E. chrono

Vanderbilt Microfluidics

iGEM 2014

New Track, New Team

- Vanderbilt iGEM was formed this past February by a group of freshmen interested in research
- Collaboration between Vanderbilt iGEM and the Vanderbilt Institute for Integrative Systems Biology Research and Education (VIIBRE)
- Dealt with many hurdles this past year, not just in research

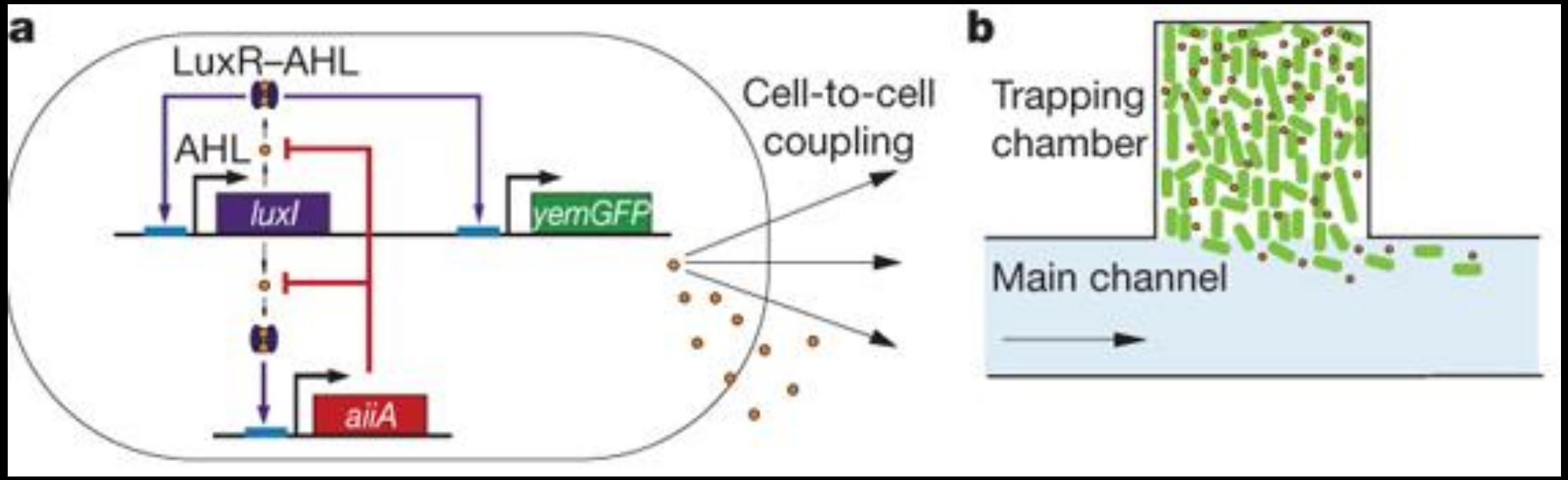
What are microfluidic devices?

- Leverage microliter quantities of fluids to enable high throughput experiments
  - Individual cell manipulation
  - Genetic circuit assembly
  - Organ-on-a-chip devices (OoC)

Big Bold Plans: *E. chrono*

- Develop an integrated synthetic biology and microfluidic platform
- Leverage genetic circuits combined with engineering to take synthetic biology to new heights

Quorum sensing leads to a cool idea



Credit: Figure 1, Danino, T.; Palomino-Mondragon, O.; Tsmiring, L; Hasty, J *A Synchronized Quorum of Genetic Clocks*. Nature 2010, 463, 326-330.

Build a fluorescent *E. coli* watch

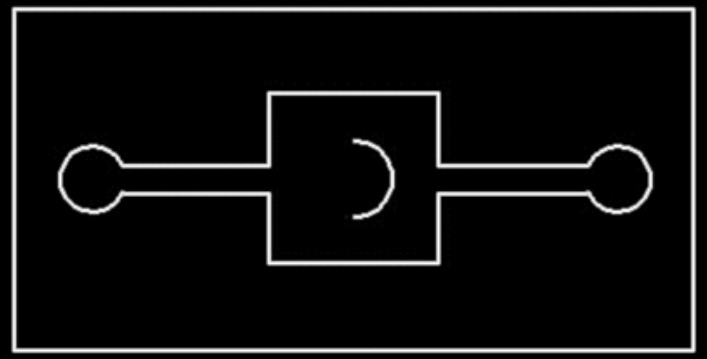
- Team member Sam Budoff calls and gives me the crazy idea to make a watch
- With the idea in hand, all we needed now was the how
- Combine microfluidics technologies seamlessly with synthetic biology and genetic circuits

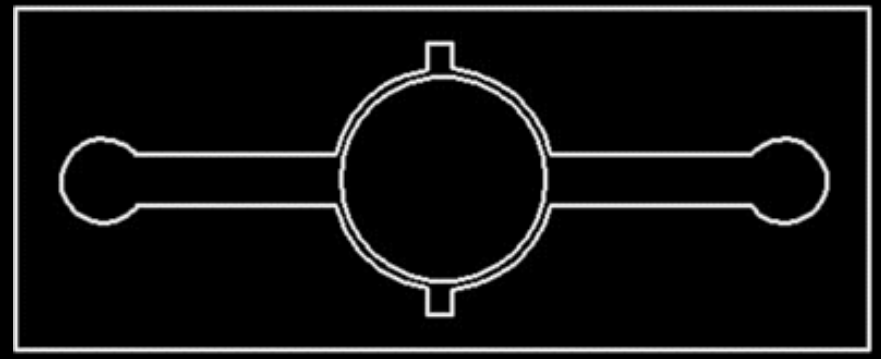
Purpose

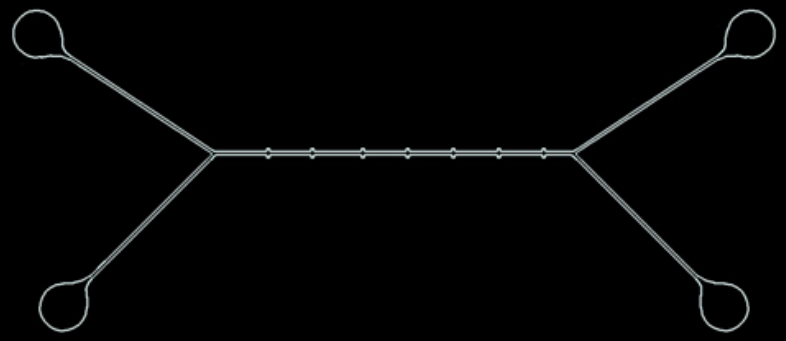
- There were three main goals for our project:
- Learn the microfluidic design and development process and pass this knowledge on to college and high school students
- Investigate methods of microfluidic device fabrication easily accessible for future iGEM teams to utilize
- Develop novel microfluidic devices capable of manipulating cells for use in an *E. coli* watch

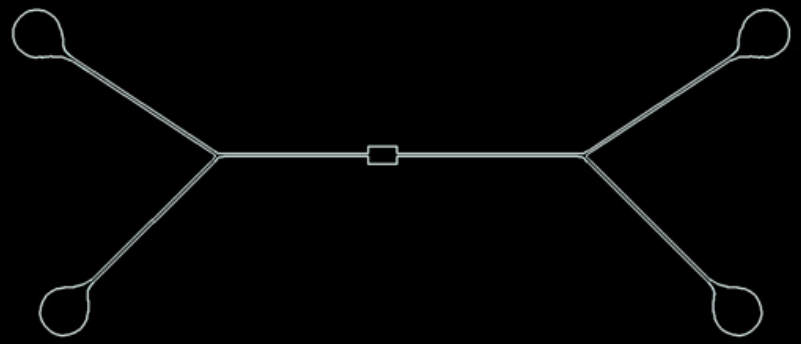
Designing Devices

- Develop our own devices using AutoCAD and Inkscape









Standard photolithography is slow and expensive

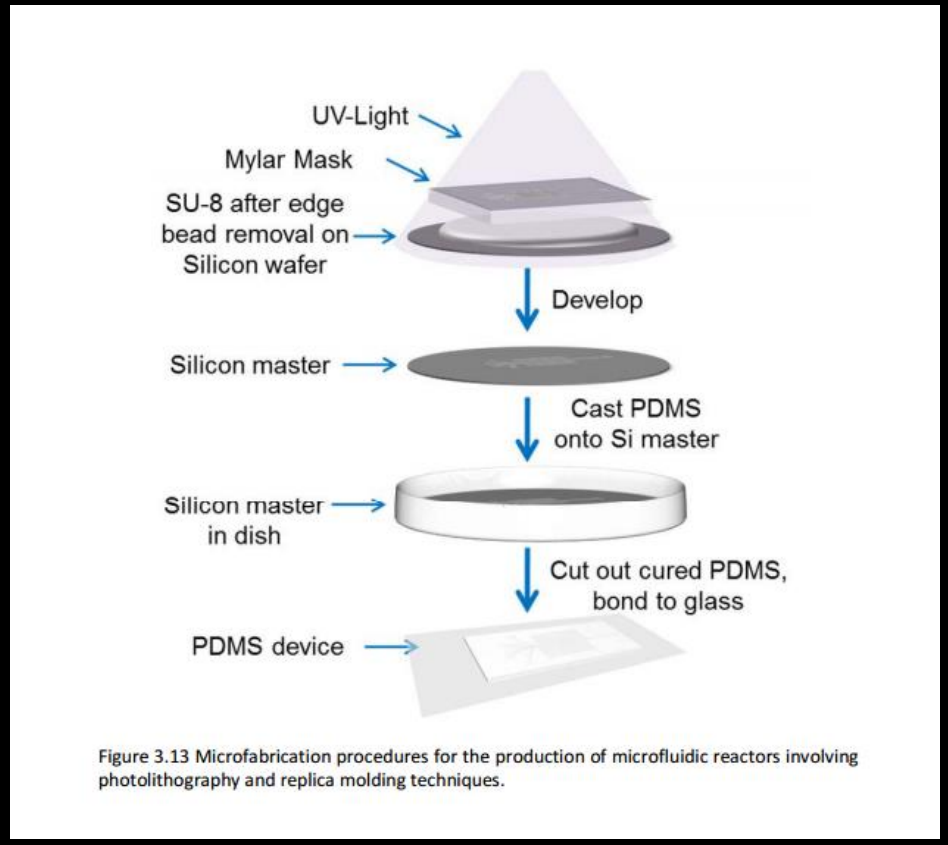


Figure 3.13 Microfabrication procedures for the production of microfluidic reactors involving photolithography and replica molding techniques.

Foil embossing method

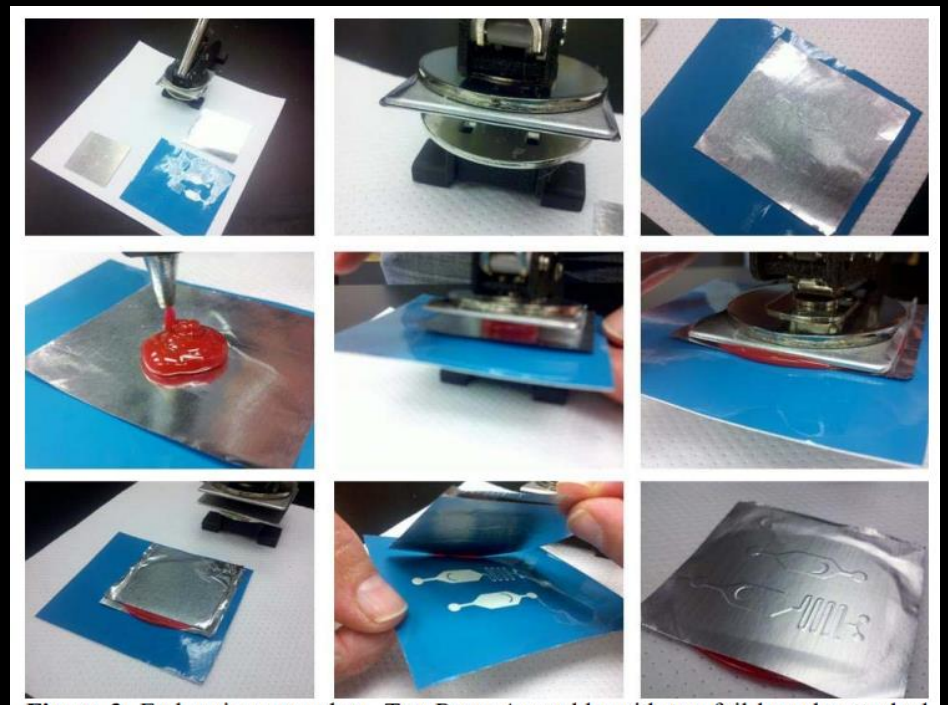
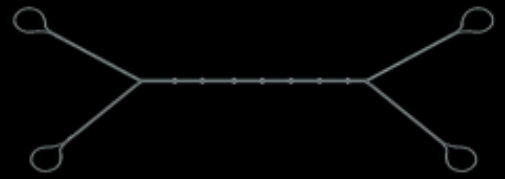


Figure 3: Embossing procedure. Top Row: Assembly with top foil loosely attached to top pressure plate. Close-up of top foil on pressure plate. Bottom foil on ABM vinyl with light embossing of ABM pattern showing through. Middle Row: Dollop of hot glue directly on pattern. Assembled sandwich of ABM, hot glue, and two foil layers in the embosser. Compression of the embosser with hot glue extruding from edge. Bottom Row: Fresh embossed sandwich cooling on bench. Parting embossed foil master from ABM vinyl. Embossed foil master, feature side up. Device design by Cameron Togrye.

Our solution: Vinyl cutting

Cut Design

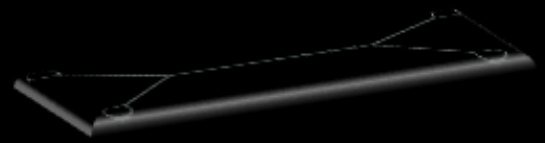


Level Design on Glass Slide

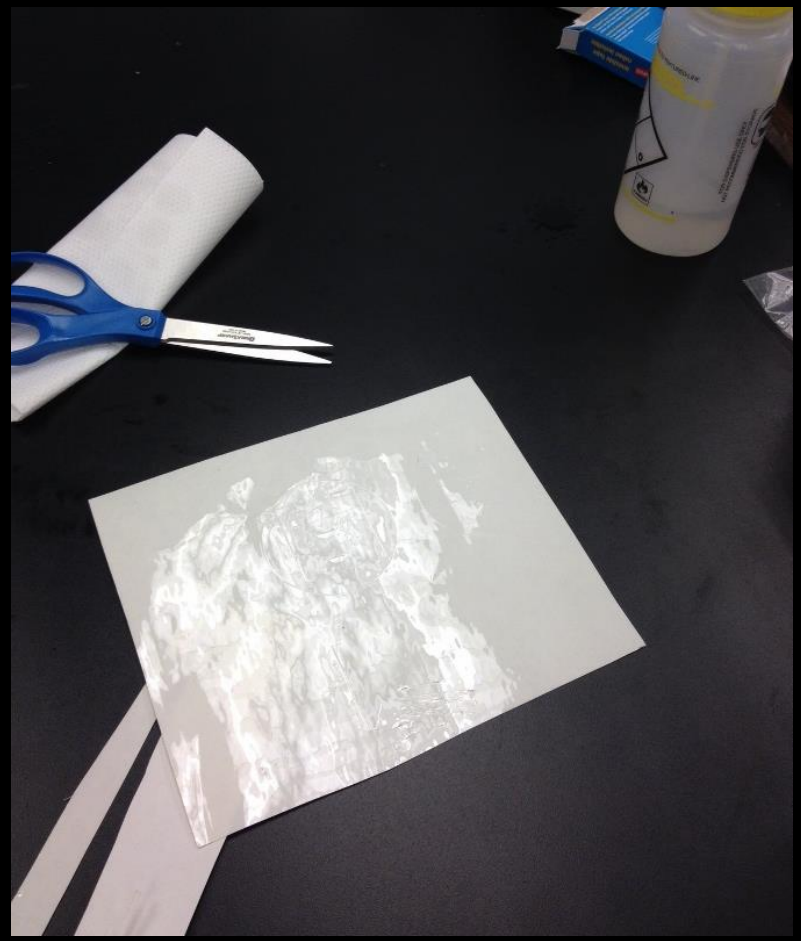
Coat in PDMS

Cut out Device and Punch

Plasma Bond to Glass Slide

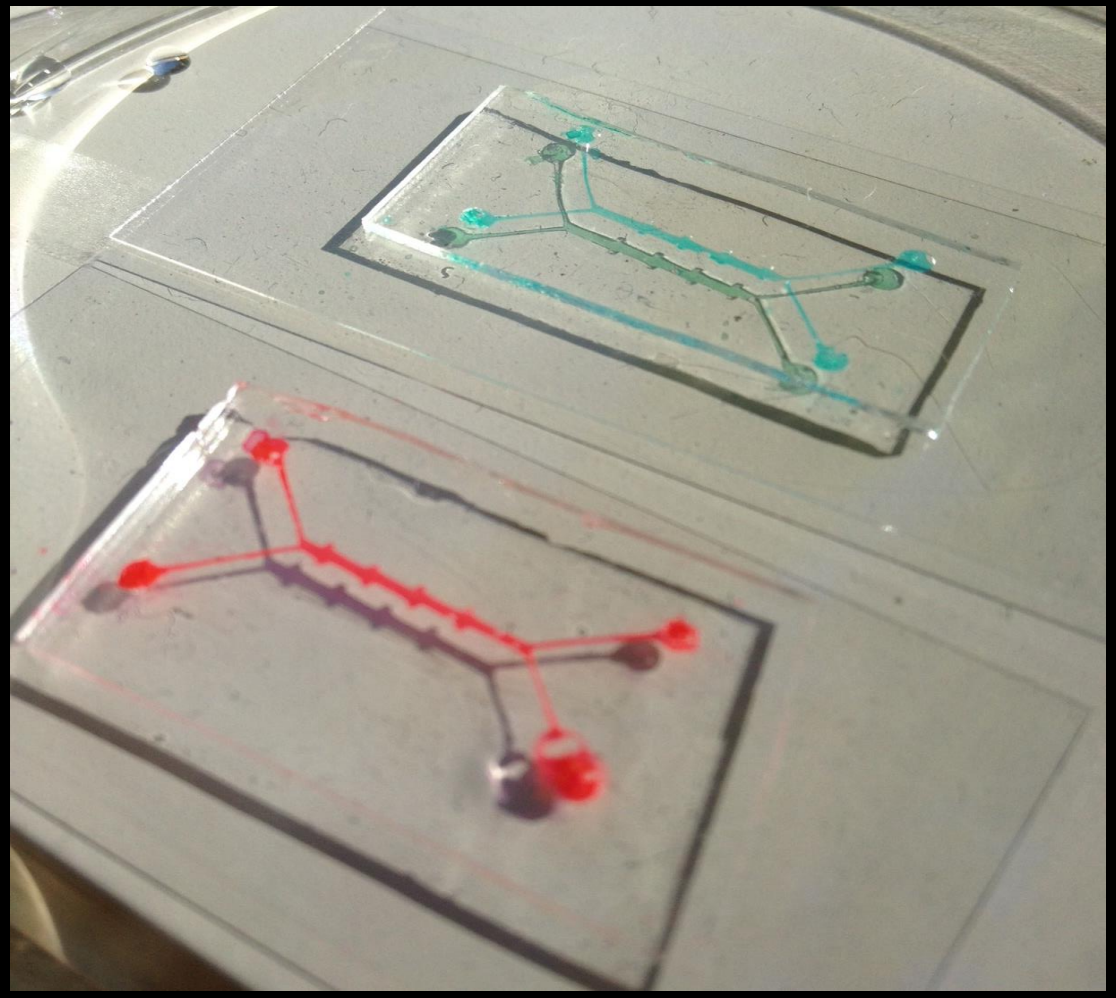


Vinyl cutting is faster and cheaper



Vinyl cutting is faster and cheaper

Finished Microfluidic Devices



High School Outreach
Vanderbilt School for Science and Math

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Conclusions:

- Easy, fast, and cheap microfluidic device fabrication made available to future iGEM teams
- Designed and fabricated novel devices to integrate into future experiments and the *E. chrono* project
- Hope to work more closely with synthetic biology teams next year and leverage microfluidic technologies for the development of parts

Acknowledgments: