

DTU



Microbiomes on Mars

Agenda

- Who am I?
- Genomics
- Metagenomics
- Life on Mars

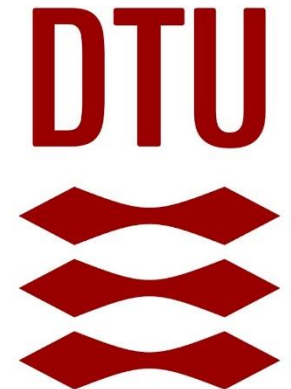
Who am I?

- Previously at Copenhagen University and Helmholtz Zentrum München
- Associate Professor and Group leader of the Metagenomics group at DTU
- Application of the newest tools and developing to raise novel biological questions
- Analyses the microbiome in anything from environmental to clinical samples

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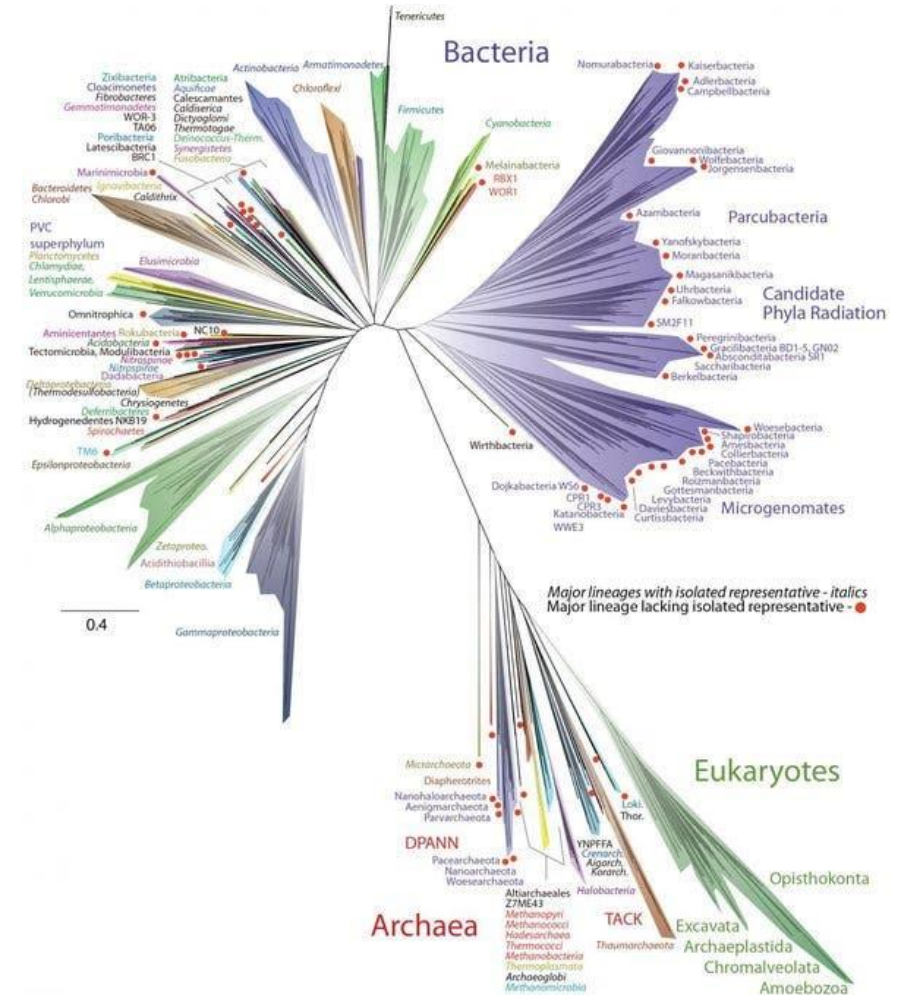
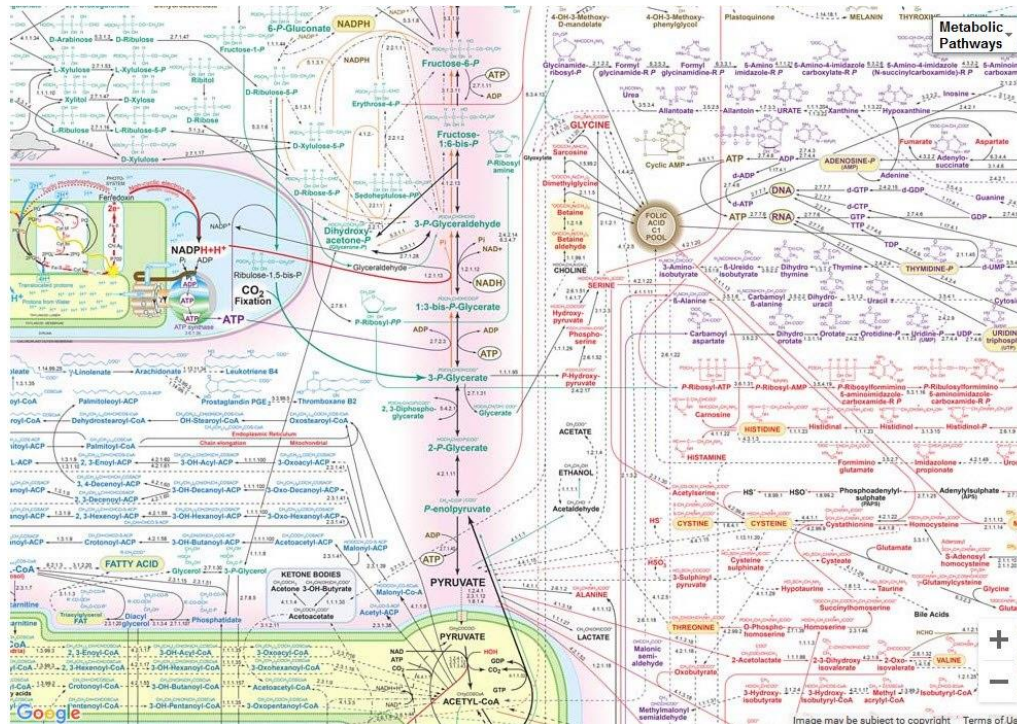


HelmholtzZentrum münchen
German Research Center for Environmental Health



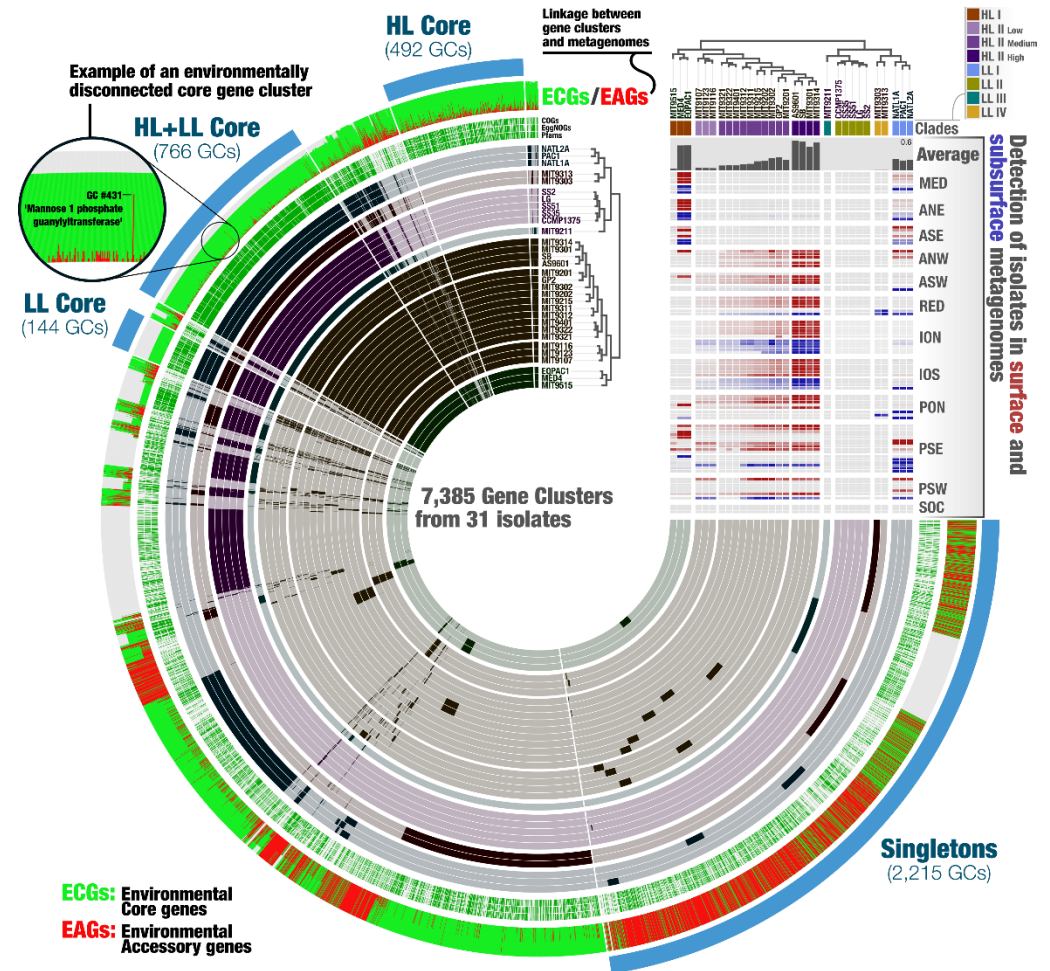
Microbial genomics

- DNA sequencing
- Allows taxonomy annotation
- Allows functional annotation



Comparative genomics

- Align similar genomes
- Identify core and accessory genes
- Link to phenotype



Metagenomics?

"Metagenomics (Environmental Genomics, Ecogenomics or Community Genomics) is the study of genetic material recovered directly from environmental samples."

A Microbiome is all the microbes in a defined habitat



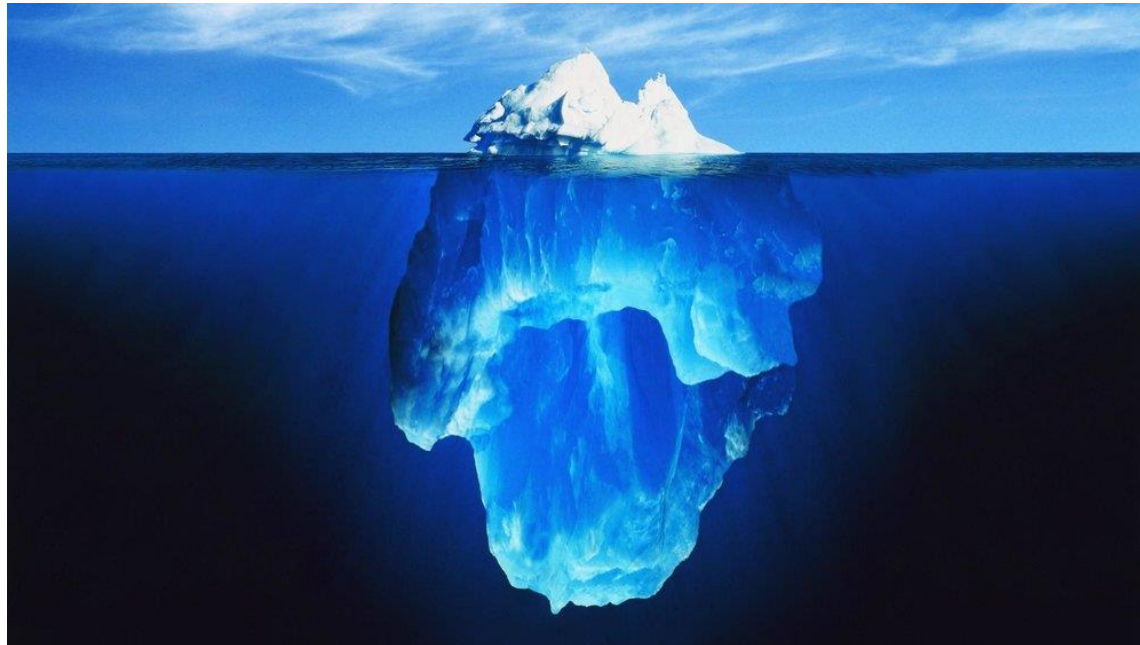
Pre-sequencing days

- Culturable organism chosen as models
- Might not be representative even for close relatives



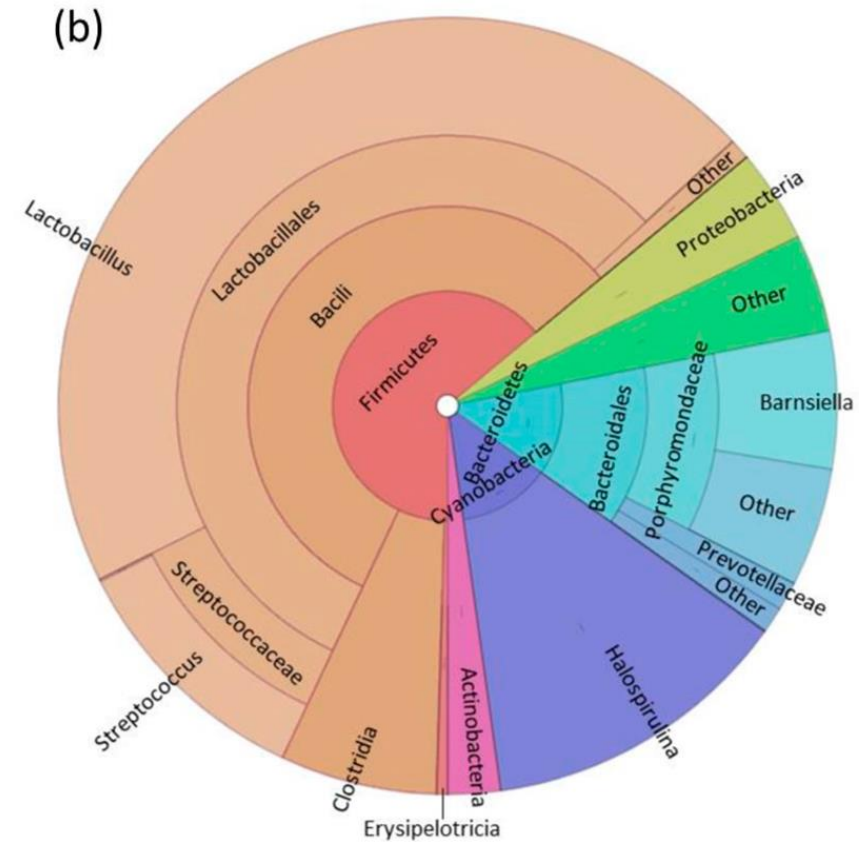
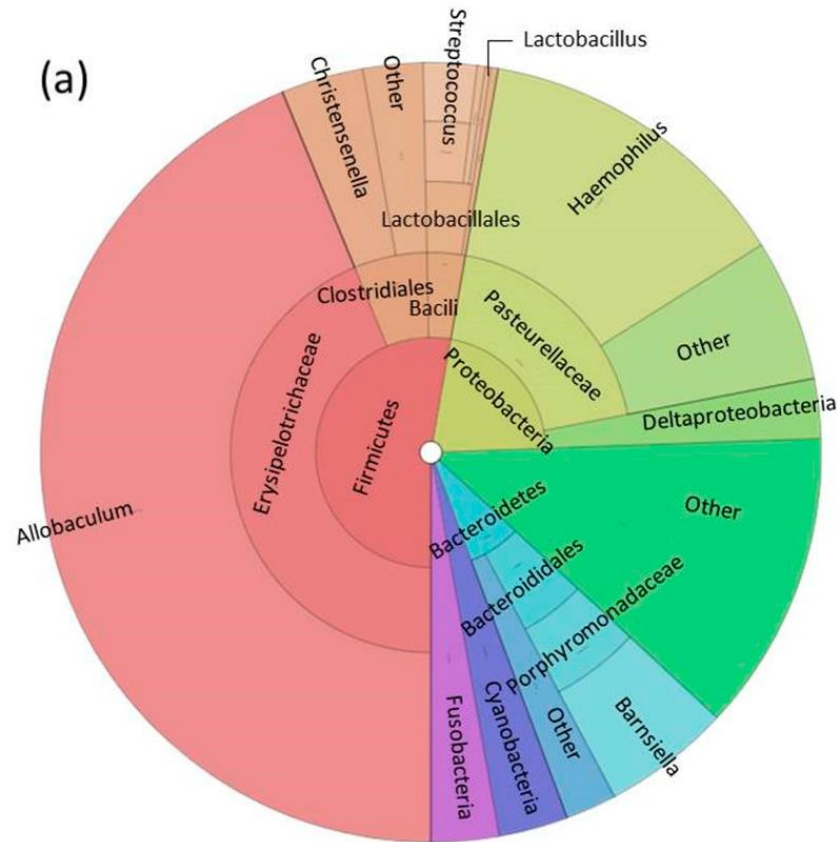
From culturing to DNA sequencing

- Microbiome research previously limited to culturable organisms
- +99% of prokaryotes in the environment cannot not be cultured



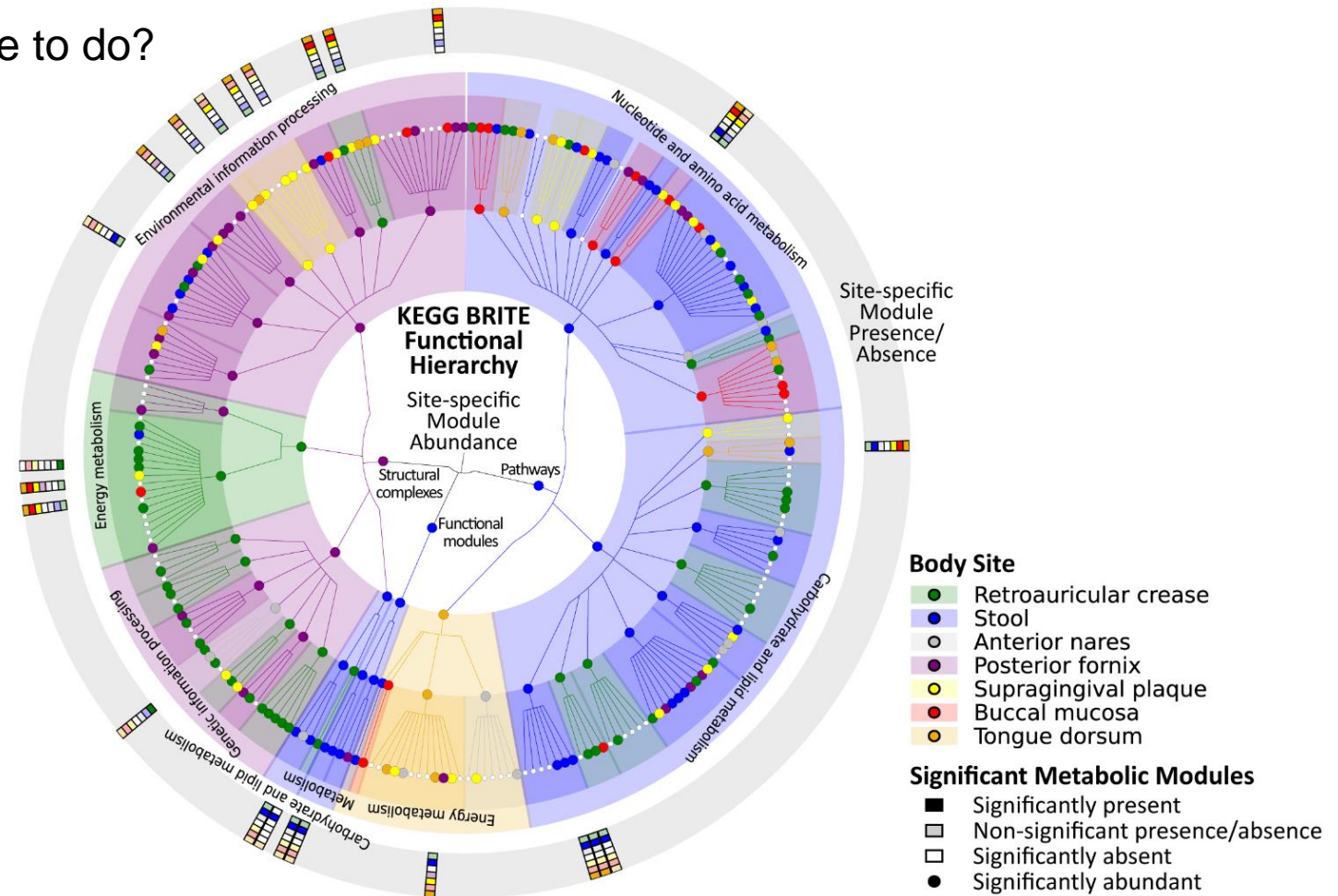
Microbial composition

- Who is there?



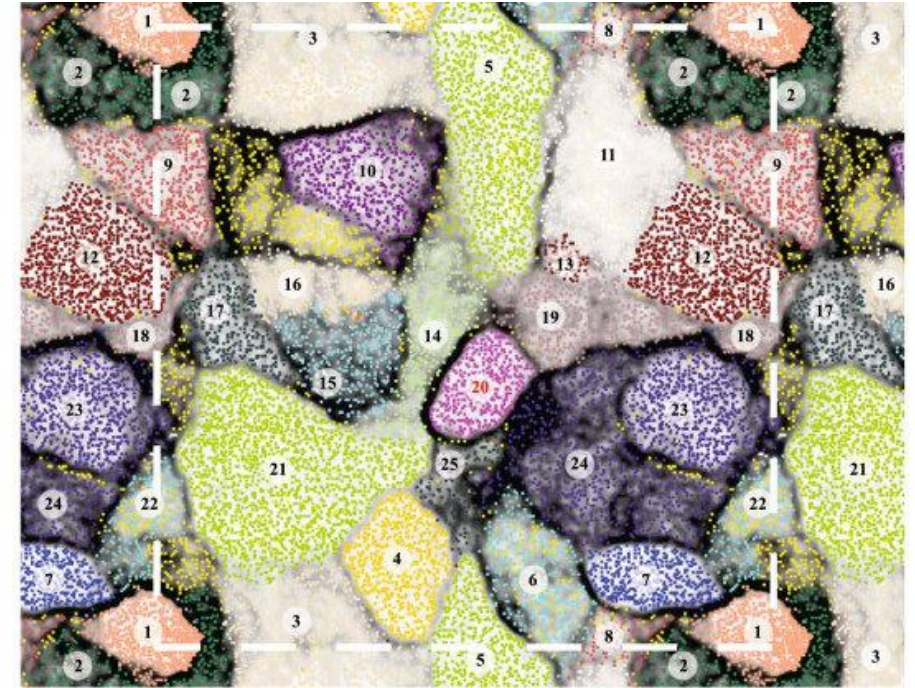
What functionality does the microbiome possess

- What are they able to do?



Reconstruct genomes

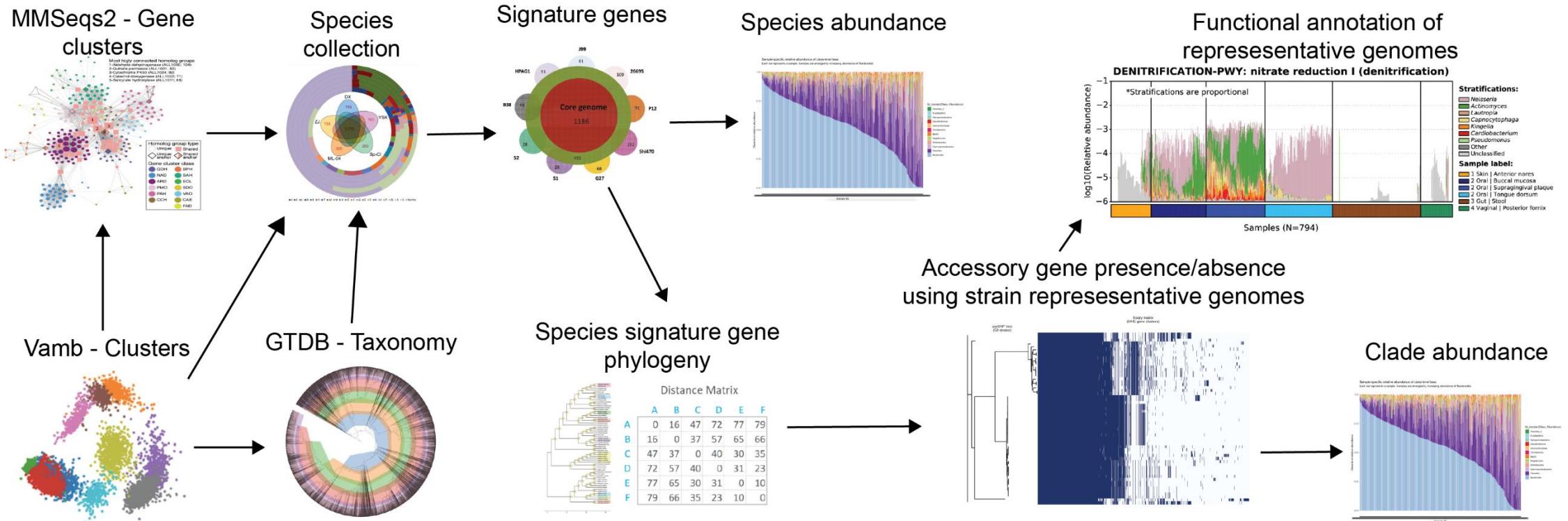
- Reconstruct entire genomes
- Associate plasmid and viruses with their hosts
- How fast are they reproducing?



<i>Unbinned</i>				12, 13	<i>Actinomyces urogenitalis</i>
<i>Clostridium butyricum</i>	1			12	<i>Actinomyces urogenitalis</i> - Phage
<i>Leuconostoc</i> sp.	2			14	<i>Escherichia coli</i> - Strain B
<i>Veillonella</i> sp. - Species A	3, 16			14	<i>Enterococcus faecalis</i> - Plasmid
<i>Enterococcus faecalis</i>	4			14	<i>Escherichia coli</i> - Strain A/B - Plasmid
<i>Escherichia coli</i> - Strain A	5, 21			15	<i>Propionibacterium</i> sp.
<i>Escherichia coli</i> - Strain A - Phage	5			16	<i>Veillonella</i> sp. - Species A - Plasmid
<i>Staphylococcus</i> sp.	6, 22			22	<i>Veillonella</i> sp. - Species A - Phage
<i>Staphylococcus</i> sp. - Plasmid A	unbinned			17, 25	<i>Negativicoccus succinicivorans</i>
<i>Staphylococcus</i> sp. - Plasmid B	unbinned			18, 19	<i>Veillonella</i> sp. - Species B
<i>Staphylococcus</i> sp. - Phage	unbinned			23	<i>Veillonella</i> sp. - Species B - Phage
<i>Streptococcus anginosus</i>	7			20	<i>Varibaculum cambriense</i>
<i>Clostridium bartlettii</i>	8, 9			23, 24	<i>Streptococcus parasanguinis</i>

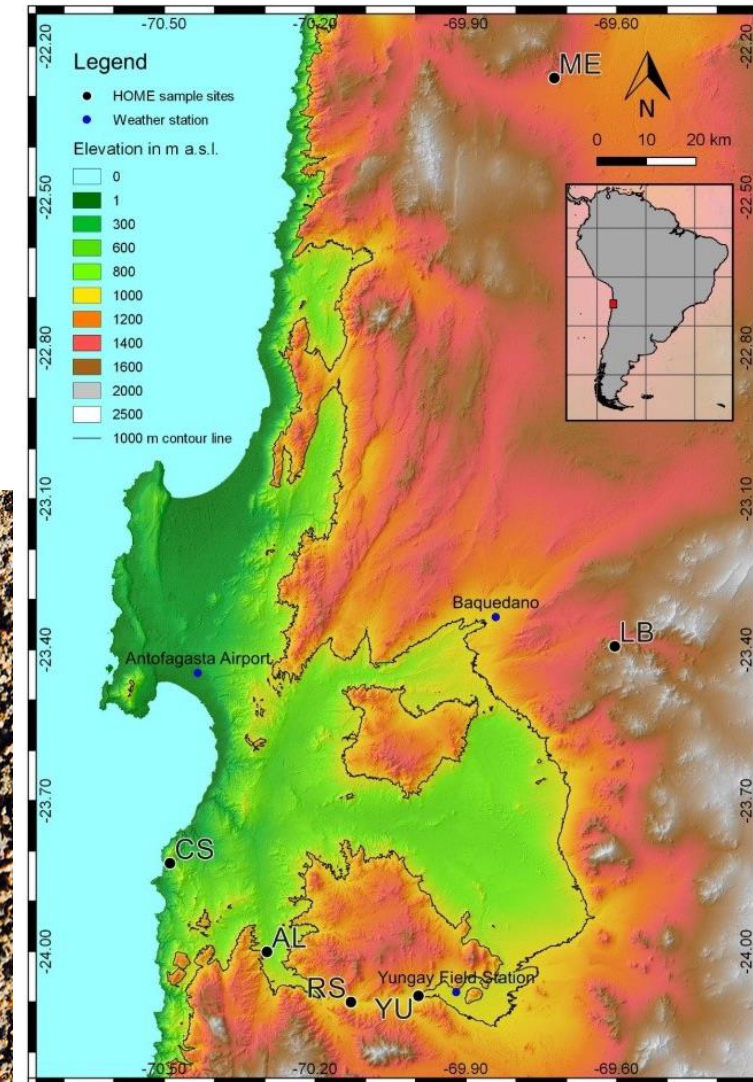
MAGinator

- Metagenomics at strain level



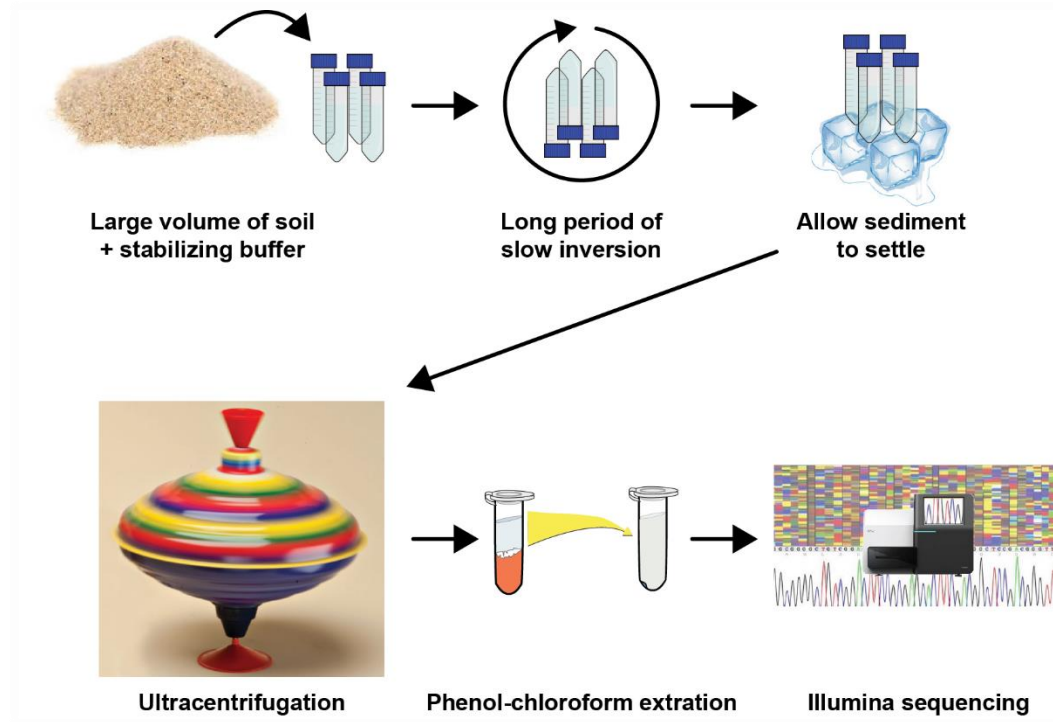
Life on Mars

- Multi-lab effort head by Dirk Schulze-Makuch
- Atacama as proxy for Mars
- Sampling along humidity gradient
- Soils and Hypoliths



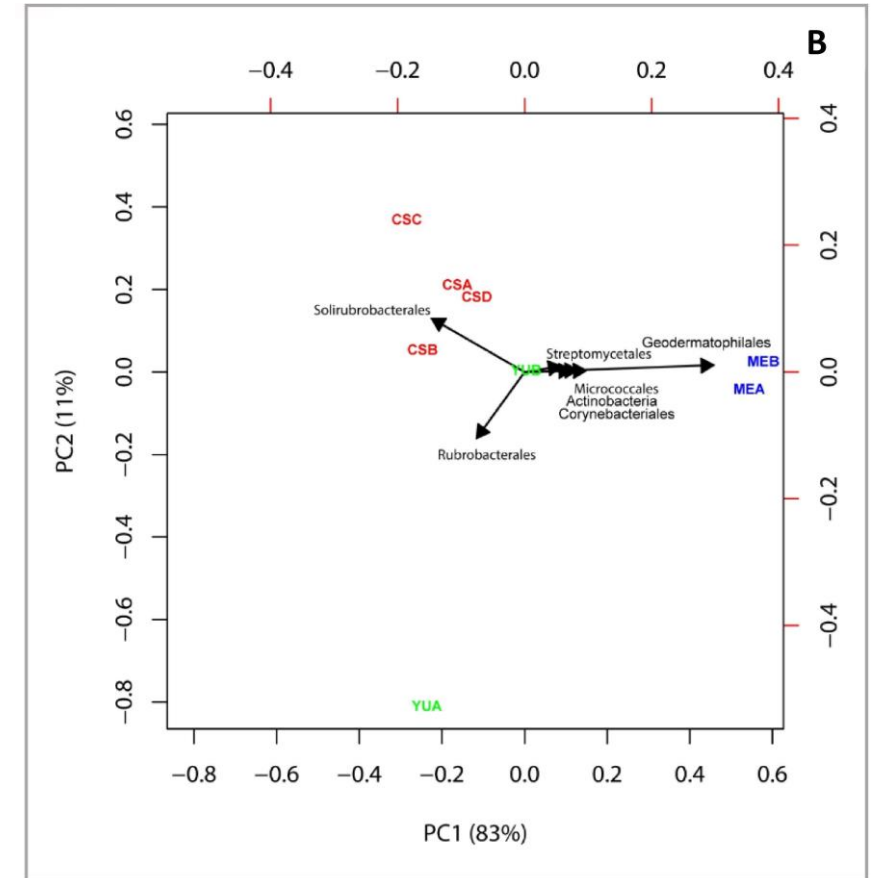
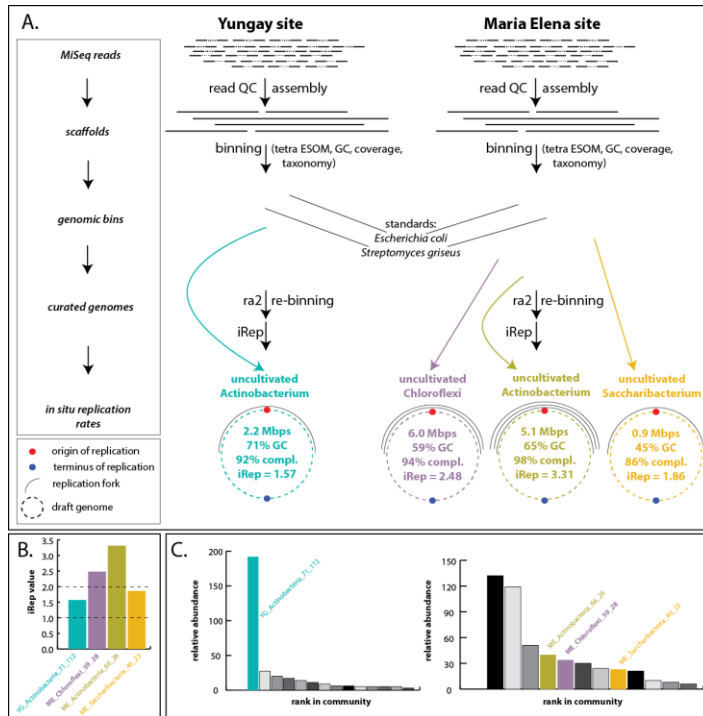
Getting DNA out of a sandbox

- Usually 500 mg of material provides plenty DNA
- We used 10 g sand per sample!



PNAS paper

- Distinct hyperarid microbiome
- Virus-host link found, "Kill the Winner"
- Intracellular higher level of ATP
- iRep indicates replication



Conclude that Atacama is at least a transient habitat

Winning!

CLIMATE · Published February 27, 2018

Bugs found in the driest spot on Earth could indicate life on Mars

By Ally Foster | news.com.au



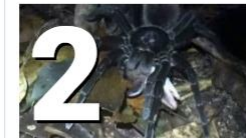
File photo: The Atacama desert in the Andes mountain range outside of Antofagasta, Chile April 15, 2013. (REUTERS/Julie Gordon)

Freak rains in the driest part of the world have revealed hidden microbes that could point

Trending in Science



Earth is greener today than it was 20 years ago thanks to 'human activity,' counterintuitive NASA study shows



Huge spider drags opossum across Amazon rainforest floor in haunting footage



California astrobiologist creates

Acknowledgements

- Helmholtz Zentrum München, Germany
 - Lisa Guan
 - Johan Sebastian Sáenz
 - Michael Schloter
- Center of Astronomy & Astrophysics, Technical University Berlin, Germany
 - Alessandro Airo
 - Dirk Schulze-Makuch

Bonus archaeal viruses !!!

