JGI JOINT GENOME INSTITUTE
UNITED STATES DEPARTMENT OF ENERGY

Building a Future for Integrative & Innovative Genome Sciences @ Berkeley Lab

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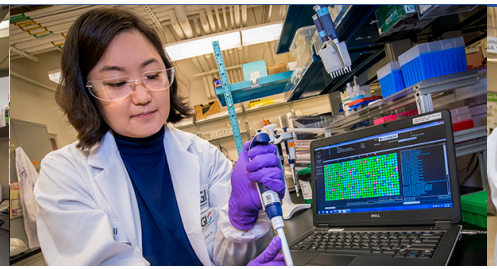
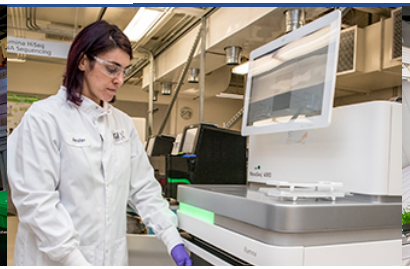
Integrative Genomics Building (IGB)
The Future Home of JGI & KBase

JGI JOINT GENOME INSTITUTE
A DOE OFFICE OF SCIENCE USER FACILITY

KBase PREDICTIVE BIOLOGY
DOE Systems Biology Knowledgebase


BERKELEY LAB

Bringing Science Solutions to the World


Joint Genome Institute: Provides enabling infrastructure for characterizing the environment…via DNA sequencing

JGI Mission

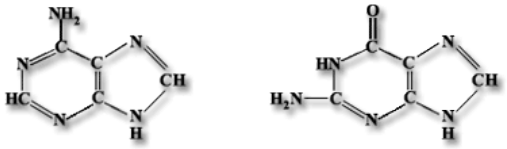

DOE JGI
Mission
To provide the global research community with integrative access to the most advanced sequencing, synthesis, molecular characterization, and genomic data science capabilities to address energy and environmental challenges relevant to the U.S. Department of Energy

What *IS* a Genome???

A GENOME is all genetic material a living thing.

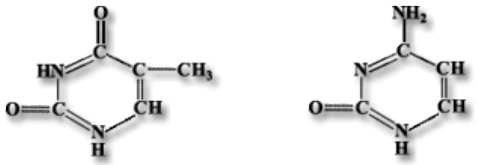
The genetic material is DNA (DeoxyriboNucleic Acid)

A



G

T



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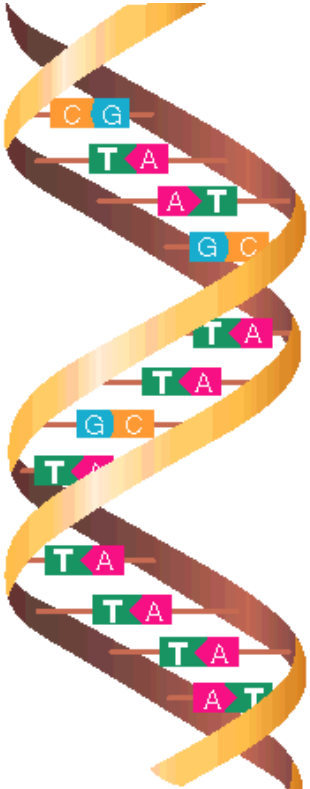
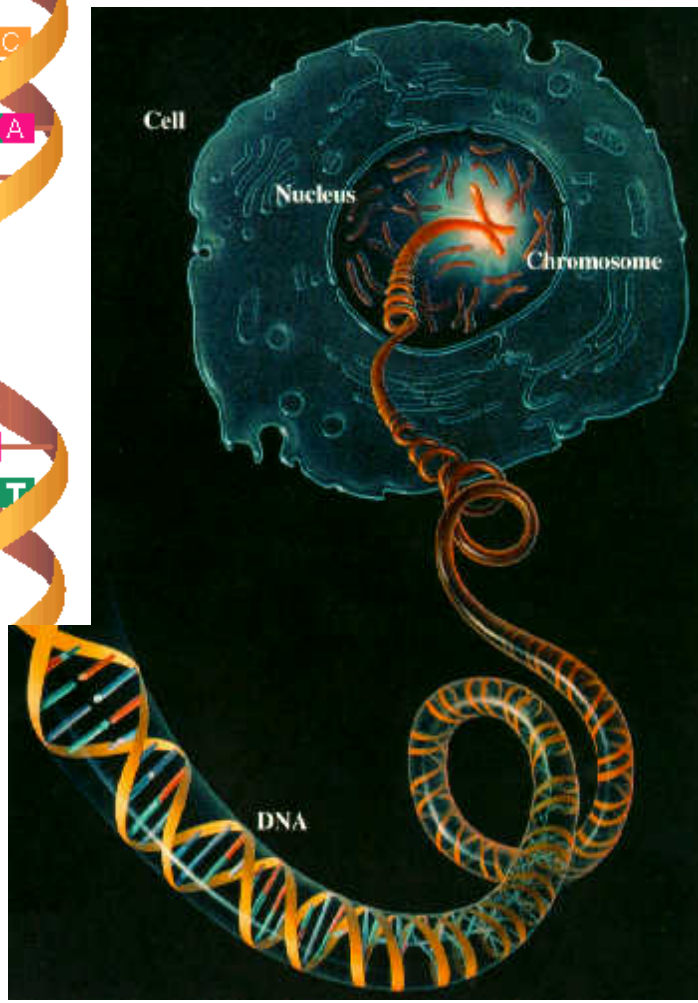




What *is* Sequencing?

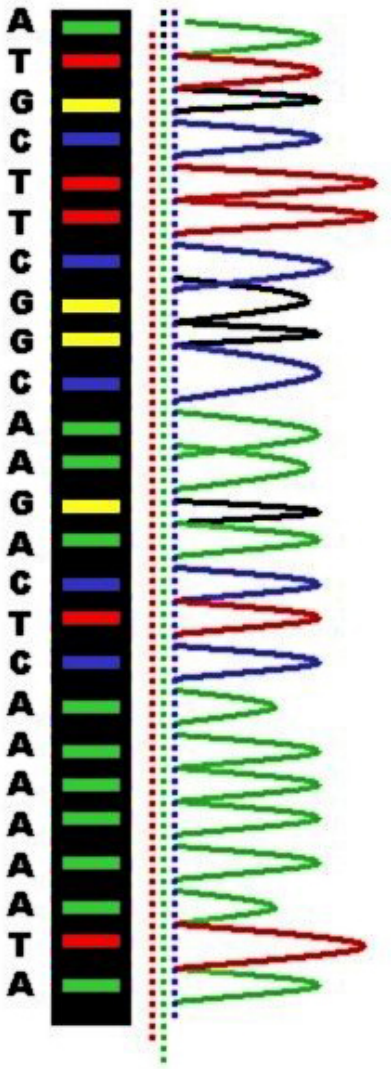
SEQUENCE = order of A, T, C, and G

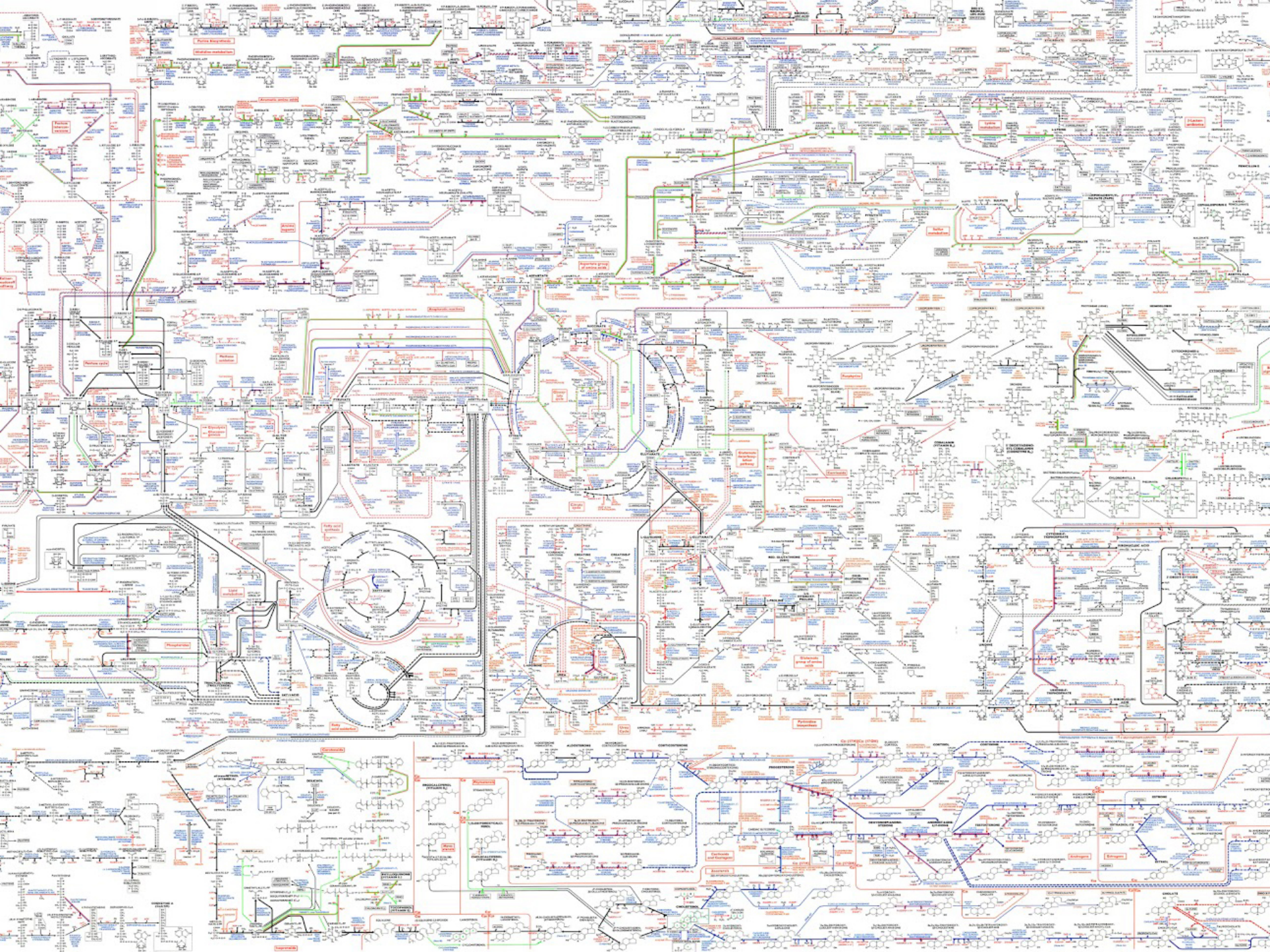
"Central Dogma of Molecular Biology"

DNA→ RNA (genes)→ Protein

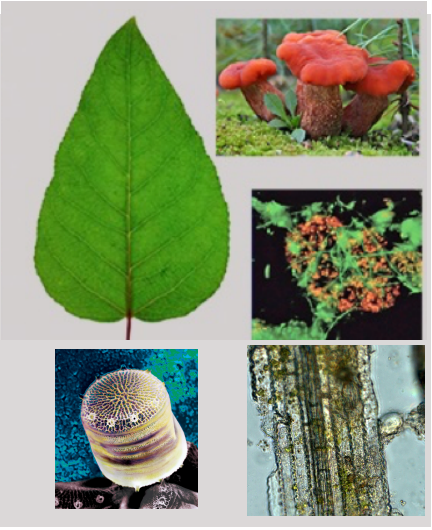
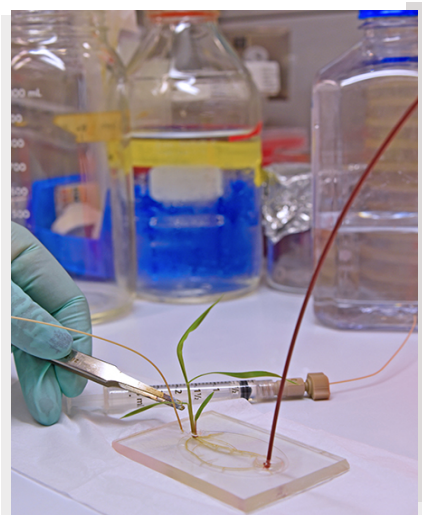
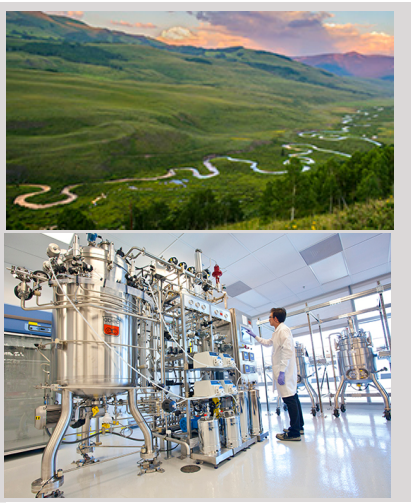
Function/Discovery/Innovation

GENOME = "software of life"





The JGI Continues to Evolve

	1997-2003	2004-2011	2012-2017	2018….
Structure	Human Genome Project	Plants, Algae, Fungi, Microbes & Communities	Host Interactions, DNA Synthesis, Metabolomics	Integrative Omics
Science				
Mission	Sequence, Assemble and Annotate **GENOMES**	Understand Gene and Genome **FUNCTION**	Model Ecosystem **SERVICES**	Harness Sequence, Functional Data for **BIOLOGY**

JGI Today

JGI JOINT GENOME INSTITUTE

We are…

U.S. DEPARTMENT OF ENERGY | Office of Science

UNIVERSITY OF CALIFORNIA

BERKELEY LAB

BioSciences

NERSC National Energy Research Scientific Computing Center

ESnet ENERGY SCIENCES NETWORK

FY2017 JGI Worldwide User Community

Users on the Map: 1,598

DOE Bioenergy Research Centers

JBEI Joint BioEnergy Inst

GREAT LAKES BIOENERGY RESEARCH CENTER

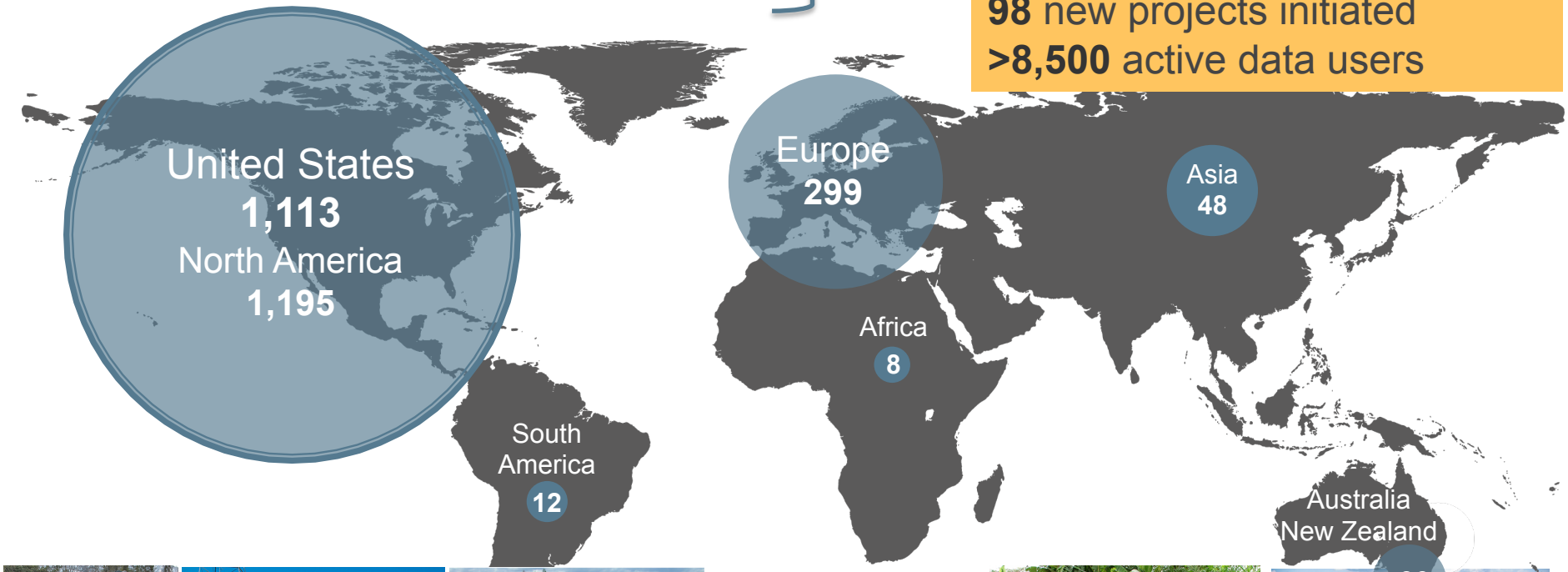
CABBI CENTER FOR ADVANCED BIOENERGY AND BIOPRODUCTS INNOVATION

cbi THE CENTER FOR BIOENERGY INNOVATION

~30%

Academic	1,130
Other	316
DOE National Laboratory	134
Industry	18

538 projects active
98 new projects initiated
>8,500 active data users



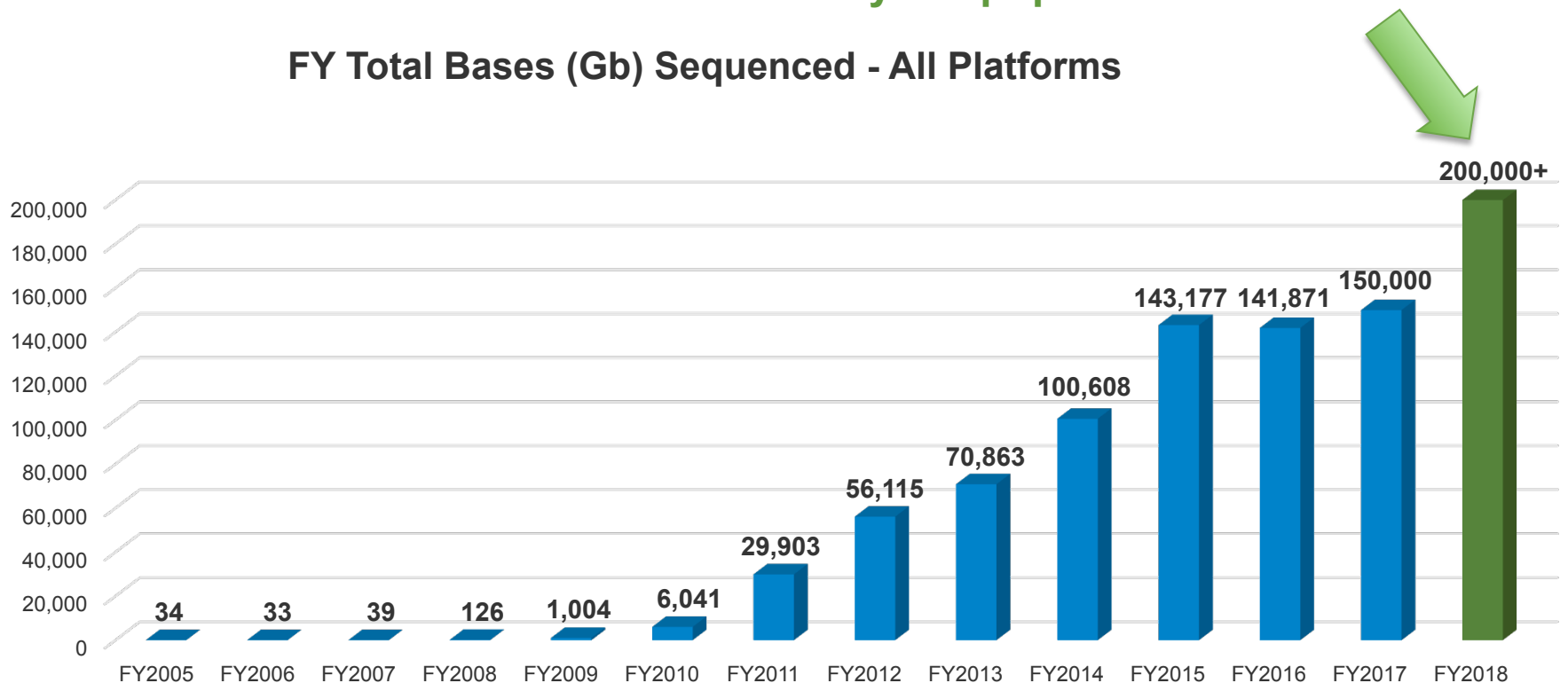




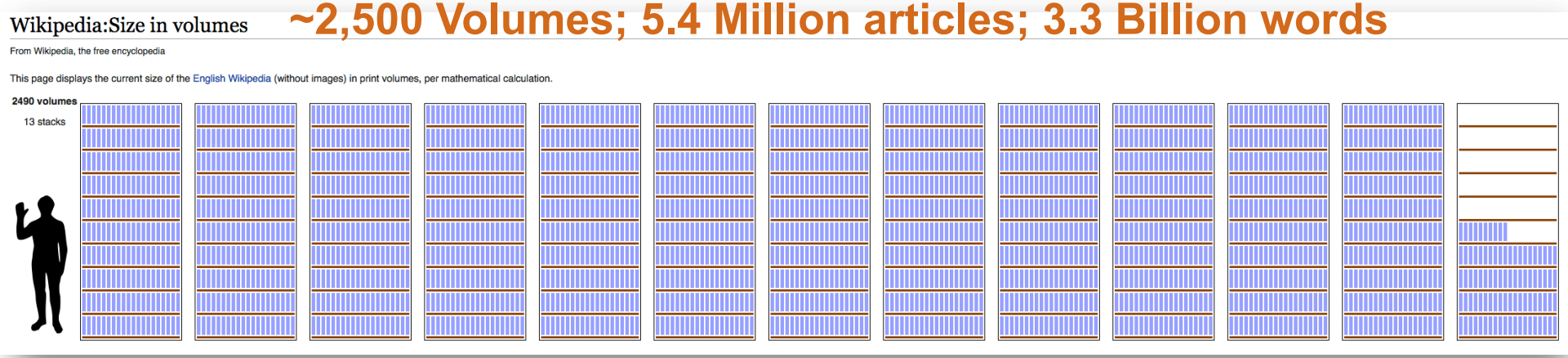

JGI Sequencing Throughput

Gb: billions of bases sequenced

>60,000 human genome equivalents – nearly the population of Walnut Creek



Flow of Data Greater than Wikipedia



~2,500 Volumes; 5.4 Million articles; 3.3 Billion words

JGI= 270,500 volumes per week = >100x Wikipedia

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CGGGACAAATTCCGGTCTAGCGGACAAATCGATTCAGGGTAGCAAATGGACAAATTC
AGCGGACAAATCGATTCGGGACAAATTCCGGTCTCAGGGTAGCAAATGGACAAATTC
AGCGGACAAATCGATTCAGGGTAGCAAATGGACAAATTCCGGGACAAATTCCGGTCT
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Digital Information is the 21st Century Equivalent of the 20st Century Highway System

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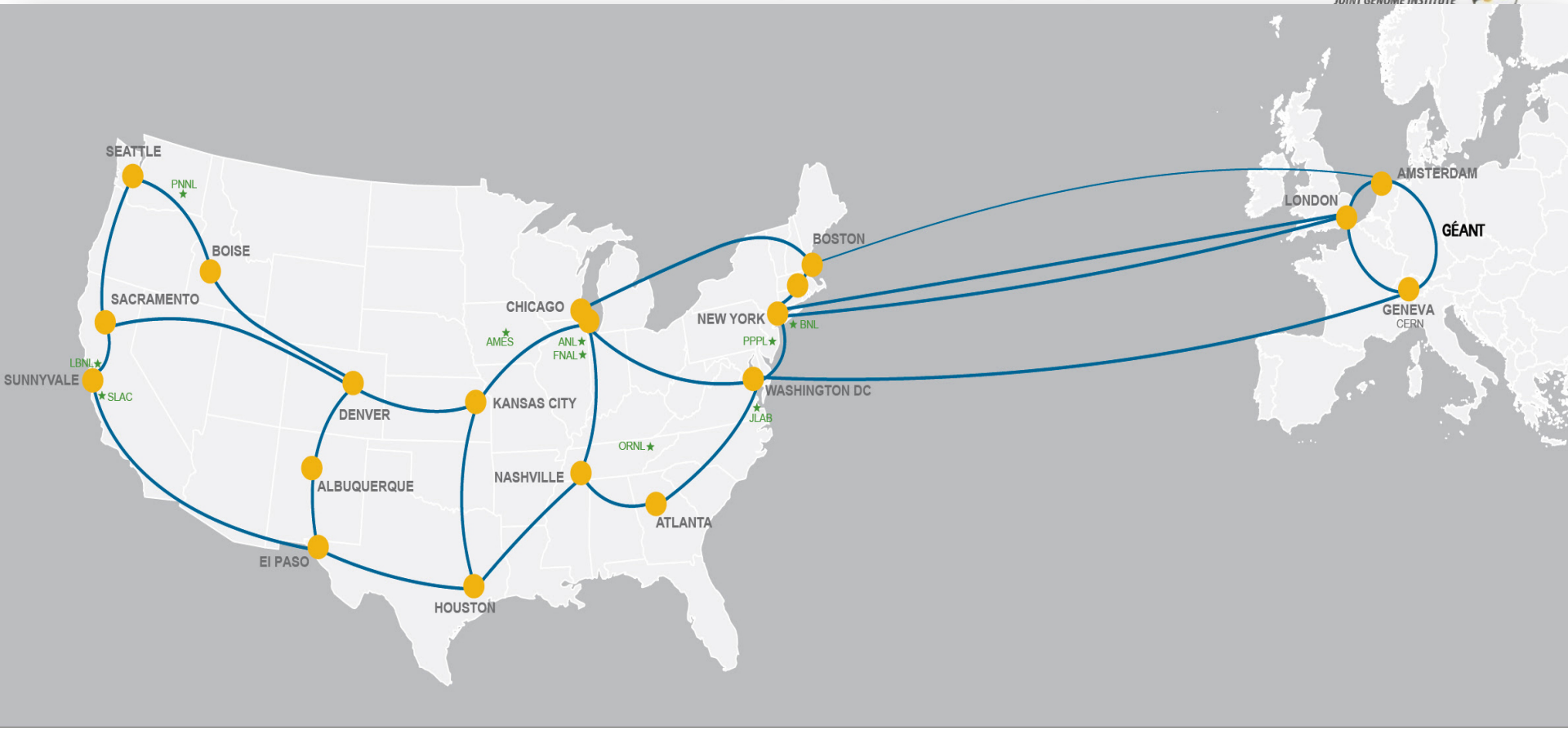


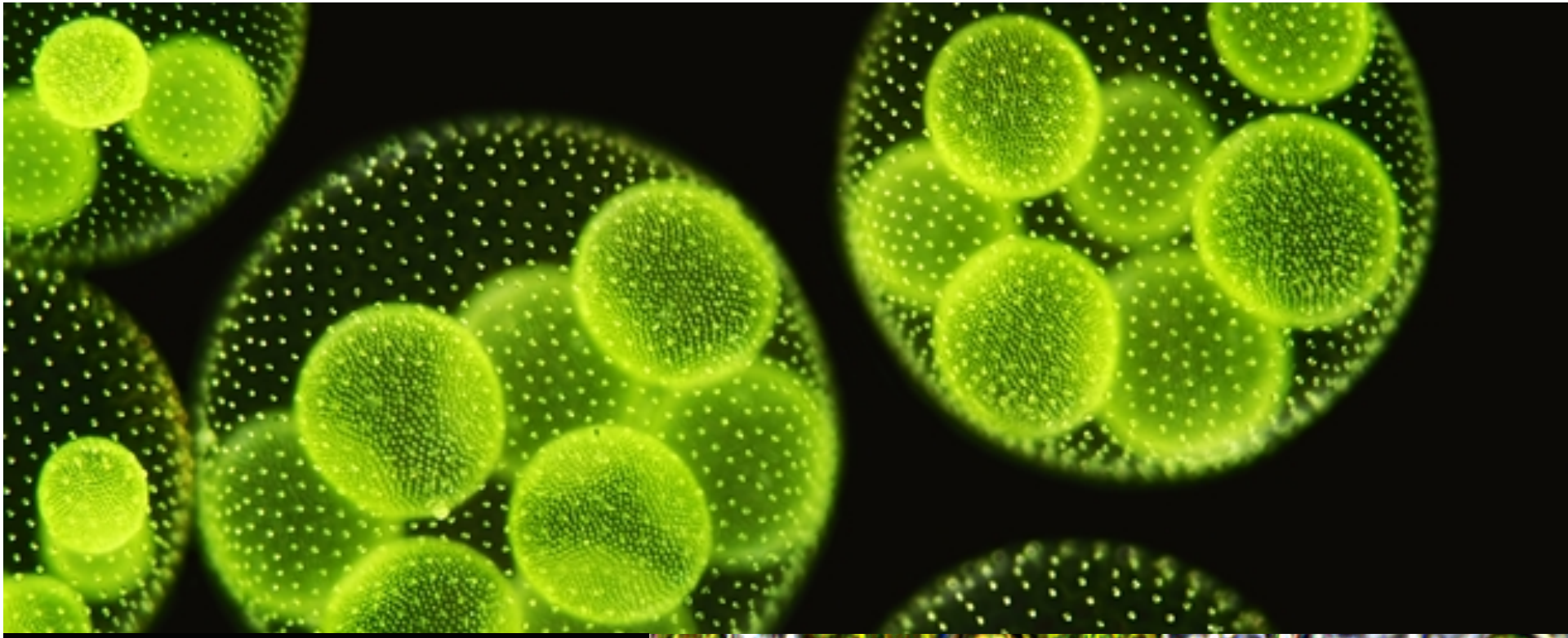
ESnet
ENERGY SCIENCES NETWORK

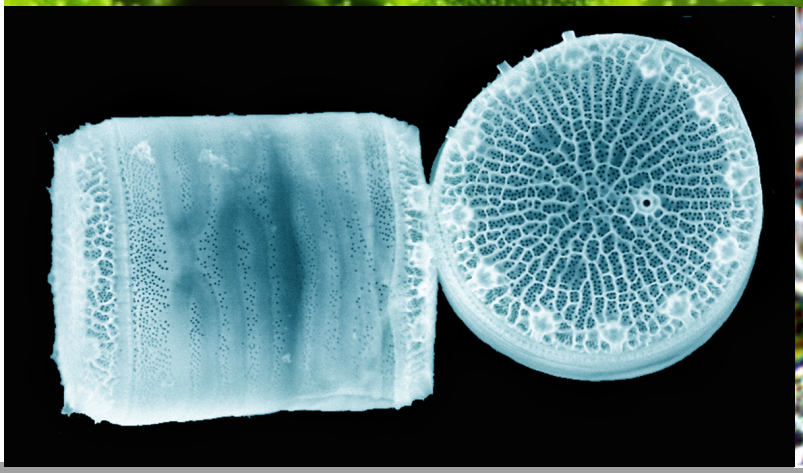
★ Department of Energy Office of Science National Labs

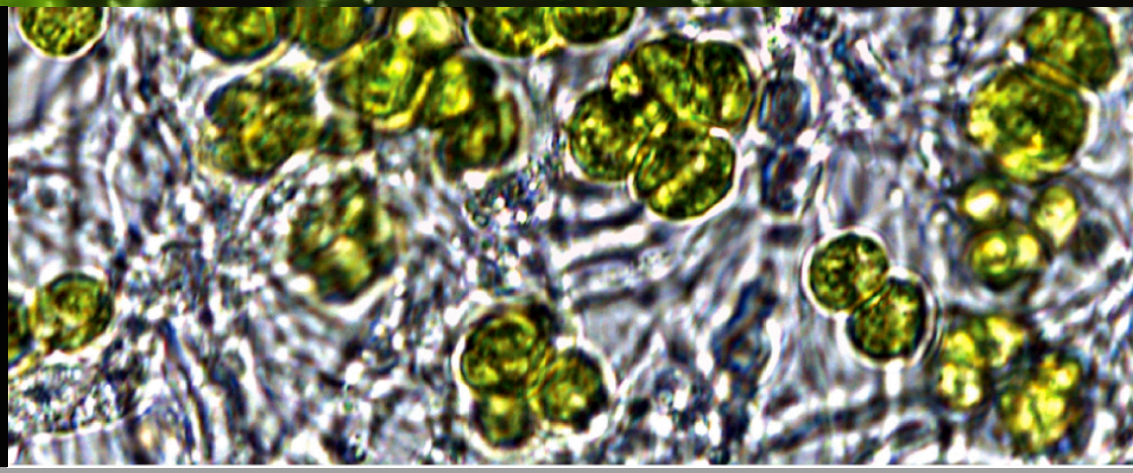
Ames	Ames Laboratory (Ames, IA)
ANL	Argonne National Laboratory (Argonne, IL)
BNL	Brookhaven National Laboratory (Upton, NY)
FNAL	Fermi National Accelerator Laboratory (Batavia, IL)
JLAB	Thomas Jefferson National Accelerator Facility (Newport News, VA)
LBNL	Lawrence Berkeley National Laboratory (Berkeley, CA)
ORNL	Oak Ridge National Laboratory (Oak Ridge, TN)
PNNL	Pacific Northwest National Laboratory (Richland, WA)
PPPL	Princeton Plasma Physics Laboratory (Princeton, NJ)
SLAC	SLAC National Accelerator Laboratory (Menlo Park, CA)

Plants – “Solar Panels”

Algae – “Lipid Producers”







Fungi – “Enzyme Producers”

Bioprospecting for Enzymes

Biomass Breakdown for Biofuel—Guts, Hot Pools & Fungi

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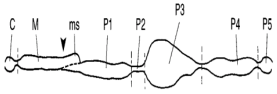
5µl



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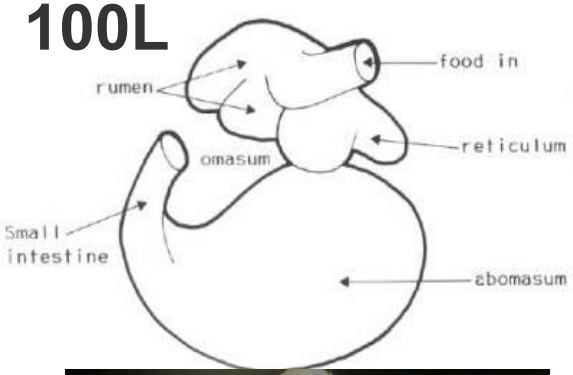
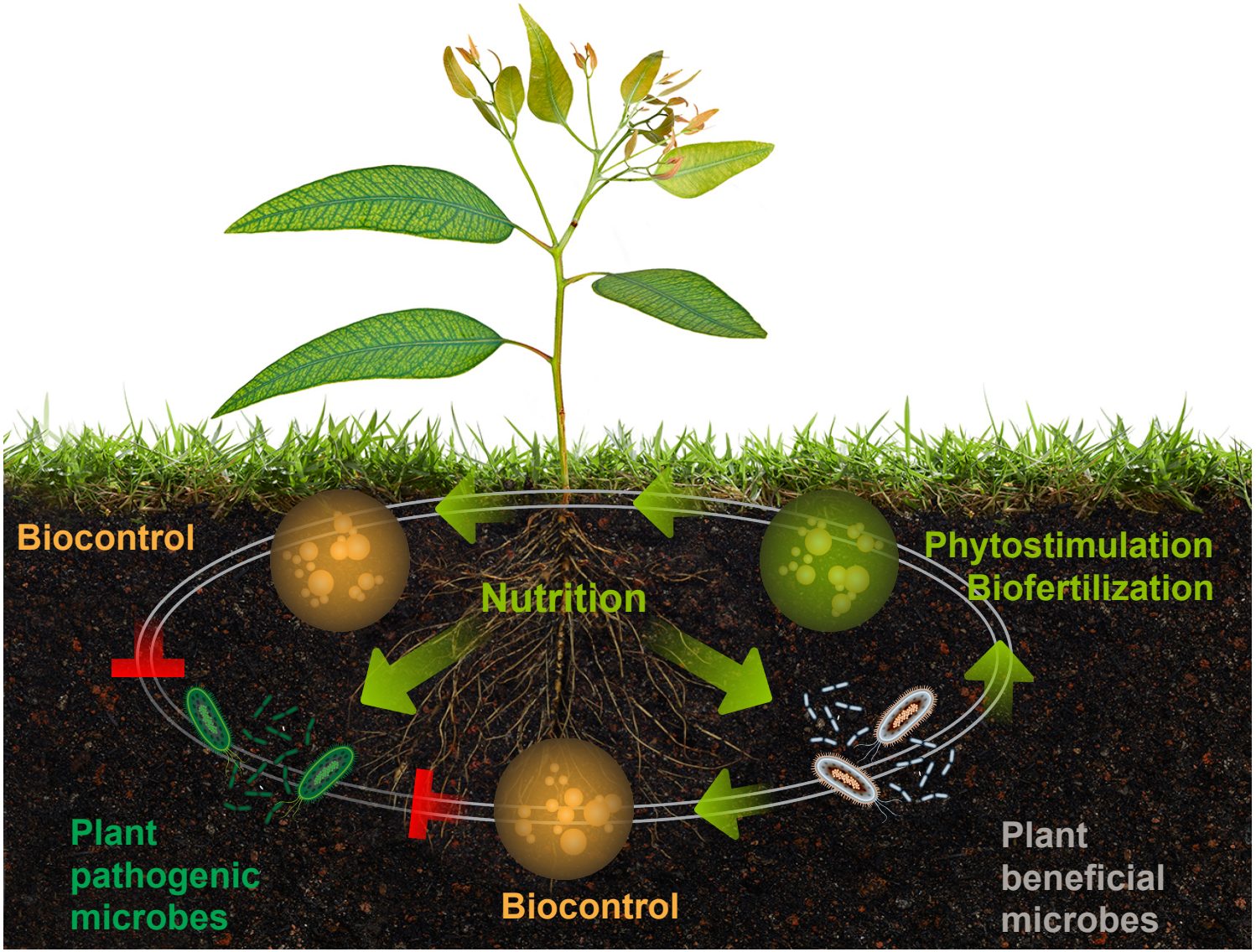


Earth: The Final Frontier…

Astronomers:
100 billion stars in our Milky Way Galaxy

Microbiologists:
100 billion cells in a handful of soil

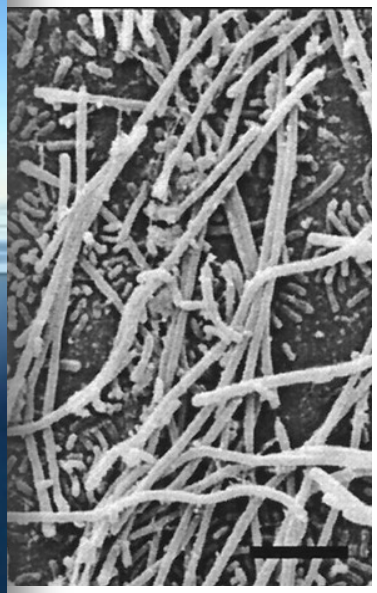
Why Soil?

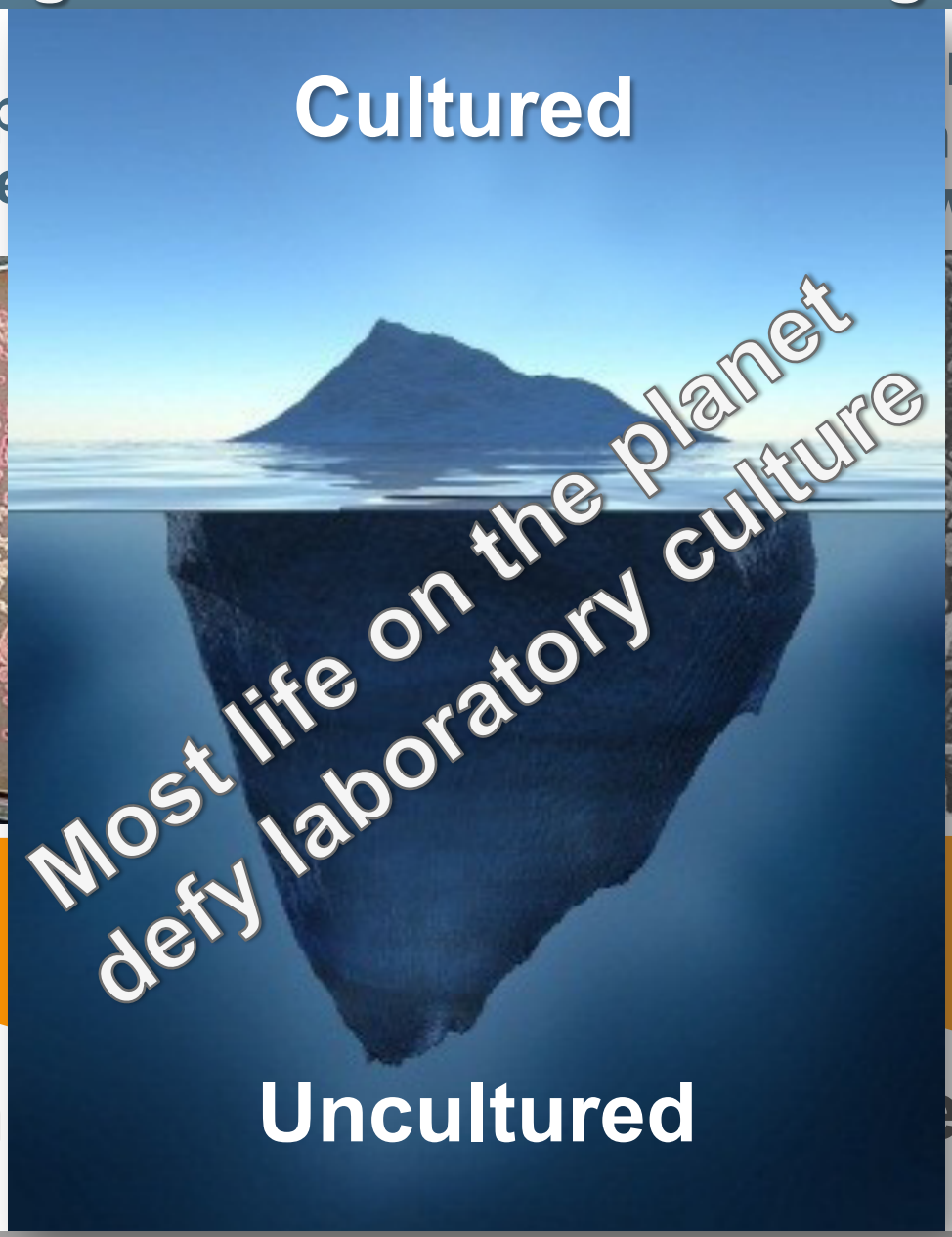

Biocontrol
Nutrition
Phytostimulation
Biofertilization
Plant
pathogenic
microbes
Biocontrol
Plant
beneficial
microbes

Characterizing the Earth Microbiome: Overcoming the Cultivation Challenge

Isolate (p
"Dome

ntal Microbial
mmunity
Wild"





Gen

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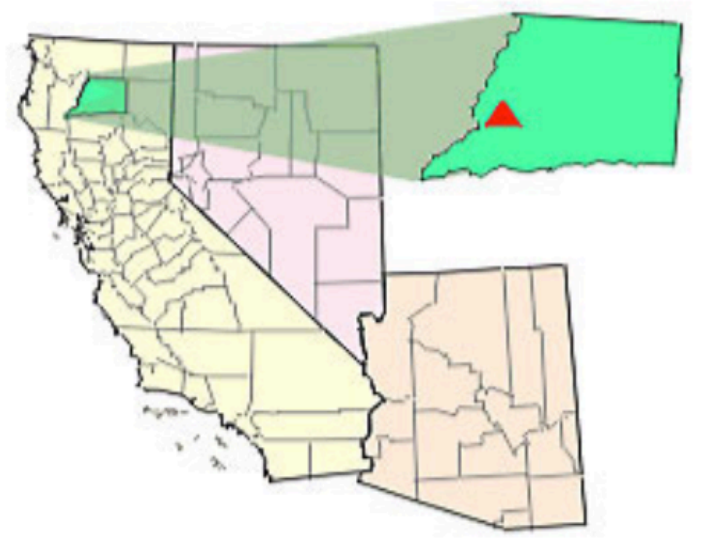
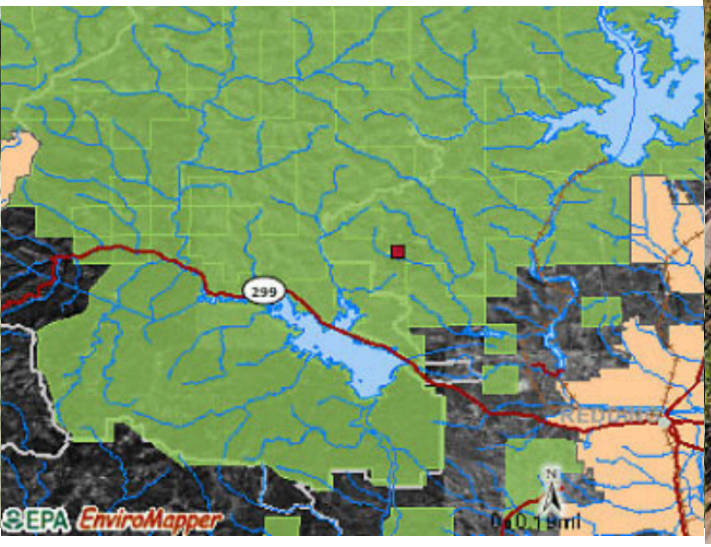
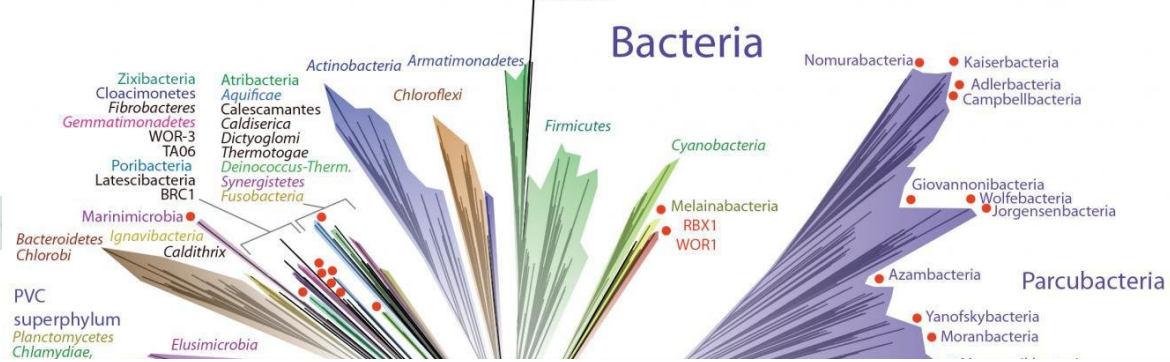
Extremeophiles→Metagenomics

Iron Mt./The Richmond Mine: Extremophiles



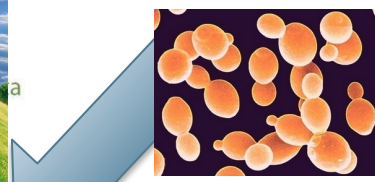




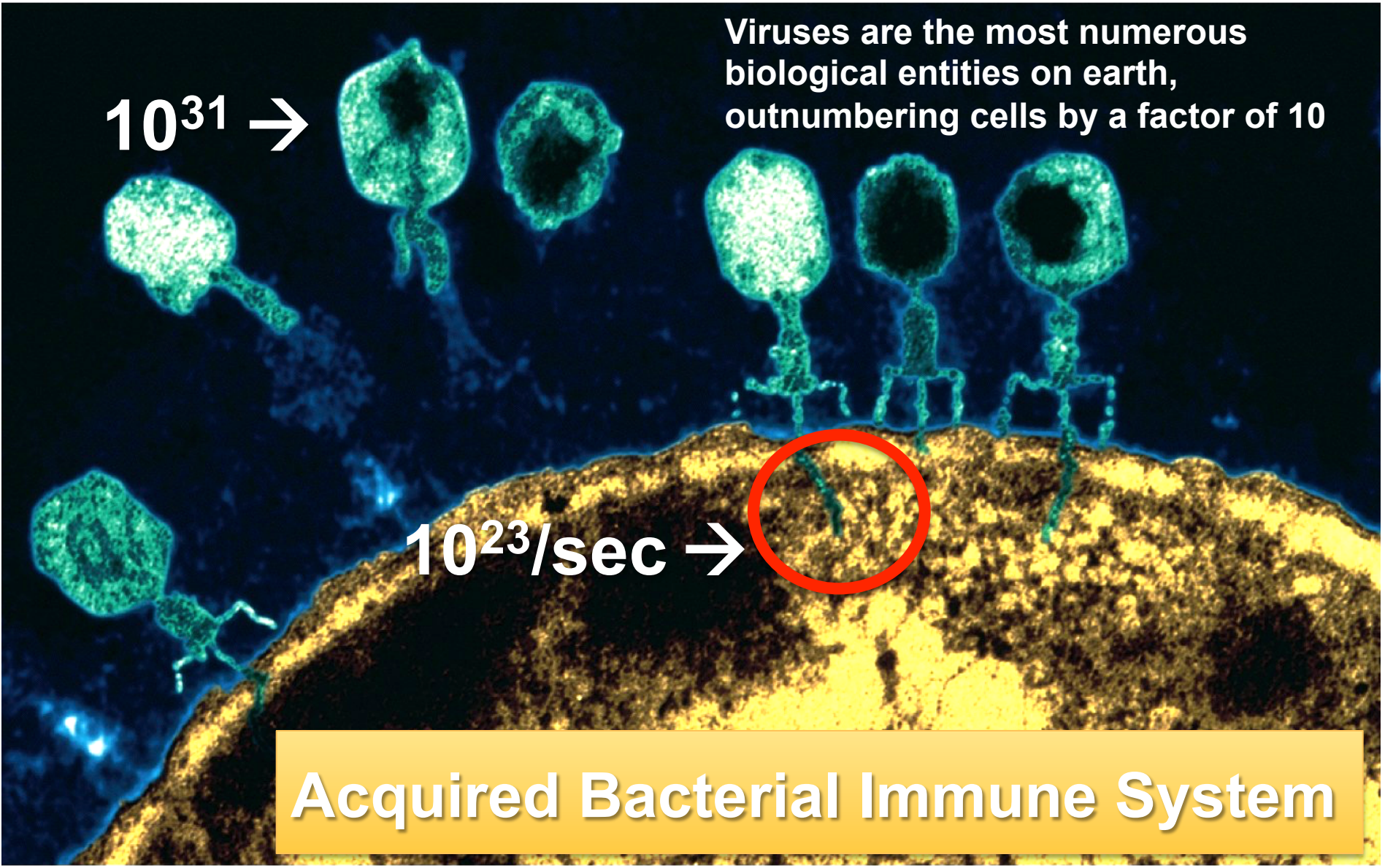
Letter | OPEN

Now >31,000 genomes from all three domains of life –Bacteria, Archaea and Eukarya– in the Joint Genome Institute's databases

The tree of life is one
biology[1]. Gene surveys
branches[2], but even ar
remained elusive. Rece
either on the nature o
known, well-classified



Bacteriophage: Viruses that Infect Bacteria



The Power of Genome Editing

Clustered, **R**egularly **I**nterspaced, **S**hort **P**alindromic **R**epeat **(CRISPR)** technology, for generating RNA-guided nucleases, such as Cas9, with customizable specificities.

UC Berkeley/Berkeley Lab JGI Connection

HOME SEARCH The New York Times

SCIENCE

Jennifer Doudna, a Pioneer Who Helped Simplify Genome Editing

Profiles in Science

By ANDREW POLLACK MAY 11, 2015

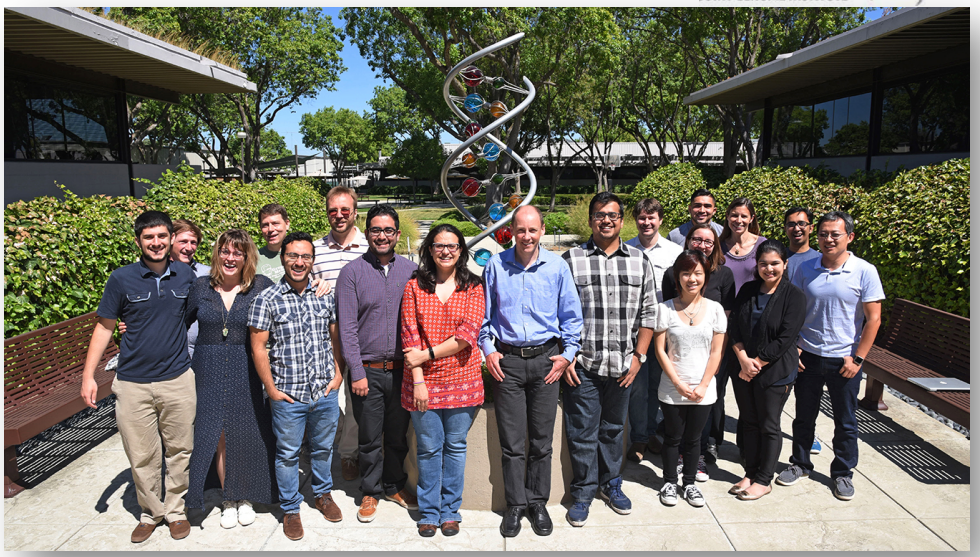
In 2005, Dr. Doudna was approached by Jillian Banfield, an environmental researcher at Berkeley who had been sequencing the DNA of unusual microbes that lived in a highly acidic abandoned mine. In the genomes of many of these microbes were unusual repeating sequences called "clustered regularly interspaced short palindromic repeats," or Crispr.

No one was quite sure what they did, though over the next few years scientists elsewhere established that these sequences were part of a bacterial immune system. Between the repeated sequences were stretches of DNA taken from viruses that had previously infected the bacteria — genetic most-wanted posters, so to speak.

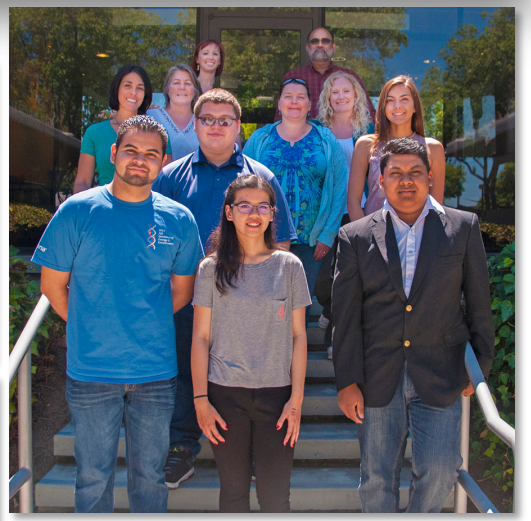
If the same virus invaded again, these stretches of DNA would permit the bacteria to recognize it and destroy it by slicing up its genetic material. Dr. Doudna was trying to figure out exactly how this happened.

Education Outreach:
Inspiring/Preparing the Next Generations

- **UC Merced Distinguished Genomics Graduate Internship Program**:
  - Founded in 2014 to provide hands-on experience genomics technologies and informatics
  - Expanded to undergrads in 2015
  - Partial support through California Louis Stokes Alliance for Minority Participation (CAMP)
- **Biotech Partners/Antioch High School Summer Internships**
- **LBNL Internship Programs:**
  - SULI (Science Undergraduate Laboratory Internship)
- **School Tours Programs:**
  - >12 High School & Community College, University facility tours per year
- **Classroom Speakers/Special Events**

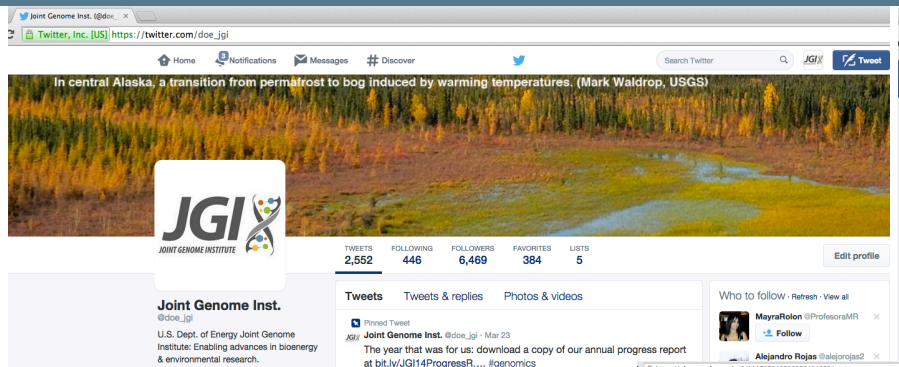


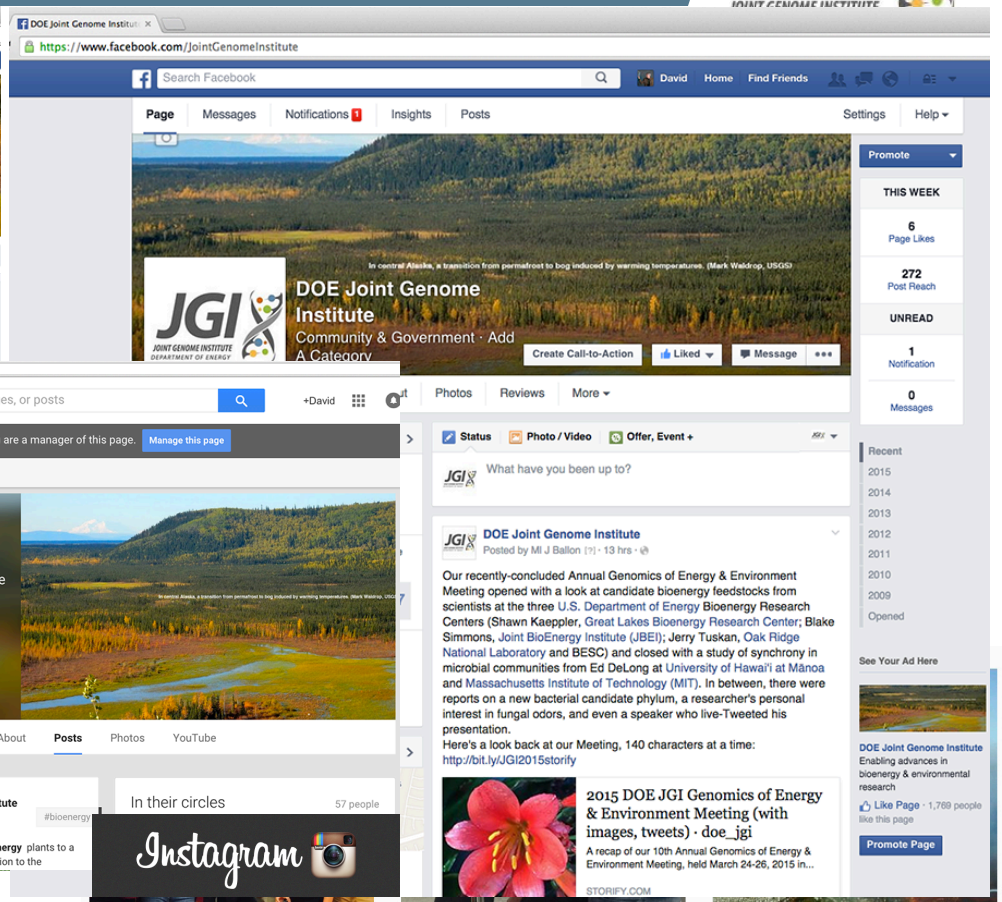
2017 UC Merced cohort

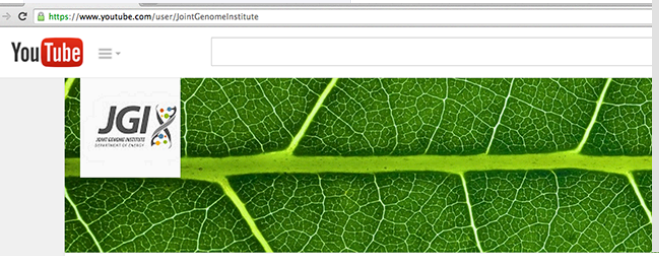


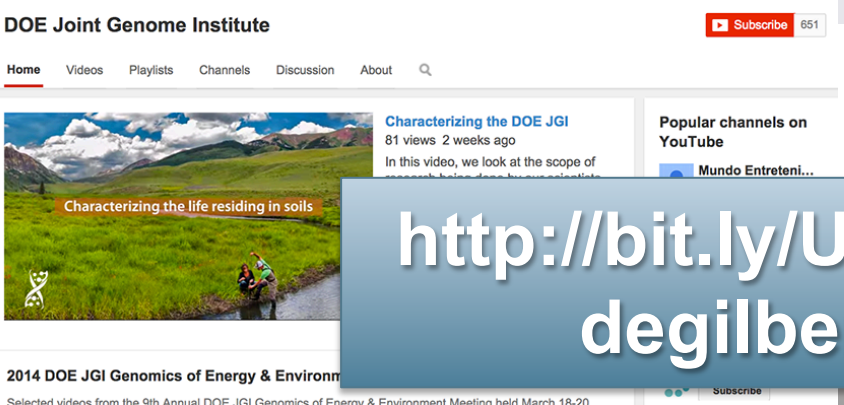
2016 Antioch High School cohort

Follow us…socially: @JGI









http://bit.ly/User-Facility-JGI

degilbert@lbl.gov