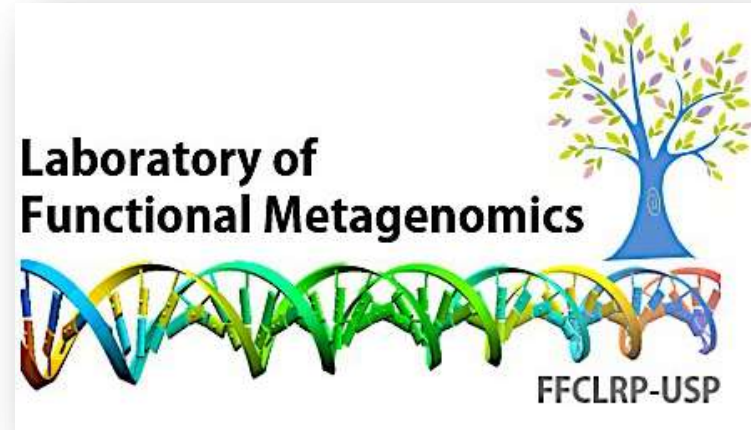
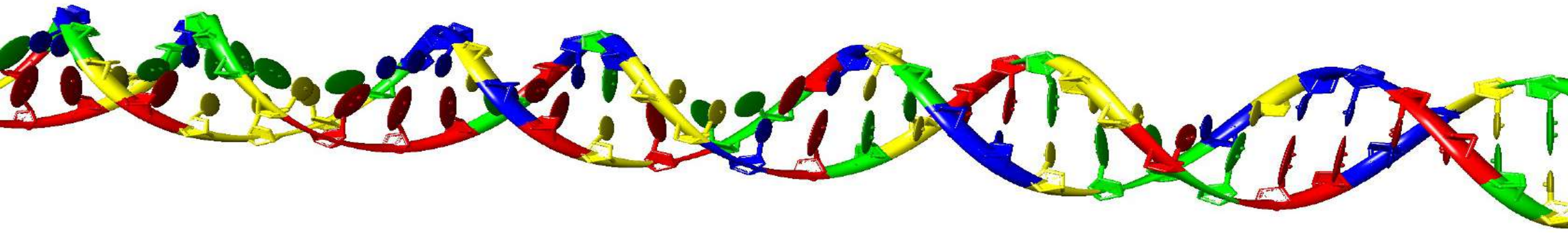


A megadiversidade escondida no mundo microbiano



Profa. María Eugenia Guazzaroni



Microrganismos e seu relacionamento com o homem

(desde o mundo do invisível)



Deterioração dos alimentos

Crescimento de microrganismos utilizando os nutrientes dos alimentos



Produção de novos alimentos

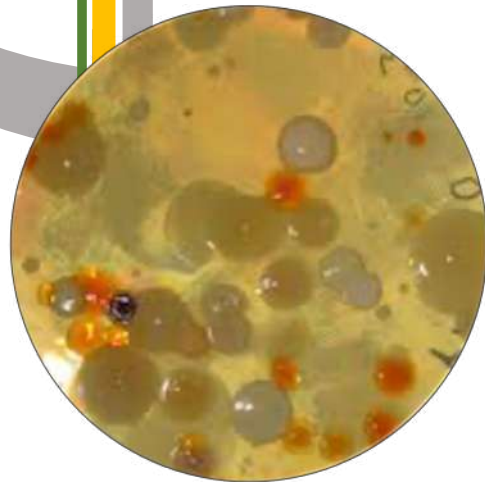
O processo fermentativo altera as características iniciais dos alimentos



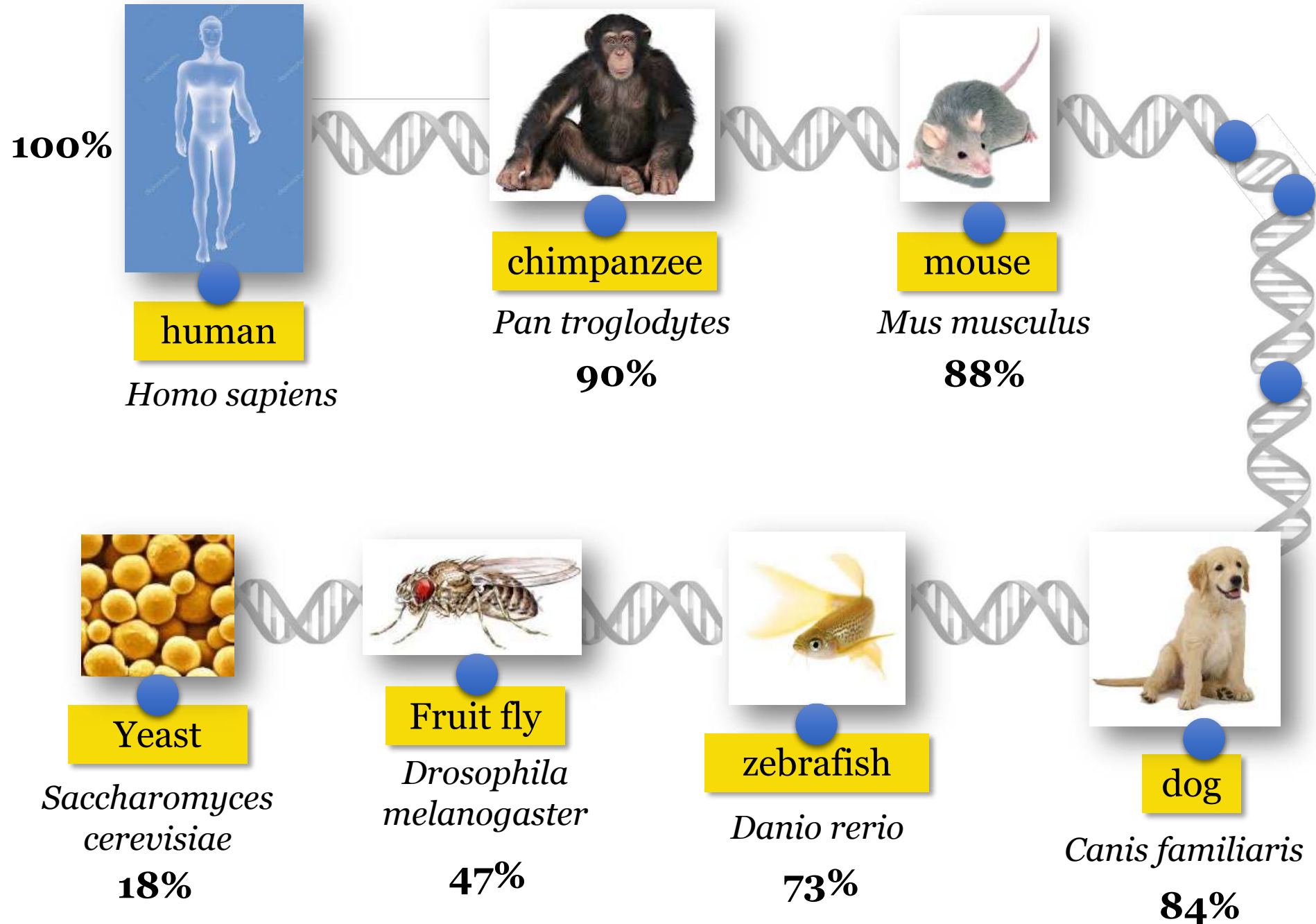
Microbiome

Sistema imune, disbiose e doenças

Porcentagem genética compartilhada entre diferentes espécies



Shared genetic percentage between different species





Up to 30% of difference
between the same specie
at genome level



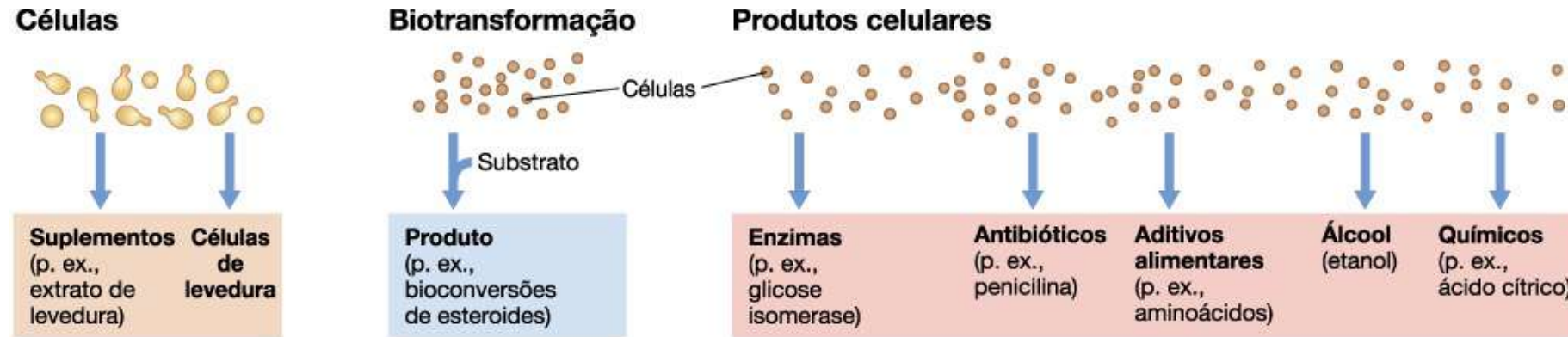
Single mutations can
produce phenotypic
variations



Norbert Pfennig

Carotenoid pigments of
phototrophic purple bacteria
(*Rhodospirillum rubrum*)

Diversity of microbial metabolism



high performance conditions



Industrial Microbiology & Bioeconomy

Until the year 2000, all the microorganisms that were studied needed to be cultivated first...



Total vs. cultivatable microbial diversity

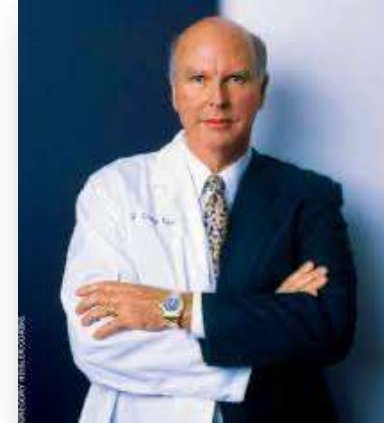


soil



viable cell counts after
cultivation

cultivation based methods find less than 3% of
the bacterial and archaeal species in a sample



Craig Venter

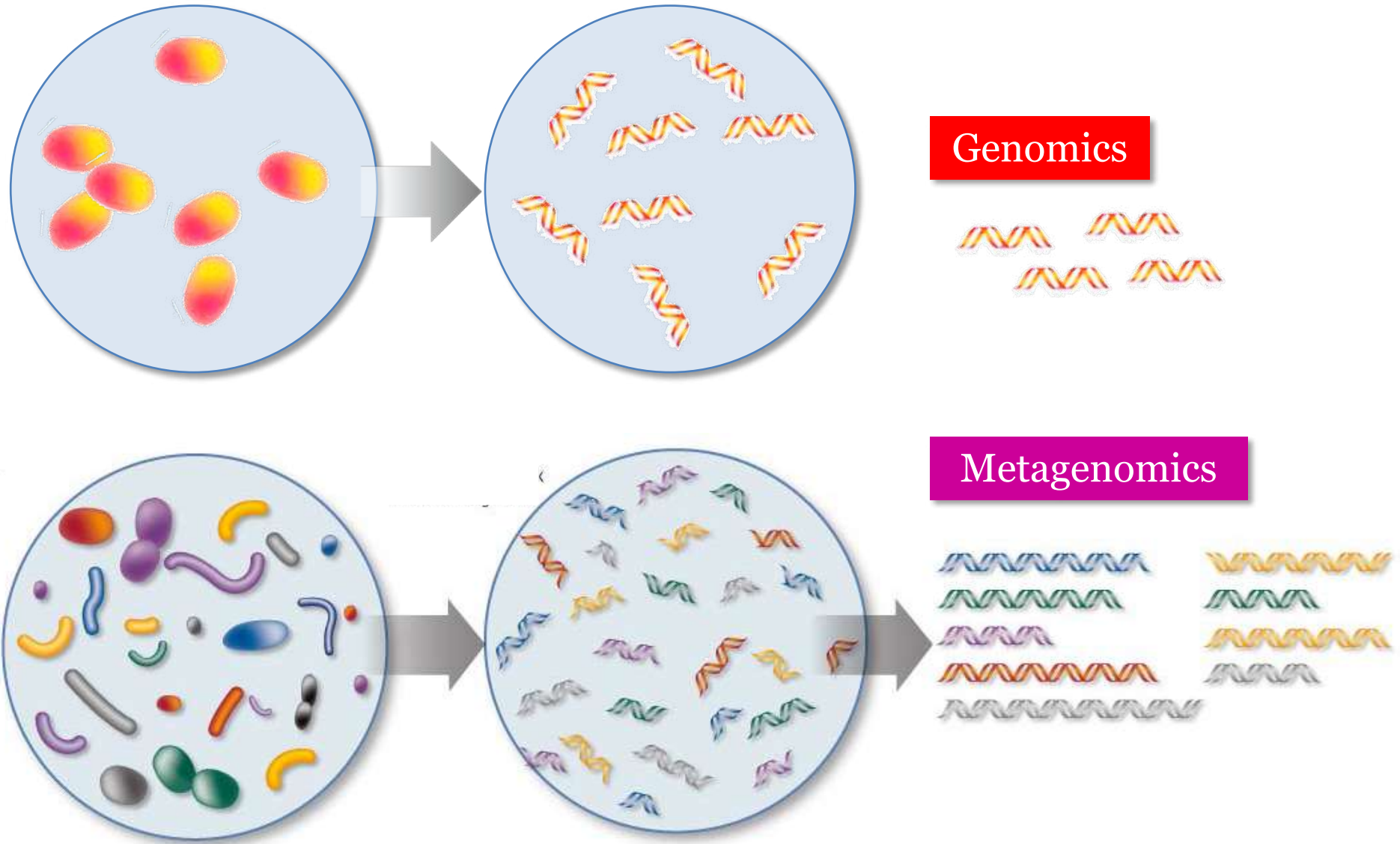
Metagenomics allows to sequence new organisms that can not be cultivated in the lab

- 1.2 milhões de genes previamente desconhecidos
- 148 linhagens bacterianas inéditas

Venter et. al., 2004. Science

Metagenomic is analogous to genomic

But the genome is not from a single microbe, but from an entire community



At present we do not know the extension of the functional diversity that microbes have

Microbial abundance

- 10^6 microbial species (OTUs*) estimated worldwide
- ~10.000 microbial species documented

Microbial total numbers

- 6×10^7 – 4.8×10^9 cells per ml or gram
- 6×10^{30} prokaryotes are estimated worldwide
- ~150.000 documented microorganisms



*operational taxonomic units (OTUs, 16S-V4 gene clusters at 97% similarity)



**...Como se estuda a diversidade dos
microrganismos?**

Molecular clocks

The 16S rRNA gene:

- ✓ Universally represented
- ✓ Conserved
- ✓ No protein coding
- ✓ Base pairing (helix)
- ✓ Proper size

Carl Woese (1977)

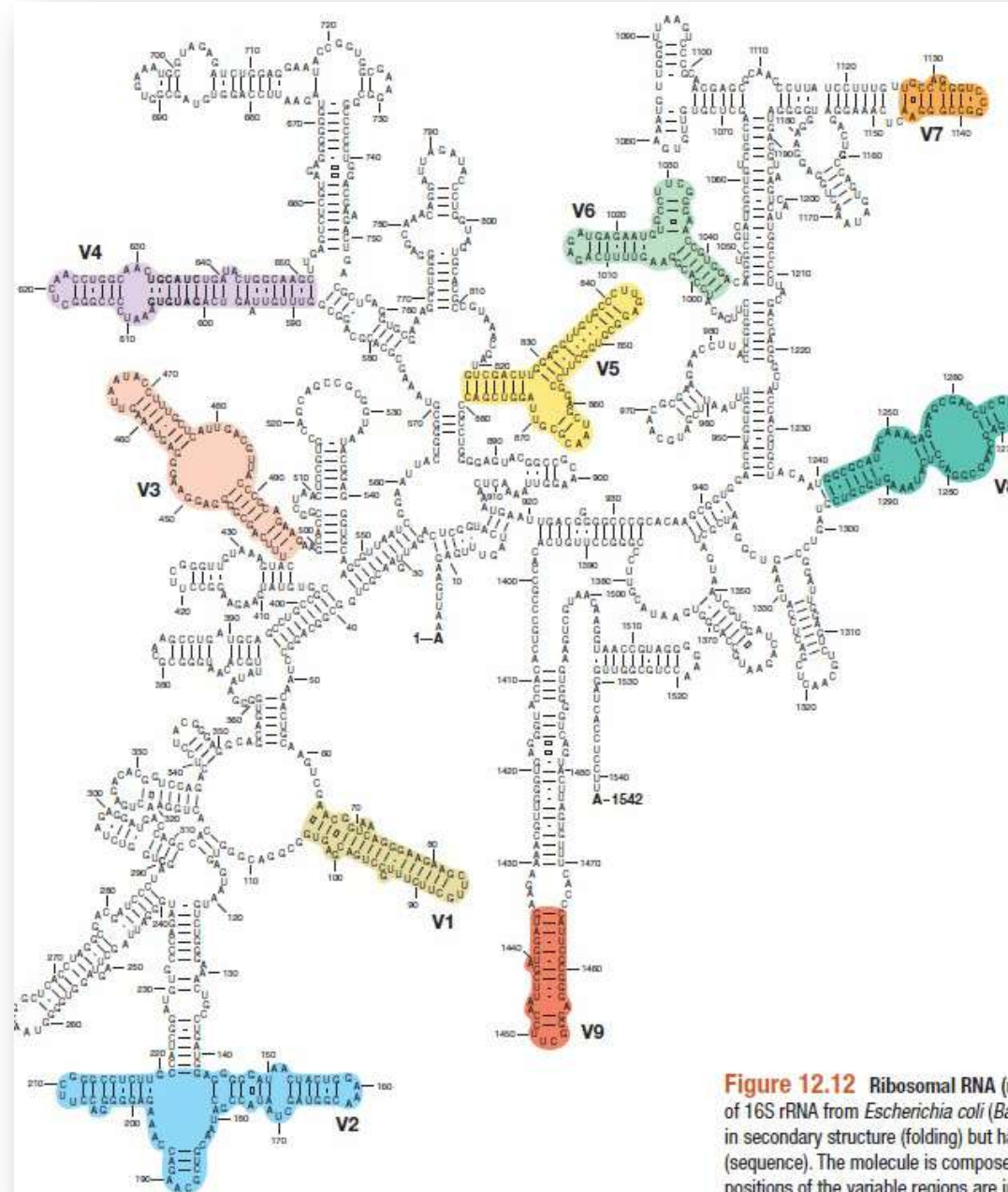


Figure 12.12 Ribosomal RNA (rRNA). Primary and secondary structure of 16S rRNA from *Escherichia coli* (Bacteria). The 16S rRNA from *Archaea* is similar in secondary structure (folding) but has numerous differences in primary structure (sequence). The molecule is composed of conserved and variable regions. The positions of the variable regions are indicated in color.

Phylogeny based in rRNA gene: the three domains of the life

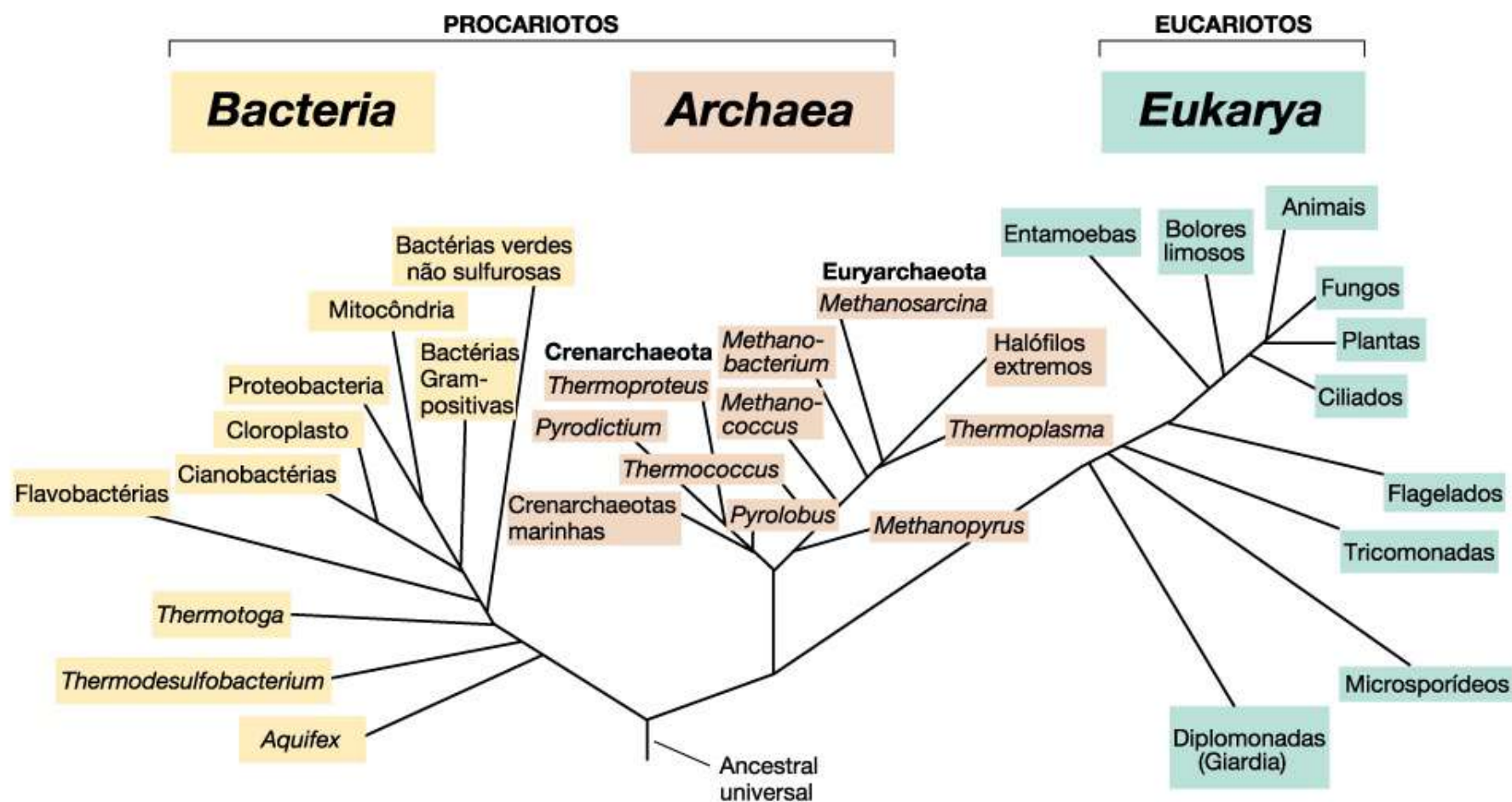


Figura 14.16 Árvore filogenética universal, determinada pela análise comparativa de seqüências do gene de rRNA. São apresentados apenas alguns dos principais organismos ou linhagens de cada domínio. Dos três domínios, dois (*Bacteria* e *Archaea*) contêm apenas organismos desprovidos de núcleo envolto por membrana (células procarióticas,  Seção 2.5).

Phylogeny based in 16S rRNA gene

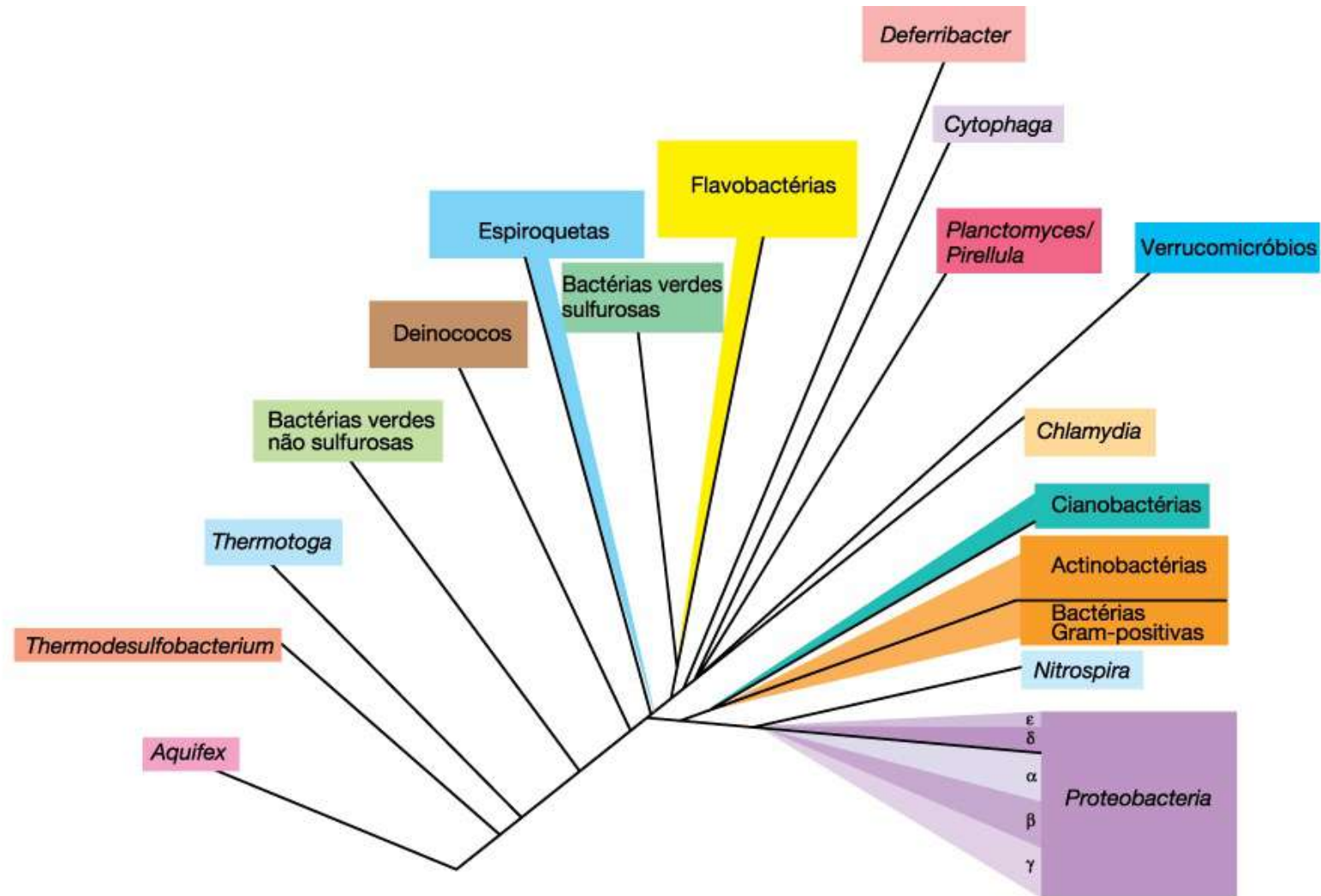
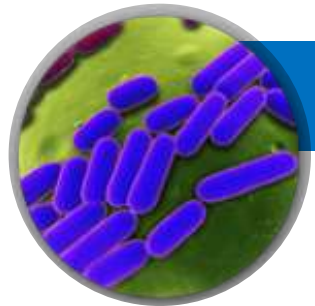
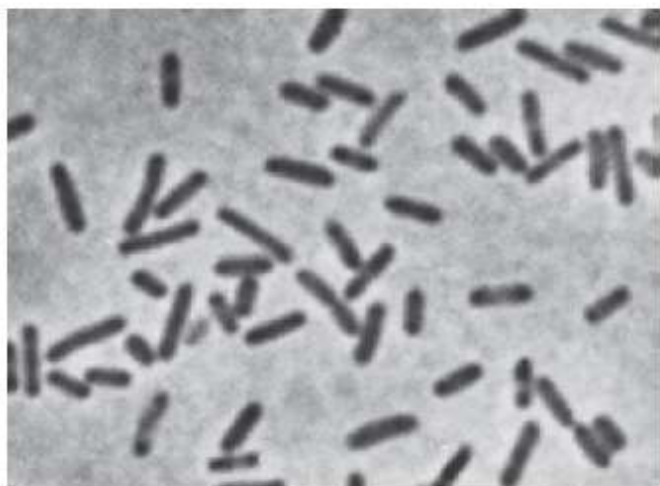


Figura 15.1 Principais linhagens (filos) de *Bacteria*, com base nas comparações das seqüências do gene de RNA ribossomal 16S. Atualmente são conhecidos mais de 80 filos de *Bacteria*, incluindo muitos filos conhecidos somente a partir de seqüências ambientais obtidas em amostragens de comunidades.

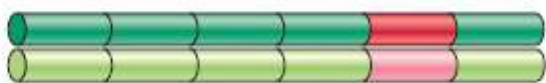


Como se faz filogenia molecular?



Norbert Pfennig

1. Isolate DNA.

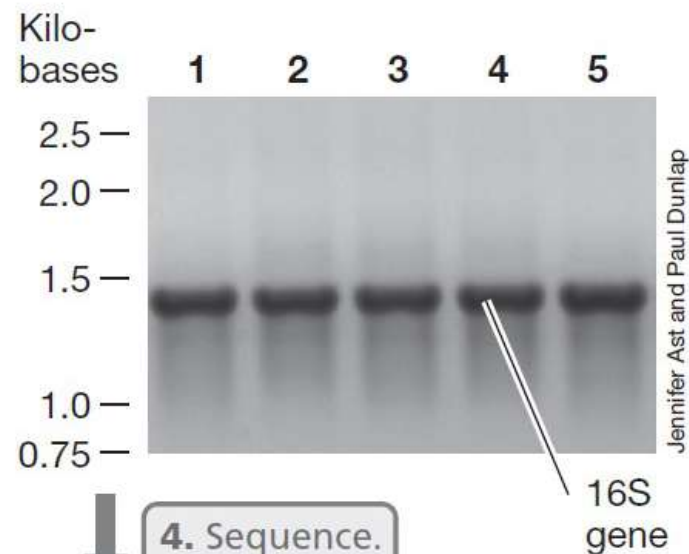


16S gene

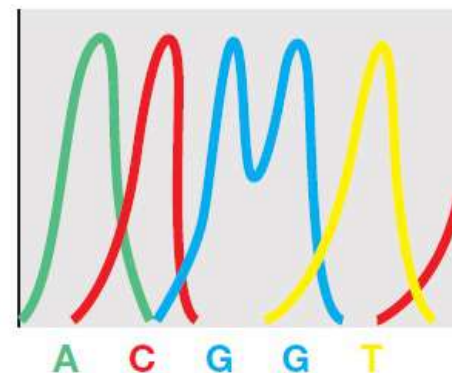
2. Amplify 16S gene by PCR.



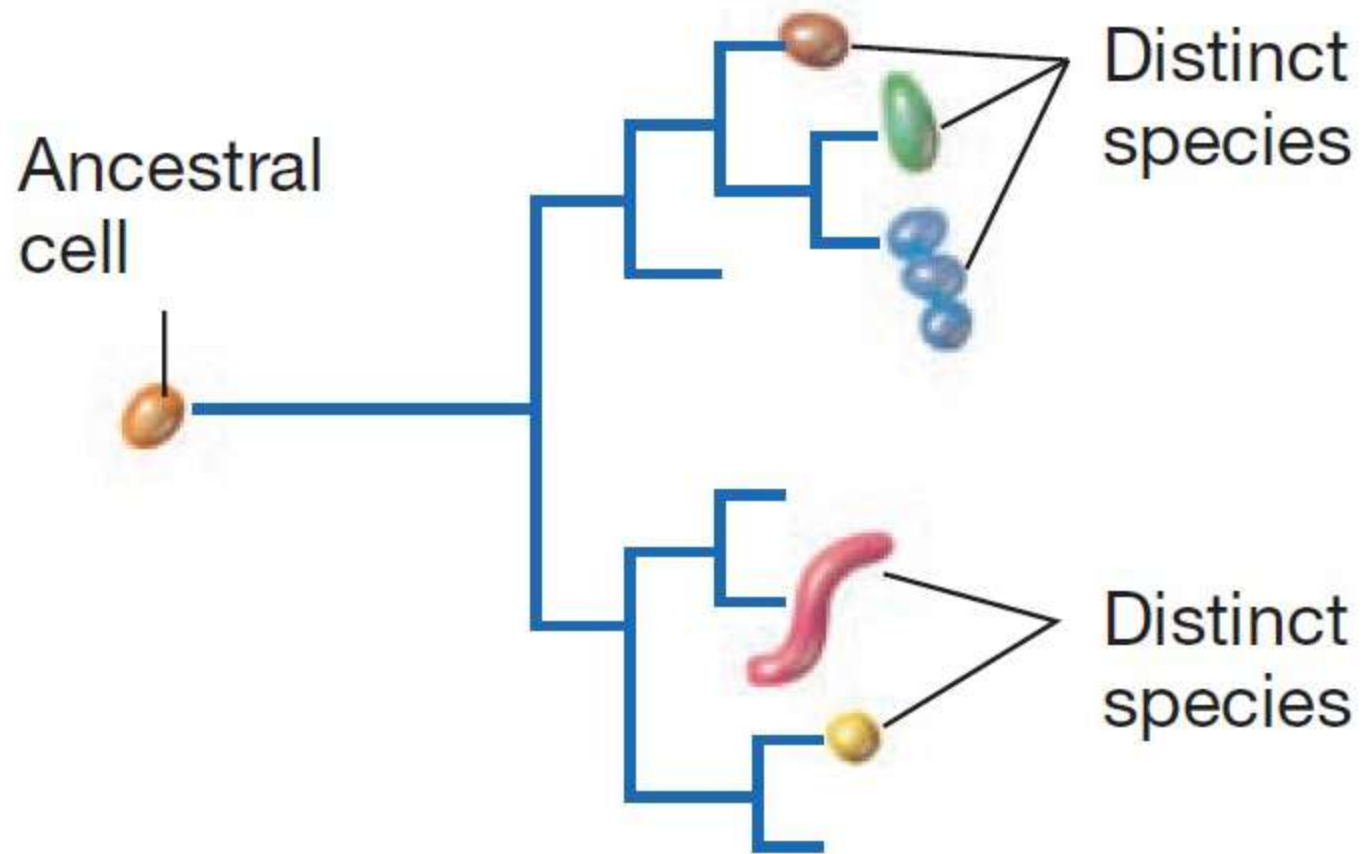
3. Run on agarose gel; check for correct size.



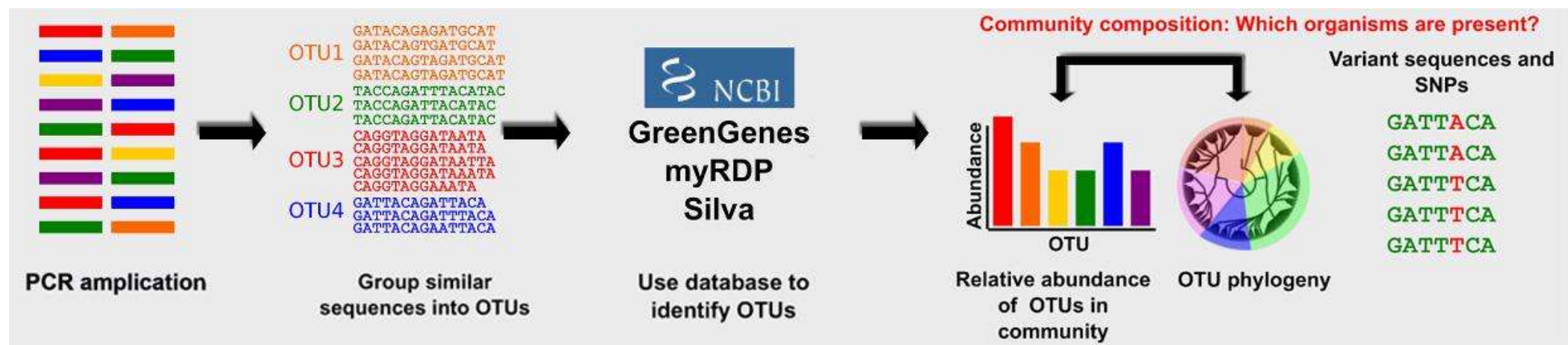
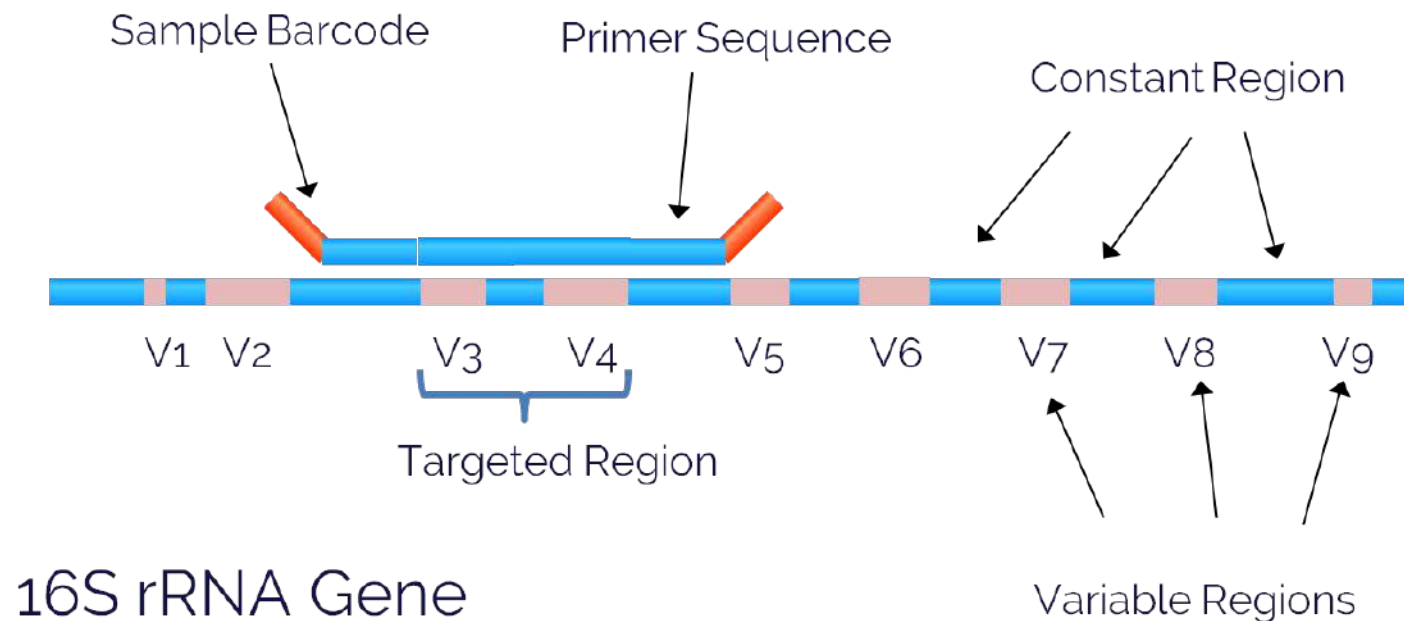
4. Sequence.

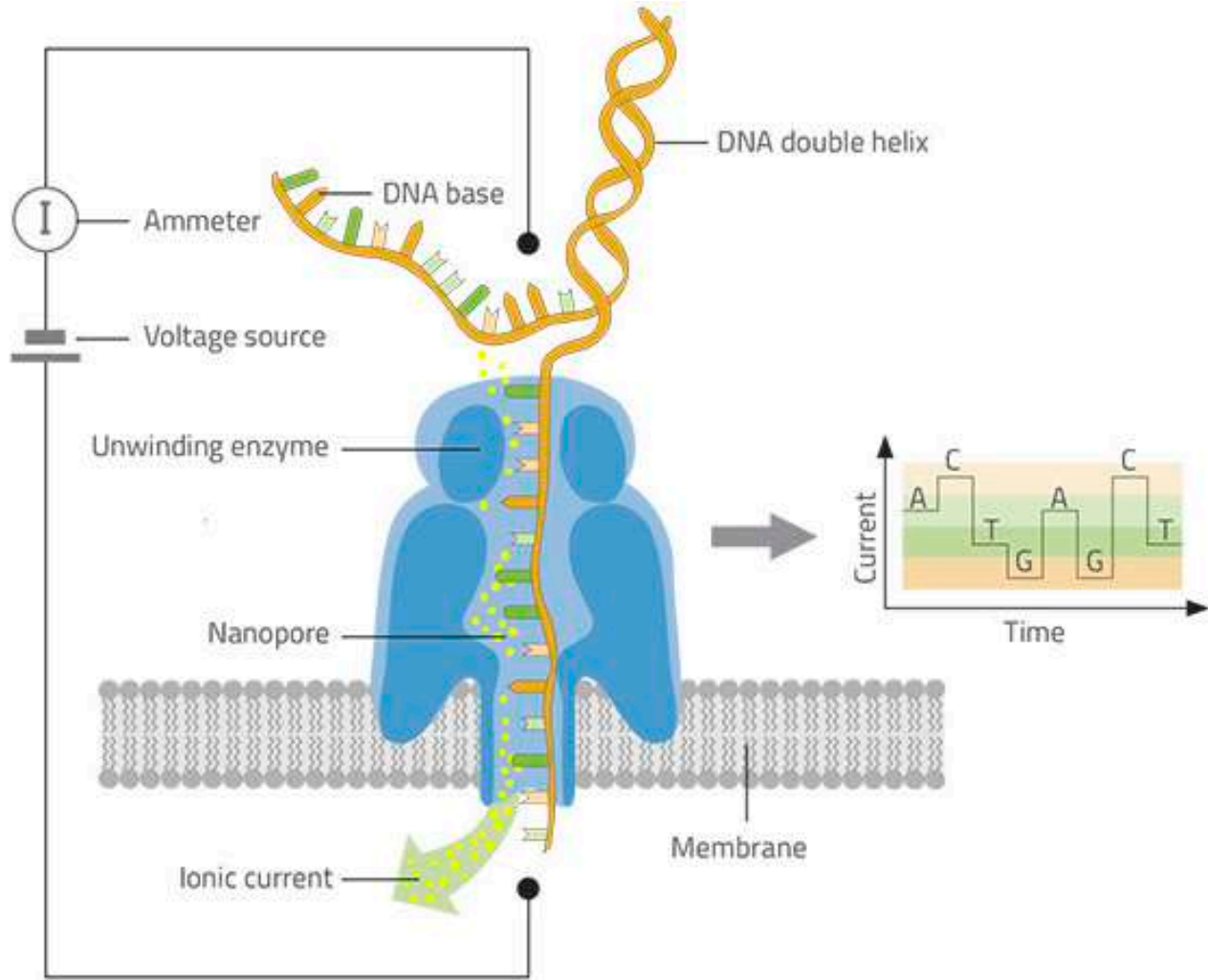


↓
**5. Align sequences;
generate tree.**



Microbial diversity analyses





MinION Mk1: portable, real time biological analyses

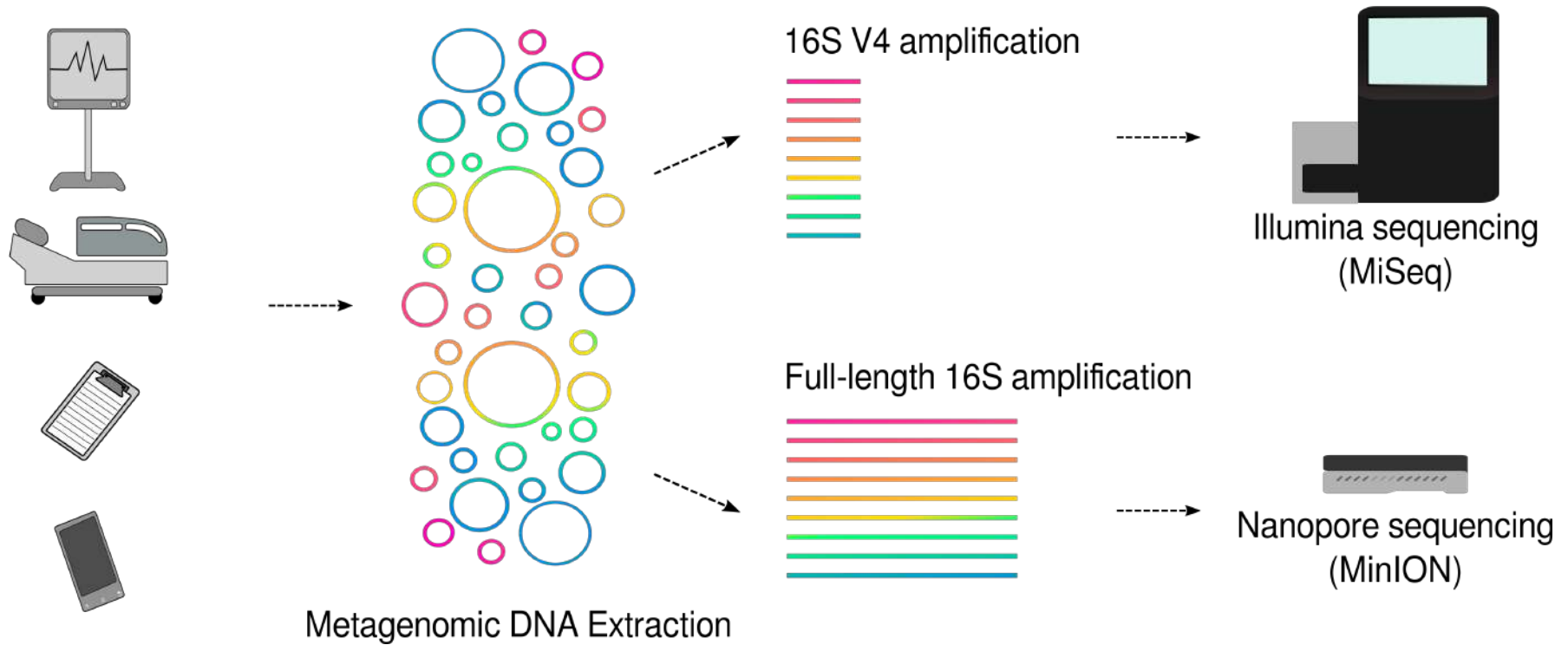
MinION

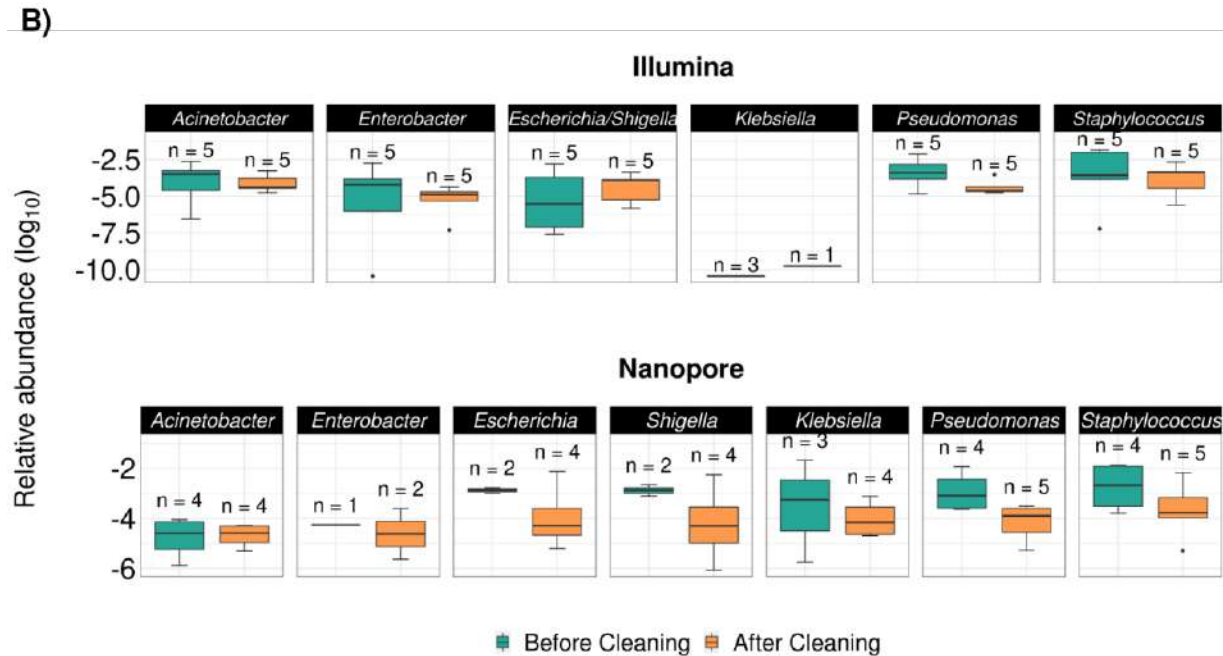
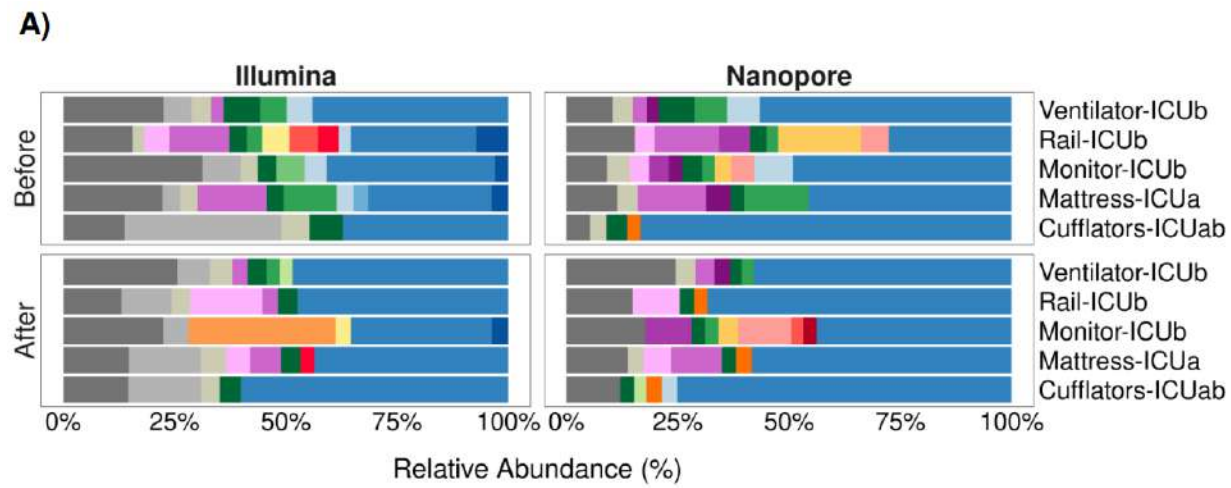
Nanopore sequencing provides rapid and reliable insight into microbial profiles of Intensive Care Units

Guilherme Marcelino Viana de Siqueira, Felipe Marcelo Pereira-dos-Santos, Rafael Silva-Rocha,
 Maria-Eugenia Guazzaroni

doi: <https://doi.org/10.1101/2021.05.14.444165>

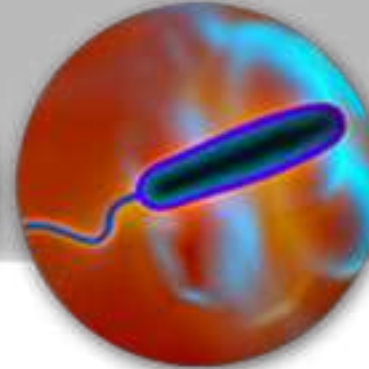
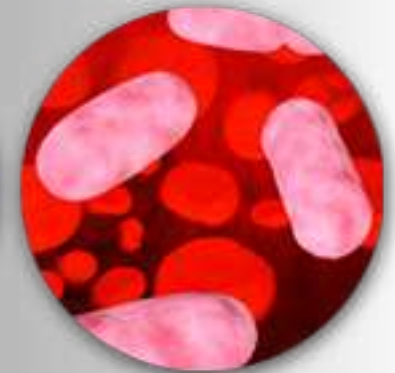
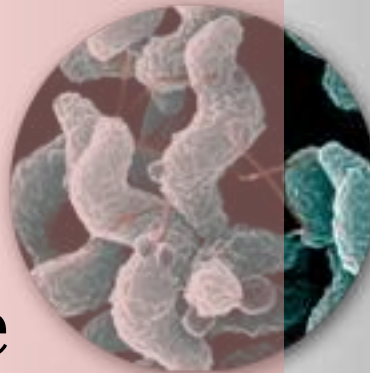
ICU / NICU Sampling





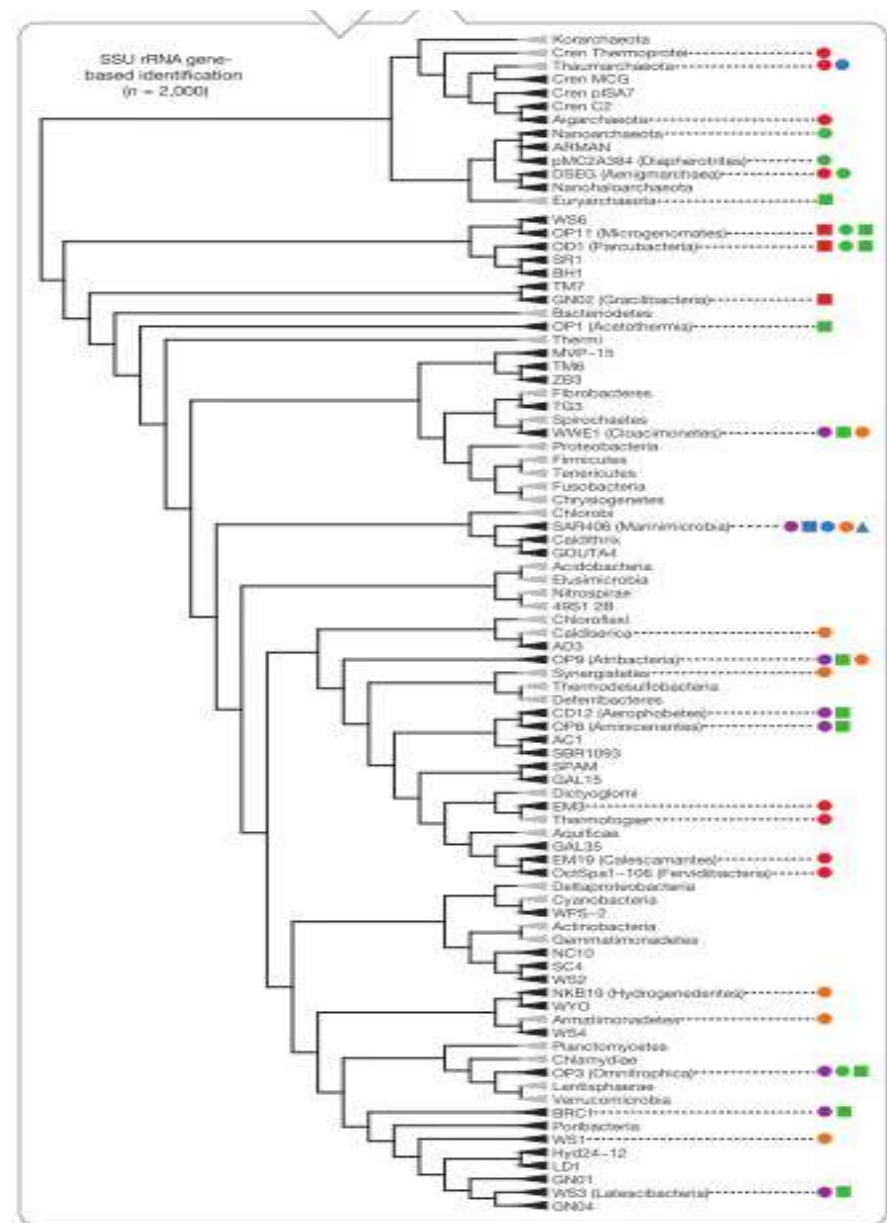
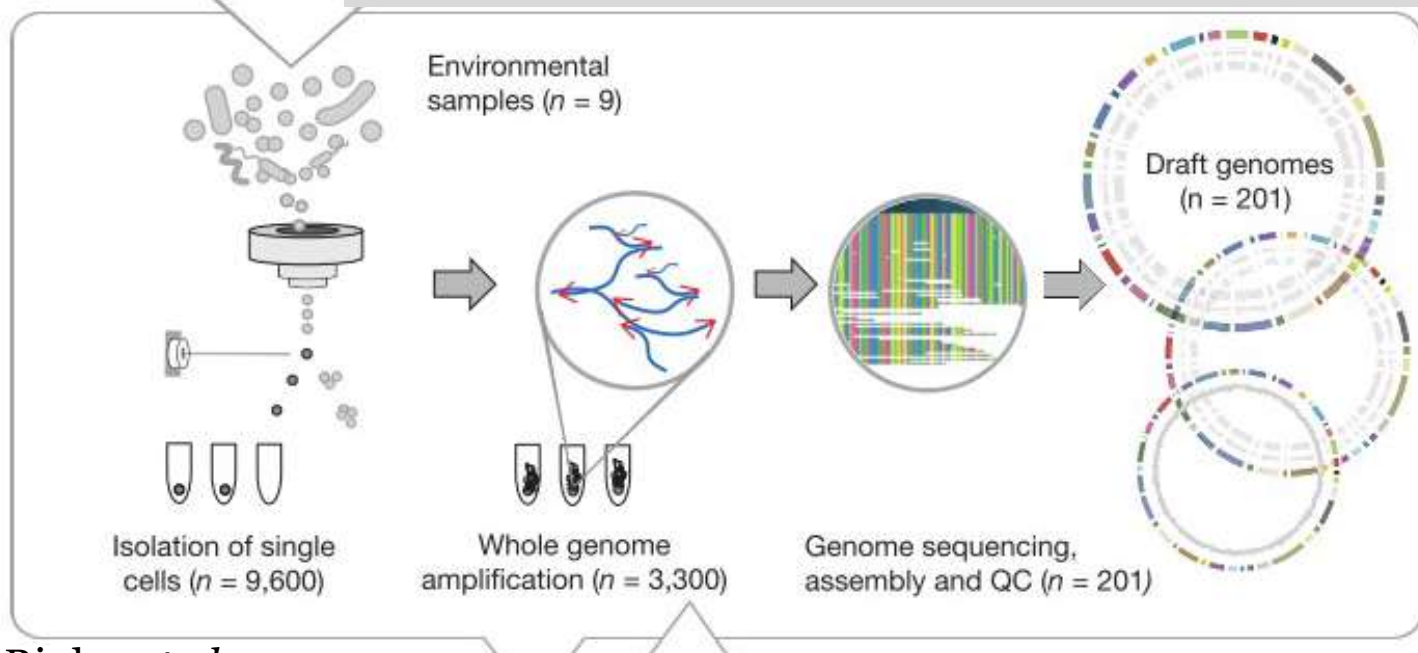
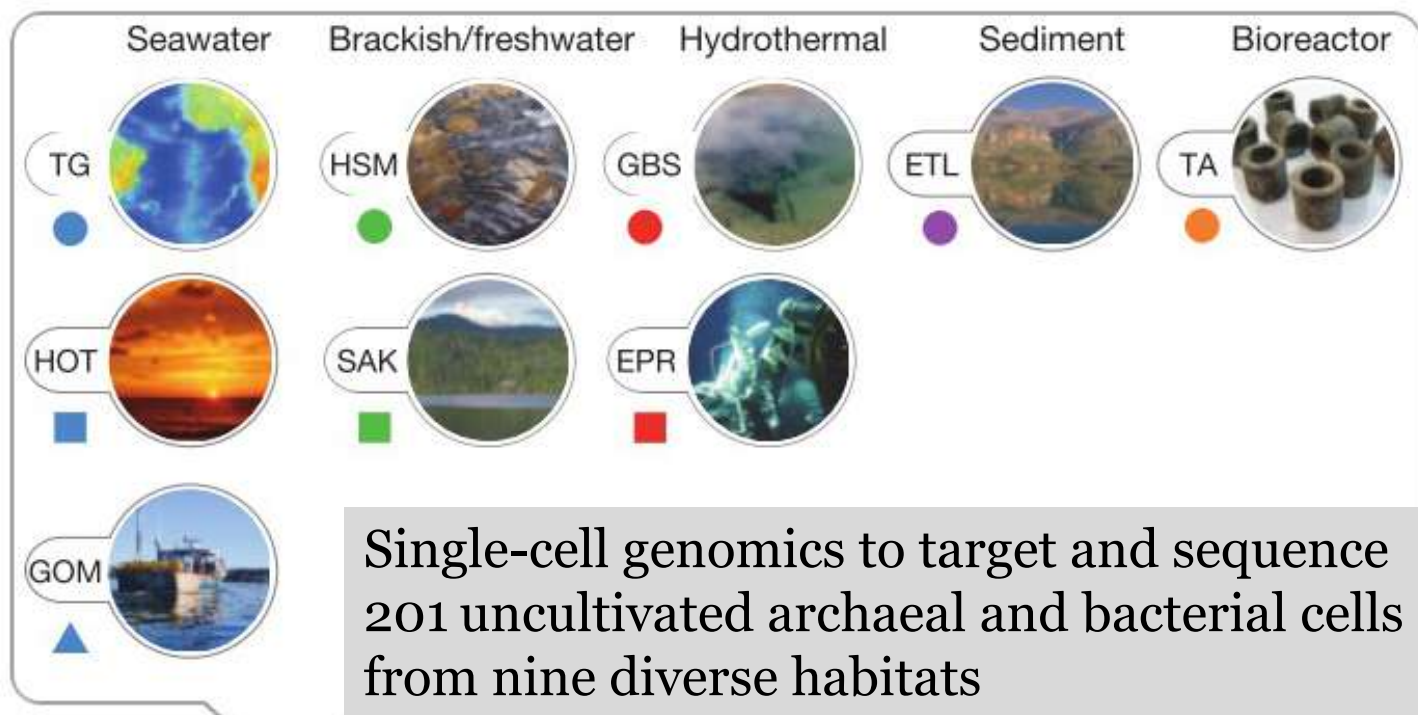
A megadiversidade escondida

- ❖ Microbial Dark Matter
- ❖ O microbioma humano
- ❖ O viroma da Terra
- ❖ Astrobiologia
- ❖ Creating artificial life



“Microbial Dark Matter”

- ❖ Microbes are the most abundant and diverse cellular life forms on Earth and colonize a wide range of environmental niches.
- ❖ However, more than 99% of bacterial and archaeal species have not been obtained in pure culture and we have only glimpsed the surface of this **mysterious microbial world**.
- ❖ This is so-called **Microbial Dark Matter** (MDM): the enormous diversity of yet-uncultivated microbes that microbiologists can only study by using cultivation-independent techniques.





MammothBiosciences

[COVID-19](#) [Diagnostics](#) [Genome Editing](#) [Protein Discovery](#)

[Partner](#)

[Resources](#) ▾

[Company](#) ▾

[We're hiring](#)

Reading and writing the code of life.

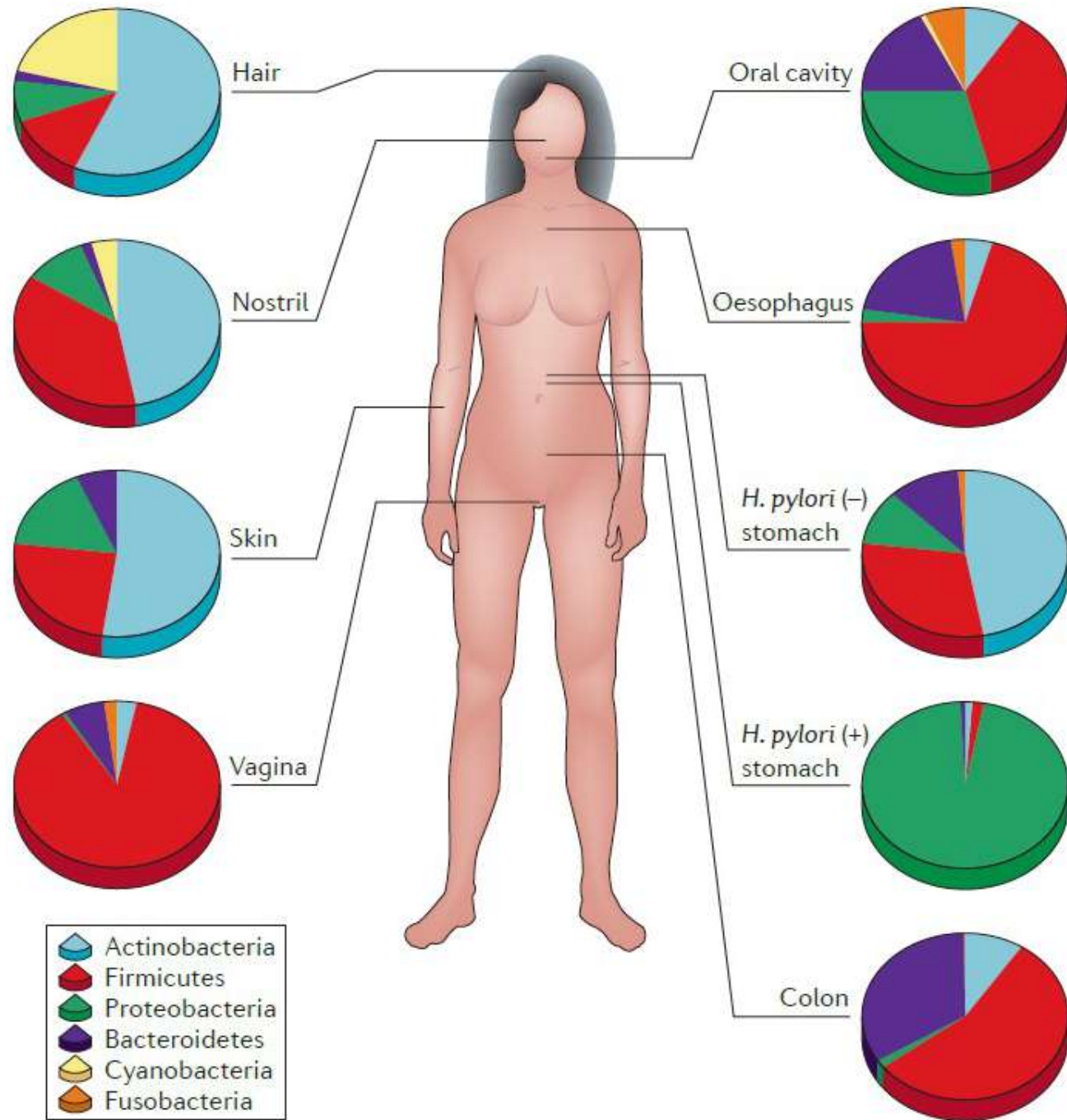
At Mammoth, we discover novel CRISPR systems that enable new possibilities for expanding biology.



OUR TECHNOLOGIES

O microbioma humano





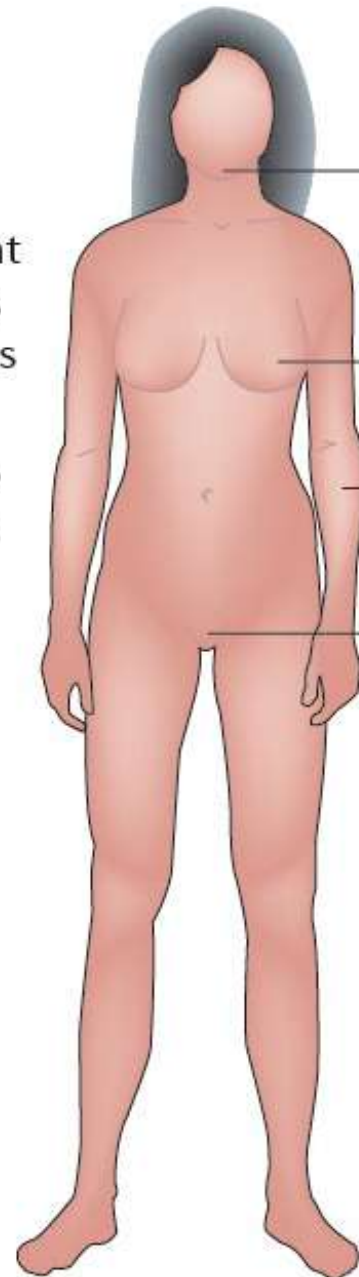
Effect of maternal exposures

Environment

- Antisepsis
- Antibiotics
- Diet

Other hosts

Epigenetics



Oral
(pre-mastication of food)

Mammary, through breastfeeding
(selection)

Cutaneous
(contact with skin)

Vaginal
(passage through birth canal)

Dental
amalgam

Bottle feeding

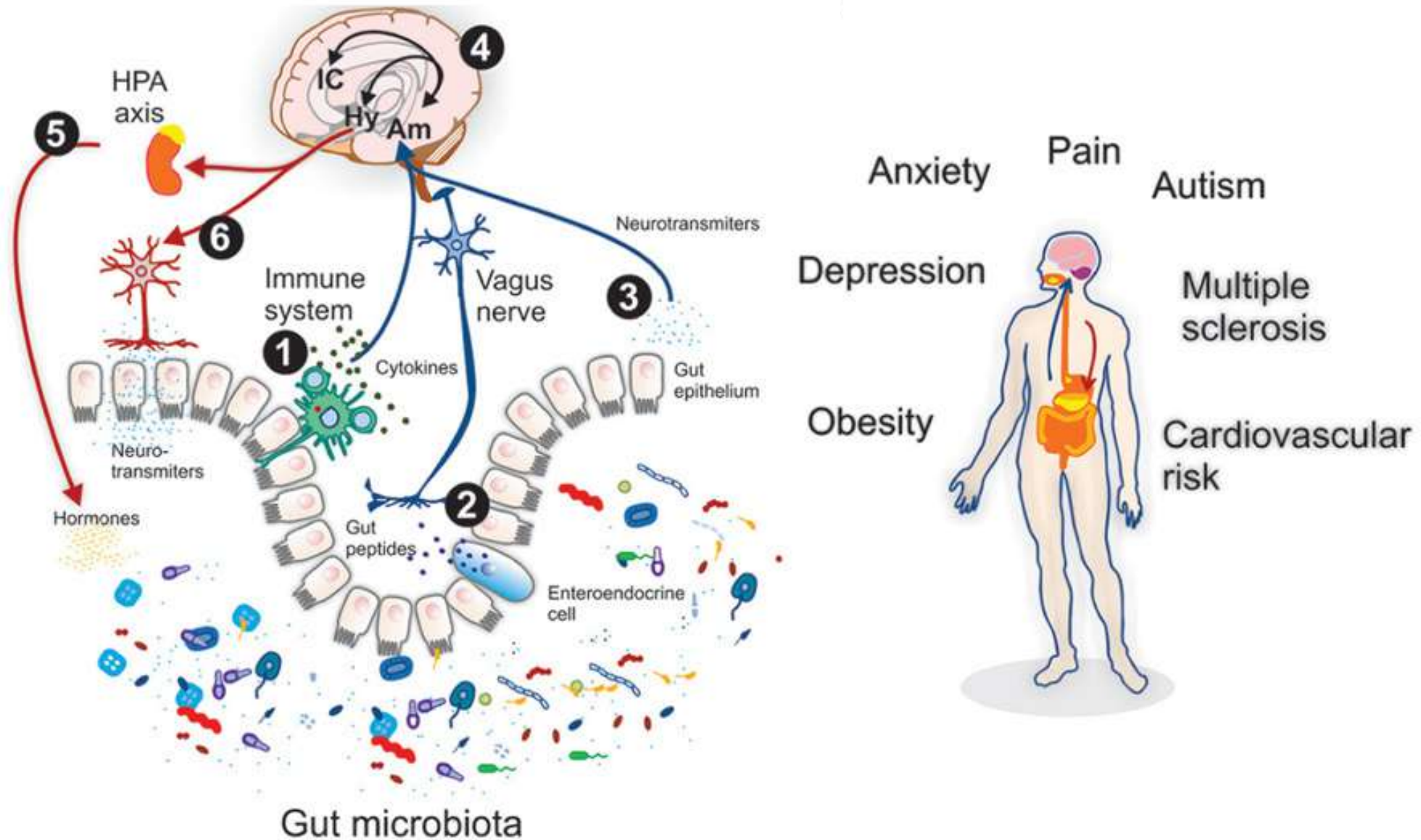


Early/
extensive
bathing

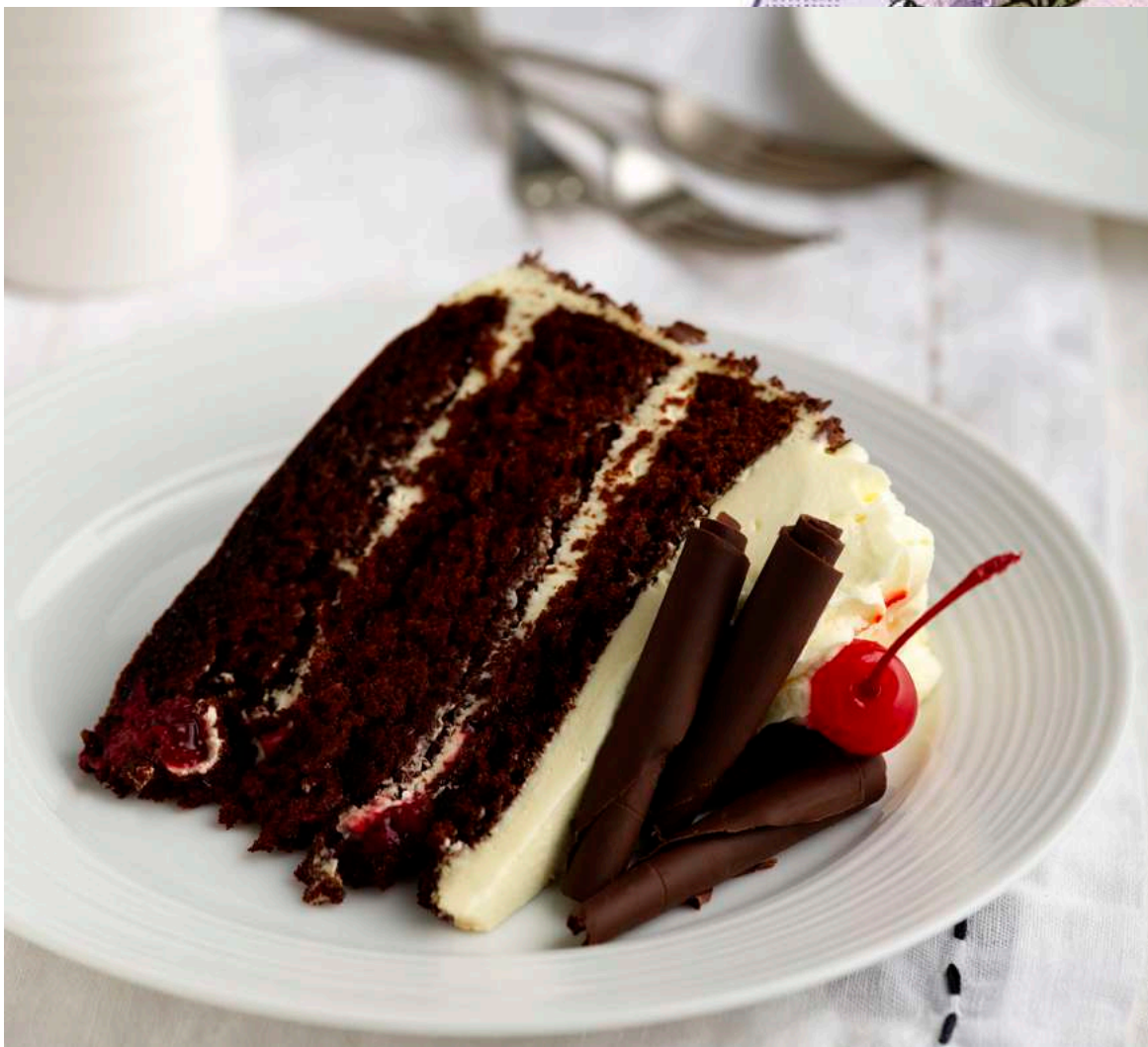
Caesarean section

Early-life
antibiotics

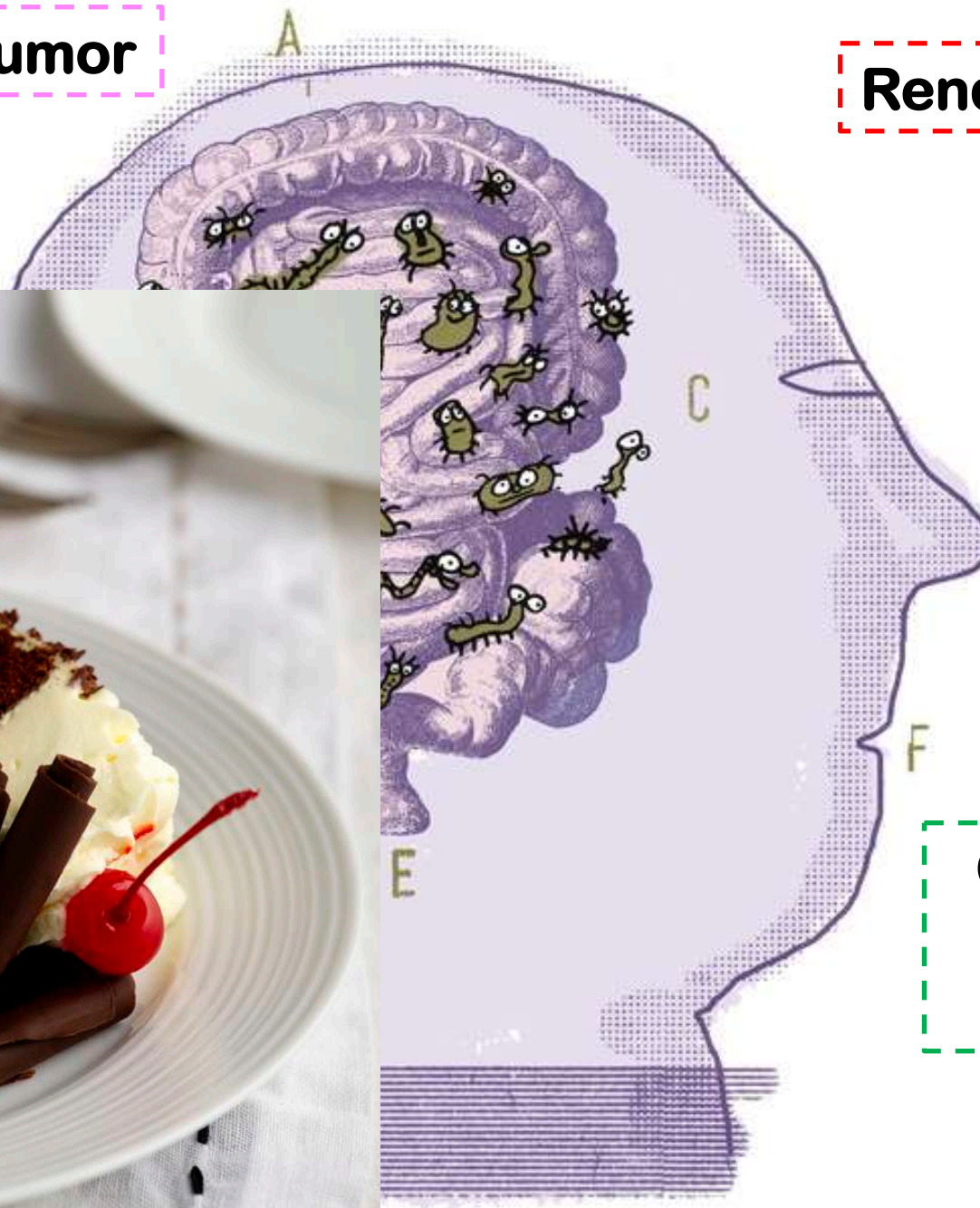
Microbial associations with emotion, cognition, and social behavior



Humor



Rendimento escolar

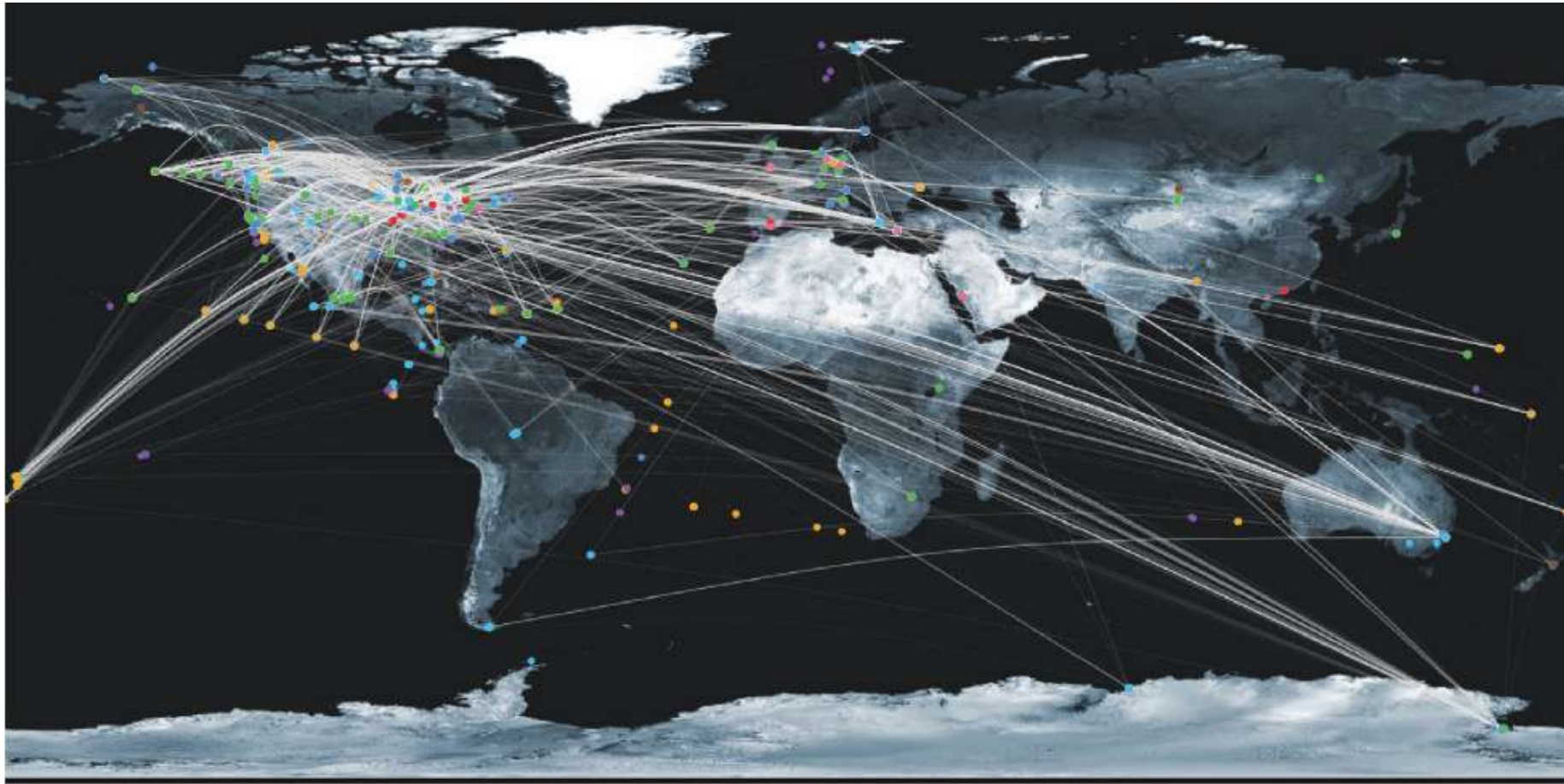


**Curar doenças
cerebrais e
psicológicas**

Uncovering Earth's virome

David Paez-Espino¹, Emiley A. Elie-Fadrosh¹, Georgios A. Pavlopoulos¹, Alex D. Thomas¹, Marcel Huntemann¹, Natalia Mikhailova¹, Edward Rubin^{1,2,3}, Natalia N. Ivanova¹ & Nikos C. Kyrpides¹

Viruses are the most abundant biological entities on Earth, but challenges in detecting, isolating, and classifying unknown viruses have prevented exhaustive surveys of the global virome. Here we analysed over 5 Tb of metagenomic sequence data from 3,042 geographically diverse samples to assess the global distribution, phylogenetic diversity, and host specificity of viruses. We discovered over 125,000 partial DNA viral genomes, including the largest phage yet identified, and increased the number of known viral genes by 16-fold. Half of the predicted partial viral genomes were clustered into genetically distinct groups, most of which included genes unrelated to those in known viruses. Using CRISPR spacers and transfer RNA matches to link viral groups to microbial host(s), we doubled the number of microbial phyla known to be infected by viruses, and identified viruses that can infect organisms from different phyla. Analysis of viral distribution across diverse ecosystems revealed strong habitat-type specificity for the vast majority of viruses, but also identified some cosmopolitan groups. Our results highlight an extensive global viral diversity and provide detailed insight into viral habitat distribution and host-virus interactions.



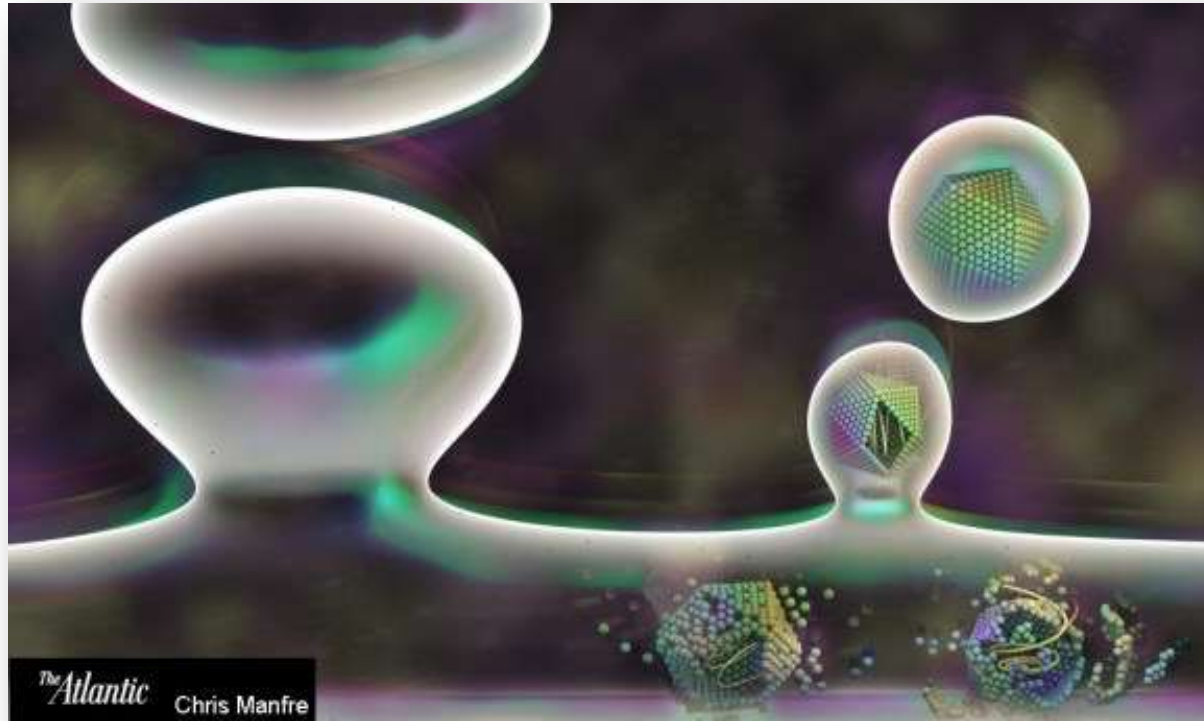
● Marine
● Freshwater
● Non-marine
Saline and Alkaline
● Thermal springs

● Host-associated
(other)
● Host-associated
(plants)

● Terrestrial (soil)
● Terrestrial (other)
■ Area of 10 pixel size

Ancestral virus sinapsis

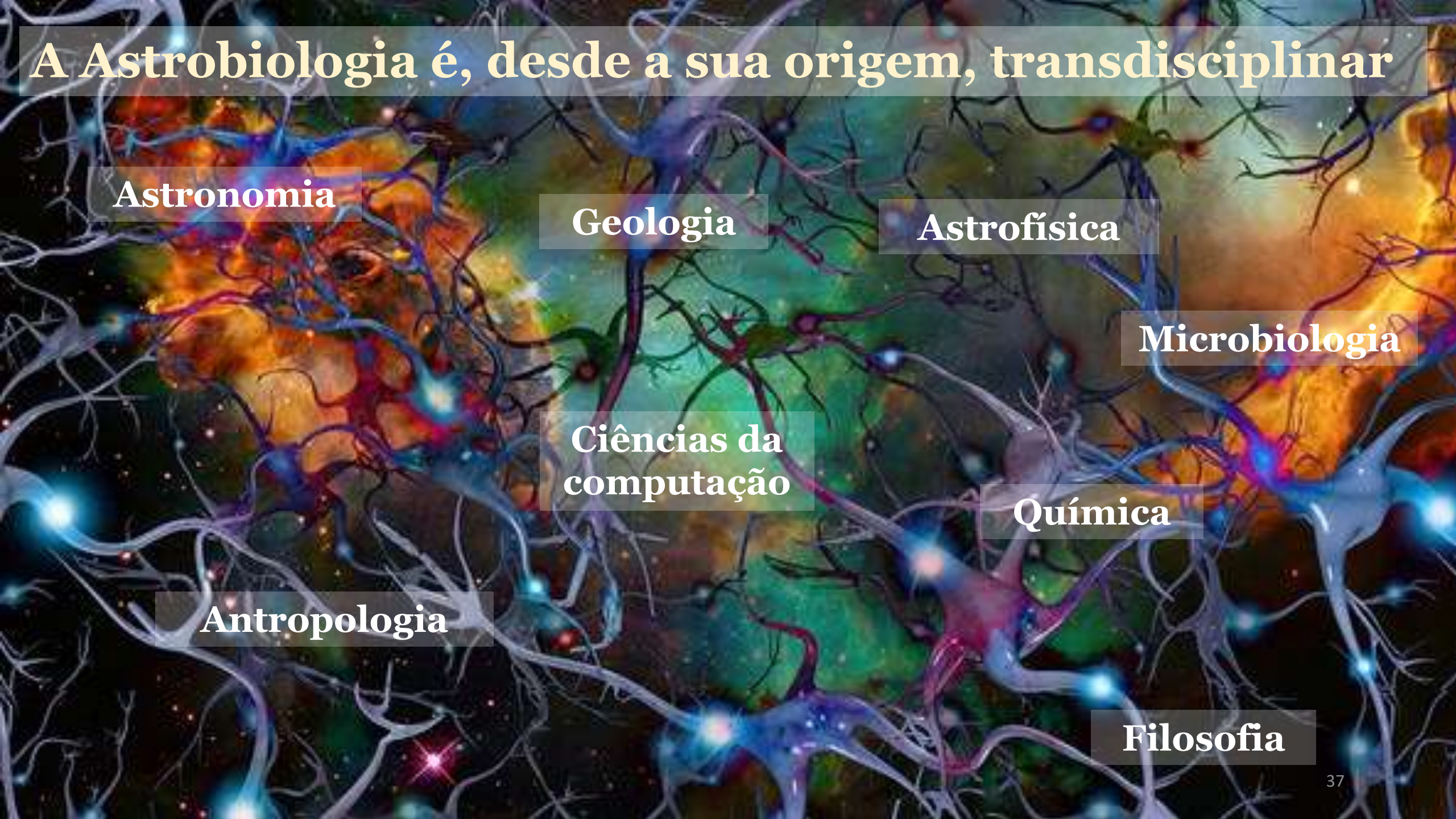
Você tem um vírus antigo no seu cérebro. Na verdade, você tem um vírus antigo na própria raiz de seu pensamento consciente.



Astrobiologia



A Astrobiologia é, desde a sua origem, transdisciplinar



Astronomia

Geologia

Astrofísica

Microbiologia

**Ciências da
computação**

Química

Antropologia

Filosofia

A Astrobiologia é uma nova ciência que surge da necessidade de investigar a origem, presença e influência da vida no Universo.



International Partners

Centro de Astrobiologia,
Spain



Associate Partners

Affiliate Partners

University of São Paulo
Research Unit in Astrobiology

Australian Centre for
Astrobiology

O que é a vida?

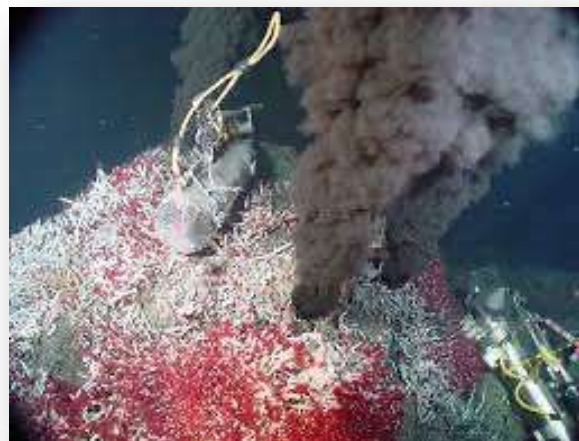
Como surgiu a vida na Terra?

Como evolui e se desenvolve?

Existe vida em outro lugar no Universo?

Qual é o futuro da vida na Terra e em outros lugares?

A vida em ambientes extremos - é assim que a vida começou na Terra - e é isso que podemos esperar encontrar em outros mundos?



Diversos trabalhos de metagenômica buscam explicar adaptações moleculares de microrganismos extremófilos

Diana Trujillo, diretora de voo do 'Perseverance': “Algo de vida tem que haver em Marte”

Engenheira aeroespacial colombiana, encarregada de narrar a aterrissagem da nave da NASA, diz que o objetivo da missão é encontrar rastros de atividade microbiana de bilhões de anos atrás

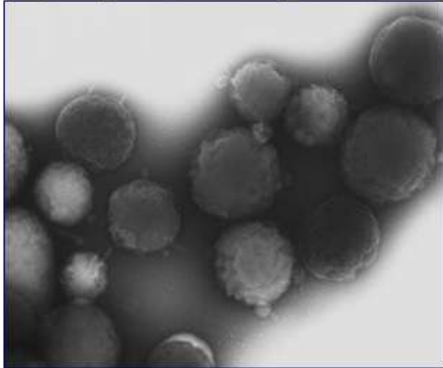


Creating artificial life

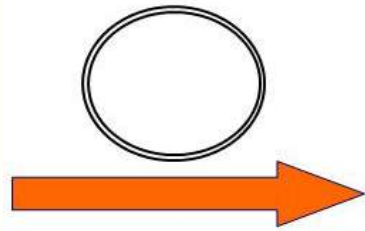
Genome Transplantation in Bacteria: Changing One Species to Another

Carole Lartigue, John I. Glass,* Nina Alperovich, Rembert Pieper, Prashanth P. Parmar,
Clyde A. Hutchison III, Hamilton O. Smith, J. Craig Venter

Mycoplasma mycoides

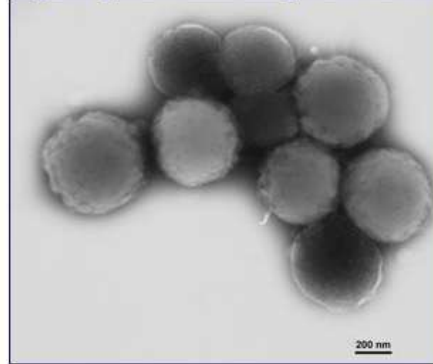


Genomic DNA donor
(synthetic)



Genoma
mínimo

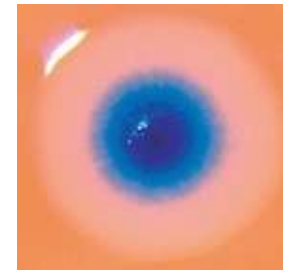
Mycoplasma capricolum



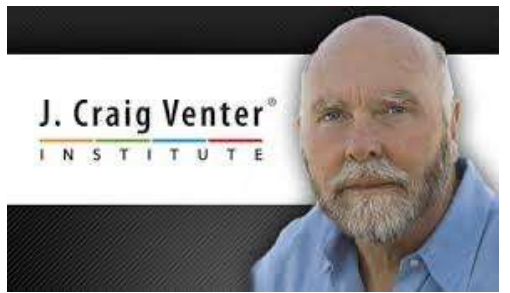
Recipient cell



*Mycoplasma
laboratorium*



Primeira célula con
cromosomo sintético

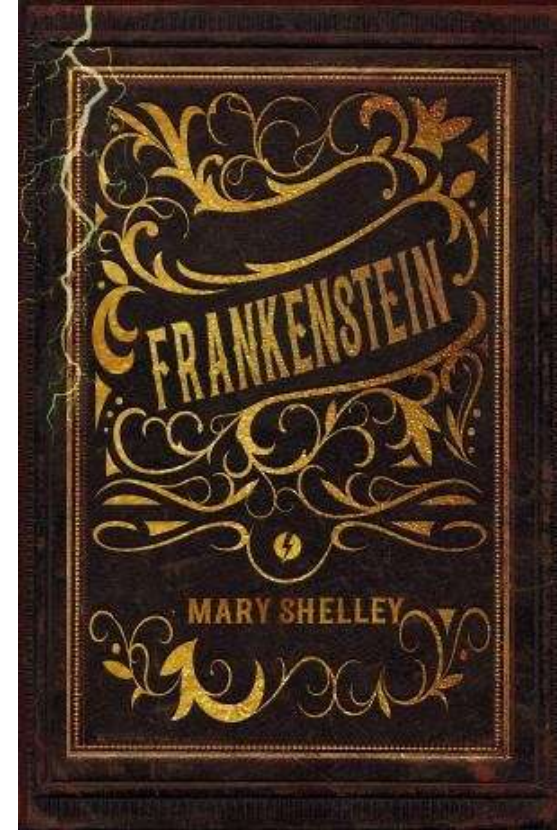


THE FIRST SYNTHETIC LIVING CREATURE

It's alive!!!



Dr. Frankenstein, 1818



“...enquadrado na tradição da novela gótica, o texto fala sobre temas como moralidade científica, criação e destruição de vida e ousadia da humanidade em sua relação com Deus...”

China-US scientists grow first human-monkey embryo, but is it ethical?

- It's not in bad taste, says Chinese researcher after injecting human stem cells into macaque embryos to explore possibility of growing organs for transplants
- Most of the embryos died and others grew only low levels of human cells, but the progress achieved leads some to raise fears over where the experiments may lead

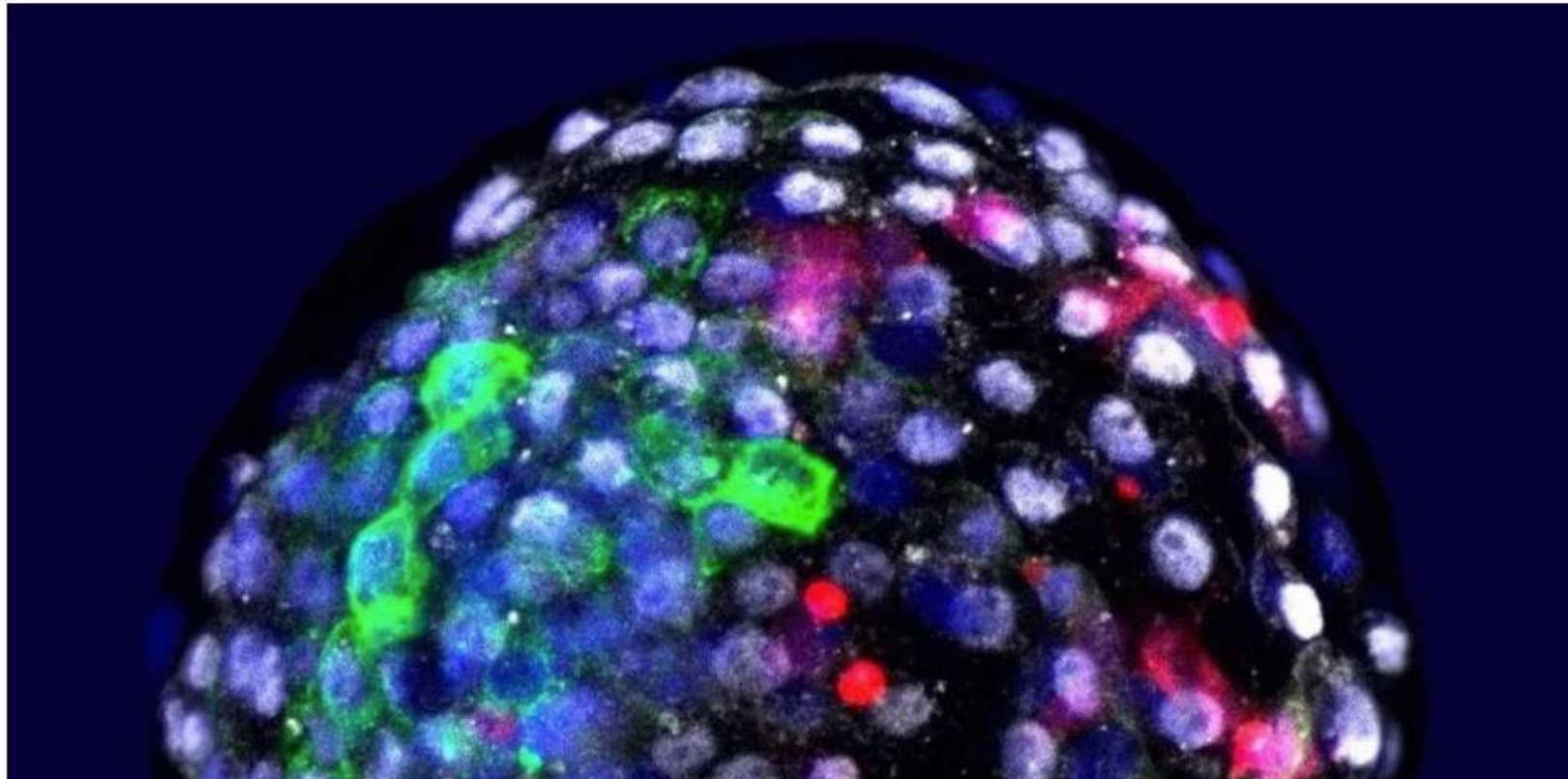


Stephen Chen in Beijing

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Published: 8:59pm, 16 Apr, 2021

Why you can trust SCMP



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