

~2012

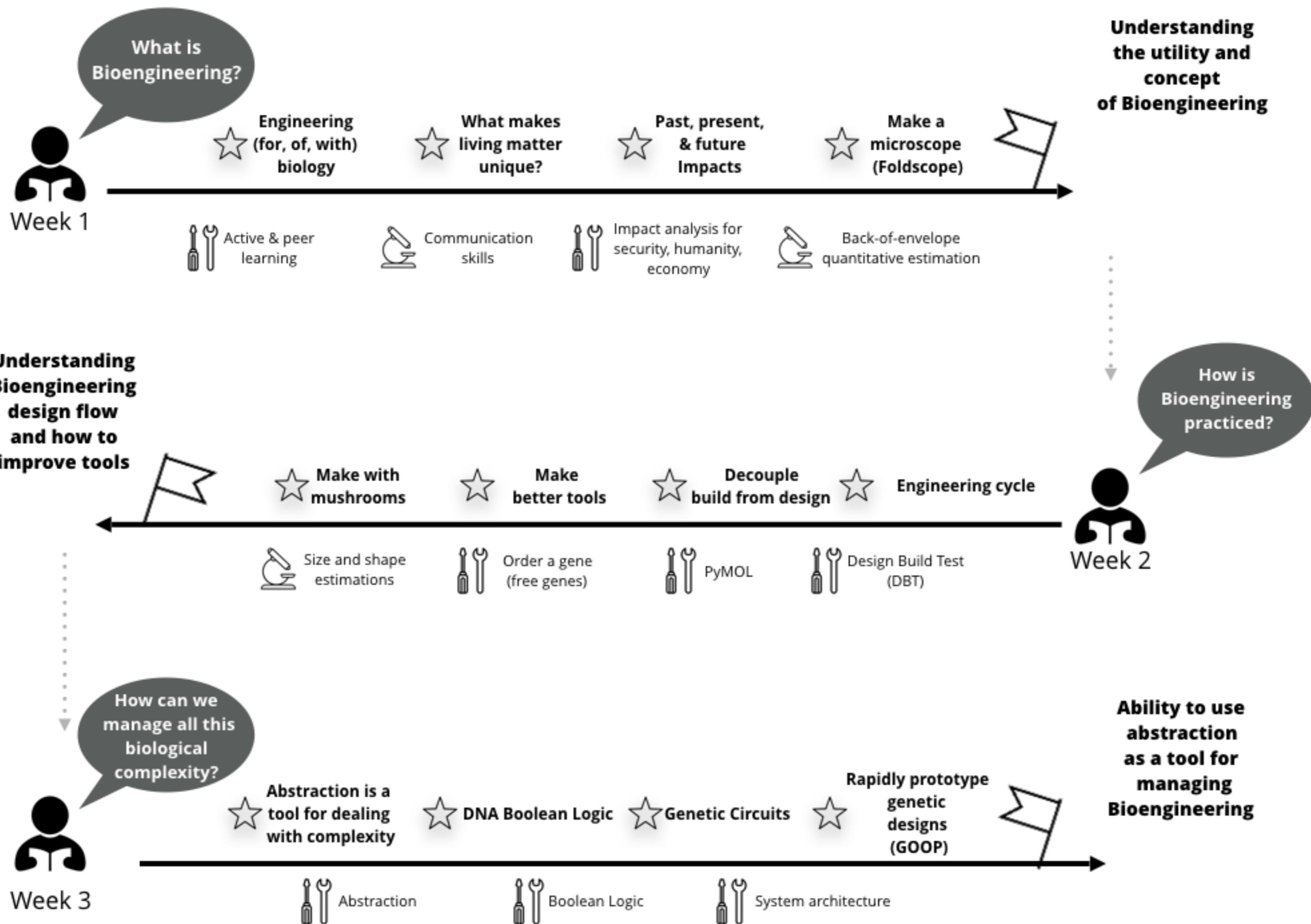


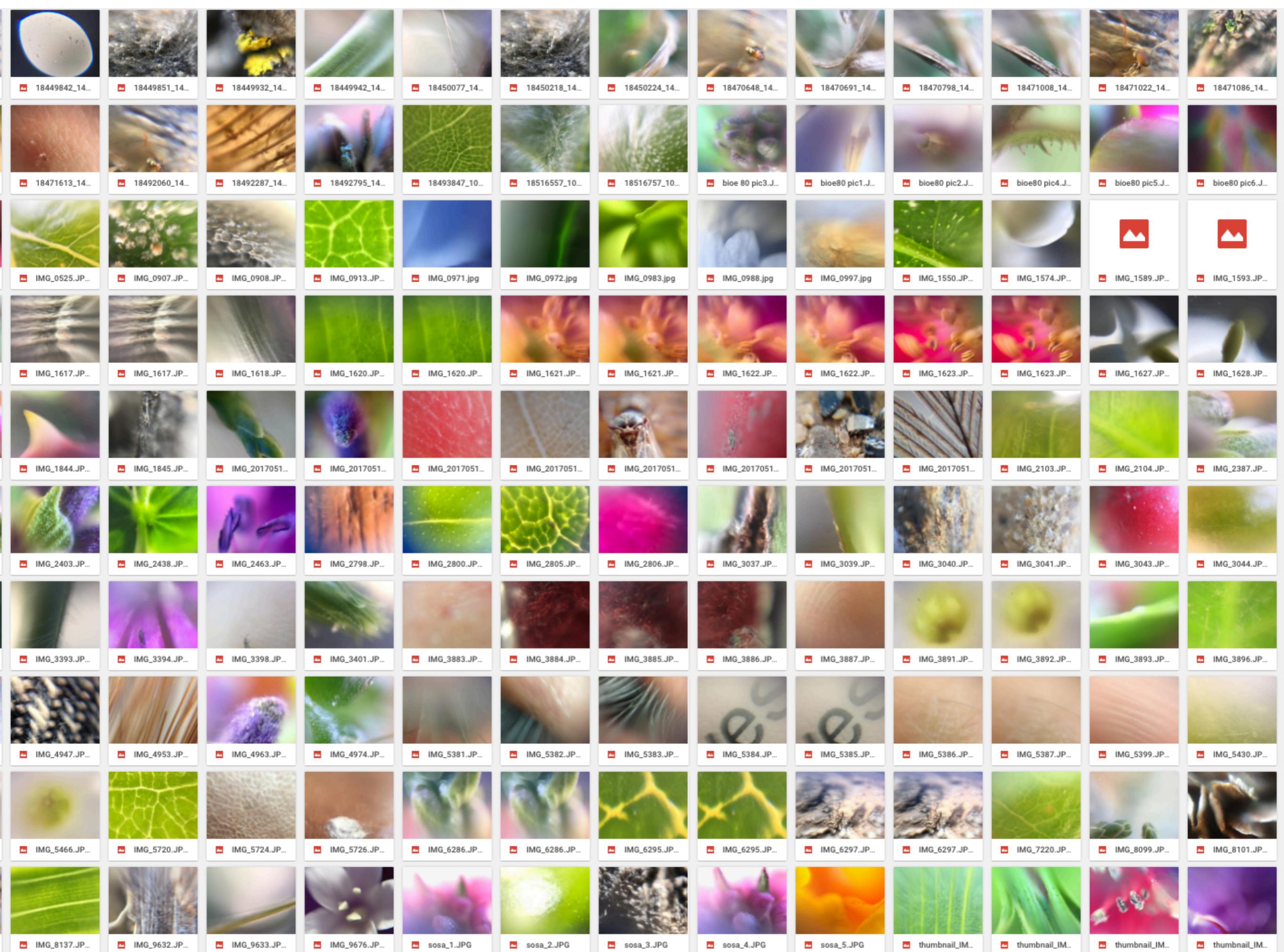
blood tissue
400 x

<https://youtu.be/Wa1A0pPc-ik>

On 6 March 2012, a promotional music video was released for "Hollow", directed by biomedical animator Drew Berry.^[124] The video, previously used in the "Hollow" app, features a three-dimensional exploration of Björk's molecules and also a molecular complex based on Björk's headscan, influenced by the works of Italian painter Giuseppe Arcimboldo.

[https://en.wikipedia.org/wiki/Biophilia_\(album\)](https://en.wikipedia.org/wiki/Biophilia_(album))











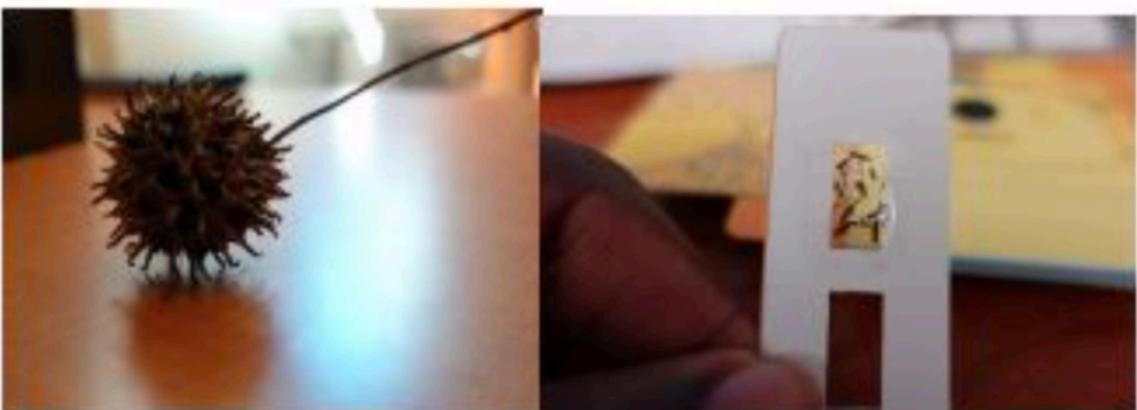




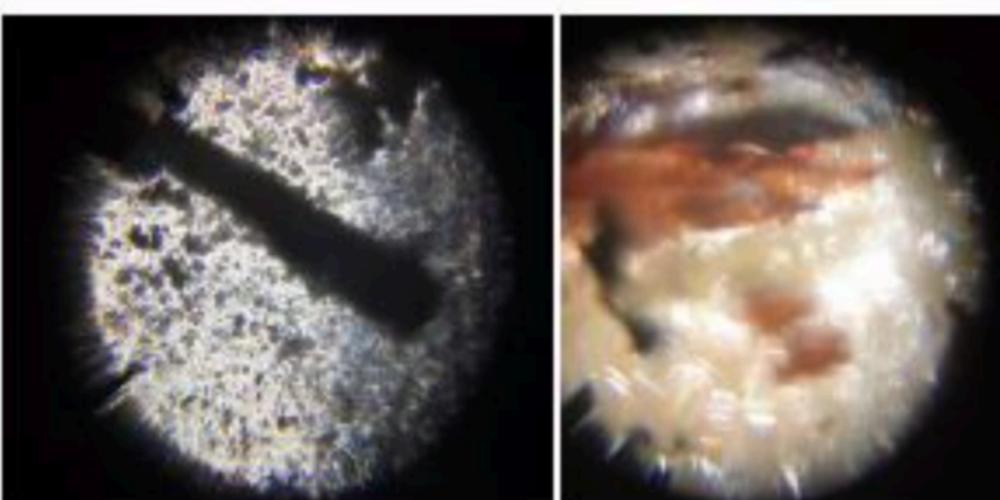


I walked through a path littered with **sweet-gum-balls** and thought it would be fun to squish them but when I stepped on them they **didn't compress**. Upon closer inspection the **structure was interesting, specifically its geometry and the combination of its spikes and holes**. It could be inspiring for futuristic/abstract art projects. I was drawn to the resistance of the structure to the will of my shoe; what about the structure made it so tough? I prepared a sample but noticed that all I could see under the foldscope was a silhouette of the spike, which wasn't particularly interesting. I then ground and flattened the spikes. Now I saw through some pieces and they looked **densely packed**, perhaps that has something to do with its strength.

I wonder: how/is the structure related to its strength?
how could we scale this up and use it?
What living matter/biology would this benefit?

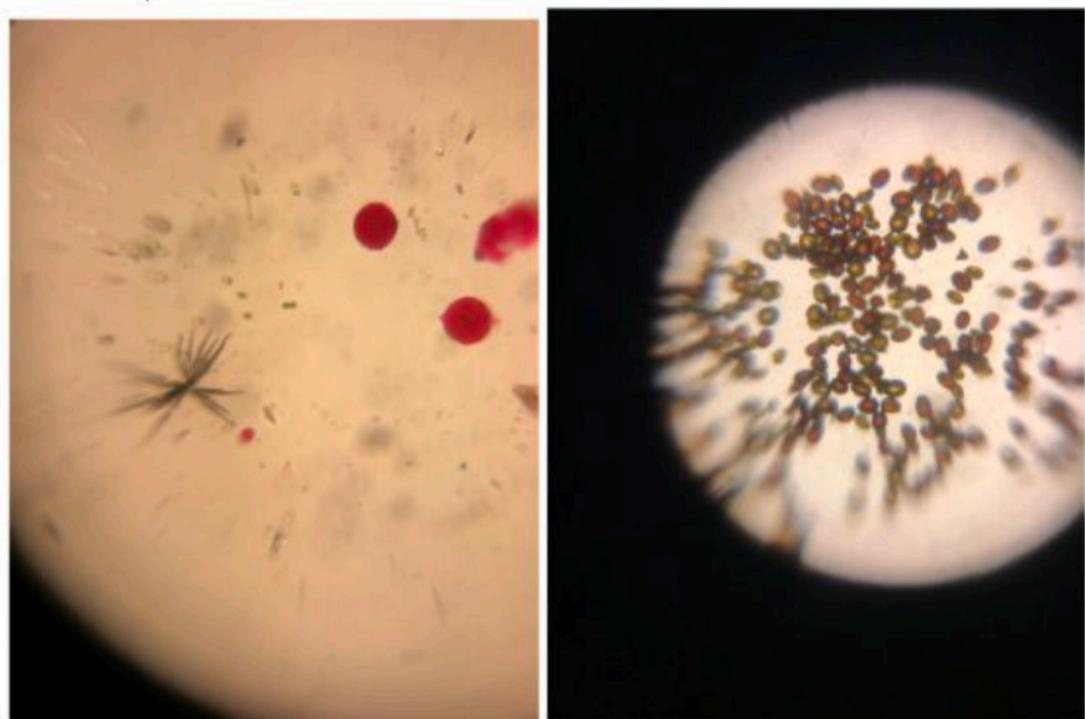


First image of sweet-gum-ball and second image of prepared sample



Three images of foldscope view of sweet-gum-ball spike. First image before it was flattened and second one after spike was crushed. Second one indicates that material is densely packed.

- a. I looked at **pollen**, which is often just an irritant to allergic people but at the same time, a necessity for life and the reproduction of plants
- b. I took **pollen samples of multiple flowers** outside my dorm by gently tapping them on a slide. My little brother had horrible pollen allergies ever since he was a kid, suffering each year as the flowers bloomed. After looking at the different types of pollen and its structure through the Foldscope, **I'm curious as to how that contributes to its transport and ability to stick to surfaces**. Drawing inspiration from its structure, perhaps we could design a vesicle or means of transport within the blood/body that doesn't need to disrupt hormonal/chemical pathways. Or maybe we could design filters for pollen detection, which could keep allergies at bay



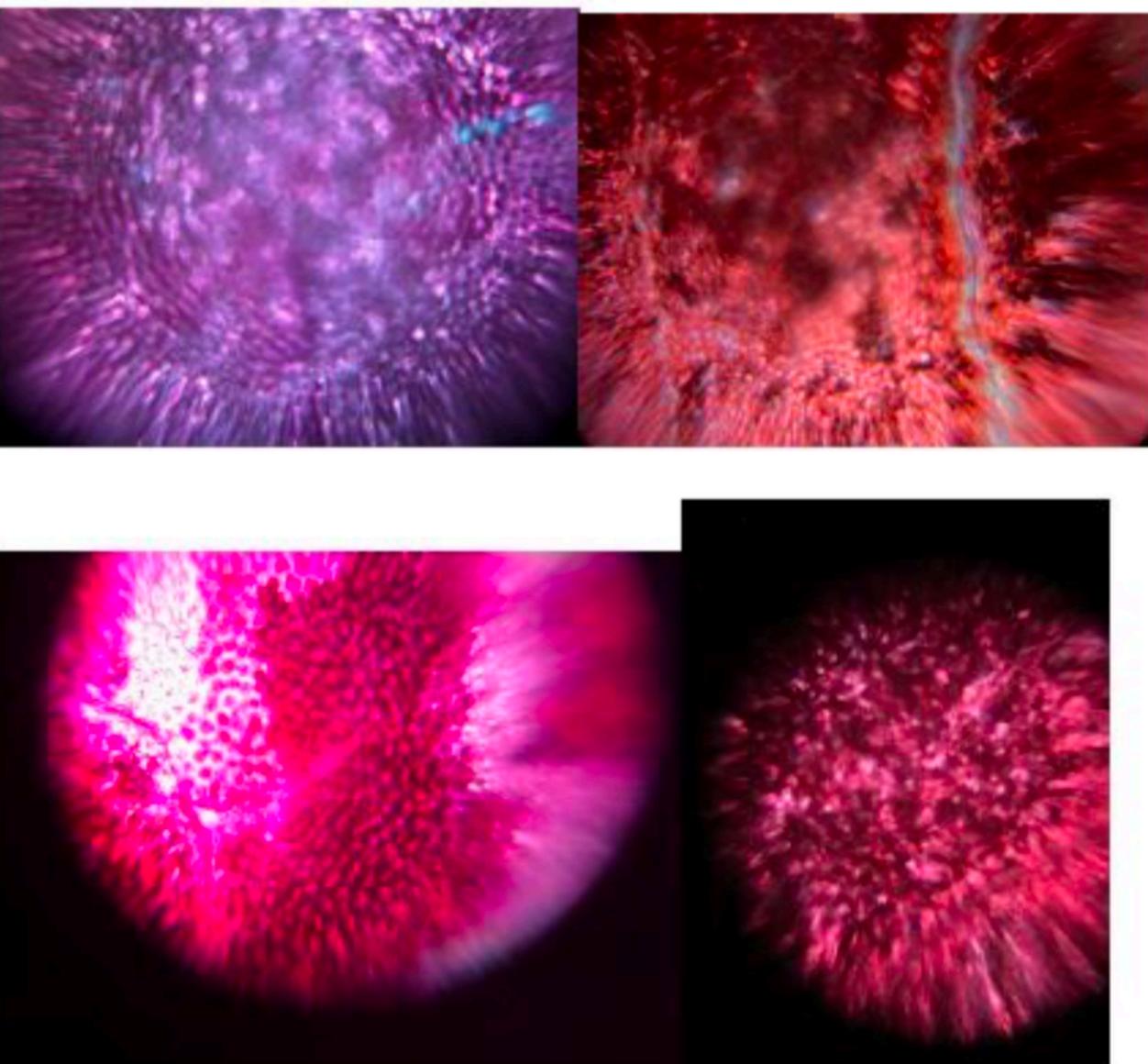
The first picture has a rounder, red pollen that resembles a spiky ball. The second picture is a large cluster of pollen that resembles coffee beans and is multi-colored.

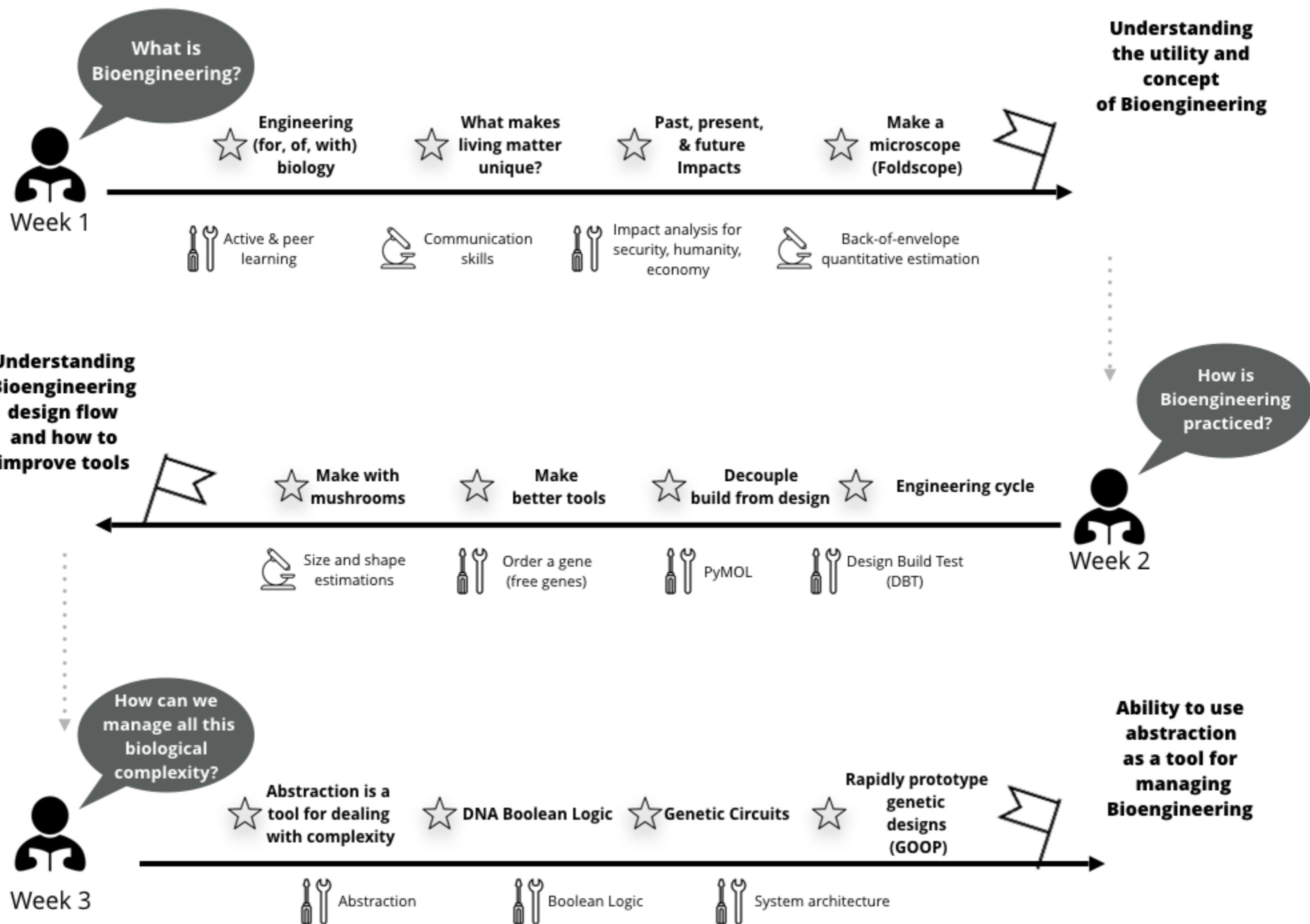
The question I asked myself for this assignment was **how the structure of different flowers differs on a cellular level**. For this experiment, I went out and picked flowers that looked significantly **different on a macroscopic scale** (color, shape, texture) and then prepared wet mounts on the slides in the foldscope kit.

My observation was that the general arrangement of the individual cells to form a whole structure seems to be very similar in all of the cells but on an individual, scale the shape of the cells is slightly different and also the shape varies between different flowers, however, is pretty consistent within a single specimen. Some images show a stronger penetration of light through the cells, meaning that these probably have thicker leafs.

Questions that I still have are:

- 1) What is the advantage of different petal thicknesses?
- 2) Why do some flowers have larger individual cells than others?





"All the News
That's Fit to Print"

VOL. CLXVIII .. No. 58,297

The New York Times

© 2019 The New York Times Company

SUNDAY, APRIL 14, 2019

Printed in California

\$6.00



CÉSAR RODRÍGUEZ FOR THE NEW YORK TIMES

Guatemalans harvesting coffee in Honduras, where severe weather has ruined crops, driving more farm workers to the United States.

Altered Genes, A U.S. Adviser And an Inquiry

By PAM BELLUCK

PALO ALTO, Calif. — "Success!" read the subject line of the email. The text, in imperfect English, began: "Good News! The women is pregnant, the genome editing success!"

Migrants Flee New Threat: Climate Change

By KIRK SEMPLE

CORQUÍN, Honduras — The farmer stood in his patch of forlorn coffee plants, their leaves sick and wilted, the next harvest in doubt.

Last year, two of his brothers and a sister, desperate to find a better way to survive, abandoned their small coffee farms in this mountainous part of Honduras and migrated north, eventually

mighty, from poverty and a neglectful government to the swings of international commodity prices.

But farmers, agricultural scientists and industry officials say a new threat has been ruining harvests, upending lives and adding to the surge of families migrating to the United States: climate change.

And their worries are increasingly shared by climate scientists as well.

ing cycles and promoted the relentless spread of pests.

The obstacles have cut crop production or wiped out entire harvests, leaving already poor families destitute.

Central America is among the regions most vulnerable to climate change, scientists say. And because agriculture employs much of the labor force — about 28 percent in Honduras alone, according to the World Bank — the livelihoods of millions of people are at stake.

Northern California: Mostly sunny south. A mix of clouds and sunshine north. Highs in upper 30s in mountains to 80s in the southern Central Valley. Weather map is on Page 22.

Google's Dragnet Ensnares Criminals, Among Others

Tracking Cellphone Data Can Be a Boon to the Police, but Privacy Issues Loom

By JENNIFER VALENTINO-DEVRIES

When detectives in a Phoenix suburb arrested a warehouse worker in a murder investigation last December, they credited a new technique with breaking open the case after other leads went cold.

The police told the suspect, Jorge Molina, they had data tracking his phone to the site where a man was shot nine months earlier. They had made the discovery after obtaining a search warrant that required Google to provide information on all devices it recorded near the killing, potentially capturing the whereabouts of anyone in the area.

Investigators also had other circumstantial evidence, including security video of someone firing a gun from a white Honda Civic, the same model that Mr. Molina owned, though they could not see the license plate or attacker.

But after he spent nearly a week in jail, the case against Mr. Molina fell apart as investigators learned new information and released him. Last month, the police arrested another man: his mother's ex-boyfriend, who had sometimes used Mr. Molina's car.

The warrants, which draw on an enormous Google database employees call Sensorvault, turn the business of tracking cellphone users' locations into a digital dragnet for law enforcement. In an era of ubiquitous data gathering by tech companies, it is just the latest example of how personal information — where you go, who your friends are, what you read, eat and watch, and when you do it — is being used for purposes many people never expected. As privacy concerns have mounted among

The Arizona case demonstrates the promise and perils of the new investigative technique, whose use has risen sharply in the past six months, according to Google employees familiar with the requests. It can help solve crimes. But it can also snare innocent people.

Technology companies have for years responded to court orders for specific users' information. The new warrants go further, suggesting possible suspects and witnesses in the absence of other clues. Often, Google employees said, the company responds to a single warrant with location information on dozens or hundreds of devices.

Law enforcement officials described the method as exciting, but cautioned that it was just one tool.

"It doesn't pop out the answer like a ticker tape, saying this guy's guilty," said Gary Ernsdorff, a senior prosecutor in Washington State who has worked on several cases involving these warrants. Potential suspects must still be fully investigated, he added. "We're not going to charge anybody just because Google said they were there."

It is unclear how often these search requests have led to arrests or convictions, because many of the investigations are still open and judges frequently seal

Continued on Page 18

In Sunday Review

The Times's
opinion
section

What would you do if you got the following email?

Good News! The women is pregnant, the genome editing success! The embryo with CCR5 gene edited was transplanted to the women 10 days ago, and today the pregnancy is confirmed!

Regards,

发自我的iPhone

- a. nothing
- b. request more information
- c. advocate terminating the pregnancy
- d. alert the authorities (which ones?)
- e. other

the h.project

Tobias Rees

Reid Hoffman Professor of Humanities, The New School of Social Research; Director, Transformations of the Human, Berggruen Institute

Date and Time:

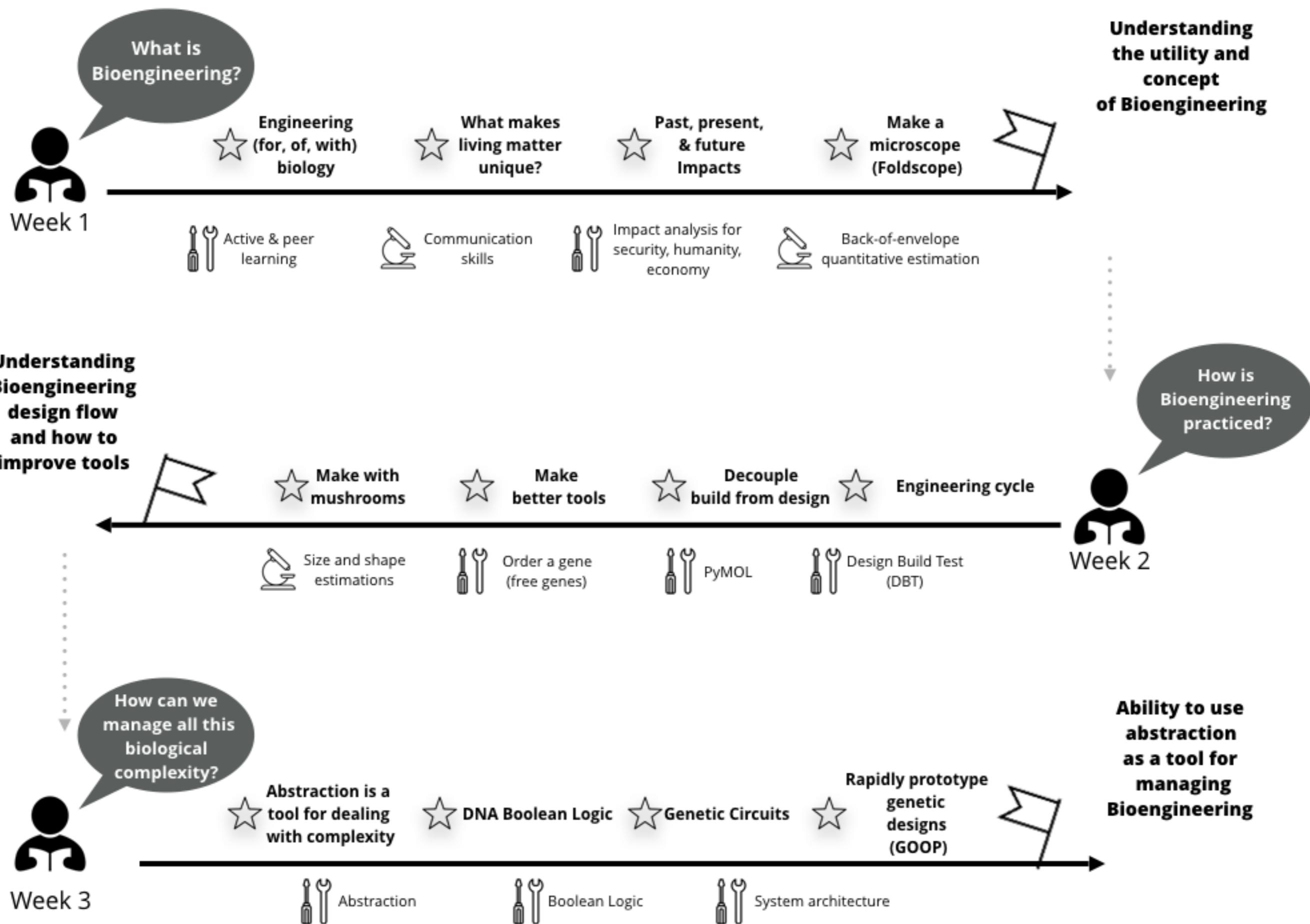
Monday, April 15, 2019 - 15:30

Location:

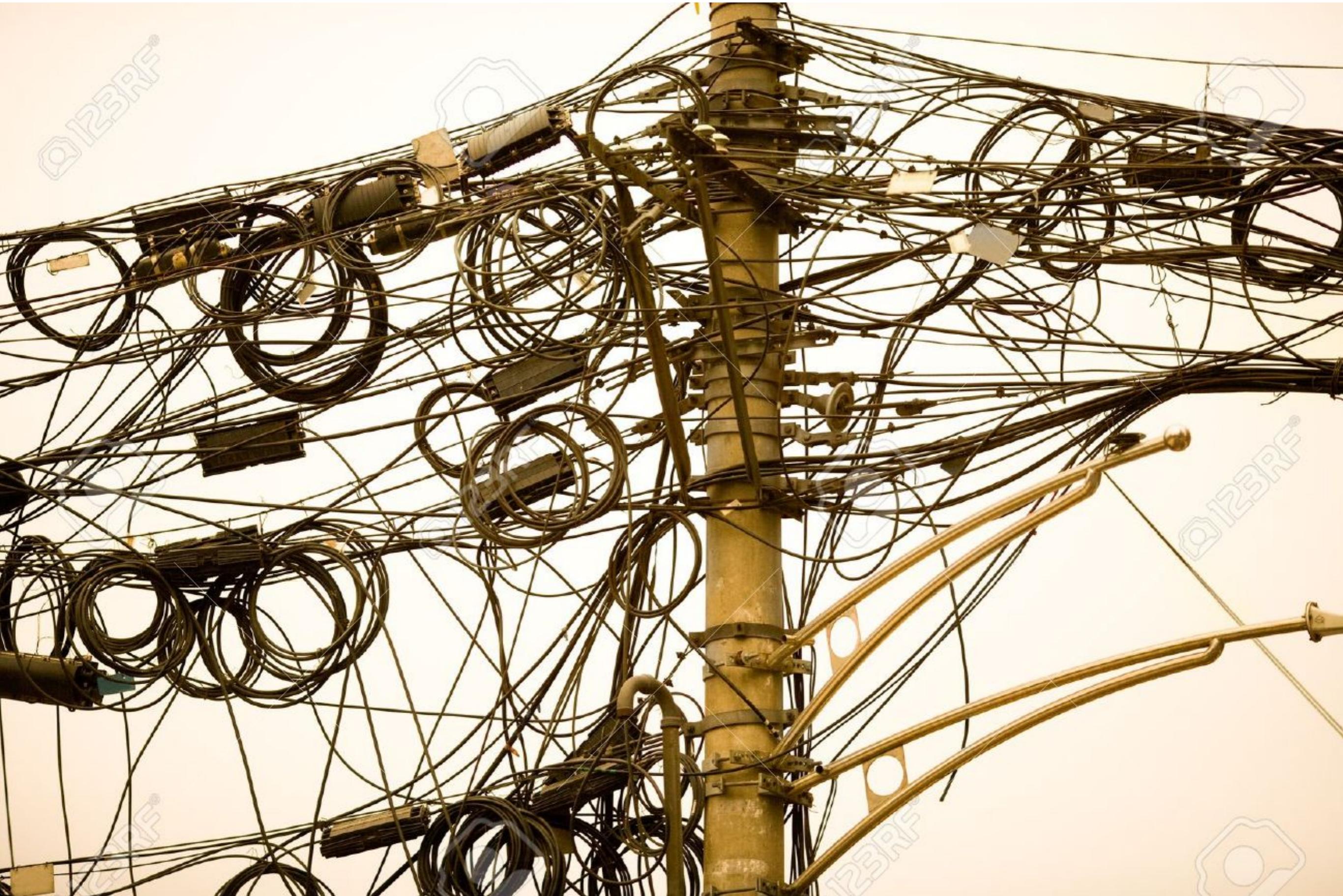
Department of Anthropology
Main Quad - Building 50
Room 51A (Colloquium Room)

Abstract:

The modern, in its aspirations time and place independent concept of ‘the human’ is a form that was invented by European philosophers between the 1630s and the 1890s. Today, this form fails us. (These failures are visible to anyone who can and cares to see). Indeed, it is a bit as if the world (we ourselves) has outgrown the human, has outgrown the vocabulary that we have had available to think about ourselves as human, that, like a scaffold, gave us the form ‘human.’



Q. What is the magnetic field? A. Who cares!



Taking Faster and Smarter to New Physical Frontiers

By DREW ENDY DEC. 5, 2011



The value of computers is often measured with terms like gigahertz, petaflop and exabyte — the speed, scale and efficiency with which they perform computations.

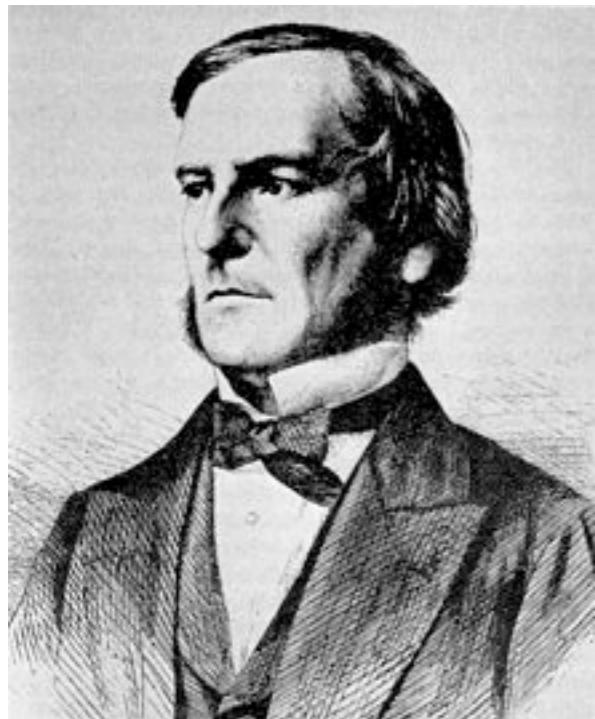
But so what? The intrinsic worth of computation ought to be a matter of the types of information being computed upon, and of when and where these computations occur. When you are lost, for example, a phone that will compute your route home is worth far more to you than an inaccessible desktop PC, no matter how fancy and powerful.

So a better way to think about the future of computing might be to ask when and where we could improve our ability to compute upon information that we greatly care about.

Consider a simple “computer” that counts to just 256, using eight bits of data storage. Could such a computer have any significant value?

Well, what if such computers could be installed inside every cell of your body? What if these computers were used to keep track of how many times each of your cells divided, forming the basis of systems that could track and control aging, development and cancer? If too many divisions are detected,

From George (logic) to Claude (electrical relays) to ...



George Boole, c.1854

AN INVESTIGATION
OF
THE LAWS OF THOUGHT,
ON WHICH ARE FOUNDED
THE MATHEMATICAL THEORIES OF LOGIC AND
PROBABILITIES.
BY
GEORGE BOOLE, LL. D.
PROFESSOR OF MATHEMATICS IN QUEEN'S COLLEGE, CORK.

11. *Signs of those mental operations whereby we collect parts into a whole, or separate a whole into its parts.*

We are not only capable of entertaining the conceptions of objects, as characterized by names, qualities, or circumstances, applicable to each individual of the group under consideration, but also of forming the aggregate conception of a group of objects consisting of partial groups, each of which is separately named or described. For this purpose we use the conjunctions "and," "or," &c. "Trees and minerals," "barren mountains, or fertile vales," are examples of this kind. In strictness, the words "and," "or," interposed between the terms descriptive of two or more classes of objects, imply that those classes are quite distinct, so that no member of one is found in another. In this and in all other respects the words "and" "or" are analogous with the sign + in algebra, and their laws are identical. Thus the expression "men and women" is, conventional meanings set aside, equivalent with the expression "women and men." Let x represent "men," y , "women;" and let + stand for "and" and "or," then we have

$$x + y = y + x, \quad (3)$$



Claude Shannon, c.1937

Analogue with the Calculus of Propositions. We are now in a position to demonstrate the equivalence of this calculus with certain elementary parts of the calculus of propositions. The algebra of logic (1), (2), (3) originated by George Boole, is a symbolic method of investigating logical relationships. The symbols of Boolean algebra admit of two logical interpretations. If interpreted in terms of classes, the variables are not limited to the two possible values 0 and 1. This interpretation is known as the algebra of classes. If, however, the terms are taken to represent propositions, we have the calculus of propositions in which variables are limited to the values 0 and 1*,

*This refers only to the classical theory of the Calculus of Propositions. Recently some work has been done with logical systems in which propositions may have more than two "truth values."

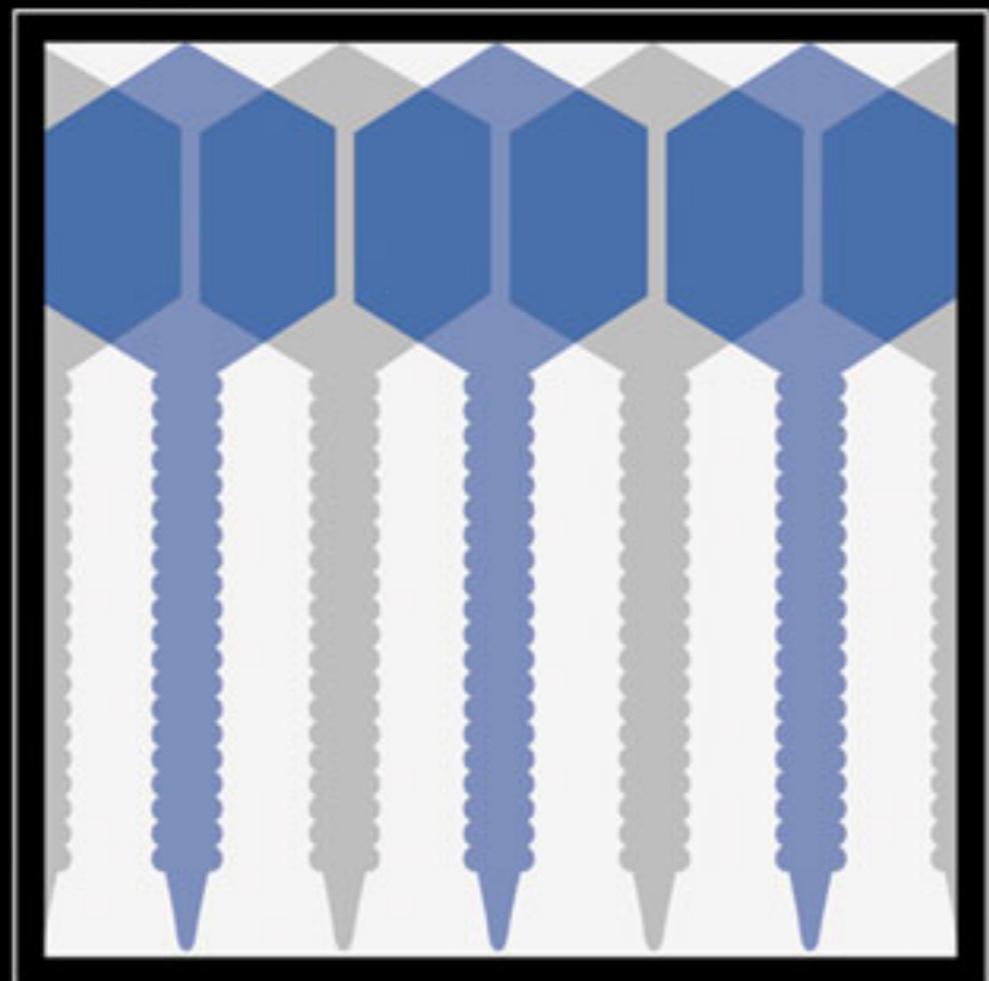
TABLE I

Analogue Between the Calculus of Propositions
and the Symbolic Relay Analysis

Symbol	Interpretation in relay circuits	Interpretation in the Calculus of Propositions
X	The circuit X.	The proposition X.
0	The circuit is closed.	The proposition is false.
1	The circuit is open.	The proposition is true.
X + Y	The series connection of circuits X and Y	The proposition which is true if either X or Y is true.
XY	The parallel connection of circuits X and Y	The proposition which is true if both X and Y are true.
X'	The circuit which is open when X is closed, and closed when X is open.	The contradictory of proposition X.
=	The circuits open and close simultaneously.	Each proposition implies the other.

A GENETIC SWITCH

Third Edition
Phage Lambda Revisited



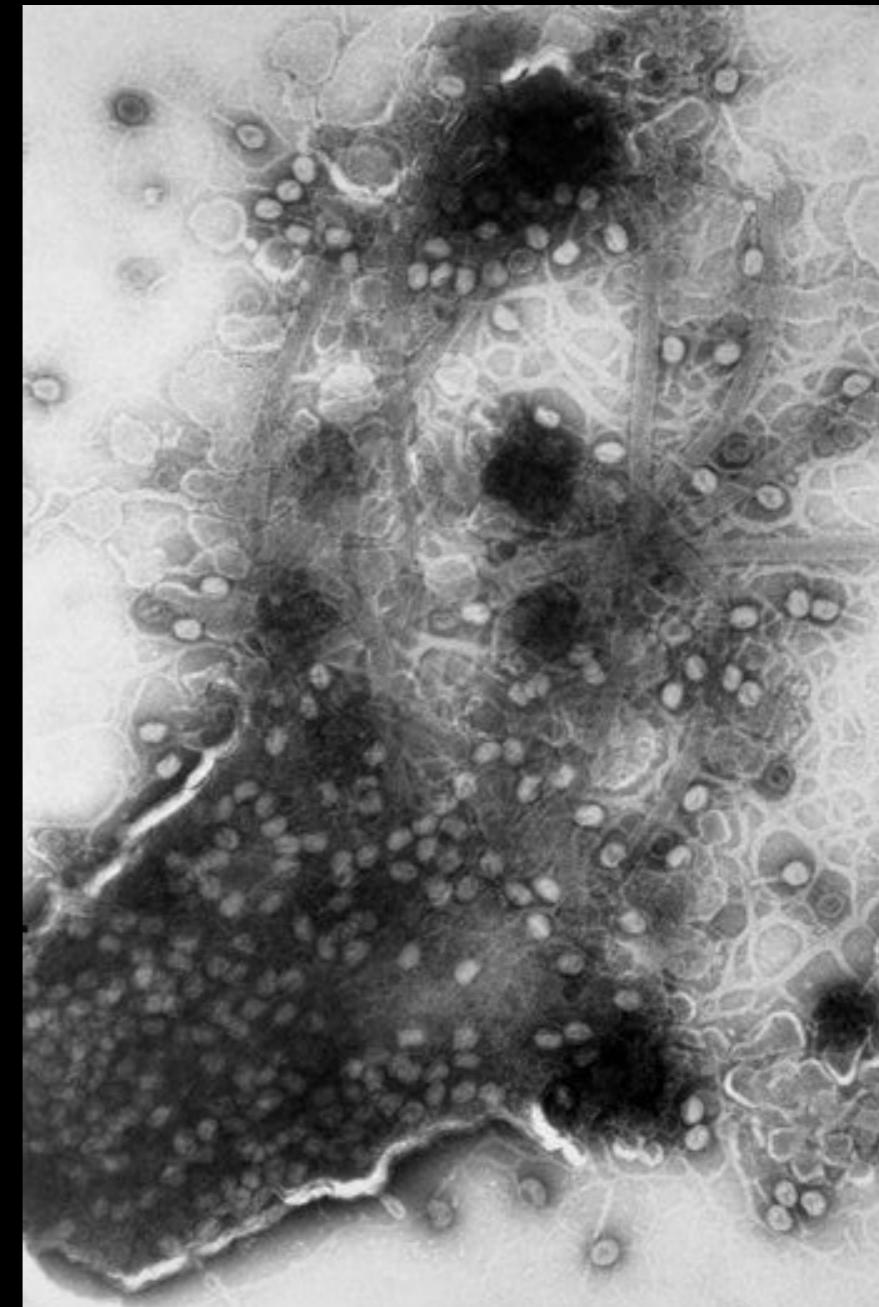
MARK PTASHNE

<https://www.cshlpress.com/link/genswitp.htm>

St-Pierre & Endy PNAS USA 2008



<http://youtu.be/sLkZ9FPHJGM>



c/o Dinsdale Lab, SDSU

MINIREVIEW

Phage-Host Interaction: an Ecological Perspective

Sandra Chibani-Chennoufi, Anne Bruttin, Marie-Lise Dillmann, and Harald Brüssow*

Nestlé Research Centre, CH-1000 Lausanne 26, Switzerland

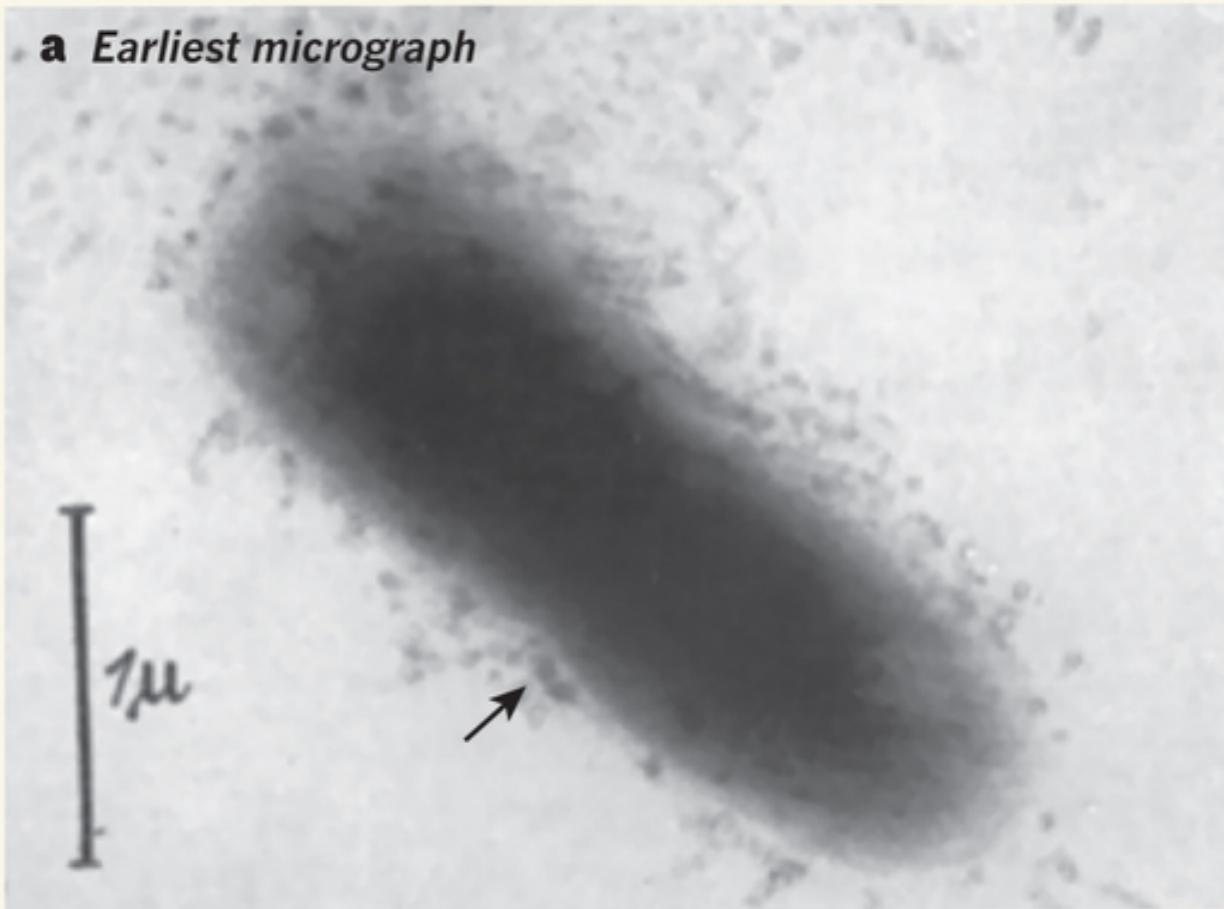
Nearly 100 years ago, Felix d'Herelle, the codiscoverer of bacteriophages, used bacteria to control insect pests and used phages against bacterial disease. His approaches reflected ecological insights before this branch of biology became an established scientific discipline. In fact, one might have predicted that phage research would become the springboard for biotechnology and ecology. However, d'Herelle was ahead of his time, and the zeitgeist in the 1930s pushed physicists into the question "What is life?" Phages as the simplest biological systems were the logical choice for this question, and phage research became the cradle of molecular biology.

NUMBERS: PHAGE TITERS IN THE BIOSPHERE

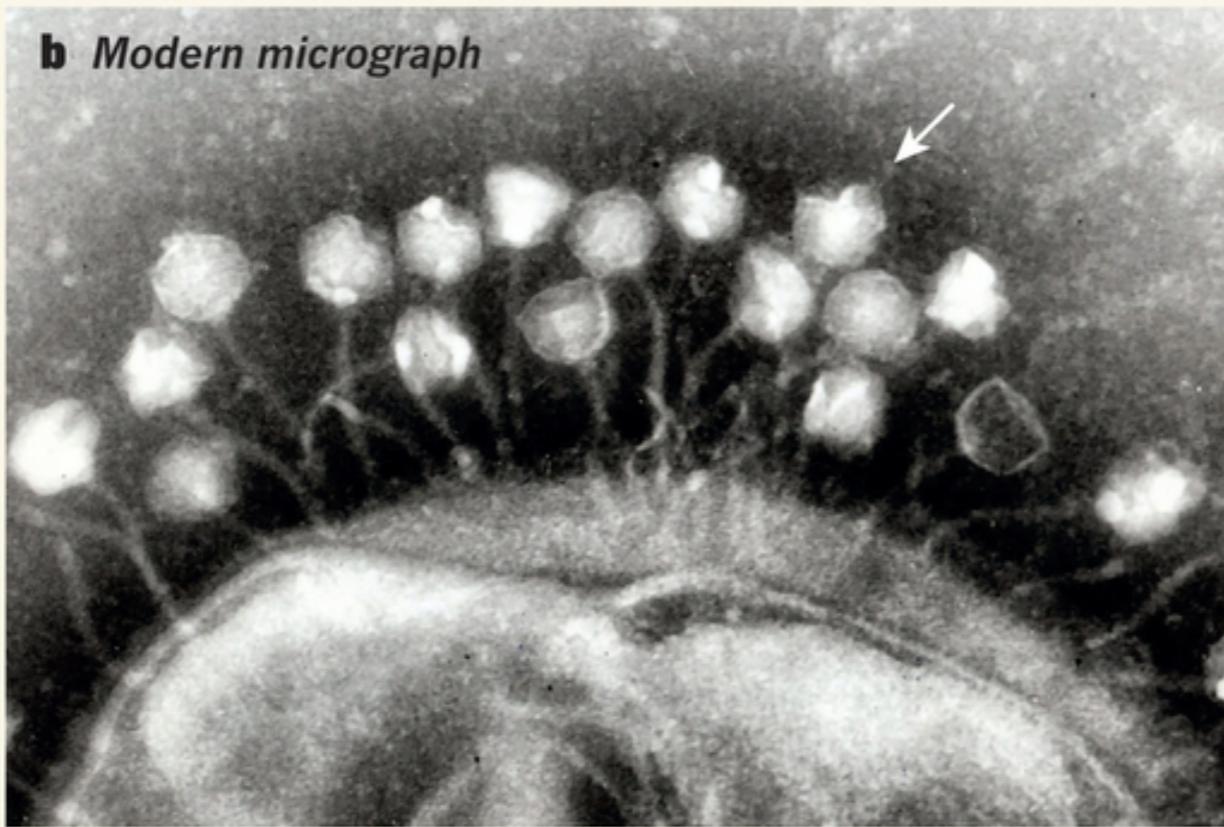
Just 14 years ago, a Norwegian group surprised the scientific community with a report on the high concentration of phage-like particles in coastal water and the ocean and even higher concentrations in lakes (5). In eutrophic estuarine water, bacteria are found at a density of 10^6 cells/ml and viruses with a concentration of 10^7 particles/ml. These concentrations are estimates that vary with the seasons and the geographical location. In addition, these figures refer to physical and not viable entities. A popular model postulates about 10 to 50 different bacterial species and 100 to 300 different phage

All these figures have important consequence for our biological view of the world. If phages outnumber bacteria in the ocean, phages are likely to be numerically the most prominent biological systems on earth, with an estimated population size of $\geq 10^{30}$ phage particles. With these numbers, even rare

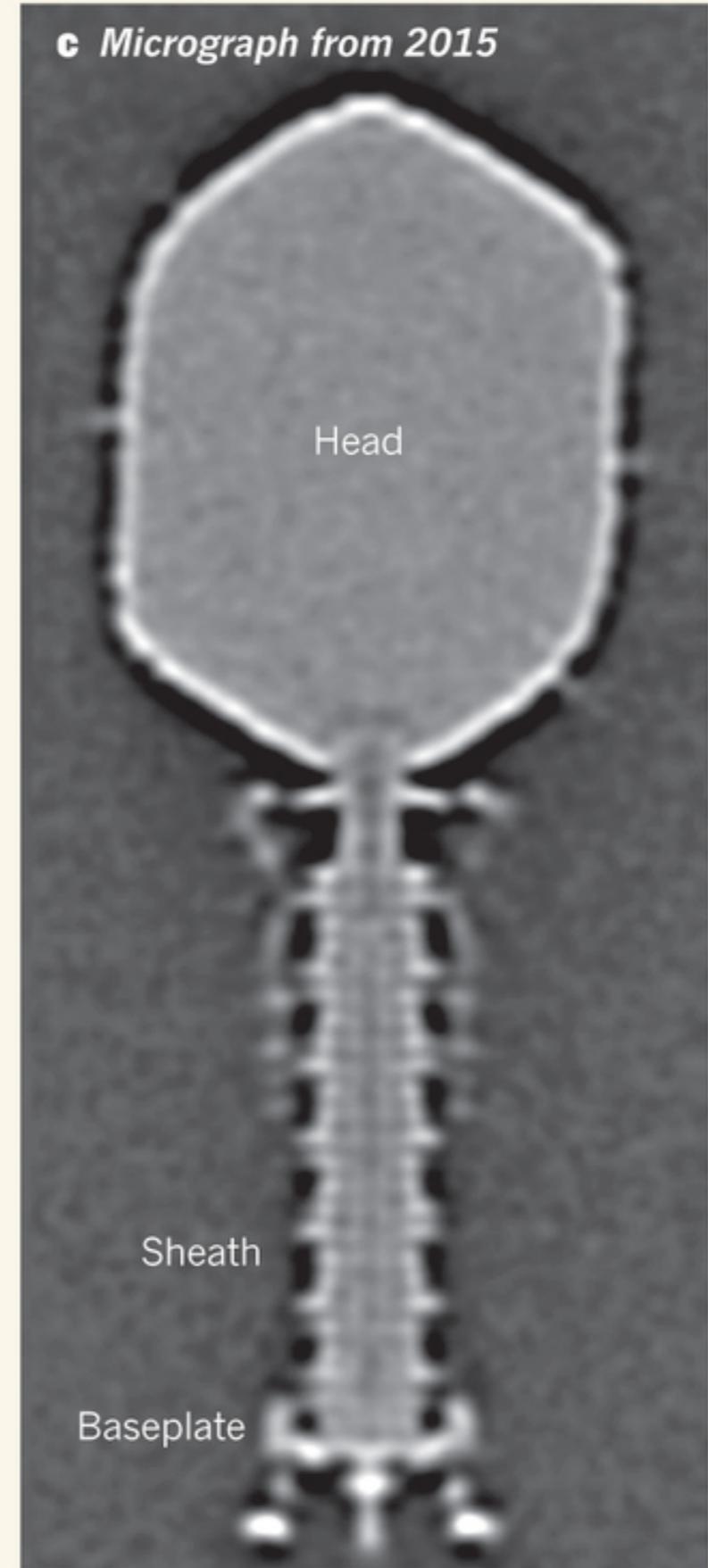
a Earliest micrograph



b Modern micrograph



c Micrograph from 2015



"In 1910, I was in Mexico, in the state of Yucatan, when an invasion of locusts occurred; the Indians reported to me that in a certain place the ground was strewn with the corpses of these insects. I went there and collected sick locusts, easily picked out since their principal symptom was an abundant blackish diarrhoea. This malady had not as yet been described, so I studied it. It was caused by bacteria, the locust coccobacillus, which were present almost in the pure state in the diarrhoeal liquid. I could start epidemics in columns of healthy insects by dusting cultures of the coccobacillus on plants in front of the advancing columns: the insects infected themselves as they devoured the soiled plants."

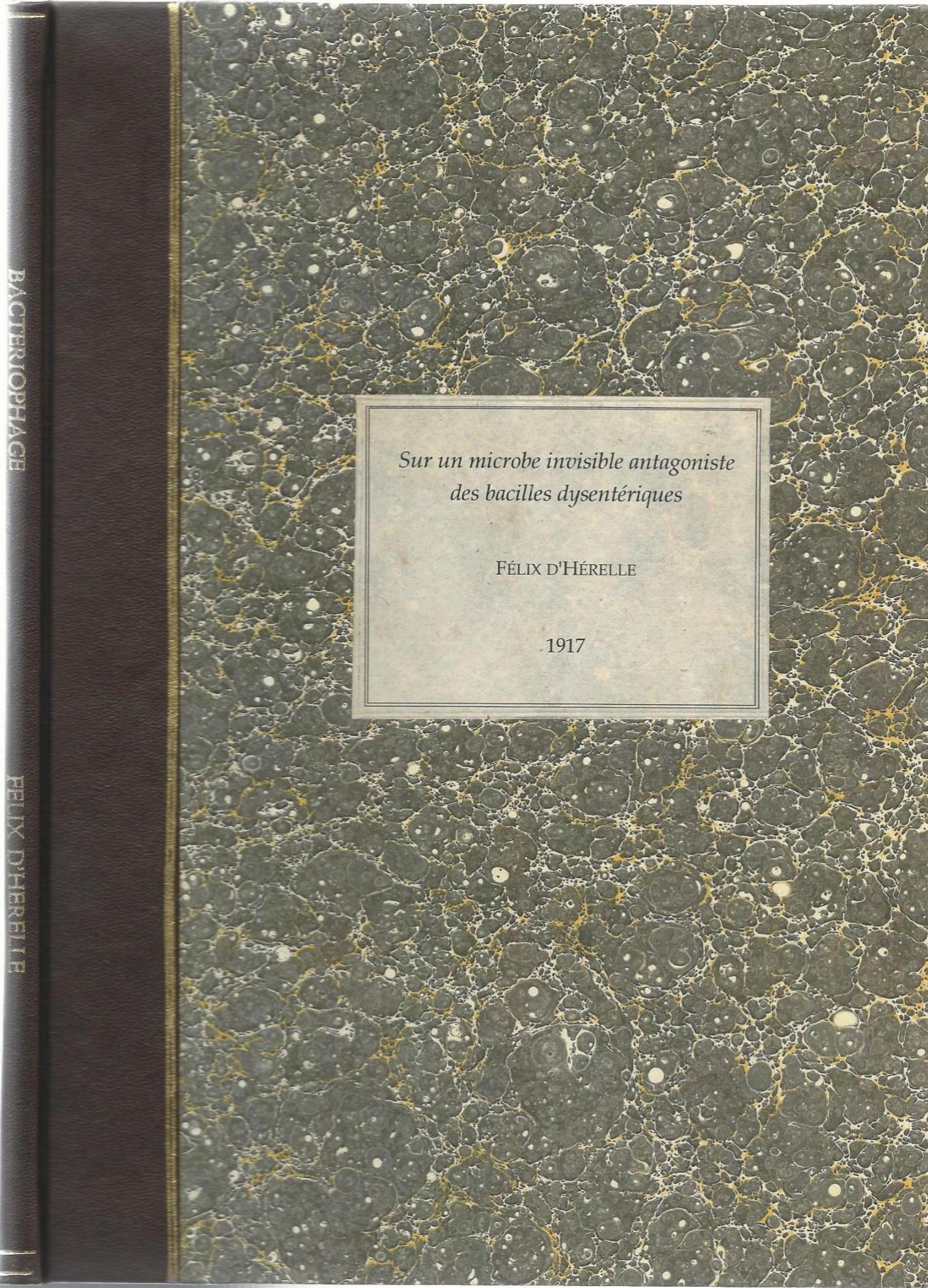


https://en.wikipedia.org/wiki/F%C3%A9lix_d%27Herelle



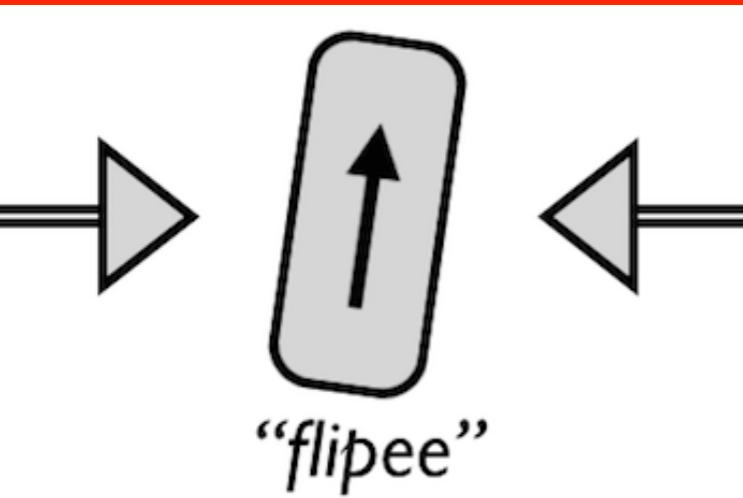
“During the years which followed, I went from the Argentine to North Africa to spread this illness. In the course of these researches, at various times I noticed an anomaly shown by some cultures of the coccobacillus which intrigued me greatly, although in fact the observation was ordinary enough, so banal indeed that many bacteriologists had certainly made it before on a variety of cultures.”

“The anomaly consisted of clear spots, quite circular, two or three millimeters in diameter, speckling the cultures grown on agar. I scratched the surface of the agar in these transparent patches, and made slides for the microscope; there was nothing to be seen. I concluded from this and other experiments that the something which caused the formation of the clear spots must be so small as to be filtrable, that is to say able to pass a porcelain filter of the Chamberland type, which will hold back all bacteria.”

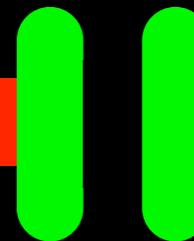




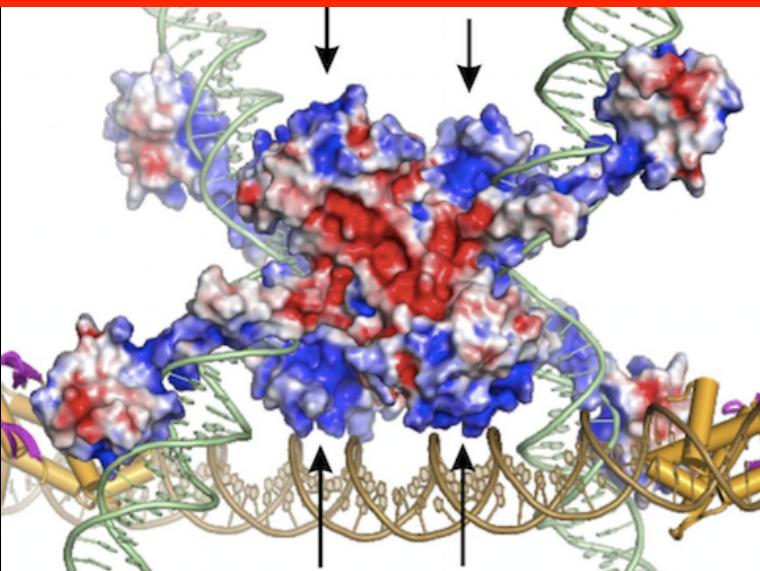
8-bit counter



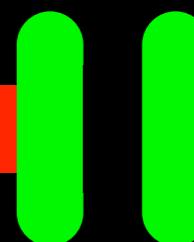
Abstraction barrier! Do not cross!



Systems = One or more devices encoding a human defined function(s).



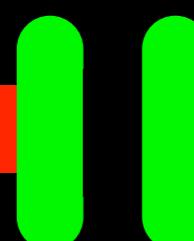
Abstraction barrier! Do not cross!



Devices = One or more parts encoding a human defined function(s).

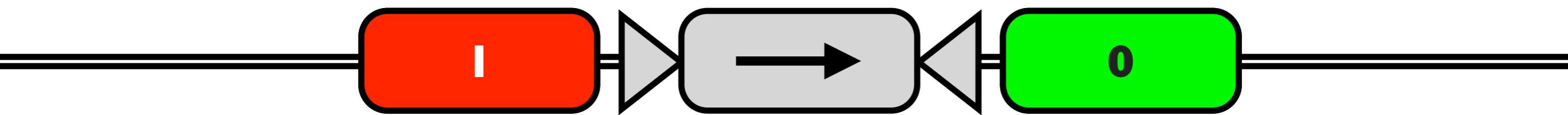
CTATAGGGAGA

Abstraction barrier! Do not cross!



DNA = Material encoding molecules

01010101



“*flipee*”

Bonnet et al., PNAS USA, 2012

**please see Nash & Pollock (1981, 1983) thru Friedland & Lu et al. (2010+) for prior work on flipping DNA and data storage



29

Fine, in theory...

But which molecular gizmo(s)
might be convinced to flip
DNA for us?

And, how do we “tame” them?



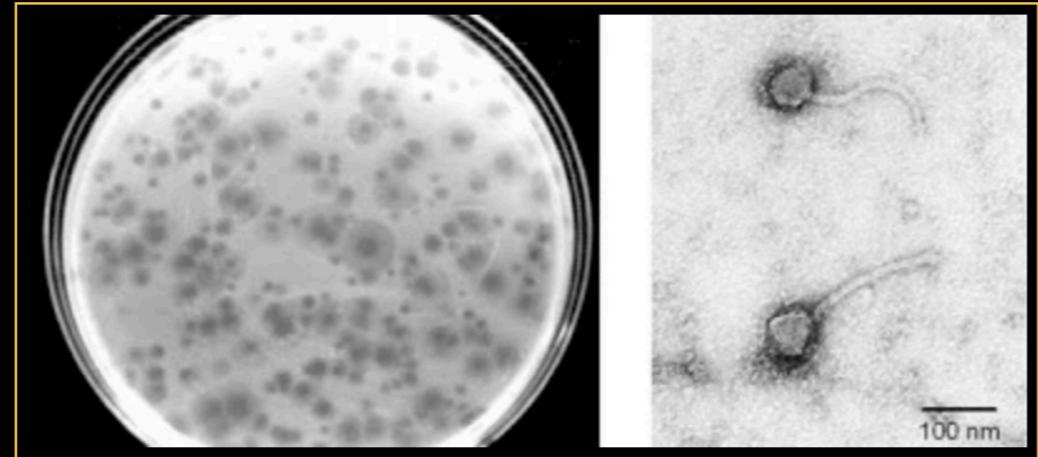
THE EVILUTIONARY BIOLOGIST

ALL SCIENCE, ALL THE TIME

THURSDAY, SEPTEMBER 10, 2009

ME

Phage Hunters



18 freshmen students have enrolled in my Genomics Research Experience course aka *Phage Hunters*. This course is supported by the Howard Hughes Medical Institute's Science Education Alliance. My students have begun the process of isolating novel Mycobacteriophages by collecting soil samples from the wild and plating them on lawns of *Mycobacterium smegmatis*, a *M. tuberculosis* relative. Unlike *M. tuberculosis*, *M. smegmatis* is non-pathogenic and is easier to grow and manipulate under experimental conditions. Nonetheless, by virtue of their close phylogenetic relationship, the two bacteria are quite similar in many respects. Thus, *M. smegmatis* may be an excellent model for deriving treatments against tuberculosis.

Collecting Mycophage is already paying handsome dividends. Albert Einstein College of Medicine Professor William Jacobs isolated a phage he named **the Bronx Bomber** from soil from his own backyard in the Bronx. With University of Pittsburgh Professor Graham Hatfull, Jacobs characterized this phage in the laboratory. They found that this phage is able to insert itself into the genome of *M. smegmatis* at a very specific location in the groEL1 gene, thus disabling the gene. One of groEL1's functions is to facilitate the production of biofilms.

ABOUT ME



 **JOHN DENNEHY**
QUEENS, NY, UNITED
STATES

I'm an evolutionary biologist who studies bacteriophage life history stochasticity and the population dynamics of host/pathogen interactions. I'm currently affiliated with Queens College and the CUNY Graduate Center. I can be reached at



The ins and outs of serine integrase site-specific recombination

Karen Rutherford, Gregory D Van Duyne 

Show more

<http://dx.doi.org/10.1016/j.sbi.2014.01.003> 

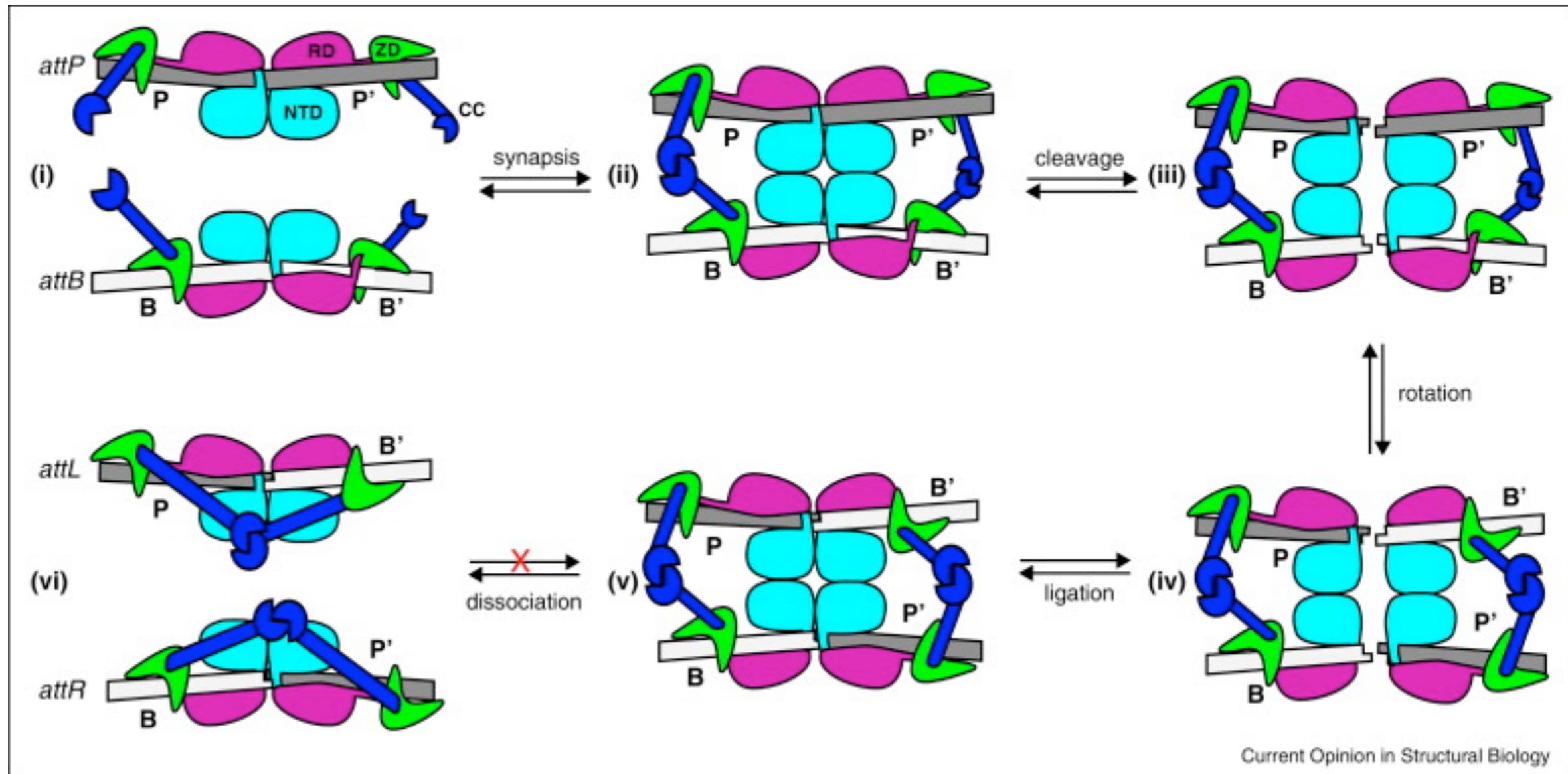
 Get rights and content

Highlights

- A serine integrase–DNA complex structure provides the basis for site selectivity.
- A coiled-coil motif influences synaptic efficiency and promotes *attP* × *attB* recombination.
- A recombination directionality factor stimulates excision and inhibits integration.
- The RDF may bind the coiled-coil motif, altering site-dependent synapsis efficiency.

Serine integrases catalyze the integration and excision of phage genomes into and out of bacterial chromosomes in a highly specific and directional manner, making these proteins powerful tools for genome engineering. In 2013, the first structure of a serine integrase–DNA complex was reported. This work revealed how the phage *attP* sequence is recognized by the integrase and provided important clues about how serine integrases bind to other attachment site sequences. The resulting structural models indicate that distinct spatial arrangements of integrase domains are present for each attachment site complex. Here we describe how serine integrases may exploit this site-dependent domain arrangement to regulate the direction of recombination. We also discuss how phage-encoded recombination directionality factors could change this directionality by altering the nature of inter-subunit interactions.

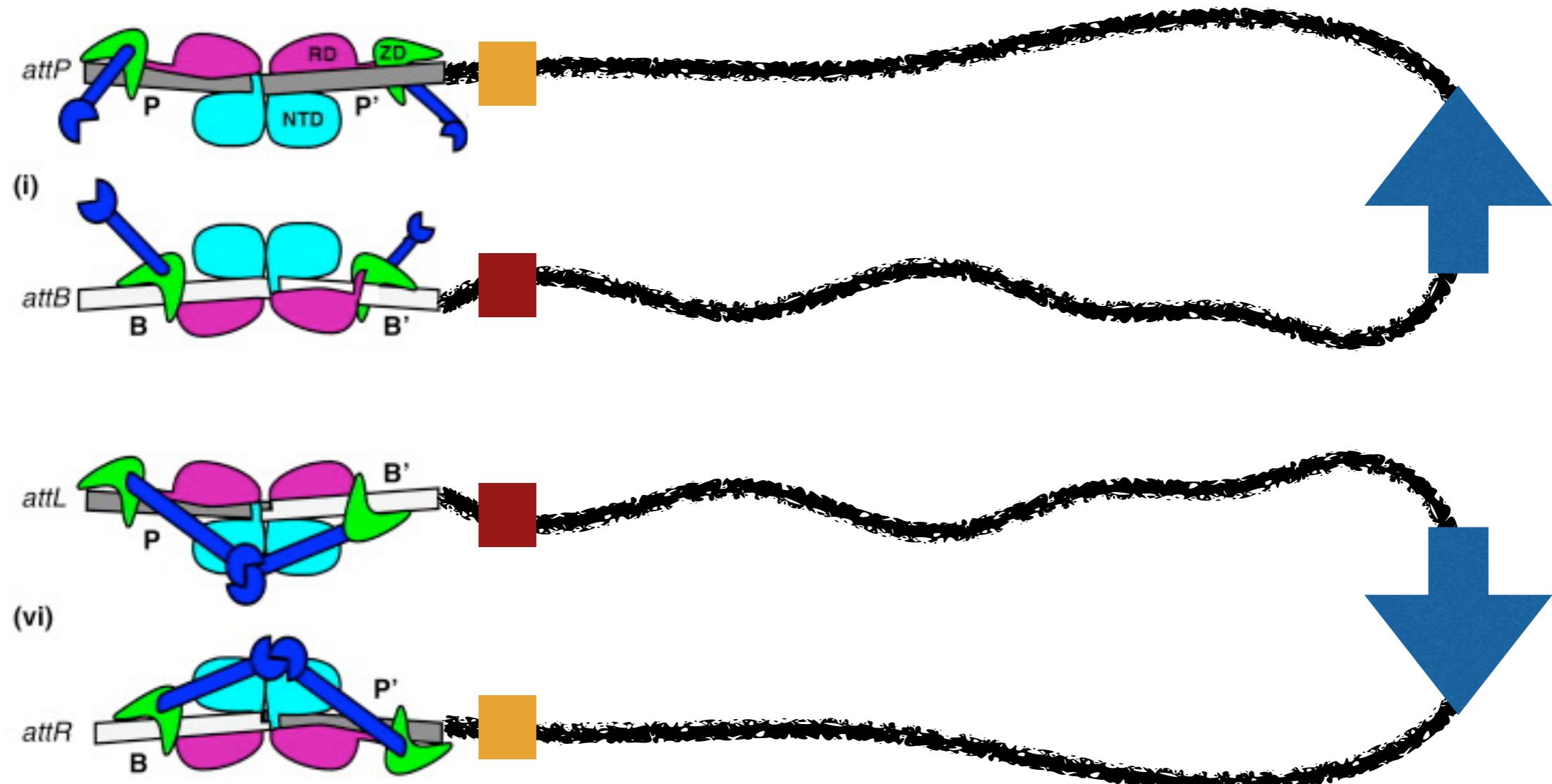
“Recombinases” mediate “cut, exchange, & paste” of two DNA molecules



Karen Rutherford & Gregory D Van Duyne (2014)
The ins and outs of serine integrase site-specific recombination
<http://dx.doi.org/10.1016/j.sbi.2014.01.003>



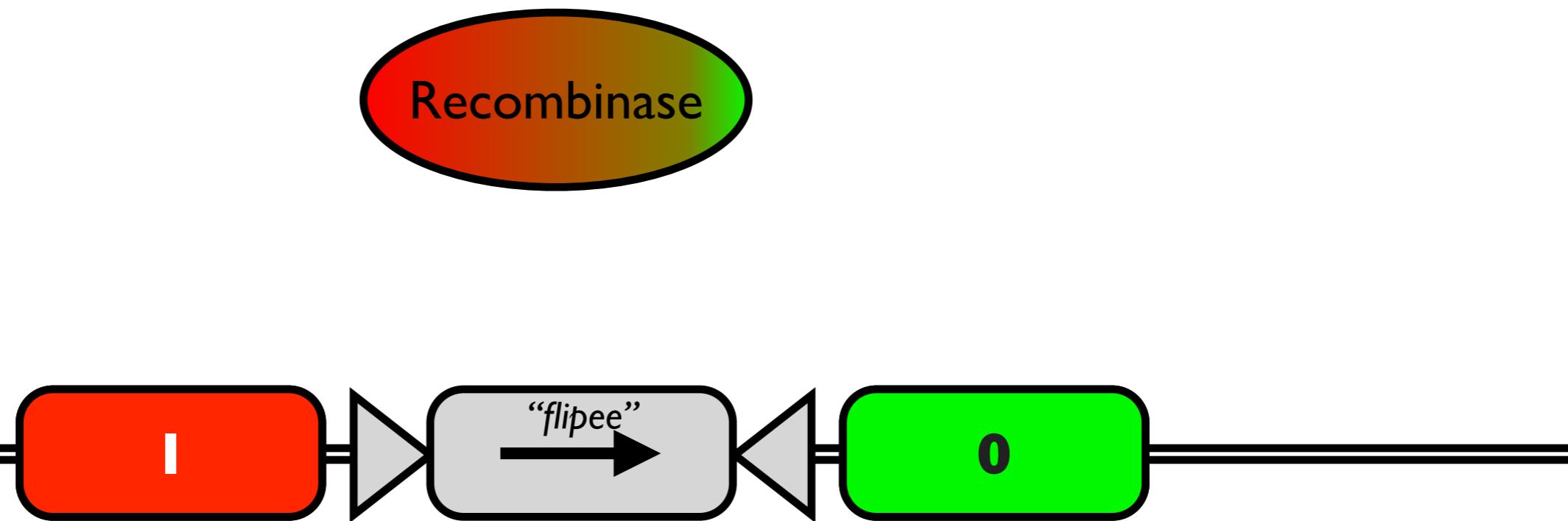
If we connect the two pieces of DNA then the connecting fragment would be flipped!



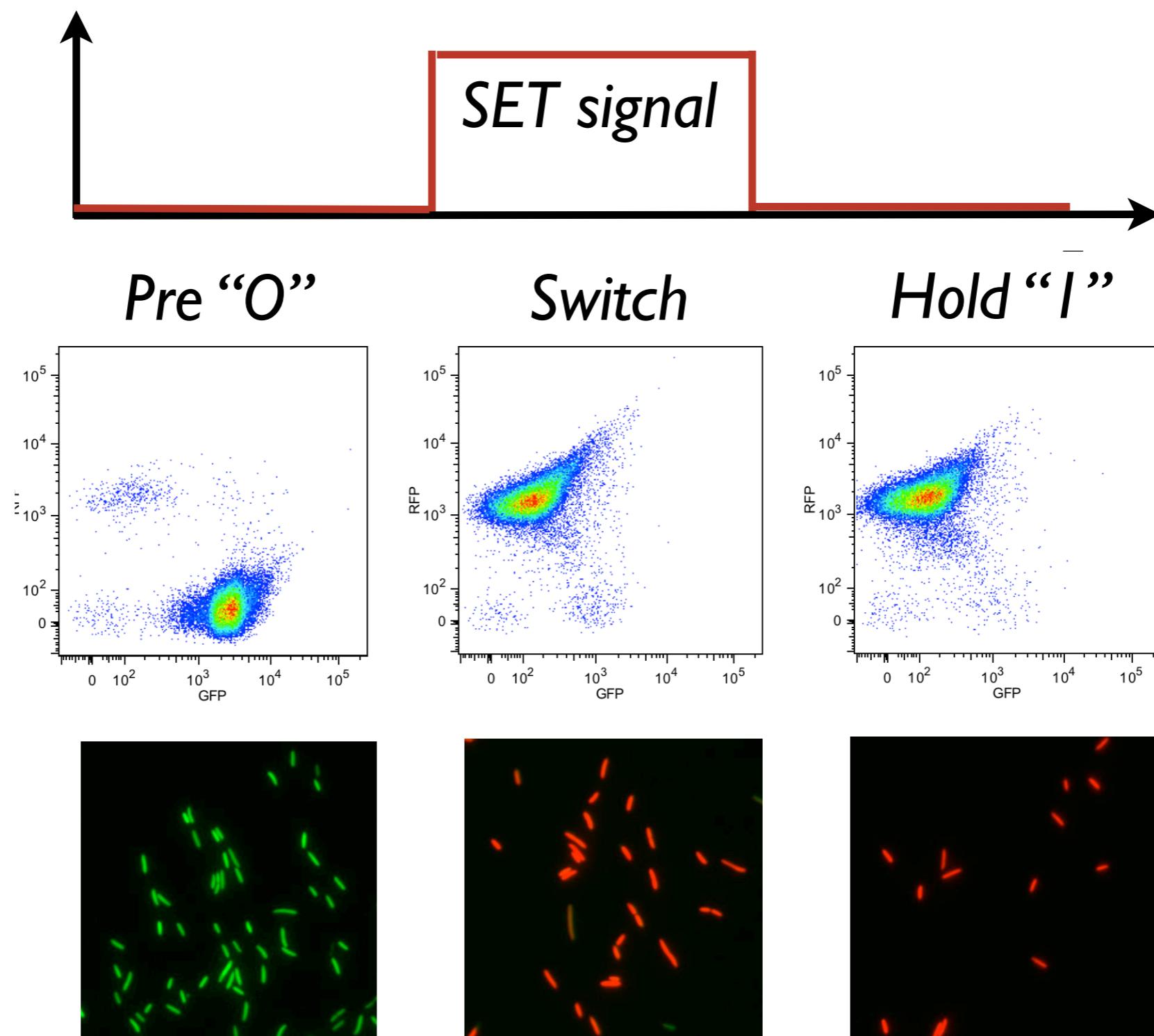
Karen Rutherford & Gregory D Van Duyne (2014)
The ins and outs of serine integrase site-specific recombination
<http://dx.doi.org/10.1016/j.sbi.2014.01.003>



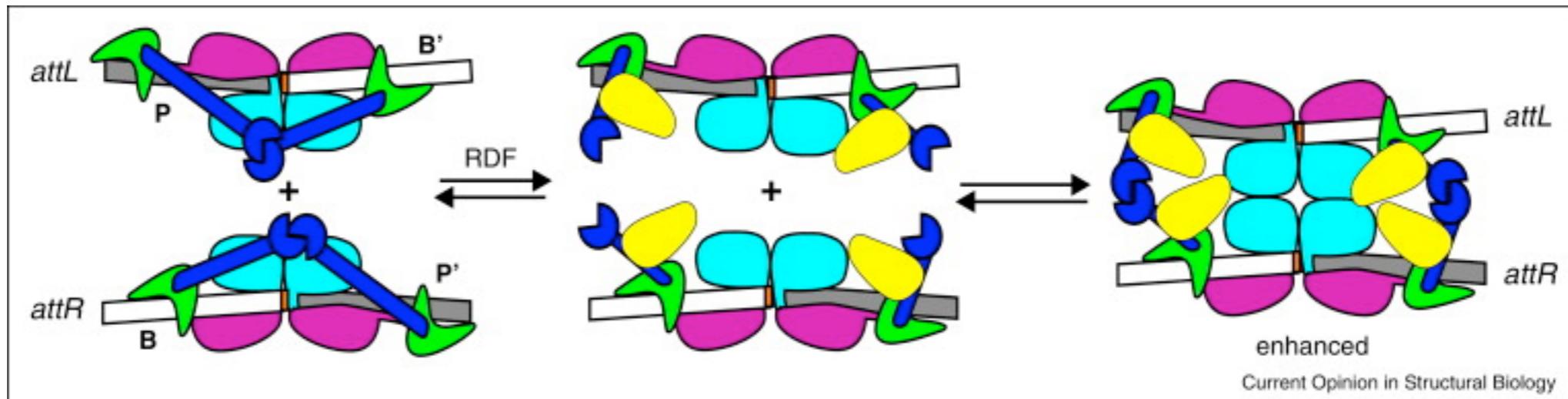
SET “flipper”



We can set one bit.



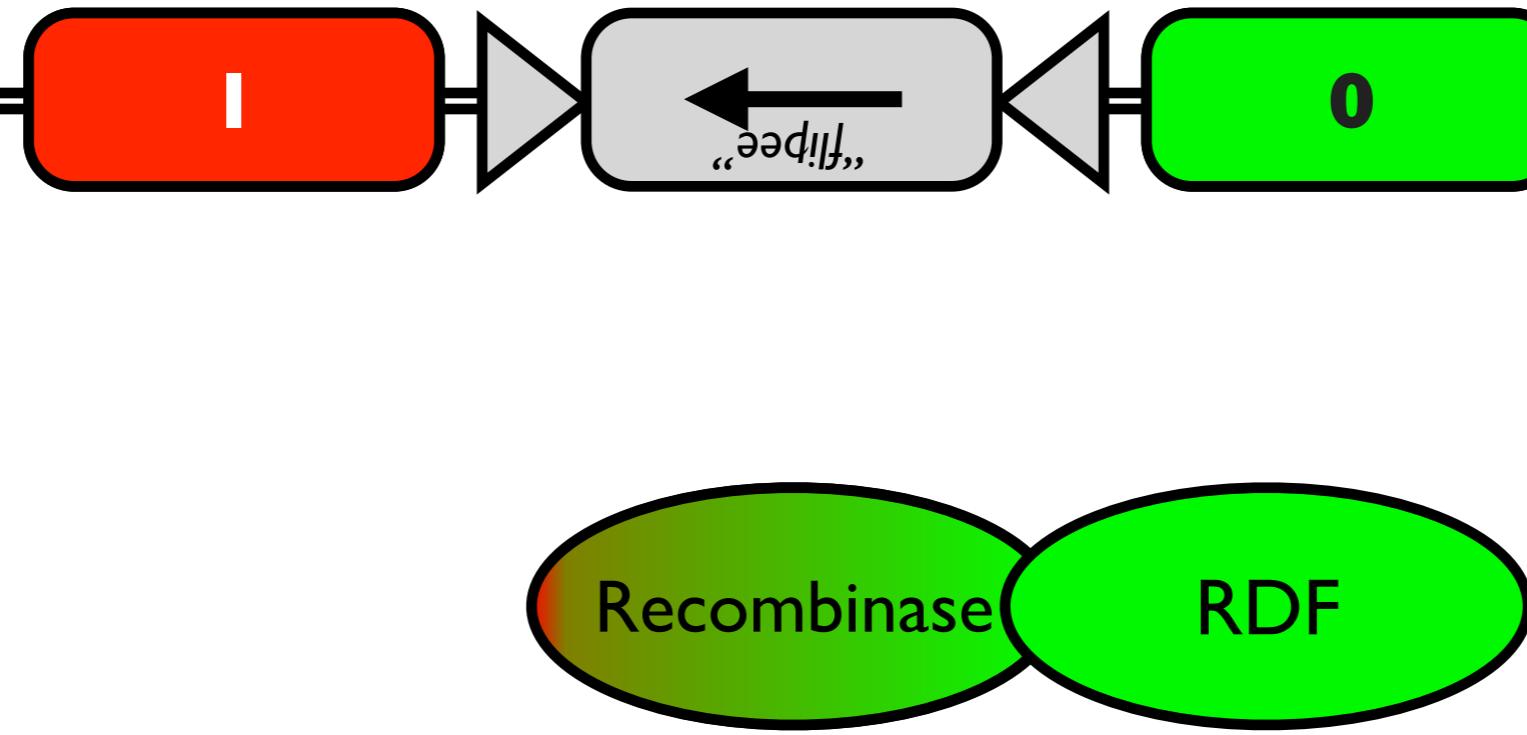
But what about flipping back?



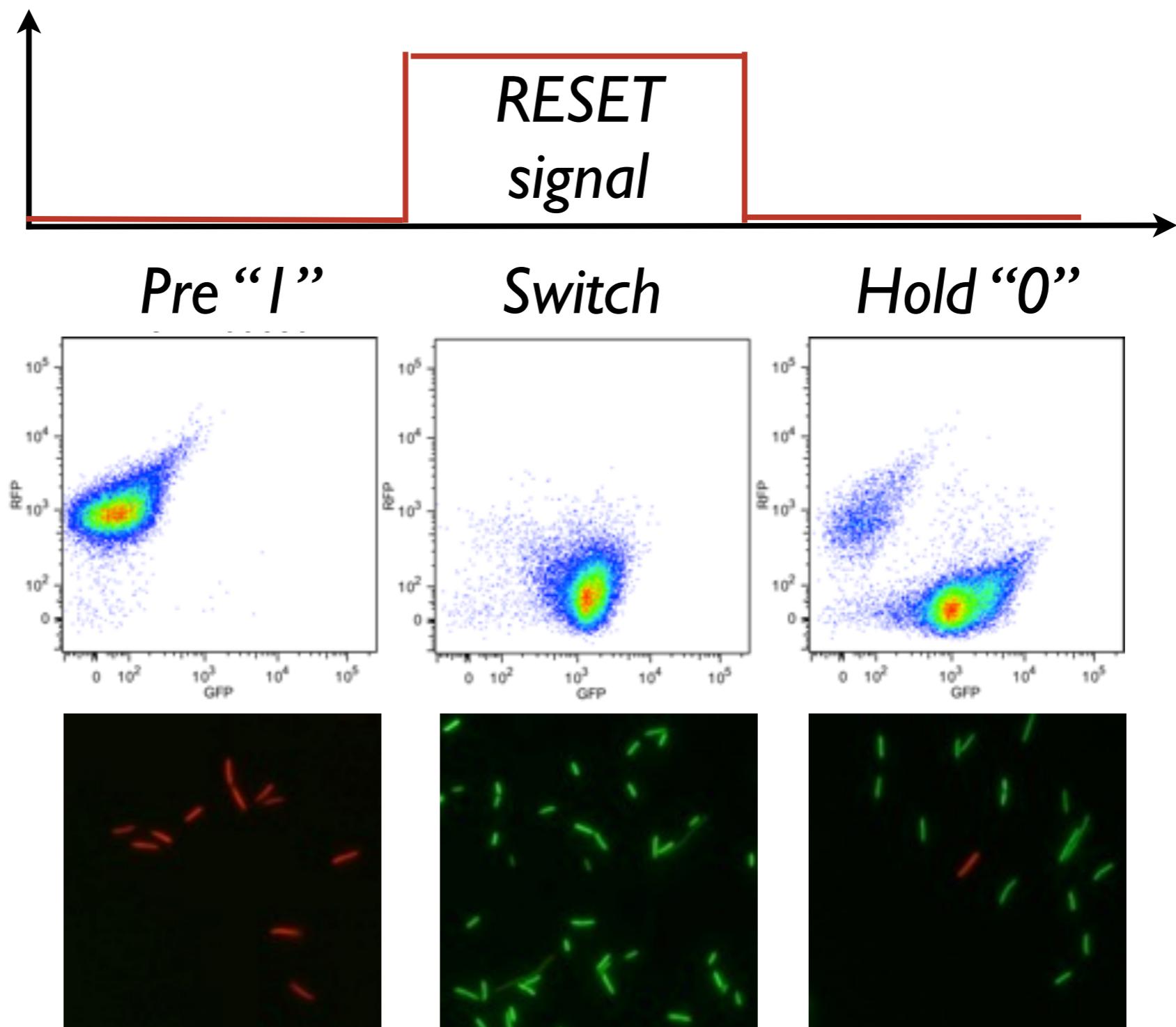
A plausible model for recombination directionality factor (RDF)-stimulated excision. The RDFs (yellow) could bind to the Int CC motifs and disrupt the intra-molecular interactions responsible for inhibiting $\text{attL} \times \text{attR}$ recombination. The RDFs may also interact with additional integrase domains and in some systems may interact with one another. Integrase domains are colored as in Figure 1.

Karen Rutherford & Gregory D Van Duyne (2014)
The ins and outs of serine integrase site-specific recombination
<http://dx.doi.org/10.1016/j.sbi.2014.01.003>

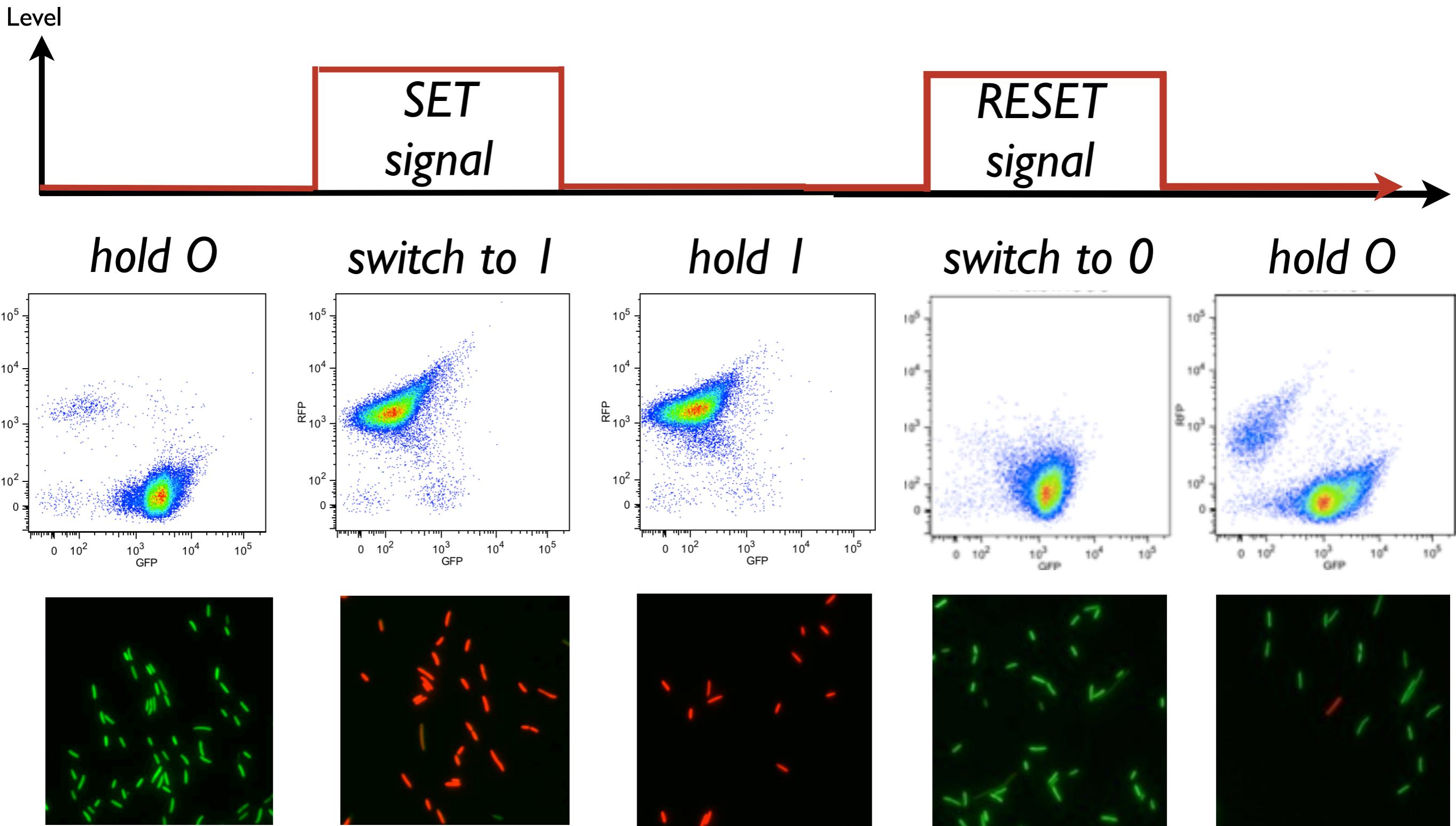




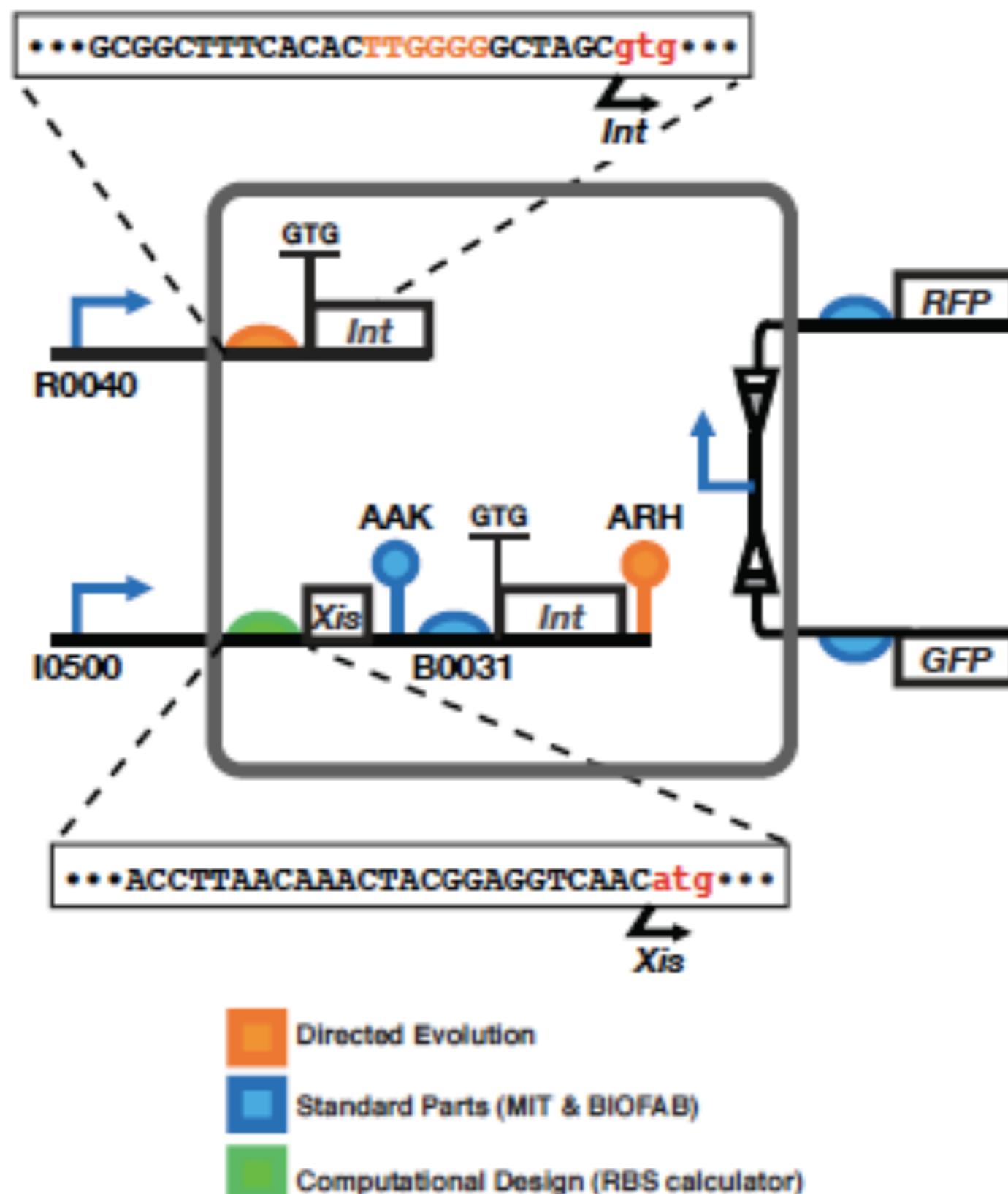
We can mostly reset one bit!



Together, we can set & reset one bit



What does this bio-bit's DNA layout look like?



What does this bio-bit's DNA sequence look like?



E.g., we now have an engineered genetic “black box” that allows us to program flipping of arbitrary DNA sequences.

Inputs: transcription signals that control levels of enzymes that mediate DNA flipping.

Output: Whatever is being flipped.