The UCI Institute for Genomics and Bioinformatics

P. Baldi,Director

www.igb.uci.edu

Institute for Genomics and Bioinformatics (IGB)

- Collection of about 100 laboratories across the Schools of Biological Sciences, Engineering, Information and Computer Sciences, Medicine, and Physical Sciences
- Physical building for the central administration and computational personnel and facilities

IGB Mission

1. **RESEARCH:** Foster and Conduct world-class basic and applied research and promote innovation at the intersection of the life and computational sciences

IGB Mission

2. **EDUCATION:** Train the next generation of scientists at the intersection of the life and computational sciences

Biomedical Informatics Training Program supported by largest NIH/NLM Training Grant over the past 10 years (over 70 alumni, ~1 M per year). Currently: 28 graduate students, 6 postdocs. Annual BIT Symposium.

IGB Mission

3. **TECHNOLOGY TRANSFER AND OUTREACH**: Work with established companies, start-ups, government agencies, and other research centers and universities world-wide to develop and transition technologies to widespread and practical applications

Several successful startups including: Antigen Discover, Reaction Explorer, and Verdezyne

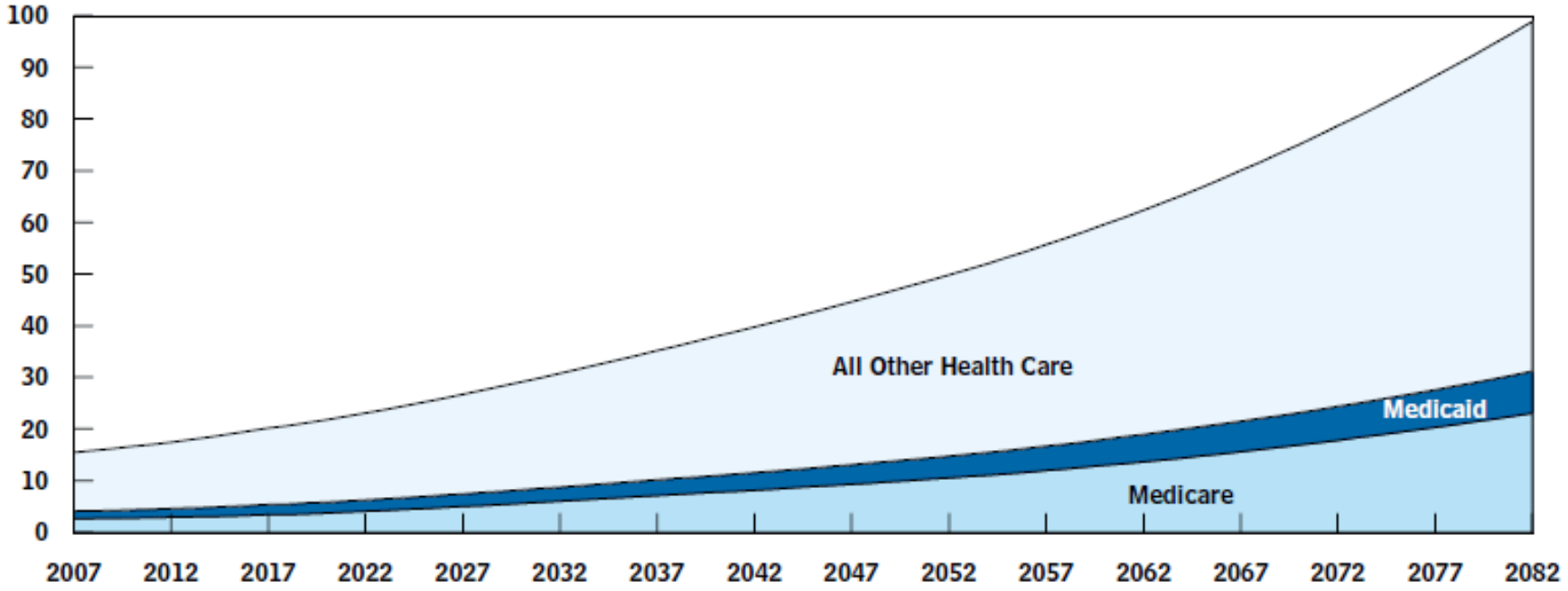
The Great Challenges

- Climate Change
- Energy
- Health Care

Figure D-1.

Projected Spending on Health Care Under an Assumption That Excess Cost Growth Continues at Historical Averages

(Percentage of gross domestic product)

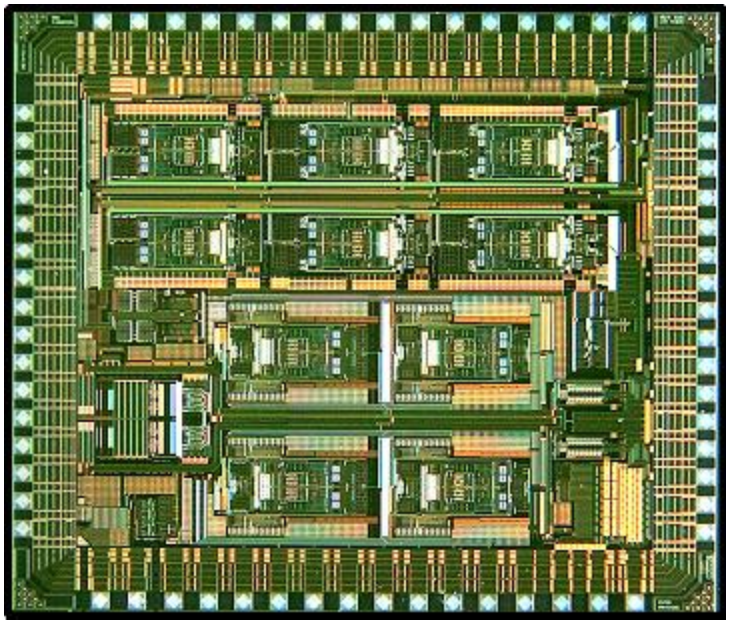


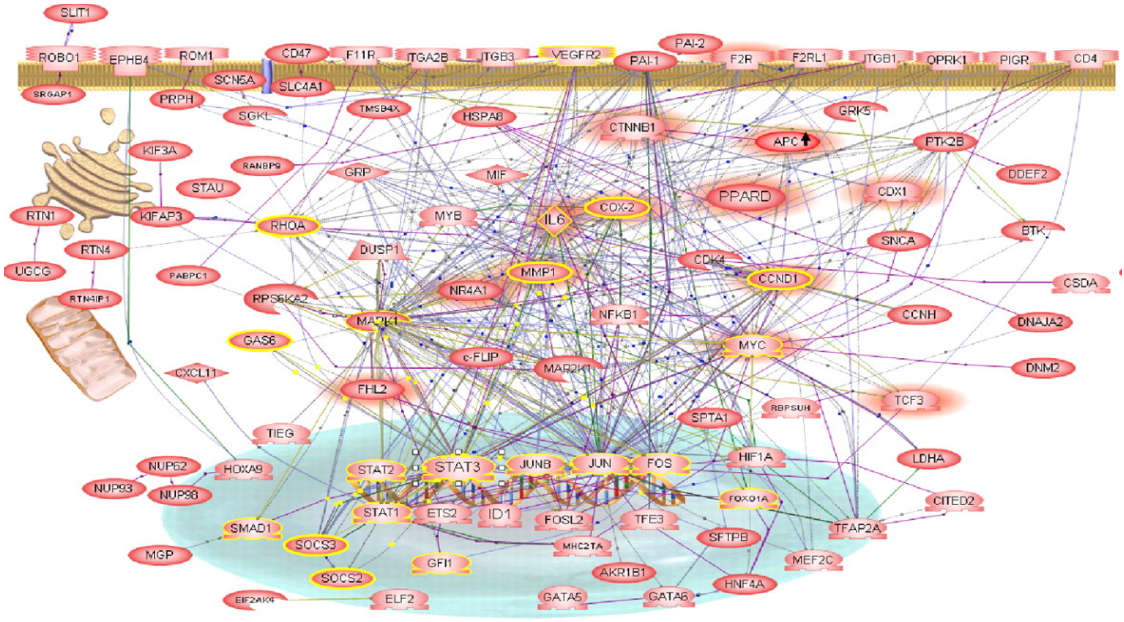
Source: Congressional Budget Office.

Notes: Excess cost growth refers to the number of percentage points by which the growth of spending on Medicare, Medicaid, or health care generally (per beneficiary or per capita) is assumed to exceed the growth of nominal gross domestic product (per capita).

Amounts for Medicare are net of beneficiaries' premiums. Amounts for Medicaid are federal spending only.

The Great Opportunities





Silicon-based computing

Carbon-based computing

ATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACA
GCATGCTTCAATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTT
CAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCTCCTTATCCTTATAGTTCATACATGC
TCAACTACTTAATAAATGATTGTATGATAATTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAAC
GAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTACT
AATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTC
ATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCTCCTTATCCTTATAGTTCATACATGCTT
AACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGT
TTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATT
CGATTATCCTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTAGTTCATACATGCTTCAACTA
TTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATAT
CTTCAACTACTTAATAAATGATCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCTTCAACTACTT
ATAAATGATTGTATGAATTTCGATTATCCTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCTTA
AGTTCATACACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATAGTTCATACATGCT
CAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATG
TTTCAATGTAAGAGATTTCGATTATCCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTC
ATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGTATTGAATTTTCAAAAATTCTTACTTTTTTTTTGGATGGACGCAAAGAAGTTTAATAATCATATTACATGG
ATTACCACCATATACATATCCATATCTAATCTTACTATATGTTGTGGAAATGTAAAGAGCCCCATTATCTTAGCCTAAAAAAACCTTCTCTTTGGAACTTTCAGTAATA
GCTTAACTGCTCATTGCTATATTGAAGTACGGATTAGAAGCCGCCGAGCGGGCGACAGCCCTCCGACGGAAGACTCTCCTCCGTGCGTCCTCGTCTTCACCGGTCGCGT
CCTGAAACGCAGATGTGCCTCGCGCCGCACTGCTCCGAACAATAAAGATTCTACAATACTAGCTTTTATGGTTATGAAGAGGAAAAATTGGCAGTAACCTGGCCCCACA
ACCTTCAAATTAACGAATCAAATTAACAACCATAGGATGATAATGCGATTAGTTTTTTAGCCTTATTTCTGGGGTAATTAATCAGCGAAGCGATGATTTTTGATCTATT
ACAGATATATAAATGGAAAAGCTGCATAACCACTTTAACTAATACTTTCAACATTTTCAGTTTGTATTACTTCTTATTCAAATGTCATAAAAGTATCAACAAAAAATTG
TAATATACCTCTATACTTTAACGTCAAGGAGAAAAAACTATAATGACTAAATCTCATTCAGAAGAAGTGATTGTACCTGAGTTCAATTCTAGCGCAAAGGAATTACCAA
ACCATTGGCCGAAAAGTGCCCGAGCATAATTAAGAAATTTATAAGCGCTTATGATGCTAAACCGGATTTTGTTGCTAGATCGCCTGGTAGAGTCAATCTAATTGGTGAA
ATATTGATTATTGTGACTTCTCGGTTTTACCTTTAGCTATTGATTTTGATATGCTTTGCGCCGTCAAAGTTTTGAACGATGAGATTTCAAGTCTTAAAGCTATATCAGA
GGCTAAGCATGTGTATTCTGAATCTTTAAGAGTCTTGAAGGCTGTGAAATTAATGACTACAGCGAGCTTTACTGCCGACGAAGACTTTTTCAAGCAATTTGGTGCCTTG
TGAACGAGTCTCATTCAGGTTGGTACGATAAACTTTACGAATGTTCTTGTCCAGAGATTGACAAAATTTGTTCCATTGCTTTGTCAAATGGATCATATGGTTCCCGTTT
ACCGGAGCTGGCTGGGGTGGTTGTACTGTTCACTTGGTTCCAGGGGGCCCAAATGGCAACATAGAAAAGGTAAAAGAAGCCCTTGCCAATGAGTTCTACAAGGTCAAGT
CCCTAAGATCACTGATGCTGAGCTAGAAAATGCTATCATCGTCTCTAAACCAGCATTGGGCAGCTGTCTATATGAATTAGTCAAGTATACTTCTTTTTTTTACTTTGTT
AGAACAACTTCTCATTTTTTTCTACTCATAACTTTAGCATCACAAAATACGCAATAATAACGAGTAGTAACACTTTTATAGTTCATACATGCTTCAACTACTTAATAAA
GATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCACAAACTTTAAAACACAGGGACAAAATTCTTGATATGCTTTCAACCGCTGCGTTTTGGATACCTAT
CTTGACATGATATGACTACCATTTTGTTATTGTACGTGGGGCAGTTGACGTCTTATCATATGTCAAAGAAAATTTGCGAAGTTCTTGGCAAGTTGCCAACTGACGAGAT
CAGTAACACTTTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCACAAACTTTAAAACACAGGG
CAAAATTCTTGATATGCTTTCAACCGCTGCGTTTTGGATACCTATTCTTGACATGATATGACTACCATTTTGTTATTGTACGTGGGGCAGTTGACGTCTTATCATATGT
AAAGTCATTTGCGAAGTTCTTGGCAAGTTGCCAACTGACGAGATGCAGTTTCCTACGCATAATAAGAATAGGAGGGAATATGCAGGAGAACGCCAGACAATCTATCATT
CATTTAAGCGGCTCTTCAAAAAGATTGAACTCTCGCCAACTTATGGAATCTTCCAATGAGACCTTTGCGCCAAATAATGTGGATTTGGAAAAAGAGTATAAGTCATCTC
GAGTAATATAACTACCGAAGTTTATGAGGCATCGAGCTTTGAAGAAAAAGTAAGCTCAGAAAAACCTCAATACAGCTCATTCTGGAAGAAATAGTGTTTCTTGTACAAC
AGGACTTGAAGCCCGTCGAAAAAGAAAGGCGGGTTTGGGATTGGGTACGGTTTCGTTGGTGCTTTTGTTGTTTTGGCCTCTAGAGTTGGATCTGCTTATCATTTGTCAT
CCCTATATCATCTAGAGCATCATTCGGTATTTTCTTCTCTTTATGGCCCGTTATTAACAGAGTCGTCATGGCCATCGTTTGGTATAGTGTCCAAGCTTATATTGCGGCA
CTCCCGTATCATTAATGCTGAAATCTATCTTTGGAAAAGATTTACAATGATTGTACGTGGGGCAGTTGACGTCTTATCATATGTCAAAGTCATTTGCGAAGTTCTTGGC
AGTTGCCAACTGACGAGATGCAGTAACACTTTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCC
CAAACTTTAAACACAGGGACAAAATTCTTGATATGCTTTCAACCGCTGCGTTTTGGATACCTATTCTTGACATGATATGACTACCATTTTGTTATTGTTTATAGTTCAT
CATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTAT
ATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAAATAAAGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCT
ATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTGTATGATTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATG
TTTCAATGTAAGATTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTC
TACATGCTTCAACTACTGTAAATAATTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATAGTTCATACATGC
TCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTT
TCAAATAAAATGTAAGAGATTTCGATTATCCTTATAGTTCATACEEEEEEECATGCGTTGACATGATATGACTACCATTTTGTTATTGTTTATAGTTCATACATGCTTC
ACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTTGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATA
ATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTGTATGATTTATATCG

Short History of Genomics

- Genomic Era:

1953: Watson-Crick

1989: Human Genome Project

2001: Human Genome Draft

2008: Venter/Watson Genomes //1,000 Genome Project

2012: $,1000/ Genome

2016: $ 100/ Genome

2025-2030: “brain-equivalent” computer power

Short History of Genomics

- Genomic Era:

1953: Watson-Crick

1989: Human Genome Project

2001: Human Genome Draft

2008: Venter/Watson Genomes //1,000 Genome Project

2012: $,1000/ Genome

2016: $ 100/ Genome

2025-2030: “brain-equivalent” computer power

- Post Genomic Era:

Short History of Genomics

- Genomic Era:

1953: Watson-Crick

1989: Human Genome Project

2001: Human Genome Draft

2008: Venter/Watson Genomes //1,000 Genome Project

2012: $,1000/ Genome

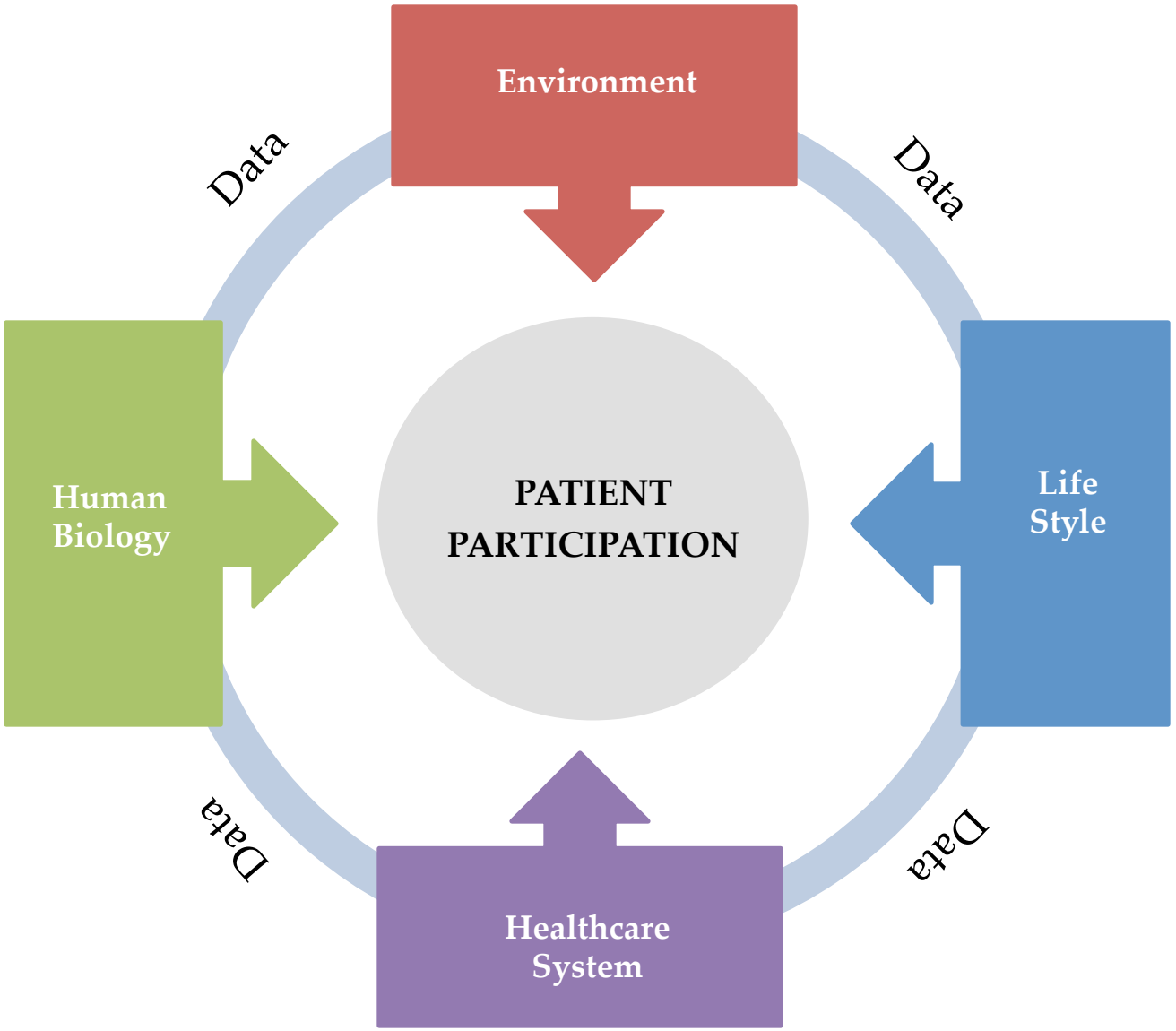
2016: $ 100/ Genome

2025-2030: "brain-equivalent" computer power

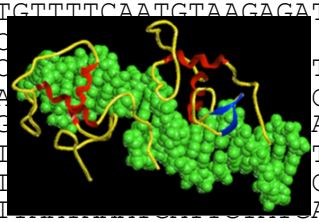
- Post Genomic Era:

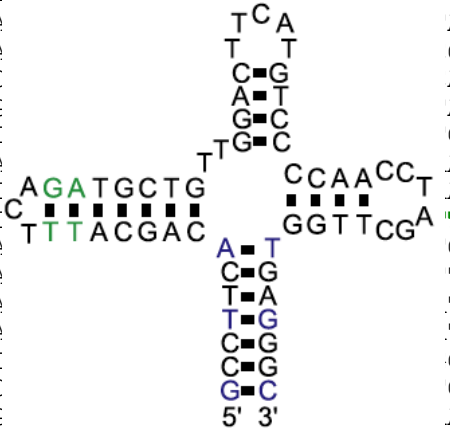
- P4 Medicine (predictive, preventative, personal, participatory) Era:

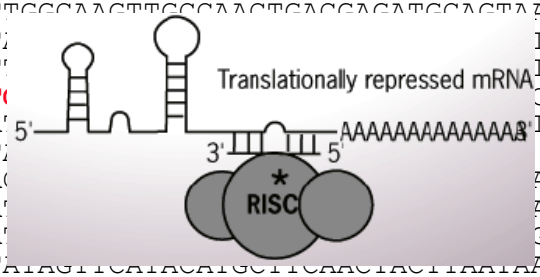
Optimization of Health



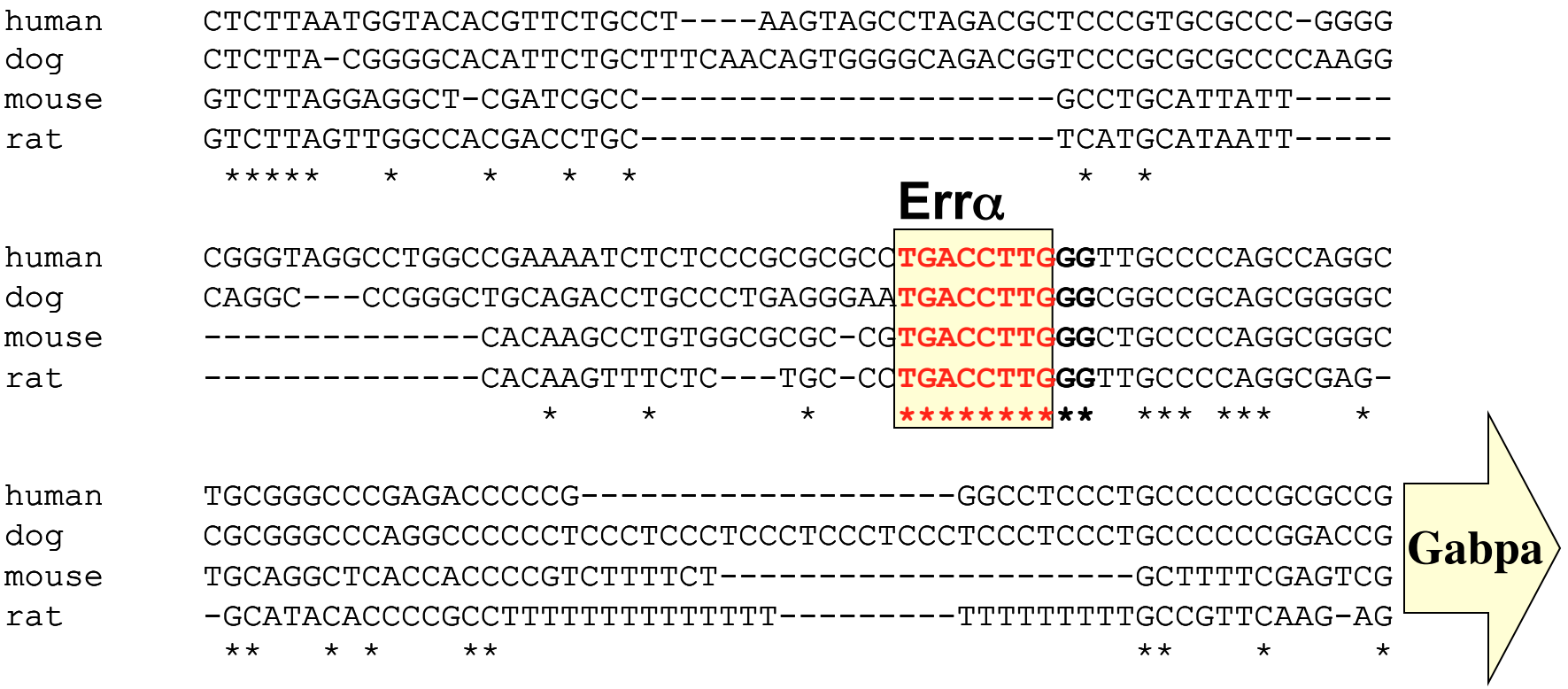
ATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACA
GCATGCTTCAATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTT
CAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCTCCTTATCCTTATAGTTCATACATGC
TCAACTACTTAATAAATGATTGTATGATAATTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAAC
GAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTACT
AATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTC
ATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCTCCTTATCCTTATAGTTCATACATGCTT
AACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGT
TTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATT
CGATTATCCTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTAGTTCATACATGCTTCAACTA
TTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATAT
CTTCAACTACTTAATAAATGATCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCTTCAACTACTT
ATAAATGATTGTATGAATTTCGATTATCCTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCTTA
AGTTCATACACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATAGTTCATACATGCT
CAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATG
TTTCAATGTAAGAGATTTCGATTATCCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTC
ATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGTATTGAATTTTCAAAAATTCTTACTTTTTTTTTGGATGGACGCAAAGAAGTTTAATAATCATATTACATGG
ATTACCACCATATACATATCCATATCTAATCTTACTATATGTTGTGGAAATGTAAAGAGCCCCATTATCTTAGCCTAAAAAAACCTTCTCTTTGGAACTTTCAGTAATA
GCTTAACTGCTCATTGCTATATTGAAGTACGGATTAGAAGCCGCCGAGCGGGCGACAGCCCTCCGACGGAAGACTCTCCTCCGTGCGTCCTCGTCTTCACCGGTCGCGT
CCTGAAACGCAGATGTGCCTCGCGCCGCACTGCTCCGAACAATAAAGATTCTACAATACTAGCTTTTATGGTTATGAAGAGGAAAAATTGGCAGTAACCTGGCCCCACA
ACCTTCAAATTAACGAATCAAATTAACAACCATAGGATGATAATGCGATTAGTTTTTTAGCCTTATTTCTGGGGTAATTAATCAGCGAAGCGATGATTTTTGATCTATT
ACAGATATATAAATGGAAAAGCTGCATAACCACTTTAACTAATACTTTCAACATTTTCAGTTTGTATTACTTCTTATTCAAATGTCATAAAAGTATCAACAAAAAATTG
TAATATACCTCTATACTTTAACGTCAAGGAGAAAAAACTATAATGACTAAATCTCATTCAGAAGAAGTGATTGTACCTGAGTTCAATTCTAGCGCAAAGGAATTACCAA
ACCATTGGCCGAAAAGTGCCCGAGCATAATTAAGAAATTTATAAGCGCTTATGATGCTAAACCGGATTTTGTTGCTAGATCGCCTGGTAGAGTCAATCTAATTGGTGAA
ATATTGATTATTGTGACTTCTCGGTTTTACCTTTAGCTATTGATTTTGATATGCTTTGCGCCGTCAAAGTTTTGAACGATGAGATTTCAAGTCTTAAAGCTATATCAGA
GGCTAAGCATGTGTATTCTGAATCTTTAAGAGTCTTGAAGGCTGTGAAATTAATGACTACAGCGAGCTTTACTGCCGACGAAGACTTTTTCAAGCAATTTGGTGCCTTG
TGAACGAGTCTCATTCAGGTTGGTACGATAAACTTTACGAATGTTCTTGTCCAGAGATTGACAAAATTTGTTCCATTGCTTTGTCAAATGGATCATATGGTTCCCGTTT
ACCGGAGCTGGCTGGGGTGGTTGTACTGTTCACTTGGTTCCAGGGGGCCCAAATGGCAACATAGAAAAGGTAAAAGAAGCCCTTGCCAATGAGTTCTACAAGGTCAAGT
CCCTAAGATCACTGATGCTGAGCTAGAAAATGCTATCATCGTCTCTAAACCAGCATTGGGCAGCTGTCTATATGAATTAGTCAAGTATACTTCTTTTTTTTACTTTGTT
AGAACAACTTCTCATTTTTTTCTACTCATAACTTTAGCATCACAAAATACGCAATAATAACGAGTAGTAACACTTTTATAGTTCATACATGCTTCAACTACTTAATAAA
GATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCACAAACTTTAAAACACAGGGACAAAATTCTTGATATGCTTTCAACCGCTGCGTTTTGGATACCTAT
CTTGACATGATATGACTACCATTTTGTTATTGTACGTGGGGCAGTTGACGTCTTATCATATGTCAAAGAAAATTTGCGAAGTTCTTGGCAAGTTGCCAACTGACGAGAT
CAGTAACACTTTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCACAAACTTTAAAACACAGGG
CAAAATTCTTGATATGCTTTCAACCGCTGCGTTTTGGATACCTATTCTTGACATGATATGACTACCATTTTGTTATTGTACGTGGGGCAGTTGACGTCTTATCATATGT
AAAGTCATTTGCGAAGTTCTTGGCAAGTTGCCAACTGACGAGATGCAGTTTCCTACGCATAATAAGAATAGGAGGGAATATGCAGGAGAACGCCAGACAATCTATCATT
CATTTAAGCGGCTCTTCAAAAAGATTGAACTCTCGCCAACTTATGGAATCTTCCAATGAGACCTTTGCGCCAAATAATGTGGATTTGGAAAAAGAGTATAAGTCATCTC
GAGTAATATAACTACCGAAGTTTATGAGGCATCGAGCTTTGAAGAAAAAGTAAGCTCAGAAAAACCTCAATACAGCTCATTCTGGAAGAAATAGTGTTTCTTGTACAAC
AGGACTTGAAGCCCGTCGAAAAAGAAAGGCGGGTTTGGGATTGGGTACGGTTTCGTTGGTGCTTTTGTTGTTTTGGCCTCTAGAGTTGGATCTGCTTATCATTTGTCAT
CCCTATATCATCTAGAGCATCATTCGGTATTTTCTTCTCTTTATGGCCCGTTATTAACAGAGTCGTCATGGCCATCGTTTGGTATAGTGTCCAAGCTTATATTGCGGCA
CTCCCGTATCATTAATGCTGAAATCTATCTTTGGAAAAGATTTACAATGATTGTACGTGGGGCAGTTGACGTCTTATCATATGTCAAAGTCATTTGCGAAGTTCTTGGC
AGTTGCCAACTGACGAGATGCAGTAACACTTTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCC
CAAACTTTAAACACAGGGACAAAATTCTTGATATGCTTTCAACCGCTGCGTTTTGGATACCTATTCTTGACATGATATGACTACCATTTTGTTATTGTTTATAGTTCAT
CATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTAT
ATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAAATAAAGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCT
ATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTGTATGATTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATG
TTTCAATGTAAGATTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCTTCAACTACTTAATAAATGATTC
TACATGCTTCAACTACTGTAAATAATTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATACATGCATAGTTCATACATGC
TCAACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATTATAGTTCATACATGCTTCAACTACTTAATAAATGATTGTATGATAATGTT
TCAAATAAAATGTAAGAGATTTCGATTATCCTTATAGTTCATACEEEEEEECATGCGTTGACATGATATGACTACCATTTTGTTATTGTTTATAGTTCATACATGCTTC
ACTACTTAATAAATGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTTGATTGTATGATAATGTTTTCAATGTAAGAGATTTCGATTATCCTTATAGTTCATA
ATGCTTCAACTACTTAATAAATGATTGTATGATAATGTTTTGTATGATTTATATCG




5' 3'


Translationally repressed mRNA
5'
AAAAAAAAAAAAAA
3'
3'
5'
RISC

Known motifs are preferentially conserved



Short History of Genomics

- Genomic Era:

1953: Watson-Crick

1989: Human Genome Project

2001: Human Genome Draft

2008: Venter/Watson Genomes //1,000 Genome Project

2012: $,1000/ Genome

2016: $ 100/ Genome

2025-2030: "brain-equivalent" computer power

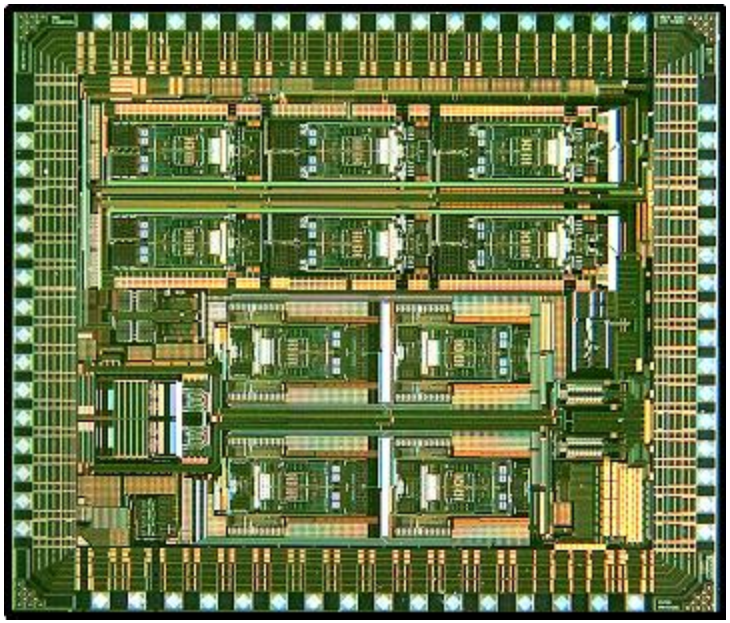
- Post Genomic Era:

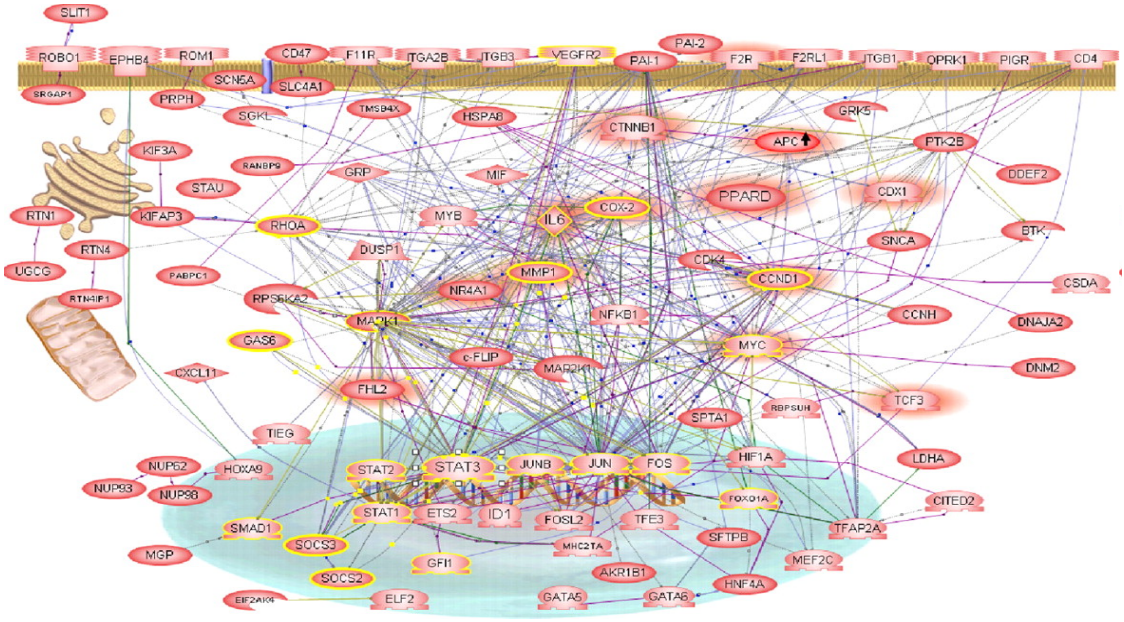
- P4 Medicine (predictive, preventative, personal, participatory) Era:

IT Infrastructure for Genomic Enabled Personalized Medicine

- $100 Genome
- Genome Storage and Integration (EMR)
- Genome Compression
- Genome Privacy
- Genome Annotation/Interpretation
- Accelerate Drug Discovery

The Great Opportunities

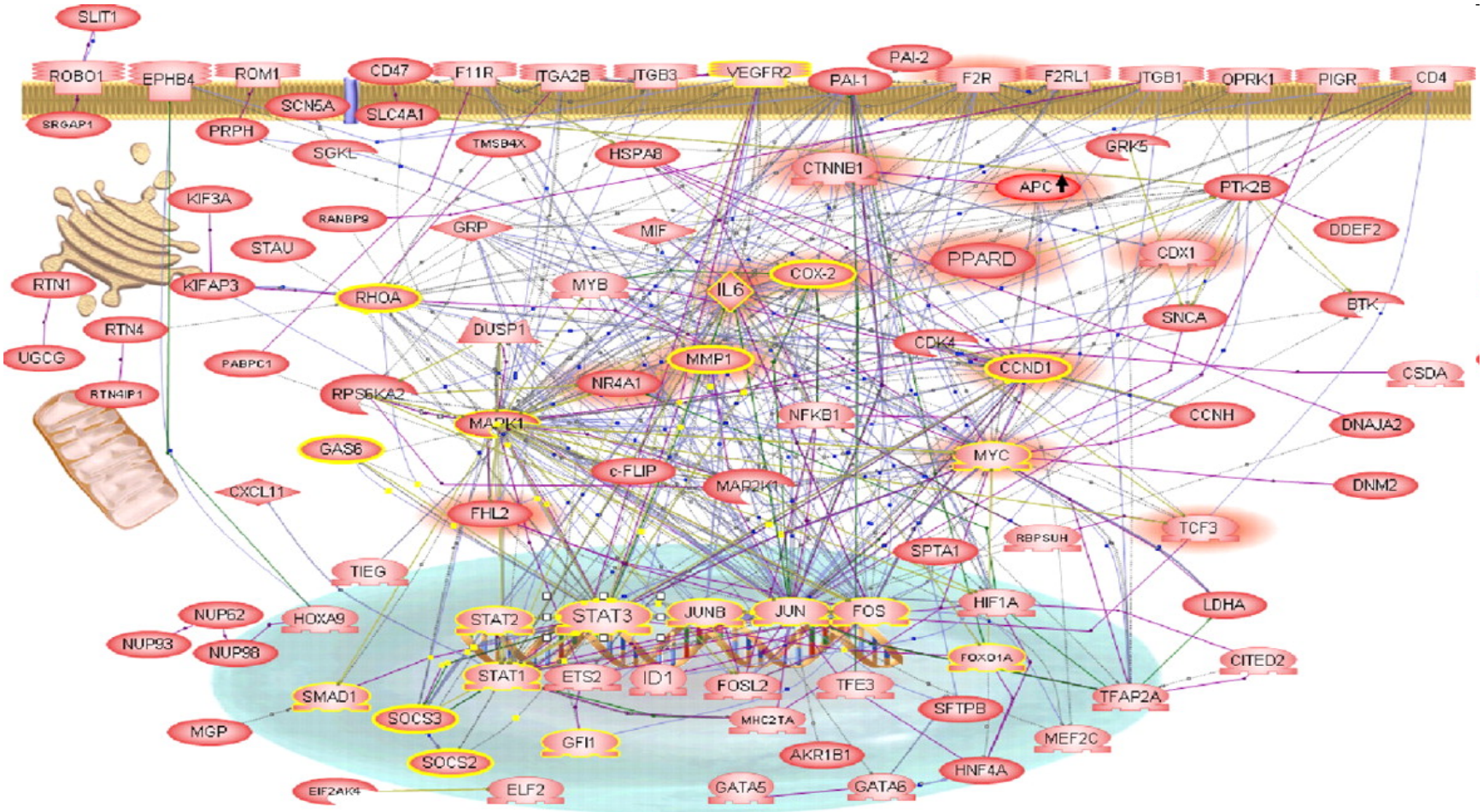




Silicon-based computing

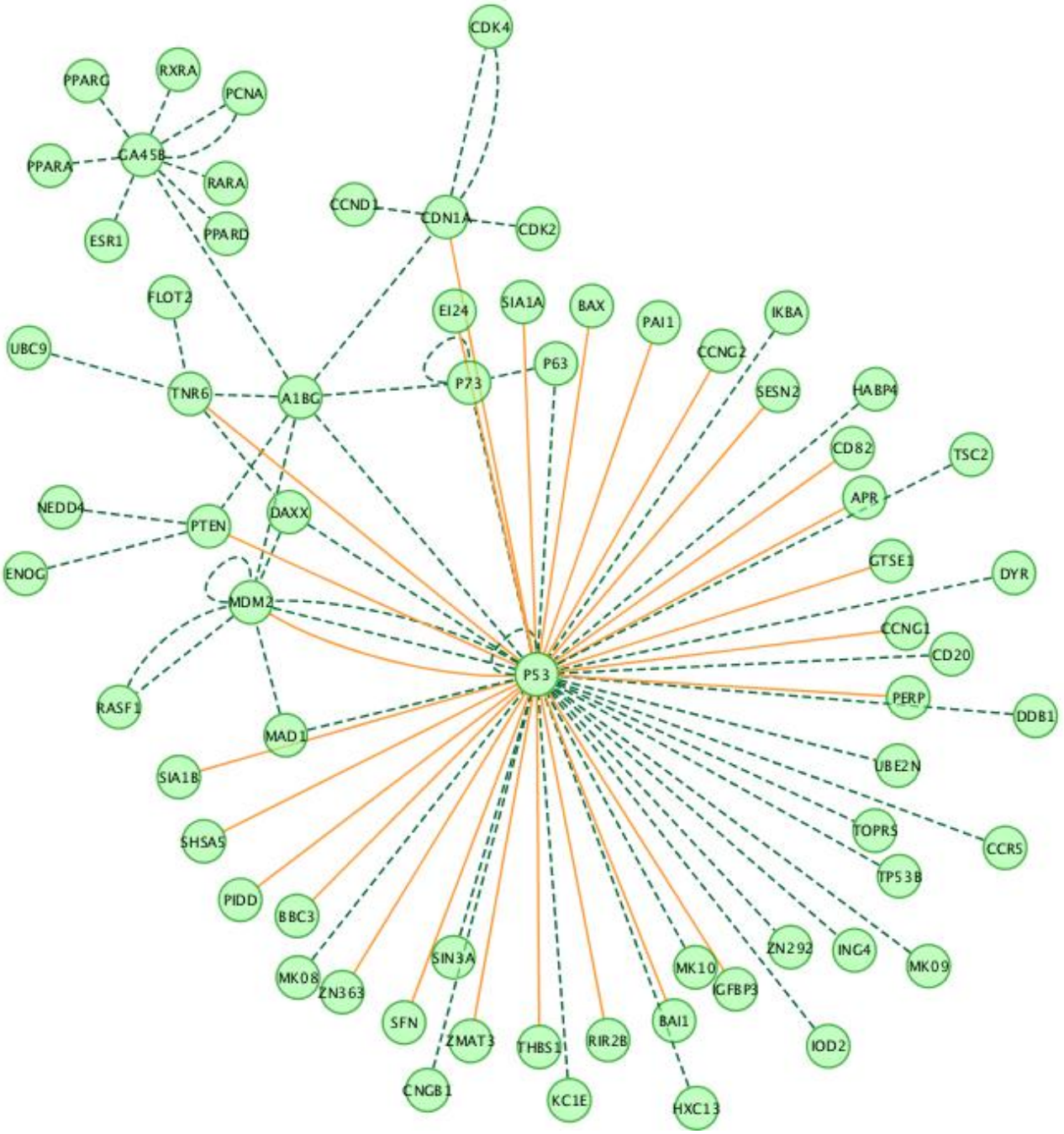
Carbon-based computing

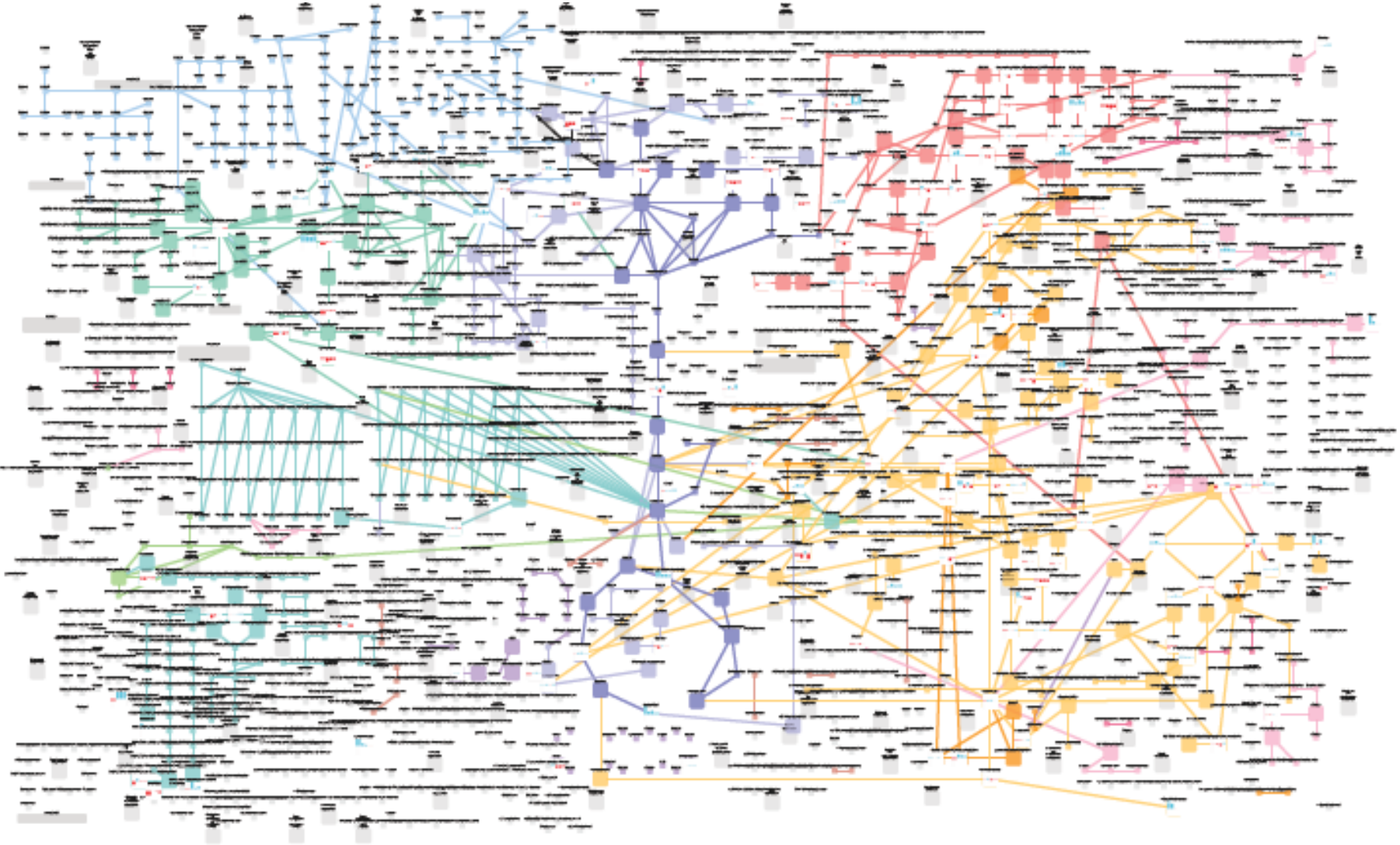
Genome Interpretation

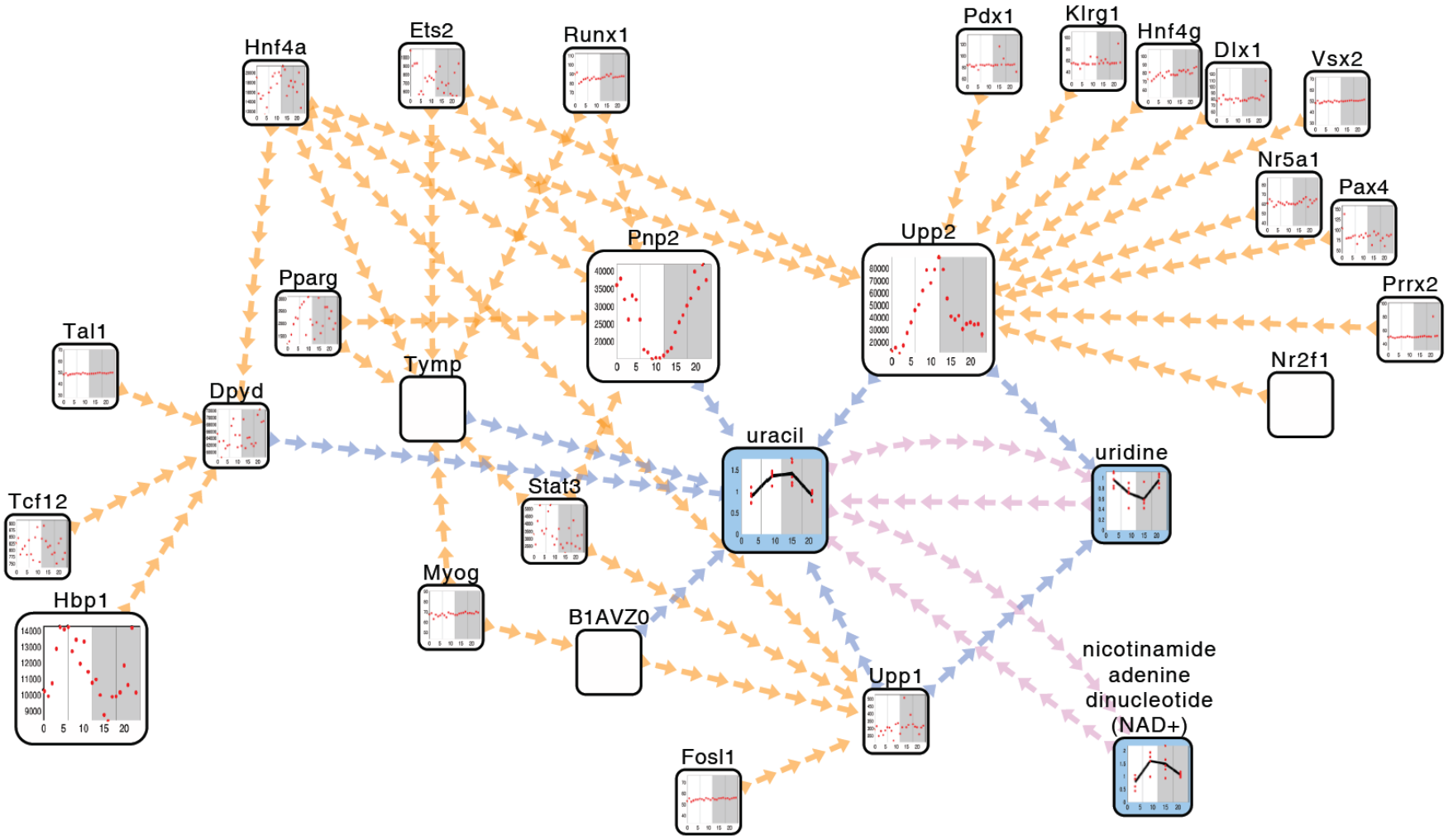


Can we begin to draw biological circuits automatically?

ctions(Orange)

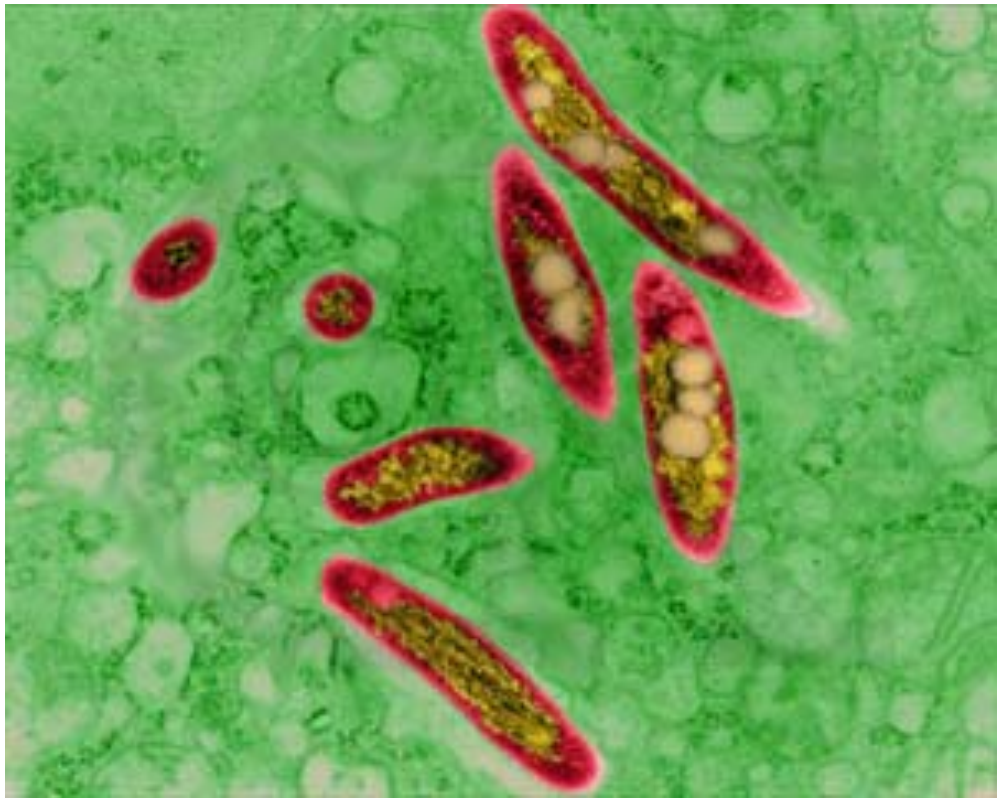




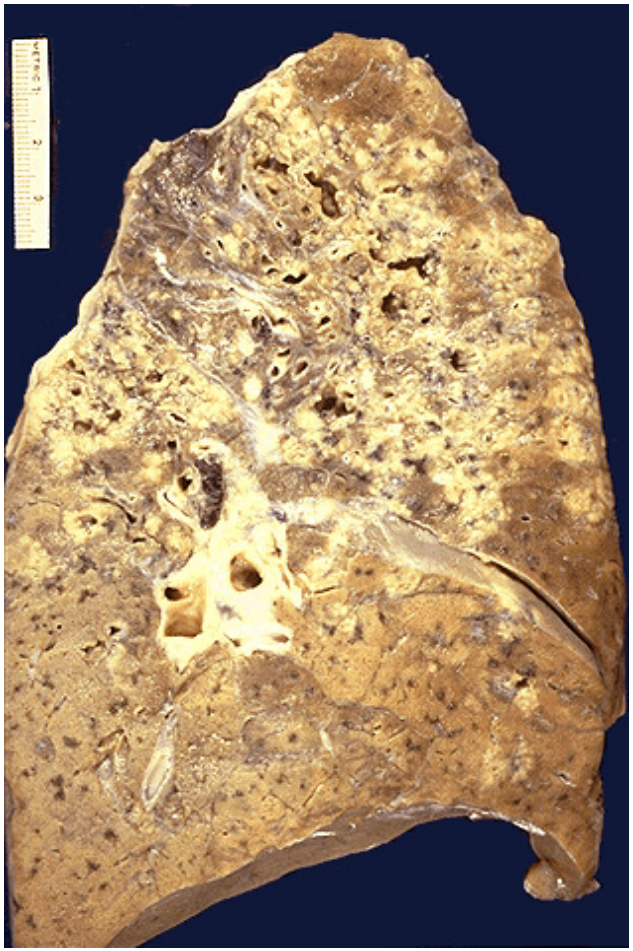

Hnf4a
Ets2
Runx1
Pdx1
Klrg1
Hnf4g
Dlx1
Vsx2
Nr5a1
Pax4
Prrx2
Nr2f1
Pnp2
Upp2
Pparg
Tal1
Tymp
Dpyd
uracil
uridine
Stat3
Tcf12
Myog
Hbp1
B1AVZ0
Upp1
nicotinamide adenine dinucleotide (NAD+)
Fosl1


$600
MARIA
$6,400
WATSON
$400
MEHRUN

Drug Discovery Example:Tuberculosis



Mycobacterium Tuberculosis
Very thick, waxy cell wall



TB: still a real threat, because…..

Urogenital Infection by *Mycobacterium bovis*
Relapsing after 50 years

K. E. Lewis[1], M. G. Lucas[2], R. Smith[3] and N. K. Harrison*[1]

Its ability to stay alive

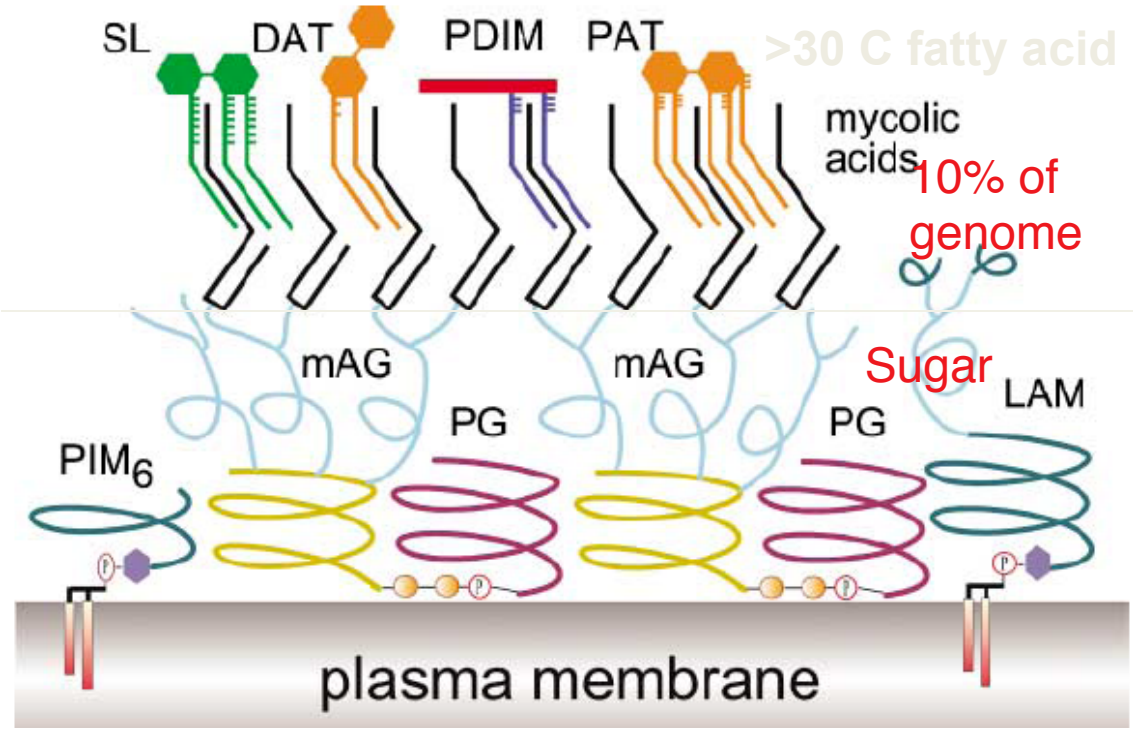
Multi-Drug Resistant
(Super TB strain)

The Cell Wall: Key to Pathogen Survival

Tuberculosis

- 7th cause of death worldwide
- 1 in 3 people have TB
- Leading cause AIDS death
- Multi-drug resistant
- *Mycobacterium tuberculosis*

Acyl-CoA $\xrightarrow{\text{6 different ACCase } \beta \text{ subunits, AccD1-6}}$

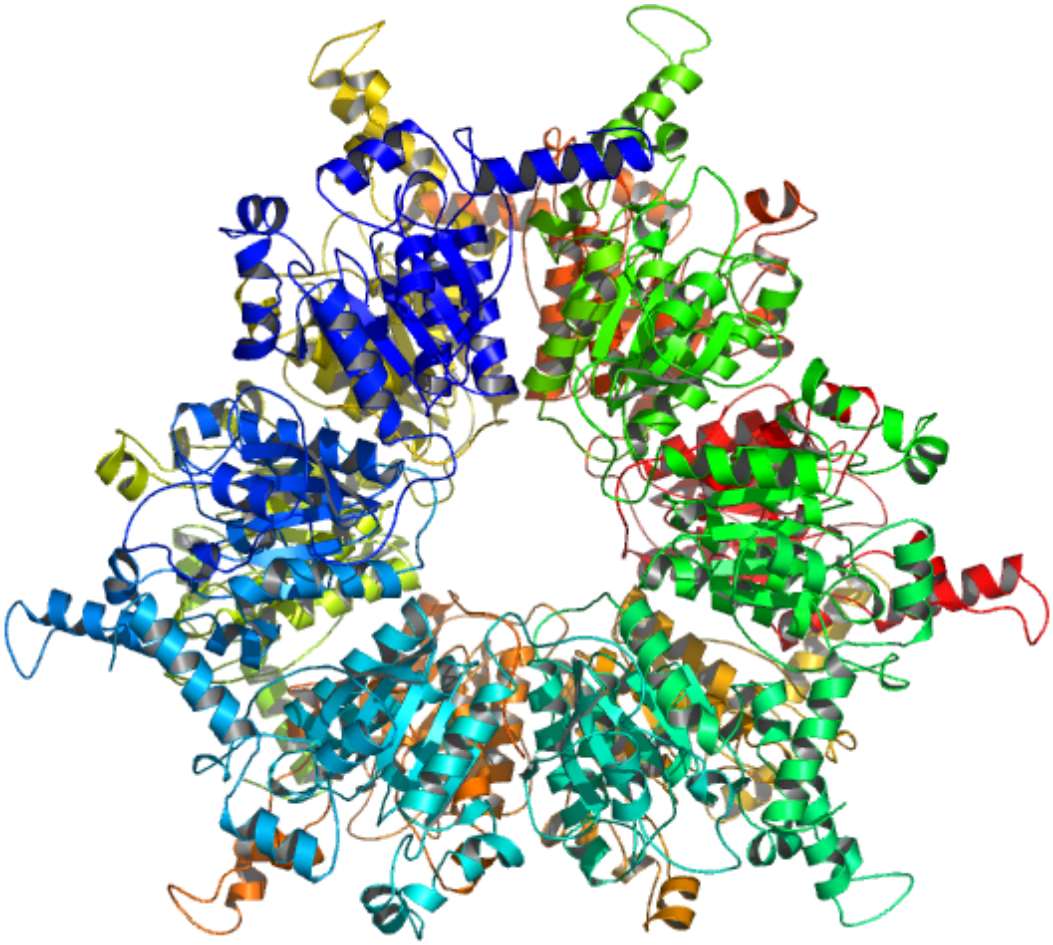


Homologs of PccB
Focus on AccD4-6

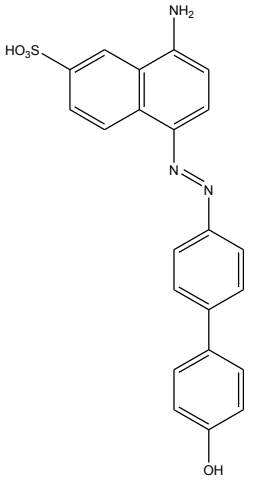
Cell wall lipids: Important for pathogen virulence, survival and latency

Substrate specificity for AccD4-6?

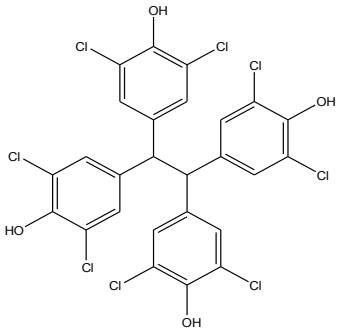
Structure of AccD5



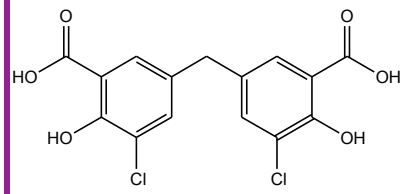
NCI 65828 (Lead 1)



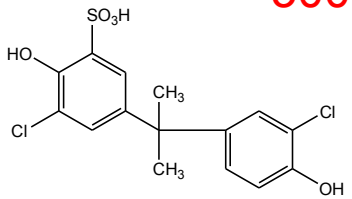
NCI 172033 (Lead 2)



NCI 622444 (IN1)

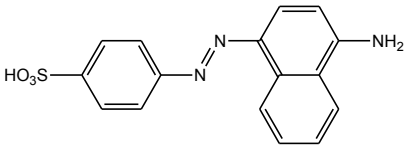


NCI 65079 (IN2)

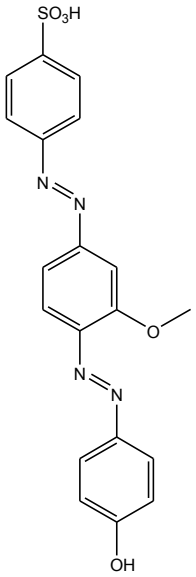


300uM

NCI 4901 (IN3)

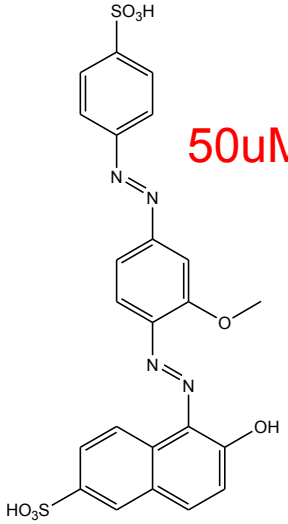


NCI 65538 (IN4)



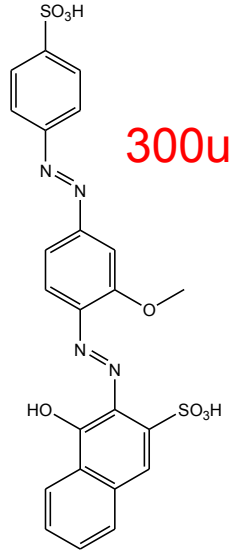
50uM

NCI 65553 (IN5)



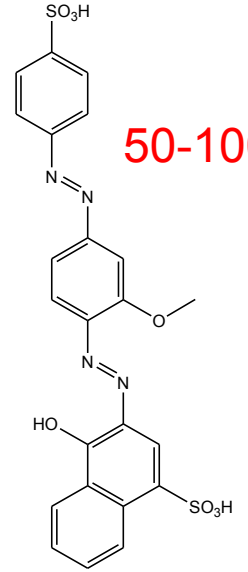
300uM

NCI 65554 (IN6)

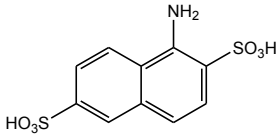


50-100uM

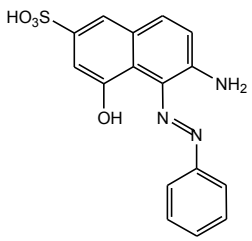
NCI 65555 (IN7)



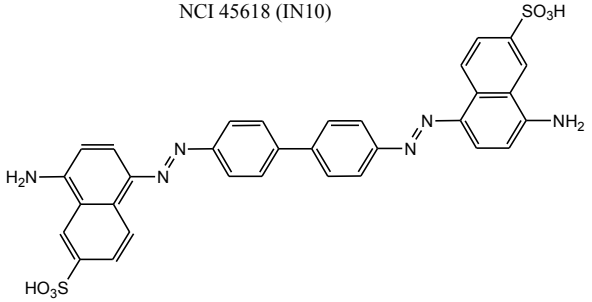
NCI 37050 (IN8)



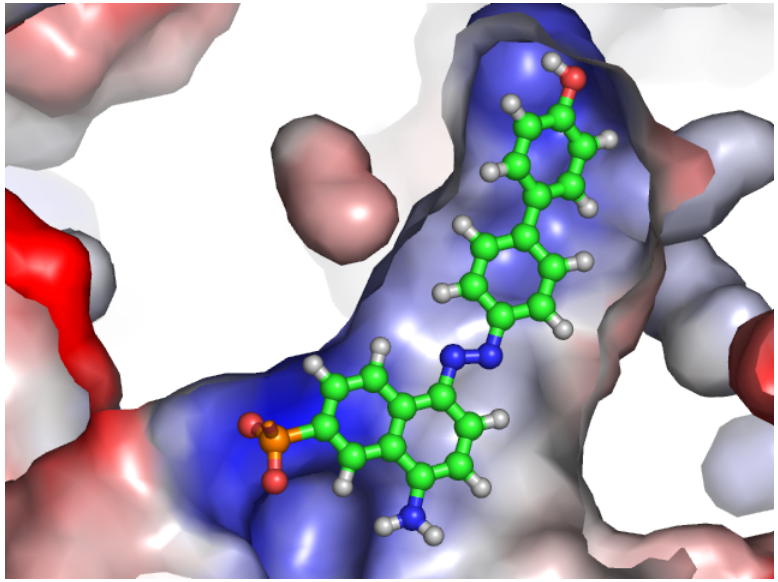
NCI 45188 (IN9)

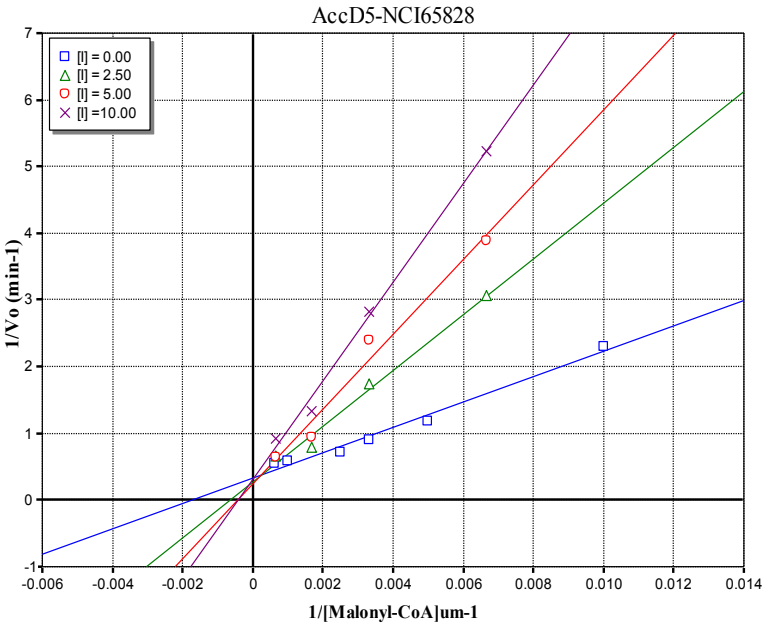


NCI 45618 (IN10)



Structure-Based Drug Design Identified AccD5 Inhibitors





$K_I = 4.7\ \mu M$

➔ New TB drug lead

T. Lin, M. Melgar, S. J. Swamidass, J. Purdon, T. Tseng, G. Gago, D. Kurth, P. Baldi, H. Gramajo, and S. Tsai.
Structure-Based Inhibitor Design of AccD5, an Essential acyl-CoA Carboxylase Carboxyltransferase Domain of *Mycobacterium tuberculosis*.
Proceedings of the National Academy of Sciences USA, 103, 9, 3072-3077, .US Patent pending

Genome-Enabled Personalized Medicine: Whole Proteome Microarray Chip Fabrication

From genomic DNA to Proteome Array in 3 days

Day 1:

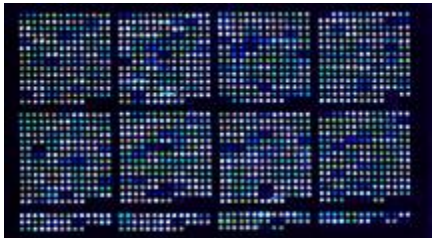
PCR
Genomic DNA +
Gene Specific
Primers

Transformation

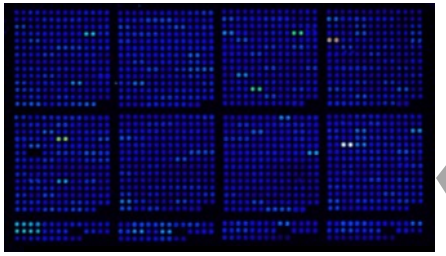
Day 2:

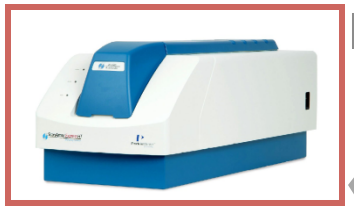
Plasmid DNA Miniprep

& Protein Expression



Day 3: Chip Printing





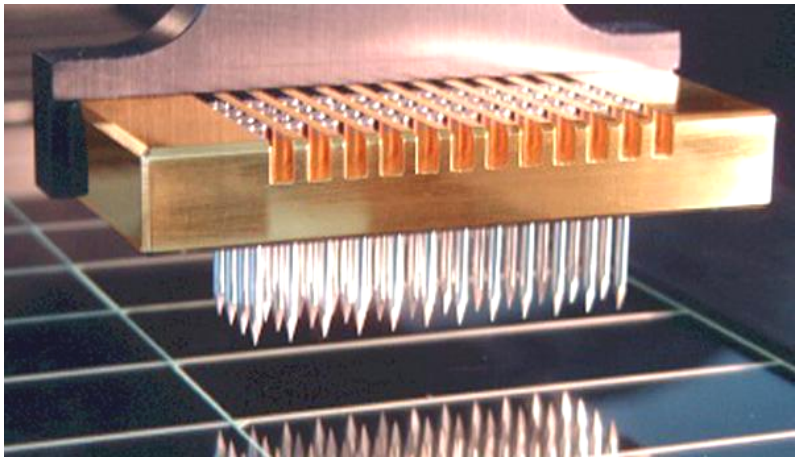
Scanning

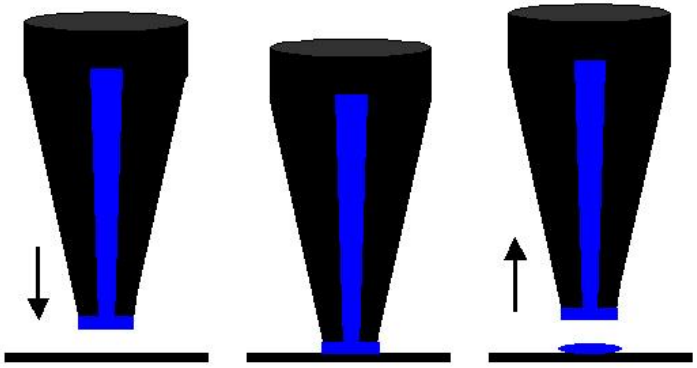
Probing

Proteome Microarray Chips

Fabrication

Contact Printing





Proteome Microarray Chips

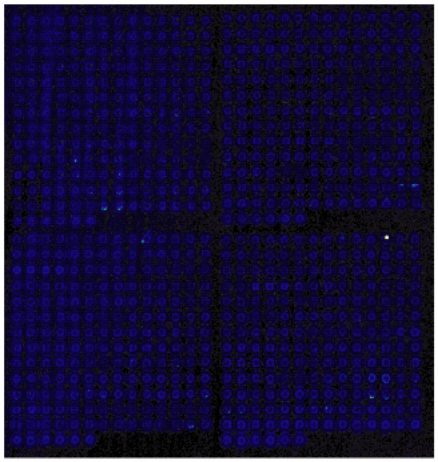
Serology

Serum from Infected Animals or Humans (1 mu l)

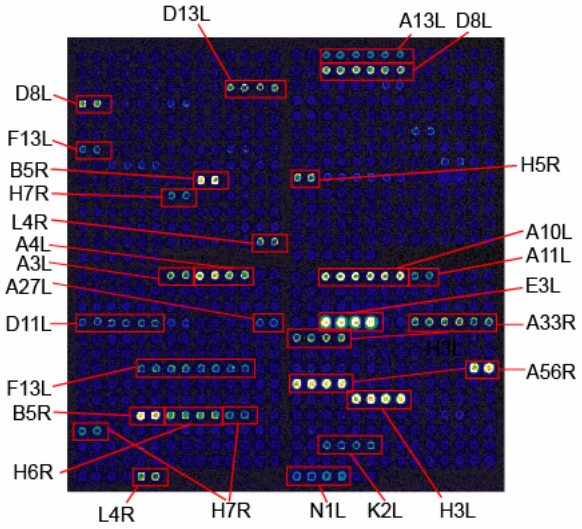
Probe a Microarray Chip

Smallpox Microarrays Probed with Mouse or Human VV Serum

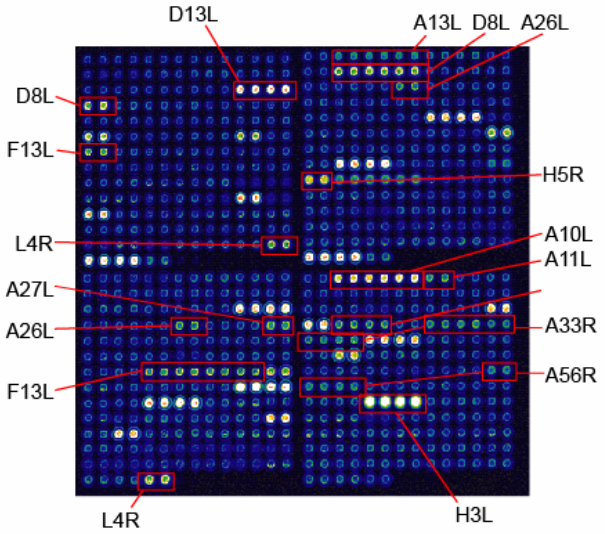
Naive Mouse



Vaccinia WR Immunized Mouse



Human Vaccinia Immune Globulin



Inventory of Cloned Genes

BLUE – New Targets
Homo Sapiens…..

BLACK – Previously Supported Targets

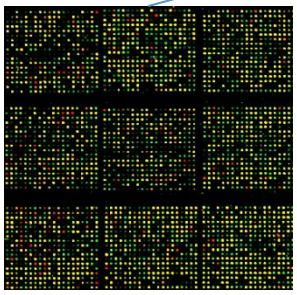
	Genomic gene #	Genes cloned	Percent Cloned
F. tularensis	1933	1874	97%
C. burnetii (TAP)	2065	2065	100%
B. burdorferi	1600	1269	84%
M. tuberculosis	3990	3899	98%
B. pseudomallei	5728	1333	23%
C. Trachomatis serovar D	894	884	99%
P. falciparum	5268	1899	36%
B. melitensis	3198	1371	43%
L. interrogans	3658	98	3%
P. vivax	5300	200 (2000 planned)	4%
Rickettsia	1500	Planned	
Bartonella	1500	Planned	
Orthopoxviruses	244	242	99%
HPV (11 types)	88	88	100%
HIV-1 (4 sub-types)	83 attempted	74	89%
Herpes 1 & 2	172	140	81%
West Nile	10	10	100%
Dengue (3 types)	55 attempted	42	76%
Arboviruses (12 types)	120	Planned	
Total	37,240	13,064	35%

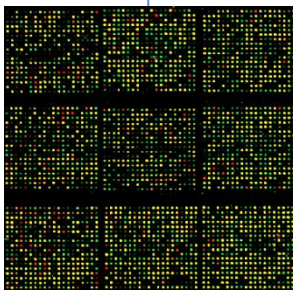
Arrays and Immunostrips

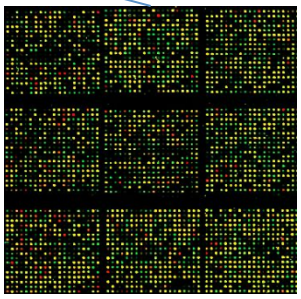
- Being tested on the field:
- F. Tularensis (Spain)
- Dengue (Brazil, Thailand, India)
- Burkholderia (Thailand)
- TB (Africa, India)
- Malaria (Africa)

Research Directions in ICS

- Data structures and compression algorithms for genomic data







Short History of Genomics

- Genomic Era:

1953: Watson-Crick

1989: Human Genome Project

2001: Human Genome Draft

2008: Venter/Watson Genomes //1,000 Genome Project

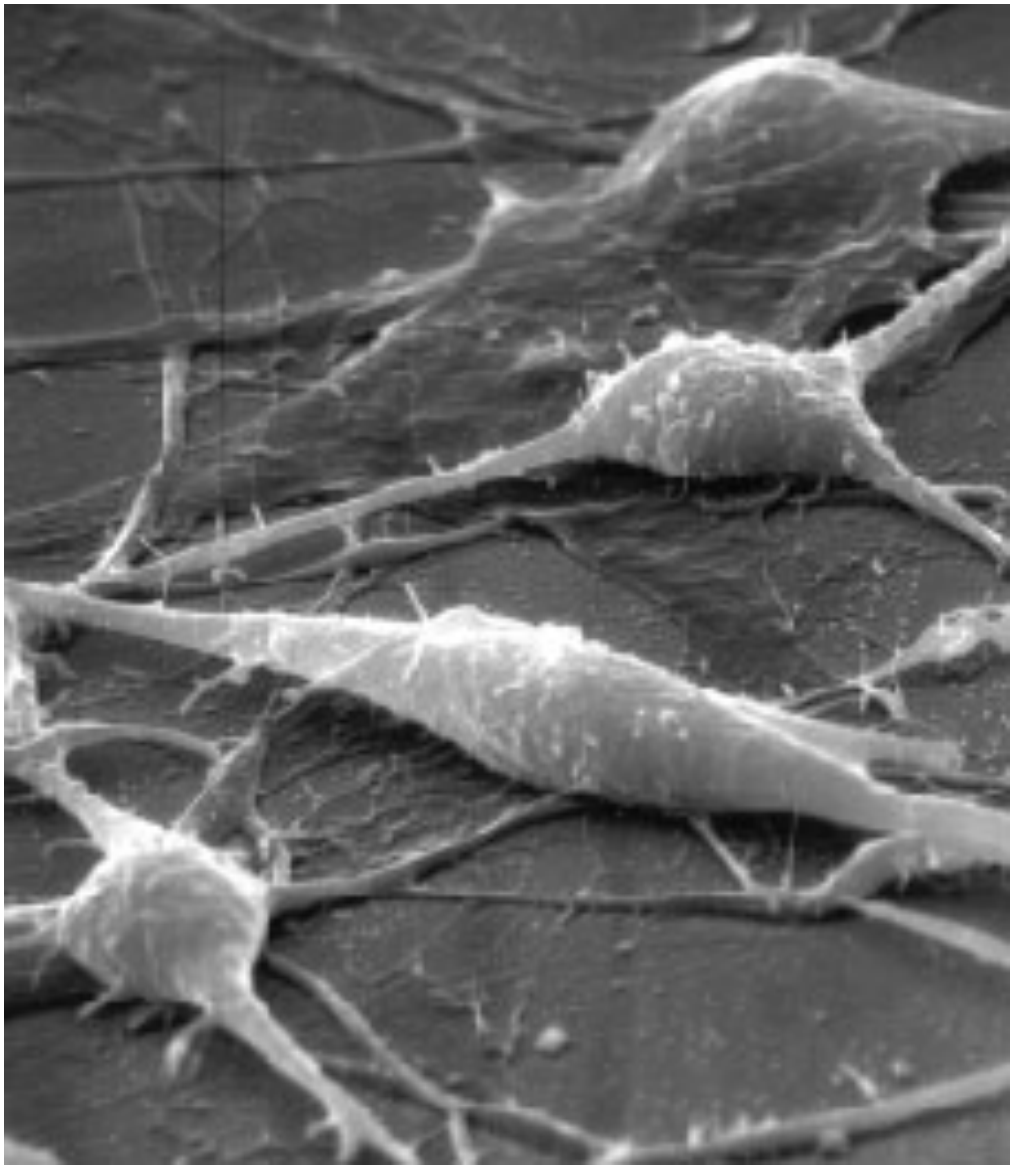
2012: $,1000/ Genome

2016: $ 100/ Genome

2025-2030: "brain-equivalent" computer power

- Post Genomic Era:

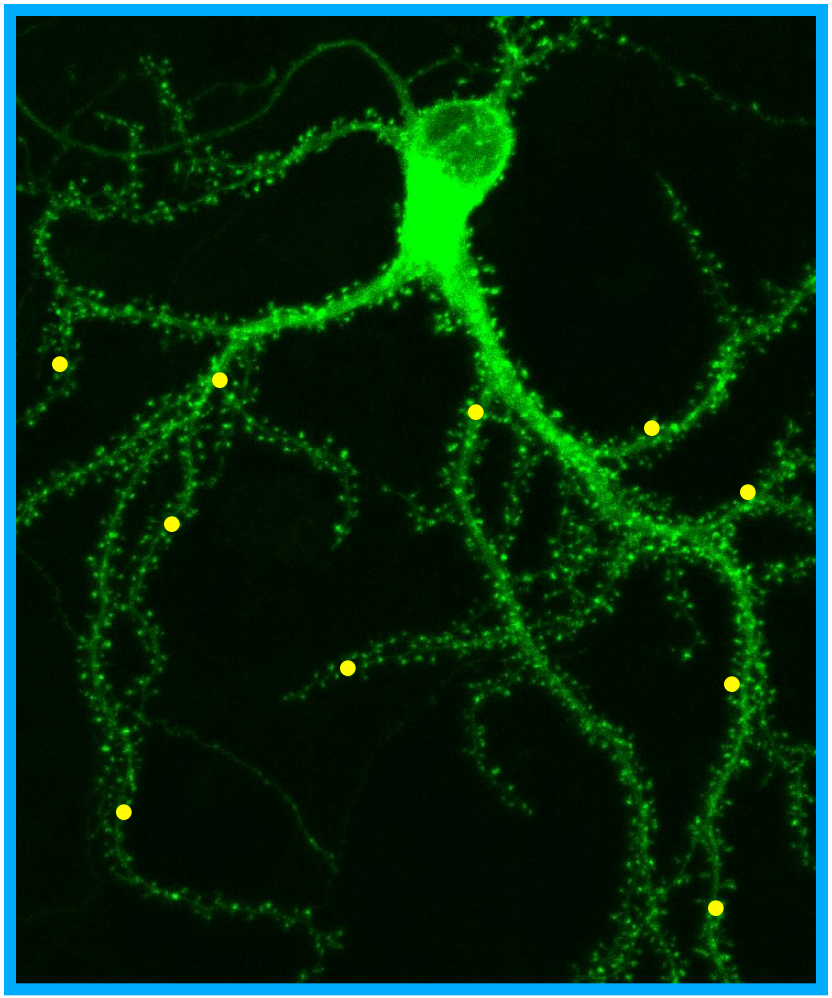
- P4 Medicine (predictive, preventative, personal, participatory) Era:



Where do you store your telephone number?

THE SYNAPTIC BASIS OF MEMORY CONSOLIDATION

© 2004, Graham Johnson



© 2007, Paul De Koninck

Many Other Activities

- Education
- Symposia, Speaker Series
- Incubator
  - Verdezyne
  - IMMport Therapeutics//Antigen Discovery Inc.
  - Reaction Explorer
- Virtual Campus