

<http://bit.ly/UCSFOSH1>

Building Open Source Scientific Equipment

How researchers are owning their instruments

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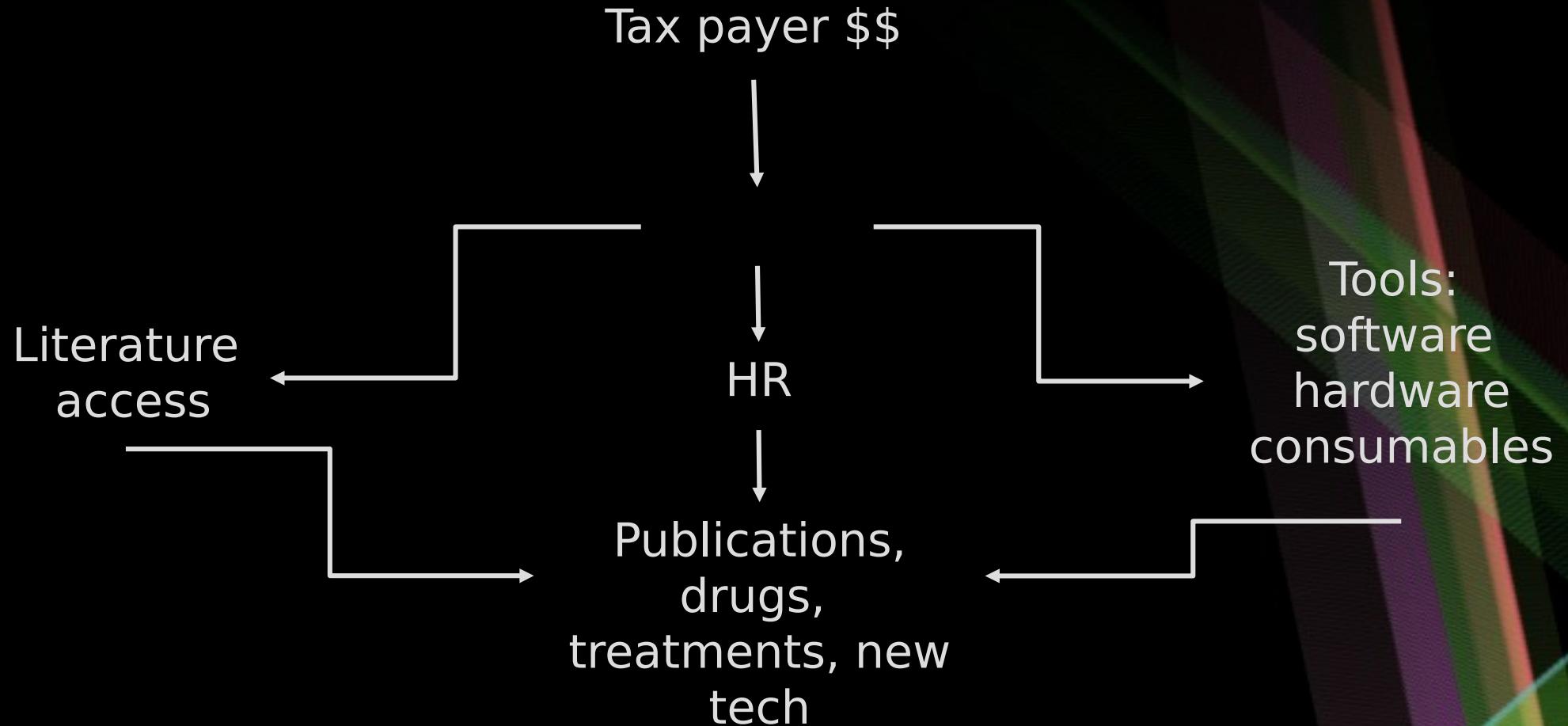
Who am I?

- Biology / Neuroscience
- Advocating Open Science:
 - Open Neuroscience (<http://bit.ly/OpenNeuro>)
 - Trend In Africa
 - Mozilla & FreiesWissen Fellow
 - Mapping scientific equipment demand (<http://bit.ly/BFOSH>)
- Building tools @ BadenLab
 - visual stimulators
 - behavioural setups
 - customizing off-the-shelf equipment

Overview

- How we are funded
- Scientific Hardware
- Example I: Flypi
- Example II: behavioural setup
- Open Science Hardware as the new norm
- Building following demand

How we are funded



How we are funded

Publications, drugs, treatments,
new tech



Patent, copyright



Technology transfer



Distribution/production Oligopoly



High Costs

Scientific Hardware

- First developed in 17th century
 - Pretty much the same design since
- “Research grade”
 - Base model ~5000€
 - Fluorescence +~5000€
 - Optogenetics +~5000€



Scientific Hardware

- Hard to customize
- Hard to repair
- Hard to update
- **Hard to calibrate**
- Only accessible in some parts of the globe



Shuts a lot of institutions/groups out of science/education

FlyPi an affordable all in one lab



PLOS | BIOLOGY

COMMUNITY PAGE

The €100 lab: A 3D-printable open-source platform for fluorescence microscopy, optogenetics, and accurate temperature control during behaviour of zebrafish, *Drosophila*, and *Caenorhabditis elegans*

Andre Maia Chagas^{1,2,3,4*}, Lucia L. Prieto-Godino^{3,5}, Aristides B. Arrenberg^{1,6}, Tom Baden^{1,3,4,7*}

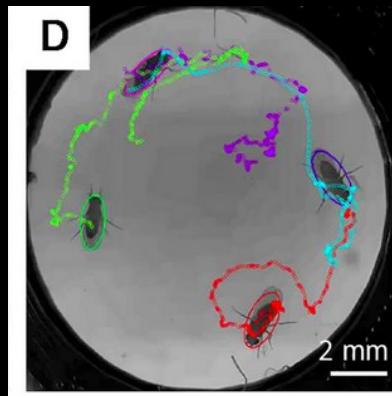
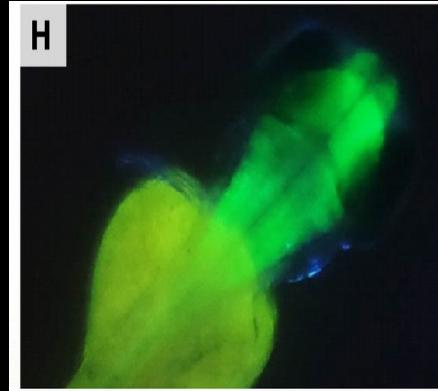
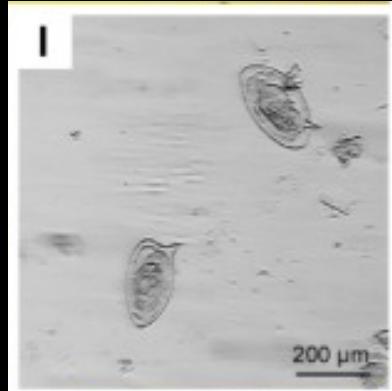
1 Werner Reichardt Centre for Integrative Neuroscience, University of Tübingen, Tübingen, Germany, 2 Graduate school for Neural and Behavioural Neuroscience, University of Tübingen, Tübingen, Germany, 3 TReND in Africa gUG, Bonn, Germany, 4 Institute of Ophthalmic Research, University of Tübingen, Tübingen, Germany, 5 Center of Integrative Genomics, University of Lausanne, Lausanne, Switzerland, 6 Institute of Neurobiology, University of Tübingen, Tübingen, Germany, 7 School of Life Sciences, University of Sussex, Brighton, United Kingdom

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<http://bit.ly/flypios>

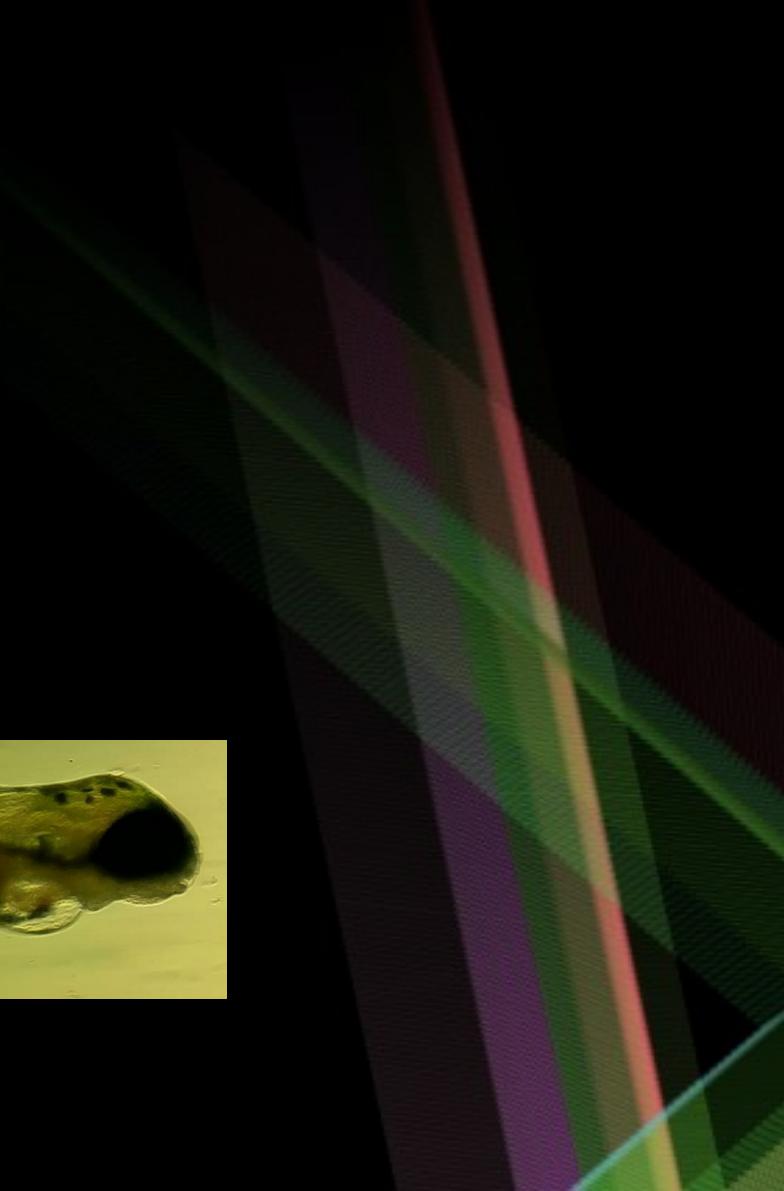


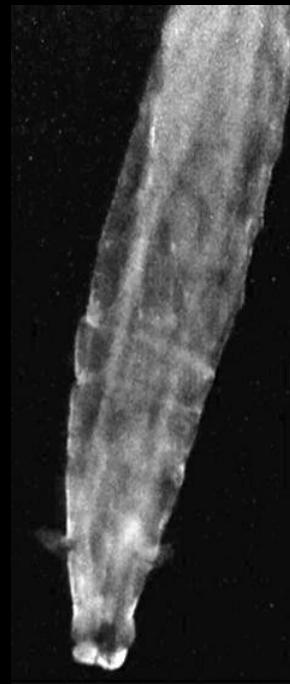
FlyPi an affordable all in one lab

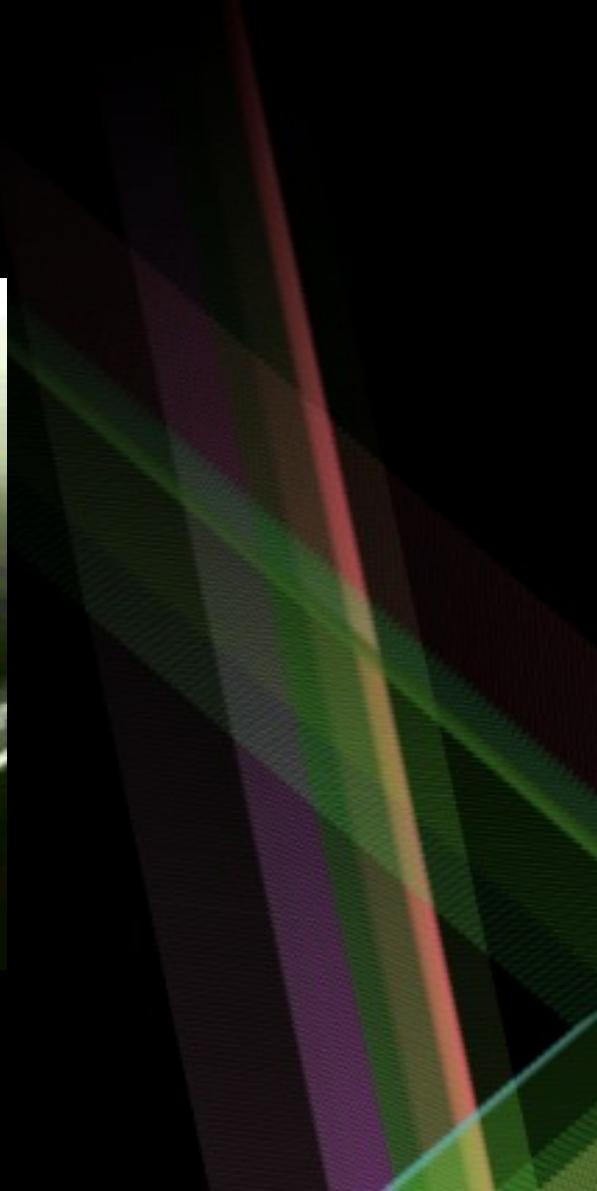


Tracking using C-Trax

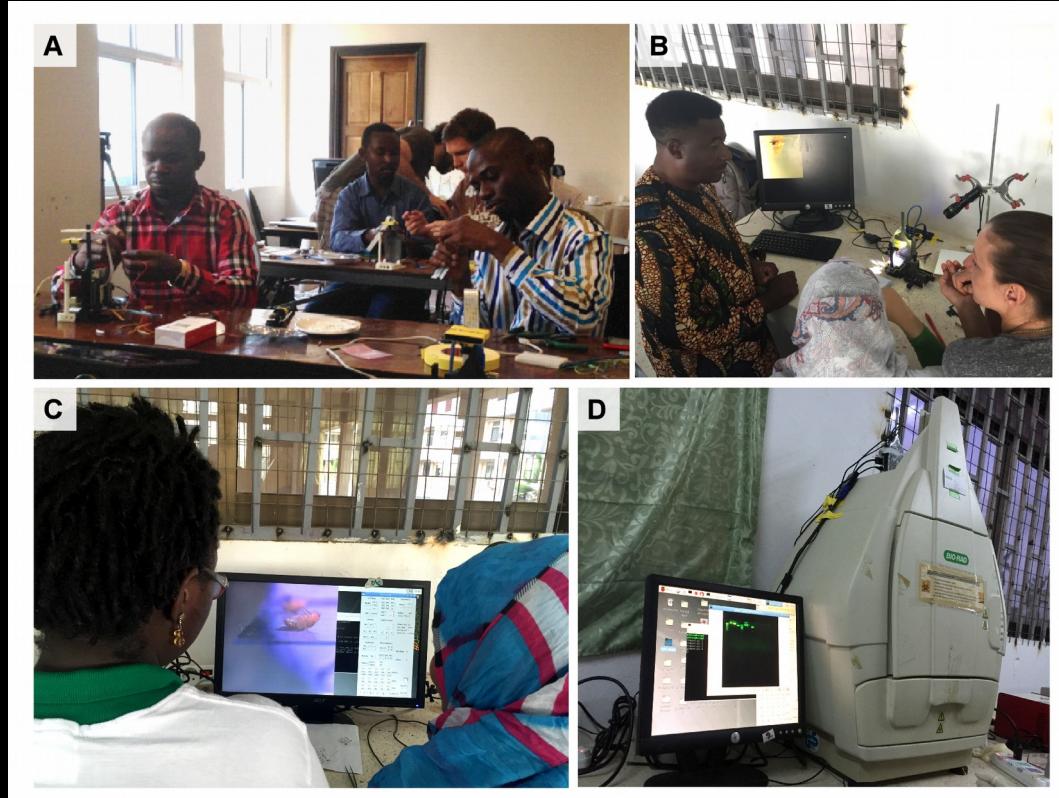
<http://bit.ly/flypipos>







FlyPi an affordable all in one lab



FlyPi an affordable all in one lab



A  B 

Contents lists available at [ScienceDirect](#)

HardwareX

[journal homepage: www.elsevier.com/locate/ohx](http://www.elsevier.com/locate/ohx)

 ELSEVIER

Hardware Article

Actifield, an automated open source actimeter for rodents

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

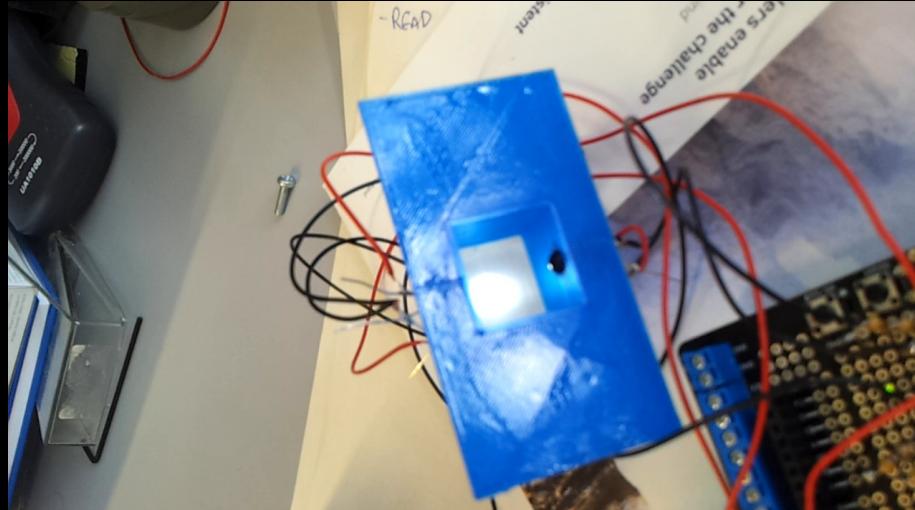
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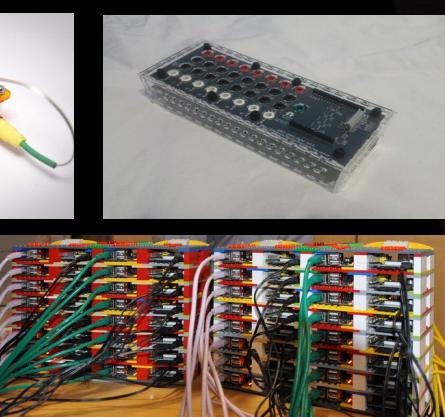
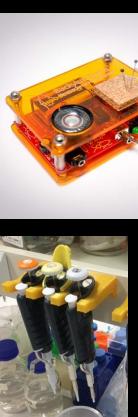
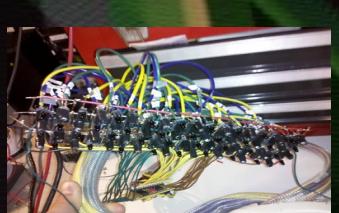
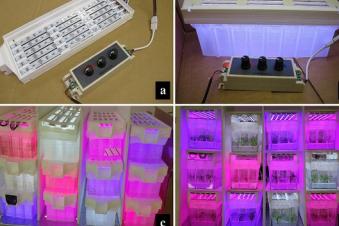
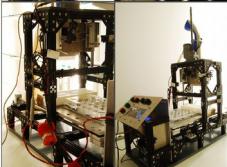
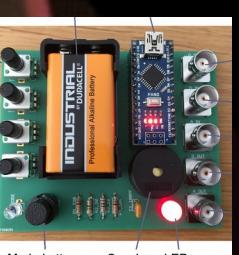
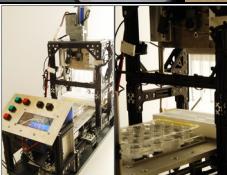
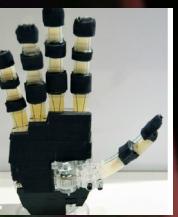
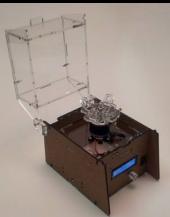
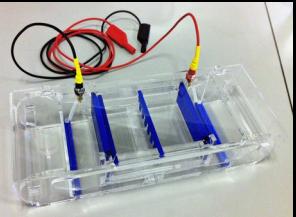
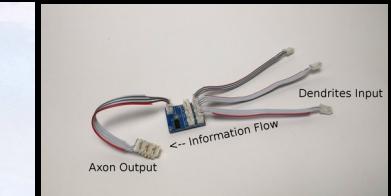
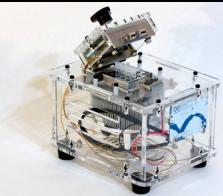


Rodent behavioural setup

- Regular (proprietary)
- 2 PCs (2 x 250€)
- Acquisition card (610€)
- Windows (130€)
- MATLAB (2000€)*
- Microsoft office (100€)
- Total: 3340€
- Open source
- 01 Raspberry Pi (31€)
- Arduino (10€)
- Linux (0€)
- Python (0€)
- LibreOffice (0€)
- Total: 41€

Rodent behavioural setup





Open Science Hardware: New norm?

- GOSH Community (<http://bit.ly/2GR6sqn>)
 - Make Open Science Hardware ubiquitous by 2025

Companies/non-profits providing OS Hardware and services around them



OS Hardware: Living in the “Cambrian explosion”

- Wikipedia >70 projects (only commercial level/big projects)
- In these slides at least another 36
- Many, MANY more in repositories online
- OS tools to create hardware are getting better and easier
 - Software
 - Fast prototyping
- Lower price for manufacturing
- Internet infrastructure
- Sharing videos, tutorials, documentation
- Some companies applying OS business models are >5 years old.

OS in research and education

- “Traditional systems:
 - Expensive (fluoresc. Scope >5000€)
 - One supplier commitment
 - Hard to fix/customize/upgrade
 - One per lab/classroom
 - Costly calibrations
 - Bugs hard to spot
 - Fixed, one size (has to) fit all
- OS systems
 - Affordable (fluoresc. Scope <250€)
 - Buy parts from anywhere
 - Know your tools from inside out
 - Many per lab/classroom
 - Calibrate before every experiment
 - Bugs are easier to spot
 - Adaptable to local realities

Build following demand



- Projects normally start with a local need:
 - one lab, in one department, inside one institution...
- What if we could map the needs researchers have?
 - And build OS Hardware based on that demand?
 - Online survey <http://bit.ly/BFOSH> Please share!
 - Landing page: <https://fosh-following-demand.github.io/en/home>
 - Repos: <https://github.com/FOSH-following-demand>

Contributions and suggestions are welcome!!

Repositories and online communities

- GOSH (<http://openhardware.science/>)
- PLOS Channel (<https://channels.plos.org/open-source-toolkit>)
- Open Neuroscience (openeuroscience.com)
- Open Plant Science (<http://openplant.science/>)
- Hackaday.io (hackaday.io)
- CTA - UFGRS (<http://cta.if.ufrgs.br/capa/>)
- 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)
- Hackteria (hackteria.org)
- Open Behaviour (<http://openbehavior.com/>)

Thanks!

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