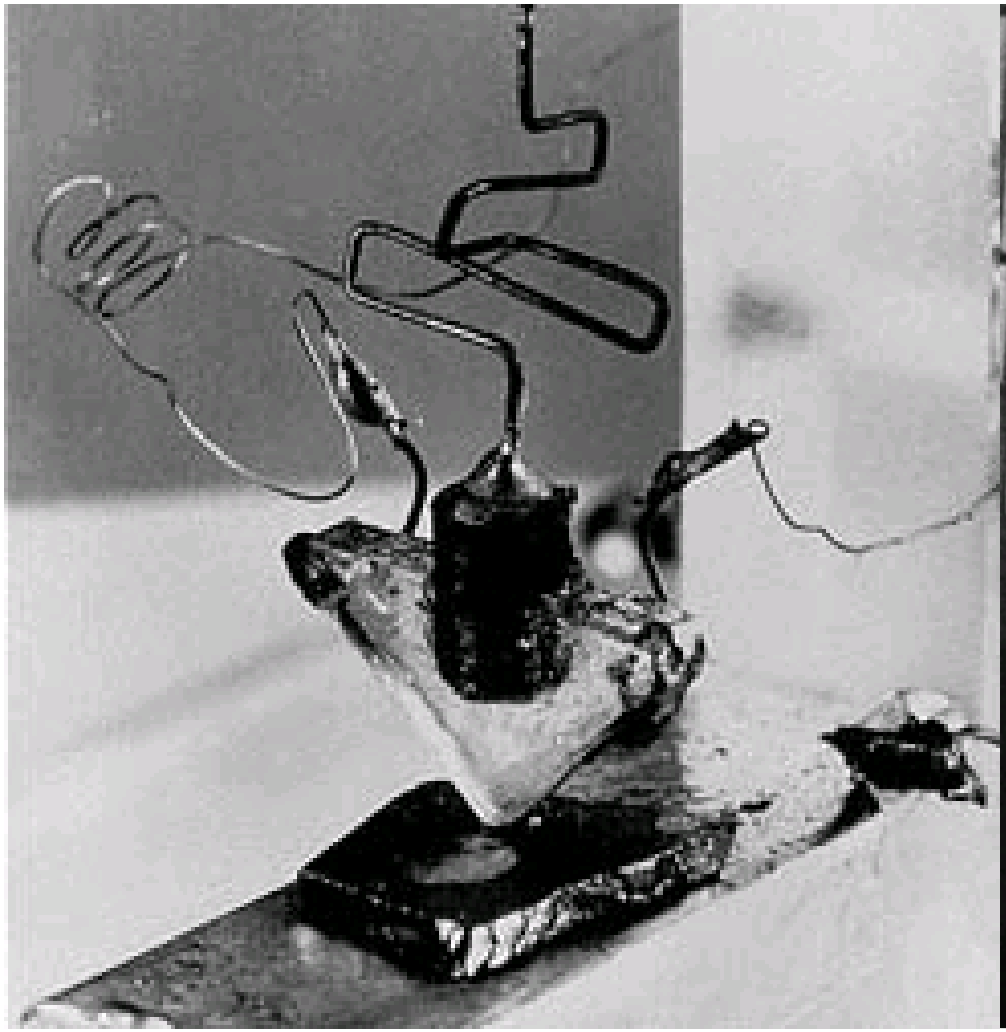
iGEM program overview

March 18, 2008

Andrew Hessel
ahessel@gmail.com

Foundation of IT



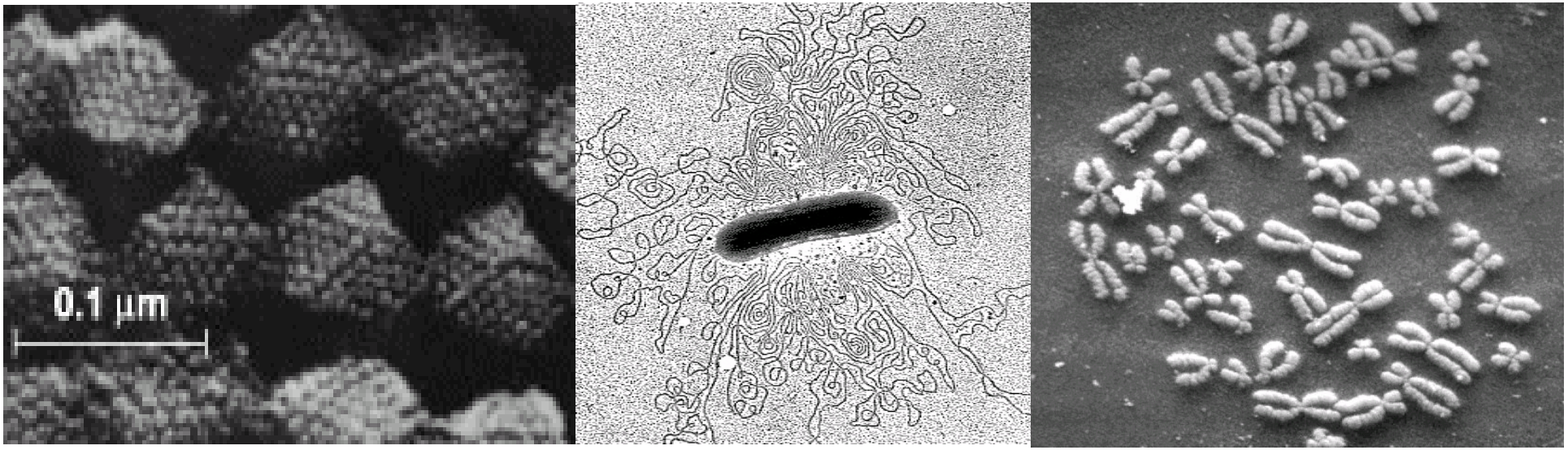
1947

Foundation of Bioengineering

1953


PAA

8000X for $49.99



50 KB 5 MB 6 GB

DNA is a programming language for biochemistry (metabolism).

It can also specify how to build hardware.

Nature supports incredible diversity – over 2 million species we can see!

.

ATG-TCA-AAT-AAA-AGT-AAT-GAT-AAT-GGC-AGA-GCA-TAT-GAG-TTT-GCA-TTT-ATA-AAT-GAA-

TTA-GGA-CGC-ATT-GCA-ACT-CAA-AAT-CAG-AAT-ATA-AAT-ATC-GAA-AAG-AAT-TCT-AGC-TAT-

TAC-GTA-GTT-GAG-AAA-TCT-TGG-AGT-ACA-TTA-TCG-GAT-CTT-GAA-AAA-GAA-AAA-TAT-ACA-

AAA-AGT-GCA-ATT-GCT-GGT-ATC-AAT-CTT-ATA-ACA-AGC-TTA-GAG-CCA-ATA-ATA-GAA-GAT-

GGT-AAT-GGT-GTA-TTA-AAC-TTA-AAA-ATA-CAA-GCT-GAT-AAT-AAA-GGT-GAA-TTA-GGC-GAT-

ATT-AGA-GAT-ATT-TTA-ATT-CAA-AGA-GAA-AAT-ATT-AAT-TGG-GAA-ATT-GGT-TTA-AGT-TTA-

AAA-CAT-AAT-CAT-TTT-GCT-GTG-AAA-CAT-AGT-CGT-TTA-TCA-CAT-AAA-ATT-GAT-TTT-TCA-

GAA-AAA-TGG-TTC-CAA-TTA-CCT-TCT-TCT-CAA-AAT-TAT-TGG-GAT-AAT-ATA-CTC-CCT-ATT-

TTT-GAG-AAA-TTA-GAA-ATT-TAT-AAA-AAA-GAT-AAA-ATA-AAA-TGG-AGA-GAG-TTA-TCT-AAT-

AAA-GAA-GAT-TGC-ATT-TAT-TAT-CCC-ATA-CTT-AAA-TCA-TTT-ATA-GCA-GAA-ATT-AAA-GAA-

AAG-TAT-GAT-AAA-TAT-AAT-TCT-ATT-GTT-CCA-CAG-AGA-ATG-GTT-GAA-TAT-TTA-CTT-GGA-

TAT-TTT-GAT-TTC-TAT-AAA-ATC-ATA-AGT-CAA-GAT-AAT-AAG-AAA-CTA-ACA-TCT-ATT-CAA-

TCA-TTT-AAT-TTA-CGT-GGA-ACA-CTA-AAT-AAA-CCC-TCT-AAA-AAA-CGA-AAG-GCA-GAC-ATT-

TTT-ATA-CCT-GTA-GCT-AAT-TTA-CCA-ACT-AGA-ATC-ATT-GAT-ATA-GAT-TTT-AAG-CCA-AAT-

AGT-AAA-AAC-ACG-GTT-GAA-TTA-TAT-TTA-GAT-AAA-GGA-TGG-CAA-TTT-AGT-TTT-AGA-ATA-

CAT-AAT-GCT-TCT-ACT-ATT-ATT-GAA-CCG-AGC-TTG-AAA-TTT-GAT-ATA-AAA-CTT-ATT-GGT-

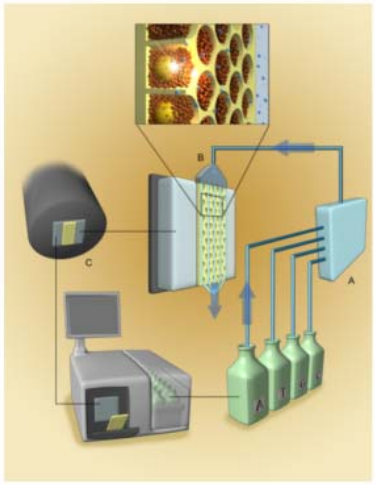
GTT-CCT-GCC-ACA-ATA-ATT-TGT-TTA-GAG-ACC-CCT-TGG-GAA-GAA-TGA

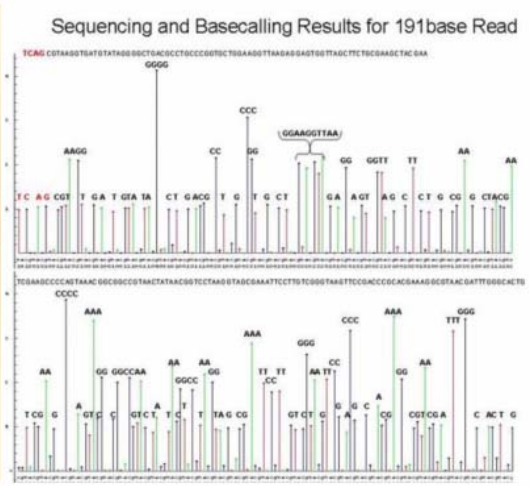
1980
500 bp/day (manual)

1987
36,000 bp/day (semi-auto)

1995
144,000 bp/day (semi-auto)

1998
500,000 bp/day (automatic)





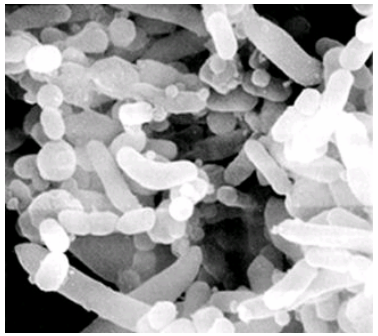
2007 – Sequencing by Synthesis
1GB bp/day (automatic)

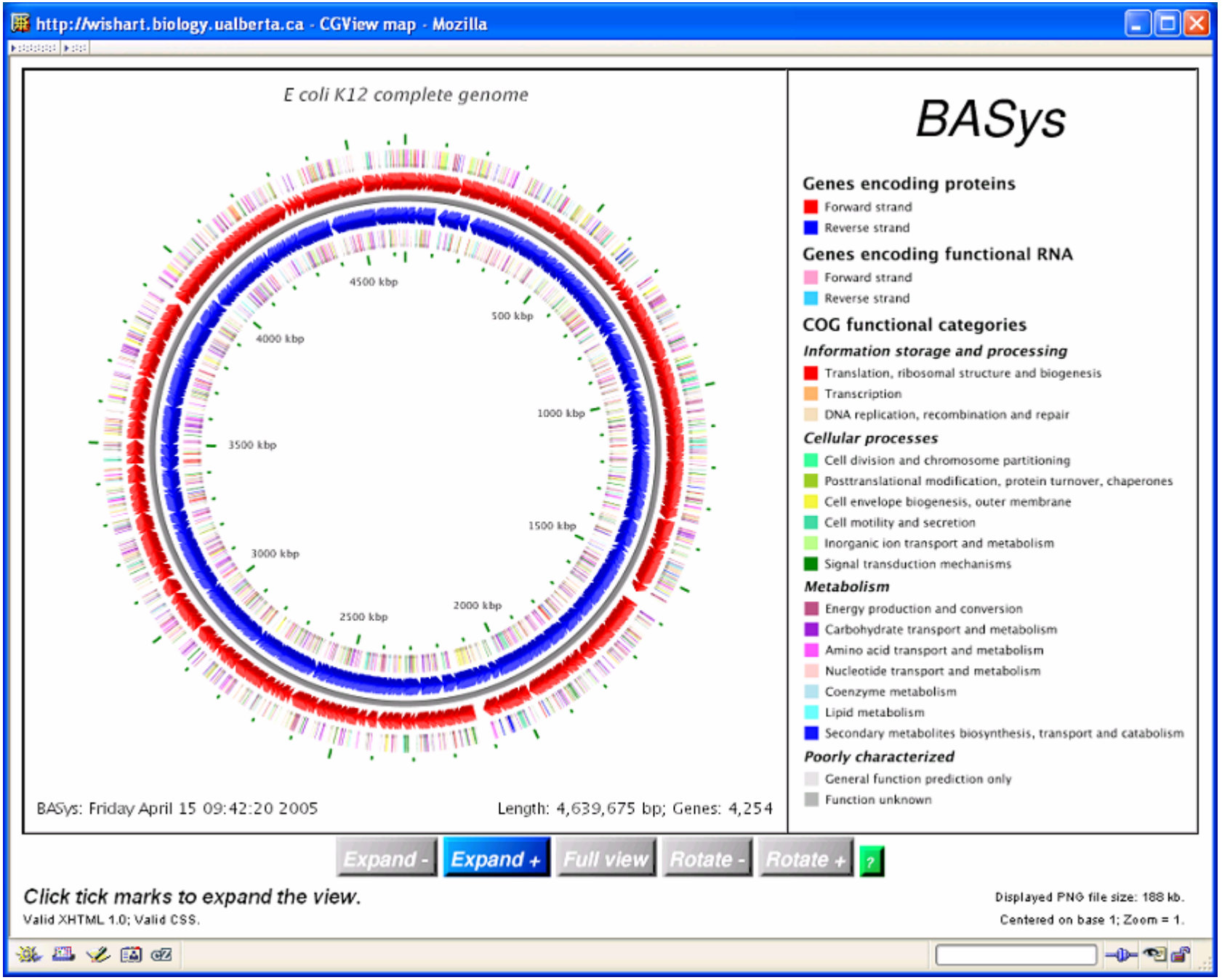
Environmental Shotgun Sequencing: Its Potential and Challenges for Studying the Hidden World of Microbes

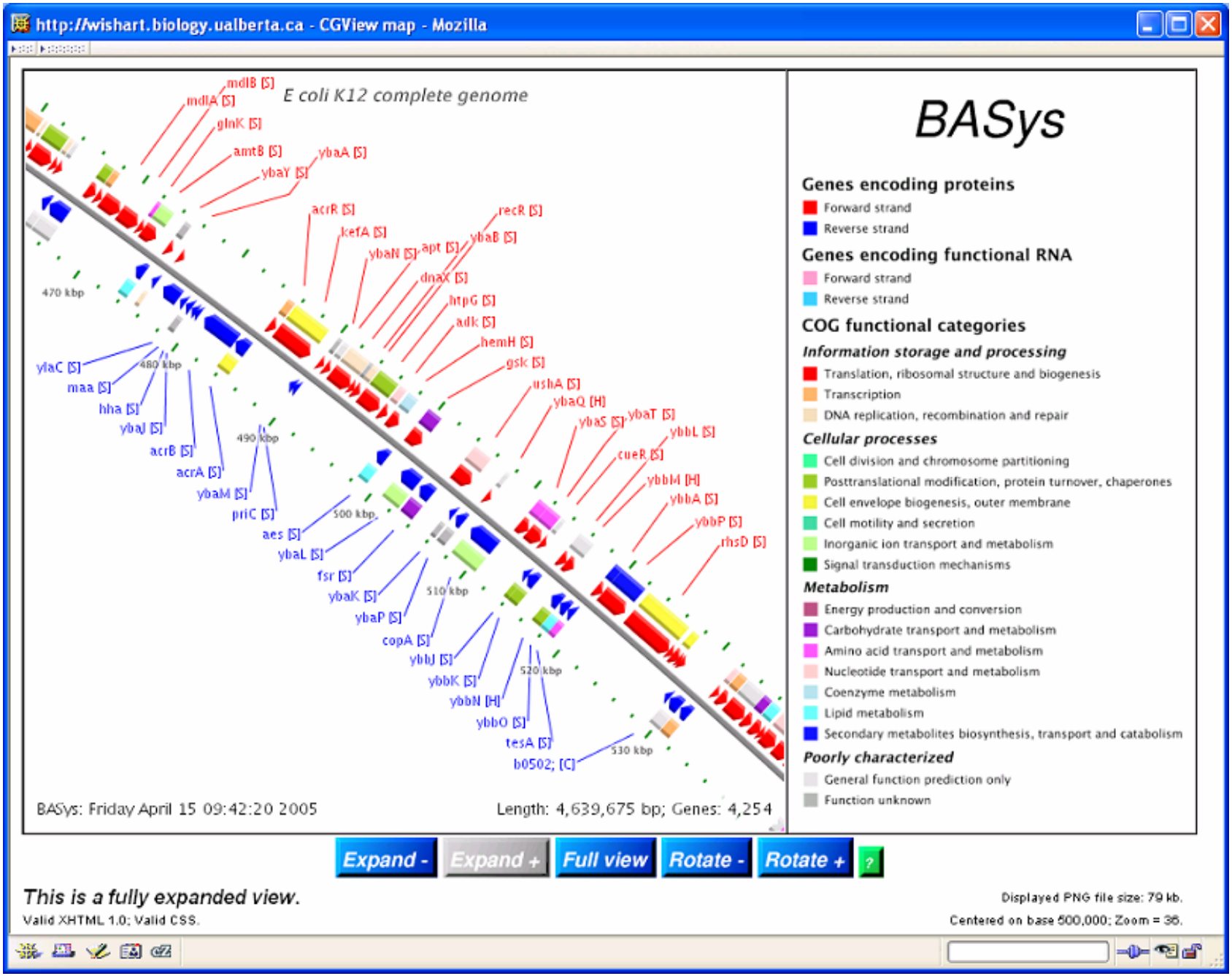









http://wishart.biology.ualberta.ca - CGView map - Mozilla
E coli K12 complete genome
4500 kbp
500 kbp
4000 kbp
1000 kbp
3500 kbp
1500 kbp
3000 kbp
2000 kbp
2500 kbp
BASys: Friday April 15 09:42:20 2005
Length: 4,639,675 bp; Genes: 4,254
BASys
Genes encoding proteins
Forward strand
Reverse strand
Genes encoding functional RNA
Forward strand
Reverse strand
COG functional categories
Information storage and processing
Translation, ribosomal structure and biogenesis
Transcription
DNA replication, recombination and repair
Cellular processes
Cell division and chromosome partitioning
Posttranslational modification, protein turnover, chaperones
Cell envelope biogenesis, outer membrane
Cell motility and secretion
Inorganic ion transport and metabolism
Signal transduction mechanisms
Metabolism
Energy production and conversion
Carbohydrate transport and metabolism
Amino acid transport and metabolism
Nucleotide transport and metabolism
Coenzyme metabolism
Lipid metabolism
Secondary metabolites biosynthesis, transport and catabolism
Poorly characterized
General function prediction only
Function unknown
Expand -
Expand +
Full view
Rotate -
Rotate +
?
Click tick marks to expand the view.
Valid XHTML 1.0; Valid CSS.
Displayed PNG file size: 188 kb.
Centered on base 1; Zoom = 1.


http://wishart.biology.ualberta.ca - CGView map - Mozilla
E coli K12 complete genome
mdlB [S]
mdlA [S]
glnK [S]
amtB [S]
ybaY [S]
ybaA [S]
acrR [S]
kefA [S]
ybaN [S]
apt [S]
recR [S]
ybaB [S]
dnaX [S]
htpG [S]
adk [S]
hemH [S]
gsk [S]
ushA [S]
ybaQ [H]
ybaS [S]
ybaT [S]
ybbL [S]
cueR [S]
ybbM [H]
ybbA [S]
ybbP [S]
rhsD [S]
470 kbp
480 kbp
490 kbp
500 kbp
510 kbp
520 kbp
530 kbp
ylaC [S]
maa [S]
hha [S]
ybaJ [S]
acrB [S]
acrA [S]
ybaM [S]
priC [S]
aes [S]
ybaL [S]
fsr [S]
ybaK [S]
ybaP [S]
copA [S]
yblJ [S]
ybbK [S]
ybbN [H]
ybbO [S]
tesA [S]
b0502; [C]
BASys
Genes encoding proteins
Forward strand
Reverse strand
Genes encoding functional RNA
Forward strand
Reverse strand
COG functional categories
Information storage and processing
Translation, ribosomal structure and biogenesis
Transcription
DNA replication, recombination and repair
Cellular processes
Cell division and chromosome partitioning
Posttranslational modification, protein turnover, chaperones
Cell envelope biogenesis, outer membrane
Cell motility and secretion
Inorganic ion transport and metabolism
Signal transduction mechanisms
Metabolism
Energy production and conversion
Carbohydrate transport and metabolism
Amino acid transport and metabolism
Nucleotide transport and metabolism
Coenzyme metabolism
Lipid metabolism
Secondary metabolites biosynthesis, transport and catabolism
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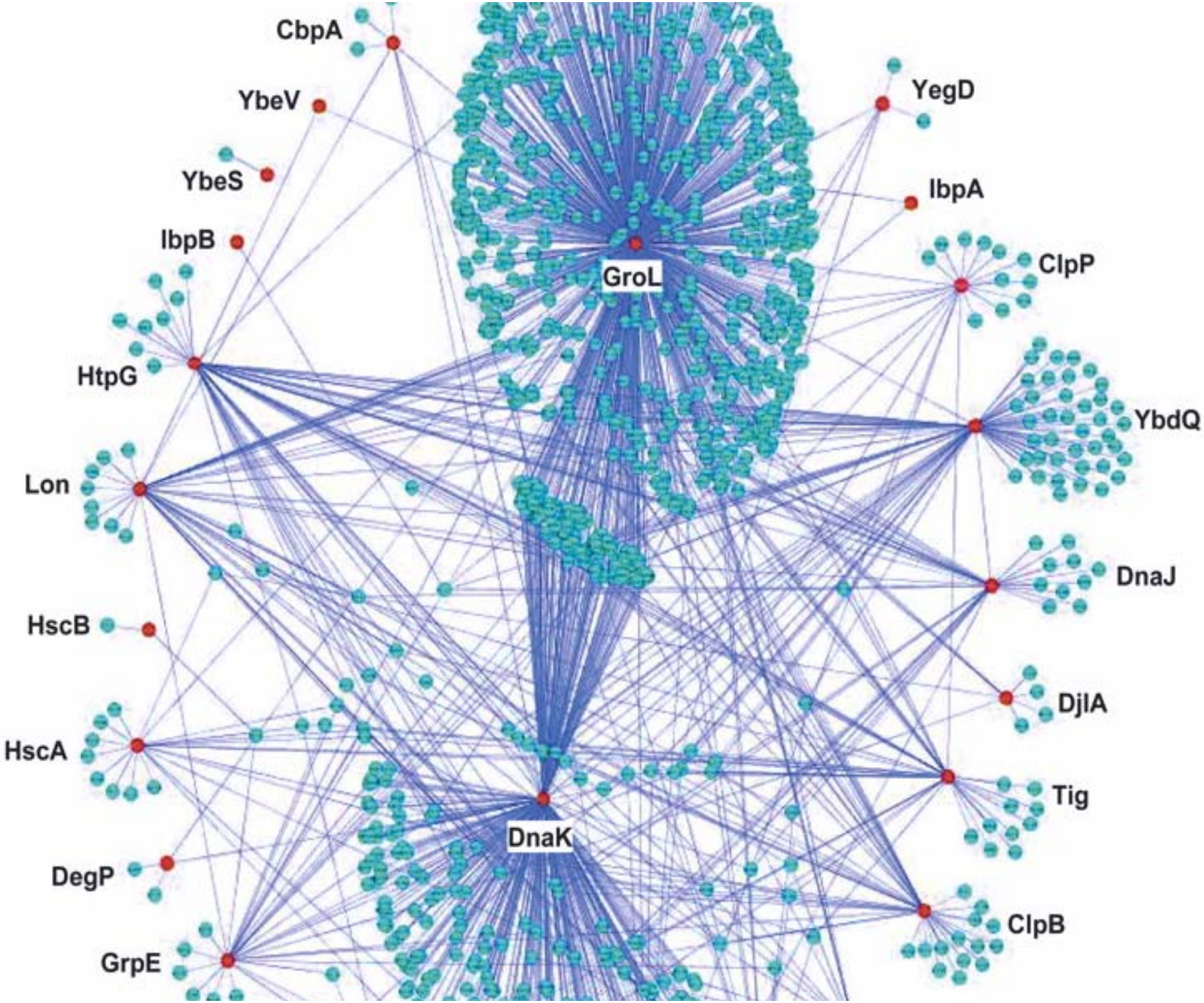
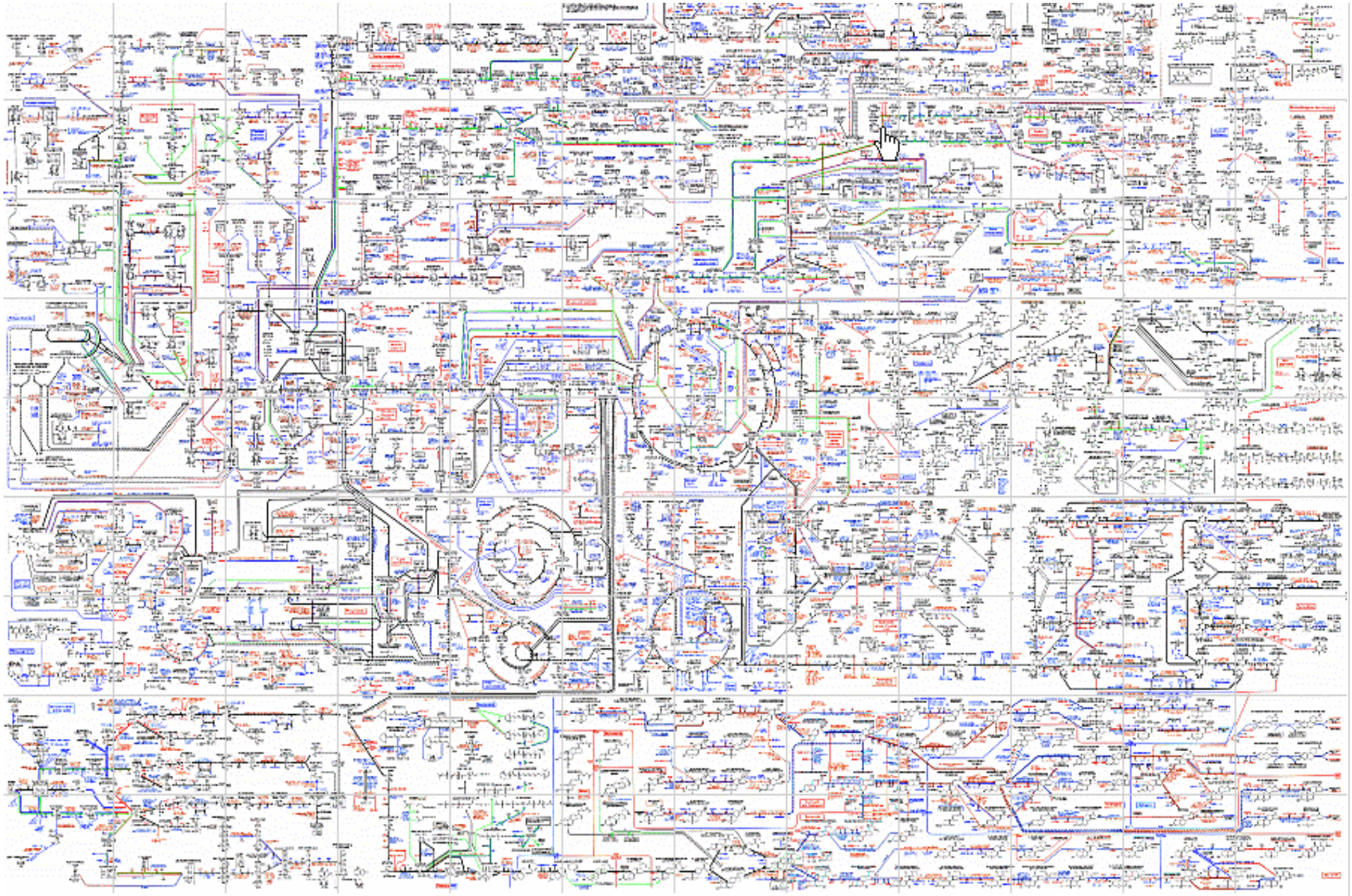
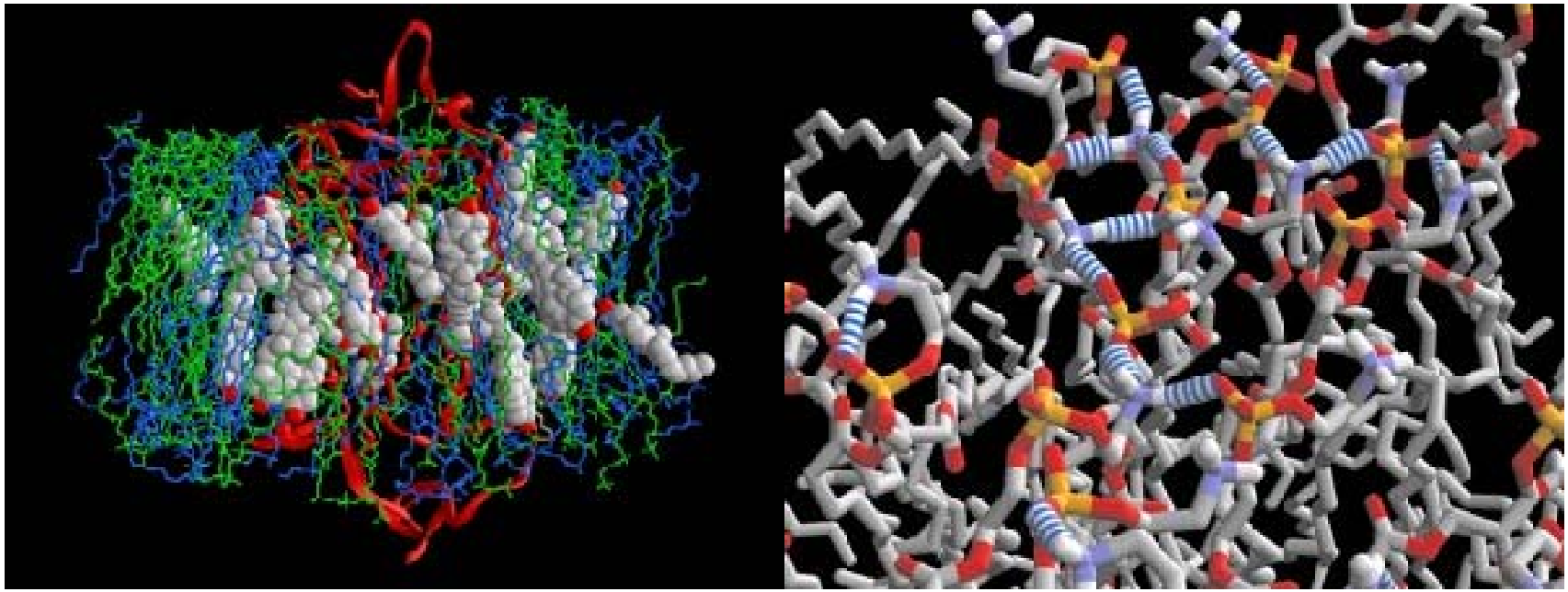
Function unknown
BASys: Friday April 15 09:42:20 2005
Length: 4,639,675 bp; Genes: 4,254
Expand -
Expand +
Full view
Rotate -
Rotate +
?
This is a fully expanded view.
Valid XHTML 1.0; Valid CSS.
Displayed PNG file size: 79 kb.
Centered on base 500,000; Zoom = 36.


CbpA
YbeV
YbeS
IbpB
HtpG
Lon
HscB
HscA
DegP
GrpE
GroL
DnaK
YegD
IbpA
ClpP
YbdQ
DnaJ
DjlA
Tig
ClpB



IBM's BlueGene/L: world's fastest supercomputer, 3 years running

596 TFLOPS (trillion floating point operations per second)

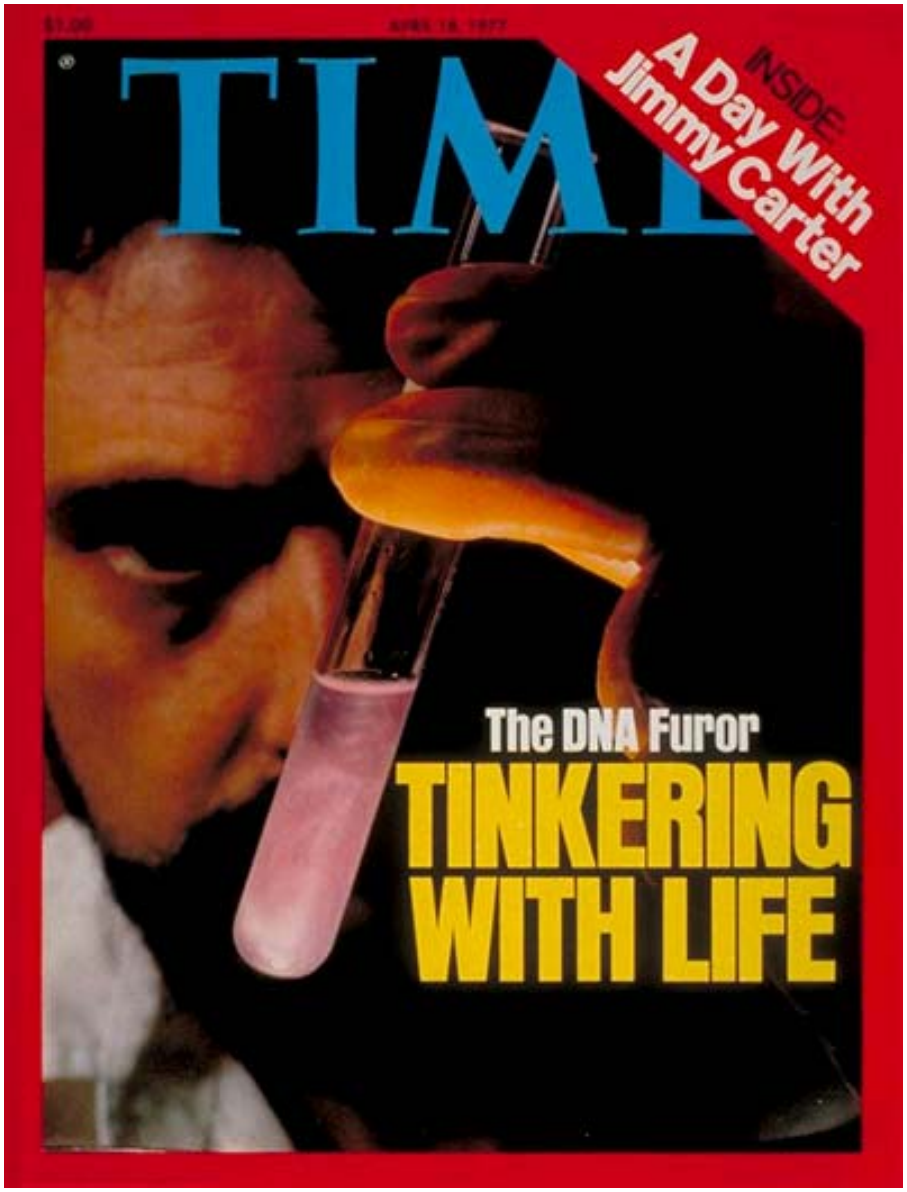


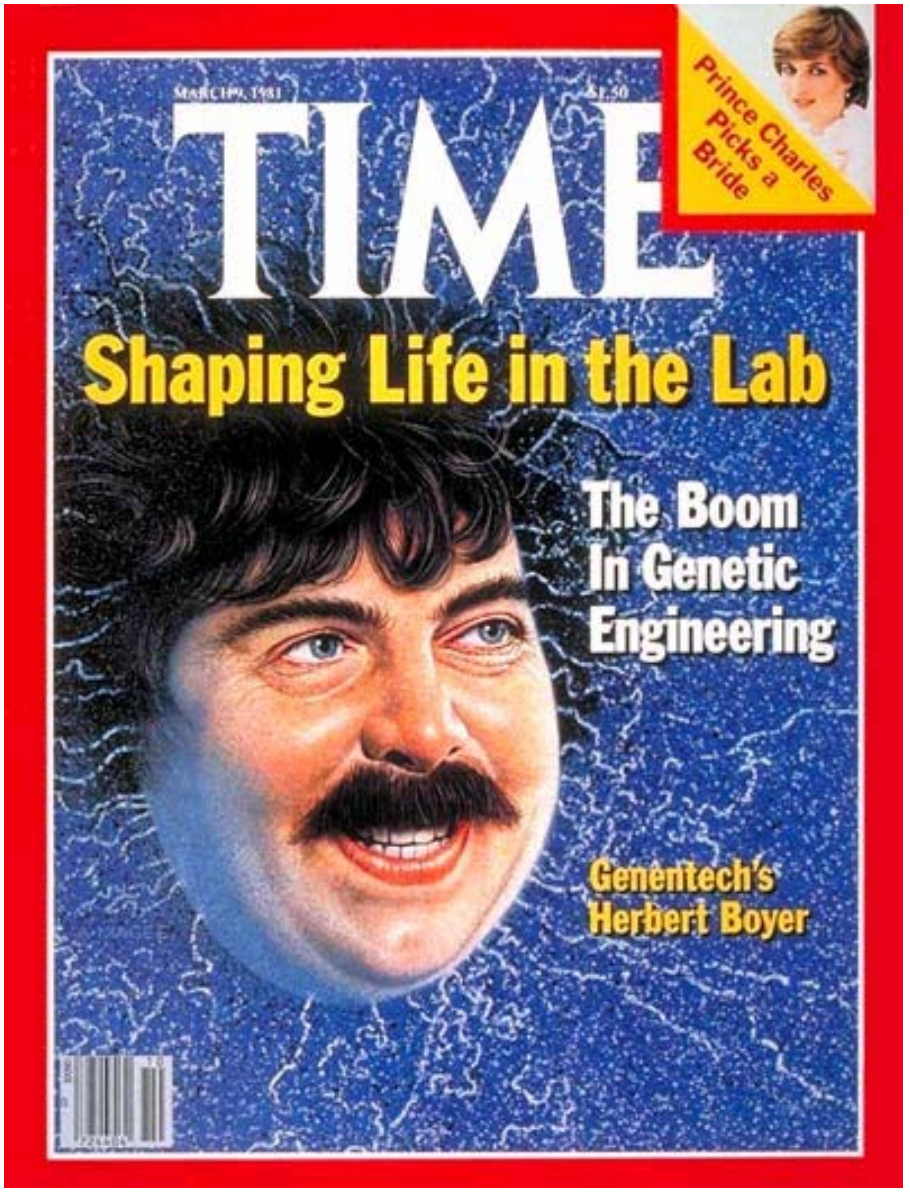
The problem with reverse engineering…

REDUCTION | COMPLEXITY

If we didn't build it, we may not be able to fully understand it.

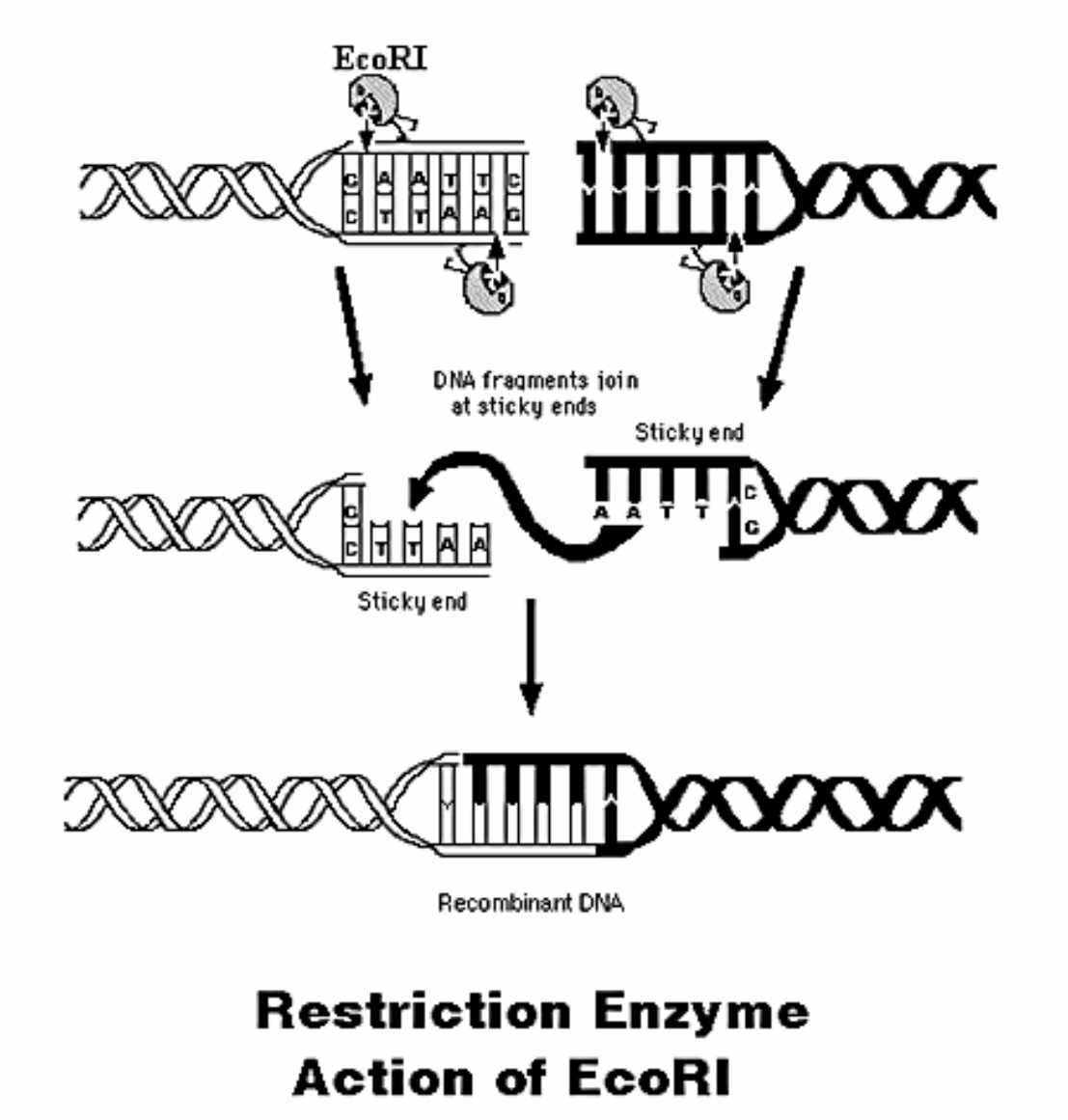
Towards “forward” bio-engineering


TIME
INSIDE
A Day With Jimmy Carter
The DNA Furor
TINKERING WITH LIFE


TIME
Prince Charles Picks a Bride
Shaping Life in the Lab
The Boom In Genetic Engineering
Genentech's Herbert Boyer

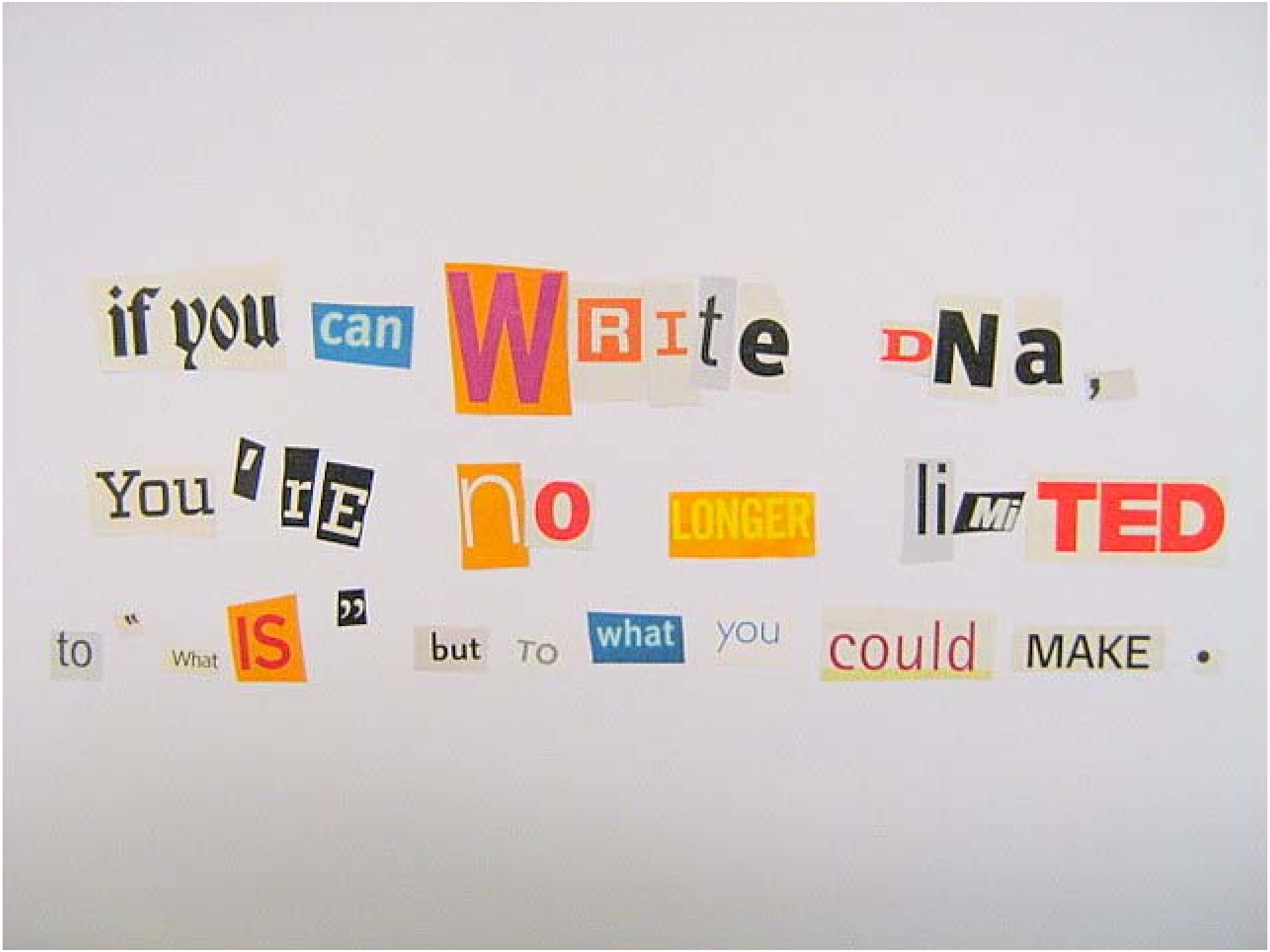
Over 3500 RE's available

REBASE®

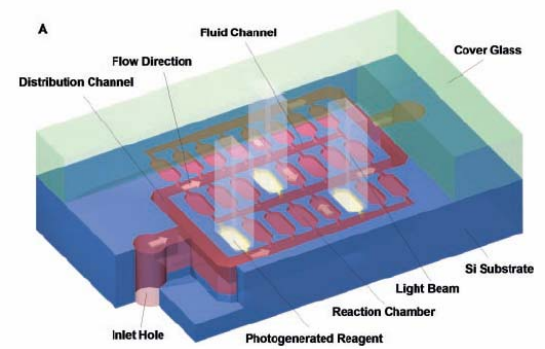


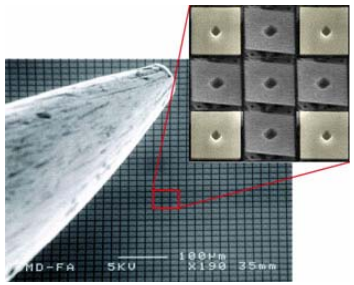
Restriction Enzyme Action of EcoRI

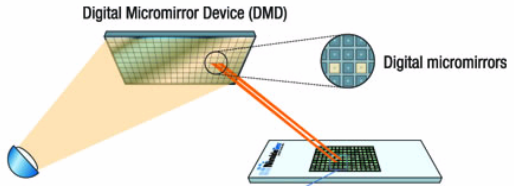

WARNING

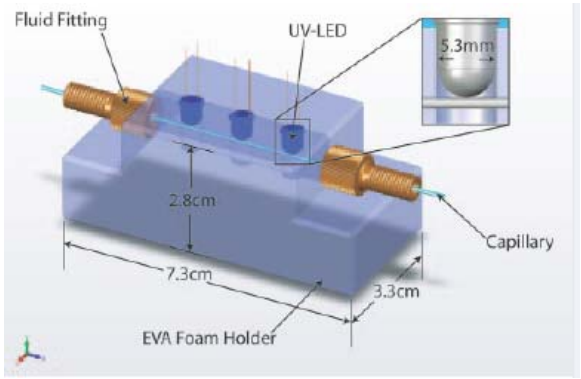

if you can WRIte DNa,
You 're no LONGER limiTED
to " What IS " but TO what you could MAKE .


BECKMAN


A
Fluid Channel
Flow Direction
Distribution Channel
Cover Glass
Si Substrate
Light Beam
Reaction Chamber
Inlet Hole
Photogenerated Reagent




Digital Micromirror Device (DMD)
Digital micromirrors


Fluid Fitting
UV-LED
5.3mm
2.8cm
Capillary
7.3cm
3.3cm
EVA Foam Holder

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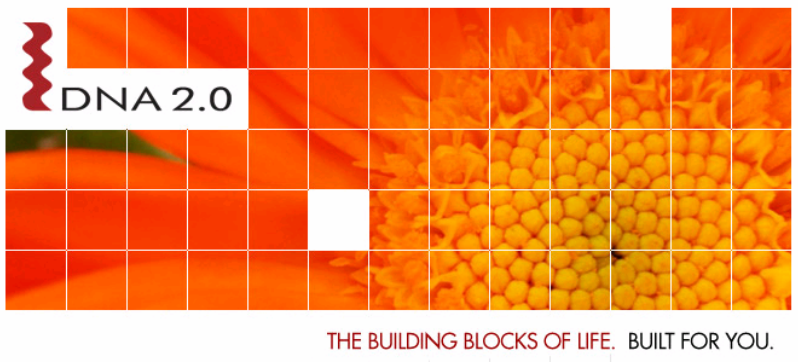
Custom **Gene Synthesis**
What if you could engineer any **gene**
to speed up R&D? Build with us.
www.codondevices.com



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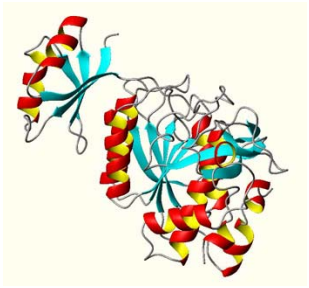
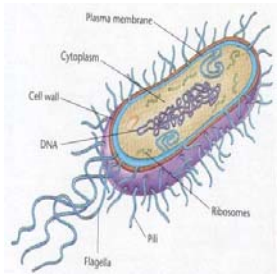
GENEART
THE GENE OF YOUR CHOICE

Applications dependent on synthetic capabilities and $





single genes

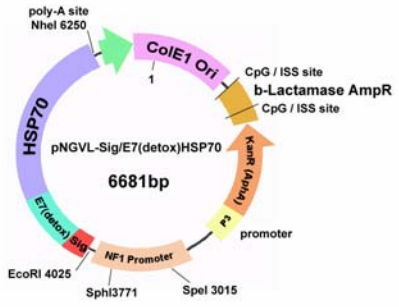
minimal life

base pairs

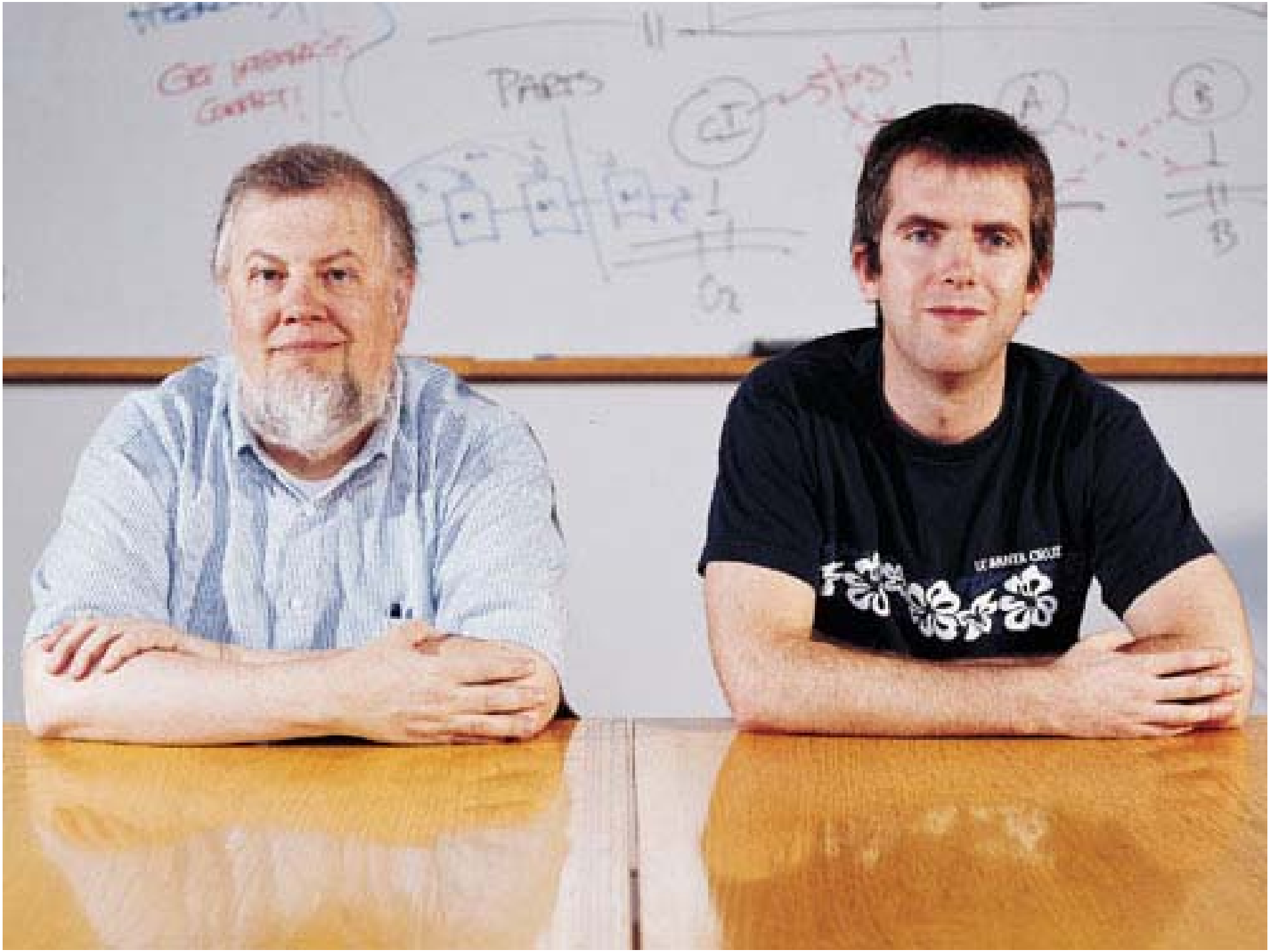
10^2 10^3 10^4 10^5 10^6 10^7

genetic circuits, viruses, GEMs

Engineered organisms




TED


PARTS

Systems

- Measurement
- Measurement (Under Development)
- Projects(empty)

Devices

- Reporters
- Protein Generator
- Inverters
- Composite Devices
- Signalling
- Measurement

Parts

- Ribosome Binding Sites
- Protein Coding
- Terminators
- Regulatory
- Conjugation
- RNA
- DNA

Chassis

- E.coli Strains
- Cell-Free Systems

Mammalian

Vectors

- Plasmids

Other

- Yeast Parts
- Construction
- Intermediate
- PCR Primer
- Tags
- Other
- Deleted
- Bacteriophage T7

Transcriptional Regulators

jump to part

BBa_

navigation

- Main Page
- Browse Part Types
- iGEM Wiki
- Community portal
- Recent changes
- Recent part changes

resources

- User Accounts
- Add a Part
- Part Searches
- DNA Repositories
- Sequence Analysis
- Assembly Tool
- Help

search

Go Search

toolbox

- What links here

Available repressible regulators (normally ON) -?-

Show 0 more parts

Edit

-?-	Name	Description	Direction	Control -?-	Output Low	Output High	Length
A W	BBa_I14032	promoter P(Lac) IQ	Forward				37
A W	BBa_R0040	promoter (tetR, negative)	Forward	aTc, tetracyline			54
A W	BBa_R0051	promoter (lambda cI regulated)	Forward	lambda cI			49

Available inducible regulators (normally OFF) -?-

Show 0 more parts

Edit

-?-	Name	Description	Direction	Control -?-	Output Low	Output High	Length
A	BBa_I12007	Modified lambda Prm promoter (OR-3 obliterated)	Forward	cI			82
A	BBa_R0062	Promoter (luxR & HSL regulated -- lux pR)	Forward	luxR, HSL			55
A	BBa_R0079	Promoter (LasR & PAI regulated)	Forward	PAI			157
A	BBa_R0080	Promoter (AraC regulated)	Forward	araC			149

Available other regulators

Show 172 more parts

Edit

-?-	Name	Description	Direction	Control -?-	Output Low	Output High	Length
A W	BBa_I0500	Inducible pBad/araC	Forward	araC, arabinose			1210
A W	BBa_I13453	Pbad promoter					130
A W	BBa_J13002	TetR repressed POPS/RIPS generator	Forward	ATc			74
A W	BBa_J13023	3OC6HSL+LuxR dependent POPS/RIPS generator					117
A W	BBa_J23100	constitutive promoter family member					35
A W	BBa_J23101	constitutive promoter family member					35
A W	BBa_J23102	constitutive promoter family member					35
A W	BBa_J23103	constitutive promoter family member					35
A W	BBa_J23104	constitutive promoter family member					35
A W	BBa_J23105	constitutive promoter family member					35
A W	BBa_J23106	constitutive promoter family member					35
A W	BBa_J23107	constitutive promoter family member					35
A W	BBa_J23108	constitutive promoter family member					35
A W	BBa_J23109	constitutive promoter family member					35
A W	BBa_J23110	constitutive promoter family member					35
A W	BBa_J23111	constitutive promoter family member					35

BBa_F2620

3OC$_6$HSL → PoPS Receiver

http://parts.mit.edu/registry/index.php/Part:BBa_F2620

Authors:
Barry Canton [bcanton@mit.edu]
Anna Labno [labnoa@mit.edu]

Last Update: 15 January 2007

Description

A transcription factor (LuxR, BBa_C0062) that is active in the presence of cell-cell signaling molecule 3OC$_6$HSL is controlled by a TetR-regulated operator (BBa_R0040). Device input is 3OC$_6$HSL. Device output is PoPS from a LuxR-regulated operator. If used in a cell containing TetR then a second input signal such as aTc can be used to produce a Boolean AND function.

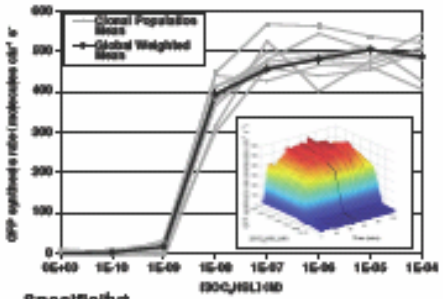
Characteristics

Input Swing: 1E-9 to 1E-6 M 3OC$_6$HSL, exogenous
Output Swing: 0±1 to 503±1 GFP molecules ctu^{-1} s^{-1}
Switch Point: 7±1 nM 3OC$_6$HSL, exogenous
LH Response: 9 min ($t_{50\%}$), 27 min ($t_{90\%}$)

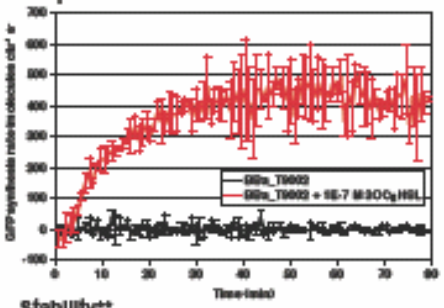
Key Parts

BBa_R0040: TetR-regulated operator
BBa_C0062: luxR ORF
BBa_R0062: LuxR-regulated operator

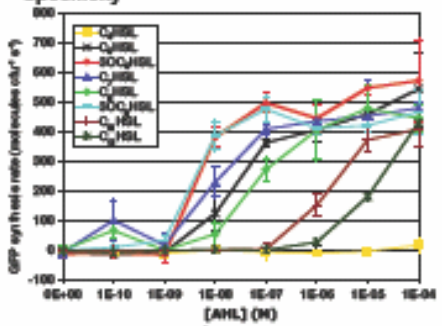
Transfer Function*



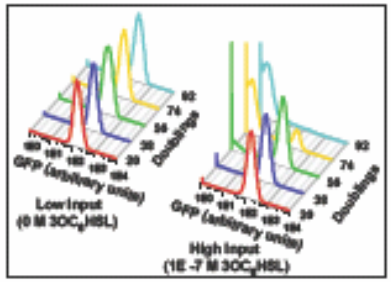
Response Time*



Specificity*



Stability**



Demand (low/high input)

Translational: 256/8048 ribosomes ctu^{-1}
3.8E3/1.2E5 charged tRNA ctu^{-1} s^{-1}

Stability (low/high input)

Genetic: >32/74 replication events**
Performance: >32/74 replication events**

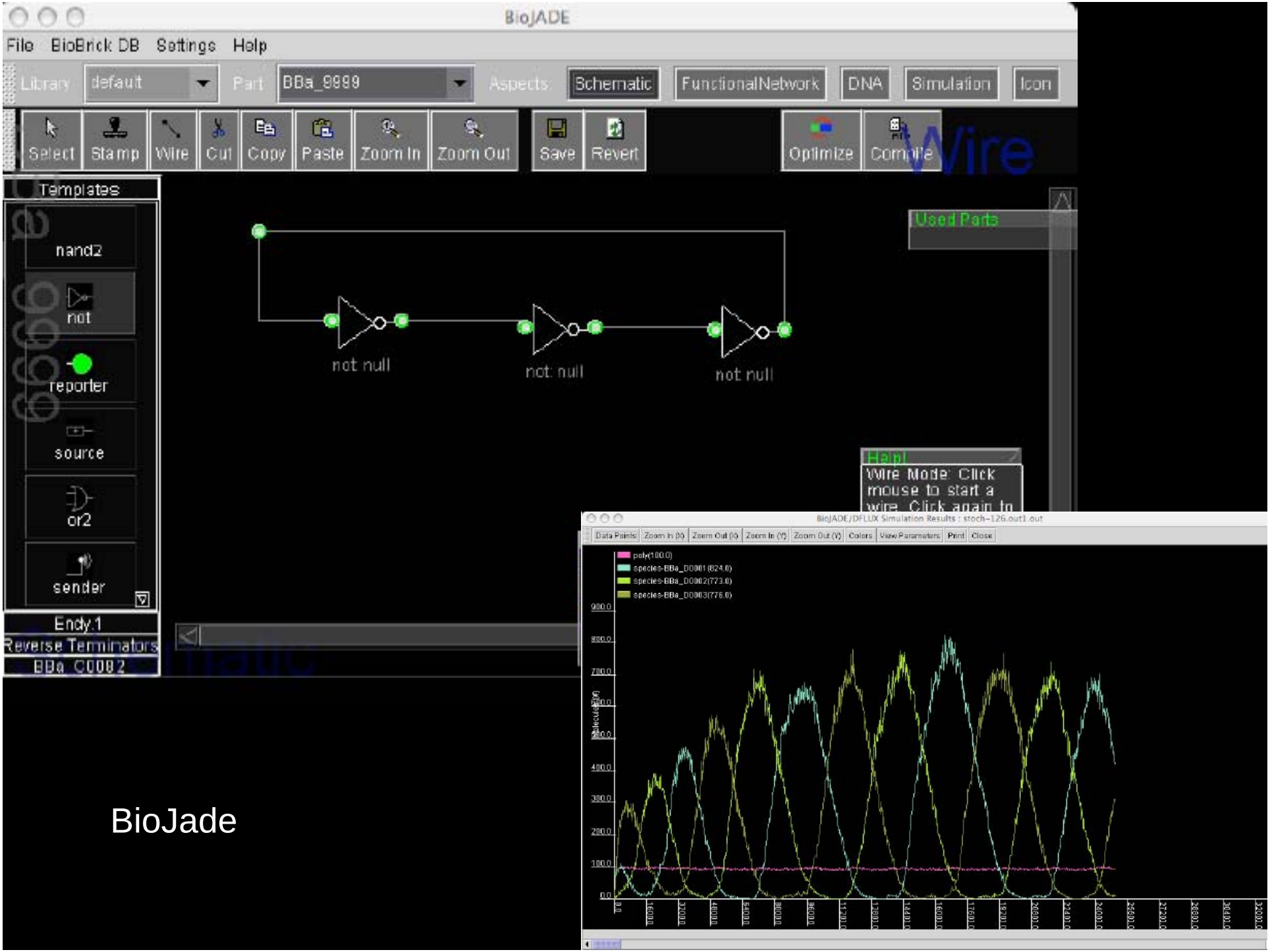
Compatibility

Chassis: Compatible with *MC4100*, *MG1655*, and *DH5α*
Plasmids: Compatible with *pSB3K3* and *pSB1A2*
Devices: Compatible with *E0240*, *E0430* and *E0434*
Crosstalk with systems containing *TetR (C0040)*
Signaling: Crosstalk with input molecules similar to 3OC$_6$HSL

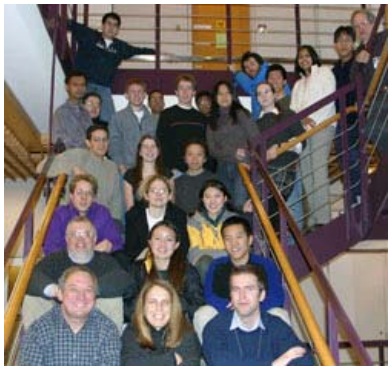
Conditions (abridged)

Output: Indirect via *BBa_E0240*
Vector: pSB3K3
Chassis: MG1655
Culture: Supplemented M9, 37°C
**Equipment:* PE Victor3 plate reader
***Equipment:* BD FACScan cytometer

Signaling Devices


BioJADE
File BioBrick DB Settings Help
Library default
Part BBa_9999
Aspects Schematic FunctionalNetwork DNA Simulation Icon
Select Stamp Wire Cut Copy Paste Zoom In Zoom Out Save Revert
Optimize Compile
Templates
nand2
not
reporter
source
or2
sender
Endy.1
Reverse Terminators
BBa_C0082
not null
not null
not null
Used Parts
Help!
Wire Mode: Click mouse to start a
BioJADE/DFLUX Simulation Results : stoch-126.out1.out
Data Points
Zoom In (X)
Zoom Out (X)
Zoom In (Y)
Zoom Out (Y)
Colors
View Parameters
Print
Close
poly(100.0)
species-BBa_D0001(824.0)
species-BBa_D0002(773.0)
species-BBa_D0003(776.0)
BioJade

Synthetic biology requires an unprecedented level of interdisciplinary cooperation, fewer laboratory skills, and less overhead than conventional genetic engineering.



iGEM 2007 Wiki

International Genetically Engineered Machine Competition

Go Search

article discussion edit history Create an account or log in

teams jamboree participate help about registry

Cambridge & Melbourne Leap Together

Cambridge University & Melbourne Univeristy leap together after co-winning the Best BioBrick Part award.

iGEM?

Hundreds of undergraduates all over the world spend their summer making Synthetic Biology a reality by participating in the annual International Genetically Engineered Machine competition.

iGEM through the years

- 2008
- 2007
- 2006

Learn More

Results of the Jamboree

sat & sun, nov 3-4

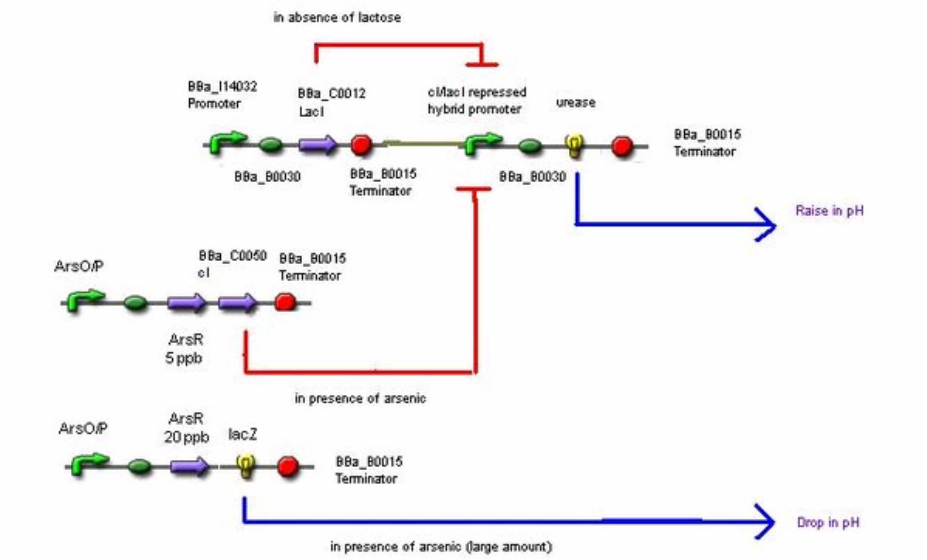
iGEM 2007 is now officially concluded! Congratulations to all!

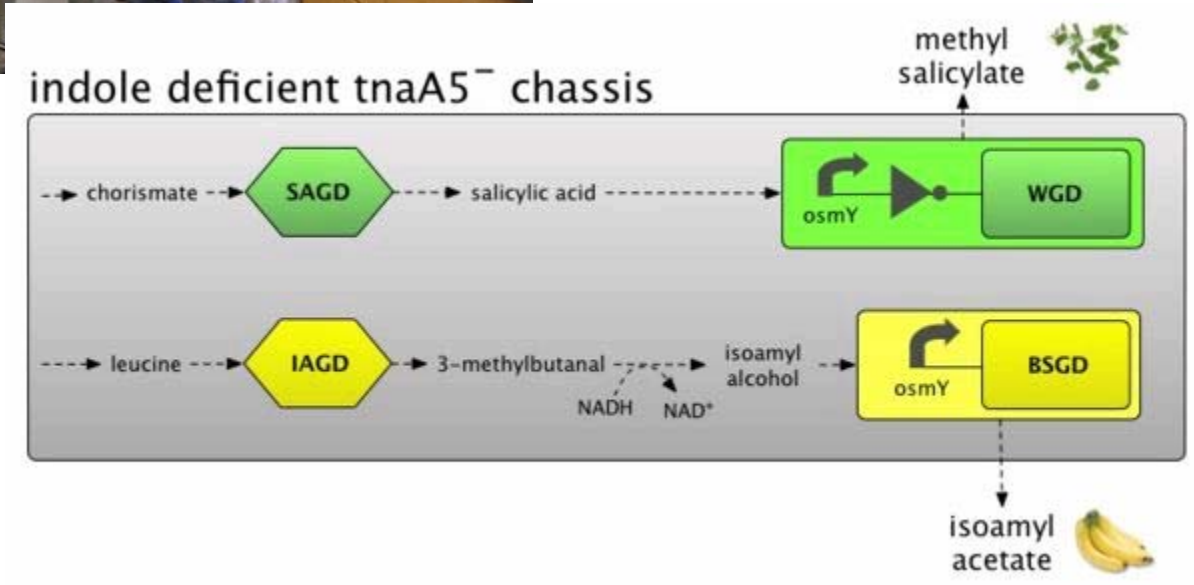
- Results
- See the medal winners
- Media (including links to videos and flickr™ photo gallery)
- Learn about iGEM 2008

calendar

Jamboree roster + fees due	*fri 12 oct 12*
iGEM wiki frozen + parts postmarked	*fri 26 Oct 07*
Jamboree!	*sat-sun 3-4 nov 07*
Registry + BioBrick foundation workshops	*sun-tue 4-6 nov 07*


Harvard
Brown
Boston
McGill
Waterloo
Toronto
Edmonton
Calgary
Lethbridge
Utah
Missouri
Davidson/Missouri
Bay Area RSI
Berkeley LBL
Berkeley UC
UCSF
Caltech
Mississippi
Rice
Prairie View
Mexico
Minnesota
Colombia
Wisconsin
Michigan
Duke
Purdue
Virginia Tech
Virginia
Princeton
Penn State
CSHL
MIT
Imperial
Cambridge
Dundee
Edinburgh
Glasgow
Paris
St. Petersburg
ETHZ
Freiburg
Ljubljana
Peking
UST China
Tsinghua
Tianjin
Tokyo
Chiba
Taipei
Turkey
Bangalore
Valencia
Bologna
Naples
Melbourne


in absence of lactose
BBa_I14032
Promoter
BBa_C0012
LacI
cI/lacI repressed
hybrid promoter
urease
BBa_B0015
Terminator
BBa_B0030
BBa_B0015
Terminator
BBa_B0030
Raise in pH
ArsO/P
BBa_C0050
cI
BBa_B0015
Terminator
ArsR
5 ppb
in presence of arsenic
ArsO/P
ArsR
20 ppb
lacZ
BBa_B0015
Terminator
Drop in pH
in presence of arsenic (large amount)


indole deficient tnaA5⁻ chassis
methyl salicylate
chorismate
SAGD
salicylic acid
osmY
WGD
leucine
IAGD
3-methylbutanal
NADH
NAD+
isoamyl alcohol
osmY
BSGD
isoamyl acetate

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Latest News: Flames come up short against 'Hawks

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Sci-Tech

Under a magnification of 6836x, this scanning electron micrograph (SEM) depictes a number of Gram-negative Escherichia coli bacteria of the strain O157:H7. (Courtesy of Centers of Disease Control and Prevention)

Alberta team trying to turn E. coli into fuel

Updated Mon. Nov. 5 2007 8:12 AM ET

The Canadian Press

CAMBRIDGE, Mass. -- A University of Alberta team trying to turn E. coli into fuel has earned a first place finish in the energy category at an international genetic engineering competition at MIT.

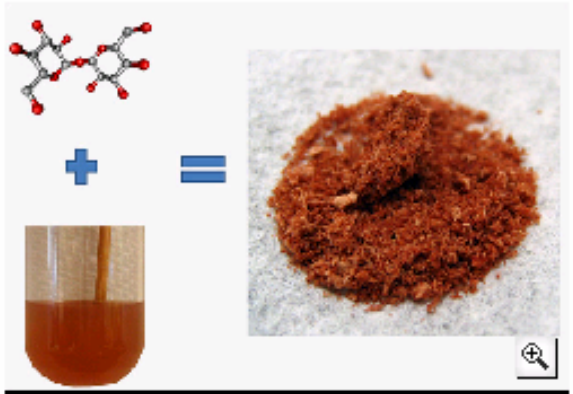
Andrew Hessel, a consultant with the Alberta Ingenuity Fund who has helped teams from three Alberta universities compete, says while none of the teams from the University of Calgary, the University of Lethbridge or the U of A made it to the final competition, he calls it a fantastic educational experience.

USER TOOLS

WIRED

Genetic-Engineering Competitors Create Modular DNA Dev Kit

By Alexis Madrigal 11.13.07 | 7:30 PM



University of California-Berkeley students created "bacto-blood," which can be freeze-dried and may one day be used for blood transfusions.
Image: Austin Day

College and high school students are helping MIT scientists develop an open source development kit for biological systems that could do for cells what Linux has done for computers.

As part of the International Genetically Engineered Machines competition held in Cambridge, Massachusetts, last week, Peking University students created tiny assembly lines out of bacteria. Their entry, "Towards a Self-Differentiated Bacterial Assembly Line," won them the grand prize among 50 teams from around the world.

"Biology is going to be able to make the things that we want," said Tom Knight, an MIT engineer and co-founder of iGEM. "And when that happens, the economics of production are going to change dramatically. It doesn't take a billion-dollar [facility] to make stuff. It takes a hundred-dollar incubator."

WIRED

The Top 10 New Organisms of 2007

The New York Times

English, Algebra, Phys Ed ... and Biotech

Jim Wilson/The New York Times

George Cachianes, left, formerly of Genentech, teaches biotechnology at Lincoln High School in San Francisco.

BERKELEY CENTER FOR SYNTHETIC BIOLOGY

A JOINT PROGRAM OF THE CALIFORNIA INSTITUTE FOR QUANTITATIVE BIOMEDICAL RESEARCH (QB3) AND LAWRENCE BERKELEY NATIONAL LABORATORY (LBNL)

The California Institute for Quantitative Biomedical Research (QB3) and Lawrence Berkeley National Laboratory (LBNL) have joined forces to accelerate the growth of synthetic biology, a new field that promises major new advances in preventing and treating disease, generating new energy sources, and preventing and mitigating environmental threats.

Opening in spring 2005 in a spacious, modern building in west Berkeley, the Berkeley Center for Synthetic Biology gives renowned scientists and engineers the chance to pool their talents and collaborate in new ways, with enormous potential benefits for California's citizens in the form of advances in biomedicine and energy renewables and economic growth.

Synthetic biologists study the control and design of biological components and new organisms to solve a host of important health, energy, and environmental problems that cannot be solved using naturally occurring biological entities. The inherently

QB3 and LBNL scientists occupy lab space in a building renovated in 1997 for biotech research, previously leased by Bayer, featuring large labs, viral suites, and tissue culture rooms. UCSF Mission Bay and numerous biotech firms are nearby.

MIT establishes groundbreaking biological engineering major

February 17, 2005

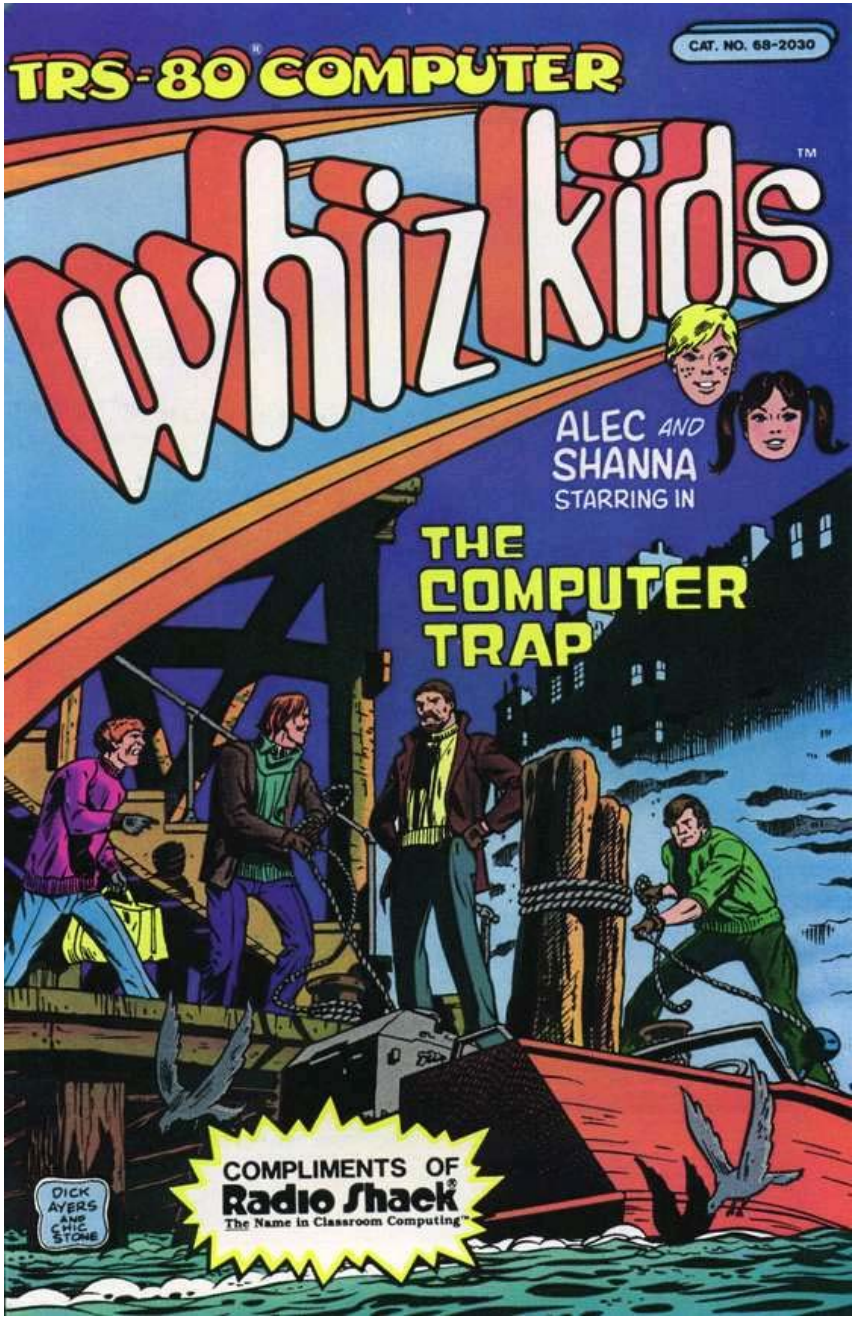
The Massachusetts Institute of Technology faculty yesterday approved a new course of study for undergraduates, in biological engineering, the first entirely new curriculum established at the Institute in 29 years.

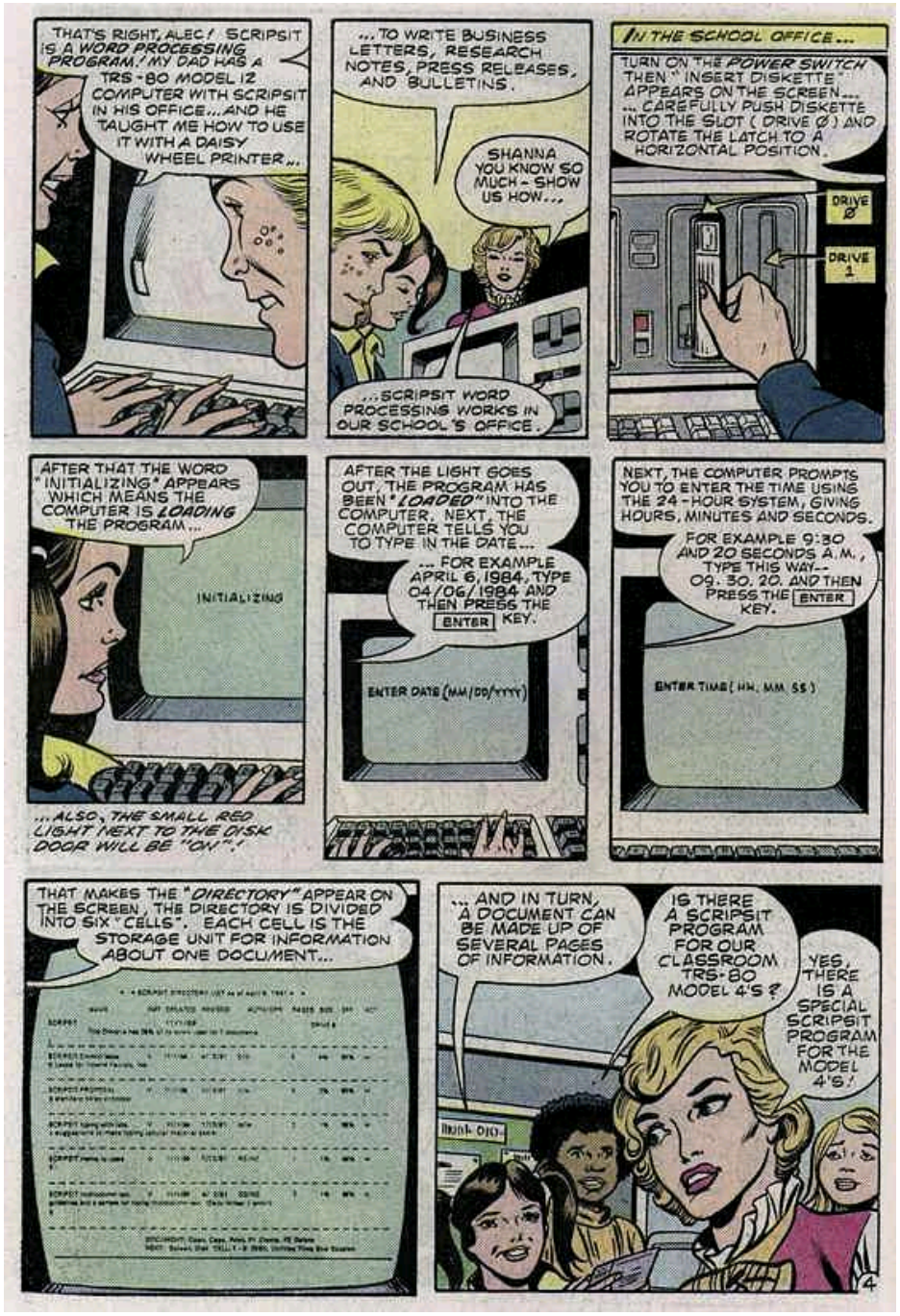
UNIVERSITY OF ALBERTA
QUAECUMQUE VERA

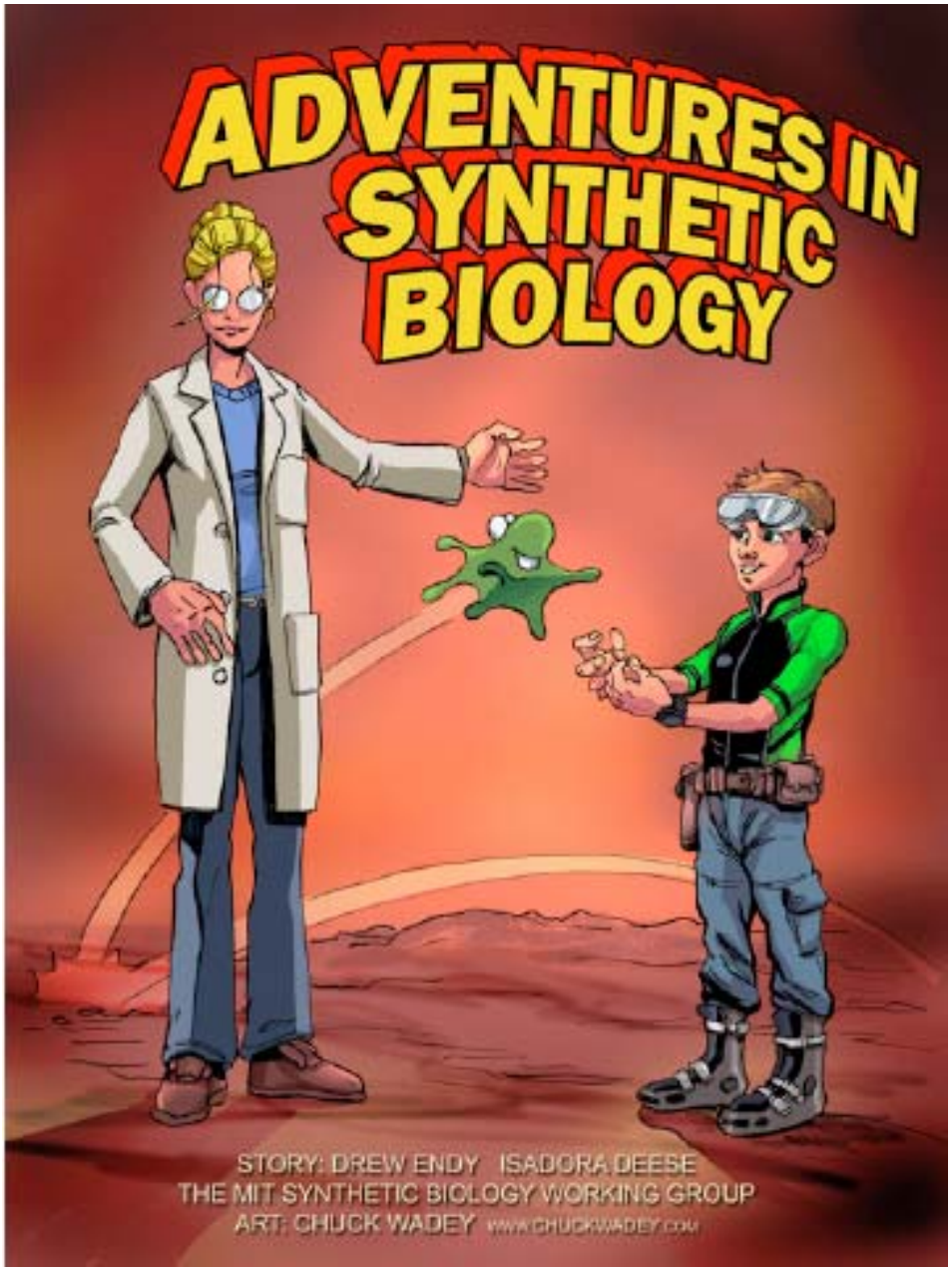
UNIVERSITY OF CALGARY
MO SHULE TOGAM SUAS

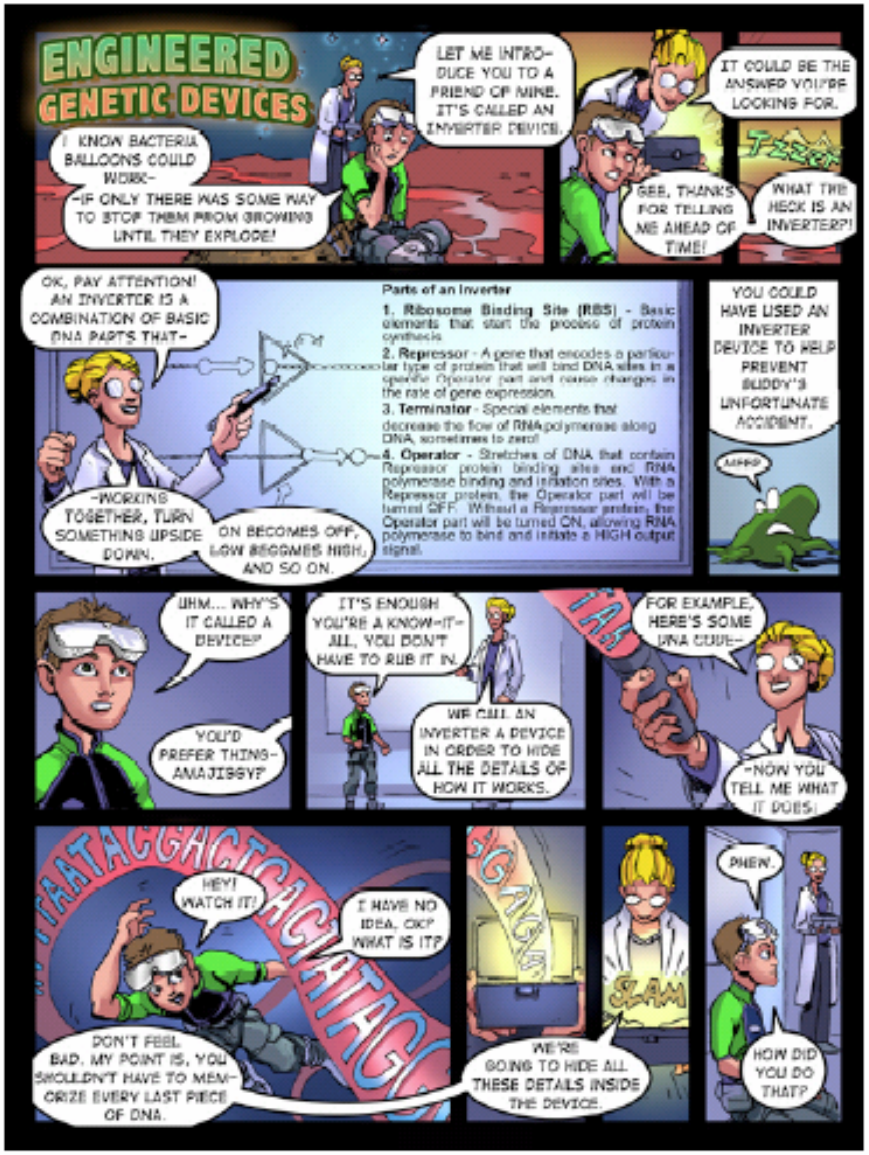
University of Lethbridge
FIAT LUX

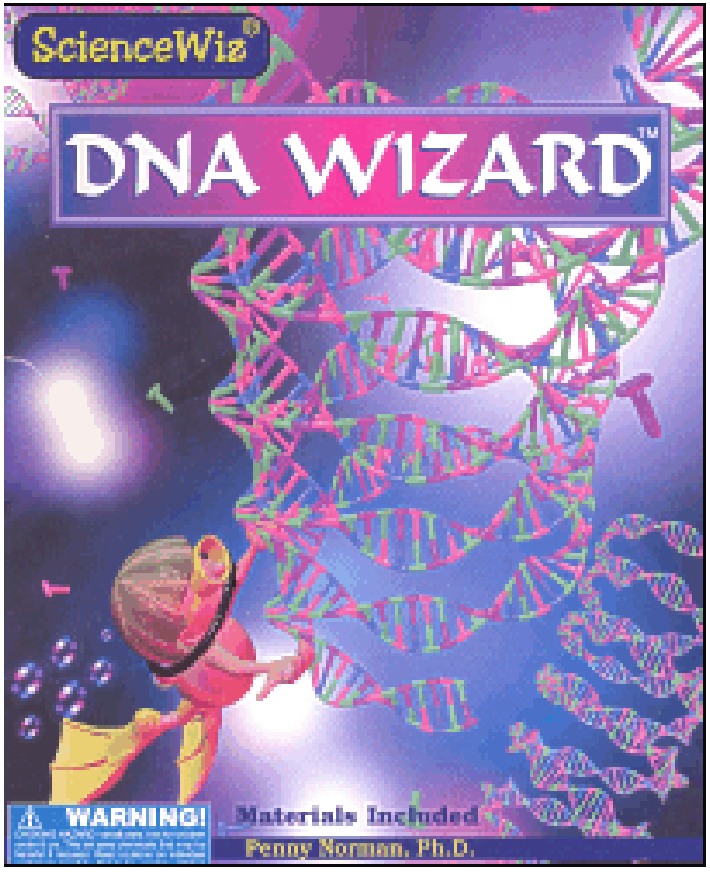

MAY 3, 1982
$1.50
TIME
-.3%
INFLATION VANISHES!
At Least for
A Month
COMPUTER GENERATION
A New Breed of Whiz Kids


TRS-80® COMPUTER
CAT. NO. 68-2030
whizkids™
ALEC AND SHANNA STARRING IN
THE COMPUTER TRAP
COMPLIMENTS OF
Radio Shack®
The Name in Classroom Computing™
DICK AYERS AND CHIC STONE


THAT'S RIGHT, ALEC! SCRIPSIT IS A WORD PROCESSING PROGRAM! MY DAD HAS A TRS-80 MODEL 12 COMPUTER WITH SCRIPSIT IN HIS OFFICE... AND HE TAUGHT ME HOW TO USE IT WITH A DAISY WHEEL PRINTER...
...TO WRITE BUSINESS LETTERS, RESEARCH NOTES, PRESS RELEASES, AND BULLETINS.
SHANNA YOU KNOW SO MUCH - SHOW US HOW...
...SCRIPSIT WORD PROCESSING WORKS IN OUR SCHOOL'S OFFICE.
IN THE SCHOOL OFFICE...
TURN ON THE POWER SWITCH THEN "INSERT DISKETTE" APPEARS ON THE SCREEN... ...CAREFULLY PUSH DISKETTE INTO THE SLOT (DRIVE Ø) AND ROTATE THE LATCH TO A HORIZONTAL POSITION.
DRIVE Ø
DRIVE 1
AFTER THAT THE WORD "INITIALIZING" APPEARS WHICH MEANS THE COMPUTER IS LOADING THE PROGRAM...
INITIALIZING
...ALSO, THE SMALL RED LIGHT NEXT TO THE DISK DOOR WILL BE "ON"!
AFTER THE LIGHT GOES OUT, THE PROGRAM HAS BEEN "LOADED" INTO THE COMPUTER. NEXT, THE COMPUTER TELLS YOU TO TYPE IN THE DATE...
... FOR EXAMPLE APRIL 6, 1984, TYPE 04/06/1984 AND THEN PRESS THE ENTER KEY.
ENTER DATE (MM/DD/YYYY)
NEXT, THE COMPUTER PROMPTS YOU TO ENTER THE TIME USING THE 24-HOUR SYSTEM, GIVING HOURS, MINUTES AND SECONDS.
FOR EXAMPLE 9:30 AND 20 SECONDS A.M., TYPE THIS WAY-- 09.30.20. AND THEN PRESS THE ENTER KEY.
ENTER TIME (HH.MM.SS)
THAT MAKES THE "DIRECTORY" APPEAR ON THE SCREEN. THE DIRECTORY IS DIVIDED INTO SIX "CELLS". EACH CELL IS THE STORAGE UNIT FOR INFORMATION ABOUT ONE DOCUMENT...
...AND IN TURN, A DOCUMENT CAN BE MADE UP OF SEVERAL PAGES OF INFORMATION.
IS THERE A SCRIPSIT PROGRAM FOR OUR CLASSROOM TRS-80 MODEL 4'S?
YES, THERE IS A SPECIAL SCRIPSIT PROGRAM FOR THE MODEL 4'S!
4


ADVENTURES IN SYNTHETIC BIOLOGY
STORY: DREW ENDY ISADORA DEESE
THE MIT SYNTHETIC BIOLOGY WORKING GROUP
ART: CHUCK WADEY WWW.CHUCKWADEY.COM


ENGINEERED GENETIC DEVICES
I KNOW BACTERIA BALLOONS COULD WORK- -IF ONLY THERE WAS SOME WAY TO STOP THEM FROM GROWING UNTIL THEY EXPLODE!
LET ME INTRODUCE YOU TO A FRIEND OF MINE. IT'S CALLED AN INVERTER DEVICE.
IT COULD BE THE ANSWER YOU'RE LOOKING FOR.
GEE, THANKS FOR TELLING ME AHEAD OF TIME!
WHAT THE HECK IS AN INVERTER?!
OK, PAY ATTENTION! AN INVERTER IS A COMBINATION OF BASIC DNA PARTS THAT-
Parts of an Inverter
1. Ribosome Binding Site (RBS) - Basic elements that start the process of protein synthesis.
2. Repressor - A gene that encodes a particular type of protein that will bind DNA sites in a specific Operator part and cause changes in the rate of gene expression.
3. Terminator - Special elements that decrease the flow of RNA polymerase along DNA, sometimes to zero!
4. Operator - Stretches of DNA that contain Repressor protein binding sites and RNA polymerase binding and initiation sites. With a Repressor protein, the Operator part will be turned OFF. Without a Repressor protein, the Operator part will be turned ON, allowing RNA polymerase to bind and initiate a HIGH output signal.
-WORKING TOGETHER, TURN SOMETHING UPSIDE DOWN.
ON BECOMES OFF, LOW BECOMES HIGH, AND SO ON.
YOU COULD HAVE USED AN INVERTER DEVICE TO HELP PREVENT BUDDY'S UNFORTUNATE ACCIDENT.
MMMP
UHM... WHY'S IT CALLED A DEVICE?
YOU'D PREFER THING-AMAJIBBY?
IT'S ENOUGH YOU'RE A KNOW-IT-ALL, YOU DON'T HAVE TO RUB IT IN.
WE CALL AN INVERTER A DEVICE IN ORDER TO HIDE ALL THE DETAILS OF HOW IT WORKS.
FOR EXAMPLE, HERE'S SOME DNA CODE-
-NOW YOU TELL ME WHAT IT DOES.
HEY! WATCH IT!
I HAVE NO IDEA, OK? WHAT IS IT?
DON'T FEEL BAD. MY POINT IS, YOU SHOULDN'T HAVE TO MEMORIZE EVERY LAST PIECE OF DNA.
WE'RE GOING TO HIDE ALL THESE DETAILS INSIDE THE DEVICE.
PHEW.
HOW DID YOU DO THAT?



http://www.electrowiz.com/

Why do bioengineering?

- Any chemical process can be done with biochemistry – no need for harsh chemical conditions, temperature, etc.
- Runs on sugar or sunlight
- Bio-compatible and biodegradable
- Self-reproducing > very low cost
- Potentials are virtually untapped
- Evidence suggests many of today's engineering activities will begin to move towards bioengineered processes > big economic shift on the order of computing
- Life and life processes are important – should be widely used and understood, not in the hands of a few elites – hence the need for "open source biology"

- Registration fees ($1000/team)
- Teach the teachers meeting (MIT, May)
- Regional meetings and seminars
- Travel and accommodation for up to 100 students to MIT Jamboree in November
- $5,000 research start-up fees
- Support, technical advice, media relations