HTGAA Bootcamp

Accessible Protocols

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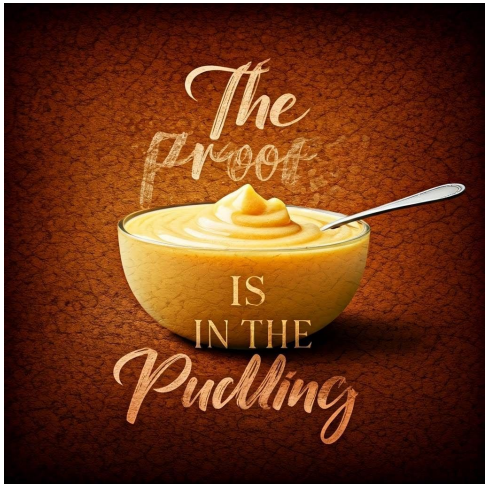
Goals

1. Offer a potential path to global students that do not have access to a well equipped lab or to students that have access to a lab but reagents are unaffordable

2. **Create a starting point for developing low cost protocols** for HTGAA

3. Offer a path to independent research and experimentation

Molecular biology particularities



- Molecular biology is a highly experimental science. That, in a sense is very liberating
- In molecular biology, like in cooking “The proof is in the pudding!”
- Problem! Many students and researchers in underfunded circumstances lack access to essential resources for labs.
- Potential Solution: Using alternatives and substitutes

Why Accessibility in Biology Matters

- **B**iology is fundamental to understanding and solving global challenges (e.g., health, environment, biotechnology).
- Accessible science education would provide equal opportunities for all students, regardless of their financial background.
- Goal: Empower students to perform molecular biology experiments without constraints of cost or lack of access.

Resource types: Devices, Reagents, Labware, Others

Devices: Commercial ones starting from 100$ to 100K

Some easy to make in the DIY sphere

Some, especially the ones that need metal parts are hard to make

Some can be bought second hand and they usually need repair, Ebay a decent source

Labware Ex, Petri Dishes, tubes etc

Usually affordable with places like Amazon and Aliexpress offering them for under 10$. Labware is not a high accessibility barrier

Reagents - generic name for ‘substances’ used in molecular biology

Can be inorganic: Ex salt, Can be organic: Ex enzymes, organisms etc

Challenges :

Reagents can be very expensive usually hundreds to thousands of $ for regular experiments

Many companies do not sell reagents to public, Some reagents require cold-chain transportation

DIY Devices for Molecular Biology

Disadvantages:

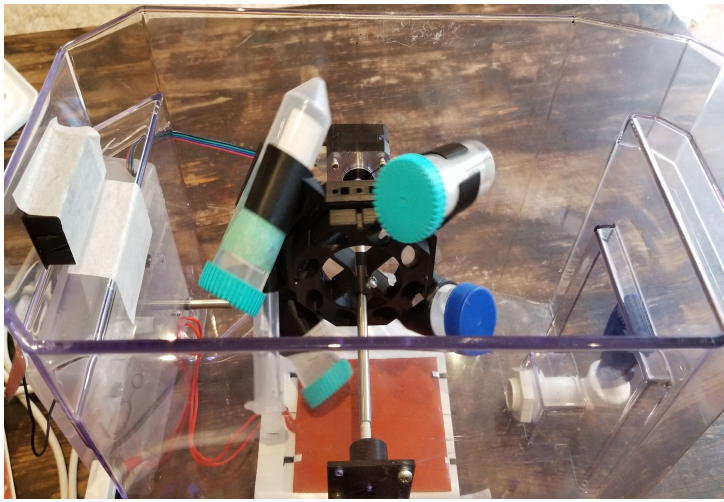
It takes time and skills to build

- Can be more difficult to use
- Can have a lower precision

Advantages

- Less expensive (usually) and sometimes affordable
- Easy to fix
- Easy to extend and add new functionality

Quality? It depends. It's not easy to find reliable, tested DIY versions



Science is often done with DIY devices. Kary Mullis the inventor of PCR did dot buy a PCR machine. Louis Pasteur did not order his labware but had to design and build it.

Accessible protocols

- This is an attempt of offering a path to external students that do not have access to a well equipped lab
- These are experimental at this point and only a handful are validated
- Not all the in-class labs have an equivalent accessible protocol
- Many countries have different rules for handling different organisms and levels of bio-security That is the responsibility of the student. The onus is on the student to comply with local regulation
- While trying to follow the spirit of the in-class labs, some of the protocols do not offer alternatives for all the steps
- Accessible is a relative term. Our goal was to develop protocols that are under 100-200$ per experiment and usually an order of magnitude less expensive than the in-class students protocols
- We hope we will learn from this experience and add more alternatives as we go so we invite you to contribute suggestions

Accessible protocols

- We do not have all answers as this is a difficult task
- We tried to test all these but not all options are tested at this point
- We tried to offer 2 options for the devices: a **minimalist** one usually done with existing implements with little modification and a **full function** one that requires building skills and sometimes equipment
- We try to offer 2 options for reagents:
  - A **minimalist** one that usually involve reagents from the pharmacy or grocery stores
  - **A full function** one that requires purchase of reagents from alternative sources

Sample of minimalistic lab

materials page. That contains tested references or designs from reliable sources.

Plate making

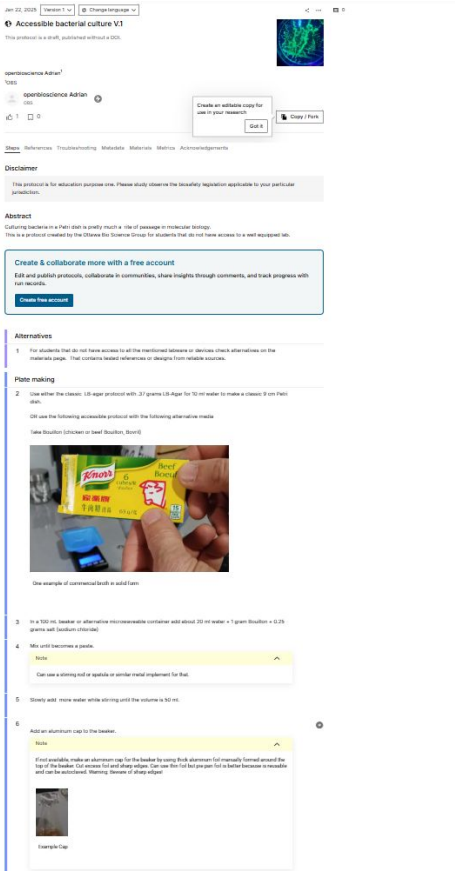
2 Use either the classic LB-agar protocol with .37 grams LB-Agar for 10 ml water to make a classic 9 cm Petri dish.

OR use the following accessible protocol with the following alternative media

Take Bouillon (chicken or beef Bouillon, Bovril)

One example of commercial broth in solid form

3 In a 100 mL beaker or alternative microwaveable container add about 20 ml water + 1 gram Bouillon + 0.25 grams salt (sodium chloride)



Accessible bacterial culture V.1

Disclaimer

Abstract

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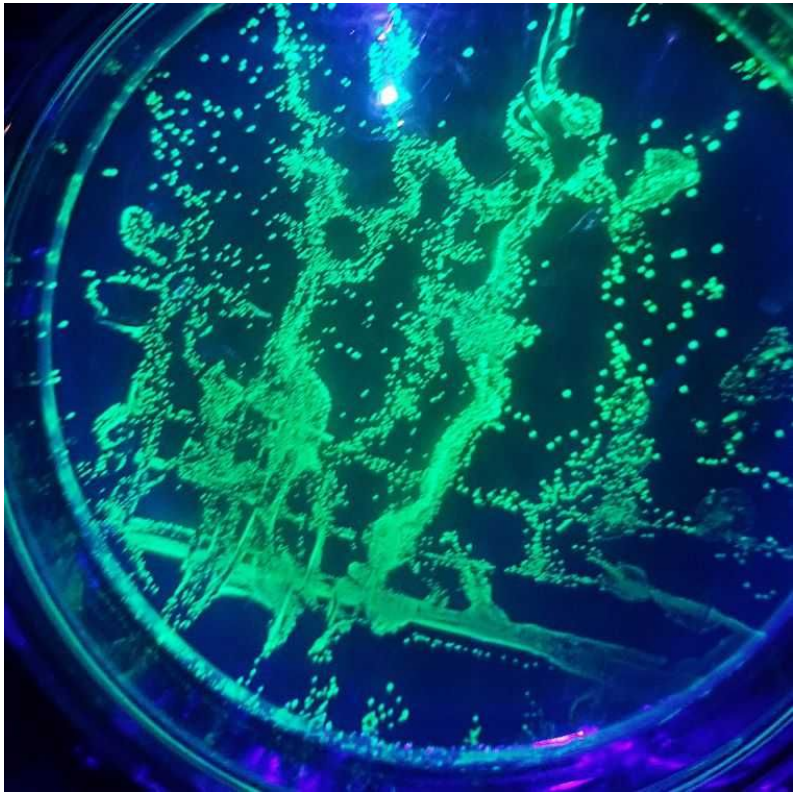
Alternatives

Plate making



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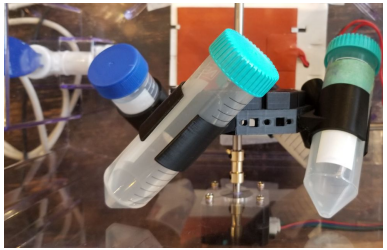
Some Resources

- Open Bioeconomy Lab. Build technologies for an open, globally inclusive and equitable bioeconomy
- HardwareX: A journal dedicated to open-source scientific hardware. It features highly detailed, validated designs for molecular biology tools
- **GitHub. Search for molecular biology. Some of my projects.**
- Universities: for instance University of Utah. https://learn-genetics.b-cdn.net/labs/gel/build_gel_box.pdf



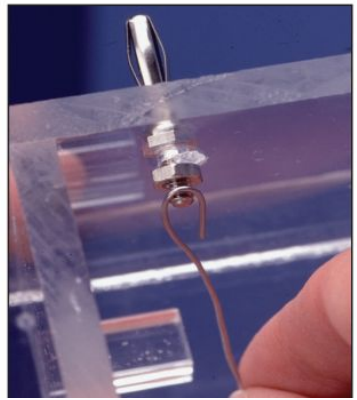
Module

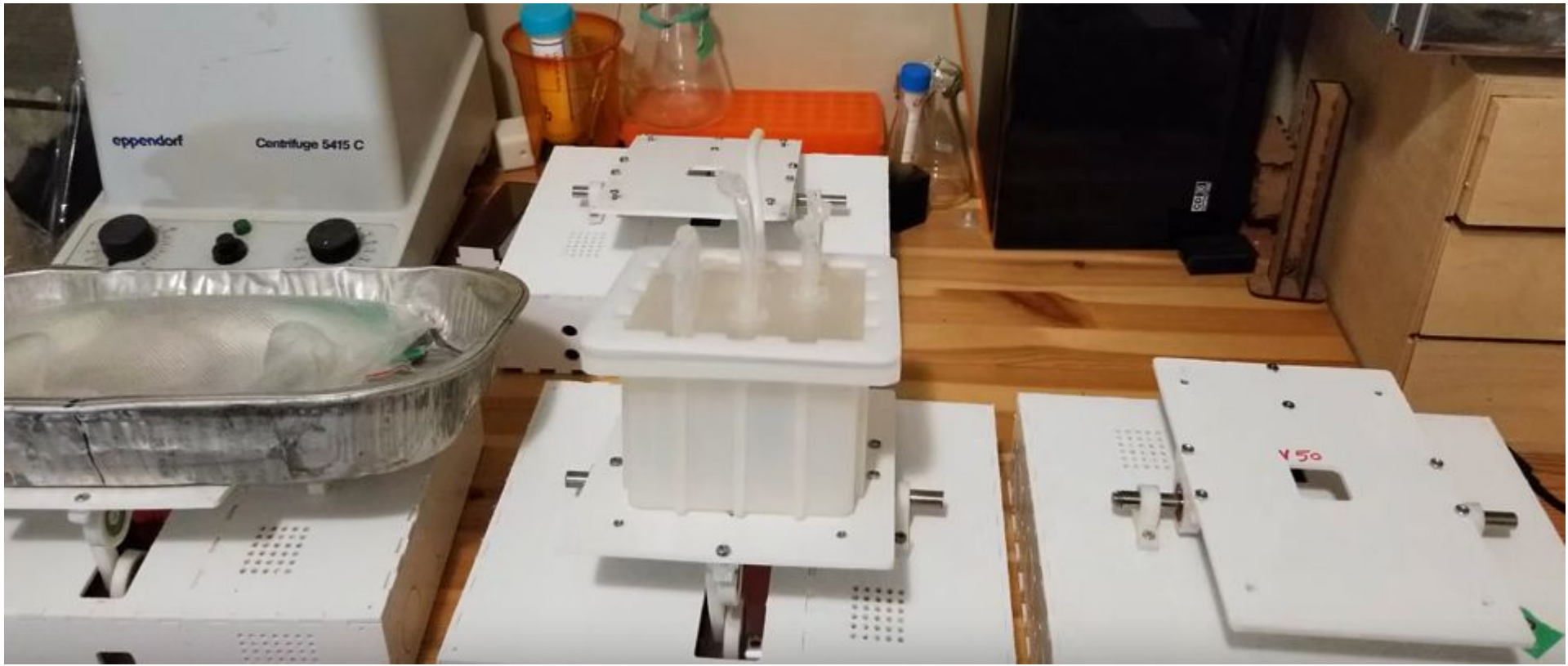
Do It Yourself Genetic Research

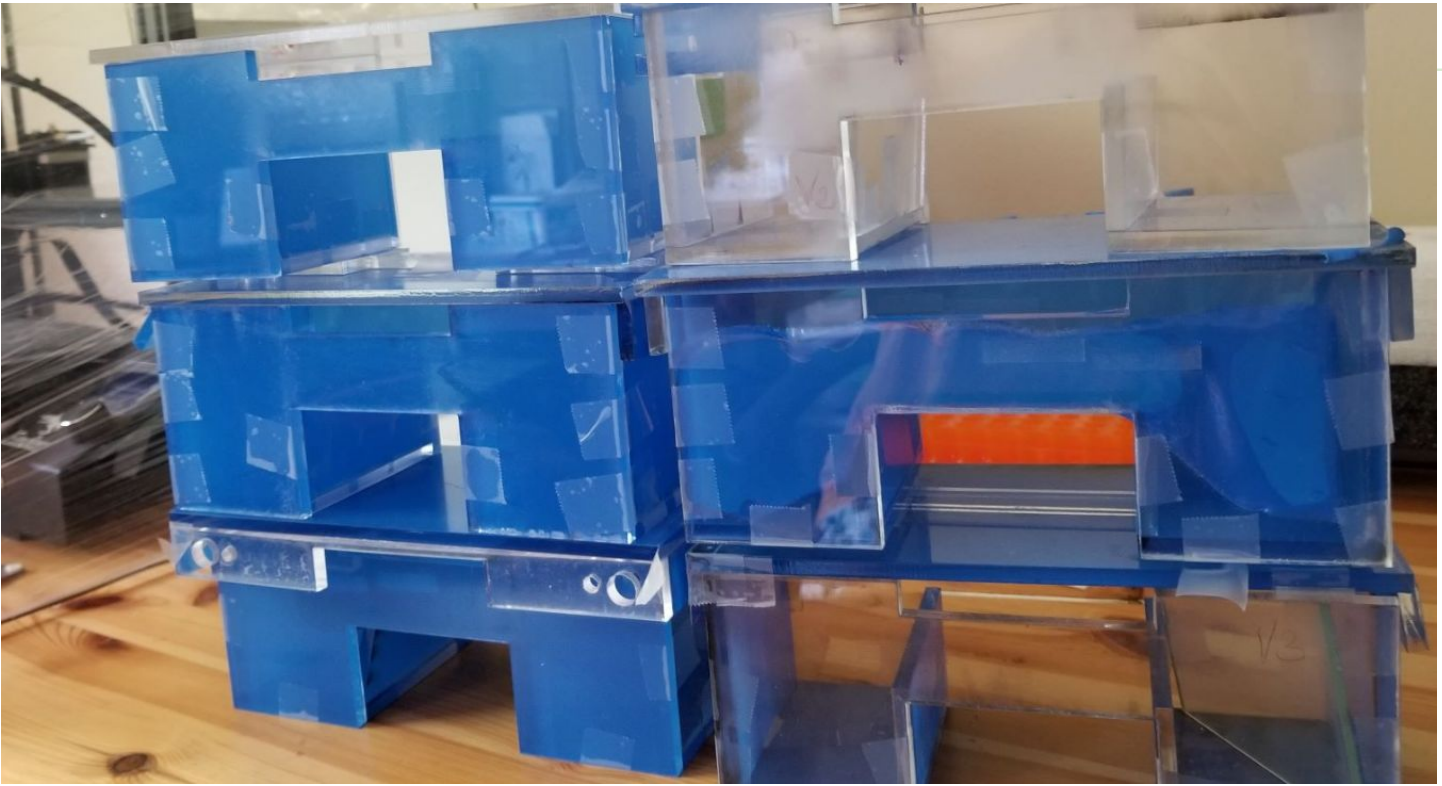
http://gslc.genetics.utah.edu Learning Center

Build a Gel Electrophoresis Chamber

1. Install a Standard Banana Plug in each of the two holes you drilled in the Electrophoresis Chamber Long Side. The Plug ends should face outward, with a nut on the inside of the chamber. Use a small adjustable wrench to help tighten the Plugs in place.
2. Place the second nut on the threaded side of the Plug but do not tighten it.




eppendorf
Centrifuge 5415 C



Thank you for your attention !