

Hardware Aberto para Ciência aberta

Trazendo a pesquisa para o século XXI

Open Hardware day 2025

Andre Maia Chagas, PhD



Hello

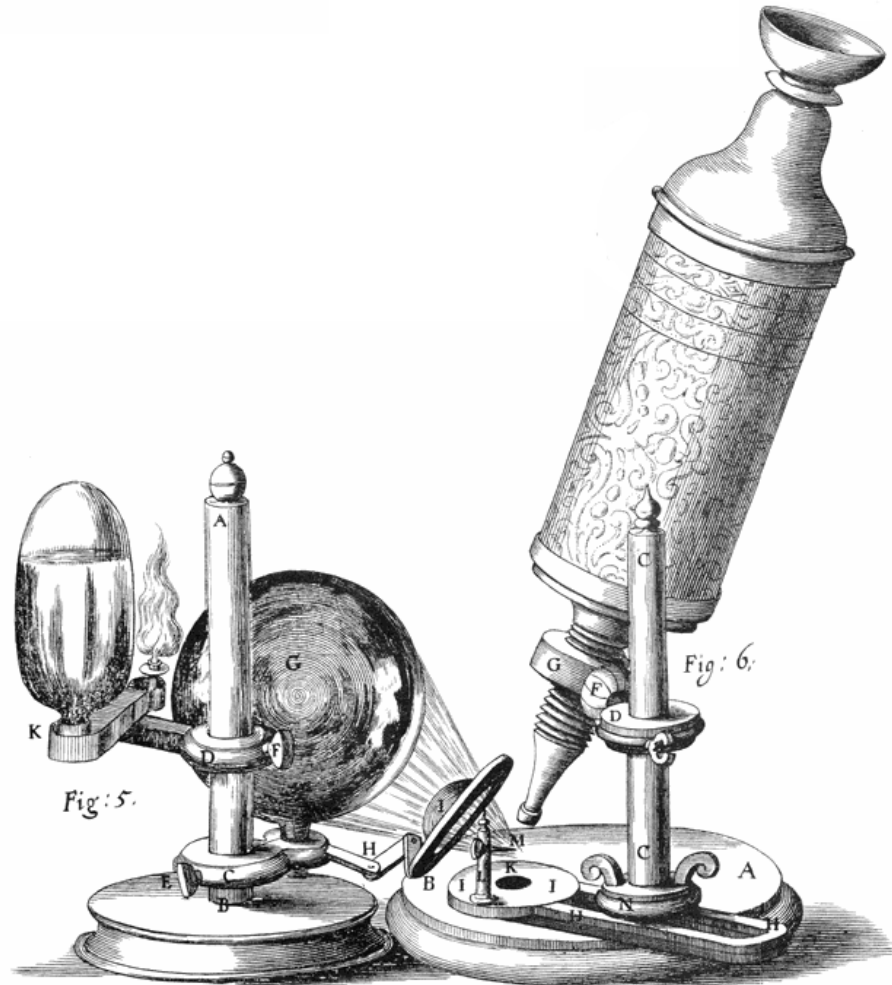


- Professor PUC Campinas (esperando validação de títulos)
- Professor visitante [@Sussex Neuroscience](#)
- Open Science Coordinator [@Trend in Africa](#)
- Founder [@Open Neuroscience](#)
- Professor visitante @Yobe State University

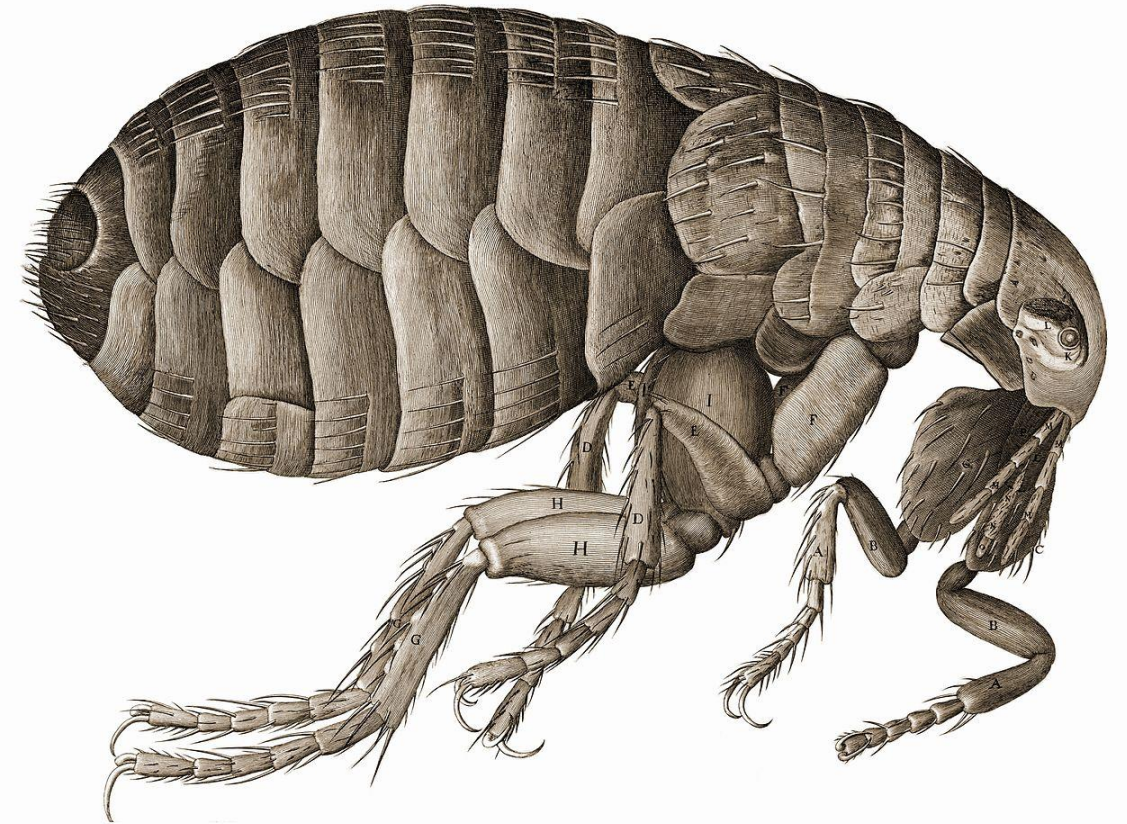
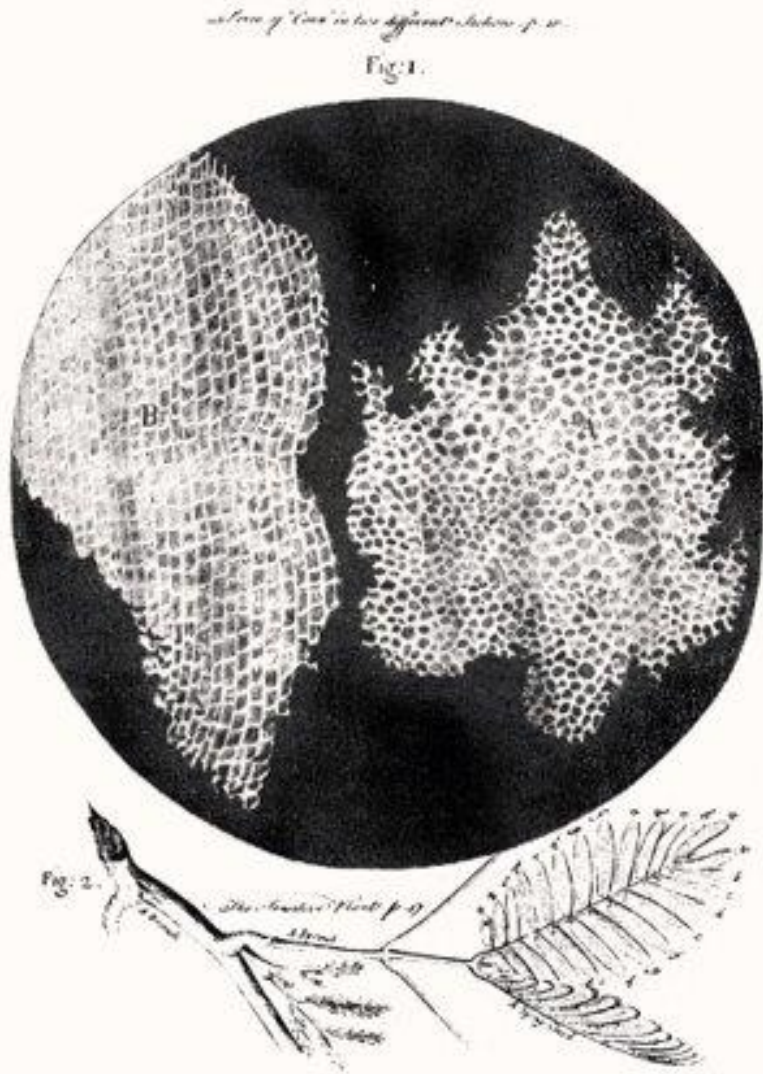
Open Science Lab in numbers

- Open work fosters collaborations:
 - 19 papers in 2019-2024 period (collaborators in Nigeria, USA, Brazil, Germany)
 - Active support for 25 labs/groups in Sussex
- Teaching:
 - Python programming,
 - 3D printing and design
 - Intro to electronics
 - Open Hardware best practices
- In 2023/2024 academic year:
 - > 100 projects (repairs, new tools, teaching, invited talks, papers, reviews, etc)
 - > 60k£ in savings (tool repair, customisation, etc)

Humans create tools...



Tools recreate humanity



Modern microscopes...



[By Chad Anderson, CC BY-SA 2.0](#)



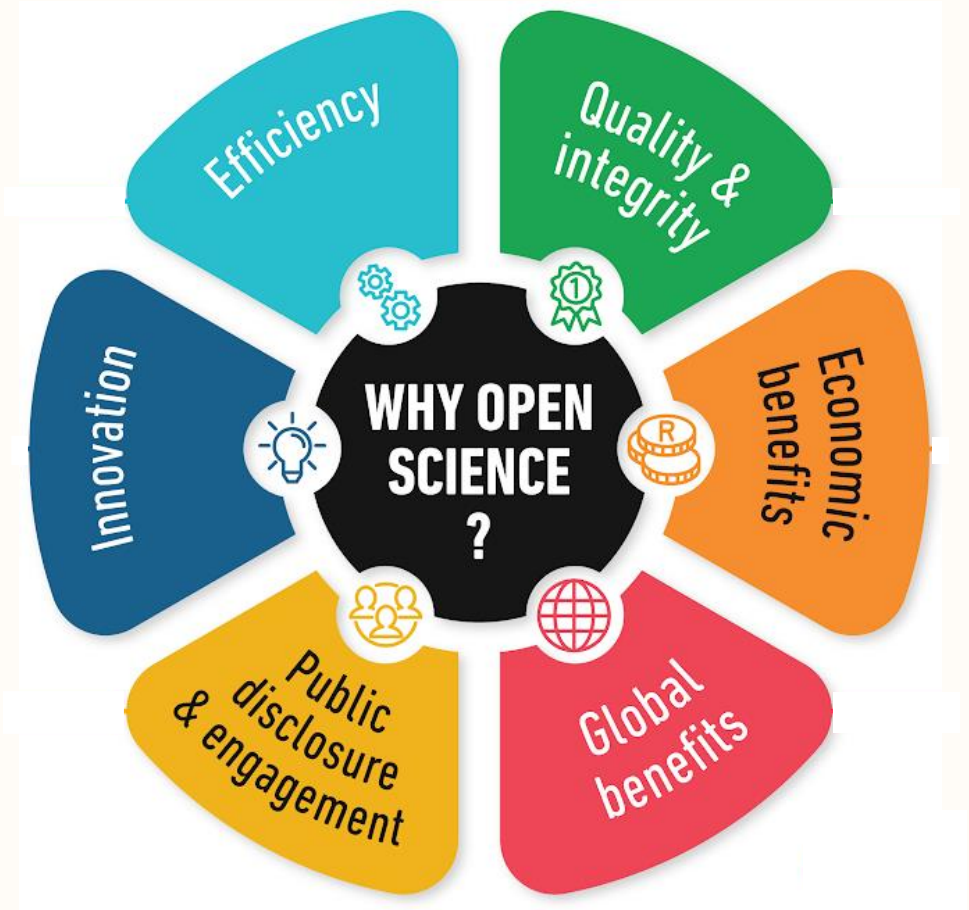
[By Zephyris at the English language Wikipedia, CC BY-SA 3.0](#)

Open Source / Open Science

Specific licenses guide the game of freely shared resources.

Publicly funded research needs to generate public goods.

We need to be able to scrutinize, replicate and confirm them.



The current academic model is broken

Reproducibility

- Only 39 out of 100 landmark papers in psychology are reproducible
- 50% of top cancer studies fail reproduction

Representation

- 96% of psychology studies are conducted with WEIRD participants

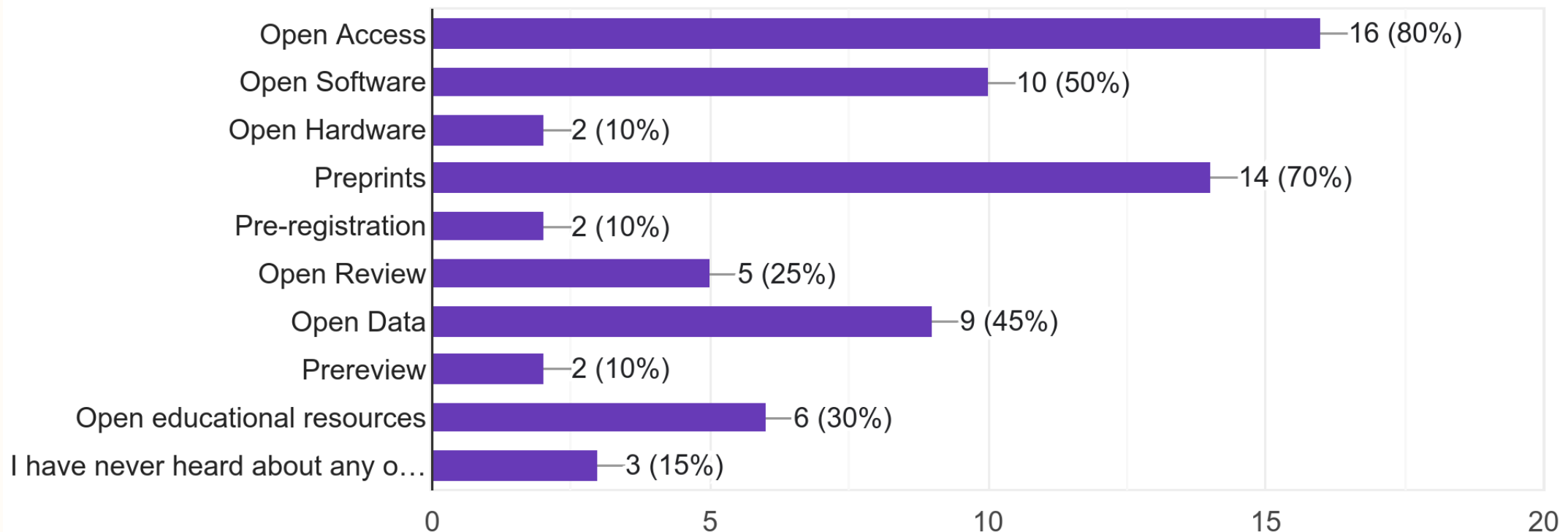
Access

- Public funded research is locked behind hefty fees by ~5 publishing companies

Open Science knowledge

Are you familiar with one or more of these aspects of Open Science? (it is absolutely fine if you have not even heard of them!)

20 responses

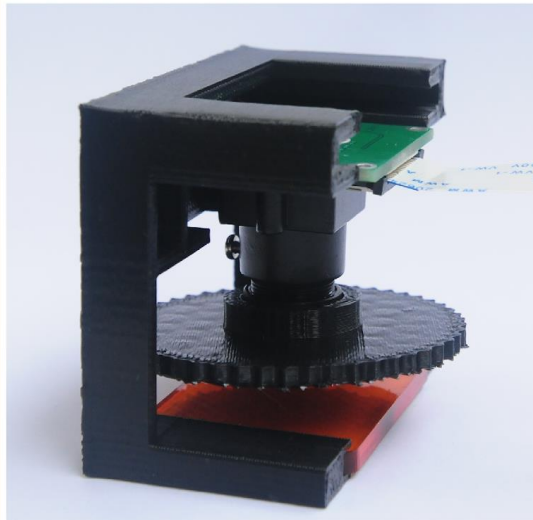


Open Microscopes



[Chagas et al 2017](#)

- Fluorescence
- Optogenetics
- Thermogenetics
- macro/microscopy
- Behavioural tracking



[Nunez et al 2017](#)

- Track bacteria growth
- Macro/microscopy
- Fluorescence



[Sharkey et al 2016](#)

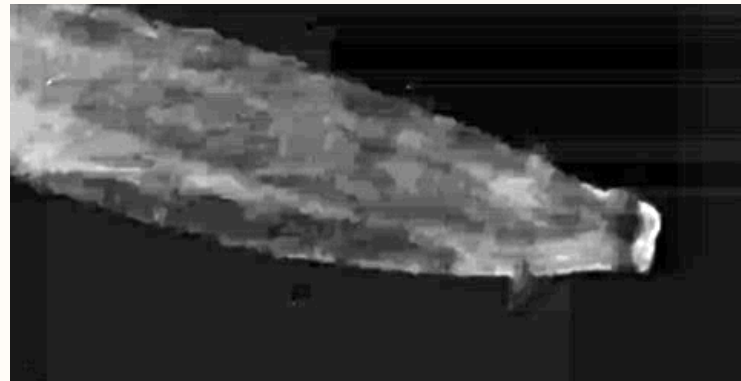
- Optical scope
- Movement precision in Micrometers

Open Microscopes



[Chagas et al 2017](#)

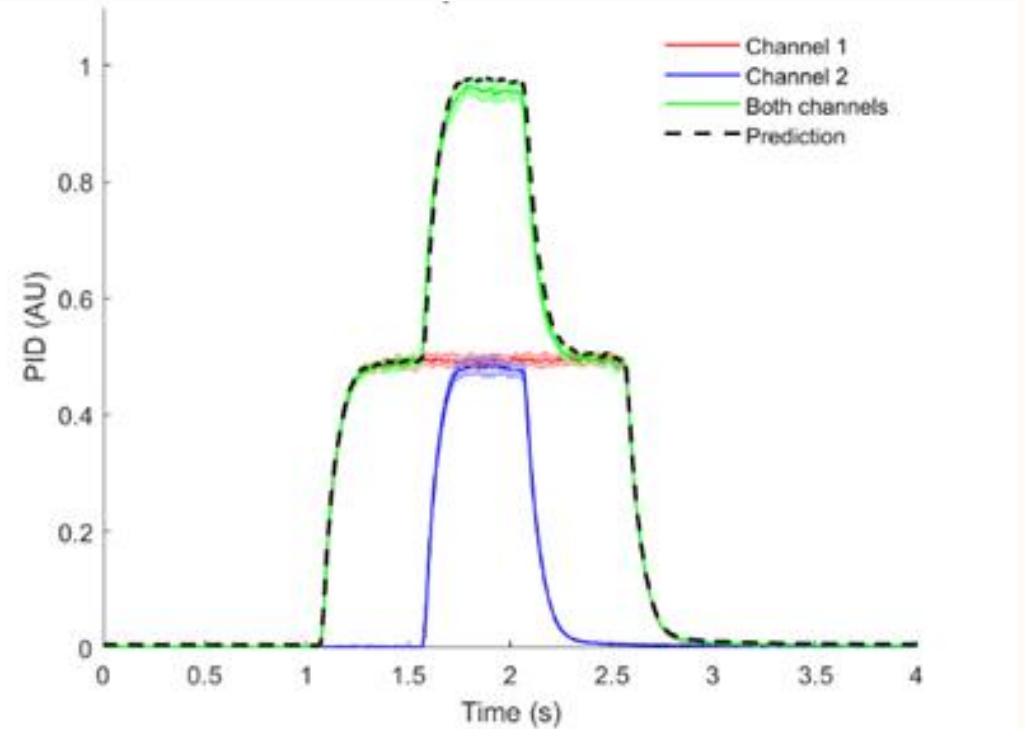
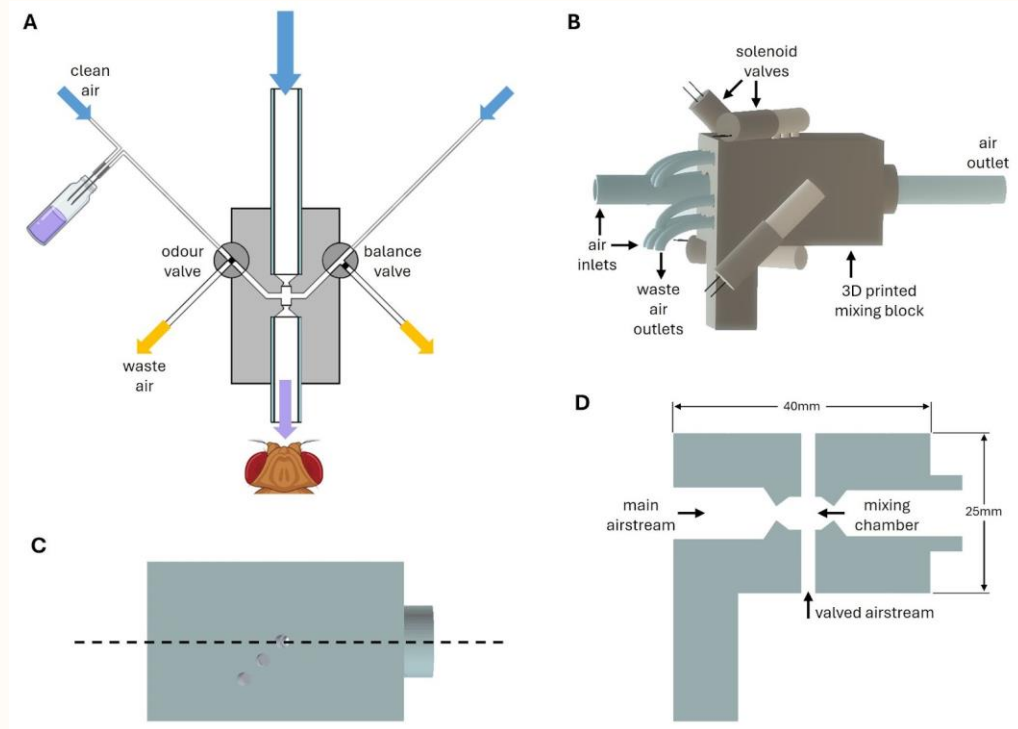
- Fluorescence
- Optogenetics
- Thermogenetics
- macro/microscopy
- Behavioural tracking



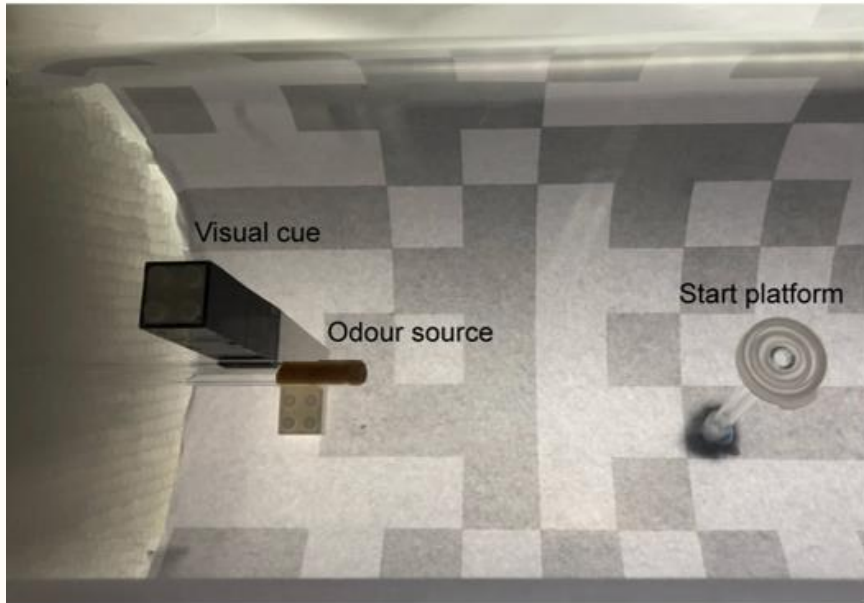
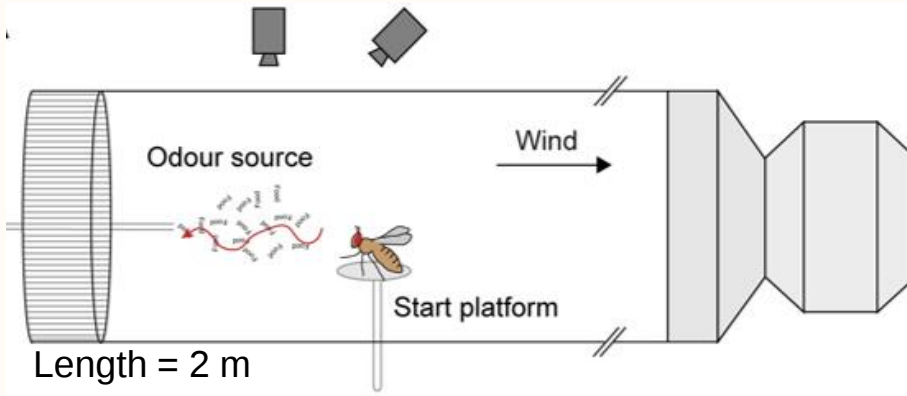
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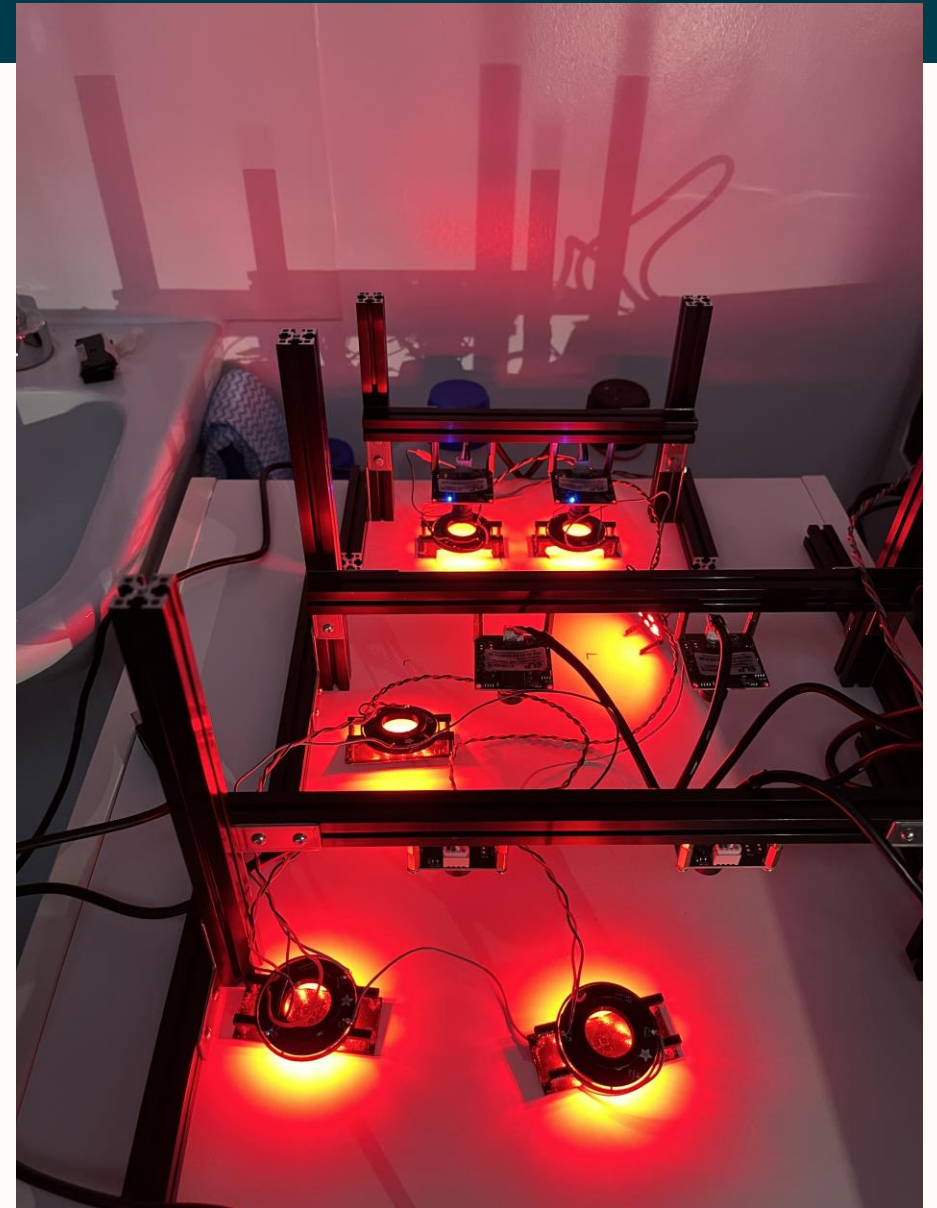
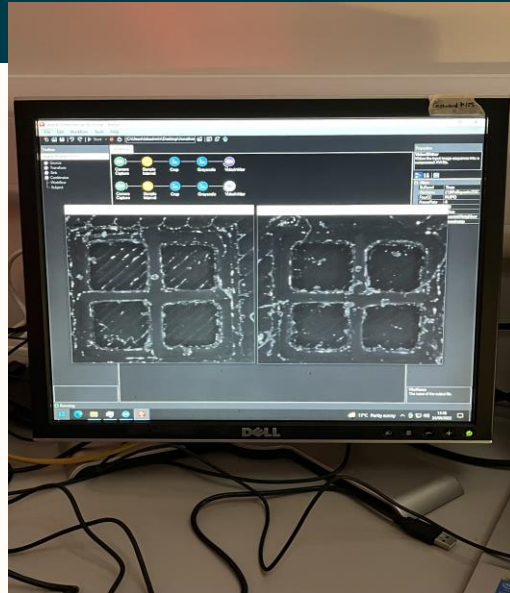
Open sourcing existing designs



And remixing their use



Parallelization



Developmental Biology, Neuroscience

A microRNA that controls the emergence of embryonic movement

Jonathan A. C. Menzies, Andre M. Chagas, Claudio R. Alonso ✉

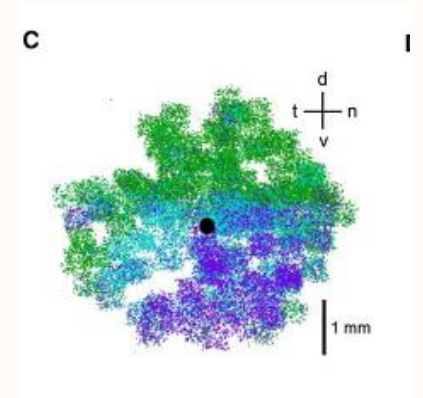
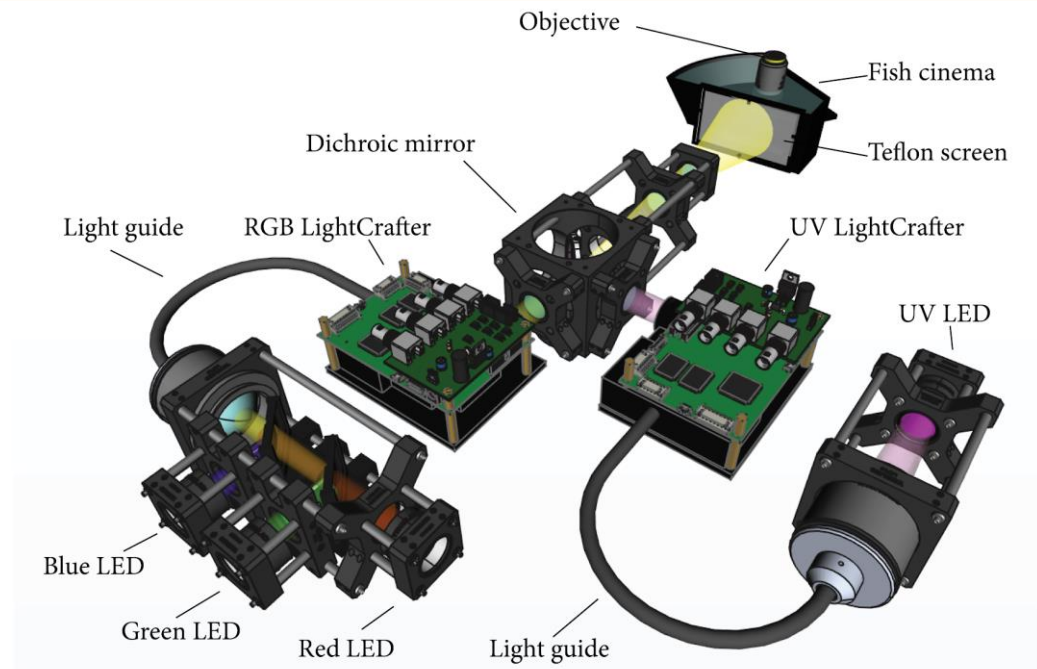
Department of Neuroscience, Sussex Neuroscience, School of Life Sciences, University of Sussex, Brighton BN1 9QG, UK

<https://doi.org/10.7554/eLife.95209.1>  

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Tools tailored for experiments and animal models

An arbitrary-spectrum spatial visual stimulator for vision research

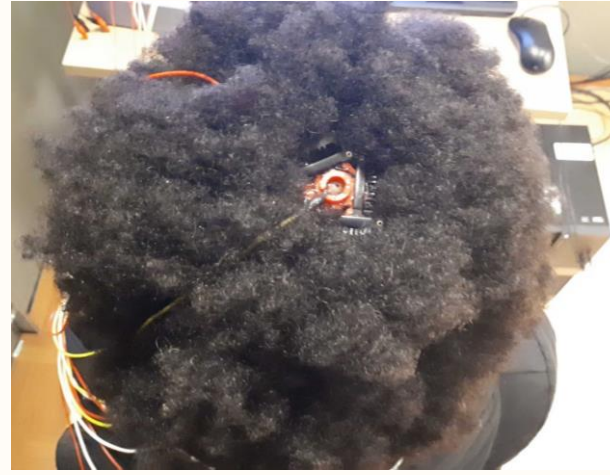


Baden et al 2013 neuron

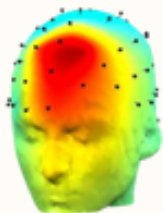
Katrin Franke, André Maia Chagas, Zhijian Zhao, Maxime JY Zimmermann, Philipp Bartel, Yongrong Qiu, Klaudia P Szatko, Tom Baden, Thomas Euler 

University of Tübingen, Germany; University of Sussex, United Kingdom

Innovation & inclusivity



Human
Psychophysiology
Lab



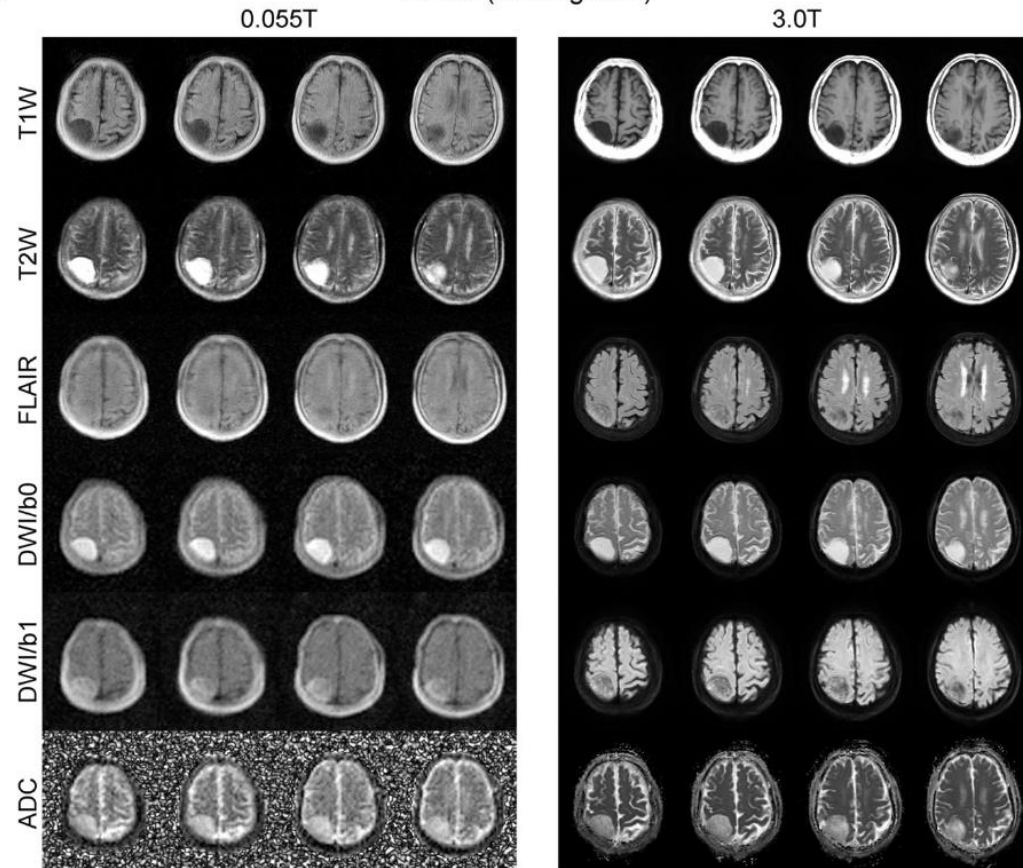
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Manguele *et al* in prep

Open MRI

Brain Images of Adult Brain Tumor and Trauma Patients

a



Open MRI

- Open, distributed development (Germany, Belgium, Uganda, Paraguay, Bolivia)
- ~20.000,00 Euros
- No need active cooling
- No need for recurring maintenance contracts
- Portable

<https://www.opensourceimaging.org/2023/01/09/first-open-source-mri-scanner-presented-the-osii-one/>



On the economical impact...



Contents lists available at [ScienceDirect](#)

HardwareX

journal homepage: www.elsevier.com/locate/ohx

Economic savings for scientific free and open source technology: A review

Joshua M. Pearce^{a,b,c}

^a Department of Materials Science and Engineering, Michigan Technological University, Houghton, MI 49931, USA

^b Department of Electrical and Computer Engineering, Michigan Technological University, Houghton, MI 49931, USA

^c Department of Electronics and Nanoengineering, School of Electrical Engineering, Aalto University, Espoo, Finland

On the economical impact...

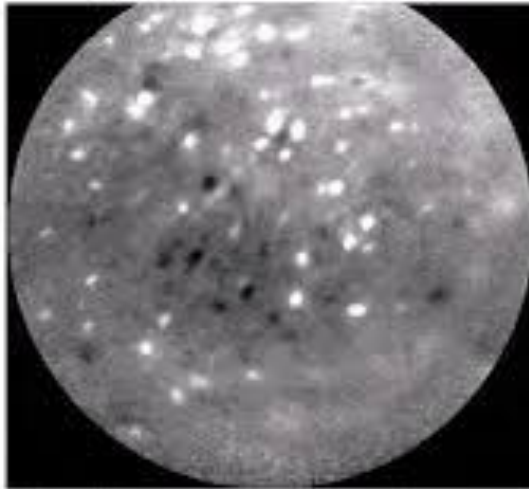
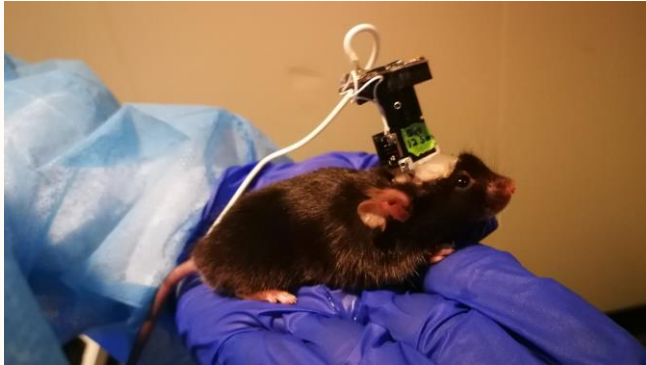
Leveraging Open Source Technologies to develop scientific tools:

- Leads to economics **SAVINGS OF AT LEAST 87%** when compared to proprietary tools
 - For some items there is enough saving to actually fund personnel.

PLUS:

- Replicability
 - Modularity
 - Customization
 - Education
-
- Research projects are now mostly limited by imagination. We can build the tools to answer the questions. Reducing the limitation of “what can be done with the available tools”

On the economical impact...

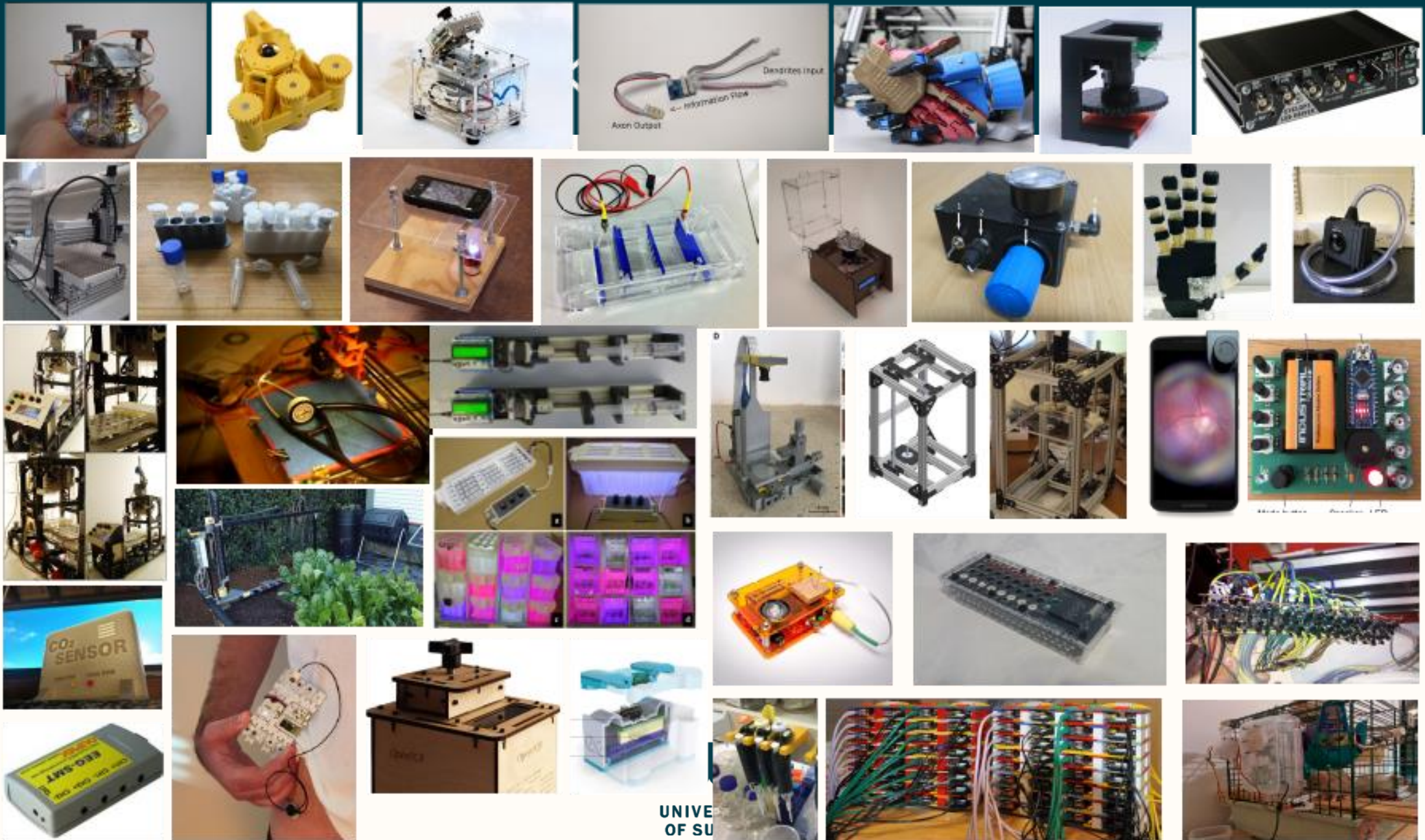


Daniel Aharoni
@DanielBAharoni

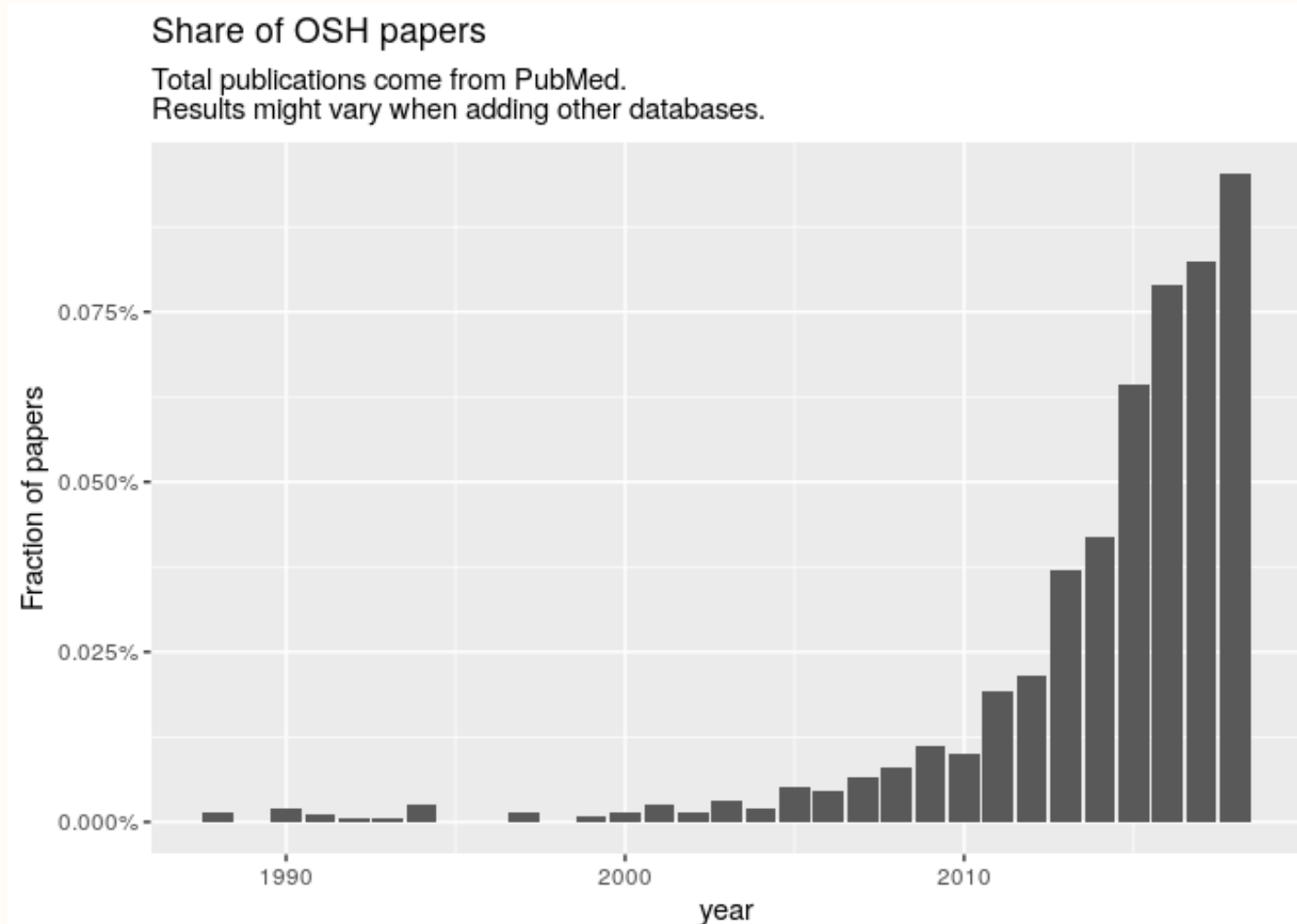
Roughly 2,500 [@MiniscopeTeam](#) Miniscopes have been built since 2016 (not 2011). Putting aside the importance of democratizing access to science & accel. tech. dev. across many labs, this amounts to a ~\$200M savings in public funds compared to if these were purchased commercially.

10:47 PM · Aug 20, 2021 · Twitter Web App

60 Retweets 11 Quote Tweets 380 Likes



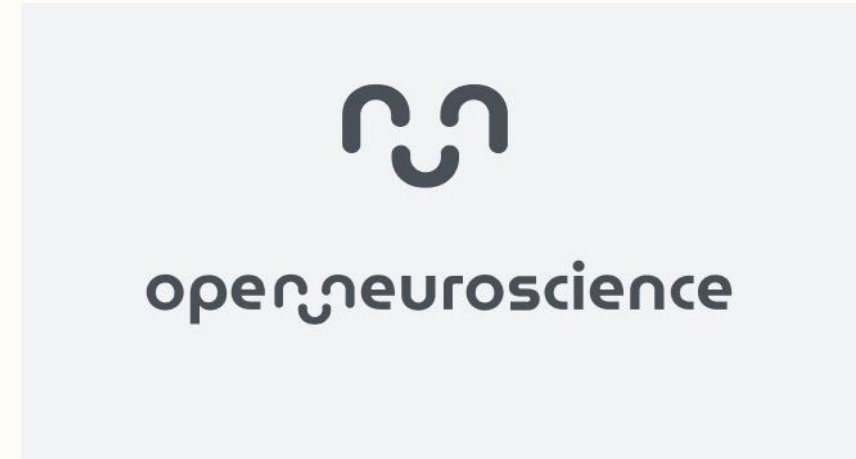
Cambrian explosion of hardware



[Figure by M Andina](#)

Open Neuroscience

- Online curated repository
 - >150 shared projects
 - <https://open-neuroscience.com>
 - Distributed contributors across the world
 - Tech stack itself is open source (<https://github.com/open-neuroscience>)
 - Mastodon@open_neuroscience@fosstodon.org
 - X: @openneurosci
 - LinkedIn: <https://www.linkedin.com/company/open-neuroscience>
- Seminar series:
 - >20 seminars
 - >19.5k visualisations
 - >1.2k watched hours

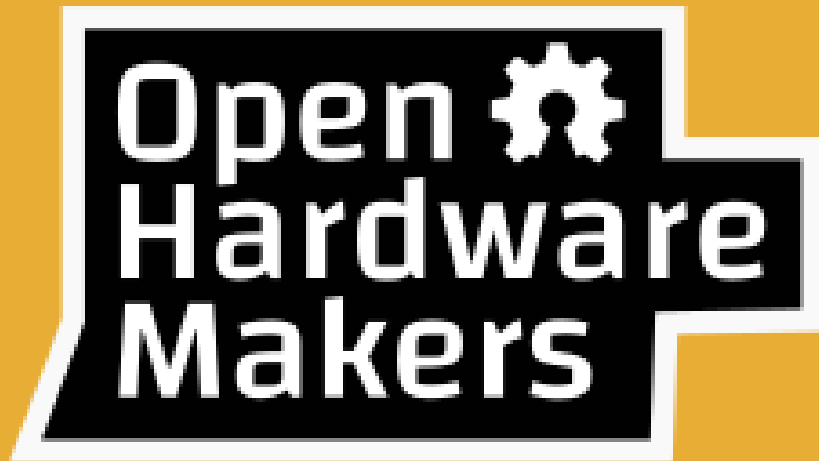


Seminar



Share project

Best practices course/material



<https://openhardware.space>

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Repositories and online communities

- GOSH (<http://openhardware.science/>)
- Open Neuroscience (<https://open-neuroscience.com>)
- Hackaday.io (hackaday.io)
- Instructables (instructables.com)
- Journal of open Hardware (<https://openhardware.metajnl.com/>)
- HardwareX (<https://www.journals.elsevier.com/hardwarex/>)
- Appropedia ([http://www.appropedia.org/Welcome to Appropedia](http://www.appropedia.org/Welcome_to_Appropedia))
- Hackteria (hackteria.org)
- Open Behaviour (<http://openbehavior.com/>)
- The behavioural forum (<https://www.cost-teatime.org/about/thebehaviourforum/>)
- Printables (<https://www.printables.com/>)
- NIH 3D exchange (<https://3d.nih.gov/>)

OH as a tool for development

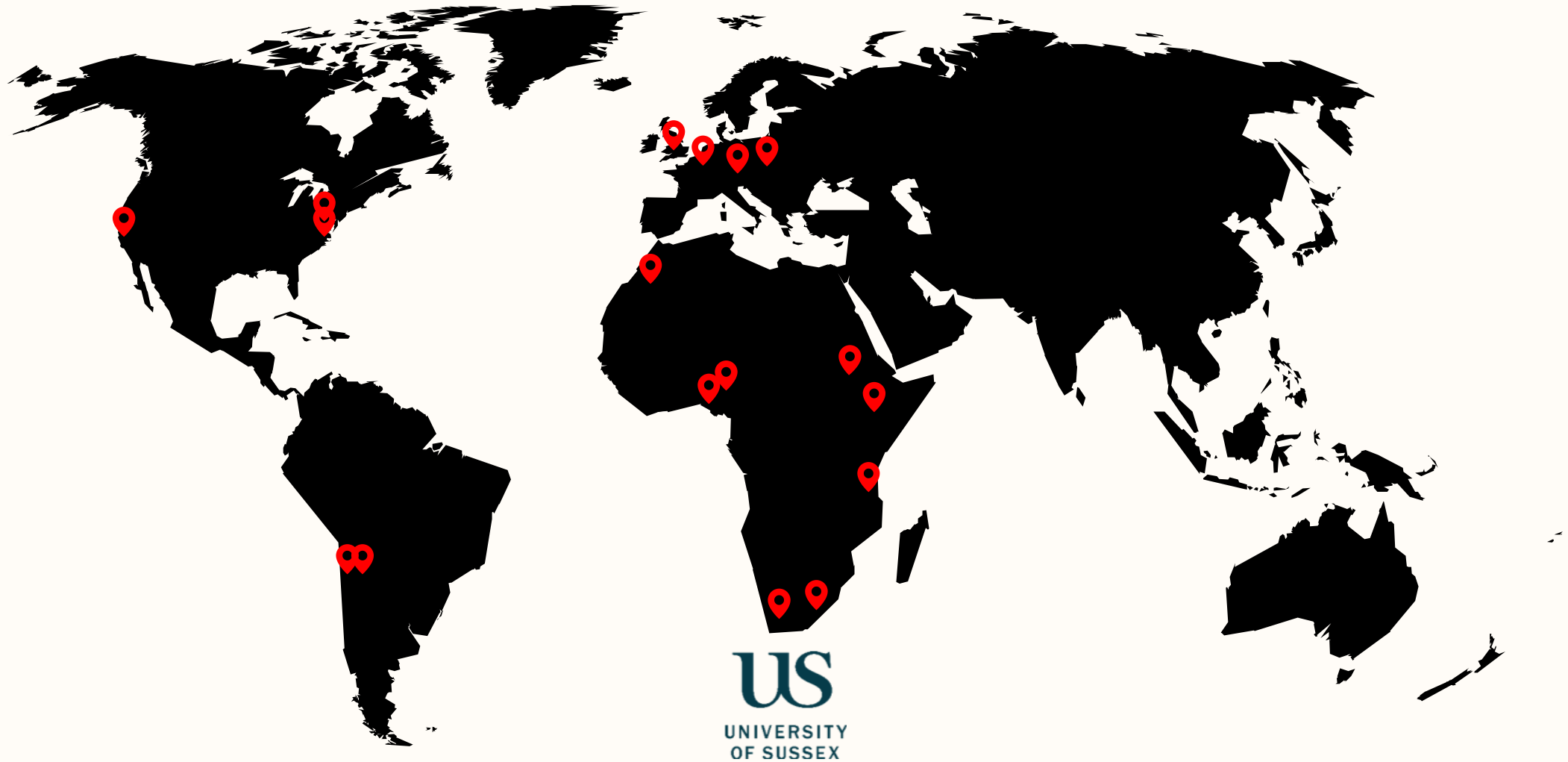




To go far, go together..



Go together



In the last 10 years, ~330 students in intensive Open Source training



Locally developed tools...



Contents lists available at [ScienceDirect](#)

HardwareX

journal homepage: www.elsevier.com/locate/ohx



Hardware Article

Actifield, an automated open source actimeter for rodents

Victor Wumbor-Apin Kumbol^{a,*}, Elikplim Kwesi Ampofo^b, Mary Ayeko Twumasi^b

^aDepartment of Pharmacology, Faculty of Pharmacy & Pharmaceutical Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

^bDepartment of Pharmacognosy, Faculty of Pharmacy & Pharmaceutical Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana



...for data collection

DE GRUYTER

J Basic Clin Physiol Pharmacol 2021; ■■■(■■■): 1–8

Oluwaseun S. Faborode*, Issa O. Yusuf, Paschal O. Okpe, Ann O. Okudaje and Samuel A. Onasanwo

Exposure to prolonged unpredictable light impairs spatial memory via induction of oxidative stress and tumor necrosis factor-alpha in rats

<https://doi.org/10.1515/jbcpp-2020-0160>

Received July 4, 2020; accepted January 23, 2021;
published online April 20, 2021

also revealed significant changes in the concentrations of MDA, SOD, catalase, and GSH levels ($p < 0.05$), not GST. Similarly, there was an increased TNF- α expression



TREND

Fast response in COVID-19

PLOS BIOLOGY

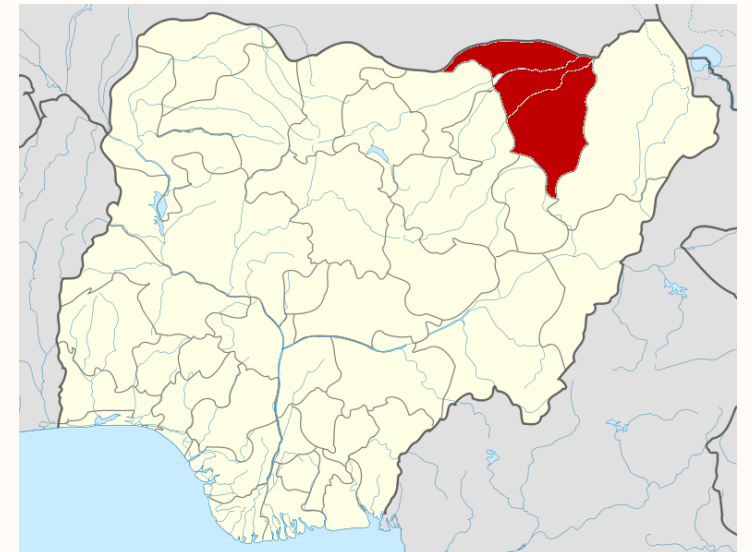
 OPEN ACCESS

COMMUNITY PAGE

Bypassing shortages of personal protective equipment in low-income settings using local production and open source tools

Royhaan Olamide Folarin , Mahmoud Bukar Maina, Abisola Kaosara Akinbo, Tamramat Iyabo Runsewe-Abiodun, Omobola Abioye Ogundahunsi, Ahmed Adebawale Adedeji , Andre Maia Chagas 

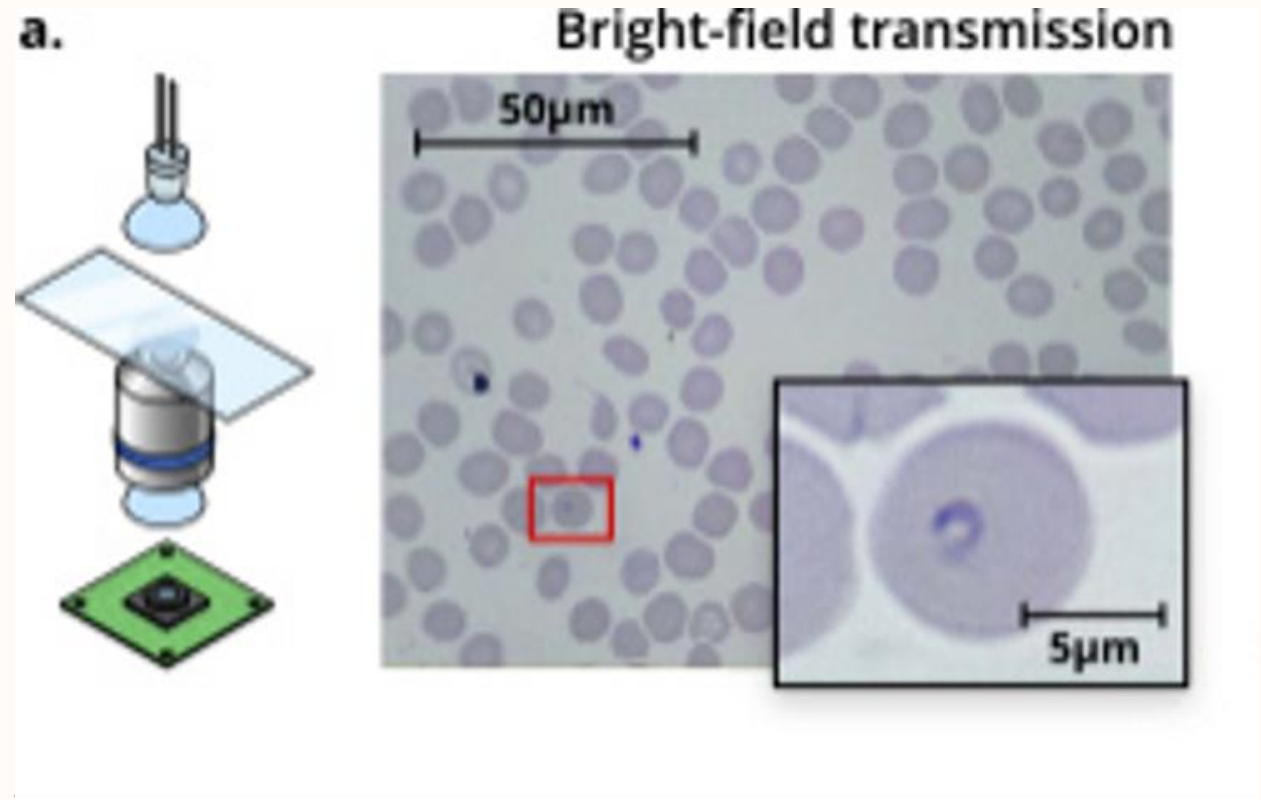
BioRTC



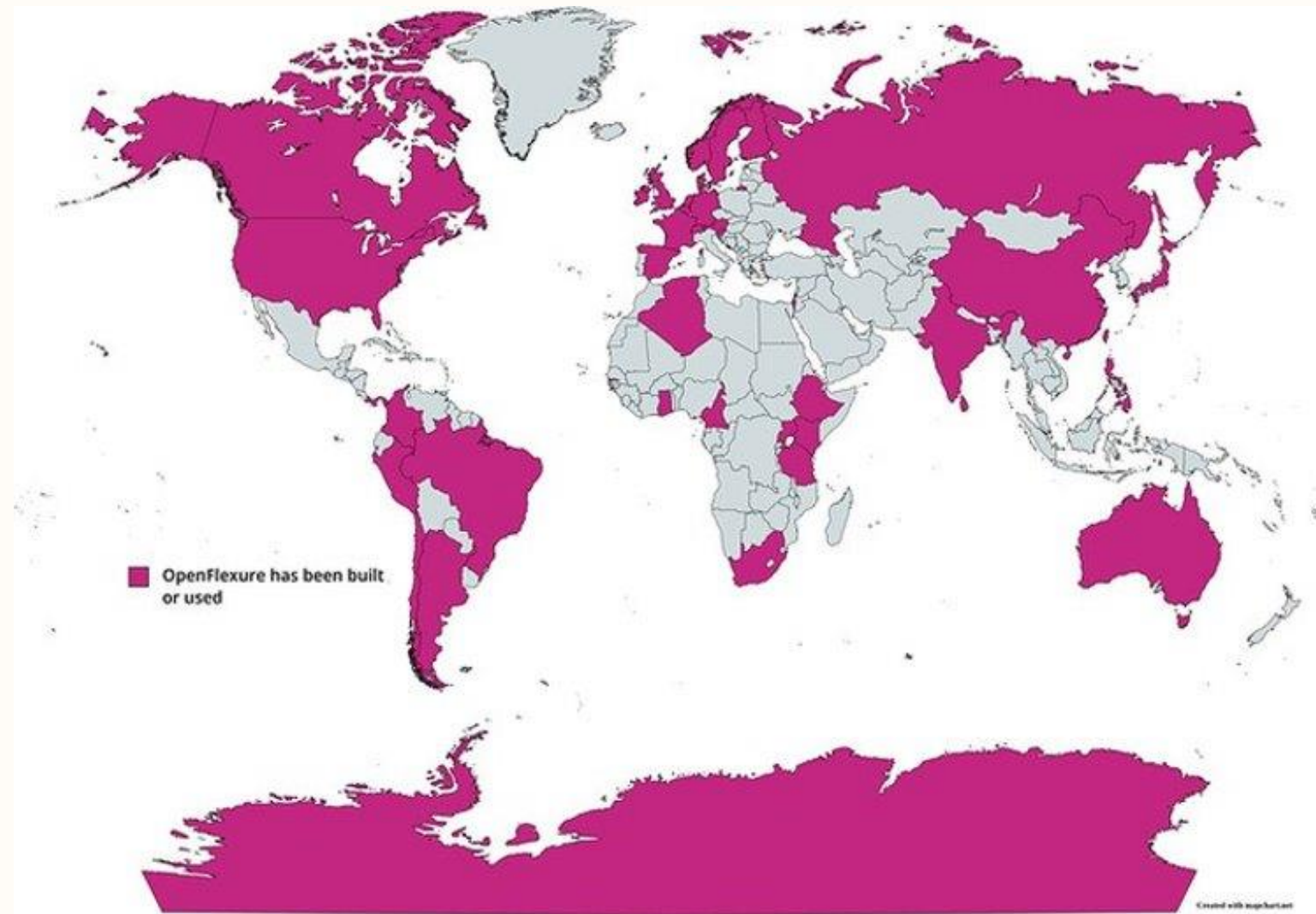
OpenFlexure



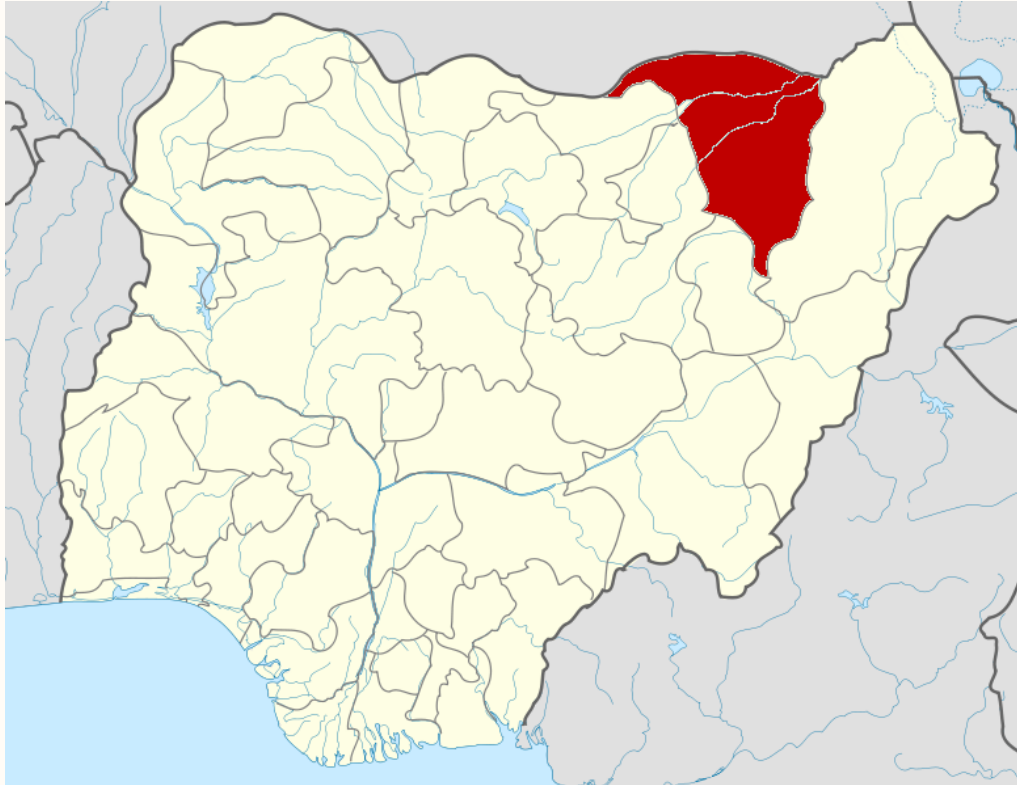
[Sharkey et al 2016](#)



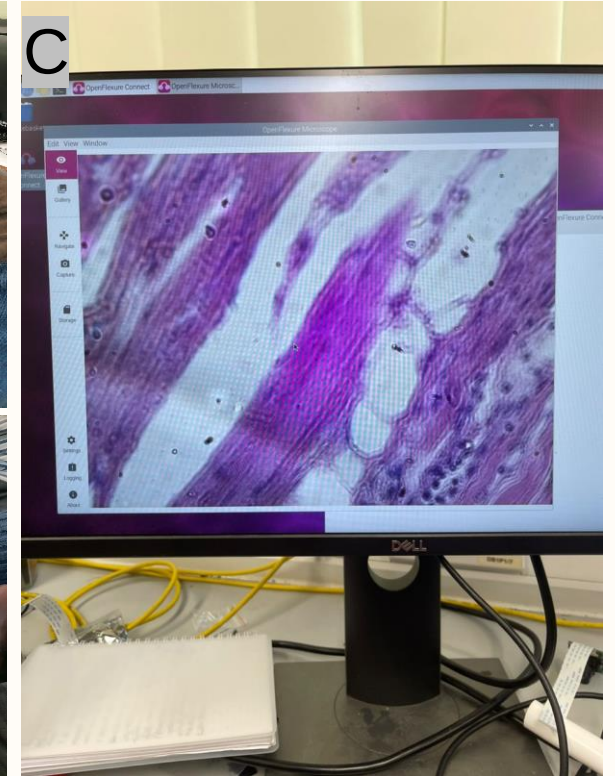
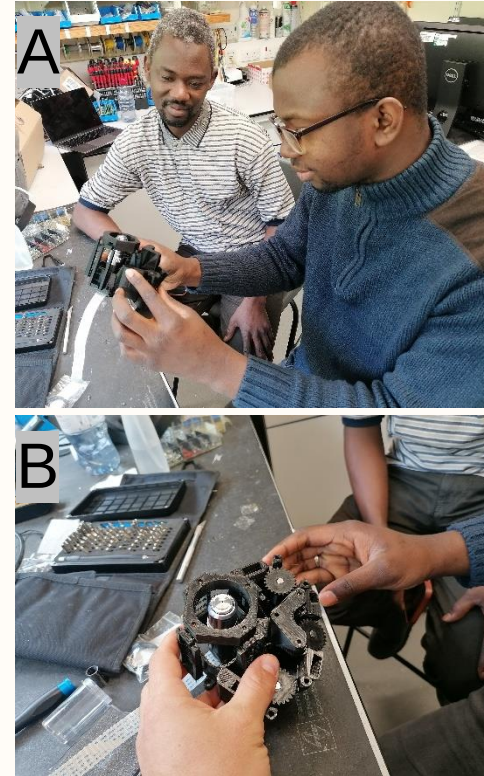
OpenFlexure



Malaria detection using OSH



https://en.wikipedia.org/wiki/Yobe_State#/media/File:Nigeria_Yobe_State_map.png

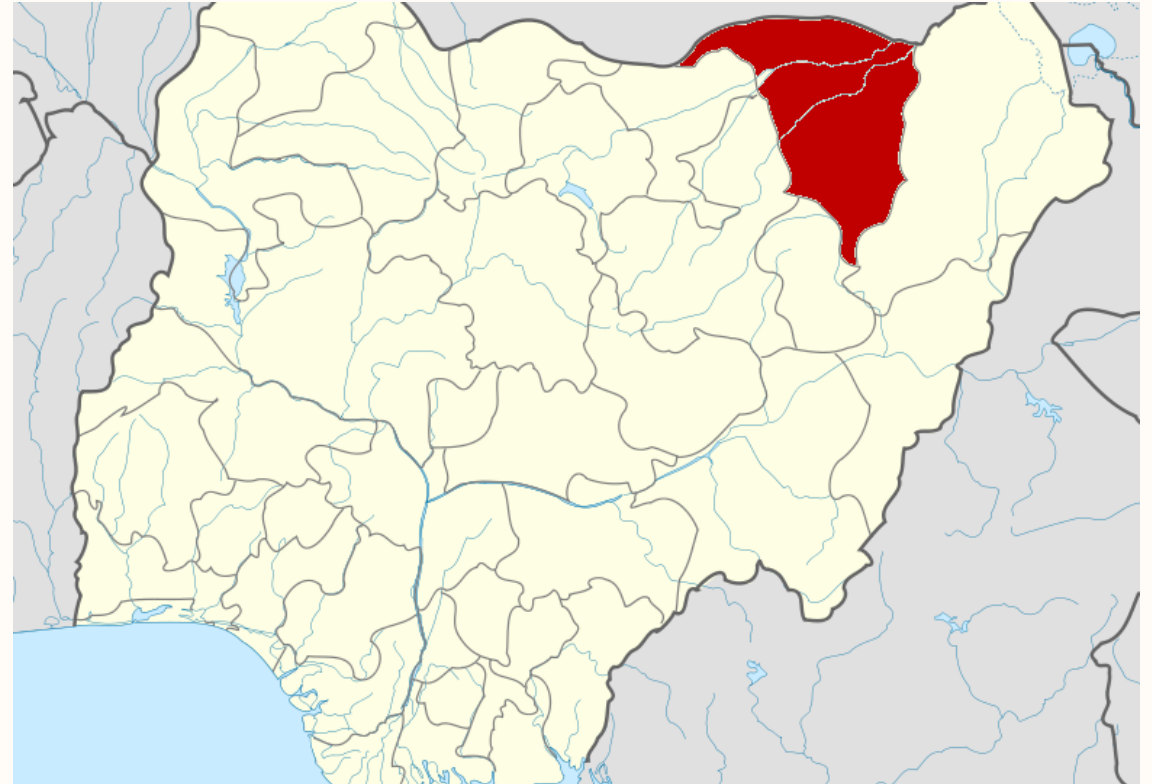


Malaria detection using OSH

Detecting Malaria leveraging open hardware

2025\2026:

- 1) Train ~400 health agents in building, operating, and maintaining OH microscopes and smear making machines
- 2) Telepathology infrastructure in collaboration with Daniel Rosen's team @ University of Houston



https://en.wikipedia.org/wiki/Yobe_State#/media/File:Nigeria_Yobe_State_map.png

Precious Bottles

~ 450 years to degrade
~ 1M bottles sold/minute

- Using open source tech, we are recycling them into 3D printing filament.

Data from

<https://www.nationalgeographic.com/environment/article/plastic-bottles>



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Thank you!



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