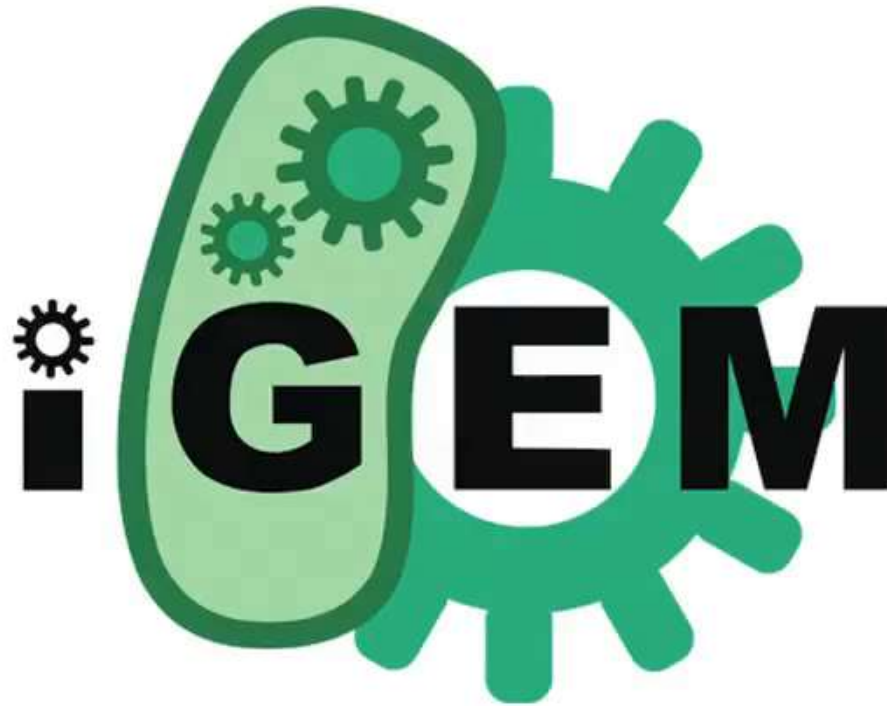


iGEM Winter 2018 Info Session



International Genetically Engineered Machine

Agenda

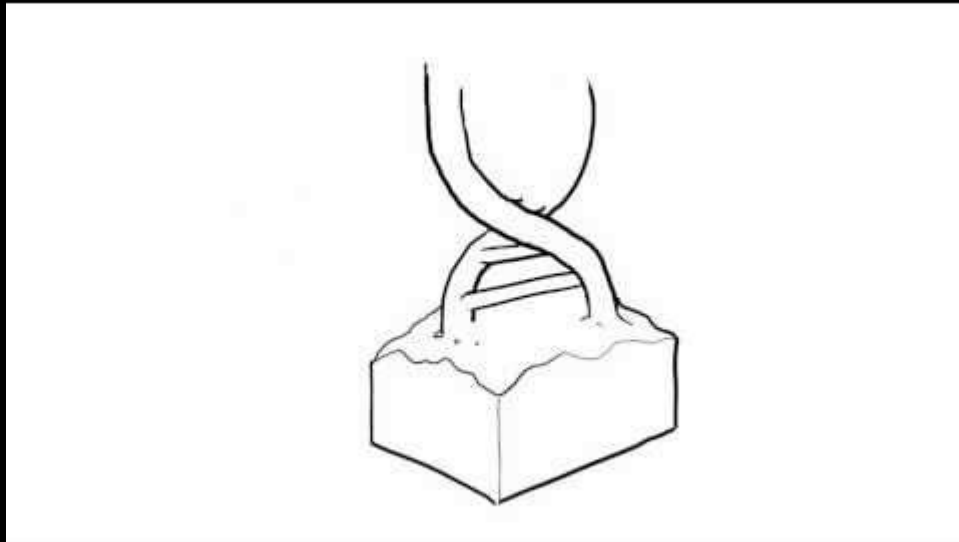
1. Introduction to iGEM
 - a. Synthetic Biology
 - b. What does every team need to do?
 - c. Previous Projects
2. Subteams of iGEM
3. iGEM as a class
4. Preparing for the Competition
5. Funding
6. Q&A

Welcome to iGem!

International student team competition in Synthetic Biology



Videos Explaining SynBio



What do we do?

Spring

- Project Development + Training
- Getting to know each other + being certified

Summer

- Bulk of research and lab

Autumn

- Finishing touches (this is not a calm process)
- Fly to Boston to present findings!

iGEM Projects need...:

- Team
- Track
- Website
- Poster
- Presentation
- Biobrick

Team!

Members



Advisers



iGEM is Interdisciplinary!

Biochemistry
Electrical Engineering
Mechanical Engineering
Bioengineering
ACMS
Biology
Informatics
HCDE
Education
Math
Physics
Computer Science

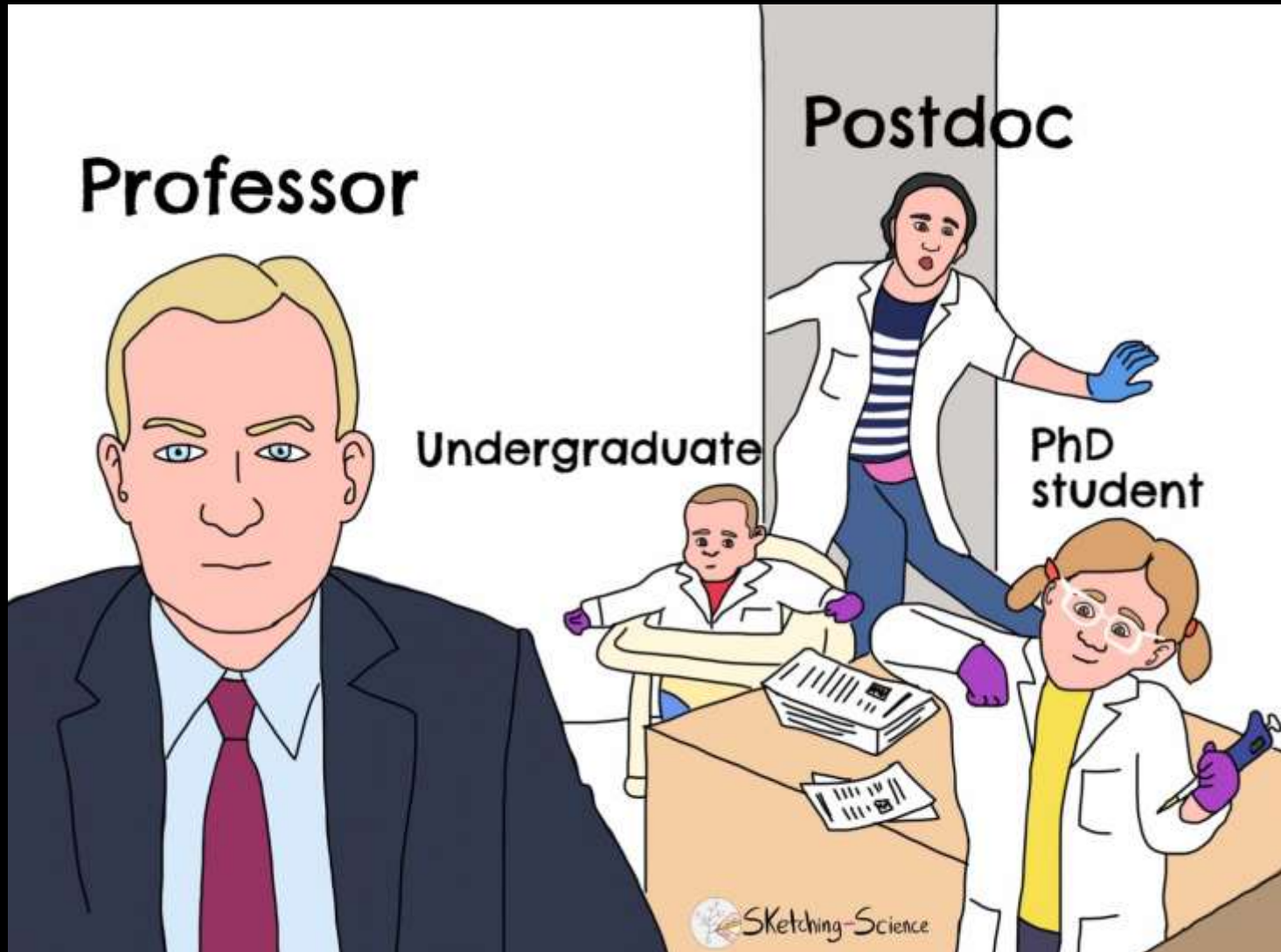
Intended and Declared!

Professor

Postdoc

Undergraduate

PhD
student



Team! (Professors)



Prof. Herbert Sauro
(BioE,EE)

Systems Biology Software +
Biological Control Systems



Dr. Karen Thickman
(BioE)

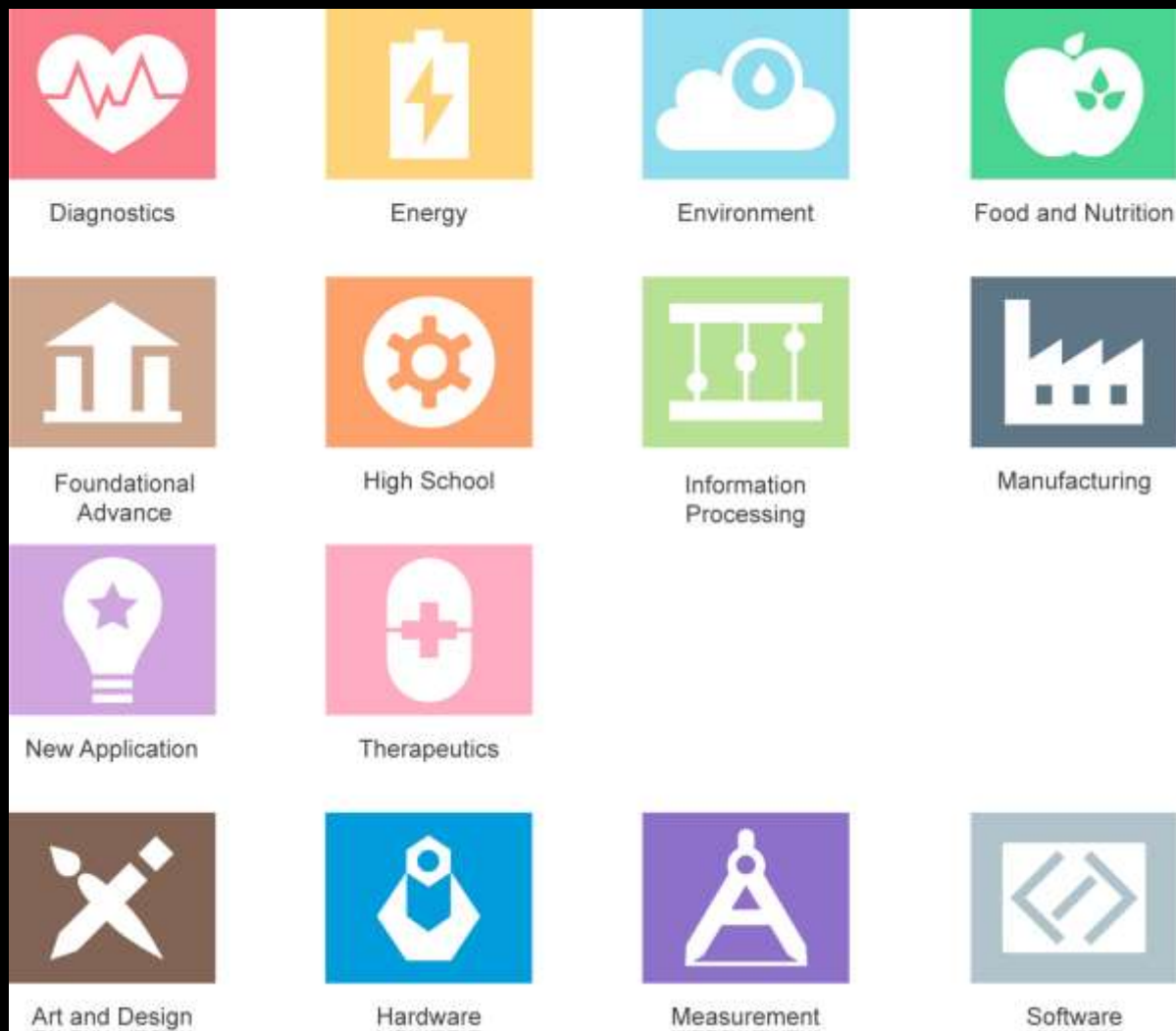
Genomics + Molecular Genetics



Prof. Liangcai Gu
(Biochem,IPD,Genome)

Protein barcoding for interactome studies

Track!



Website!

<http://2017.igem.org/Team:Washington>



Home • Our Lab • Dry Lab • Human Pathway • Projects • Team

Viva la Violacein: a Real-Time Metabolics Tracker

Overview

Project Overview

Synthetic biology can be used to create new, cost-effective, metabolites resulting from metabolic pathways. However, managing cultures containing these metabolic pathways is difficult and time-consuming. Constantly measuring and adjusting culture conditions in order to produce a desired metabolite in a specific quantity is both tedious and labor intensive. Furthermore, modern assays that accomplish this, such as high precision liquid chromatography, can also be prohibitively expensive.

Our project aims to reduce the amount of time and effort needed to maintain cultures through real-time, automated analysis of metabolic products in an adjustable turbidostat. This includes the creation of an affordable image analysis system that reads visual data to measure the current state of a culture and then provide feedback to release inducers to alter the expression of the metabolic pathway.

Our project utilizes the violacein pathway as a pigment-based proxy to predict the production of other metabolic pathways. By regulating gene expression within the violacein gene set with two different inducible promoters, we are able to yield up to four different color outputs. These outputs are measured by an open-sourced Raspberry Pi setup, which captures visual data, calculates feedback based on the culture's RGB value, and then directs the gradual release of inducer chemicals to maintain or change the culture's color over time. Therefore, this process allows us to better understand the relationship between gene expression and actual metabolite production rate.

Currently, yeast strains capable of coexpressing both a violacein and a non-visible pathway are being cloned. In addition to this, a machine comprised of 3D-printed syringe pumps, a turbidostat, and image analysis software is in development. By combining biological, software, and hardware systems, we expect our unique design to be able to generate previously unavailable visual data in certain biosynthesis processes, such as those involved in antibiotic production or fermentation.

Click on a circle to see more information!

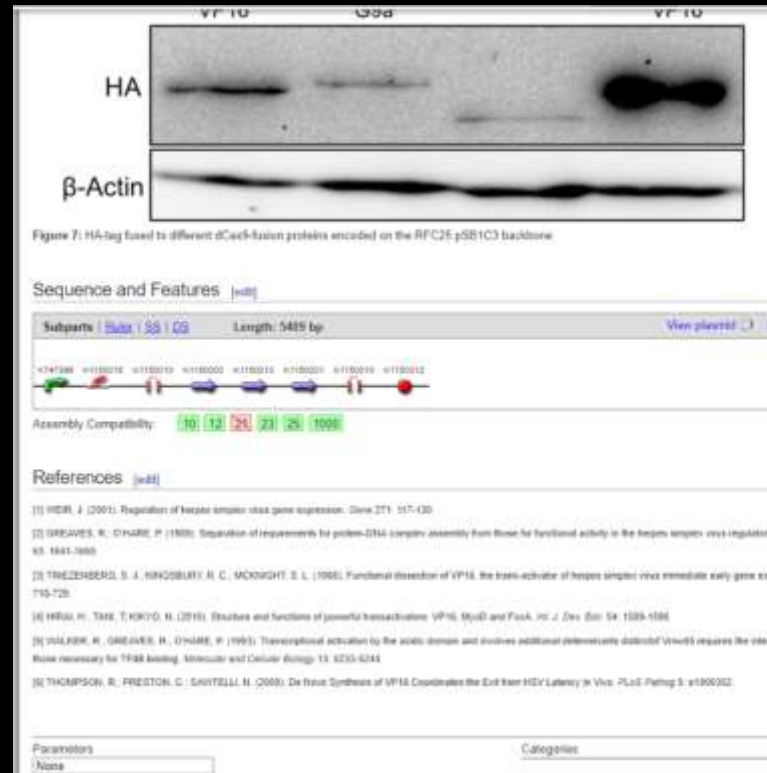


Poster + Presentation!



BioBricks!

- Part Submission:
 - Entry in the Biobrick wiki repository



Registry of Standard Biological Parts

tools catalog repository assembly protocols help search

main page design experience information part tools edit

Part:BBa_K1150020

Designed by: M. Scheidmann Group: iGEM13_Freiburg (2013-09-17)

uniCAS Activator (CMV promoter)

The Freiburg iGEM team 2013 designed a fusion protein consisting of dCas9 and VP16 [1-6] for sequence-specific transactivation of a desired target locus (more information) [9]. Therefore, we used our double mutated dCas9 (BBa_K1150000) [9] impaired in its cleavage activity and fused it to the 5' end of the sequence coding for the transactivation domain of VP16 (BBa_K1150001) [9]. To ensure nuclear localization of the construct a nuclear localization signal (NLS) was fused to both ends of dCas9-VP16. For detection of expression the fusion protein was tagged with a HA-epitope coding sequence (BBa_K1150016) [9] and its expression was put under control of the CMV promoter (BBa_K747096) [9] and BGH terminator (BBa_K1150012) [9]. Figure 1 illustrates the detailed design of the whole device.

CMV:Ha-NLS-dCas9-Linker-VP16-NLS-BGH	
Function	gene activation
Use in	Prokaryotic cells
RFC standard	RPC 10 [9], RFC 10 [9] compatible
Backbone	pSB1C3
Submitted by	[1] [9]

Figure 1: Construct design. dCas9 was fused via a 3 amino acid linker to VP16. The resulting fusion construct was flanked by NLS sequences and tagged by a HA epitope. The CMV promoter and BGH terminator were chosen to control gene expression.

By co-transfecting our RNA plasmid (BBa_K1150034) [9] which includes the tracrRNA and the separately integrated, desired crRNA, the dCas9 specifically binds to the targeted DNA sequence. With the help of the transactivation domain of VP16, transcription factors are recruited and the pre-initiation complex can be built. By placing this construct upstream of a promoter region any gene of interest can be activated.

Figure 3: Position of the target loci on the SEAP plasmid. The diagram shows a circular plasmid with a target locus and a CMV promoter driving the mCherry reporter gene.

Figure 5: Position of the target sites in front of the mCherry reporter construct. The diagram shows a linear DNA sequence with four target sites (Target 4 & 3, Target 2, Target 1) and a CMV promoter driving the mCherry reporter gene.

Figure 6: Results of mCherry activation via dCas9-VP16 using different crRNAs. Scale bar = 200µm.

Have Fun!



Student responsibilities + expectations

- Have an attitude to **learn** and **willingness** to participate!
- Ability to **work in a team** in a fast-paced environment
- Be available during **Summer** (if you have to juggle an internship and lab...talk to us)
- Dedicate **5-10 hr/wk** in winter/spring, **10 - 20 hr/wk** in summer/fall.
- Stay **up to date** on communications & contribute your own thoughts!

Previous Projects

...

Infinite Possibilities!

iGEM Tracks

Projects can be applied to...

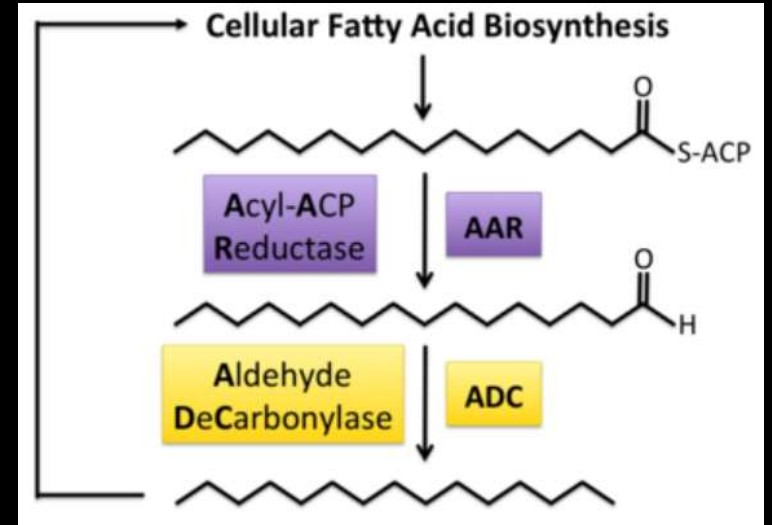
- Medicine & Diagnostics
- Environment
- Energy
- Food & Agriculture
- Fundamental science advancement
- Hardware
- Software



Washington 2011 - Make It or Break It

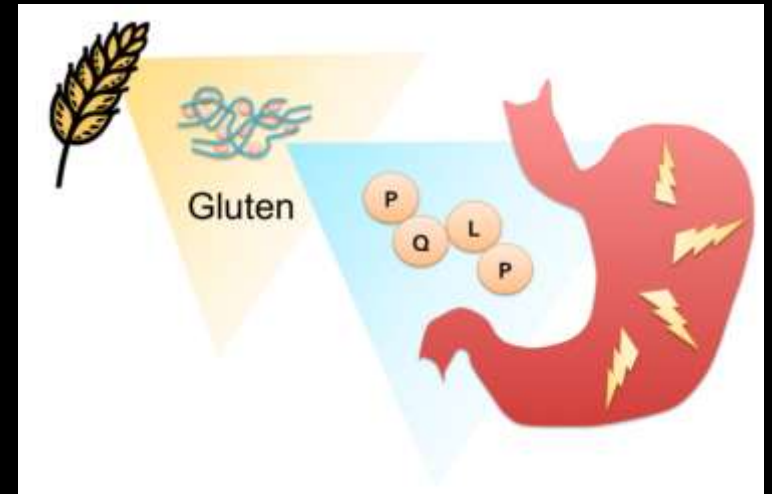
Diesel Production

- *E. coli* produce alkanes by introducing a pair of genes that convert fatty acid synthesis intermediates into alkanes.



Gluten Destruction

- Reengineered a gluten-degrading protease enzyme to have increased gluten-degrading activity, allowing for the breakdown of gluten in the digestive track for patients with gluten intolerance.



TAS Taipei High School 2017 - NANOTRAP

Removal of harmful nanoparticles from wastewater treatment centers

- Bind citrate-capped nanoparticles with a membrane protein and trap nanoparticles using *E. coli* biofilm
- Built a prototype filter with biofilm
- Worked with both urban and rural wastewater treatment plants to develop ideas

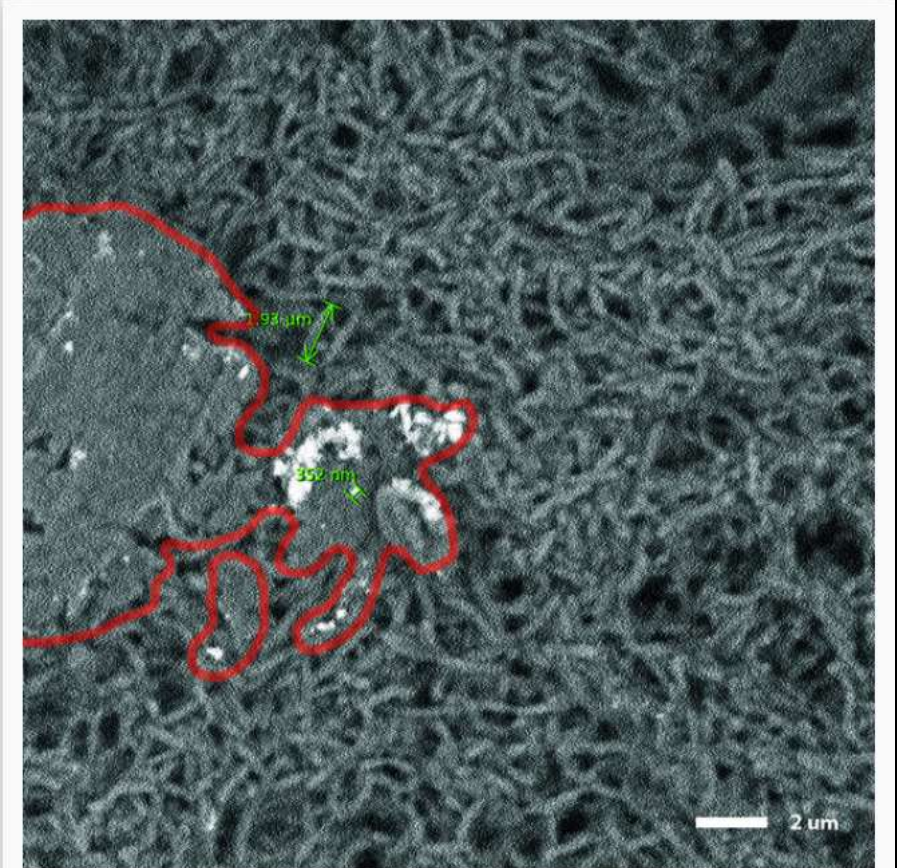
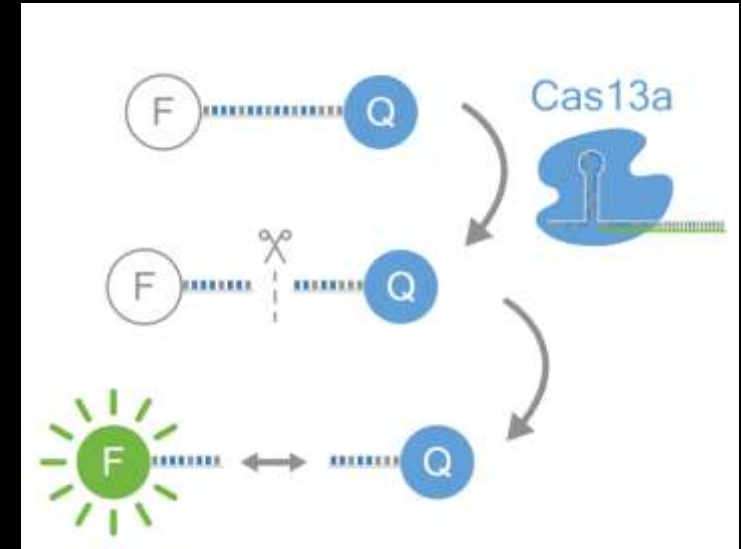


Figure 3-6 SEM Image showing AuNPs trapped by biofilm. A biofilm+AuNP sample was fixed with GA. Some EPS is preserved (red) and AuNPs (white) seemed to aggregate and adhere onto the EPS. SEM Imaging: Justin Y.

Munich 2017 - CascAID

Cas13a controlled assay for rapid detection of infectious diseases in the clinic

- Engineered genetic pathway for detection of RNA viruses and other pathogens
- Paper and silicone microfluidics
- Sample processing and detection hardware
- Mathematical modeling and analysis software
- Human-centered design





Wetlab

The image shows a laboratory environment. In the foreground, a woman in a red and blue plaid shirt is on the left, and a man in a blue button-down shirt and glasses is on the right, wearing white gloves. They are both looking towards the center. In the background, there are shelves filled with various lab supplies, including boxes, bottles, and racks of test tubes. A central inset, outlined in black, shows a person in a white lab coat working at a lab bench, surrounded by various pieces of equipment and containers. The text 'Wetlab' is overlaid on this inset, with three dots below it.

...

Main Project

- Simple explanation: make it happen!
- BioBricks!

Registry of Standard Biological Parts

tools catalog repository assembly protocols help search

main page design experience information part tools add

Part:BBa_K1150020
Designed by: M. Schroedermann Group: iGEM13_Freiburg (2013-08-07)

uniCAS Activator (CMV promoter)

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CMV-Ha-NLS-dCas9-Linker-VP16-NLS-BGH	
Function	gene activation
Use in	Eukaryotic cells
RFC standard	RFC 10 [9], RFC 10 [9] compatible
Backbone	pSB1C3
Submitted by	[1] [9]

Figure 1: Construct design. dCas9 was fused via a 3 amino acid linker to VP16. The resulting fusion construct was flanked by NLS sequences and tagged by a HA-epitope. The CMV promoter and BGH terminator were chosen to control gene expression.

By co-transfecting our RNA plasmid (BBa_K1150034) [9] which includes the tracrRNA and the separately integrated, desired crRNA, the dCas9 specifically binds to the targeted DNA sequence. With the help of the transactivation domain of VP16, transcription factors are recruited and the pre-initiation complex can be built. By placing this construct upstream of a promoter region any gene of interest can be activated.

Figure 3: Position of the target loci on the SEAP plasmid.

Figure 5: Position of the target sites in head of the mCherry response construct.

Figure 6: Results of mCherry activation via dCas9-VP16 using different crRNAs. Scale bar = 250µm.

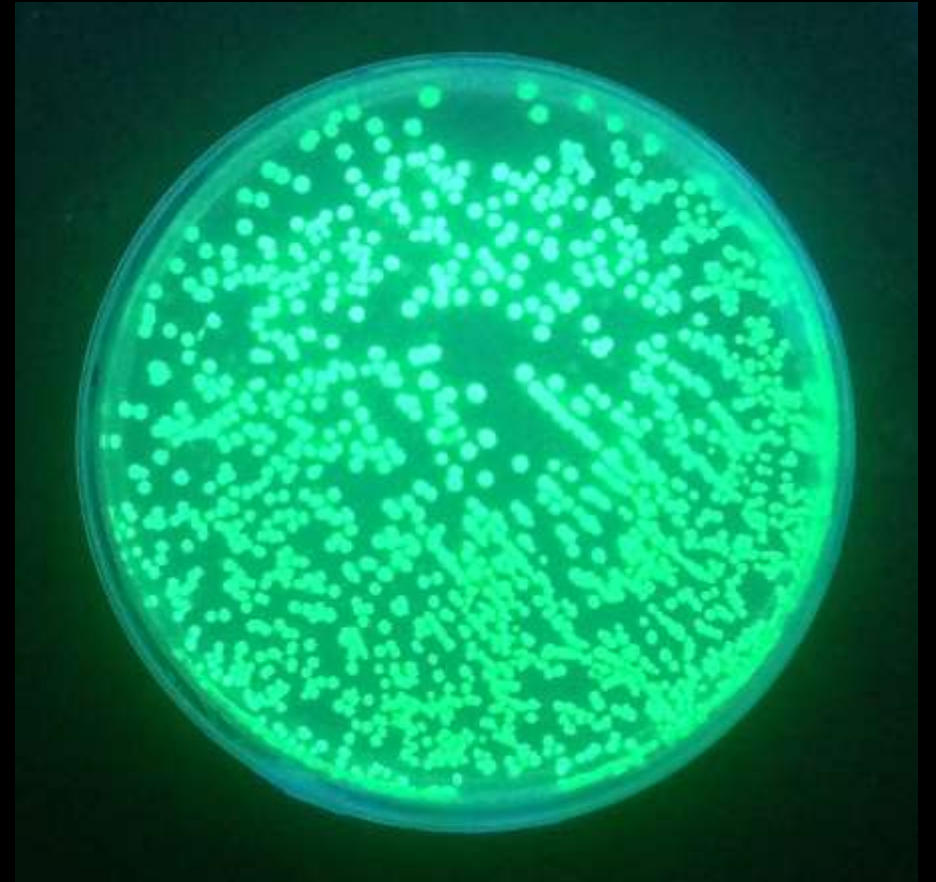
Proof of expression [pdf]

With the help of the HA-tag we performed Western blots to verify the expression of BBa_K1150020 and to estimate its expression rate (Fig. 7).

CMV:dCas9-VP16	CMV:dCas9-G9a	CMV:dCas9	SV40:dCas9-VP16
[Western blot bands]			

Interlab

- Measurement replicability
- Largest interlaboratory study
- A chance to get published! And...
- A chance to lead a project!



What do we want from you?

- Your address, credit card number, SSN, soul, and all your waking hours from now until eternity
- Initiative, Good nature, Endurance, Motivation
- ~10 hours a week to start, then more

What do you get out of all this?

- Molecular Biology Lab Techniques
 - PCR, Gel Electrophoresis, Miniprep, Transformation, etc.
- Research Skills
- Communication and Leadership



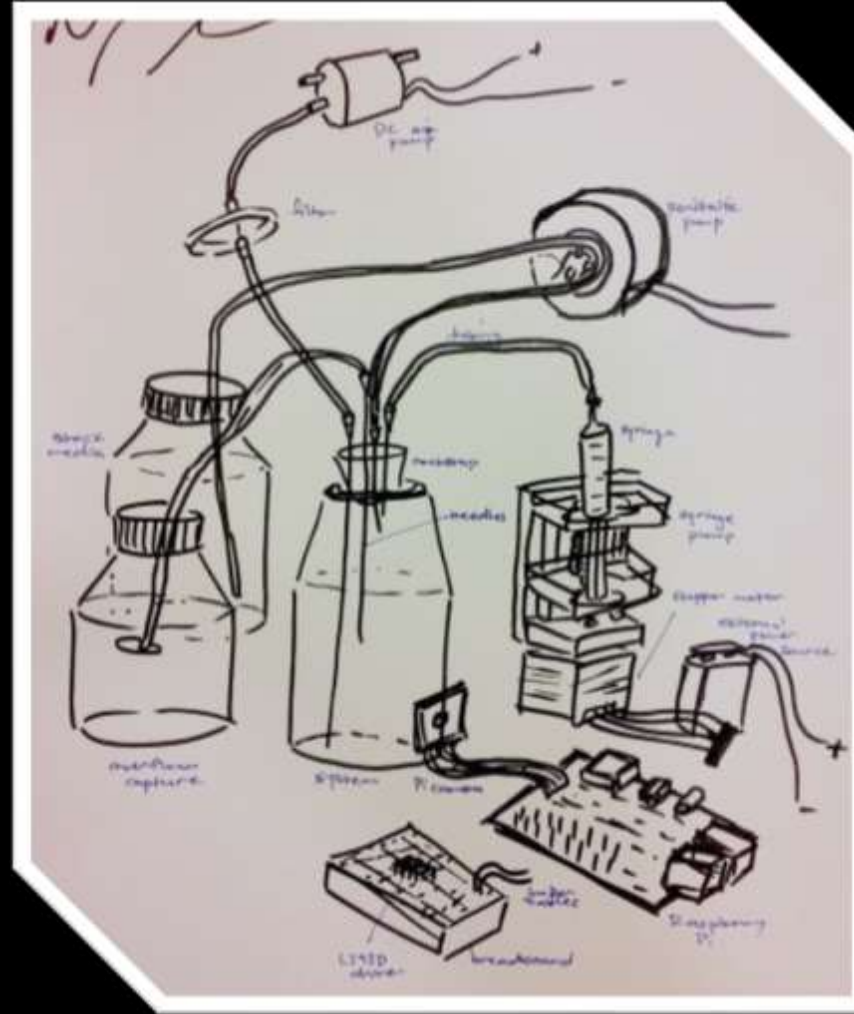
Drylab



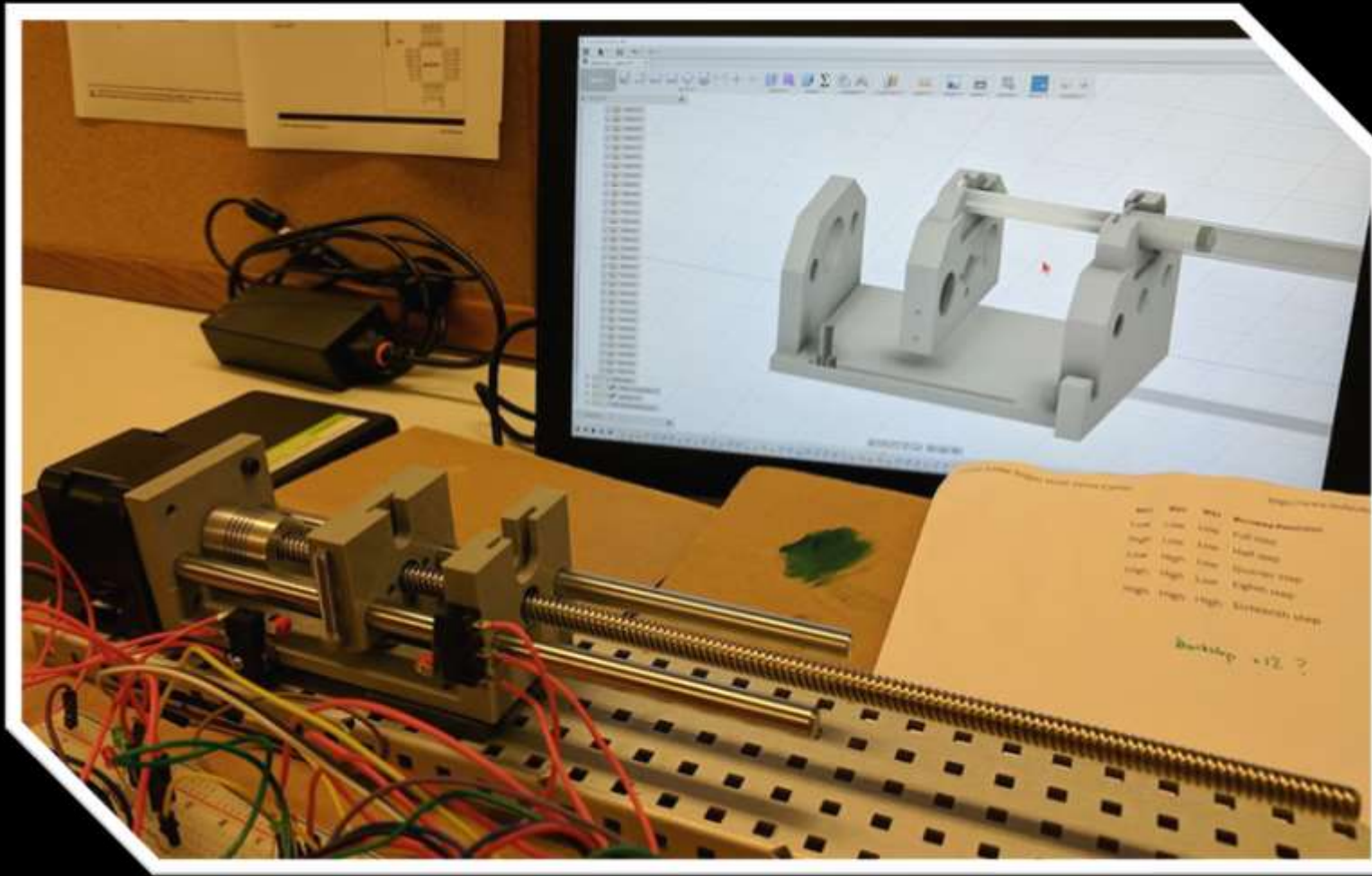
What we did last year



What we did last year



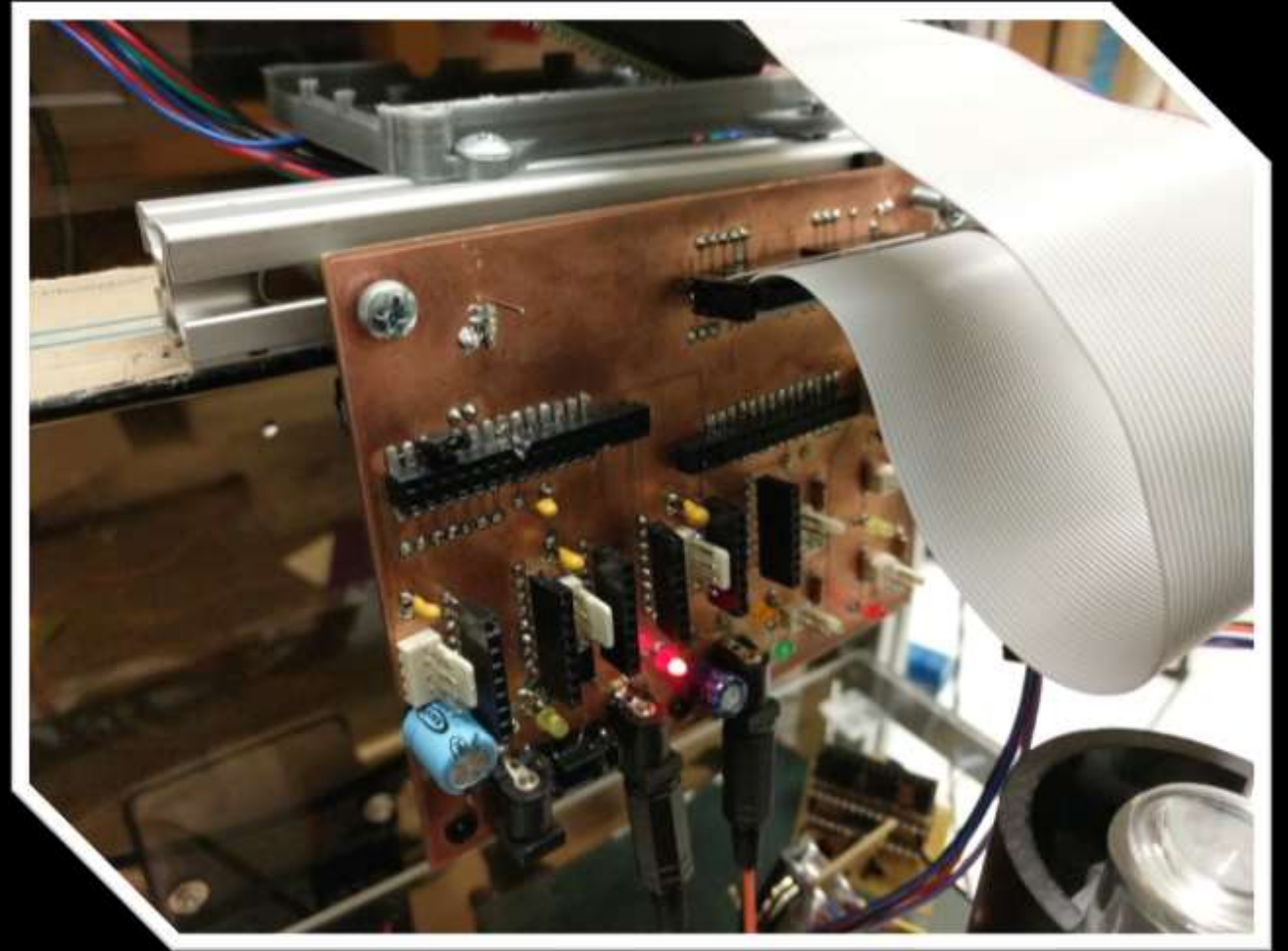
What we did last year



- CAD
- 3D Printing
- Assembly
- Power tools

What we did last year

- Eagle EDA
- Printing PCBs
- Soldering
- Wiring

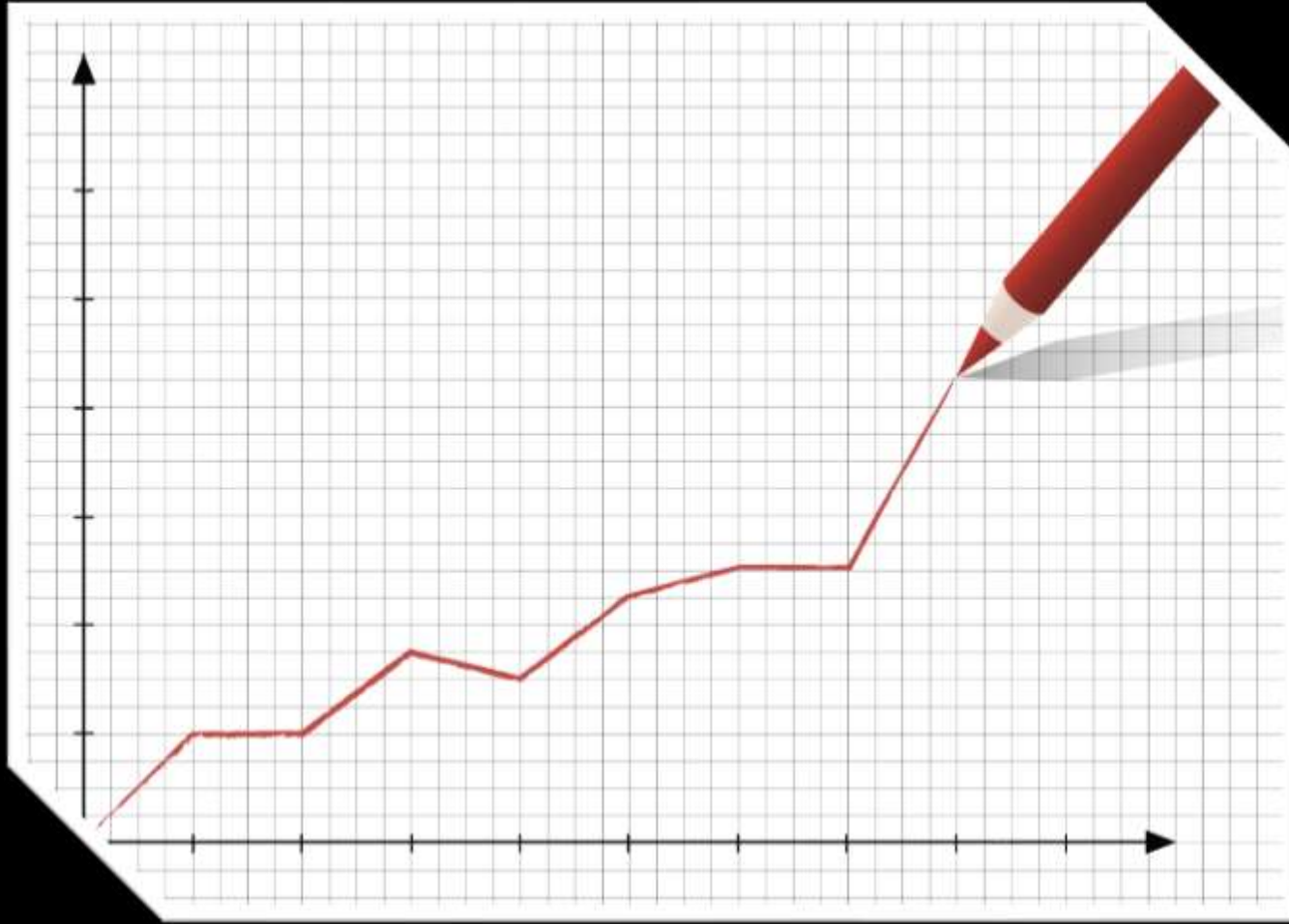


What we did last year



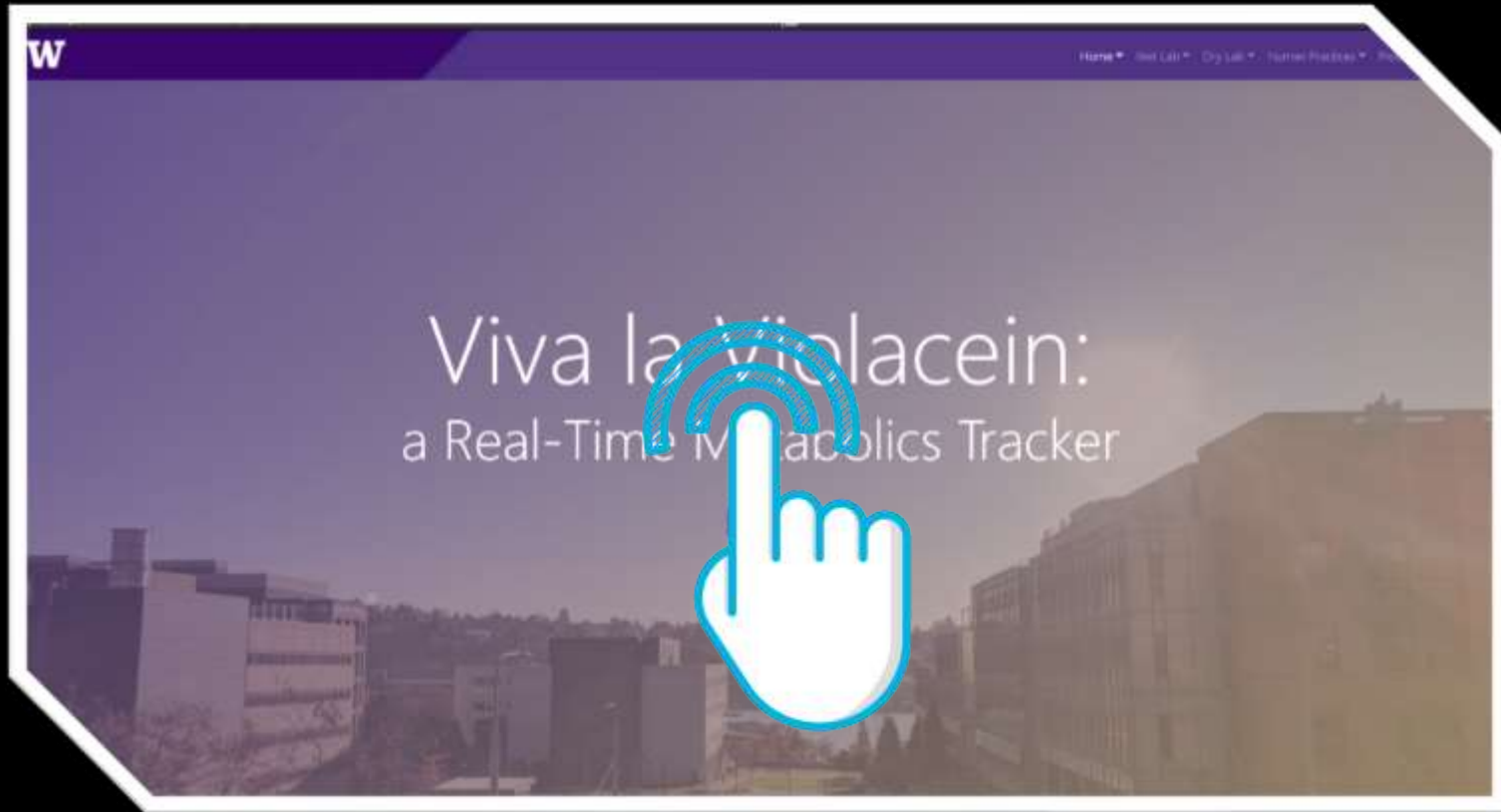
The future

What we want to do



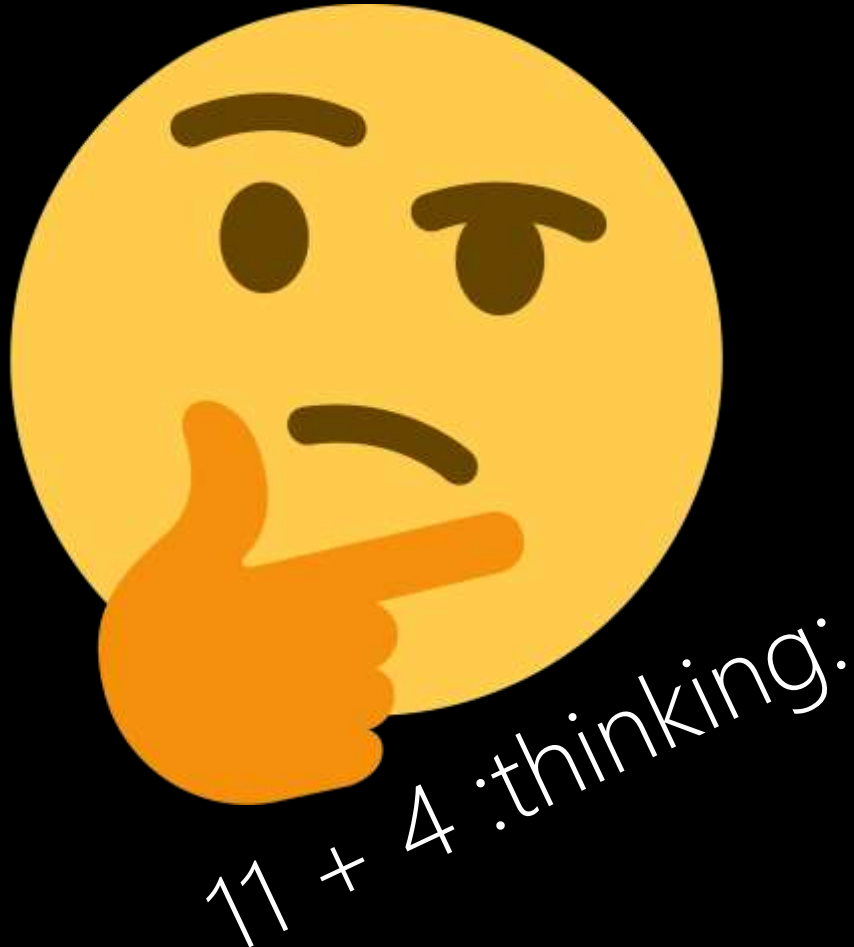
- Math modeling
- MATLAB
- R
- Data analysis

What we want to do



- HTML, CSS, heavy JavaScript
- Photoshop

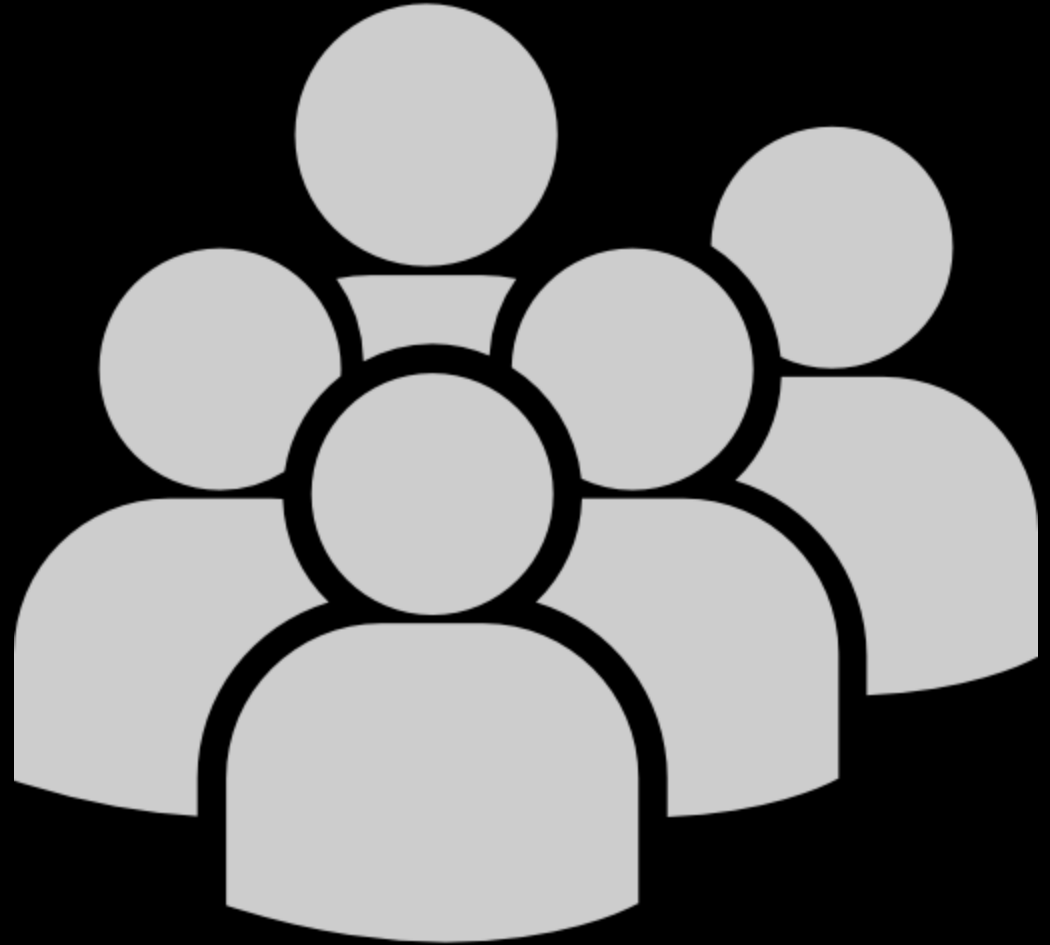
What we want to do



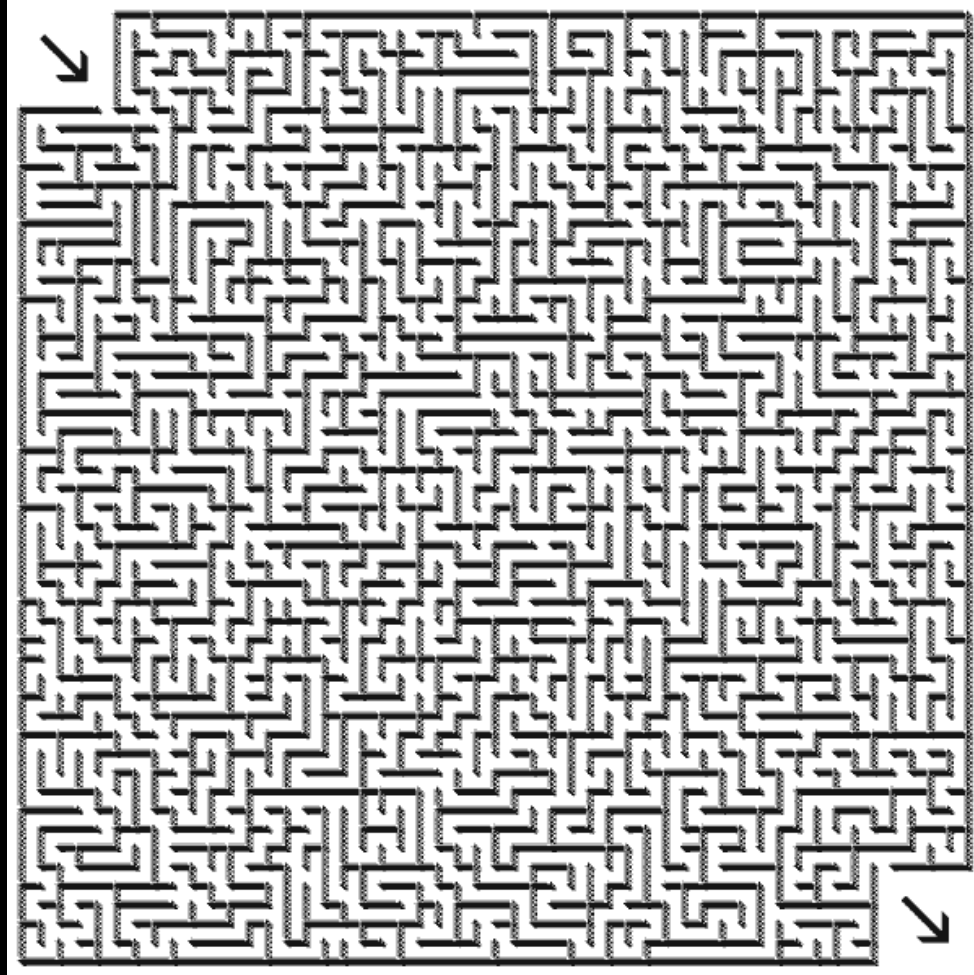
- Independence and problem solving skills

What we want to do

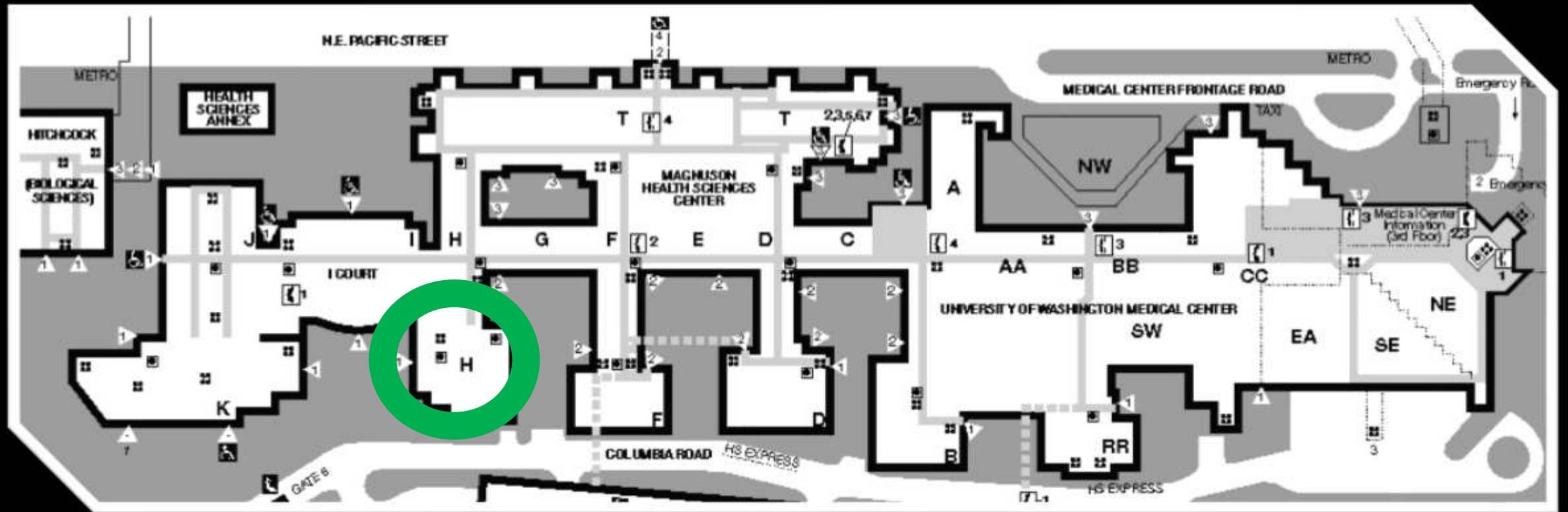
- Community for sharing knowledge
- Collaborate with Outreach team



Where we work



Where we work



Time commitment

- Around 5-10 hours/week



What you need

- Laptop
- GitHub account
- A Brain



What you will learn

- Things listed earlier
- How to not get scared to ask questions
- How to ask for clarification
- How to use a magical tool:

What you will learn



Outreach/Human Practices

...

Talking to non-scientists/children

Science? So who cares?

- Future scientists!

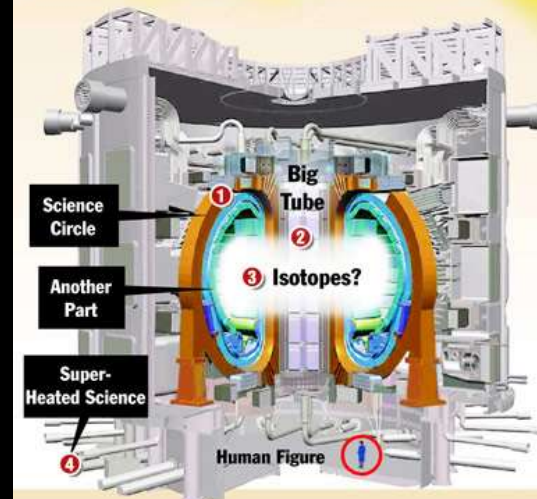
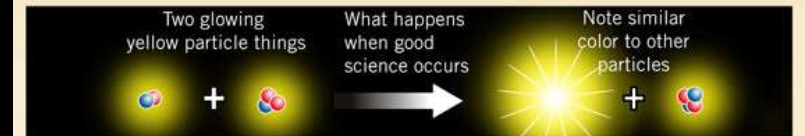
- Big Milk

- You! and Me!



Onion Science Thursday Giant Machine Creates Science

The Onion explains the inner workings of the complex, expensive science thing.



A Science Machine

The expensive device will test and execute more science than ever before

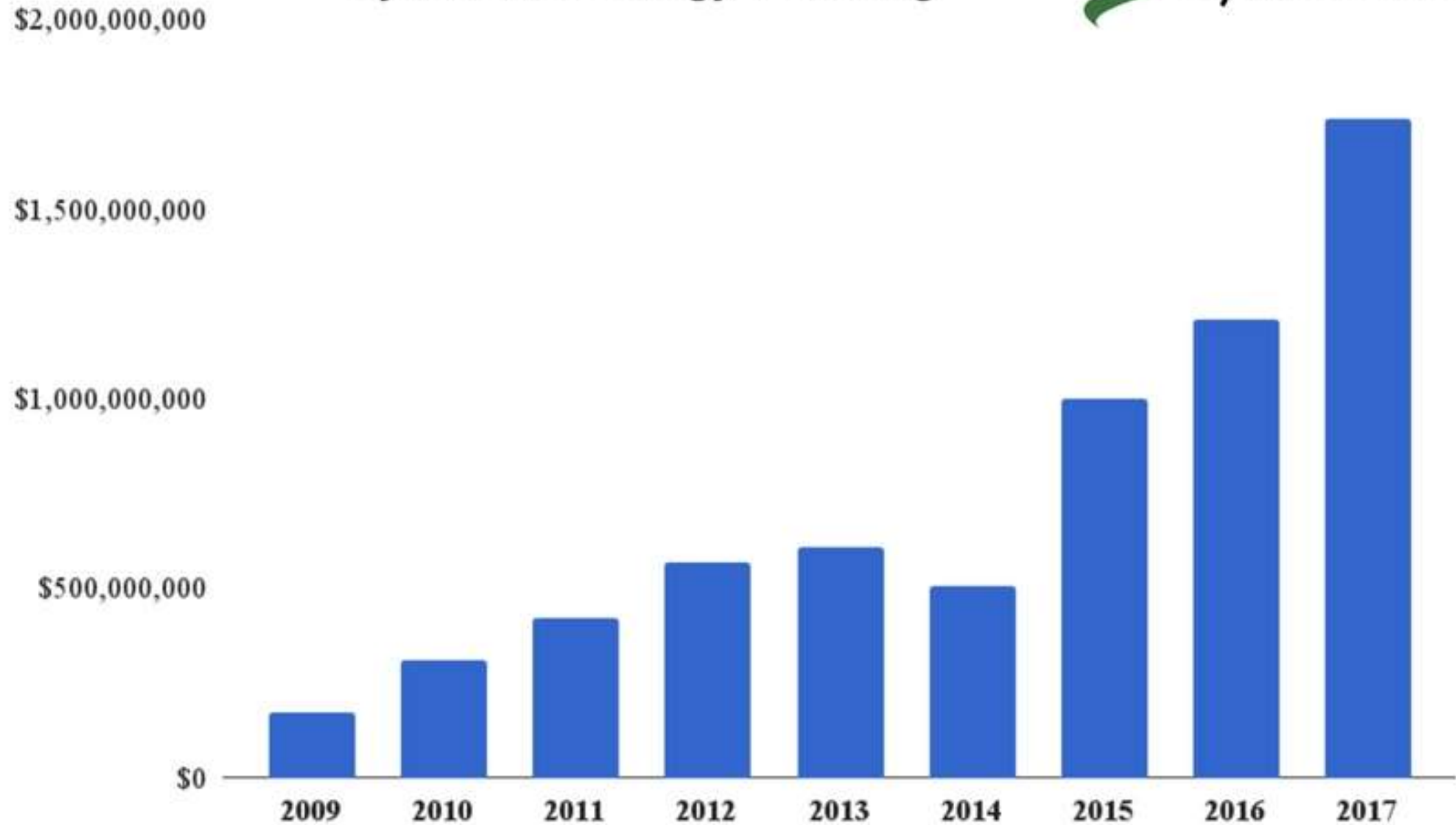
- 1 Scientists make sure machine's On/Off button is switched to On
- 2 Parts of the machine begin to move, at first slowly, and then rapidly
- 3 A lot of science begins to generate
- 4 Many things light up and sounds of thunder happen
- 5 Science ends

Business, Policy, & Social Media

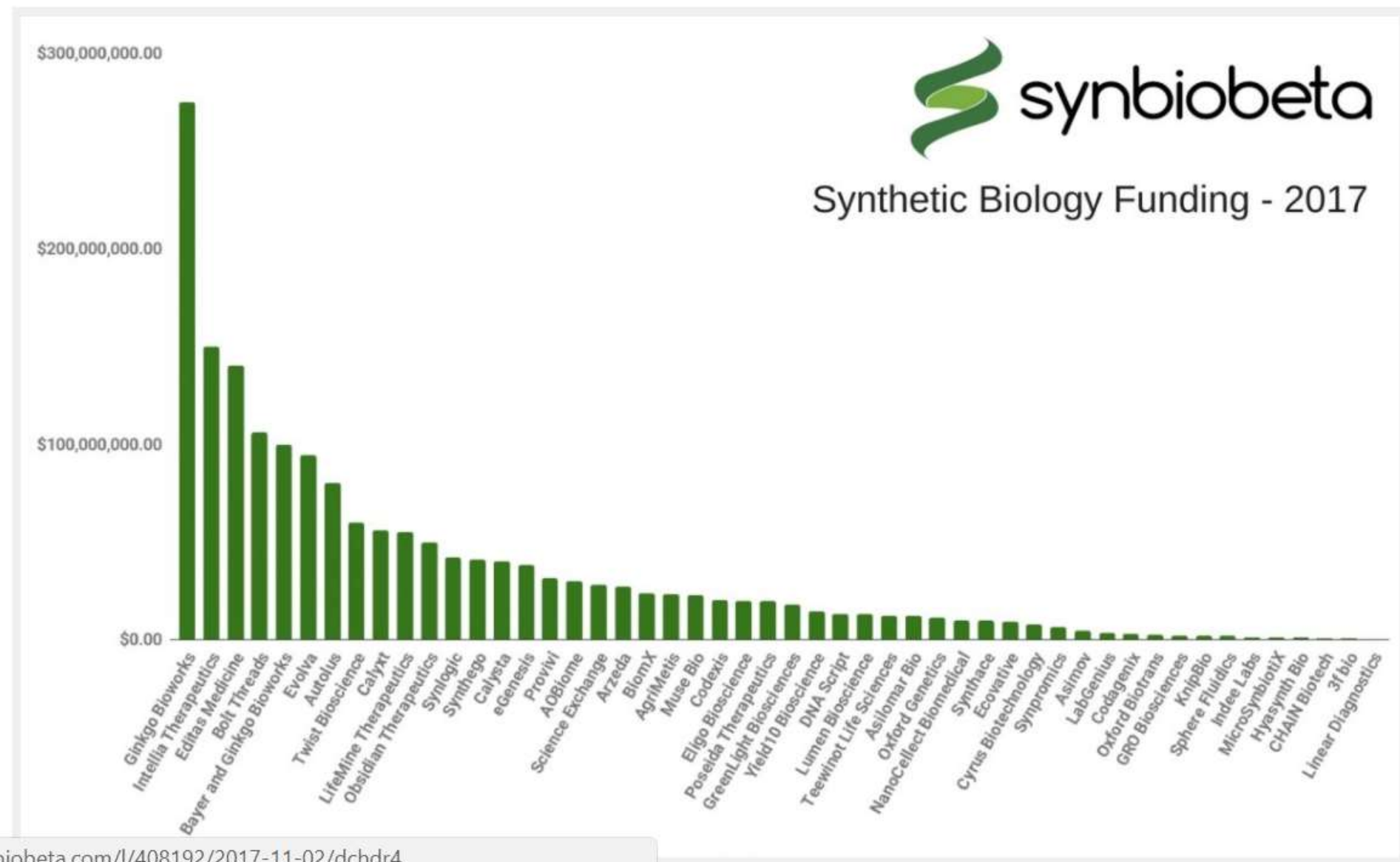
...

Help us sell our ideas!

Synthetic Biology Funding



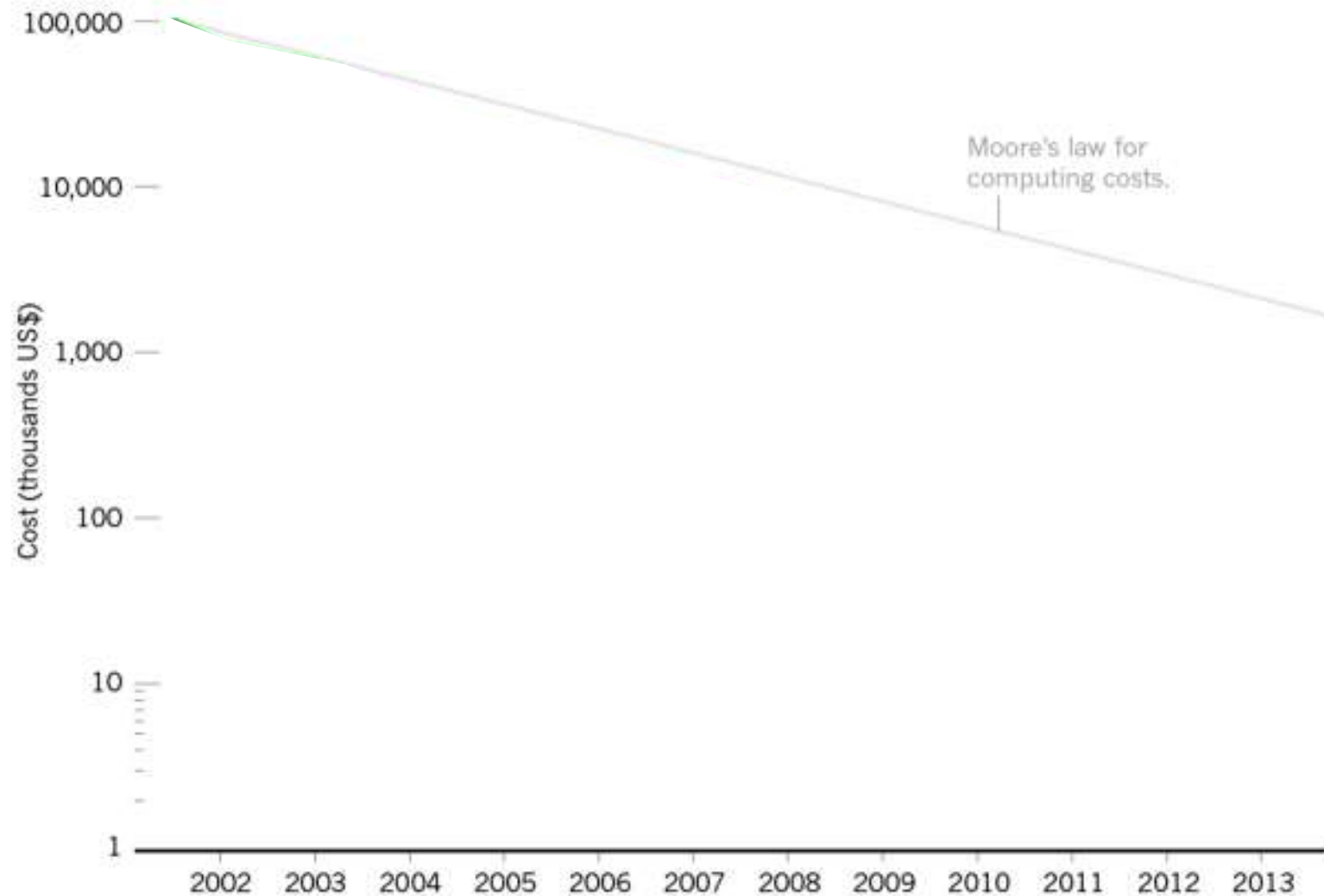
These Fifty Synthetic Biology Companies Raised \$1.7B in 2017





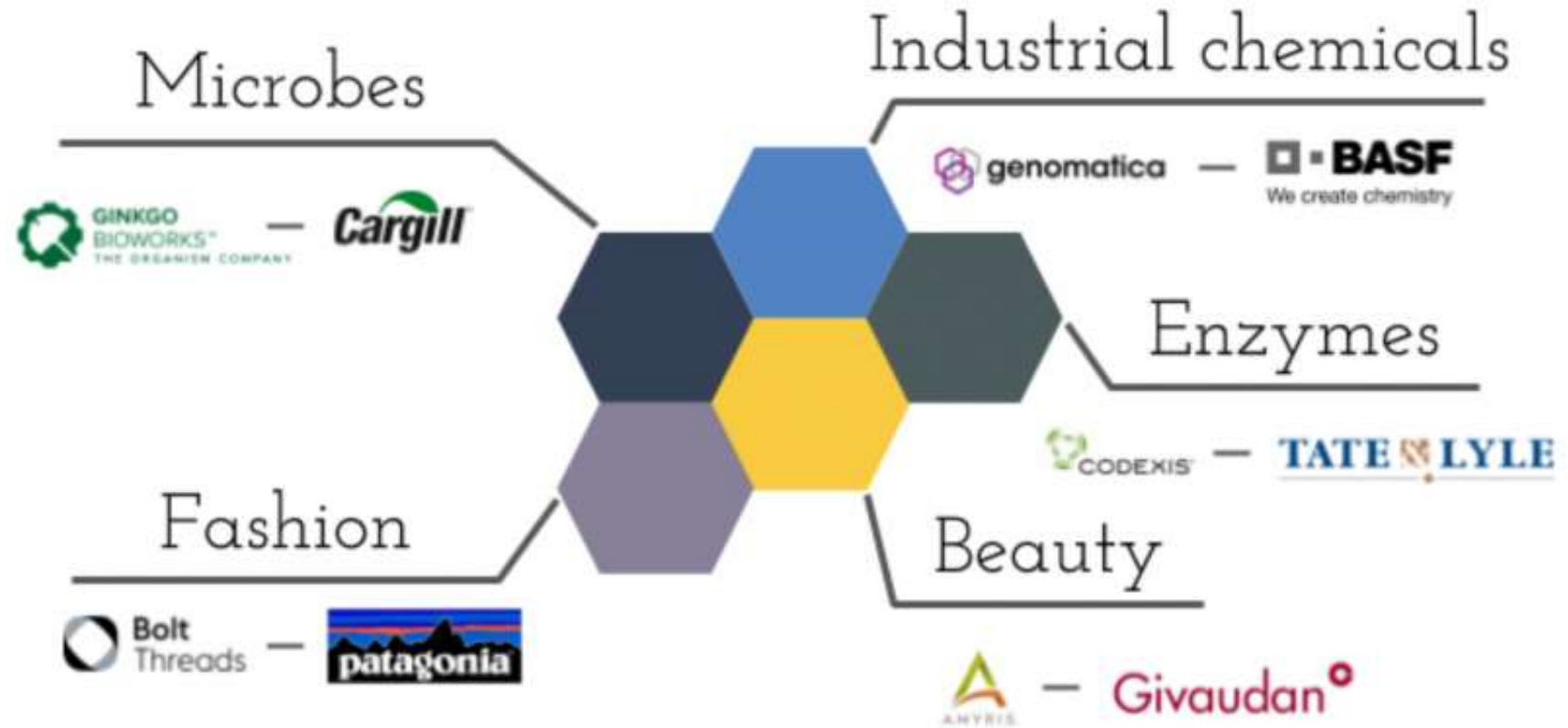
Falling fast

In the first few years after the end of the Human Genome Project, the cost of genome sequencing roughly followed Moore's law, which predicts exponential declines in computing costs. After 2007, sequencing costs dropped precipitously.





Companies now focus on high-value products



And are getting traction with larger companies

Business & Entrepreneurship

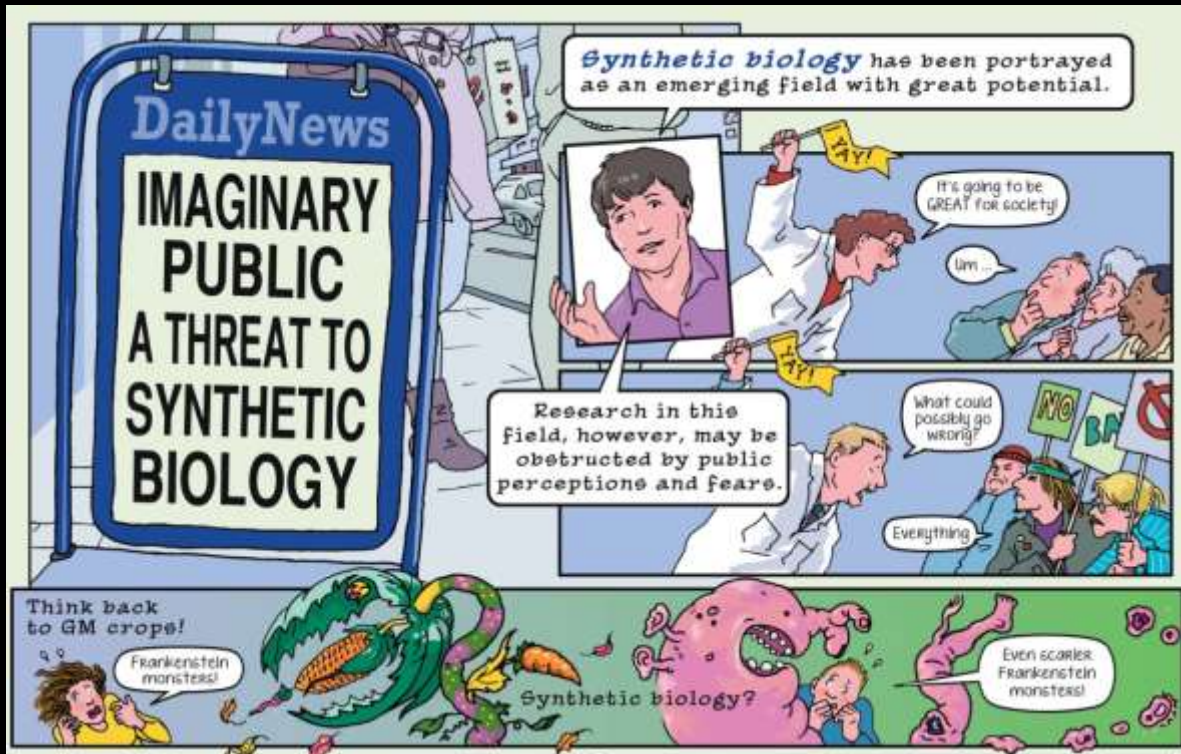
Filling a need (market demand) should inform design decisions in our project

- Write to companies to pitch our ideas and get funding
- Perform market research and SWOT analysis
- Fulfill requirements for iGEM entrepreneurship awards
- Practice technical writing and business skills



Public Policy & Ethics

Regulation and government policy plays a significant role in our research.



- Learn about policies related to synthetic biology, GMOs, and biotech research
- Research project-related ethical issues
- Interact with local experts and government officials regarding our project
- Write policy briefs related to our project
- Help us make a positive impact in our community!

Social Media

- Help us increase our reach through Facebook, Twitter, and Instagram
- Write content highlighting our team members & project for social media
- **MAKE MEMES**
- Work with design team to market our team and ideas!
 - Videos
 - Animations
 - Art





DESIGN & ANIMATIONS

WHAT WE'VE ACCOMPLISHED SO FAR



UW iGEM

Want research experience?
Join iGEM, an interdisciplinary, undergraduate-led student lab focused on synthetic biology.

Info Sessions:
Thurs Jan 11 6-7pm
Fri Jan 12 5-6 pm
Foeg N130



uwigem@uw.edu
tinyurl.com/uwigem



Build a biotech business plan

Work in an agile biotech competition team

Take advantage of the fast-growing SynBio economy

Network with biotech companies

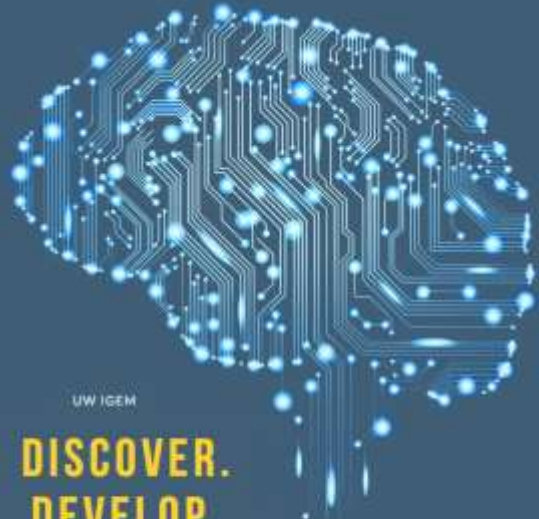
Compete in a synthetic biology competition

Learn about cutting-edge biotech development

Currently looking for business majors interested in the biotech field.
Jan. 11, 6-7pm
Jan. 12, 5-6pm
Foeg N130
UW iGEM Info Session

Facebook Event page:

Email: uwigem@uw.edu
Website: tinyurl.com/uwigem




UW iGEM

**DISCOVER.
DEVELOP.
INTERESTED?**

GAIN MODELING, CAD, HARDWARE, PROGRAMMING, AND COMPUTATIONAL BIOLOGY EXPERIENCE

INFO SESSIONS:
THURS 11 JAN • 6-7 PM
FRI 12 JAN • 5-6 PM
FOEG N130

uwigem@uw.edu
tinyurl.com/uwigem



PROJECTS TO UNDERTAKE

Design posters, flyers, and a website

- Team and Project logos
- Outreach informational flyers
- Competition material
 - Project Poster
 - Presentation Slides
 - Wiki figures and animation

Develop a project storyline and introductory animation video

Think up of and tackle fun projects

- Creative introductory pictures

Interested in any of these projects? Talk to Hannah & join the design team! :D



Companion Class



(0-2) Credit Class

- Learn skills you will need in lab
- Different classes for wetlab & drylab
- Necessary to attend, not necessary to officially register
- Works around *your* schedule

Grading

- *Not a weed-out course*
- Mostly participation credit
 - Do you come to lab?
 - Do you come to class?
- Personal Feedback

Instruction

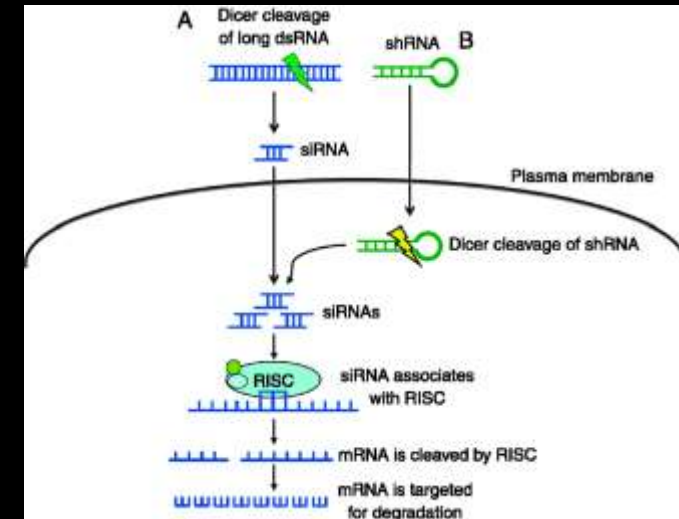
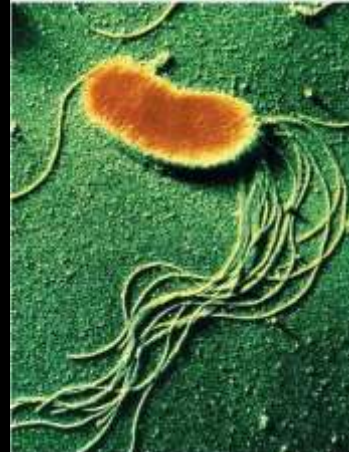
- Taught by your peers
- Really friendly
- Open to helping you both in class and in lab

Scheduling

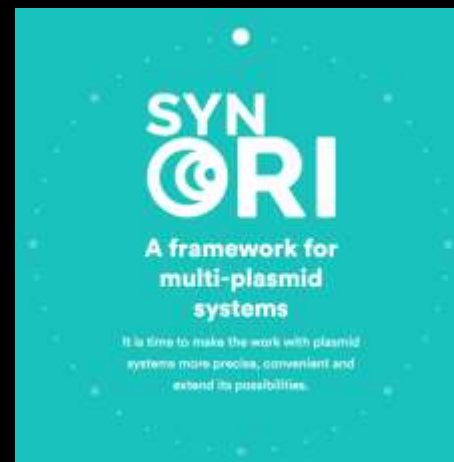
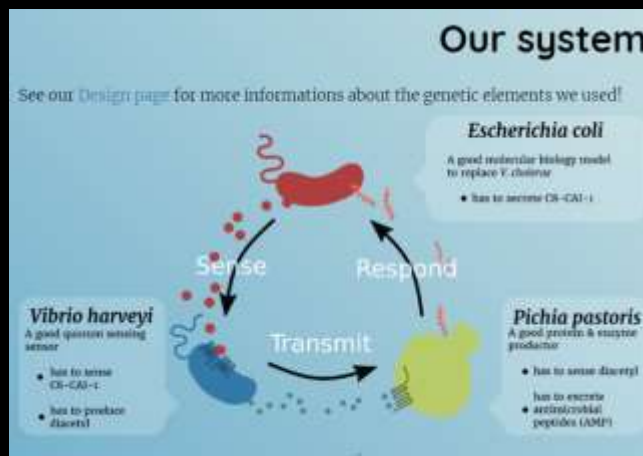
- When we will meet depends on when everybody is available
- We'll collect everybody's schedules and find the best fit

Current Project Ideas

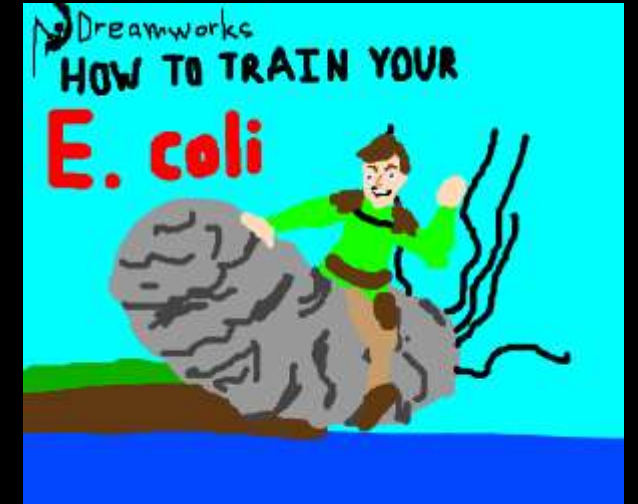
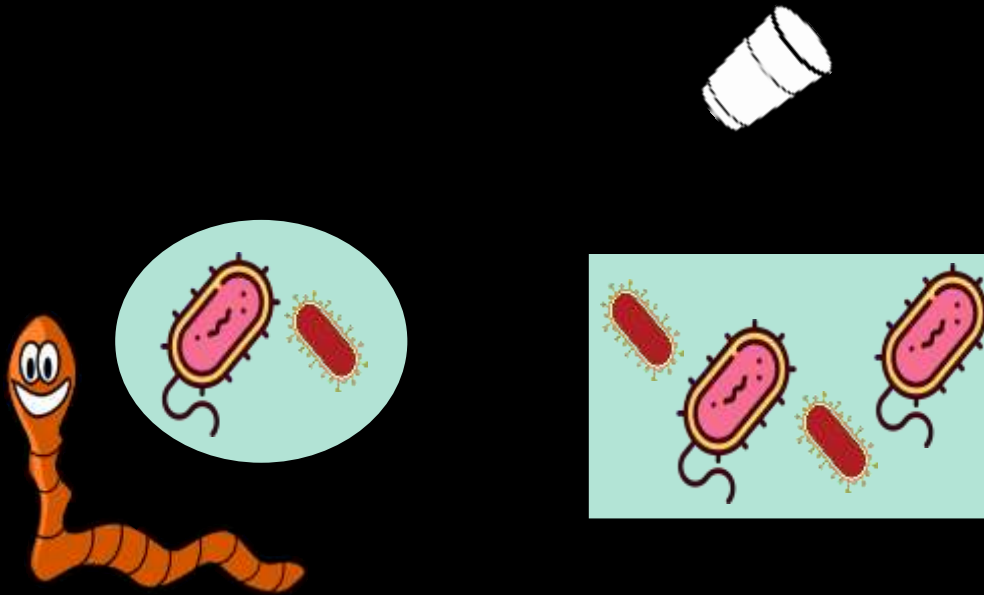
Eradicating cheatgrass



Robust water purification



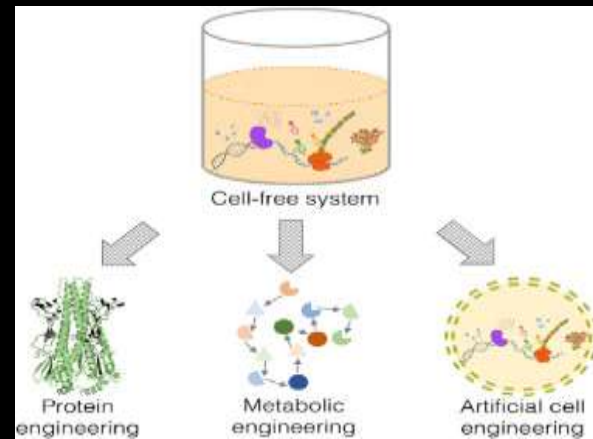
Styrofoam-Digesting Bacteria



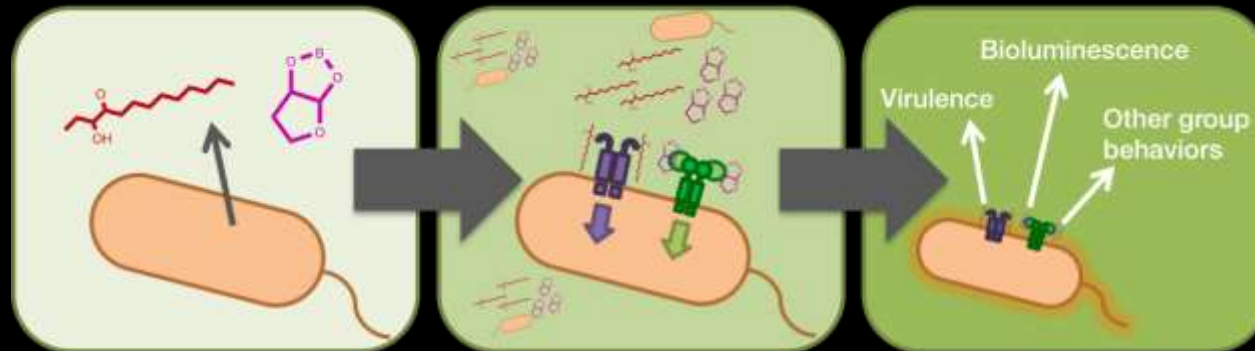
Permanent hair removal cream



Optimizing metabolic pathways and protein expression with a cell free system



Quorum sensing bacteria



An aerial, black-and-white photograph of the Hynes Convention Center in Boston, MA. The building is a large, modern structure with a prominent, curved, glass-enclosed section. It is situated in a dense urban environment, with several other tall buildings visible in the background. A parking lot with several cars is visible in the foreground, adjacent to the convention center. The overall scene is a high-angle, wide shot of the city center.

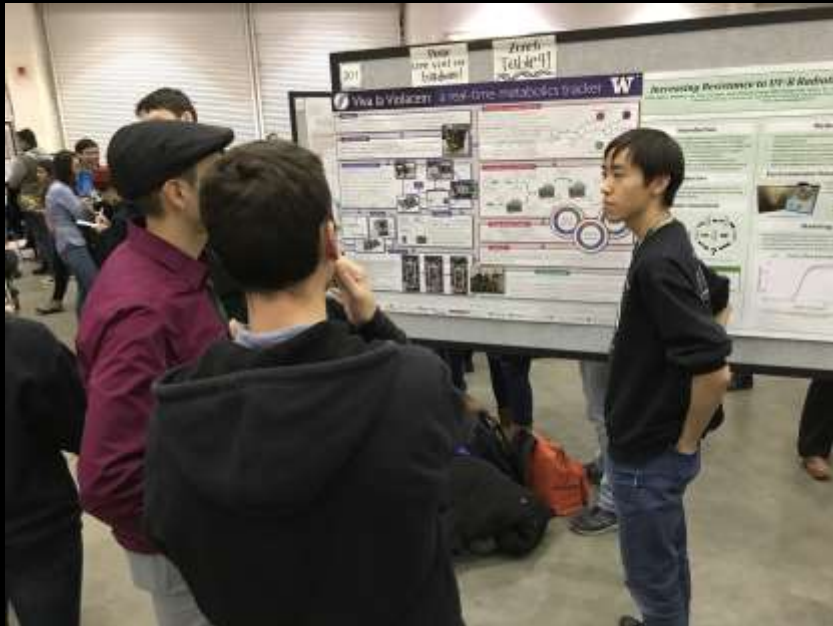
2018 iGEM Jamboree

Competition Date: October 24-28, 2018

Where: Hynes Convention Center in Boston, MA

What is the Giant Jamboree?

- Annual international conference held in Boston
- Project presentations
- Panels of acclaimed judges
- Awards ceremony



What can we do at the Giant Jamboree?

- Watch other teams' presentations
- Poster sessions
- Social events
- Workshops
- Career fair
- Explore Boston!



Individual Cost Break Down

3 Main Categories make up the itinerary:

- Airplane Tickets
- Hotel or Airbnb Stay
- Individual Registration Fee

Total Cost

\$300 Airfare

\$75 Airbnb

+ \$700 Registration Fee

\$1,075

URP Grant

“We encourage all students who have a paper, **poster**, or scholarly creative work that has been accepted for presentation at a professional conference to apply for an award.” – URP

Every member is eligible to apply! SO APPLY

Last year, every person who applied received the award.

SO ONCE AGAIN, APPLY!!!!

~ \$300-400

HUB Grant

- \$1500 that the iGEM RSO applies for
- Last year each member received \$125

With both grants taken into account: \$550

Team! (Leadership+Advisors)

Admin	Wetlab	Drylab	Human Practices + Design
			

Team! (Leadership+Advisors)

Admin	Wetlab	Drylab	Human Practices + Design
			



Team! (Leadership+Advisors)

Admin	Wetlab	Drylab	Human Practices + Design
			



Team! (Leadership+Advisors)

Admin	Wetlab	Drylab	Human Practices + Design
			



Team! (Leadership+Advisors)

Admin	Wetlab	Drylab	Human Practices + Design
			



Question Time!

- General questions now
- Specific/personal questions to relevant people after we break up