Life Beneath the Surface: Prokaryotic Ecological Roles in Mexican Lava Tubes

M. Nayeli Luis-Vargas
/Na-jelly/

AUSTRALIAN
SPELEOLOGICAL
FEDERATION

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Who am I?

Nayeli
/Na-jelly/

Biologist

Some experience in caves

And I fell in love with <u>microbial ecology</u>...

LA TROBE
UNIVERSITY

What is microbial ecology?

Antonie van Leeuwenhoek (1674):
"They are tiny moving organisms."

Bacteria
Archaea
Algae
Fungi

= **Prokaryotic**

What is microbial ecology?

Everything is everywhere…but the environment selects.

MICROBIOME of whatever

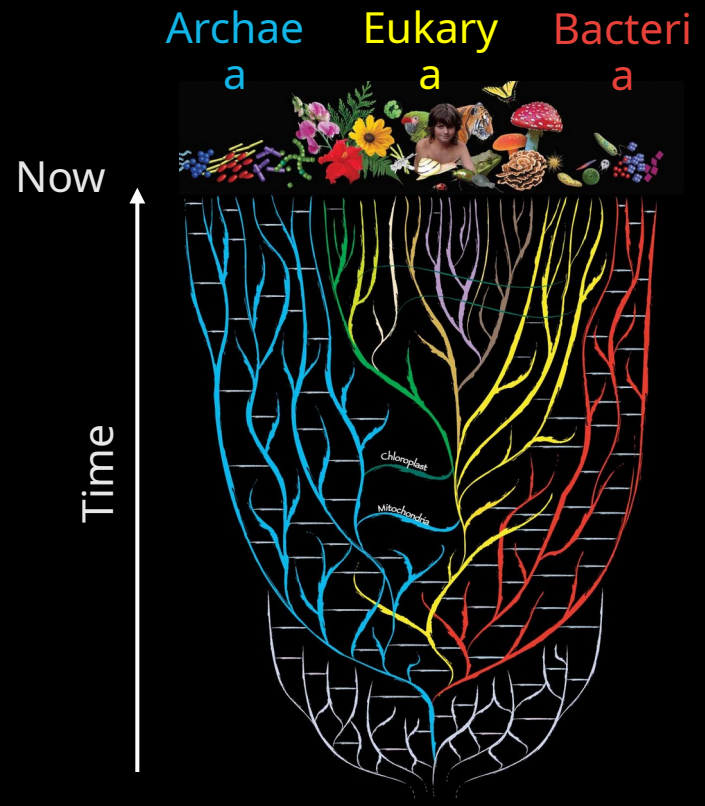
What is microbial ecology?

1. Who are they?
2. What are they doing? = What their roles are?
3. How can they respond to changes around them?

What is microbial ecology?

1. Who are they?
2. What are they doing?
3. How can they response to changes around them?

Name surname



What is microbial ecology?

1. Who are they?

2. What are they doing?

3. How can they respond to changes around them?

Everybody needs energy and carbon to survive

What is microbial ecology?

1. Who are they?

2. What are they doing?

3. How can they respond to changes around them?

Everybody needs energy and carbon to survive

Sunlight

Inorganic source

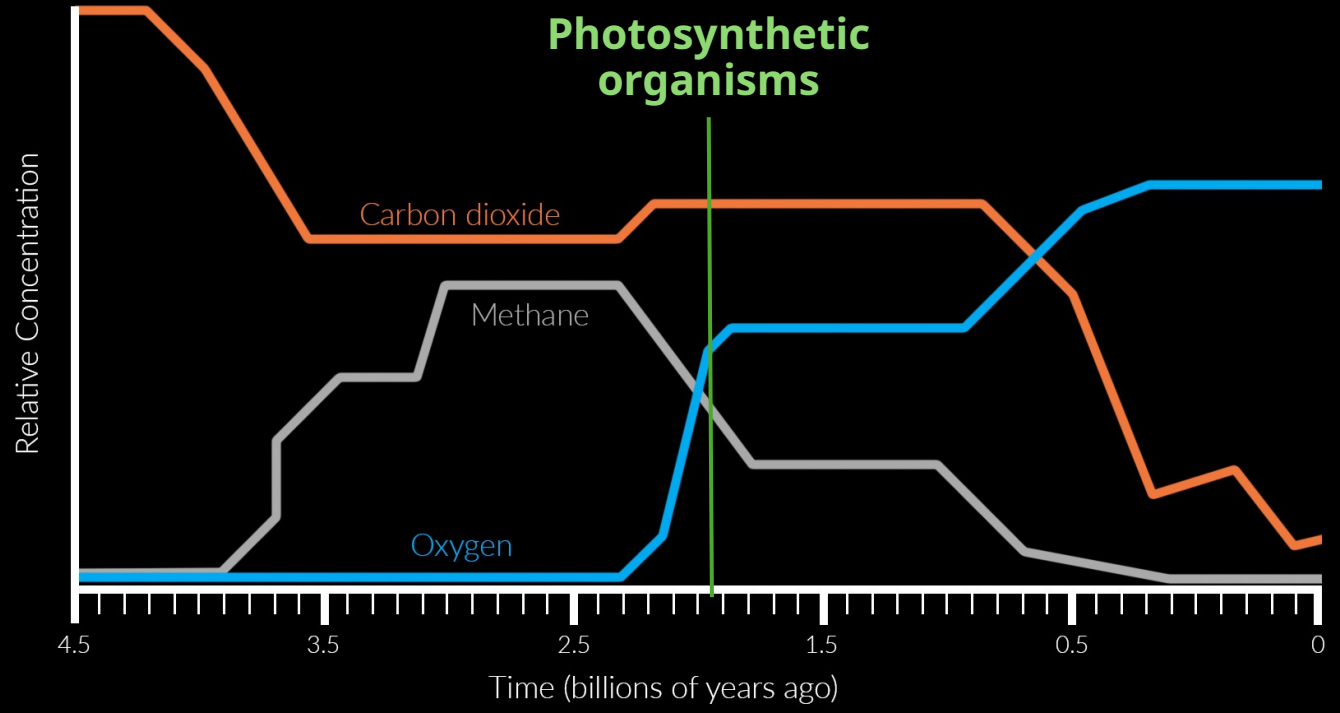
Organic source

2. What their roles are?

Autotrophs
Phototrophs

Heterotrophs

Microbugs have driven Earth's processes, since they appeared



00:00

04:00

Life appeared

13:00

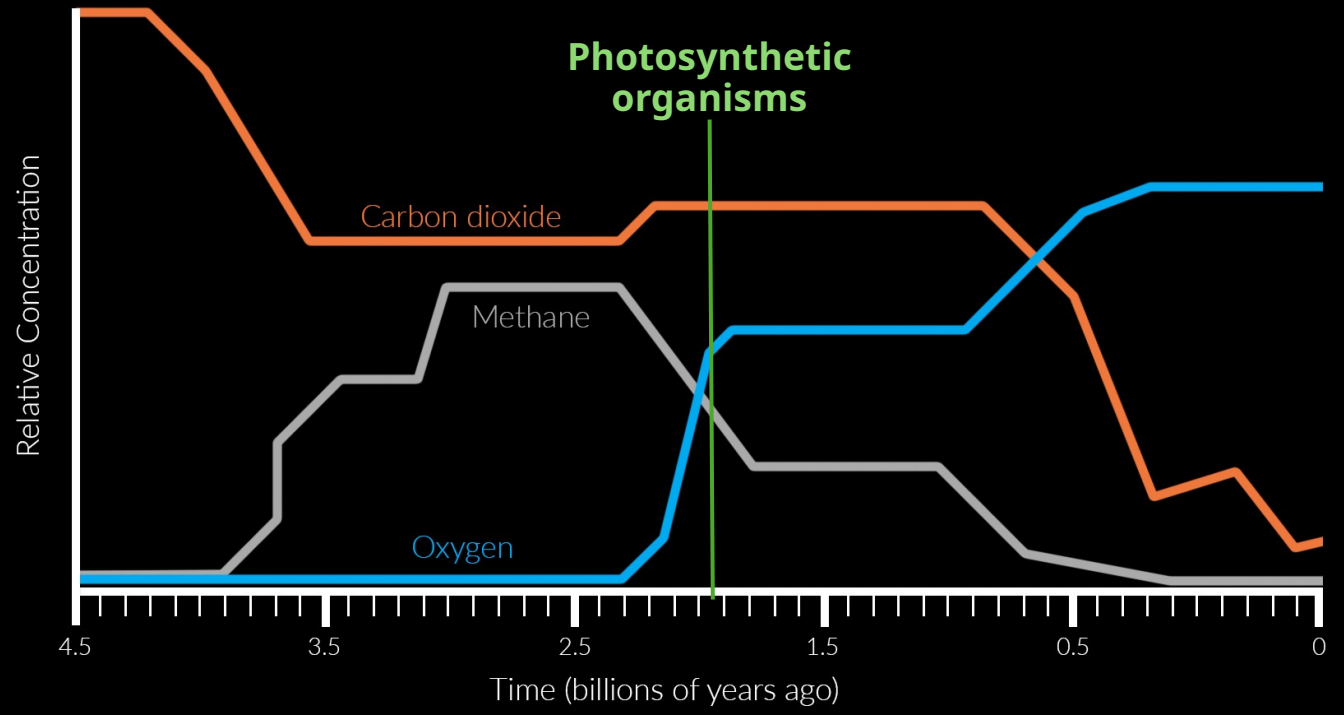
Someone can survive using sunlight and CO_2

Microbial mat

Organ-sedimentary structure

Shark Bay, Aus

Microbugs have driven Earth's processes, since they appeared



00:00

04:00
Life appeared

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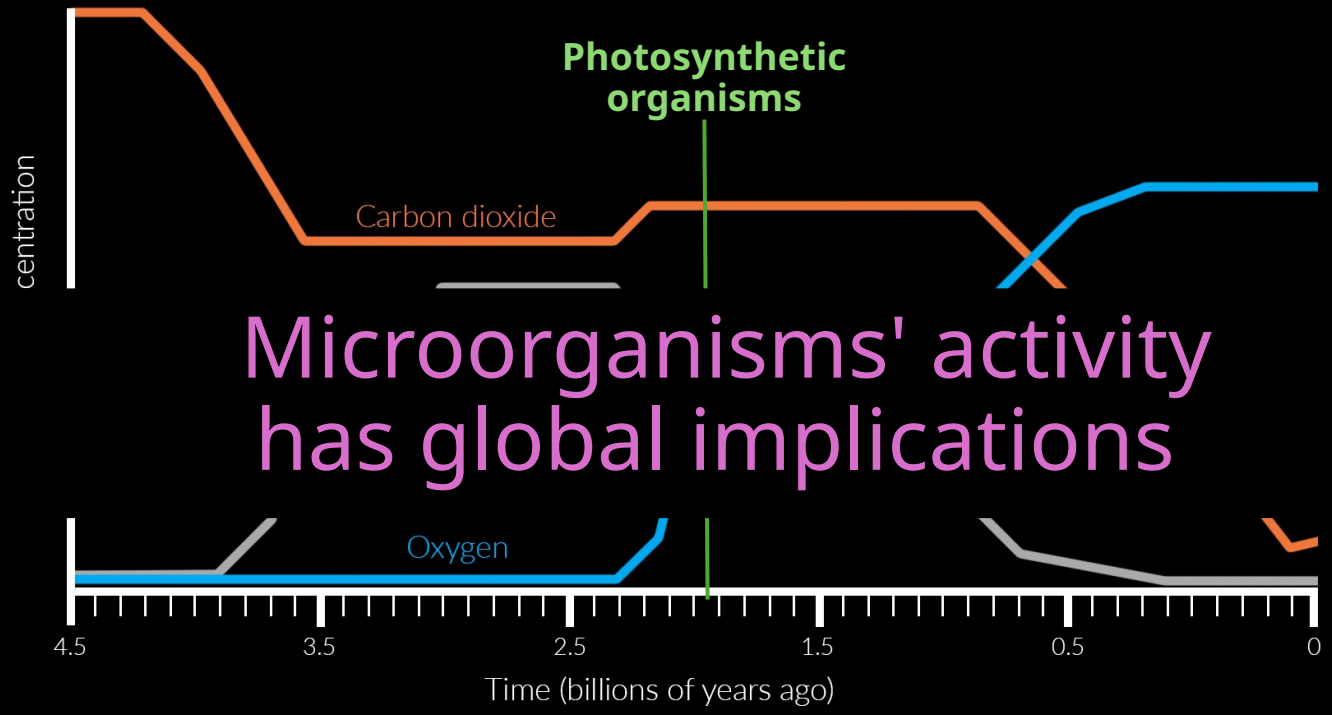
Someone can survive using sunlight and CO_2

23:58:58
Humans appeared and destroyed everything

Microbugs have driven Earth's processes, since they appeared



Microorganisms' activity has global implications

00:00

04:00
Life appeared

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Humans appeared and destroyed everything

What is microbial ecology?

1. Who are they?

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Microorganisms in Mexican lava caves

Professor Rafael López Martínez

Professor Rocío Alcántara Hernandez

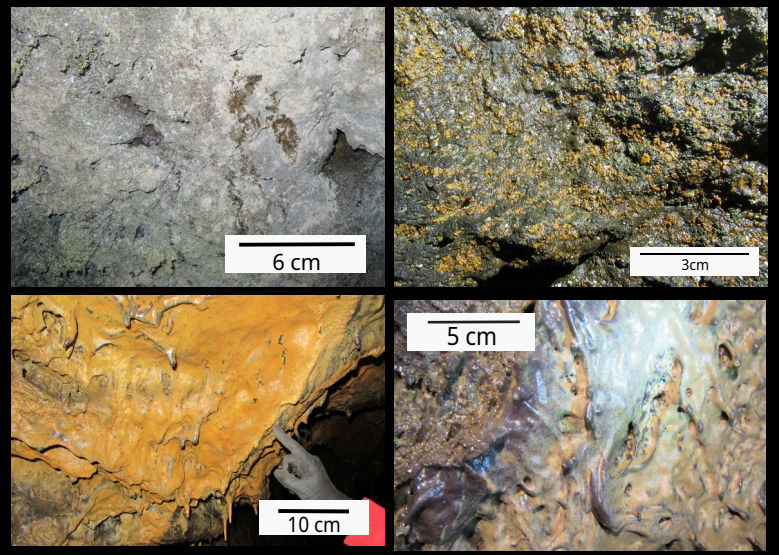
Biofilms

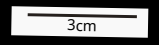
Terrestrial stromatolites

Lopez-Martinez et al., 2016

Are all the slimes the same in different caves?

Biofilms

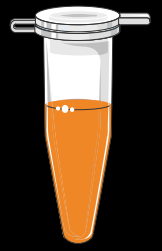




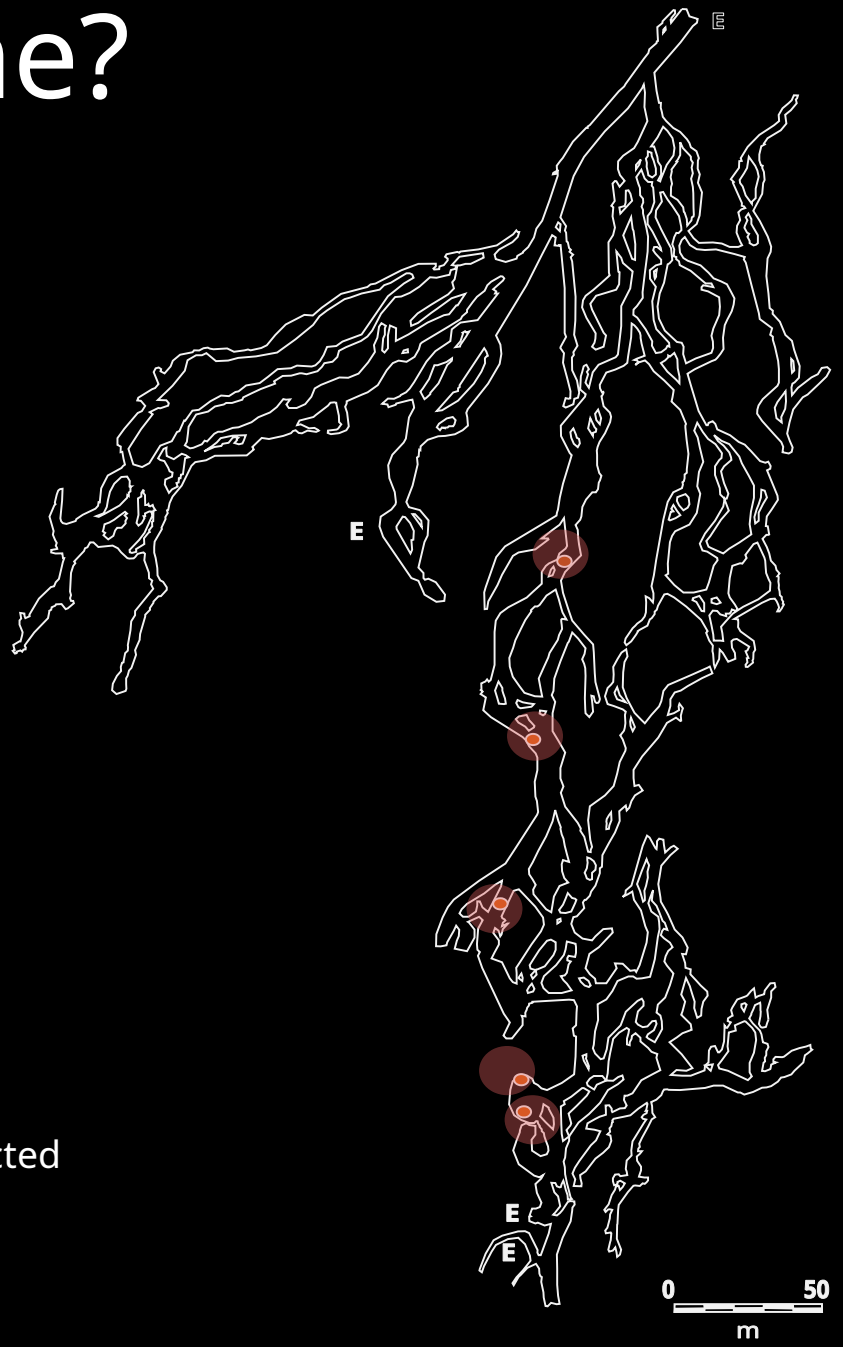
Church lava tube system

Are all the caves the same?

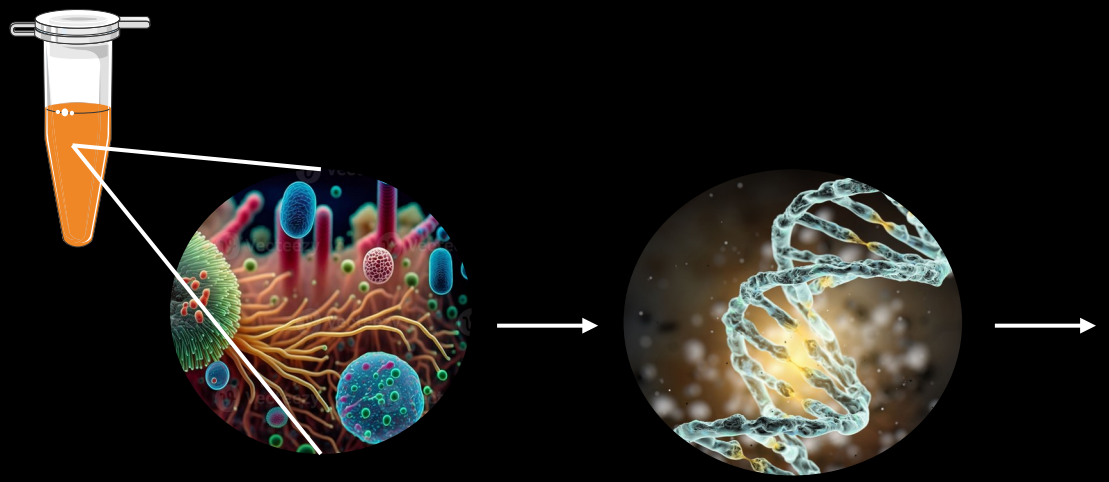
That's me
200 years ago.



We collected slimes and extracted DNA



DNA is a detailed instruction manual for every organism

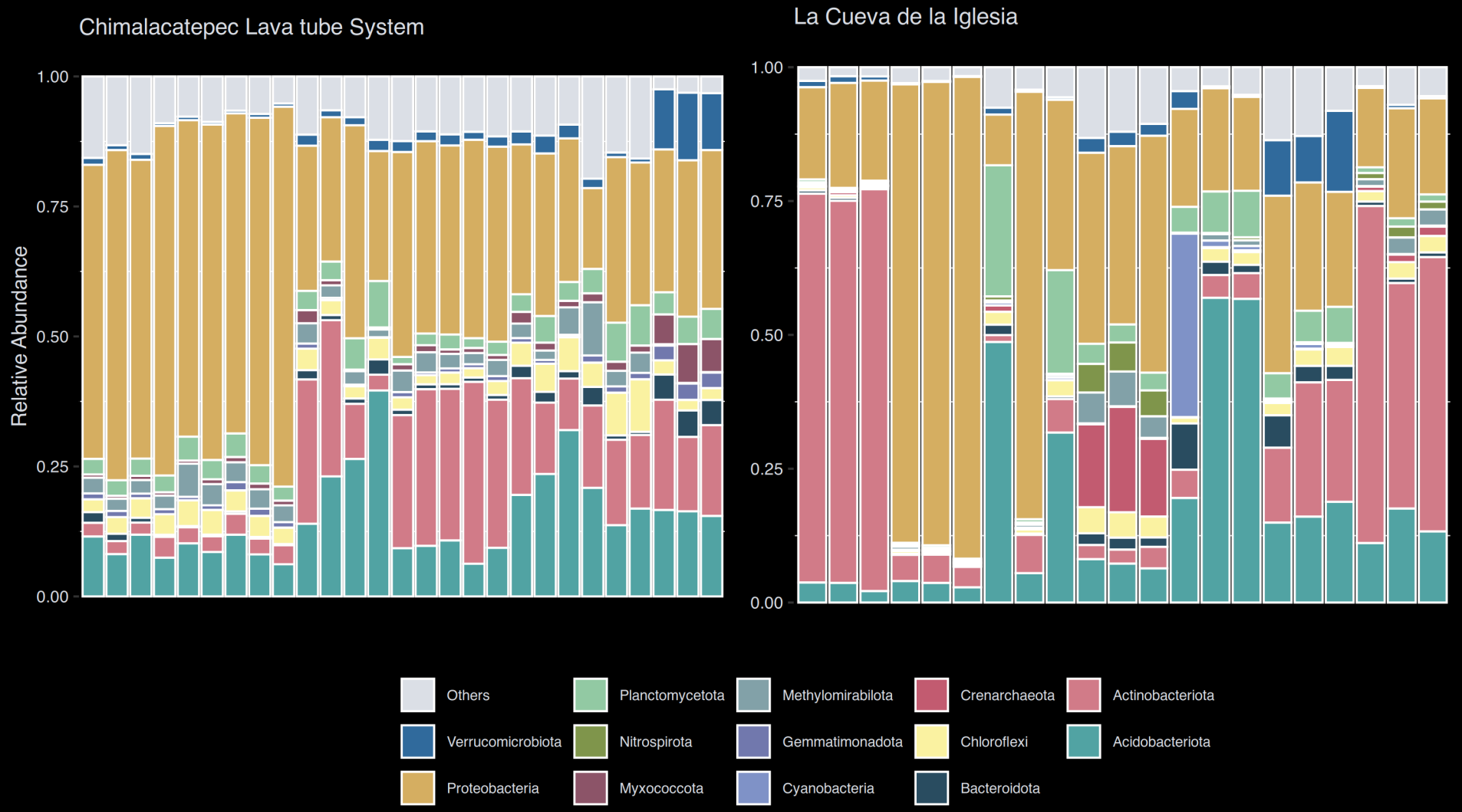


Parts of the DNA can tell us who they are

Others what they can do

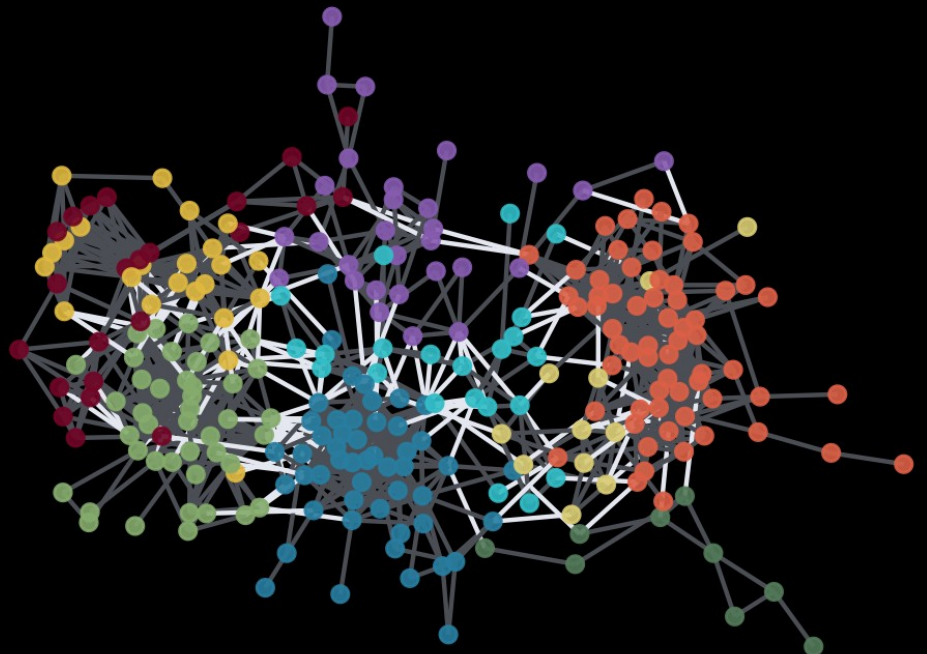
ATGCGTACCTGGAATCGTTAGCCTTACGGTACCGAATTCGCGTGAGCTTACGA
TCGTGGCATAGCTTAGGCGTCCGATCGTTAAGCTAGGCGTATCGGCTACGATG
CTTGAACGTACGCGTCCAGTAGGCTTACGATCGATCGTAGGCTTCCGATAGCT
ACGTCGATGCTTCCGTAGCTGCGTAGGCGTGATAGCGTAGCTTACCGGTAGC
GATTAGCTAGGCCGATAGCGTAGGATCCGATACGTTAGCTAGCTTAGCGGTTA
CGTGATCGTGATCGCTTACGATCGTAGCTACGATCGTAGGCTAGCCTTAGCTA
CGATCGGGTAGCTTAGCTAGCGTAGGCTTACGTAGCTAGCTTAGGCTGCGTTA
CGATAGCTTAGGCTTACGTAGCGATAGCGTACGTTAGCTAGCGATGCCAGTAC
GTTAGGCTAGCGTAGCTTACGATCGGCTTAGGCTACGTTAGCTTAGCCTACGC
TAGCTAGGGTAGCTTACGTTAGCGTACGATCGTAGCTACGTAGGCTTACGATG
CTTAGCGTTACGTAGCGTTCGCTAGCCTTAGCTACGATAGGCTTACGCTTAGC
GTACGCTGACCGTAGCTTAGCTAGCGTTAAGCTGACCGTAGCTTAGGCTTACG
TAGCTAGCGGCTTAGCTGACGCTTAGGCTTACGTAGCTTAGCTACGATCGTAG
CTGACGCTTAGGCGTAGCTTAGCTACGTGCTTAGCTACGATGCTTAGCTAGCG
TAGGCGTTACGTAGCTTAGCGTACGCTTAGCTACGTTAGCGTTAGCGTAGCTT
AGGCGTAGCTTAGCTACGATCGTAGCTTAGCTACGTAGCGTAGGCTTACGTTA
GCGTACGATCGTAGCTTAGGCTTAGCCTAGCTTAGCGTAGCTTAGCGTAGCTT
AGCGTACGCTTAGCTTAGCTAGGCTTAGCGTACGCTTAGCGTAGCGTAGGCTT
AGCTTAGCGTTAGCTTAGCGTACGCTTAGGCGTAGCGTACGTAGCTTAGCTAG
CGTAGCGTTAGCTTAGGCTTAGCTAGCGTACGCTTAGCTTAGCGTAGCTTAGC
TAGCGTAGCTTAGCTTAGCGTTAGCTTAGCGTACGCTTAGCGT

Caves are incredibly diverse

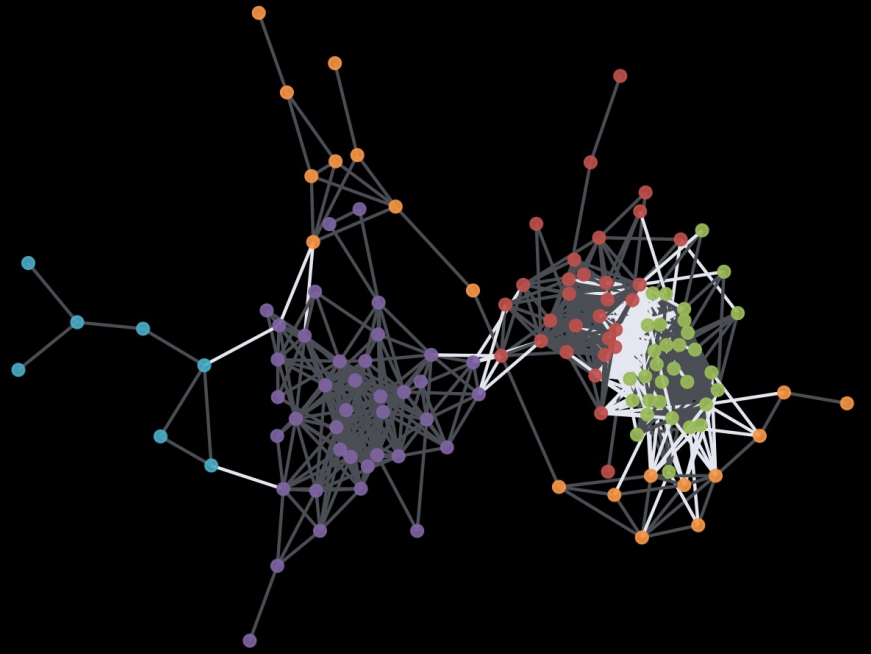


Microorganisms have very strong relationships

Biofilms

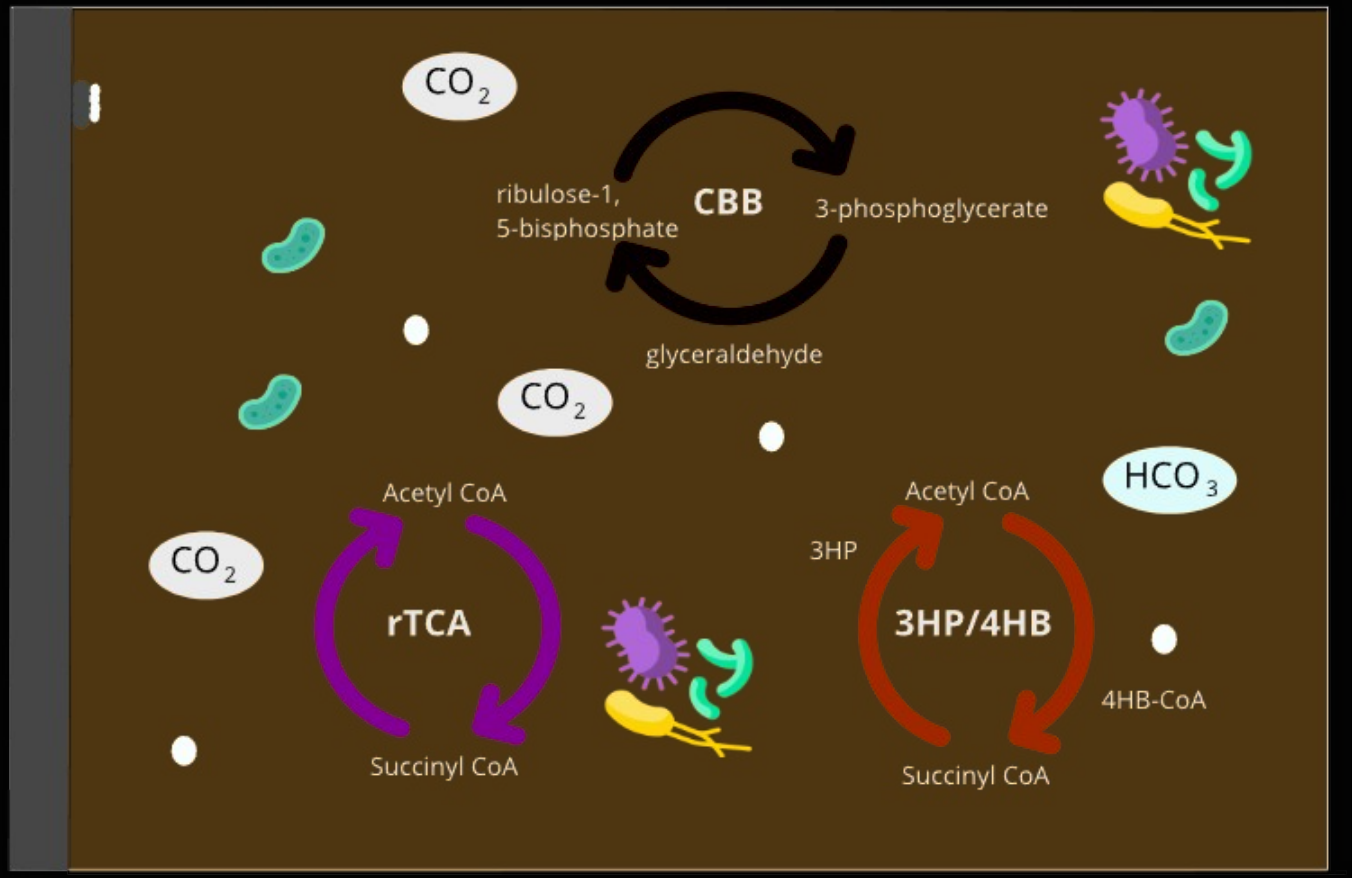


Terrestrial stromatolites



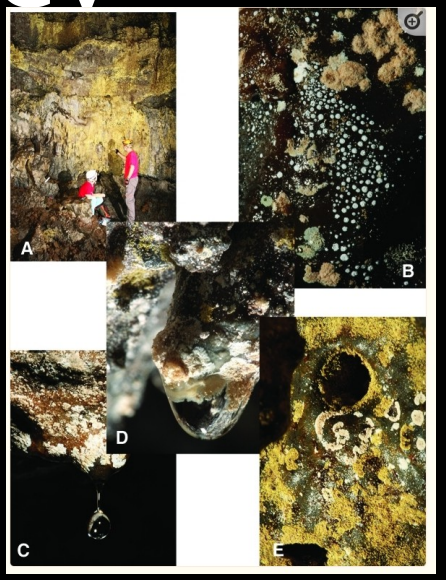
Microorganisms get carbon from inorganic sources

Autotrophs



But... how do they get energy?

We have answered very well who they are

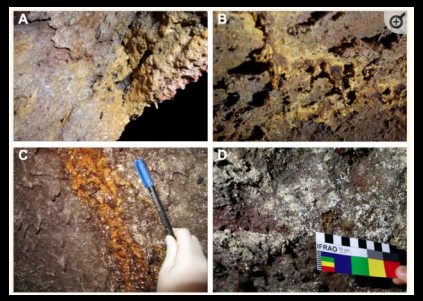


Portugal, Azores Islands

Northup et al., 2011

Luis-Vargas et al., 2019

Bay et al., 2023

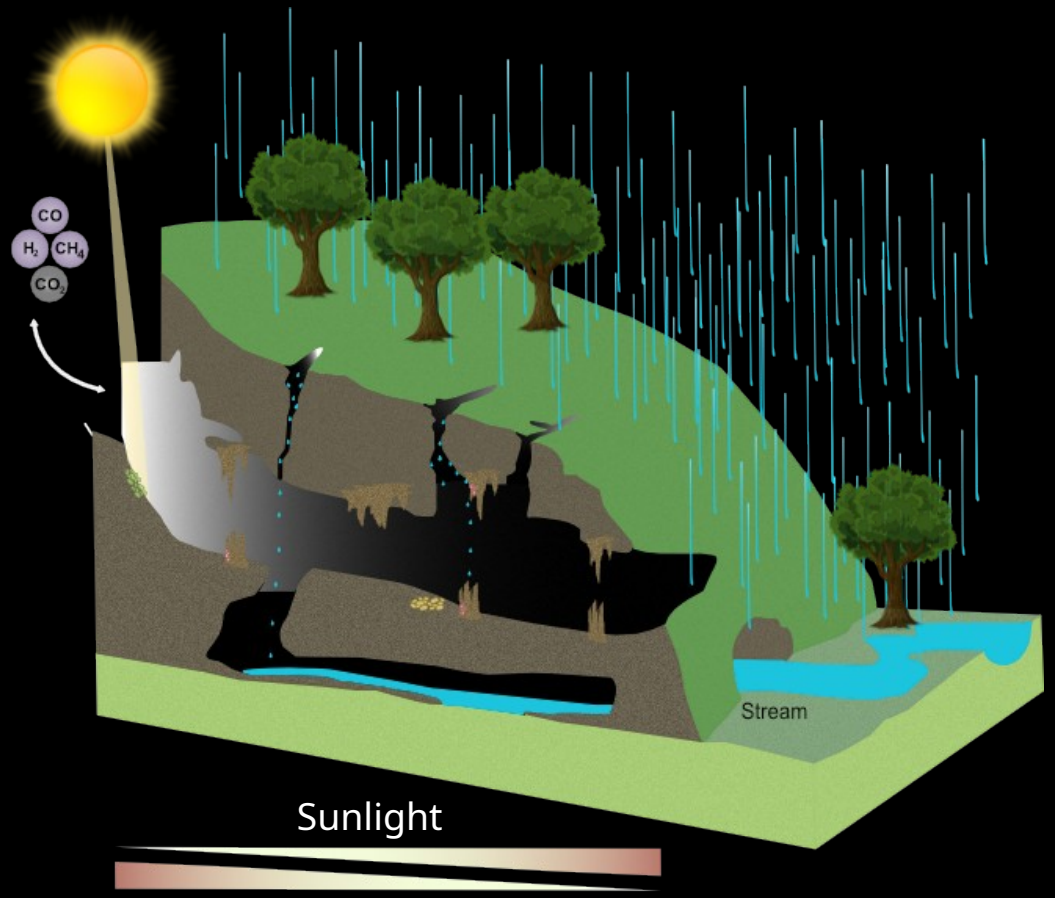


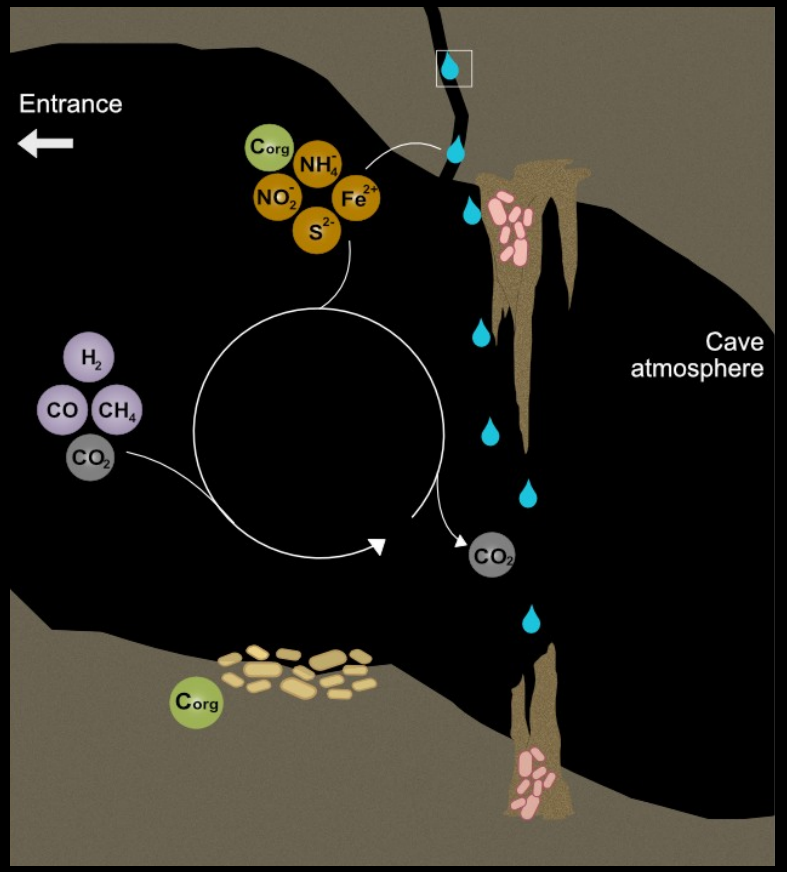
Spain, Canarias Islands

Gonzales-Pimentel et al., 2021

We hadn’t answered very well what they can do

Until Sean’s paper

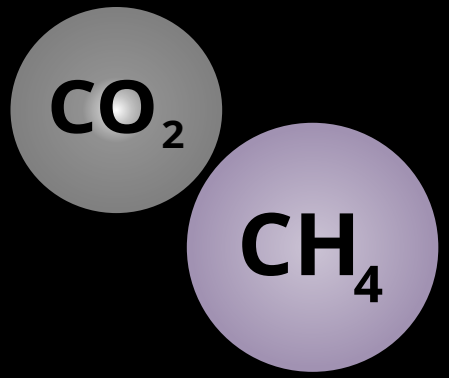




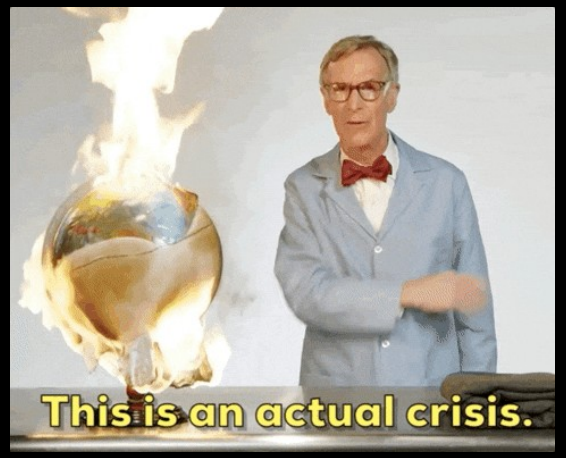
Bay et al., 2023, Luis-Vargas et al., 2024

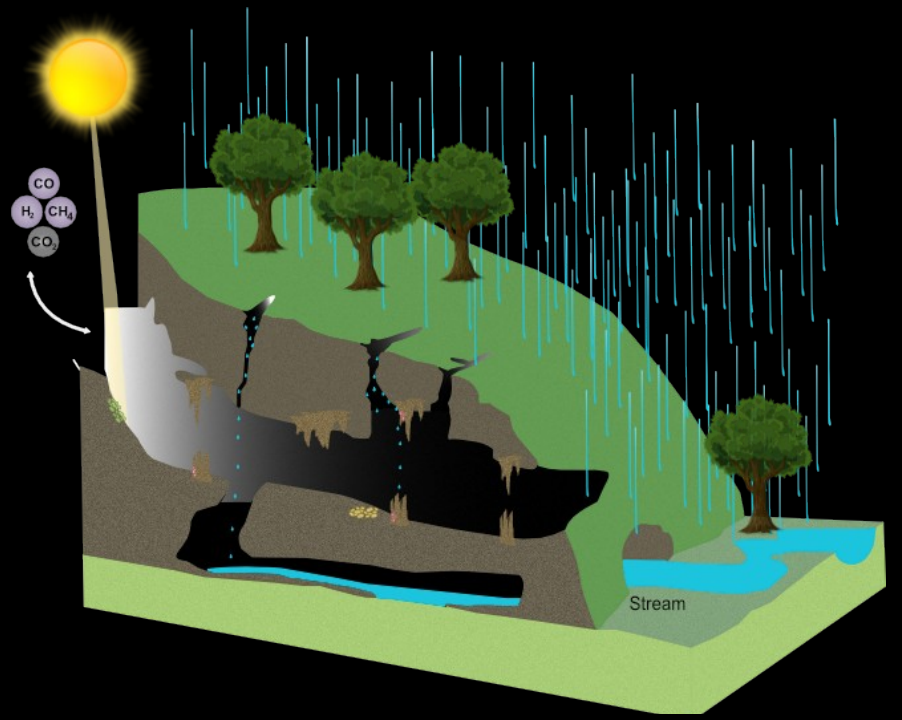
These capabilities might have global implications

Greenhouse gases



Global warming

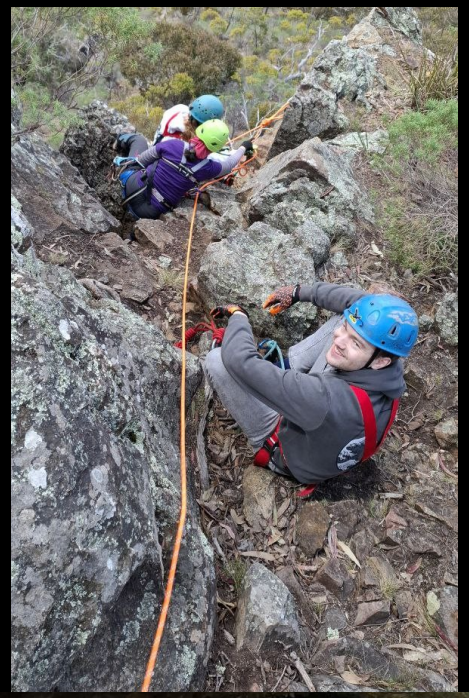




Caves as sinks

The story continues…

We cannot do science alone

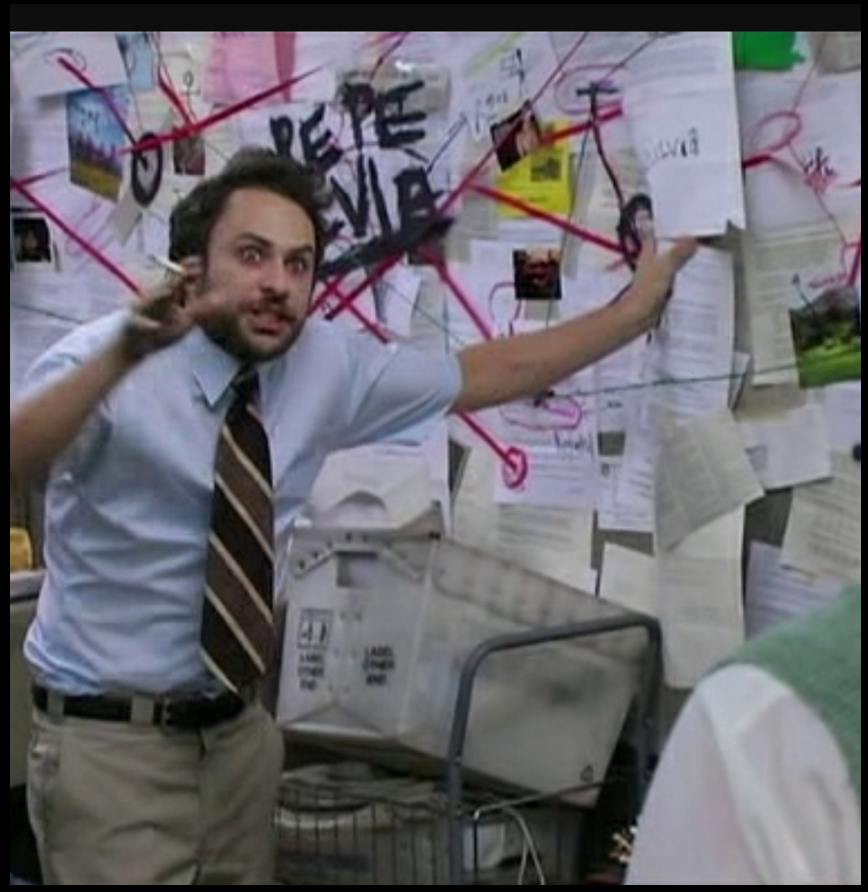


When I talk about microorganisms in caves

How I think I look

|

How I really look



References

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