Open source approaches to Intellectual Property for faster and more equitable innovation in biotechnology

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Beneficial Bio | Open Science Hardware Foundation
Building a globally inclusive biomanufacturing value chain

Using Open Source Enabling Technologies

Circular economies of resources

Shortening supply chains

Agile, just-in-time production

Open toolkits for distributed biomanufacturing of reagents

Applying open source tools to address Sustainable Development Goals

Policy towards an open, sustainable and equitable global bioeconomy

Featured Project: Open Enzyme Collection

>60 enzymes and DNA parts for manufacturing essential research reagents.

Featured Project: CRISPR TyphoidDx

Novel partnerships for diagnostic development and manufacturing in Cameroon.

Featured Project: Advancing Open Science Hardware

Policy for open science hardware in research, technology transfer and sustainable development.

Aish Venkatramani

Ana Pascual Garrigos

Yan Kay Ho

Minette Shalo

Felipe Buson
What does “Open” mean?
universal access

e.g. availability of specific molecular tools unencumbered by intellectual property;

universal participation

e.g. greater involvement of stakeholders in shaping projects using those tools;

collaborative production

e.g. multiple partners working together for a common goal

How do we make technology “Open”
**Terms of the Licenses**

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A simple, standardized legal tool that enables individuals and organizations to share their materials on an open basis. http://openmta.org
In what context and by what mechanisms can open source sharing help generate impact?
Why open source approaches?

- **accelerating R&D**
  reducing friction in access to knowledge and materials

- **user innovation**
  more diverse ideas, expanding pool of developers

- **focusing on value-add**
  know-how, collaborations and community, using the technologies, building trust and buy-in
Why not open source approaches?

need for capital
open source can be a route to profit but it is often not a route to maximising profits - monopoly is quite effective at this

need to defend or control
some projects use patents to maintain values of quality and equitable distribution under certain conditions.

it won’t be used
if it is a distraction or no one will adapt or use it, the effort needed to document an open hardware project is wasted.
What are effective collaborative engineering approaches?
Collaboration & co-creation

- **coordination challenge**
  people and things

- **navigating resources, power**
  different levels of resources, power and collaborative approaches

- **documentation**
  months can get lost to poor documentation, documenting know-how is hard
Reducing dependencies

production of the means of production

considering succession and endgame

balancing local autonomy and globalisation
Access to reagents through local production in Cameroon
Supply chain for laboratory reagents

Export of laboratory reagents (HS 3822) in 2018

Geographies of synthetic biology innovation

24000 papers containing “synthetic biology”

1128 from low and middle income countries [exc China]

Data: lens.org
Low and middle income countries were defined by the OECD DAC list.
Breakdown by region: Asia [exc China]: 653; Latin America: 357; Africa: 118
“The collapse of global cooperation [has] shoved Africa out of the diagnostics market. African countries have funds to pay for reagents but cannot buy them.”

John Nkengasong
Director, Africa CDC
Freedom to operate landscape

14,000,000 patents

1% registered in the global South

Data: lens.org
99% have rights in fewer than 20 countries
DNA polymerase
Primers
dNTPs
Buffer
DNA
One problem to address: supply chain for reagents

Export of laboratory reagents (HS 3822) in 2018

One problem to address: supply chain for reagents

Export of laboratory reagents (HS 3822) in 2018

“The gap in terms of research, research output, access to tools like enzymes and equipment couldn’t be wider.”

Lenshina Agbor
PhD Candidate
Newcastle University
Goal: increasing resilience and autonomy through a distributed supply chain
Technology accessible product and manufacturing technologies

Community networks for knowledge exchange and distribution

Enterprise mission-driven companies to deliver access at scale

Access
Open Enzyme Collection

Promoter
Tag
Reporter
Cleave
CDS
 Terminator

His
Silica
Cellulose
Chromoproteins
Fluorescent proteins
Enzymatic
Inteins
TEV
SUMO
Polymerases
Ligases
Reverse Transcriptases

10
31
5
>60

Designed by
Synthesised by
Distributed under
Funded by

OPEN BIOECONOMY LAB & many collaborators!
FREE GENES
Open MTA
SHUTTLEWORTH FOUNDATION
EPSRC
BBSRC
The Research in Diagnostics Collection is made available under an Open Material Transfer Agreement (which allows commercial use) and via Free Genes at no cost. It is now in **185 labs in 41 countries**, enabling research in diagnostics despite supply chain disruptions. Examples include:

**Joint research into LAMP and RPA for SARS-CoV-2 diagnostics in Chile and Peru.**

**Lowering the cost of ViralALERT, an assay that was a finalist in the X Prize for Rapid COVID Testing.**

**Underpinning development of BioENGINE, a UK-Africa synthetic biology and diagnostics course.**

**Type**

| 6 | Promoters |
| 8 | Affinity Tags |
| 2 | Reporters |
| 4 | Cleavage |
| 3 | Terminators |
| 20 | Coding Seq |

**Examples**

- pDawn: light inducible
- cl857_PL/PR: heat inducible
- R5: silica binding
- CipA: cellulose binding
- fuGFP: green fluorescence
- AmiCIP: blue chromoprotein
- TEV site: TEV protease
- HuyMCM2aa: salt-cleaved intein
- TZ: Strong triple terminator
- T7term: late T7 terminator
- OpenVent, Bst-LF, HIV-RT, MMV-RT, RNaseH, TEV Protease, HRP, T7 RNA Polymerase, Bsu, gp32, UvsX, UvsY, PBCV-1ligase.

**Fig 1:** Research in Diagnostics Collection syntax for MoClo Assembly.
Autoinduction using milk

Autohydrolysis (light-inducible)

Fresh 6 8 MW 4 6 8 Hours

OpenVent

Ladder 1 2

kb 8-10 5-6 4 3 2 1.5 1 0.5
Protein expression analysis - SDS-PAGE

1 plate = 1000s PCR Reactions

*OpenVent (89KDa)
Hyperlocal discovery, innovation, manufacturing
Bridging the digital-physical interface for bio-collaboration
Automation with **OpenTrons**

Increasing supply options
Opentrons
Lab robots for Biologists

- Brooklyn, NYC
- https://opentrons.com
- info@opentrons.com

Overview| Repositories 62 | Packages | People 9 | Projects

Pinned

- opentrons
  | Public |
  | Software for writing protocols and running them on the Opentrons OT-2
  | TypeScript | 235 | 121

- ot2
  | Public |
  | Open source hardware documentation for the OT-2 liquid handling robot
  | 33 | 12

- SmoothiewareOT
  | Public |
  | Forked from Smoothieware/Smoothieware
  | C++ | 5 | 5
Lab platform Opentrons closes $200M series C to build out robotics, diagnostics, cell engineering services

by Andrea Park | Sep 23, 2021 10:10am
Since 2004 the SGC has operated an Open Science approach to research for the purposes of furthering research into human disease and drug development.

We work globally with academics and industry on early stage drug discovery with a zero patent policy allowing swift collaborations to be established.
How can we as researchers increase opportunities for technologies to generate positive impacts within health systems?
Taking Pragmatic Action
Technology

- Co-creation with end users - we have heard a lot about this today
- Think about quality and regulations early (early) on in your tech development
- The technology probably won’t be the hardest part.
Impact in the world

- Good Governance
- Social Organising
Exciting experiments are underway

Global Access Health (GAH) is a social enterprise that will seek to expand access to affordable state-of-the-art medical technology through decentralized research, development, and manufacturing in and for the Global South.
Replication

Affordable, Accessible Reagents & Support

Increased demand for reagents and support

Enables further investment

Increased investment & innovation activity

Increased research productivity

Catalyses

Use our distributed manufacturing platform to catalyse a virtuous cycle
Policy Engagement

World Health Organization

COVID Technology Access Pool

TECH ACCESS PARTNERSHIP

medicines patent pool
OPEN COVID PLEDGE

ACT accelerator
ACCESS TO COVID-19 TOOLS