Synthetic Biology

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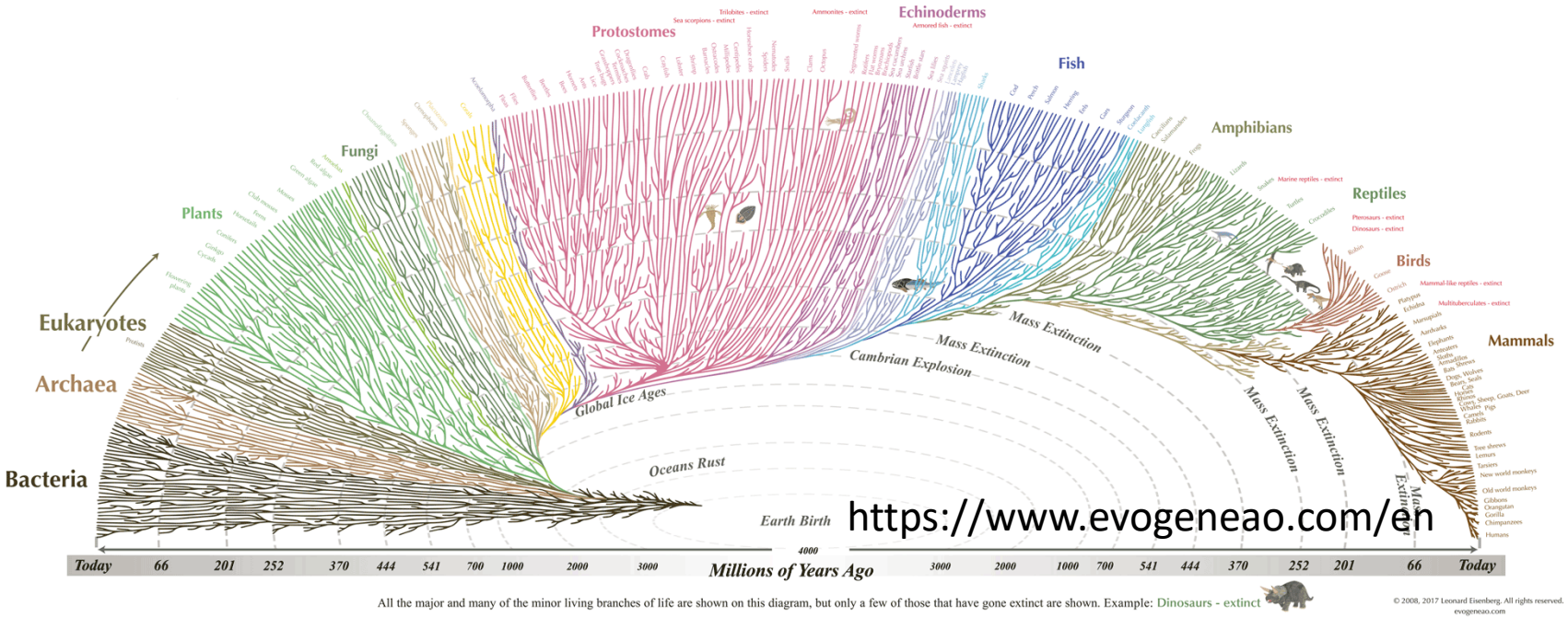
김하성

Complexity in biology

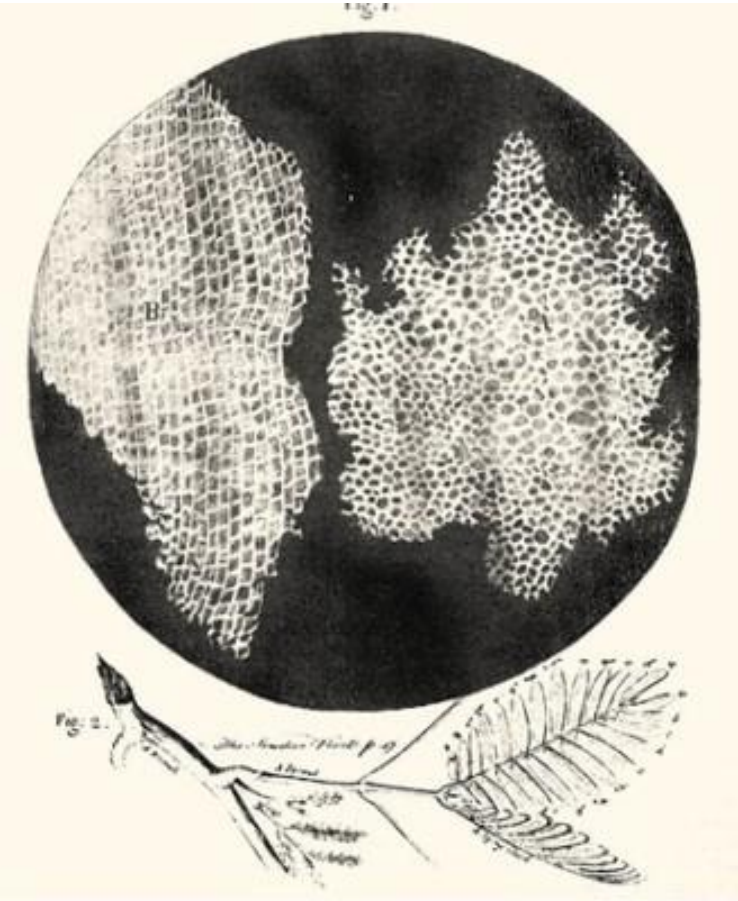


What about in physics and chemistry?

180 element in the periodic table

DNA-RNA-Protein-Cell-Organism-Biome

Discovery vs. Invention

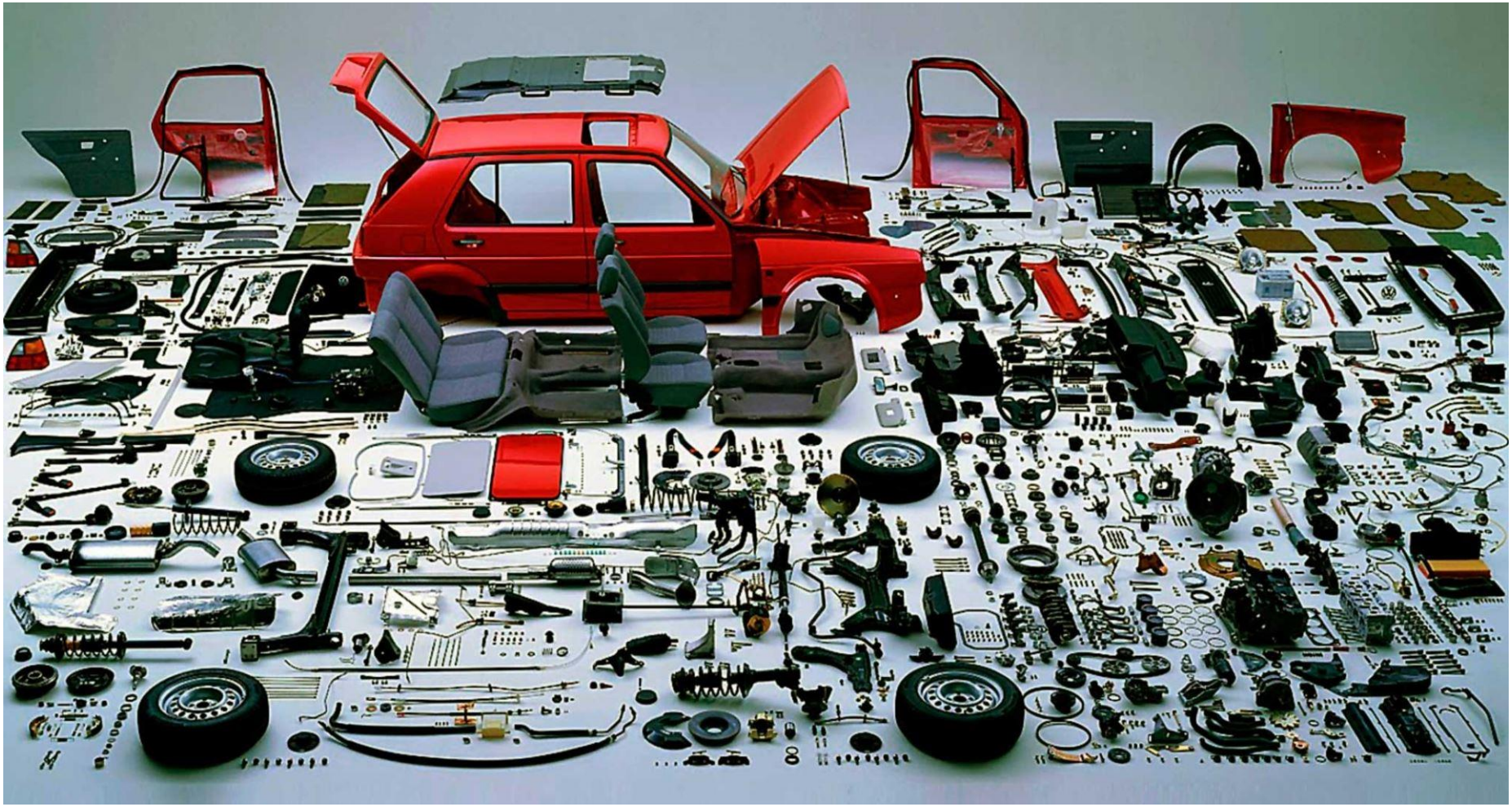


1665년 로버트 훅의『마이크로그라피아』

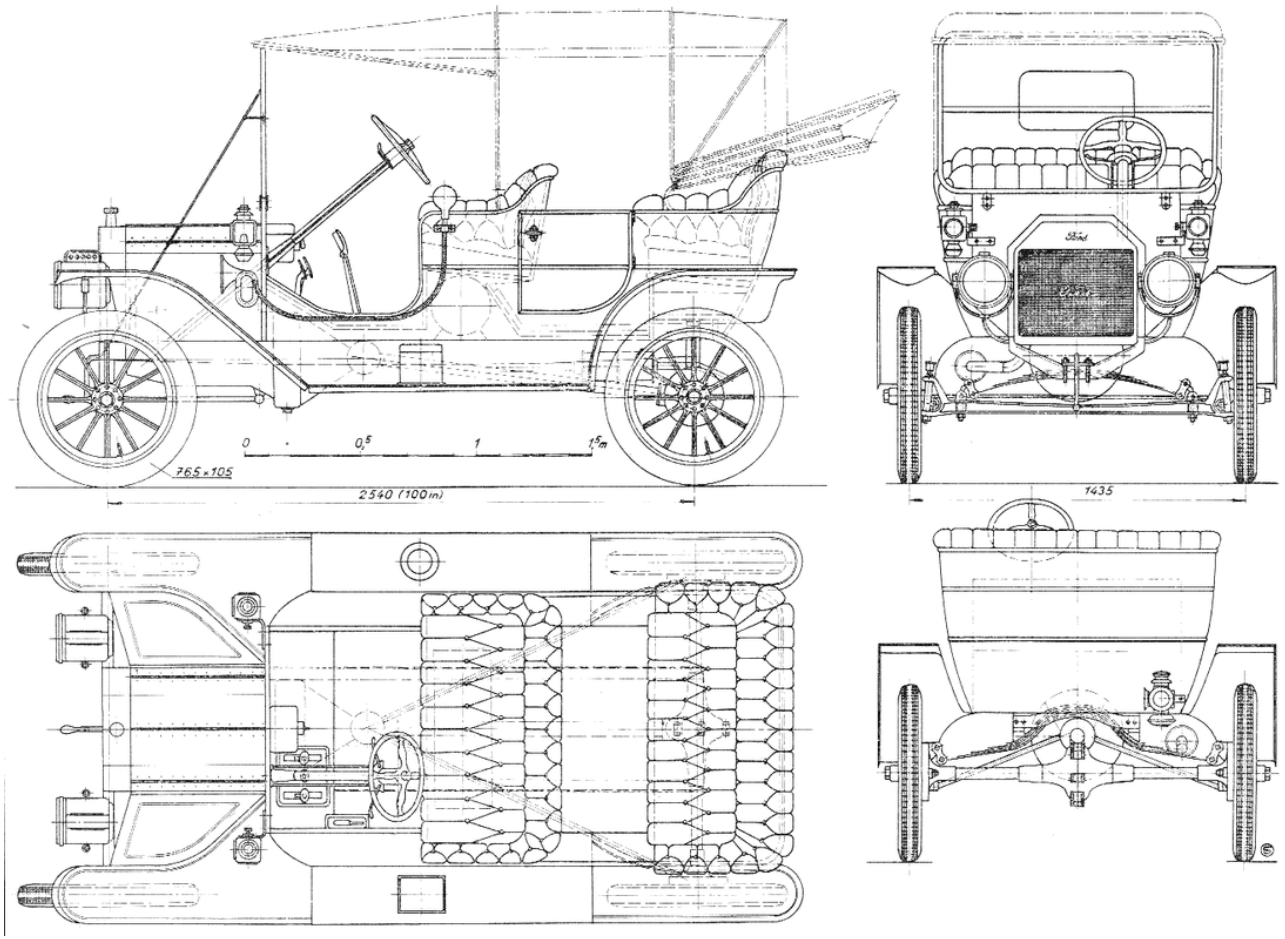
https://m.blog.naver.com/PostView.nhn?blogId=moeblog&logNo=220400859724&proxyReferer=https:%2F%2Fwww.google.com%2F

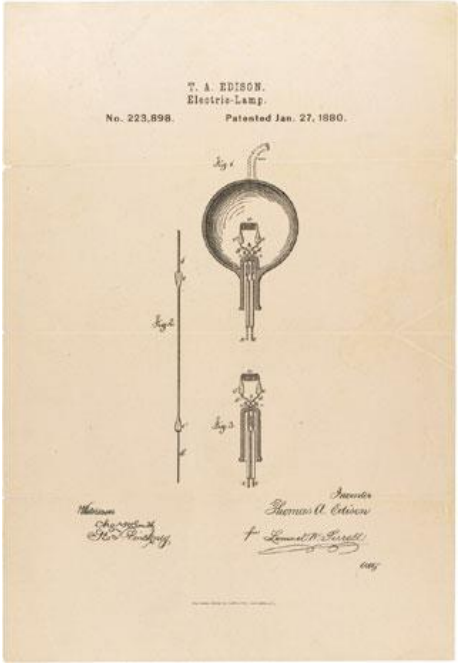
https://time.com/3517011/thomas-edison/

A complex system with assembled (DNA) parts



Blueprint

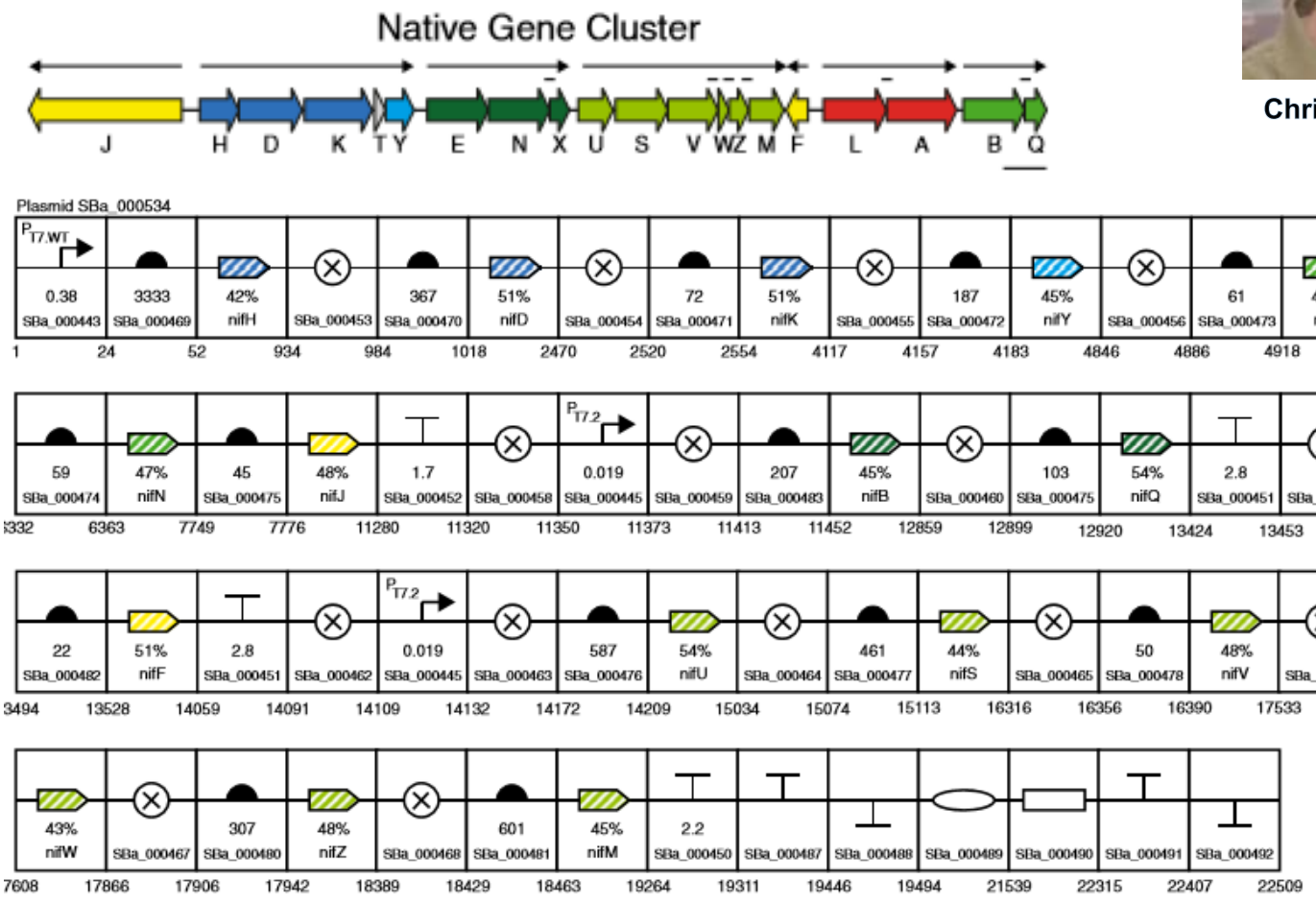




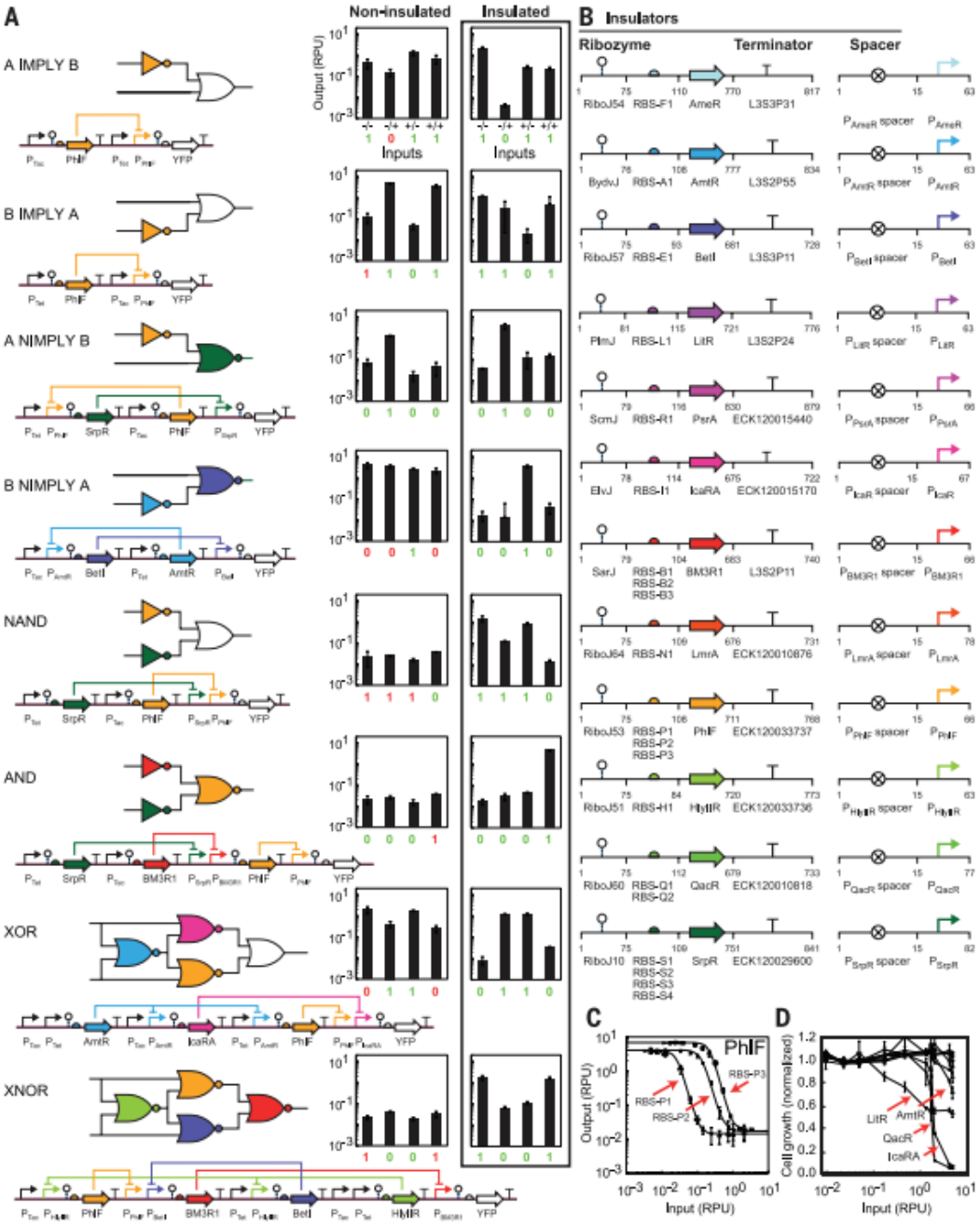
https://henryfordandfordautomotive.weebly.com/the-ford-model-t.html

Blueprint in Synthetic Biology

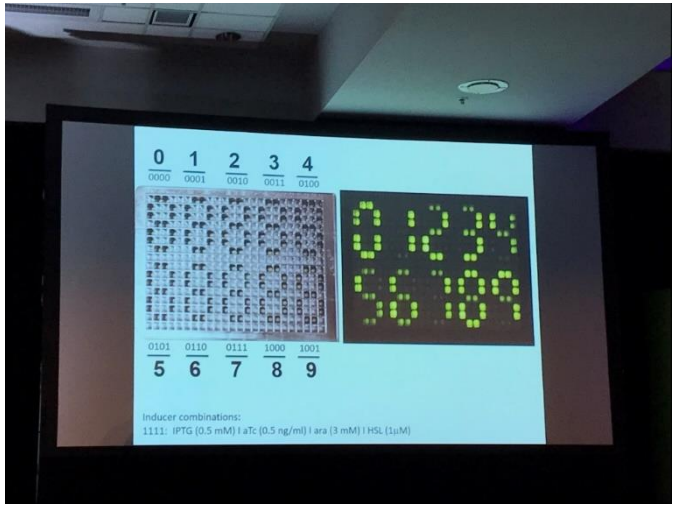
Christoph Voigt (MIT)

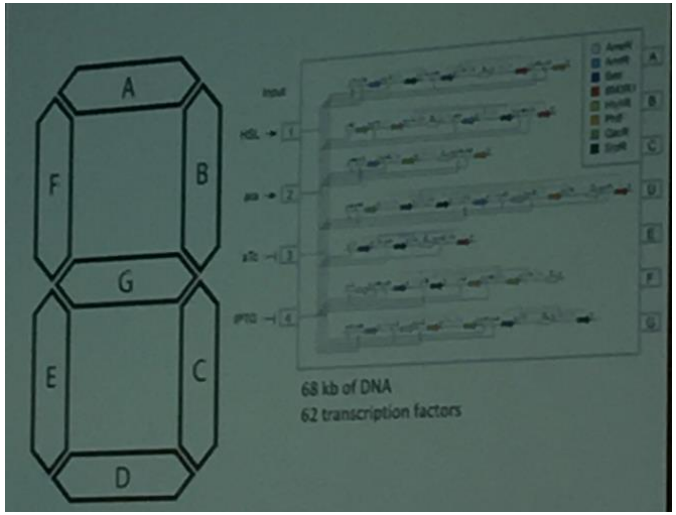


K. oxytoca nitrogen fixation gene cluster



2016 *Science*

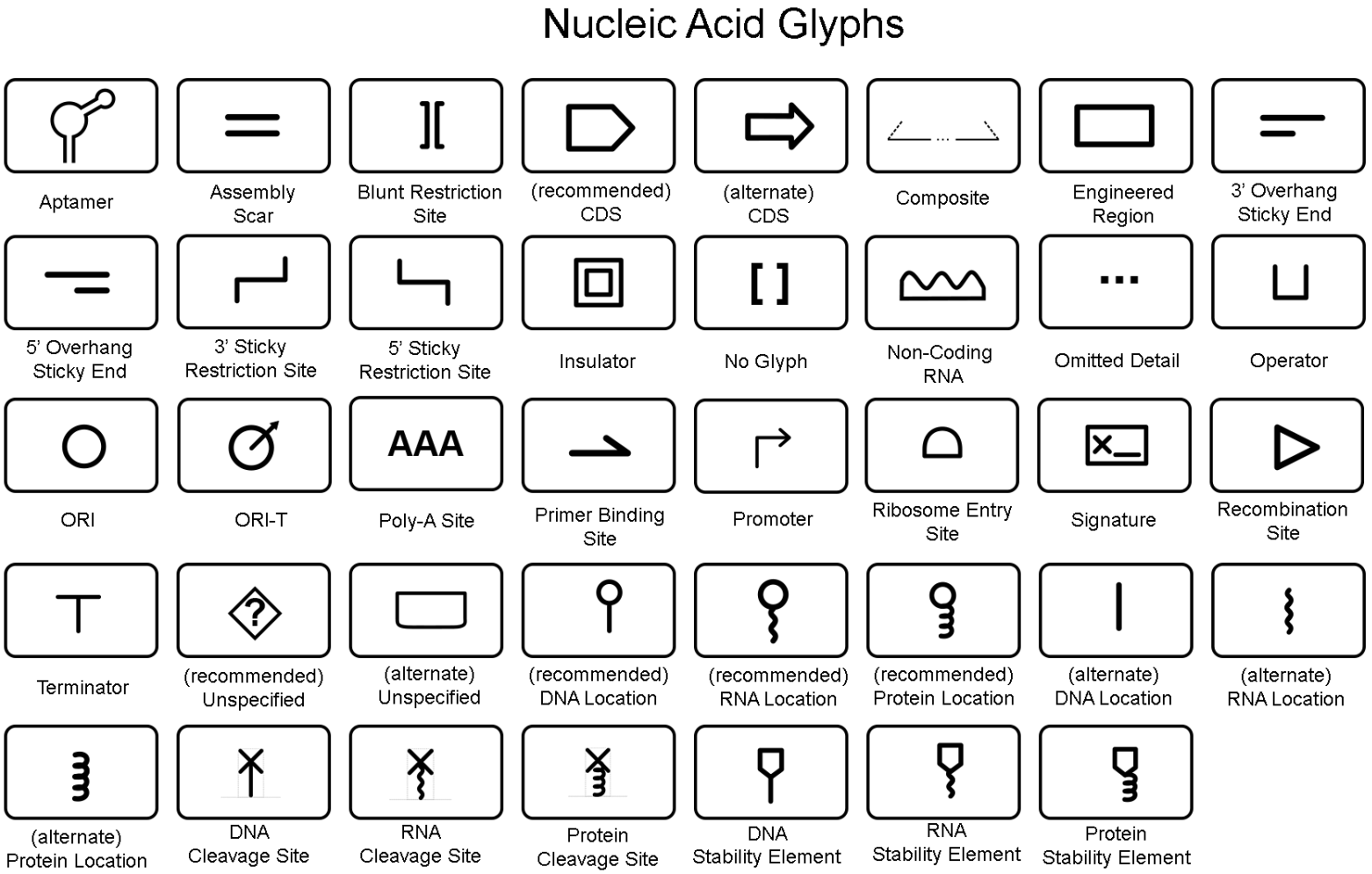




Christoph Voigt (MIT)

2016 SB7

DNA Parts
SBOL (synthetic biology open language)
http://sbolstandard.org/



BioBricks FOUNDATION (FREE GENES)

iGEM Foundation

iGEM wiki tools search PRODUCTION 2017 SERVER login

Registry of Standard Biological Parts

iGEM tools catalog repository assembly protocols help search BBa_

Promoters/Catalog/Ecoli/Positive

All the promoters on this page are *E. coli* promoters that are **positively regulated** meaning that increased levels of at least one transcription factor (other than the sigma factor) will increase the activity of these promoters.

Contents

Positively regulated *E. coli* σ^{70} promoters

This section lists promoters that are recognized by *E. coli* σ^{70} RNAP. σ^{70} is the major *E. coli* sigma factor so there should be RNAP present to transcribe these promoters under most growth conditions (although maximally during exponential growth).

More...

Name	Description	Promoter Sequence	Positive Regulators	Negative Regulators	Length	Doc	Status
BBa_I0500	Inducible pBad/araC promoter	. . . gtttctccatacccgttttttgggctagc			1210	3742	In stock
BBa_I1051	Lux cassette right promoter	. . . tgttatagtcgaatacctctggcggtgata			68	1263	It's complicated
BBa_I12006	Modified lamdba Prm promoter (repressed by 434 cI)	. . . attacaaactttcttgtatagatttaacgt			82	798	In stock
BBa_I12007	Modified lambda Prm promoter (OR-3 obliterated)	. . . atttataaatagtggtgatagatttaacgt			82	828	In stock
BBa_I12036	Modified lamdba Prm promoter (cooperative repression by 434 cI)	. . . tttcttgtatagatttacaatgtatcttgt			91	927	In stock
BBa_I12040	Modified lambda P(RM) promoter: -10 region from P(L) and cooperatively repressed by 434 cI	. . . tttcttgtagatacttacaatgtatcttgt			91	1018	In stock
BBa_I12210	plac Or2-62 (positive)	. . . ctttatgcttccggctcgtatgttgtgtgg			70	939	In stock
BBa_I13406	Pbad/AraC with extra REN sites	. . . ttttttgggctagcaagctttaccatggat			1226	817	Not in stock
BBa_I13453	Pbad promoter	. . . tgtttctccatacccgttttttgggctagc			130	3744	In stock

>20,000 DNA parts

DNA assembly

Table 1 | **Summary of physical standards in DNA assembly**

Physical standards	Underlying methodology					Limitations		Workflow		
	Restriction and ligation	HE	Type IIS RE	SSR	Long overlap	PCR required*	Forbidden restriction sites‡	Number of assembly tiers	Multipart assembly§	Hierarchical assembly
BioBrick[13] and BglBrick[15]	✓					No	4	1	No	Yes
iBrick[21]		✓				No	0	1	No	Yes
HVAS[22]		✓		✓		No	0	2	Yes; no	No‖
MoClo[29]			✓			No	3	2	Yes; yes	Yes
GoldenBraid 2.0 (REF. 30)			✓			No	3	≥2	Yes; no	Yes
GreenGate[32]			✓			No	1	2	Yes; no	Yes
Binder *et al.*[31]			✓			No	3	2	Yes; yes	Yes
PSA[37]			✓			No	0	1	No	Yes
DNA assembler[53]					✓	Yes	0	2	Yes; yes	No
MODAL[9]					✓	Yes	0	1	Yes	No
BASIC[58]			✓		✓	No	1	1	Yes	Yes
Torella *et al.*[55]¶	✓				✓	No	≥4#	2	No; yes	No
Guye *et al.*[59]		✓		✓	✓	No	0	2	Yes; yes	Yes
PaperClip[56]					✓	No	0	1	Yes	No

Casini, A., Storch, M., Baldwin, G. S., & Ellis, T. (2015). Bricks and blueprints: Methods and standards for DNA assembly. Nature Reviews Molecular Cell Biology, 16(9), 568–576. https://doi.org/10.1038/nrm4014

:(

What to make?

How to make?

- Too many parts (none characterized)
- Laborious DNA assembly

10^{82} vs. 20^{170} vs. $10^{7284000}$

2003 an independent study course at (MIT)
2015 - 259 teams,
2016 – 299 teams,
2017 – 312 teams,
2018 – 343 teams, 5,000 participants (3,000 students), 45~50 countries

DNA parts

Basic Components (Parts)

Promoters (?): A promoter is a DNA s
of the downstream DNA sequence.

Ribosome Binding Site/about (?): A
ribosomes can bind and initiate transla

Protein domains (?): Protein domains
up a protein coding sequence. Some p
target the protein for cleavage, or enab

Protein coding sequences (?): Protei
Note that some protein coding sequenc
protein from start codon to stop codon.
also included here.

Translational units (?): Translational
They begin at the site of translational i
codon.

Terminators (?): A terminator is an RN
causes transcription to stop.

DNA (?): DNA parts provide functionali
sites, spacers, recombination sites, co

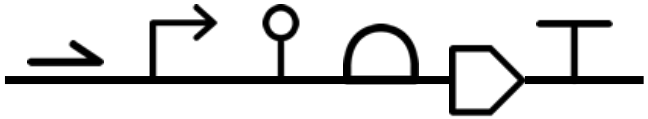
Plasmid backbones (?): A plasmid is
base pairs that replicate within the cell
plasmid sequence beginning with the B
and ending with the BioBrick prefix.

Plasmids (?): A plasmid is a circular,
that replicate within the cell independer
propagate or assemble plasmid backbo
Registry that are only available as circ
that these plasmids largely do not conf

Primers (?): A primer is a short single-
sequencing. Although primers are not a
primer sequences here.

Composite parts (?): Composite parts

http://parts.igem.org/Catalog

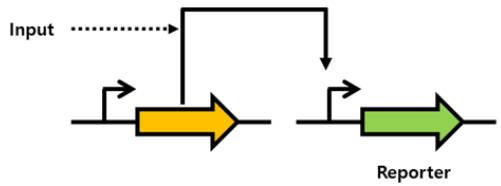


http://sbolstandard.org/

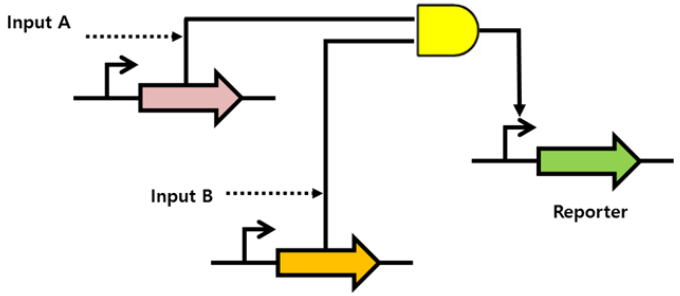
BioBrick, iGEM
Since 2003, 2015 - 259 teams, 2700 students
Over 1200 high-quality parts / 20,000 documents

Genetic circuits

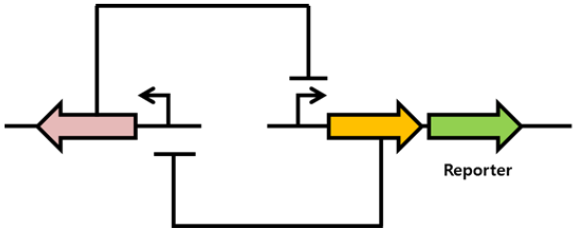
(A) Single input / Invertor



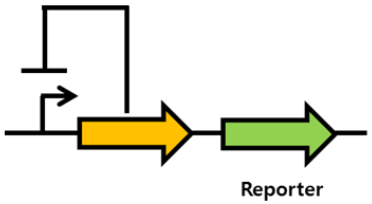
(B) Multi input



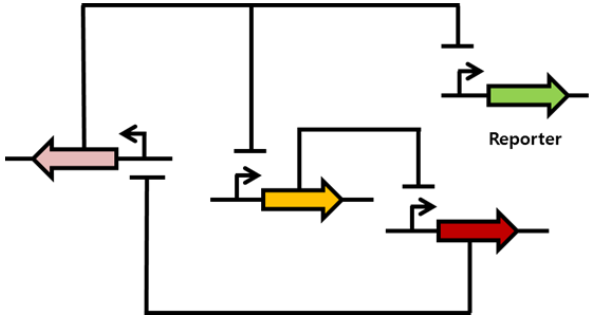
(C) Toggle switch

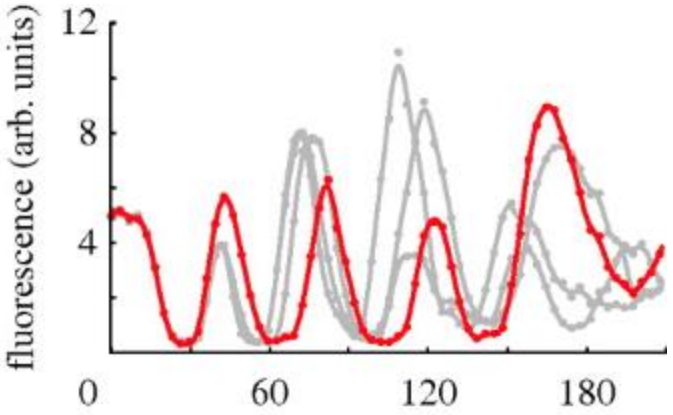


(D) Autoregulator



(E) Repressilator / oscillator





https://2020.igem.org/Main_Page