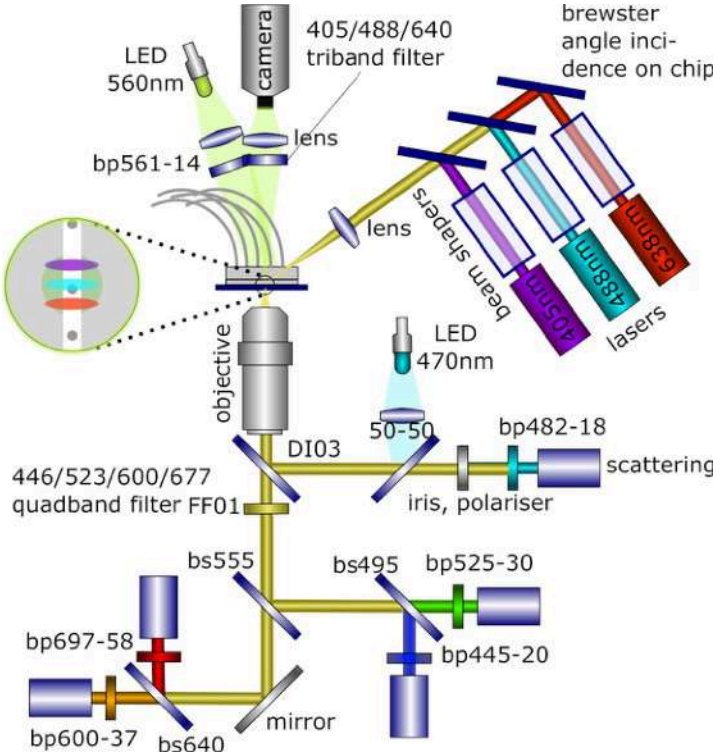
Open source cytometry & droplet sorting (FADS)

- Microscope alignment stage(s)
- High-speed imaging with strobe
- Realtime FPGA electronics
- High voltage and electrodes on-chip
- Laser + Optics
- Pumps

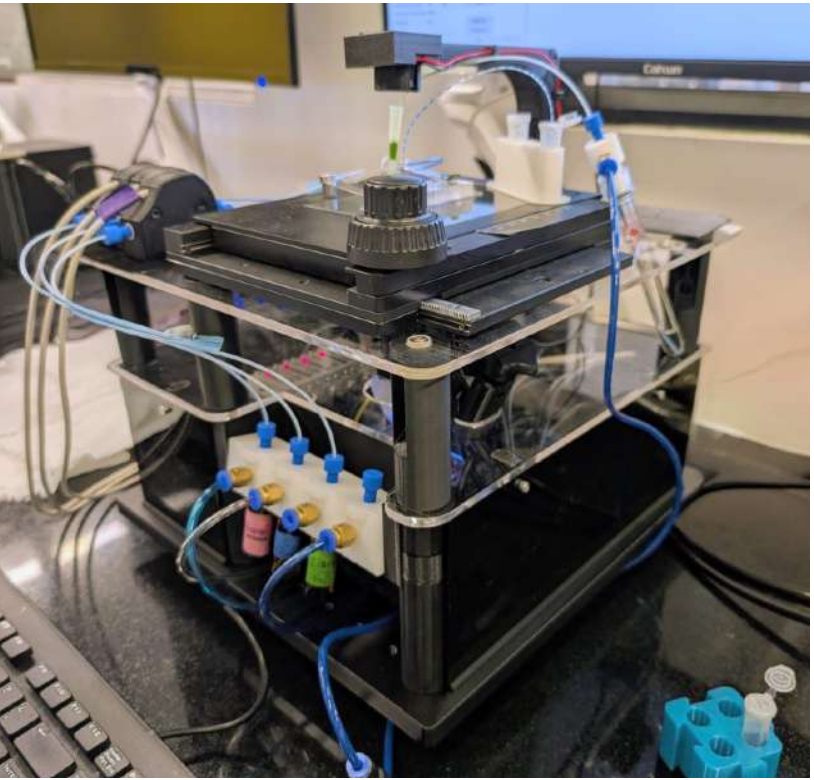


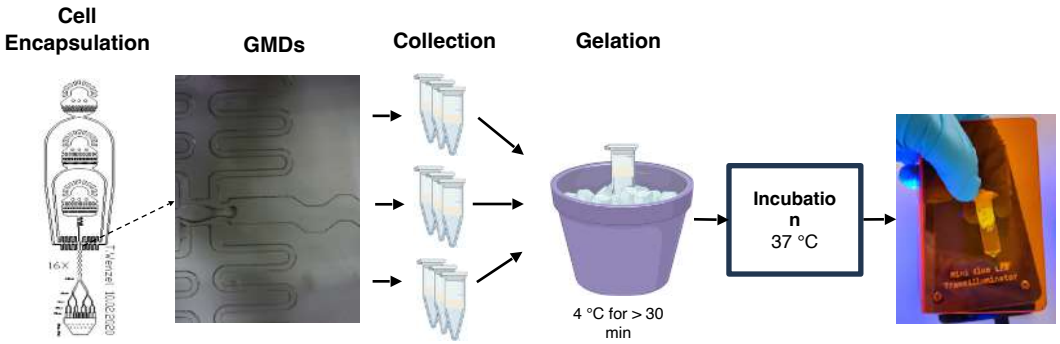


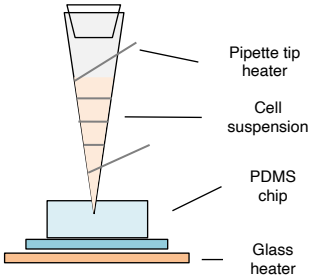




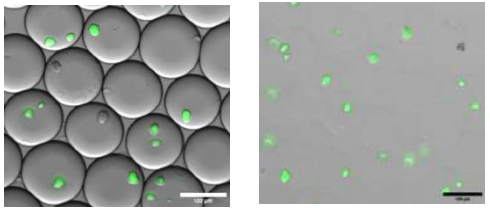
Flow Platform for Advanced Microfluidics and Gel-Microdroplets







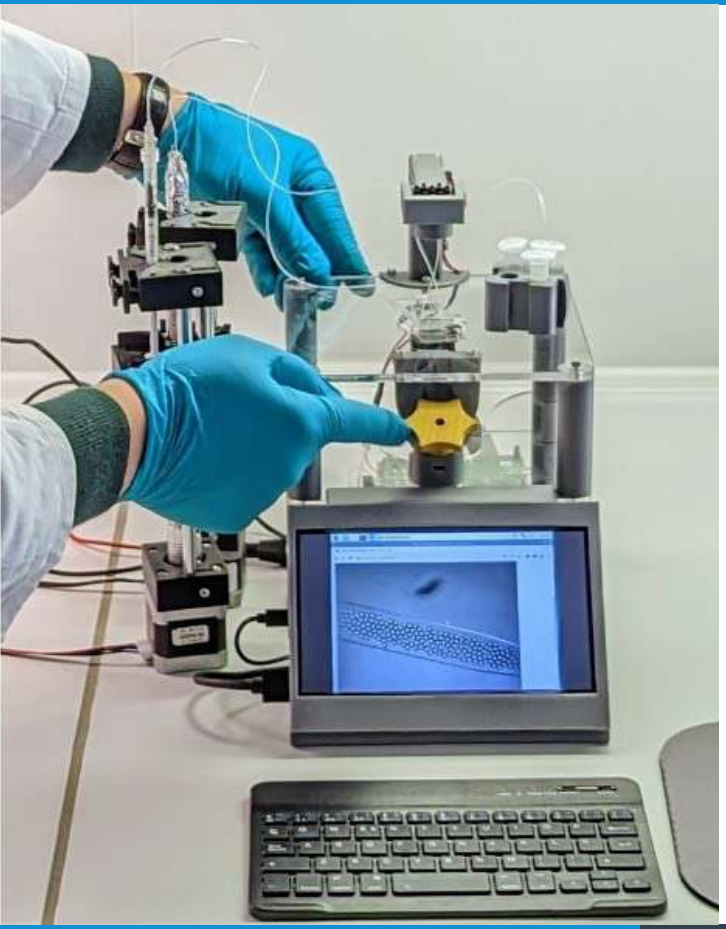
sfGFP expressing *E. coli* colonies inside of gel microdroplets (Scaler bar: 100 μm)



in oil | in buffer

Reference: Padilla-Huamantinco, P., Durán, E., Wenzel, T. Plasmid Stability Analysis with Open-Source Droplet Microfluidics. J. Vis. Exp. (214), e67659, doi:10.3791/67659 (2024).

Low-Cost Open Hardware Droplet Workstation



Open Source Syringe Pumps and Controller

- Low-cost
- Precise low-flows (with gearbox)
- Allows manual intervention
- And remote automation

https://wenzel-lab.github.io/syringe-pumps-and-controller/2_syringe-pump.html

The scope of this remote workshop

- Community building to advance microscopy with microfluidics
- Introduction (this) and lecture (YouTube, to follow)
- 1x 1:1+ consultation for application test planning (you need to make the actual plan!)
- If appropriate, we will send a microfluidic chip and tubing for testing
- Testing on your own
- Community call to share testing results

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Gracias equipo!