Genomics, Cellular Networks, Preventive Medicine, and Society

Guest Lecture to UCSD Medical and Pharmaceutical Students
Genetics in Medicine Course
Amphitheater of the Pharmaceutical Sciences Bldg
December 11, 2009

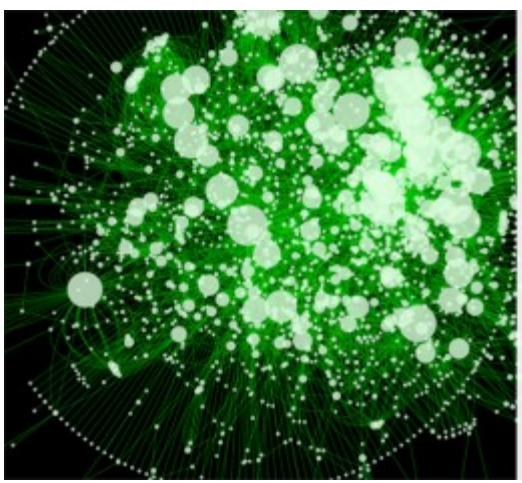
Dr. Larry Smarr
Director, California Institute for Telecommunications and Information Technology
Harry E. Gruber Professor,
Dept. of Computer Science and Engineering
Jacobs School of Engineering, UCSD
Follow me on Twitter: lsmarr

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The Digital Transformation of Health

- **Wellness, Biomedical Informatics, and Preventive Medicine**
  - Data-Intensive Biomedical Cyberinfrastructure
  - Integrating Genomics, Proteomics, System Biology, and Disease States
  - Individualized Measurements Into Interoperable Informatics Systems
  - Population Health Systems
  - Wireless Behavioral Modification
  - Coupling Engineering and Medicine
    - New Generation of Medical Devices
    - Innovations in MEMS and Nano



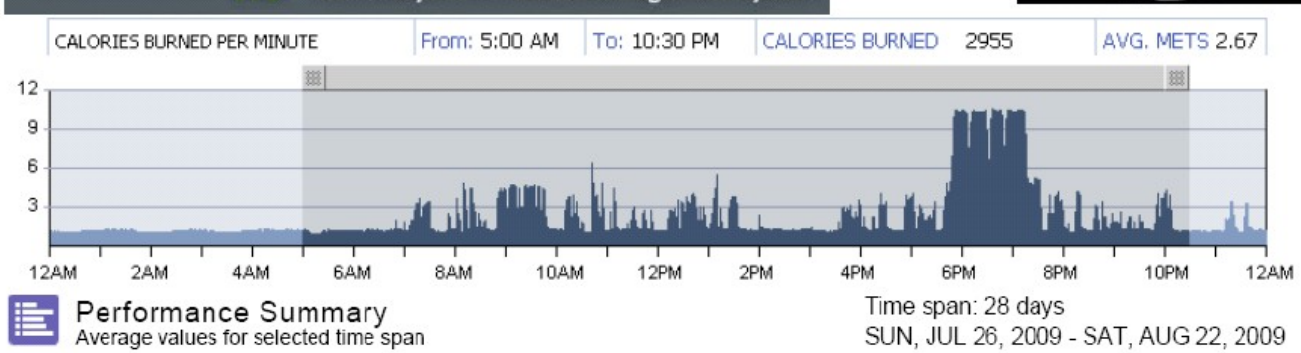
Cytoscape

An Open Source Platform for Network Analysis and Visualization

AMERICAN JOURNAL OF PREVENTIVE MEDICINE
Official Journal of APTR & ACPM

GoWear fit The Lifestyle and Calorie Management System





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Leading Causes of Preventable Deaths in the United States in the year 2000

1/3 of Deaths

Cause	Number of deaths resulting
Tobacco Smoking	435,000 deaths or 18.1% of the total deaths
Overweight and Obesity	365,000 deaths or 15.2% of the total deaths.
Alcohol consumption	85,000 deaths or 3.5% of the total deaths.
Infectious diseases	75,000 deaths or 3.1% of the total deaths.
Toxicants	55,000 deaths or 2.3% of the total deaths.
Traffic collisions	43,000 deaths or 1.8% of the total deaths.
Incidents involving firearms	29,000 deaths or 1.2% of the total deaths.
Sexually transmitted diseases	20,000 deaths or 0.8% of the total deaths.
Drug abuse	17,000 deaths or 0.7% of the total deaths.

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Mokdad AH, Marks JS, Stroup DF, Gerberding JL (March 2004). "Actual causes of death in the United States, 2000". JAMA 291 (10): 1238–45. doi:10.1001/jama.291.10.1238. PMID 15010446. www.csdp.org/research/1238.pdf.

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Center for Wireless &Population Health Systems: Program on Research

- **Wireless, Clinical, and Home Technologies to Measure and Improve Lifestyle and Other Health-Related Behaviors In:**
  - Healthy Adolescents
  - Adolescents Recovering from Leukemia
  - Adolescents Risk for Type 2 Diabetes
  - Young Adults to Prevent Weight Gain
  - Overweight and Obese Children and Adults
  - Depressed Adults
  - Post-Partum Women to Reduce Weight
  - Adults with Schizophrenia
  - Older Adults to Promote Successful Aging
  - Exposure Biology Research

CW PHS Center For Wireless & Population Health Systems
UCSD
San Diego State University
SANTECH
SDSC San Diego Supercomputer Center
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Center for Wireless &Population Health Systems Cross-Disciplinary Collaborating Investigators

- **UCSD School of Medicine**
  - Kevin Patrick, MD, MS, Greg Norman, PhD, Fred Raab, Jacqueline Kerr, PhD
  - Jeannie Huang, MD, MPH
- **UCSD Jacobs School of Engineering**
  - Bill Griswold, PhD, Ingolf Krueger, PhD, Tajana Simunic Rosing, PhD
- **San Diego Supercomputer Center**
  - Chaitan Baru, PhD
- **UCSD Department of Political Science**
  - James Fowler, PhD
- **SDSU Departments of Psychology & Exercise/Nutrition Science**
  - James Sallis, PhD, Simon Marshall, PhD
- **Santech, Inc.**
  - Sheri Thompson, PhD, Jennifer Shapiro, PhD, Ramesh Venkatraman, MS
- **PhD students and Post-doctoral Fellows (current)**
  - Barry Demchak, Priti Aghera, Ernesto Ramirez, Laura Pina, Jordan Carlson

http://cwphs.ucsd.edu

CW PHS Center For Wireless & Population Health Systems

UCSD

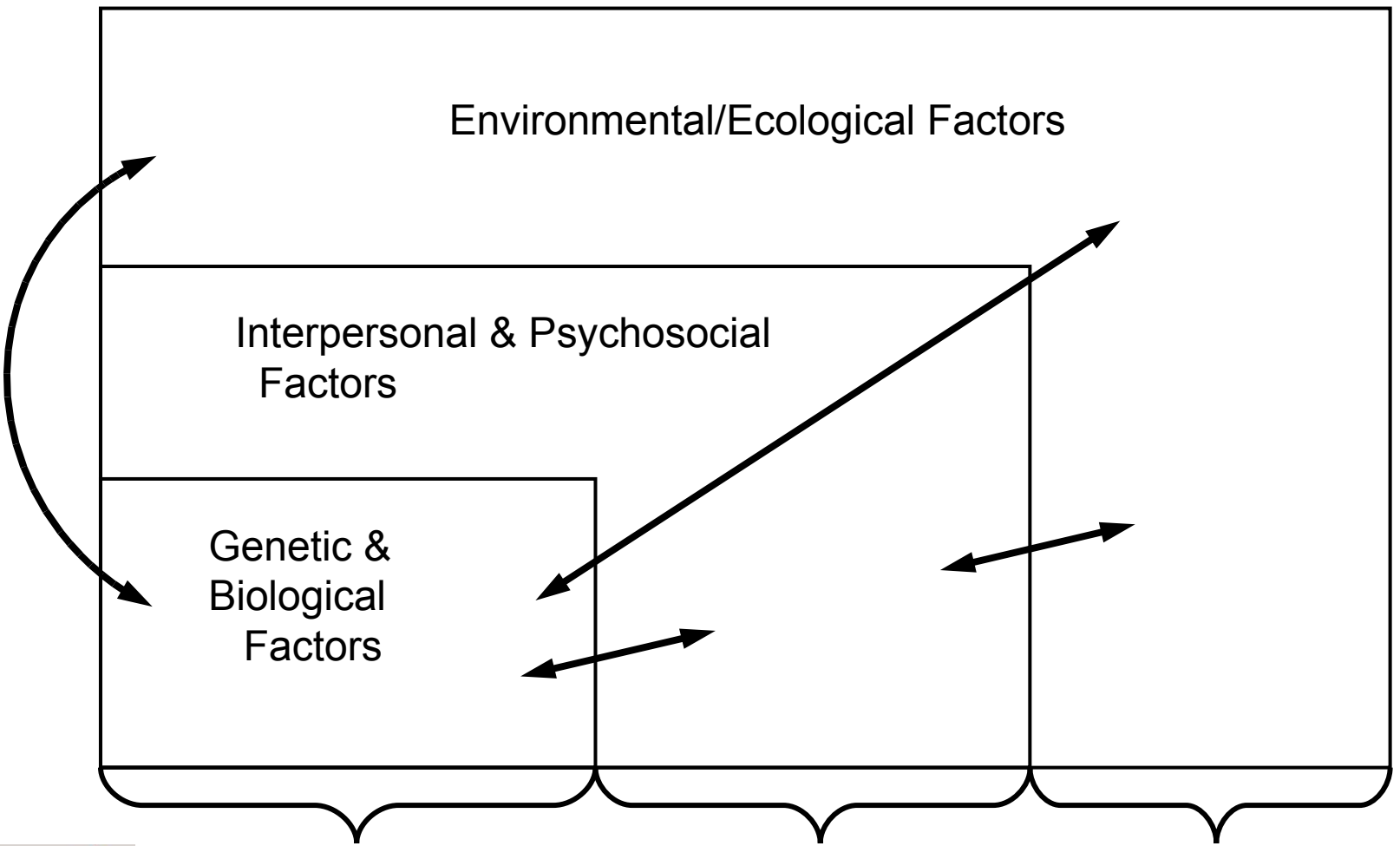
San Diego State University

SANTECH

SDSC San Diego Supercomputer Center

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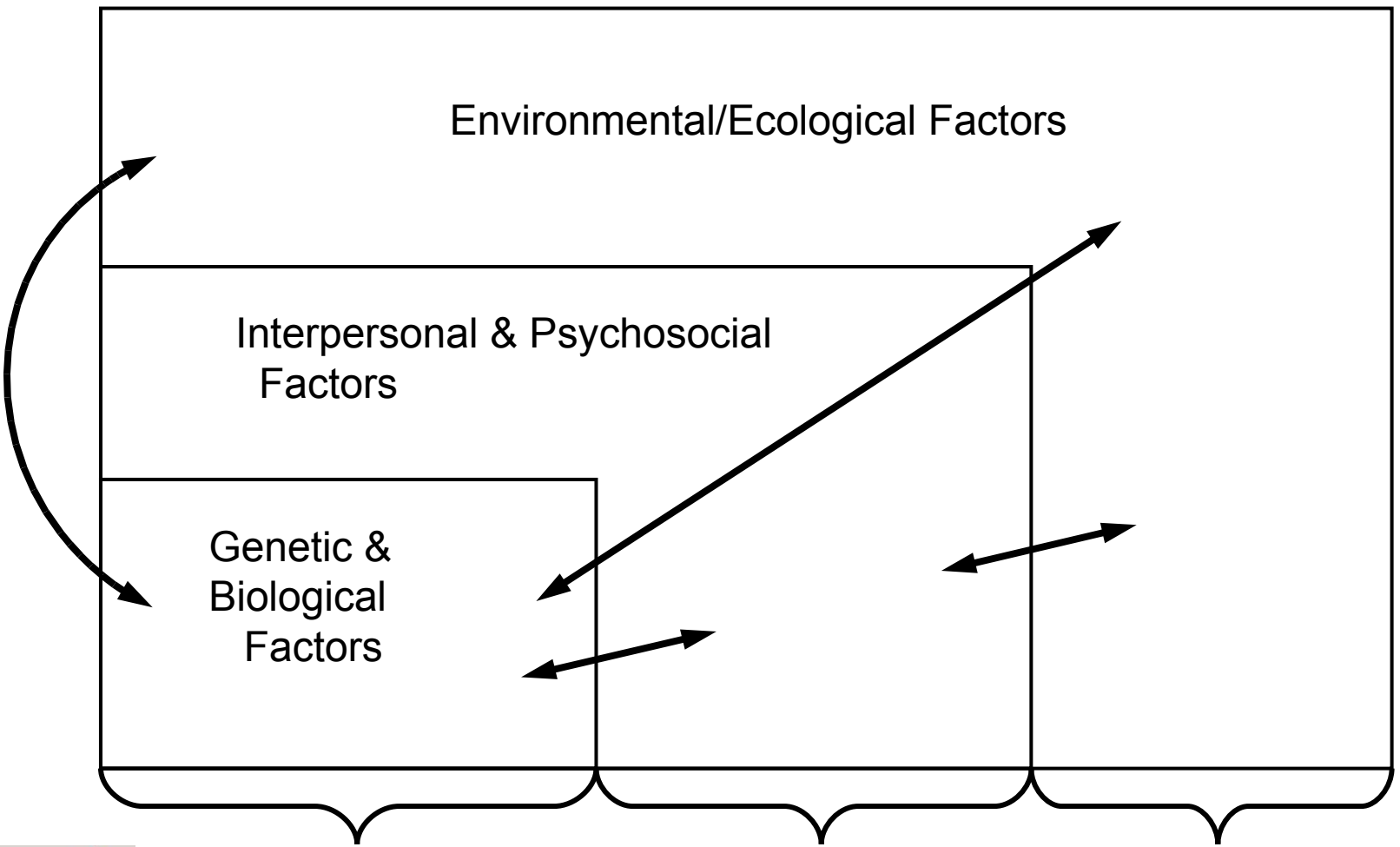
Center for Wireless &Population Health Systems: Integrative View to Support Interventions



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Center for Wireless &Population Health Systems: Developing and Testing Engineering-Based Solutions



NanoTech, Drug Delivery, Sensors, Body Area Networks (BANs)

BAN-to-Mobile-to-Database, SMS/MMS Social networks

Ubicomp, Location-Aware Services, Data Mining, Systems Sciences

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Center For Wireless & Population Health Systems

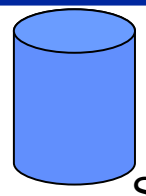
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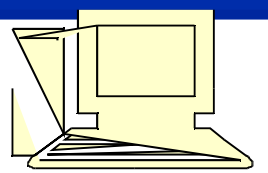
Center for Wireless &Population Health Systems: Mainly, It's All About Sensors

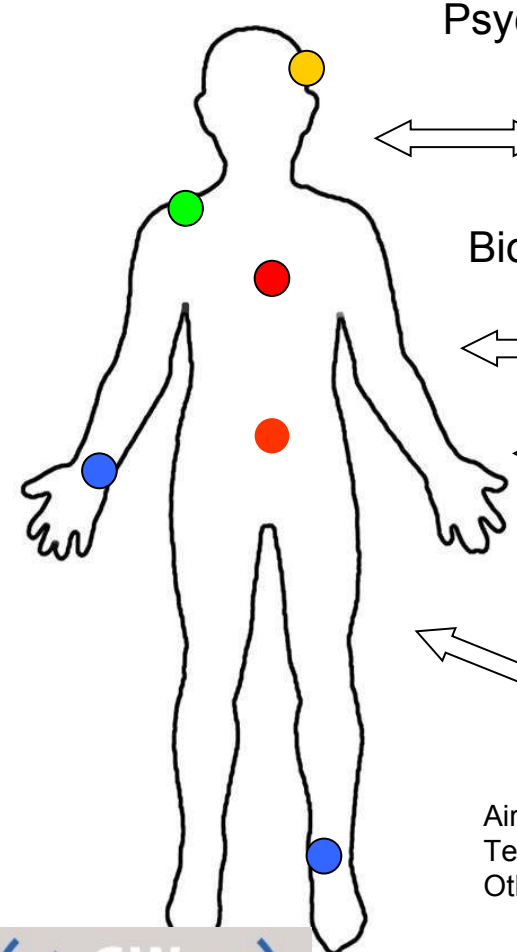
Sensors embedded in the environment

Geocoded data on safety, location of recreation, food, hazards, etc









Psychological & Social sensors

Mood, Social network (peers/family)
Attention, voice analysis

Biological sensors

BP, Resp, HR, Blood (e.g. glucose, electrolytes, pharmacological, hormone), Transdermal, Implants

Diet & Physical Activity sensors

Physical activity (PAEE, type), sedentary
Posture/orientation, diet intake (photo/bar code)

Wearable Environmental sensors

Air quality (particulate, ozone, etc)
Temperature, GPS, Sound, Video,
Other devices & embedded sensors

Sensor data
+
Clinical & Personal Health Record Data
+
Ecological data on determinants of health
+
Analysis & comparison of parameters in near-real time (normative and ipsative)
+
Sufficient population-level data to comprehend trends, model them and predict health outcomes
+
Feedback in near real-time via SMS, audio, haptic or other cues for behavior or change in Rx device

= True Preventive Medicine!

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Center For Wireless & Population Health Systems

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Wireless Sensors Allow Your Body to Become an Internet Data Source

www.bodymedia.com

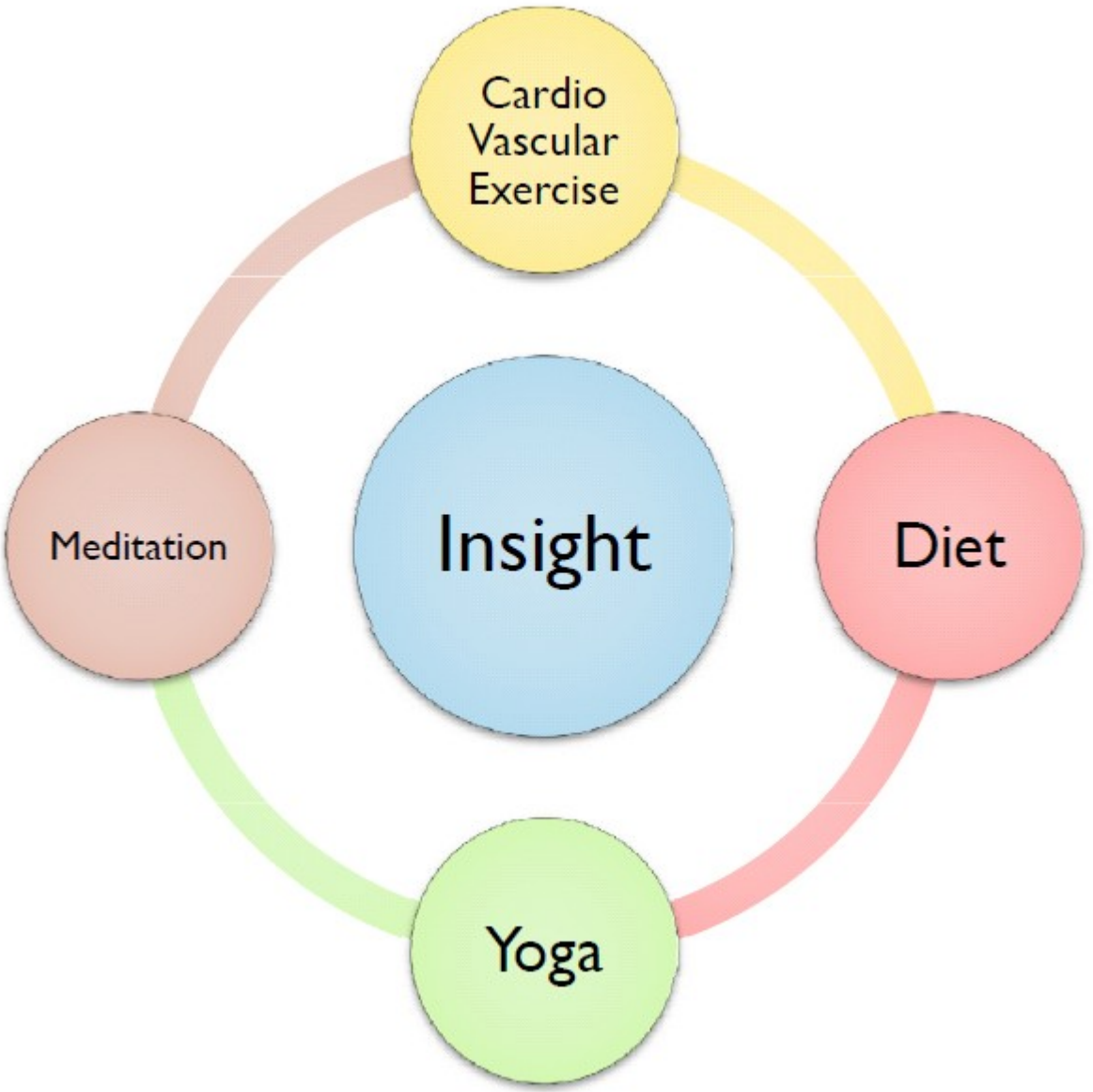


- **Next Step—Putting You On-Line!**
  - Wireless Internet Transmission
  - Key Metabolic and Physical Variables
  - Model -- Dozens of 25 Processors and 60 Sensors / Actuators Inside of our Cars
- **Post-Genomic Individualized Medicine**
  - Combine
    - Genetic Code
    - Body Data Flow
  - Use Powerful AI Data Mining Techniques

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The Impact on Personal Health from Nutrition, Exercise, Stress Management



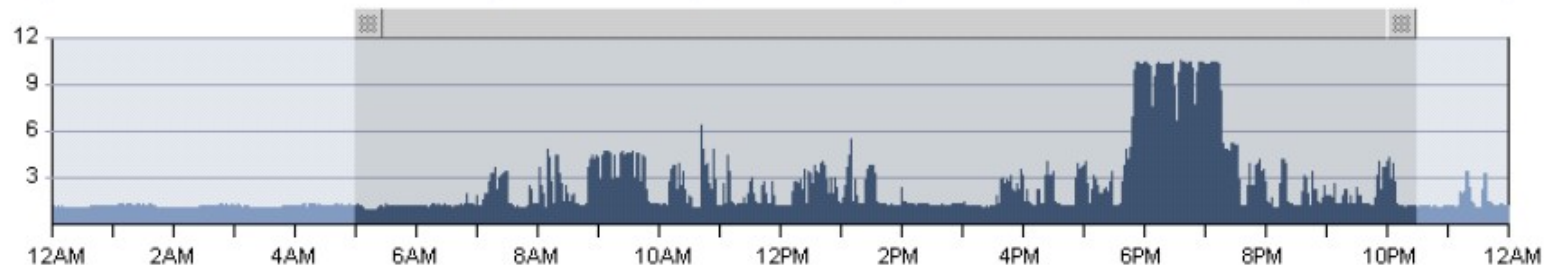
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Individual Health Requires Measurement of Your Body's Performance

GoWear fit — The Lifestyle and Calorie Management System



CALORIES BURNED PER MINUTE | From: 5:00 AM | To: 10:30 PM | CALORIES BURNED 2955 | AVG. METS 2.67



Performance Summary
Average values for selected time span

Time span: 28 days
SUN, JUL 26, 2009 - SAT, AUG 22, 2009

	TARGET	DAILY AVERAGE
CALORIES BURNED	2380 CALORIES	2684 CALORIES
PHYSICAL ACTIVITY	1:30 HRS:MINS	3:04 HRS:MINS
NUMBER OF STEPS	10000 STEPS	10002 STEPS
SLEEP DURATION	8:00 HRS:MINS	5:06 HRS:MINS

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Measuring Key Molecules in the Blood Provides Longer Term Biofeedback

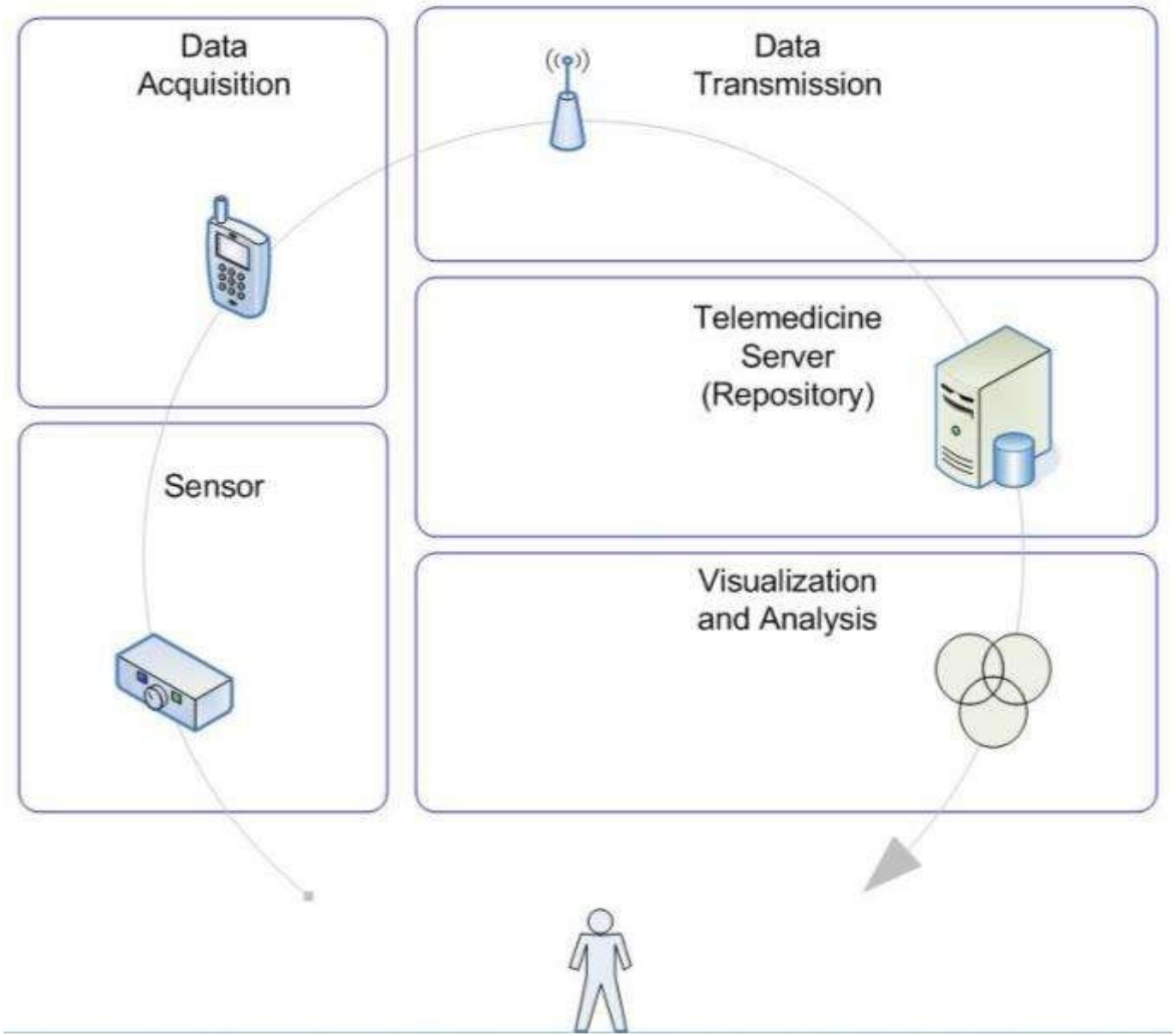
	Mar-08	May-08	Dec-08	Feb-09	Jun-09	Target
LDL	151	103	89	82	86	< 130
HDL	42	42	62	59	71	≥ 40
Triglycerides	223	100	57	81	60	< 150
hsCRP		3.4		0.5	0.7	< 1
Homocysteine		21.5		8.5		< 15
Lipoprotein(A)		62		51.2		< 30 or < 50 or < ?

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Source: Ramesh Rao, Calit2

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A Mobile Wireless System to Enhance Preventive Healthcare



Source: Paul Blair, Calit2

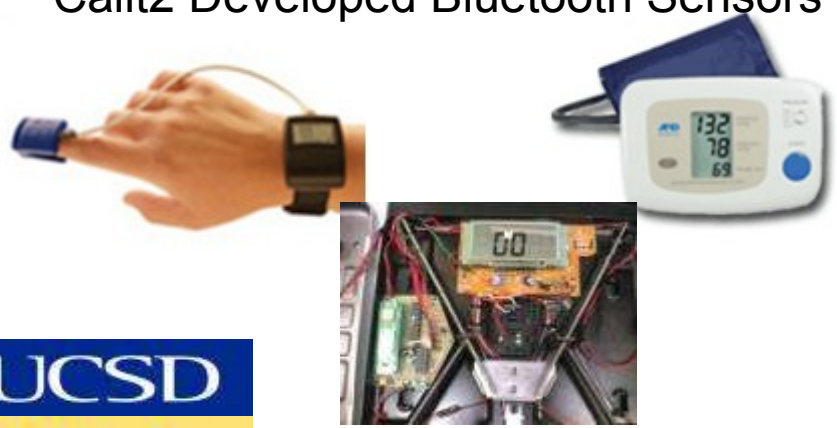
A Calit2 Prototype of a SmartPhone Based System to Enhance Preventive Healthcare

- **Diabetes**
- **Congestive Heart Failure (CHF)**
- **Cardiac**
- **Hypertension**
- **Asthmatics**
- **Congestive Obstructive Pulmonary Disease(COPD)**
- **Obesity**
- **Infection**
- **…Any chronic illness.**

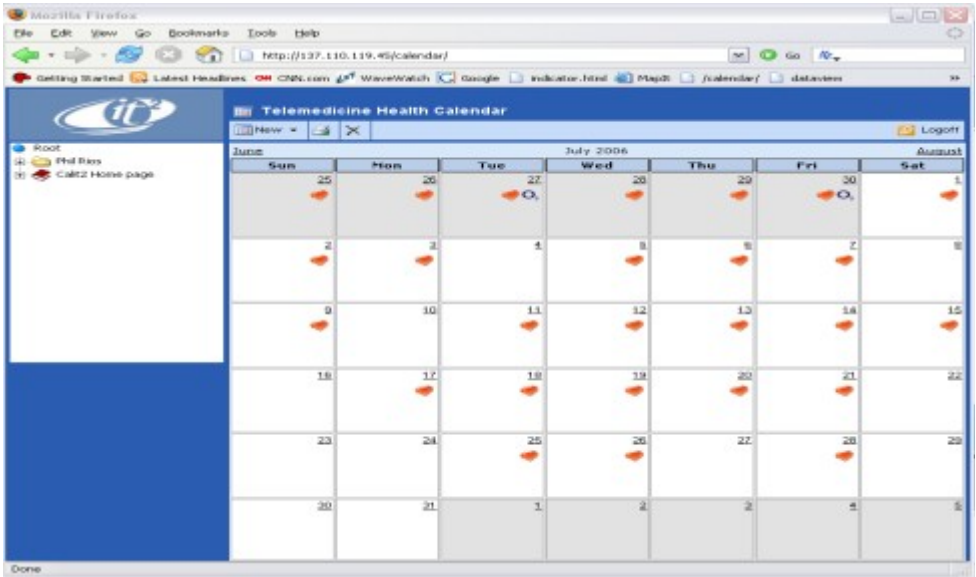
- Blood Glucose
- Body Weight and Blood Pressure
- EKG / heart rhythms
- BP (Blood Pressure)
- Respiration
- Respiration & Blood Oxygenation
- Weight & Caloric intake
- Temperature

Can be Easily Measured / Monitored, and Therefore Controlled
Before Effects are Catastrophic

Calit2 Developed Bluetooth Sensors



Source: Paul Blair, Calit2



NSF RESCUE Strongly Coupled with NIH WIISARD Grant

Wireless Internet Information System for Medical Response in Disasters

Calit2 is Working Closely with the First Responder Community







Triage

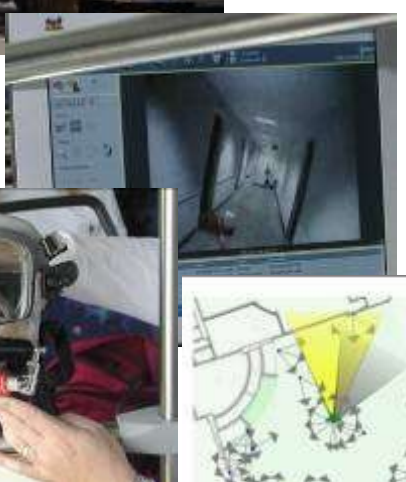
First Tier







802.11 pulse ox

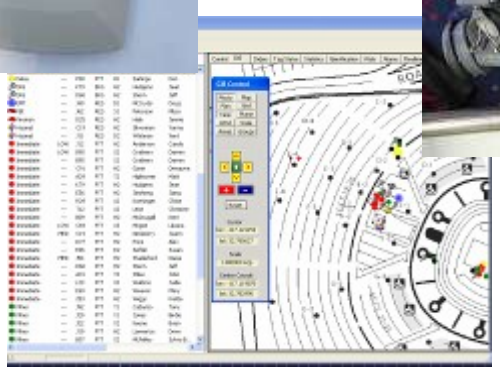




Mid Tier



Wireless Networks



Command Center

Reality Flythrough
Mobile Video

CitiSense:
Air Pollution Case Study

- 158 Million Live in Counties Violating Air Standards
  - Cancer in Chula Vista, CA Increased 140/Million Residents
  - Largely Due to Diesel Trucks and Automobiles
    - Particulates, Benzene, Sulfur Dioxide, Formaldehyde, etc.
- 30% of Public Schools Are Near Highways
  - Asthma Rates 50% Higher There
  - 350,000 – 1,300,000 Respiratory Events in Children Annually
- 5 EPA Monitors in SD Co., 4000 Sq. Mi., 3.1M Residents
  - But Air Pollution Not Uniformly Distributed in Space or Time
  - Hourly Updates to Web Page; Annual Reports in PDF Form
- Indoor Air Pollution is Uncharted Territory
  - Second-hand Smoke is Major Concern
  - Also Mold, Radon

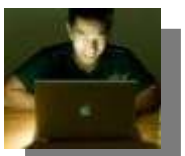
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CitiSense -



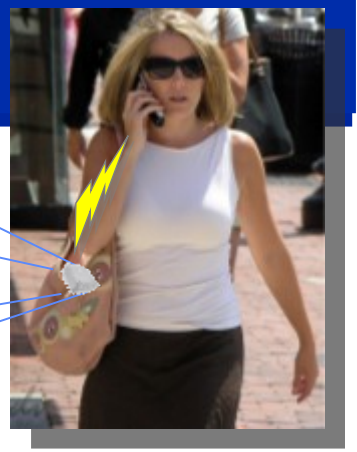
4oz
30 compounds

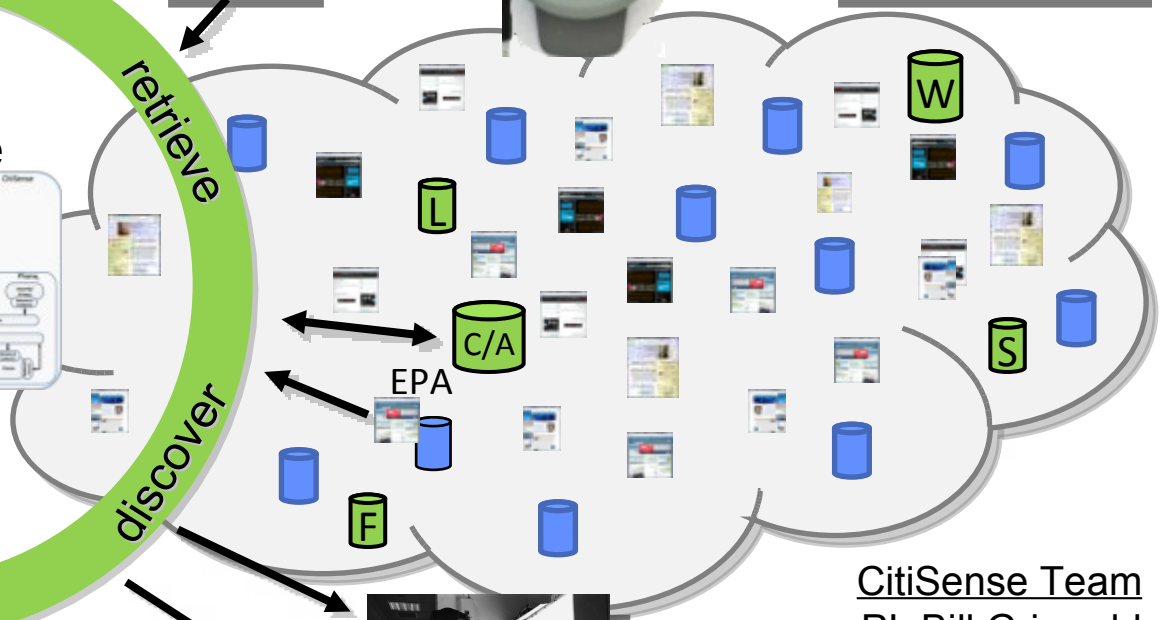


Seacoast Sci.

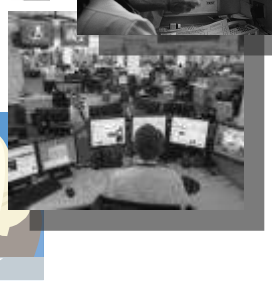


Intel MSP





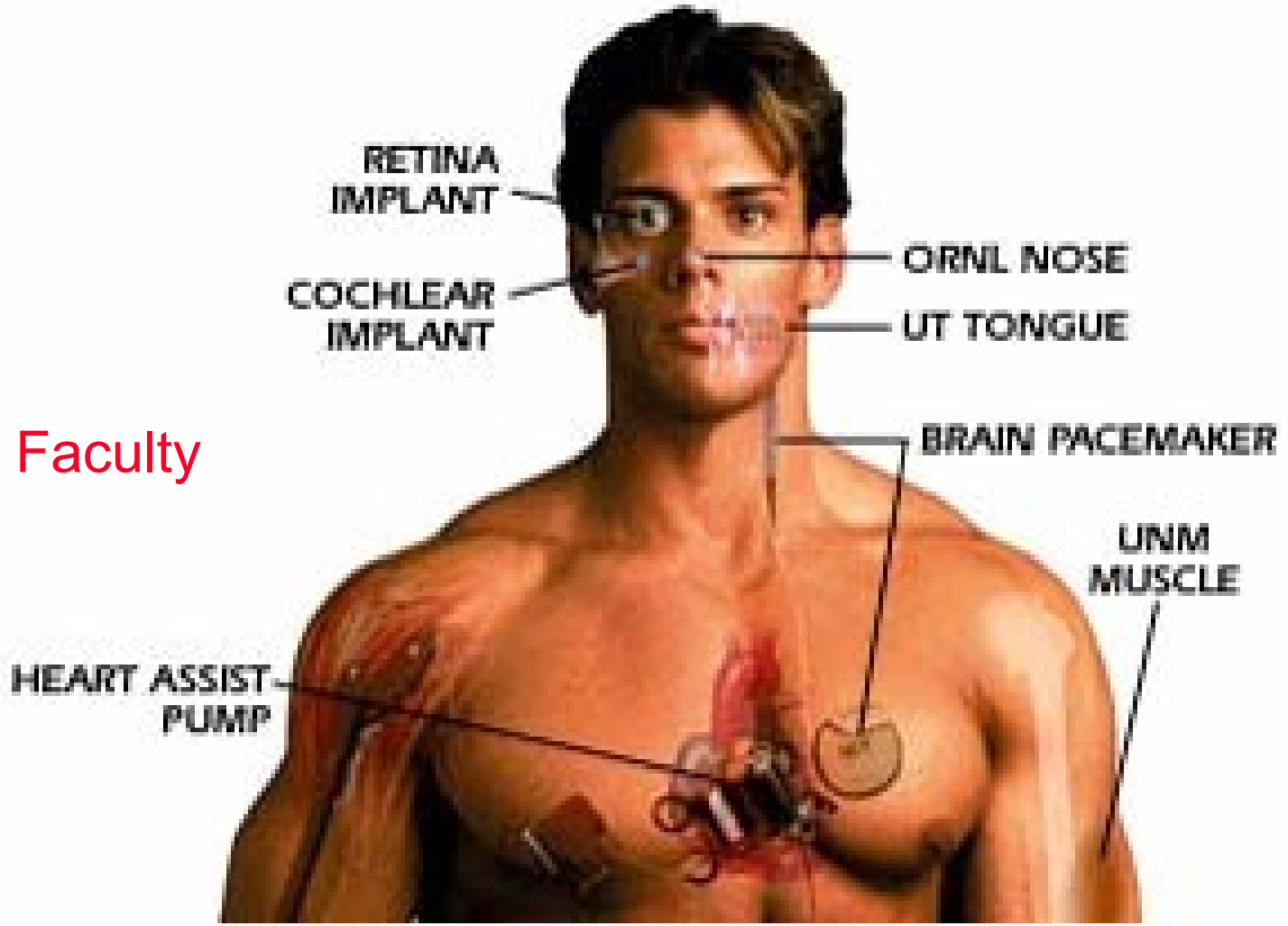




CitiSense Team
PI: Bill Griswold
Ingolf Krueger
Tajana Simunic Rosing
Sanjoy Dasgupta
Hovav Shacham
Kevin Patrick

Lifechips--Merging Two Major Industries: Microelectronic Chips & Life Sciences

65 UCI Faculty



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lifechips
university of california, irvine
www.lifechips.org

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Calit2 Brings Computer Scientists and Engineers Together with Biomedical Researchers

- **Some Areas of Concentration:**
  - Algorithmic and System Biology
  - Bioinformatics
  - Metagenomics
  - Cancer
  - Human Genomic Variation and Disease
  - Proteomics
  - Mitochondrial Evolution
  - Biomedical Instruments
  - Multi-Scale Cellular Imaging
  - Information Theory and Biological Systems
  - Telemedicine

CASB

Center for Computational Mass Spectrometry
UCSD

INSTITUTE FOR GENOMICS AND BIOINFORMATICS
University of California, Irvine

NanoTumor Center

lifechips
university of california, irvine
www.lifechips.org

camera
Marine Microbial Ecology

ICS1

JCSG
Joint Center for Structural Genomics

NCMIR
NATIONAL CENTER for MICROSCOPY and IMAGING RESEARCH
at San Diego, an NIH supported resource center

NBCR
National Biomedical Computation Resource
an NIH supported resource center

Information Theory and Applications

WISARD

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Center For Wireless & Population Health Systems

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Southern California Telemedicine Learning Center (TLC)

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Center for Algorithmic and Systems Biology@Calit2: Bringing World-Class Speakers to Conferences

Tri-Conference at the Center for Algorithmic and Systems Biology
CASB http://casb.ucsd.edu
UCSD, November 30-December 3, 2006, San Diego, CA, USA

algorithmic biology
systems biology
computational proteomics

UC San Diego and the California Institute for Telecommunications and Information Technology (Calit2) will host three conferences devoted to the disciplines of algorithmic biology, systems biology and computational proteomics. In partnership with the International Society for Computational Biology, the RECOMB Satellite Conferences on Systems Biology and Computational Proteomics will provide a forum for new methods that broadly address either or both of these areas. Algorithmic Biology will feature leaders in the field of computational biology who will discuss the emerging challenges at the interface of biology and computer science.

ALGORITHMIC BIOLOGY NOVEMBER 30, 2006	SYSTEMS BIOLOGY DECEMBER 1-2, 2006	COMPUTATIONAL PROTEOMICS DECEMBER 2-3, 2006
PAVEL PEVZNER UCSD (CHAIR)	TREY IDEKER UCSD (CHAIR)	VINEET BAFNA UCSD (CHAIR)
SERAFIM BATZOGLOU STANFORD	MARTHA BULYK HARVARD MEDICAL	MARSHALL BERN XEROX PARC
DAVID HAUSSLER UC SANTA CRUZ	ERIC DAVIDSON CALTECH	STEVE BRIGGS UCSD
MANOLIS KELLIS MIT	DAVID EISENBERG UCLA	NEIL KELLEHER UNIV OF ILLINOIS
RON SHAMIR TEL AVIV UNIV	ANNE-CLAUDE GAVIN EMBL HEIDELBERG	NEVAN KROGAN UCSF
MICHAEL WATERMAN USC	MARK GERSTEIN YALE	FOREST WHITE MIT
	DAPHNE KOLLER STANFORD	RICHARD SMITH PACIFIC NORTHWEST NATIONAL LAB
	BING REN UCSD	
	RON SHAMIR TEL AVIV UNIV	

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CALIT2 AUDITORIUM
ATKINSON HALL, UCSD
LA JOLLA, CALIFORNIA

REGISTER BEFORE NOVEMBER 8 TO RECEIVE AN EARLY REGISTRATION DISCOUNT

2007 RECOMB Satellite Conference on Systems Biology

CASB: Center for Algorithmic and Systems Biology, University of California at San Diego
November 30 - December 1, 2007

The purpose of this meeting is to bring researchers together on various aspects of systems biology, including integration of genome-wide [illegible] and metabolomic data,



For further information

CASB Center for Algorithmic and Systems Biology

Fifth Annual RECOMB Satellite Workshop on	First RECOMB Satellite Workshop on
Comparative Genomics	Computational Cancer Biology
September 16-18, 2007	September 18-20, 2007

The RECOMB Satellite Workshop on Comparative Genomics features mathematical/computational approaches and novel experimental results in comparative genomics. The new RECOMB Satellite Worskhop on Computational Cancer Biology focuses on algorithmic and statistical challenges in cancer research, particularly resulting from high-throughput assays of tumors. Hosted by UC San Diego and California Institute for Telecommunications and Information Technology.

- Francesca Ciccarelli (European Institute of Oncology) — *Gene Structure Modifications in Primate-Specific Duplicates*
- Michael B. Eisen (University of California, Berkeley)
- Matthew Hahn (Indiana University) — *Quantifying Gene Gain and Loss in Mammals*
- Katherine S. Pollard (University of California, Davis) — *Accelerated and Biased Nucleotide Evolution in the Human Genome*
- Oliver A. Ryder (Zoological Society of San Diego) — *Genomics and Bioinformatics: Applications to Conservation Efforts for Endagered Species*
- Ajit Varki (University of California, San Diego) — *Multiple Genetic Differences in Sialic Acid Biology Between Humans and Great Apes*
- Donna G. Albertson (University of California, San Francisco)
- Anne-Lise Borresen-Dale (Institute for Cancer Research, Norwegian Radium Hospital)
- Colin Collins (University of California, San Francisco)
- Paul Meltzer (National Cancer Institute)
- Paul Spellman (Lawrence Berkeley National Laboratory) — *Systematic Analysis of Breast Cancer Cell Lines*
- Rick Wilson (Washington University, St. Louis)
- Barbara J. Trask (Fred Hutchinson Cancer Research Center) — *Dynamic Duplications in the Human Genome*

CHAIRS

Glenn Tesler (University of California, San Diego); Dannie Durand (Carnegie Mellon University); Ben Raphael (Brown University); Michael Hallett (McGill University)

Calit2 UCSanDiego UC Discovery Grant McGill Cancer Centre Centre of Bioinformatics NSF Morrison Foerster Brown Center for Computational Molecular Biology University of California, San Diego Medical Center

http://casb.ucsd.edu/recombcg07/ http://casb.ucsd.edu/recombccb07/

LA JOLLA BIOINFORMATICS CONFERENCE 2008

Interfacing Industry and Academia

April 4, 8:30am - 4:30pm, Calit2 Auditorium, Atkinson Hall, UC San Diego

The Center of Algorithmic and Systems Biology (CASB) aims to bring together researchers from the biological and computational communities, from both academia and industry, to discuss the current trends and the future directions in bioinformatics.

Free Registration!
with
Complimentary Breakfast and Lunch

Registration required by March 31st, 2008
Please register on our website: http://casb.calit2.net/bioinfo/

Speakers



Ruben Abagyan
Professor of Molecular Biology, The Scripps Research Institute
Title: Computational structural proteomics for drug discovery



Howard Asher
President and CEO, Global Life Sciences, Inc.
Title: The Role of Information Technology in Pharmacy and Pharmaceutical Sciences.



Philip E. Bourne
Professor of Pharmacology, UCSD
Panel moderator



Steven Burley
CSO, SGX Pharmaceuticals, Inc.
Title: Discovery and development of selective, orally bioavailable tyrosine kinase inhibitors for targeted treatment of human cancer.



Gary Fogel
Vice President, Natural Selection, Inc.
Title: Computational Intelligence Methods in Bioinformatics



Steven Hofstadler
Vice President of Research, Ibis Bioscience, Inc.
Title: Using Information Derived from High Throughput Mass Spectrometry in the Biotechnology Arena: from Drug Discovery to Pathogen Detection and Strain Typing



Trey Ideker
Associate Professor of Bioengineering, UCSD
Title: Gaining power in gene association studies with Cytoscape: Mapping gene regulatory pathways by assembly of physical and genetic interactions



Tobias Mann
Bioinformatics Scientist, Illumina, Inc.
Title: Visualizing High Throughput Sequencing Experiments



Gerard Manning
Director, Razavi-Newman Center for Bioinformatics, Salk Institute
Title: Comparative Kinomics: How genome sequences and a billion years of evolution can help us understand protein kinase function, cell signaling and human disease



Bernhard Palsson
Professor of Bioengineering, UCSD

CASB Calit2 UC San Diego Jacobs School of Engineering UC Discovery Grant

For More Info Please Visit *http://casb.calit2.net/bioinfo/*

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Building a Genome-Scale Model of E. Coli *in Silico*

JTB 2002

E. coli i2K

Genomics

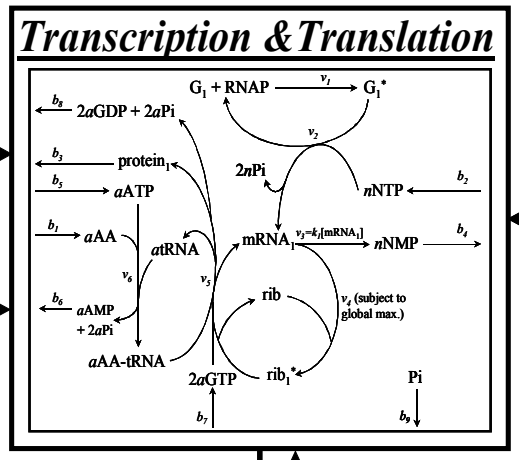
Transcriptomics

Proteomics

Metabolomics

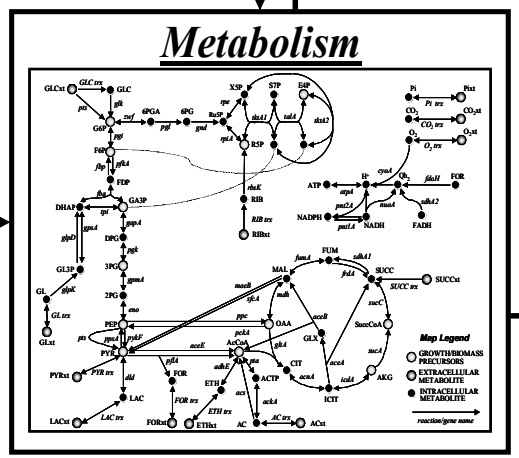
Interactomics

Environment



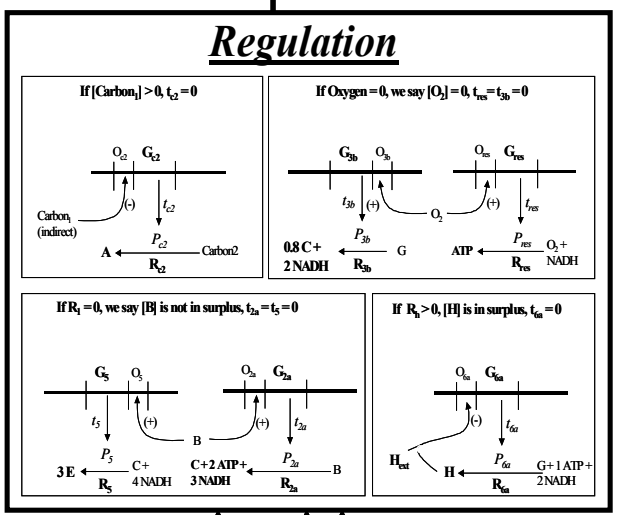
Proteins

Monomers & Energy



Regulatory Actions

JBC 2002



Input Signals

- **E. Coli**
  - **Has 4300 Genes**
  - **Model Has 2000!**

in Silico Organisms Now Available 2007:

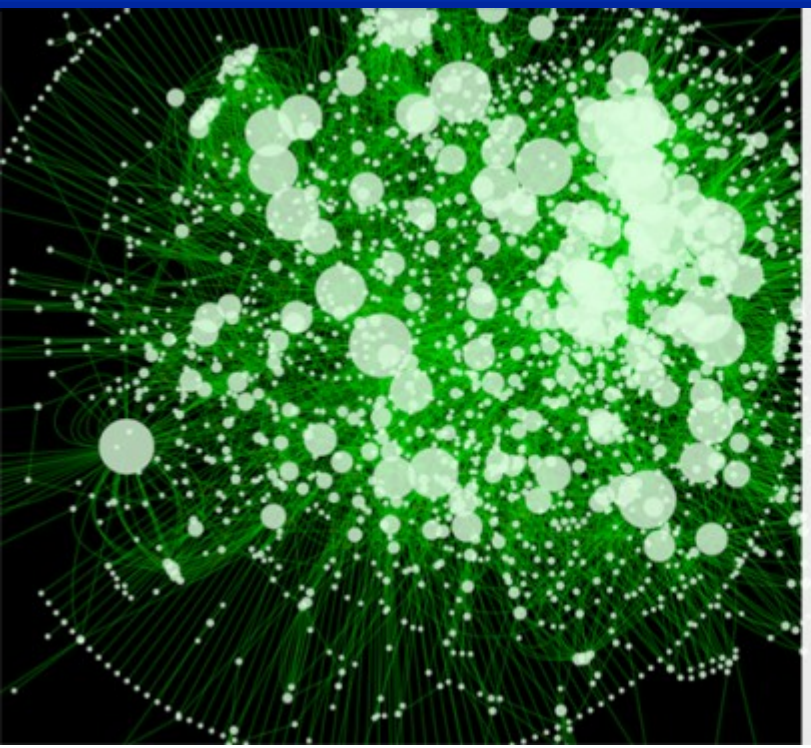
- Escherichia coli
- Haemophilus influenzae
- Helicobacter pylori
- Homo sapiens Build 1
- Human red blood cell
- Human cardiac mitochondria
- Methanosarcina barkeri
- Mouse Cardiomyocyte
- Mycobacterium tuberculosis
- Saccharomyces cerevisiae
- Staphylococcus aureus

Source: Bernhard Palsson
UCSD Genetic Circuits Research Group
http://gcrg.ucsd.edu

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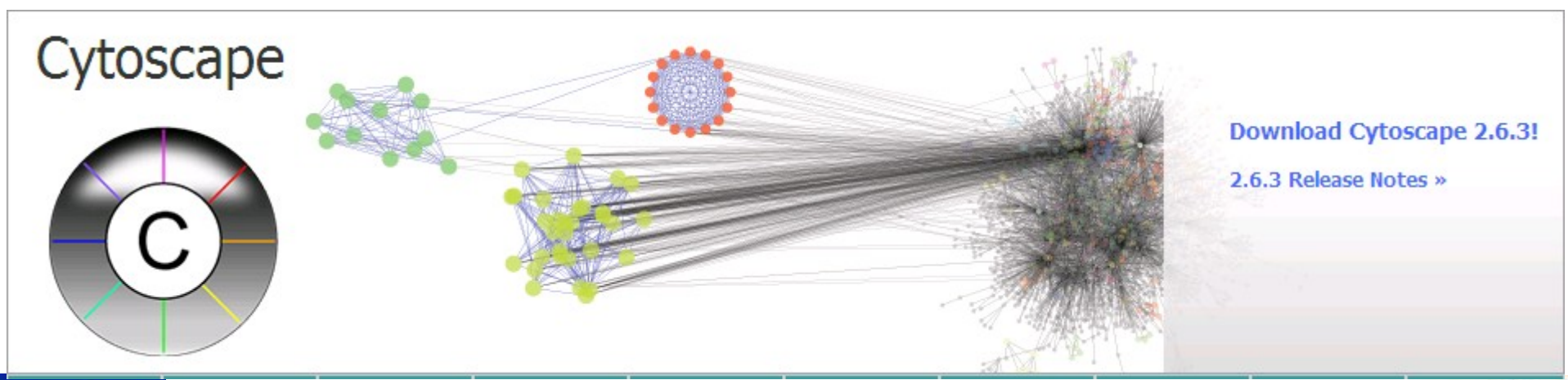
Cytoscape: OPEN SOURCE Java Platform for Integration of Systems Biology Data



Cytoscape

An Open Source Platform for Network Analysis and Visualization

- Layout and Query of Interaction Networks (Physical And Genetic)
- Visual and Programmatic Integration of Molecular State Data (Attributes)
- Ultimate Goal is to Provide the Tools to Facilitate All Aspects of Pathway Assembly and Annotation



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www.cytoscape.org

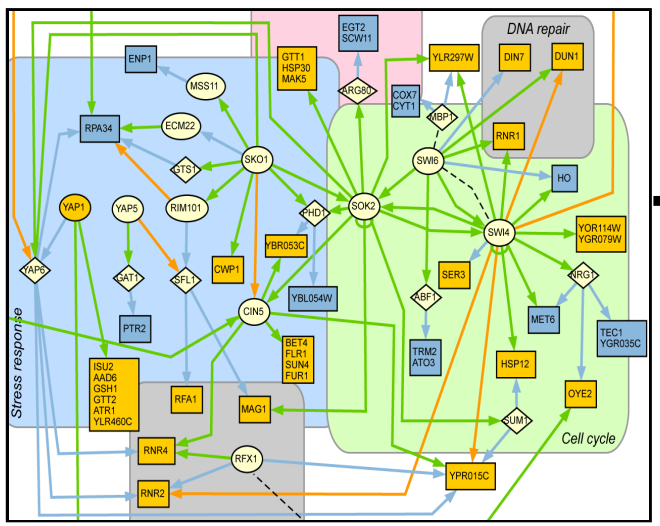
Research In The Ideker Lab

Network Evolutionary Comparison / Cross-Species Alignment to Identify Conserved Modules

Projection of Molecular Profiles on Protein Networks to Reveal Active Modules

Validation of Transcriptional Interactions With Causal or Functional Links

Alignment of Physical and Genetic Networks



Network-Based Disease Diagnosis / Prognosis

Network-Based Rationale Drug Design

Moving from Genome-wide Association Studies (GWAS) to Network-wide "Pathway" Association (PAS)

Network Assembly from Genome-Scale Measurements

Network Based Study of Disease

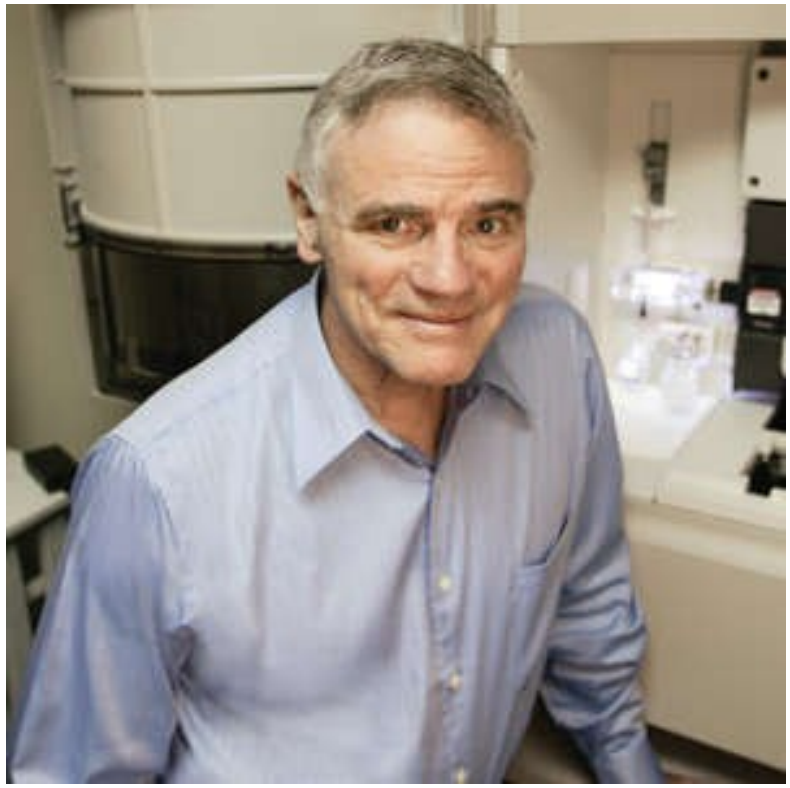
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Newsweek

A Doctor's Vision of the Future of Medicine

Leroy Hood
NEWSWEEK

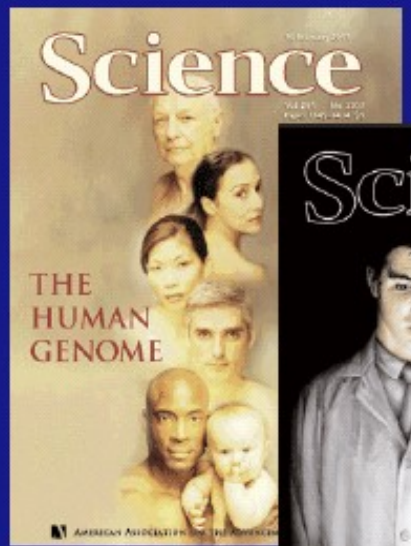
From the magazine issue dated Jul 13, 2009



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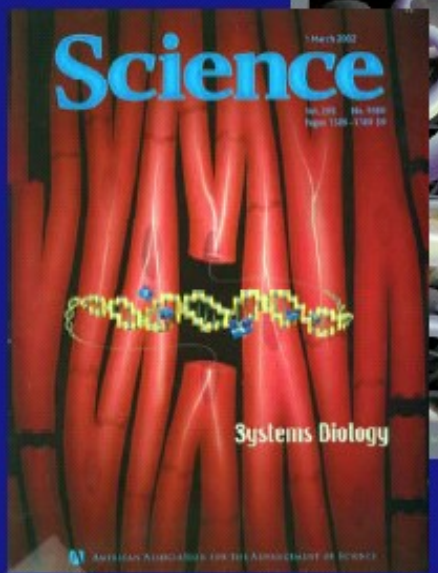
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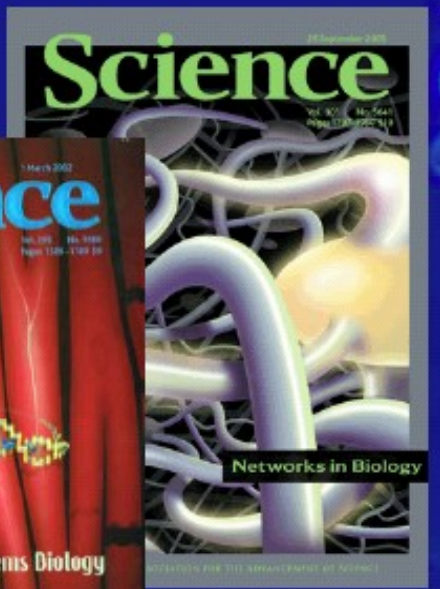
A Grand Convergence





Complexity: Biology is an Information Science

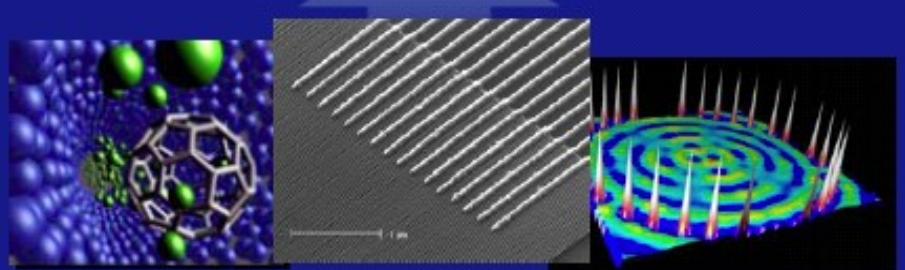




Genetics, genomics

Predictive
Personalized
Preventive
Participatory
Medicine

Systems biology

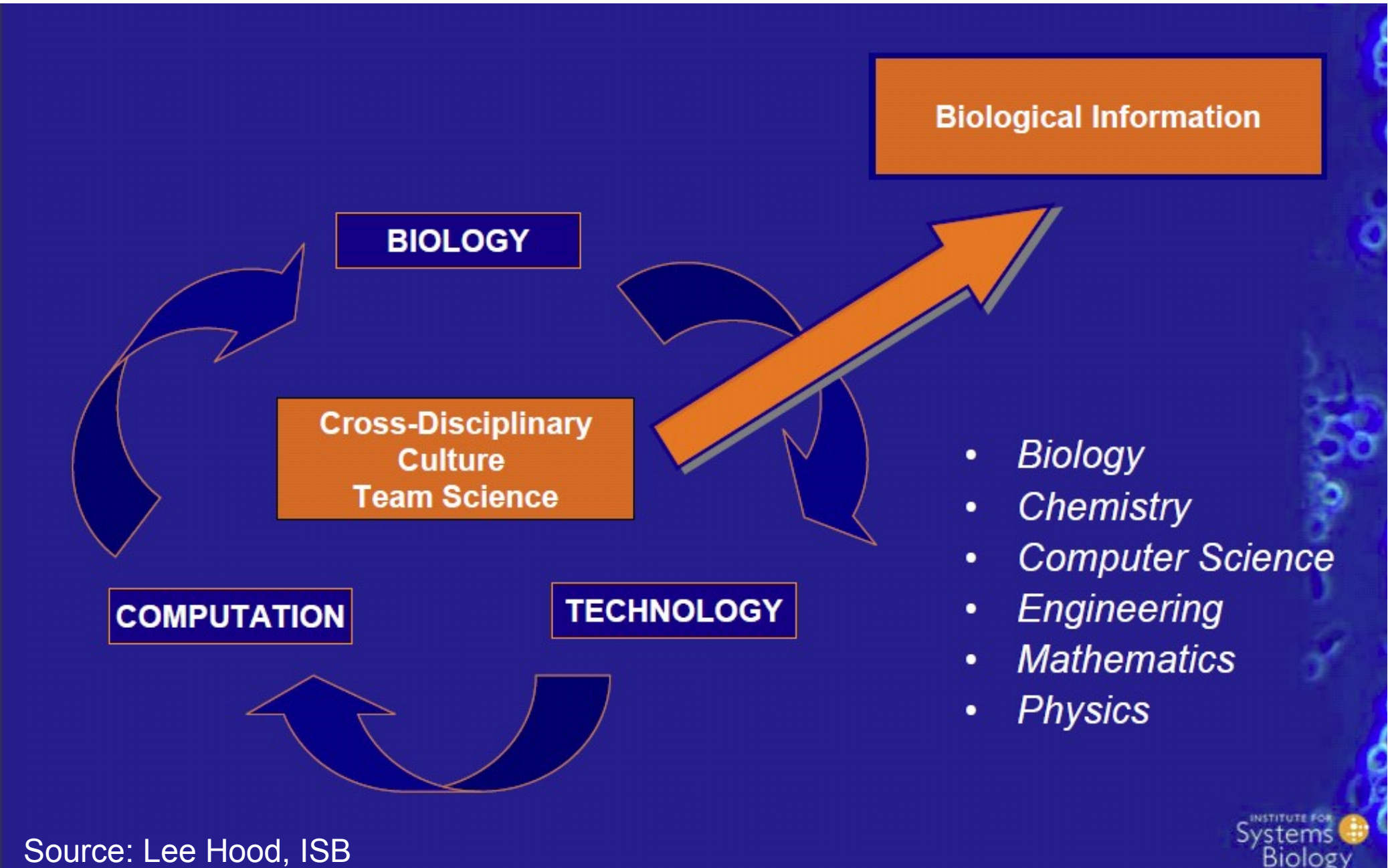


Nanotechnology

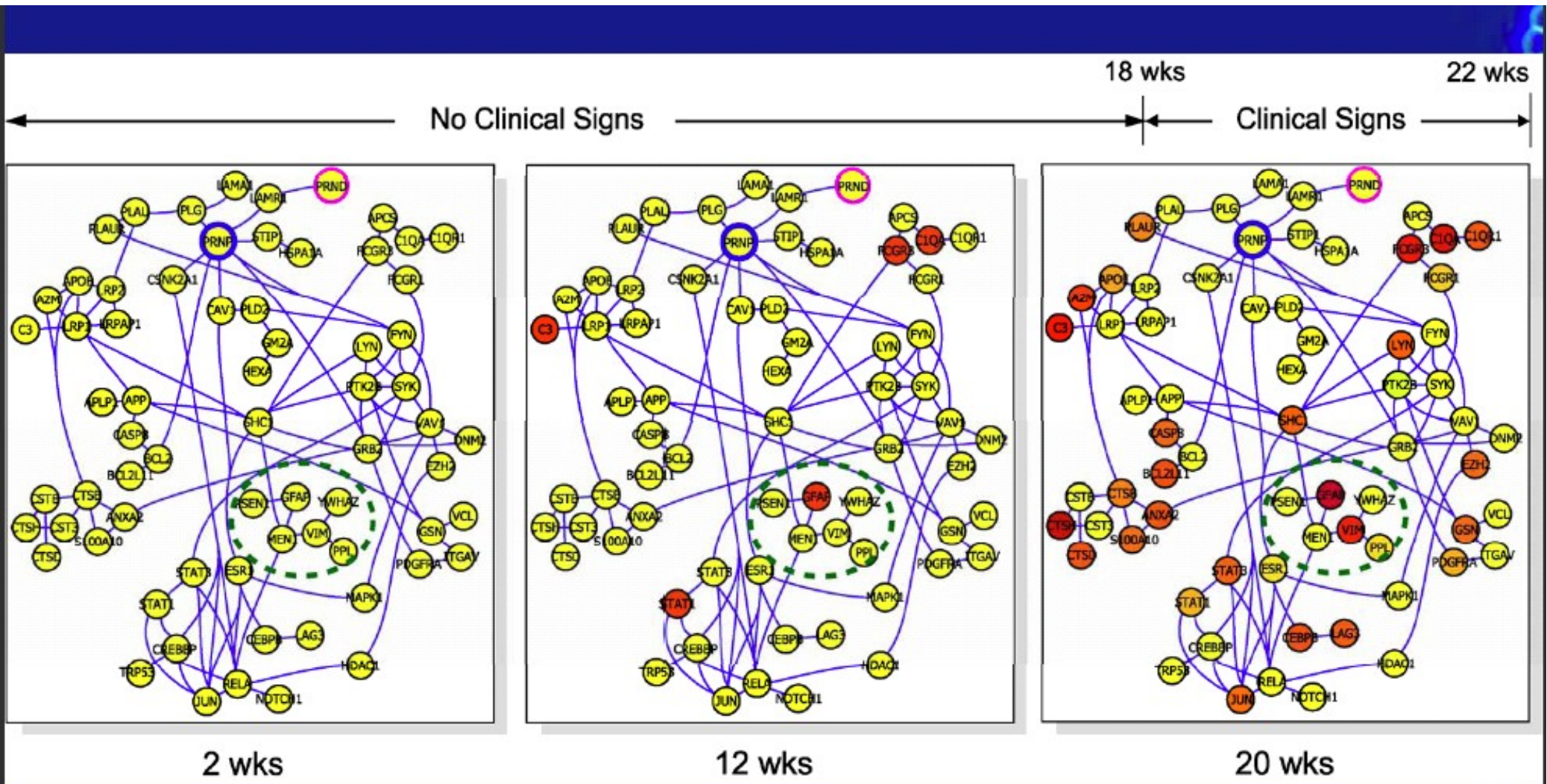
Source: Lee Hood, ISB

Institute for Systems Biology

Use Biology to Drive Technology and Computation. Need to Create a Cross-disciplinary Culture



Disease Arises from Perturbed Cellular Networks: Dynamics of a Prion Perturbed Network in Mice

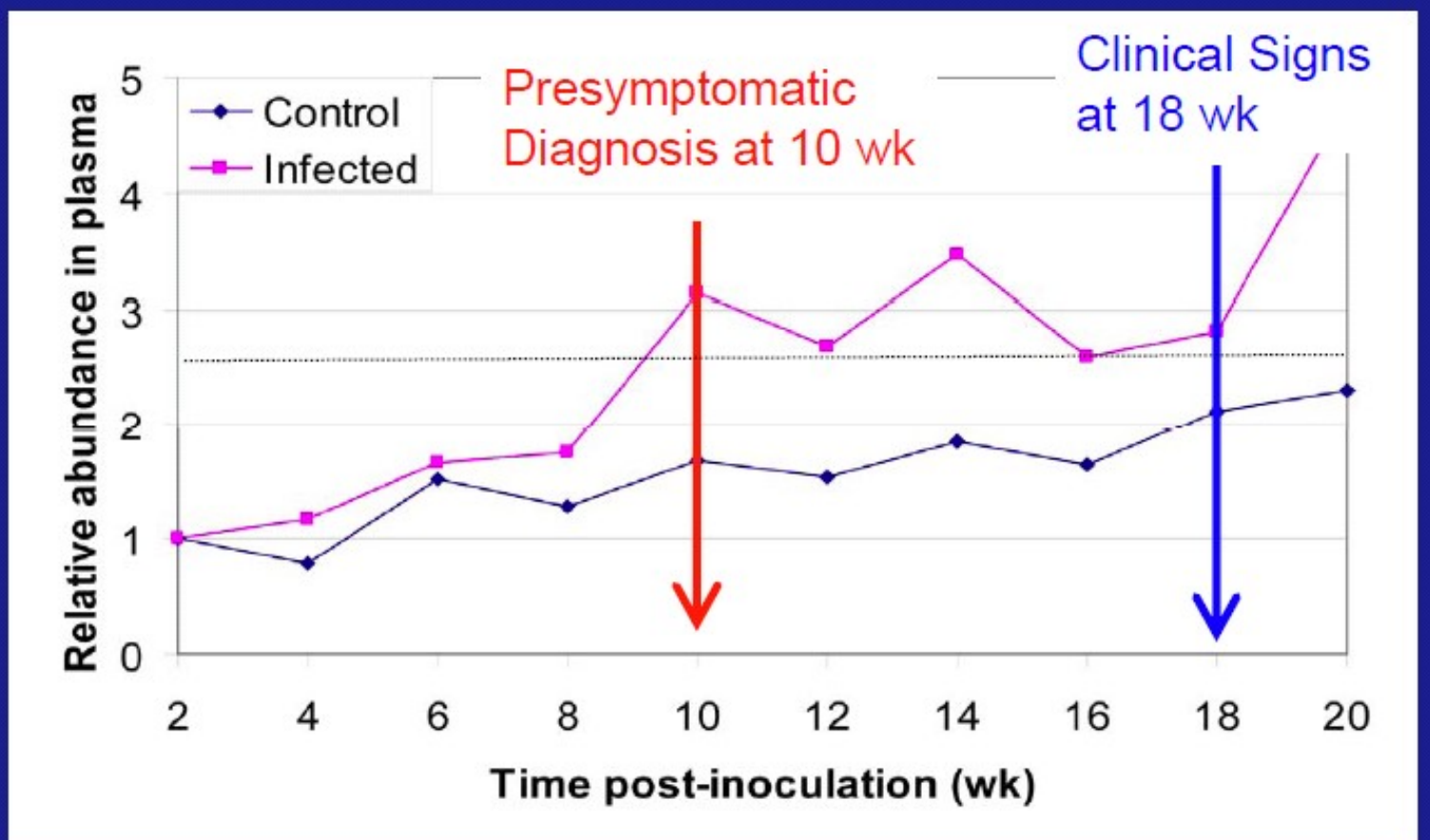


Source: Lee Hood, ISB

INSTITUTE FOR Systems Biology

Increasing Abundance of Protein A for Prion-Infected Blood Samples

Dynamic change in relative abundance of "Protein A"



Source: Lee Hood, ISB

Institute for Systems Biology

Organ-Specific Blood Proteins Will Make the Blood a Window into Health and Disease

Source: Lee Hood, ISB

- **Perhaps 50 Major Organs or Cell Types**
  - **Each Secreting Protein Blood Molecular Fingerprint**
- **The Levels of Each Protein in a Particular Blood Fingerprint Will Report the Status of that Organ**
  - **Probably Need Perhaps 50 Organ-Specific Proteins Per Organ**
- **Will Need to Quantify 2500 Blood Proteins from a Drop of Blood**
  - **Use Microfluidic/Nanotechnology Approaches**

Key Point: Changes in The Levels Of Organ-Specific Markers Can Assess Virtually All Diseases Challenges for a Particular Organ

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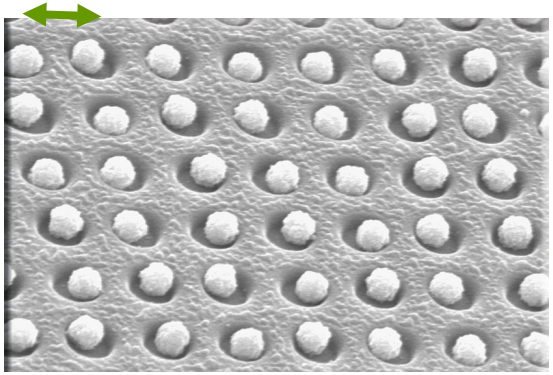
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Accelerator: The Perfect Storm-- Convergence of Engineering with Bio, Physics, & IT

1000x Magnification

MEMS

2 micron

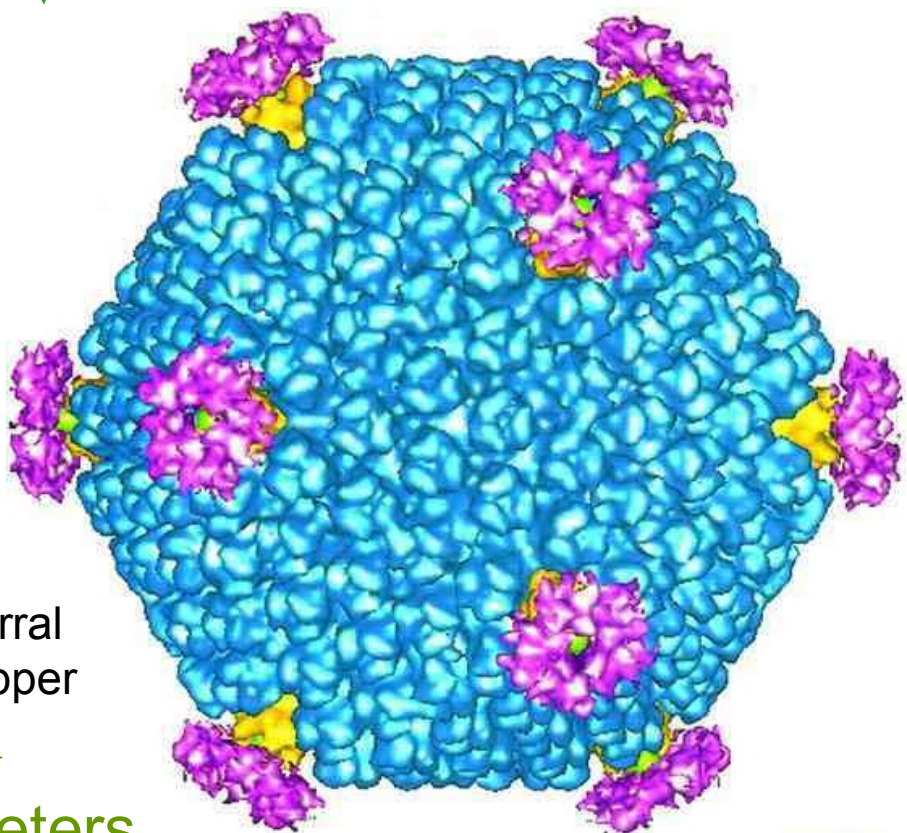


DNA-Conjugated Microbeads

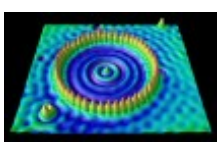


2 mm

400,000 x !



Human Adenovirus



IBM Quantum Corral
Iron Atoms on Copper

5 nanometers

400x Magnification

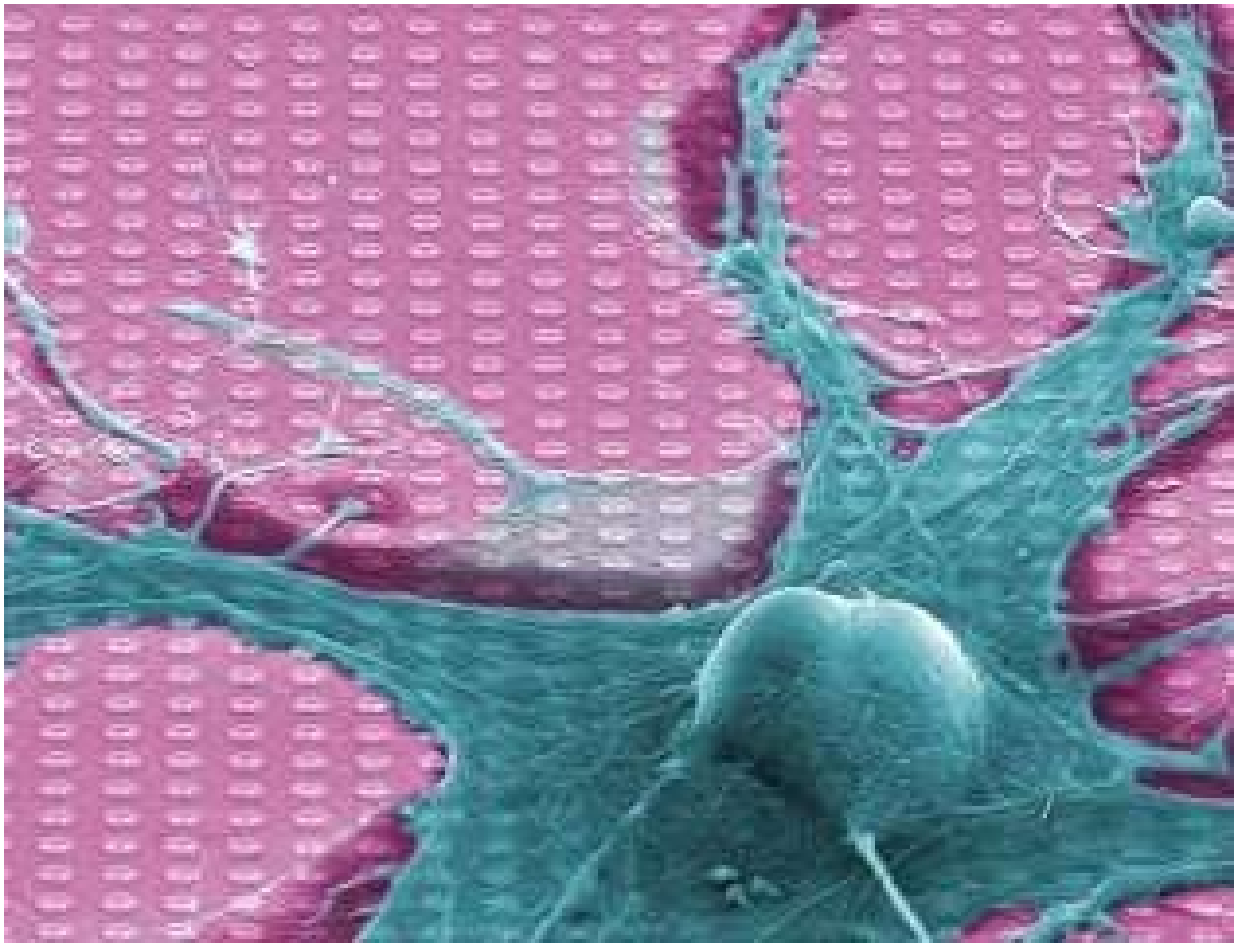
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The Intersection of Solid State and Biological Information Systems



Snail neuron grown on a CMOS chip with 128x128 Transistors.
The electrical activity of the neuron is recorded by the chip.
(Chip fabricated by Infineon Technologies)

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www.biochem.mpg.de/en/research/rd/fromherz/publications/03eve/index.html

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AMCC

FAVRILLE
Cancer treatment—we make it personal

TCZ
A Joint Venture of Cymer and Carl Zeiss SMT

Seashell Technology

freescale™
semiconductor

SAIC
From Science to Solutions

autosplice
INNOVATIVE INTERCONNECTIONS

THE SCRIPPS RESEARCH INSTITUTE

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AND AFFILIATED COMPANIES

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ThermopeutiX

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TREX ENTERPRISES
CORPORATION

BD

illumina

L3
communications

XCOM

SOLASE
photovoltaic technologies

BURNHAM INSTITUTE
for MEDICAL RESEARCH
From Research, the Power to Cure

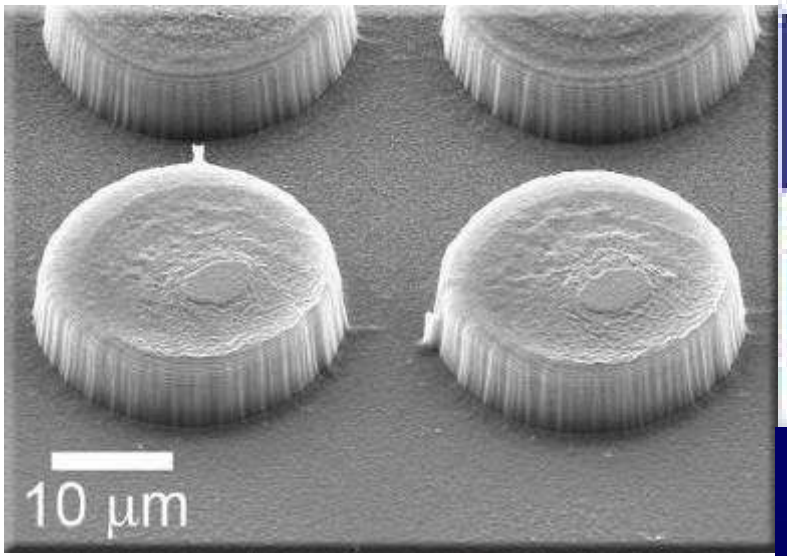
Maxwell
TECHNOLOGIES

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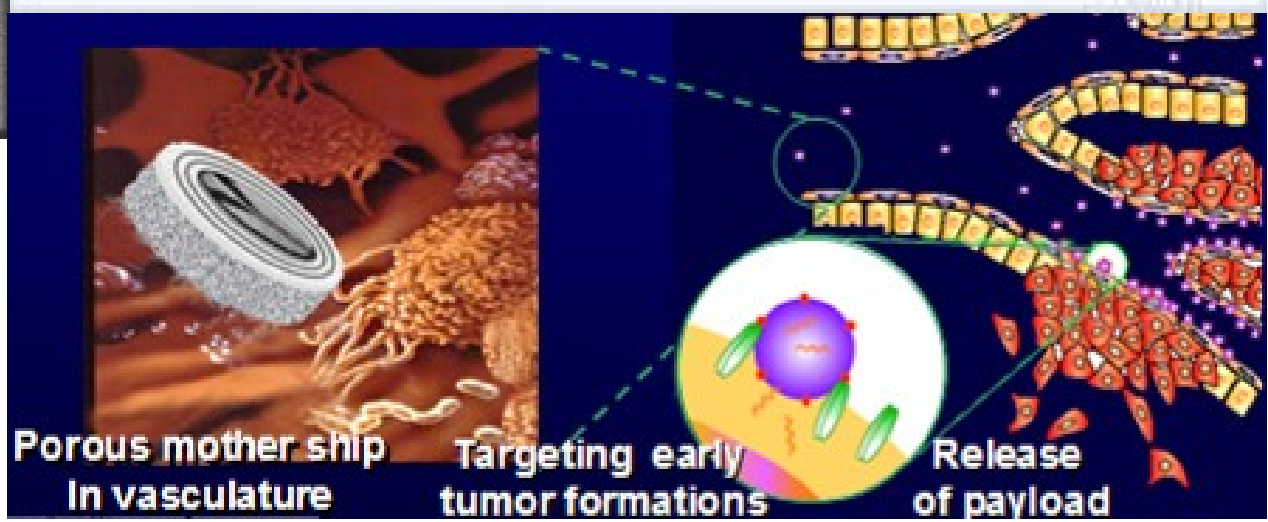
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Nano-Structured Porous Silicon Applied to Cancer Treatment

Nanodevices for In-vivo Detection & Treatment of Cancerous Tumors



Nanostructured “Mother Ships”
for Delivery of Cancer Therapeutics



Michael J. Sailor Research Group
Chemistry and Biochemistry

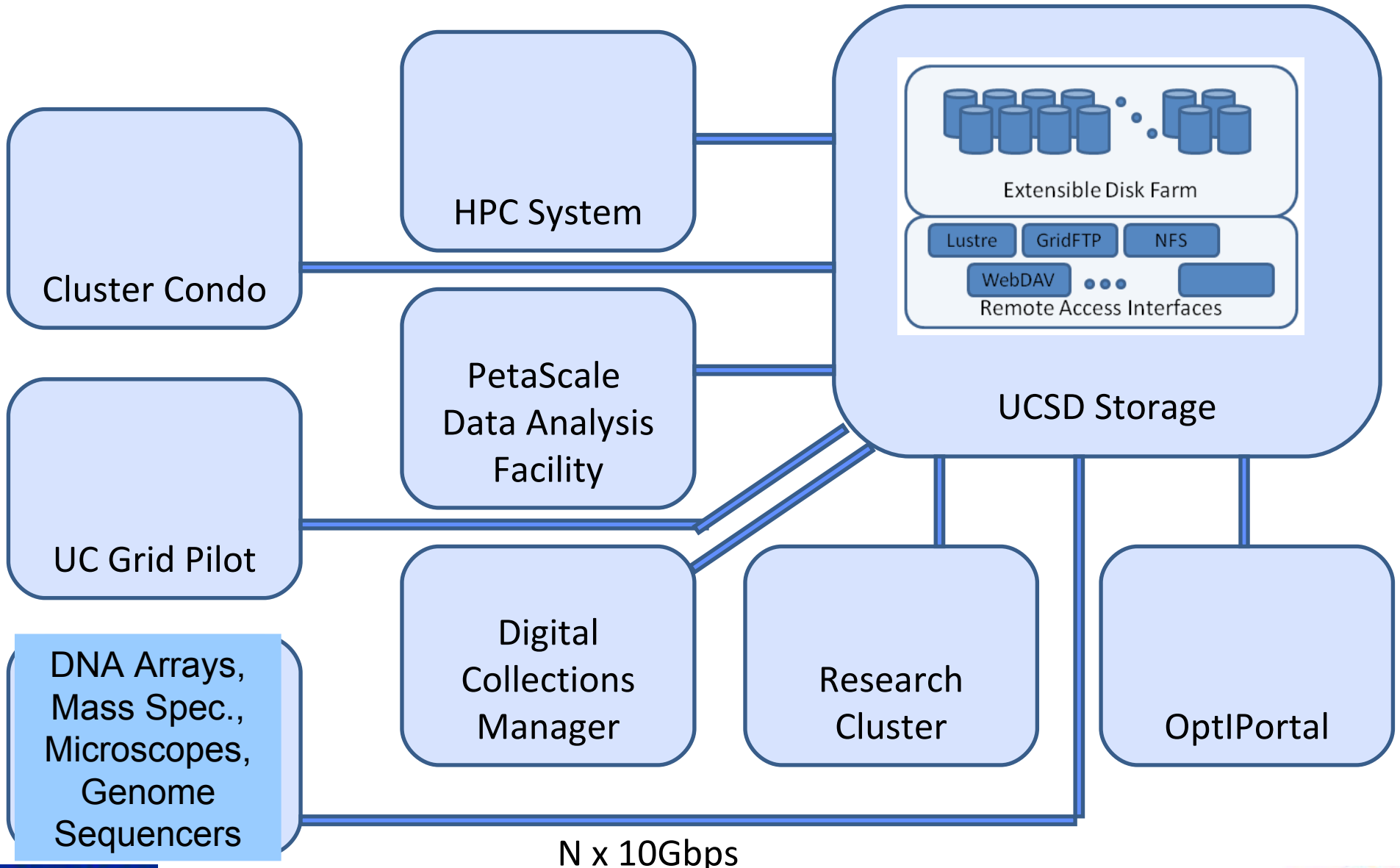
Challenge: What is the Appropriate Data Infrastructure for a 21st Century Data-Intensive BioMedical Campus?

- **Needed: a High Performance Biological Data Storage, Analysis, and Dissemination Cyberinfrastructure that Connects:**
  - **Genomic and Metagenomic Sequences**
  - **MicroArrays**
  - **Proteomics**
  - **Cellular Pathways**
  - **Federated Repositories of Multi-Scale Images**
    - **Full Body to Microscopy**
- **With Interactive Remote Control of Scientific Instruments**
- **Multi-level Storage and Scalable Computing**
- **Scalable Laboratory Visualization and Analysis Facilities**
- **High Definition Collaboration Facilities**

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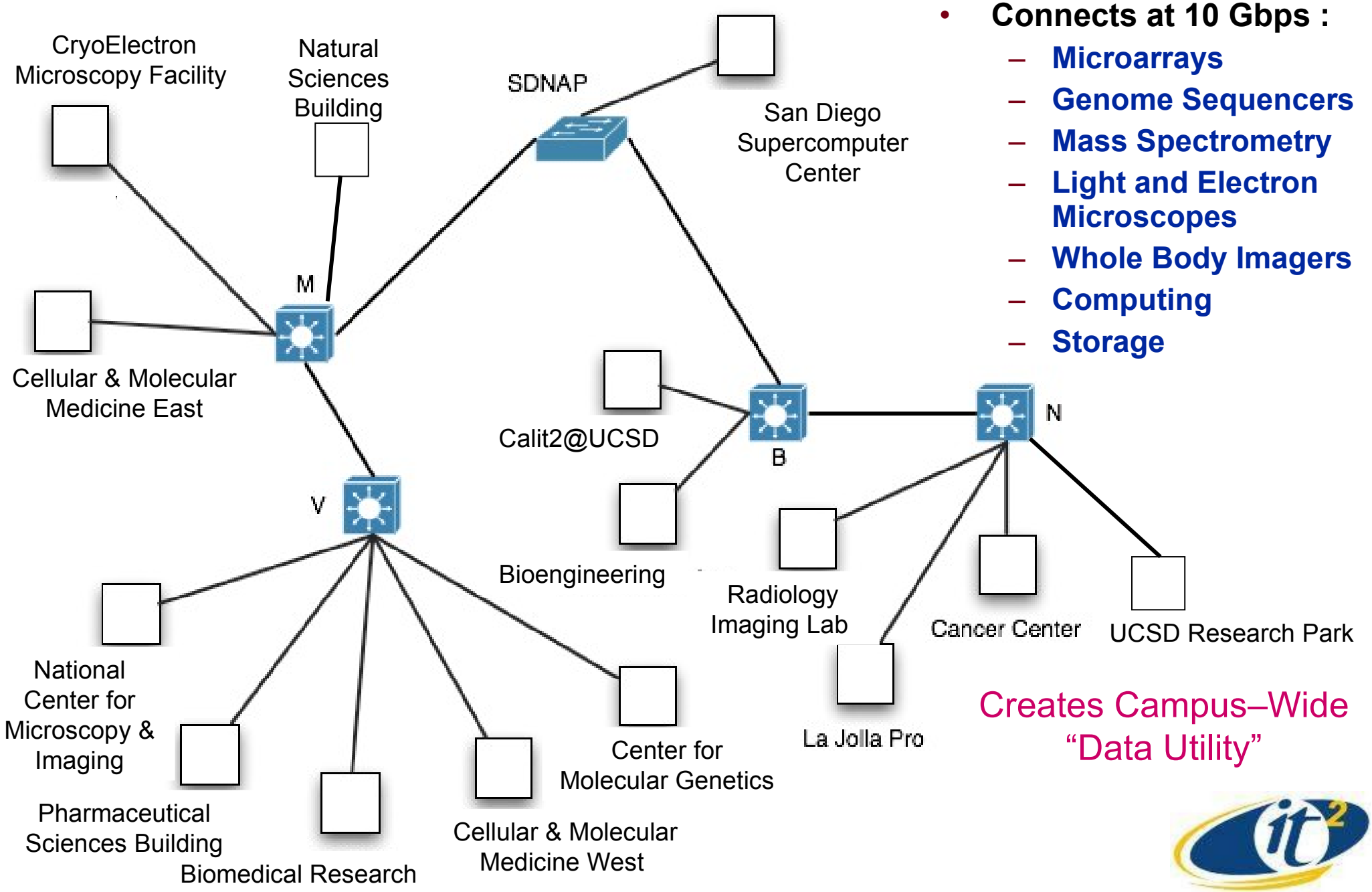
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Conceptual Architecture to Physically Connect Campus Resources Using Fiber Optic Networks



Source:Phil Papadopoulos, SDSC/Calit2

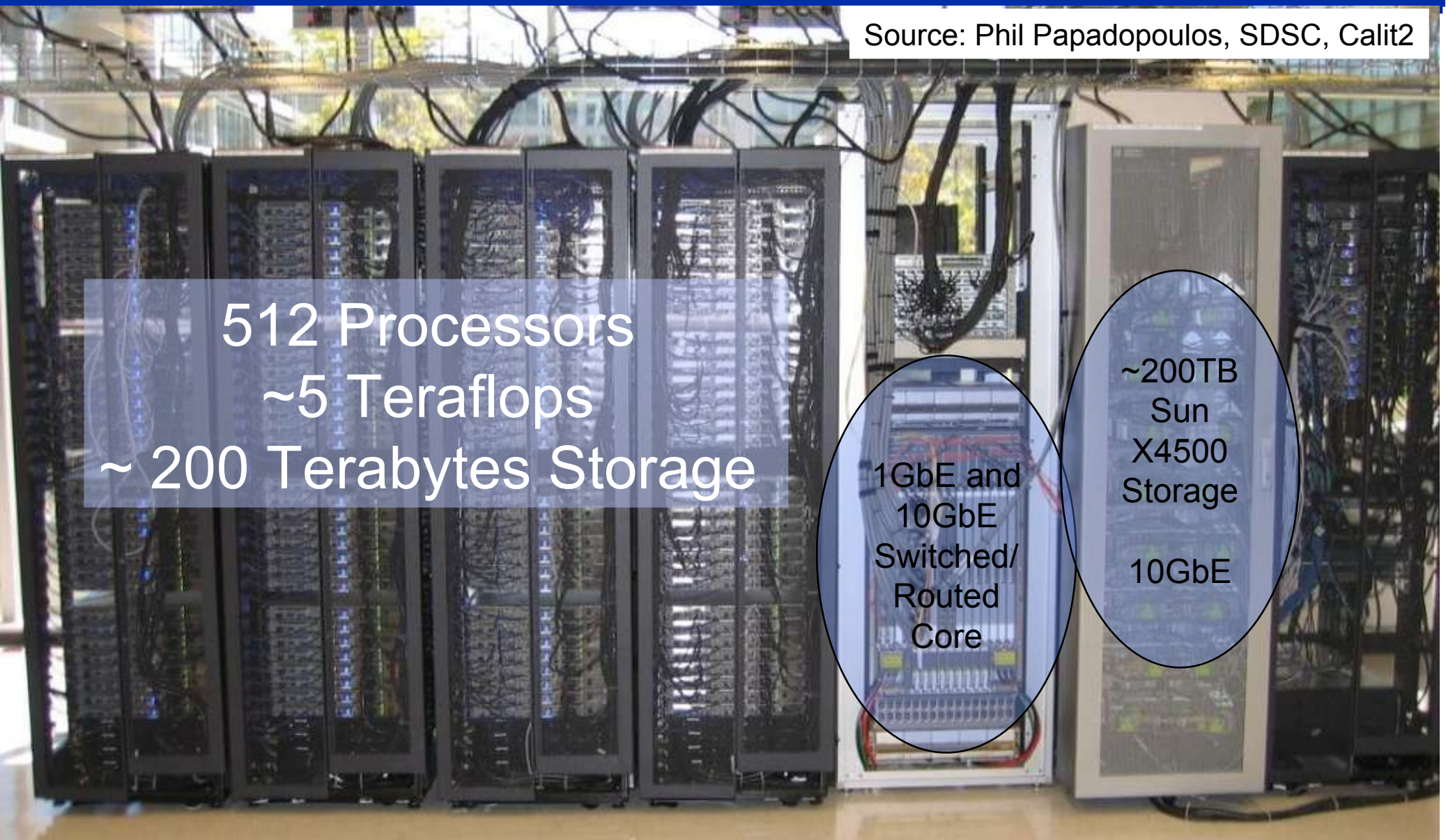
UCSD Planned Optical Networked Biomedical Researchers and Instruments



- **Connects at 10 Gbps :**
  - **Microarrays**
  - **Genome Sequencers**
  - **Mass Spectrometry**
  - **Light and Electron Microscopes**
  - **Whole Body Imagers**
  - **Computing**
  - **Storage**

Creates Campus–Wide "Data Utility"

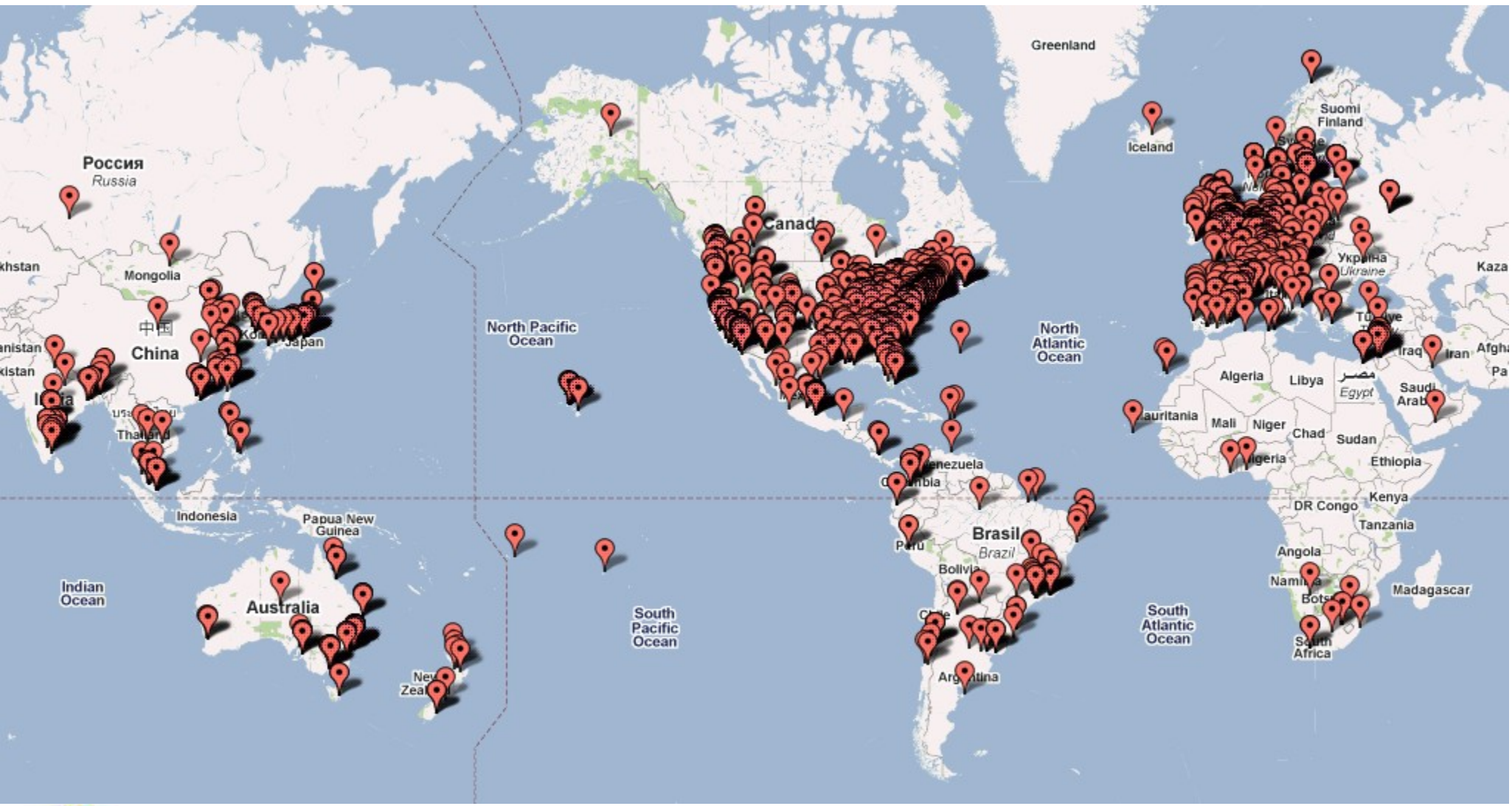
Calit2 Microbial Metagenomics Cluster- Next Generation Optically Linked Science Data Server



UCSD UCIrvine SDSC ROCKS camera Marine Microbial Ecology J. Craig Venter INSTITUTE it²

CAMERA's
Global Microbial Metagenomics CyberCommunity

Over 3200 Registered Users From Over 70 Countries



camera
Marine Microbial Ecology

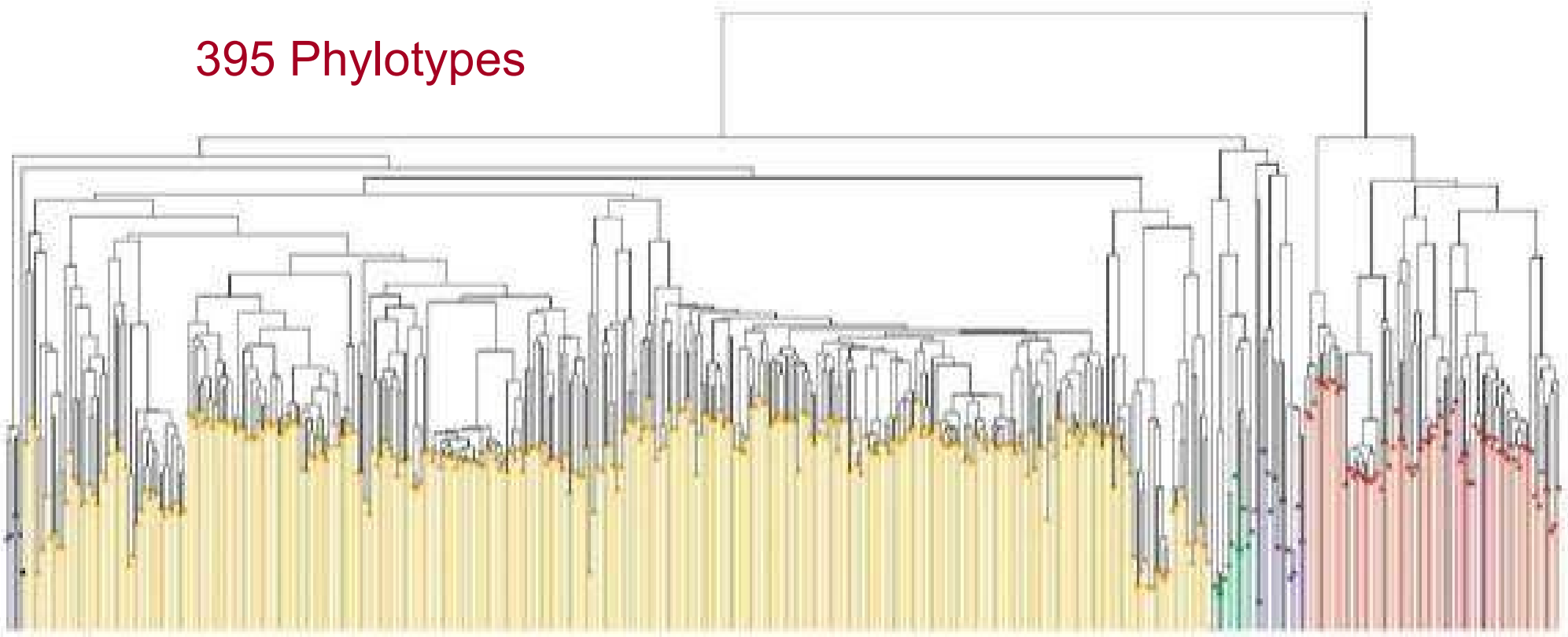
http://camera.calit2.net

it2

The Human Microbiome is the Next Large NIH Drive to Understand Human Health and Disease

- **"A majority of the bacterial sequences corresponded to uncultivated species and novel microorganisms."**
- **"We discovered significant inter-subject variability."**
- **"Characterization of this immensely diverse ecosystem is the first step in elucidating its role in health and disease."**

395 Phylotypes

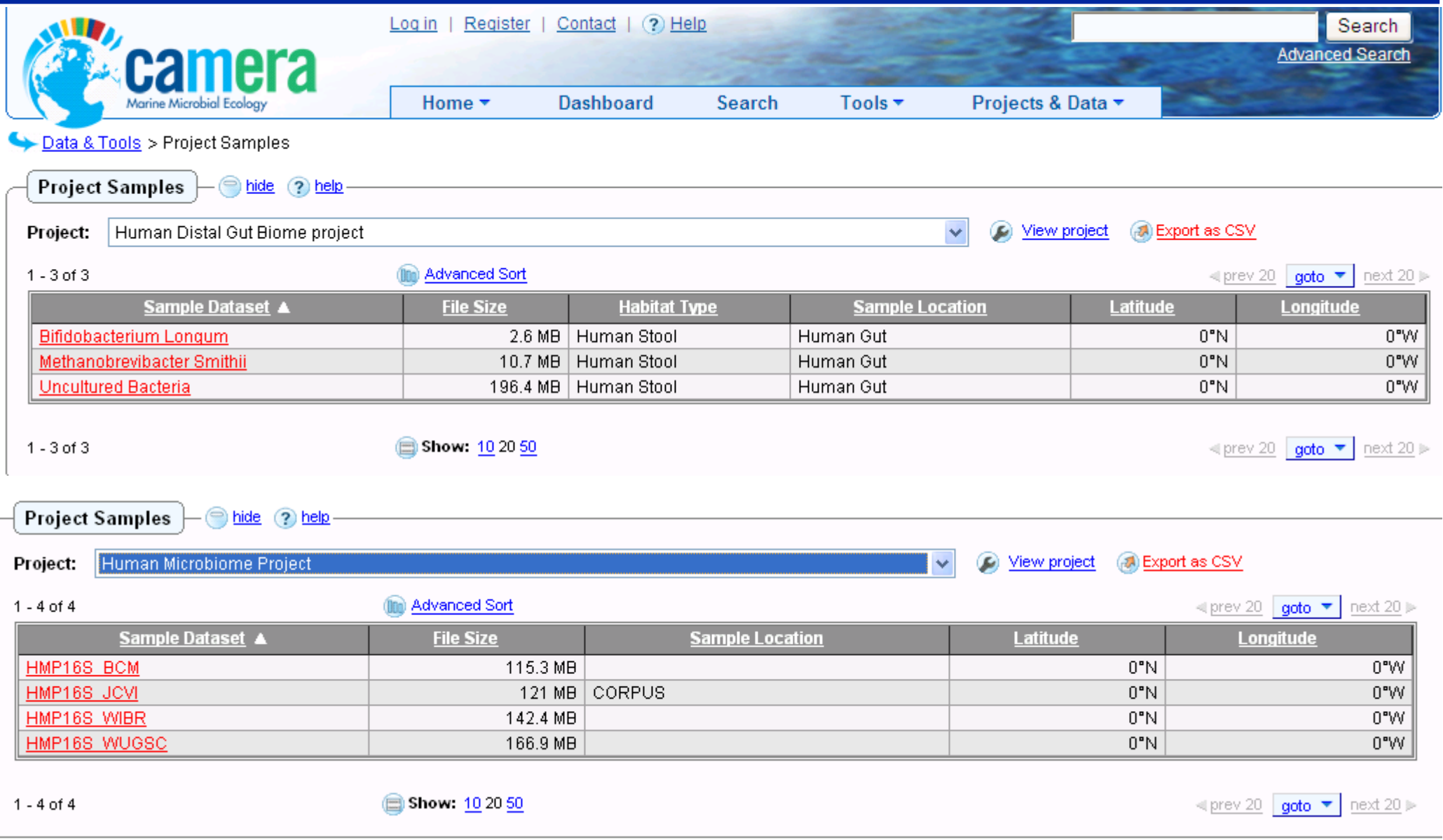


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"Diversity of the Human Intestinal Microbial Flora"
Paul B. Eckburg, et al *Science* (10 June 2005)

it²

The Human Gut is a Microbial Environment Which is Being Metagenomically Sampled



camera
Marine Microbial Ecology

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Data & Tools > Project Samples

Project Samples hide help

Project: Human Distal Gut Biome project — View project — Export as CSV

1 - 3 of 3 — Advanced Sort — prev 20 goto next 20

Sample Dataset ▲	File Size	Habitat Type	Sample Location	Latitude	Longitude
Bifidobacterium Longum	2.6 MB	Human Stool	Human Gut	0°N	0°W
Methanobrevibacter Smithii	10.7 MB	Human Stool	Human Gut	0°N	0°W
Uncultured Bacteria	196.4 MB	Human Stool	Human Gut	0°N	0°W

1 - 3 of 3 — Show: 10 20 50 — prev 20 goto next 20

Project Samples hide help

Project: Human Microbiome Project — View project — Export as CSV

1 - 4 of 4 — Advanced Sort — prev 20 goto next 20

Sample Dataset ▲	File Size	Sample Location	Latitude	Longitude
HMP16S_BCM	115.3 MB		0°N	0°W
HMP16S_JCVI	121 MB	CORPUS	0°N	0°W
HMP16S_WIBR	142.4 MB		0°N	0°W
HMP16S_WUGSC	166.9 MB		0°N	0°W

1 - 4 of 4 — Show: 10 20 50 — prev 20 goto next 20

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