Food or a free ride?

The ability of a marine microbial community to degrade plastics

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University of Warwick

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MIBTP Midlands Integrative Biosciences Training Partnership

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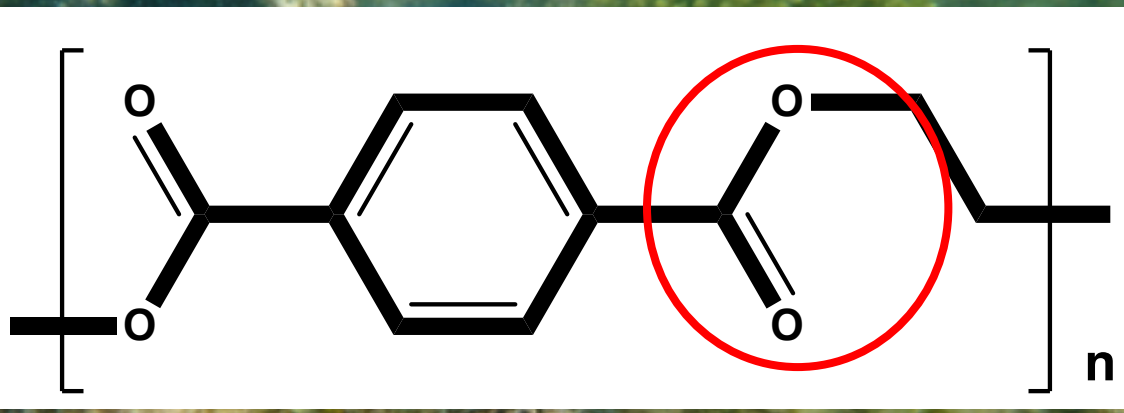
INTRODUCTION

INTRODUCTION

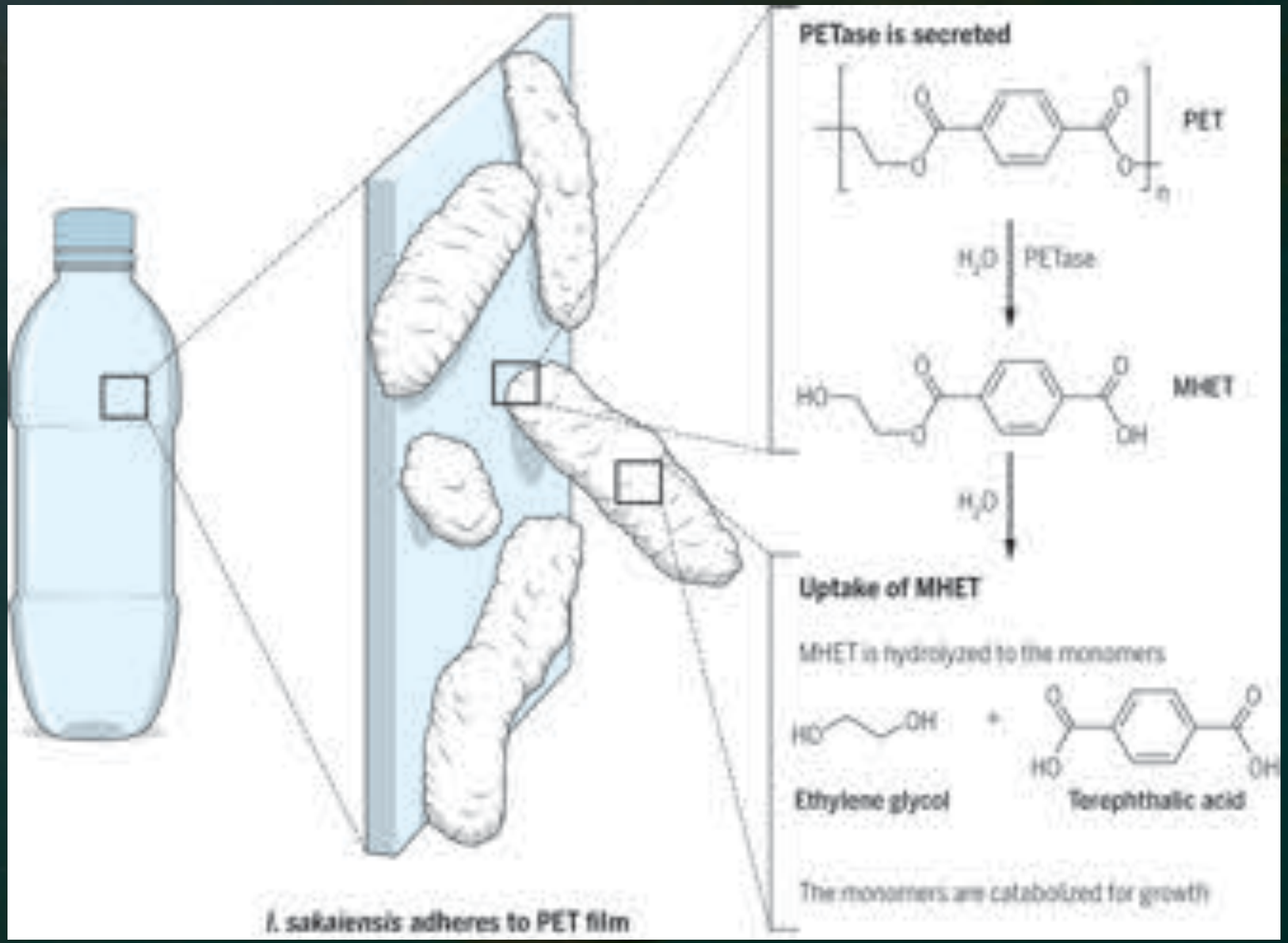
Poly(ethylene terephthalate)

PET



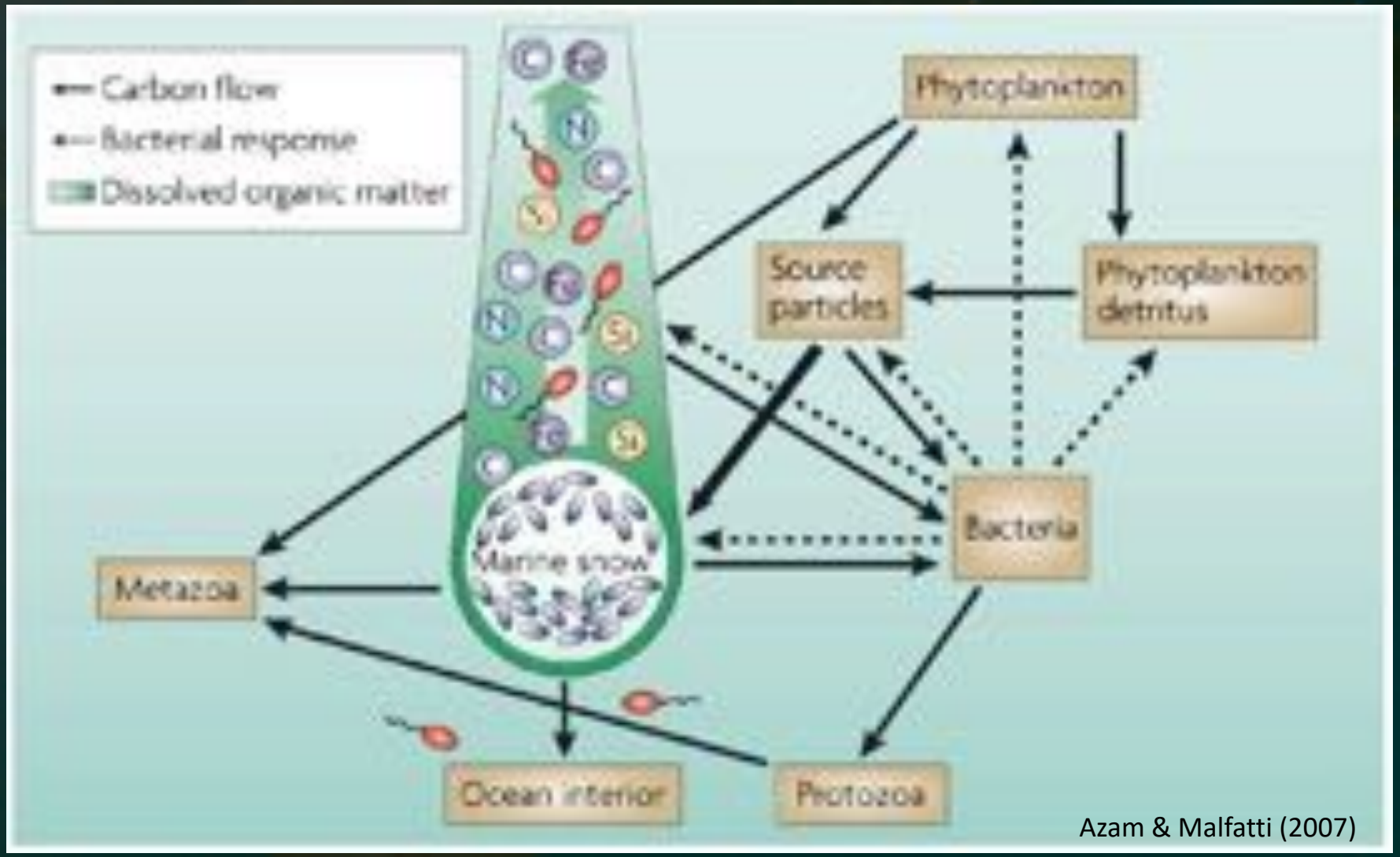
INTRODUCTION: DEGRADATION OF PET (TERRESTRIAL)

Ideonella sakaiensis – PET degrader



Yoshida *et al.* (2016)

INTRODUCTION: DEGRADATION OF NATURAL POLYMERS

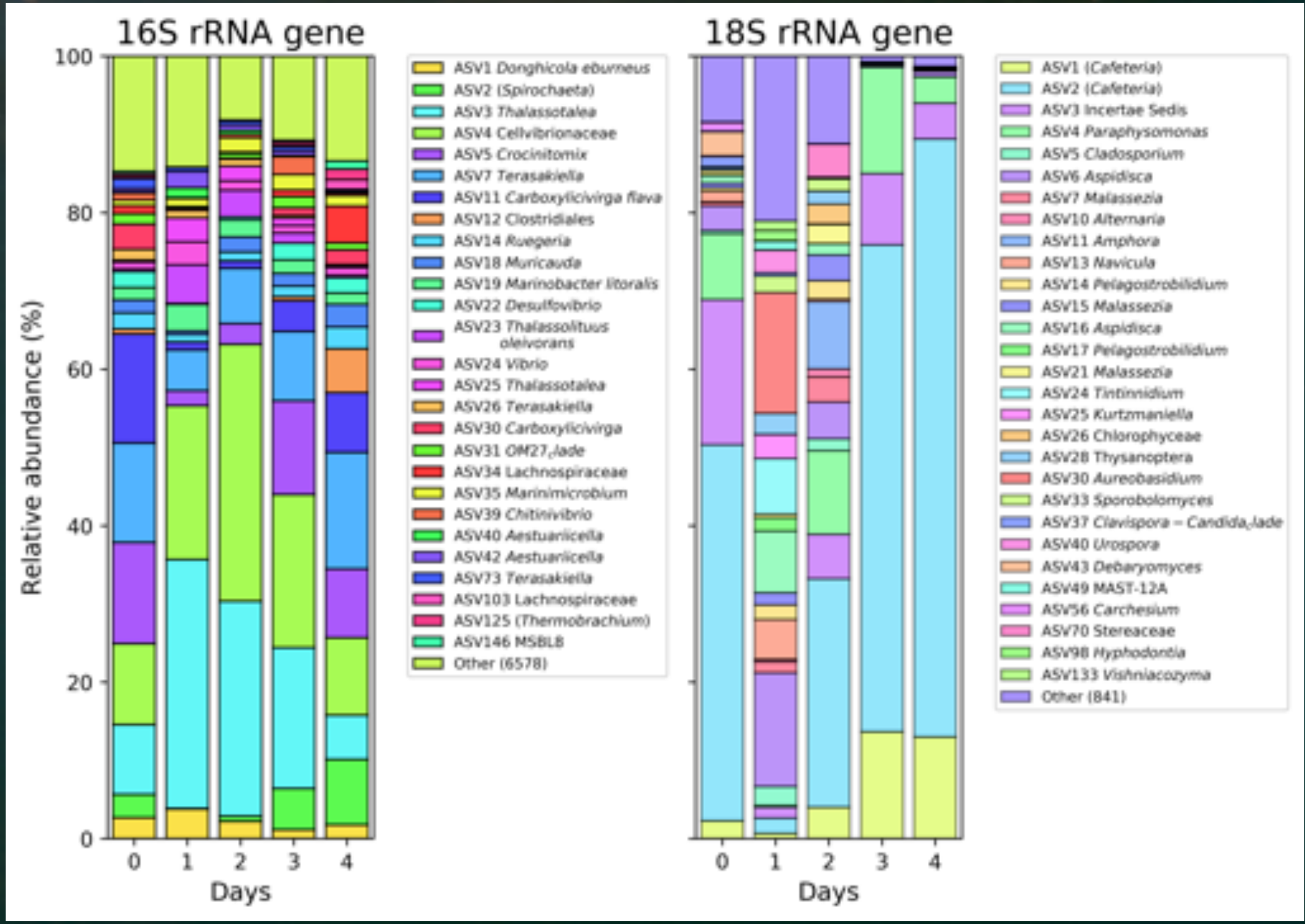


Azam & Malfatti (2007)

What can we learn about the fate and degradation of natural polymers that we can apply to the degradation of synthetic polymers?

INTRODUCTION: DEGRADATION OF CHITIN

ASV (amplicon sequence variant) ~ OTU



Wright *et al. (In review)*

INTRODUCTION: DEGRADATION OF CHITIN

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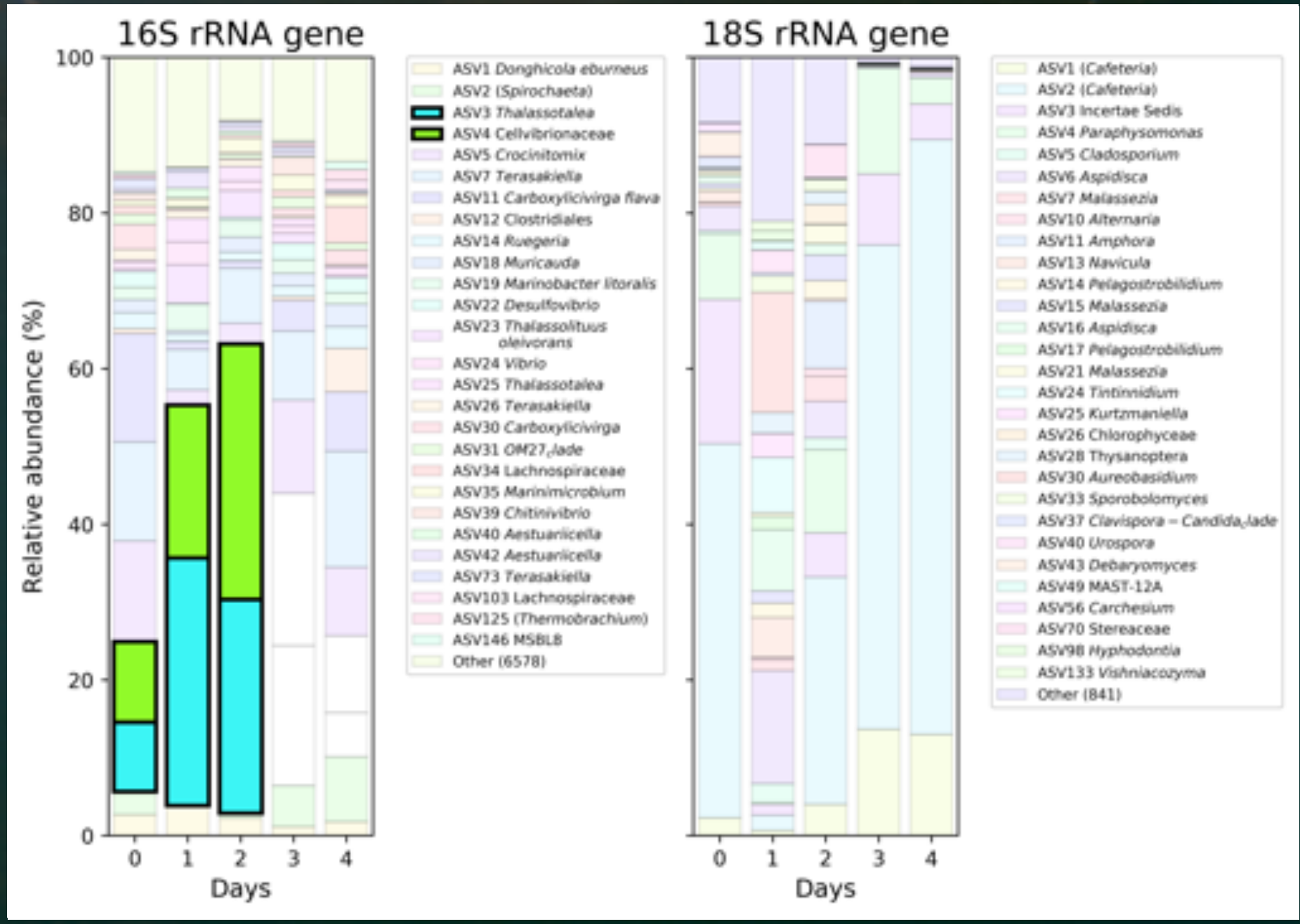

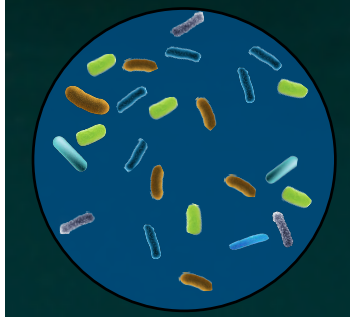

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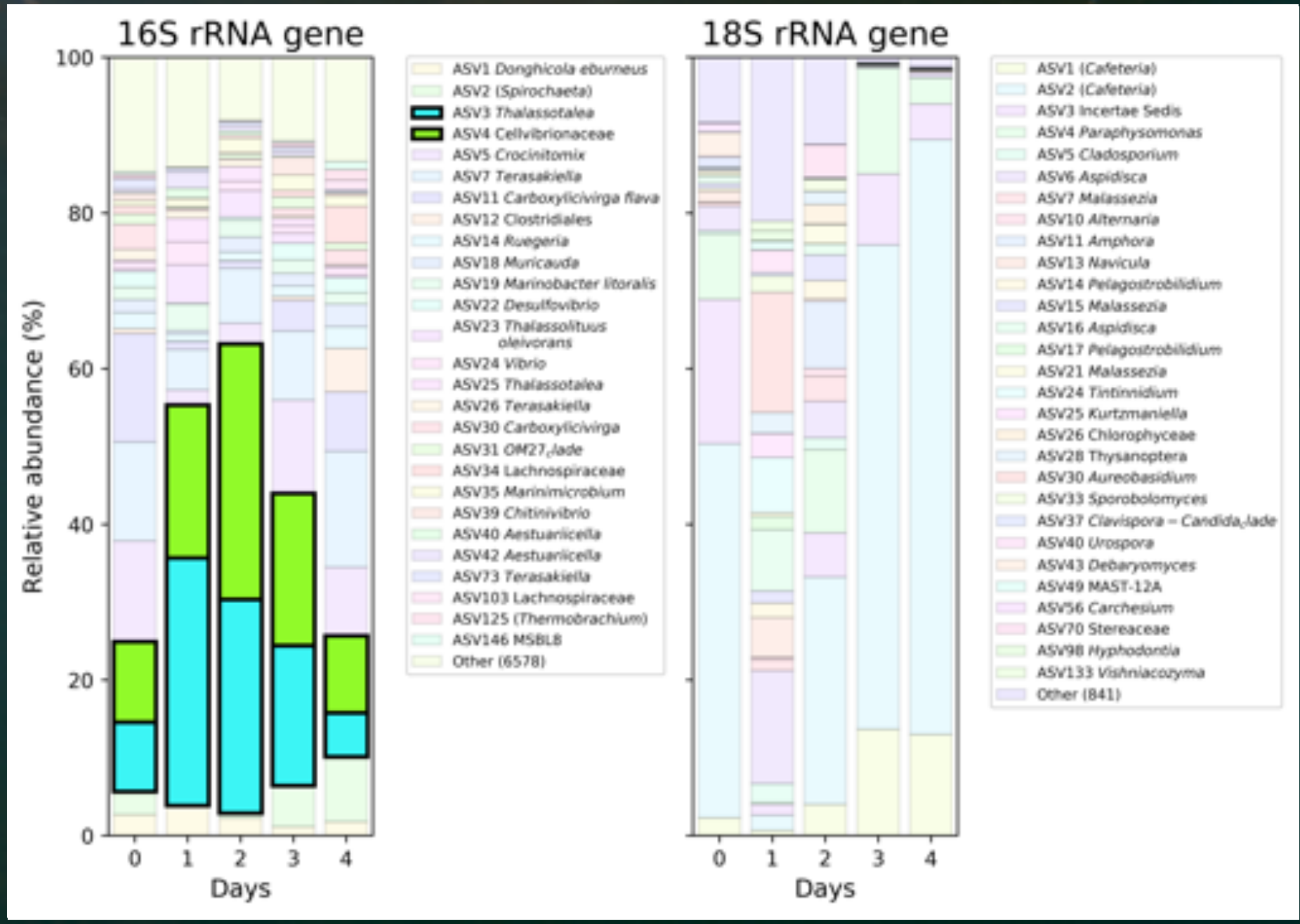

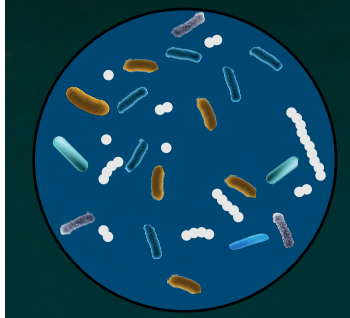

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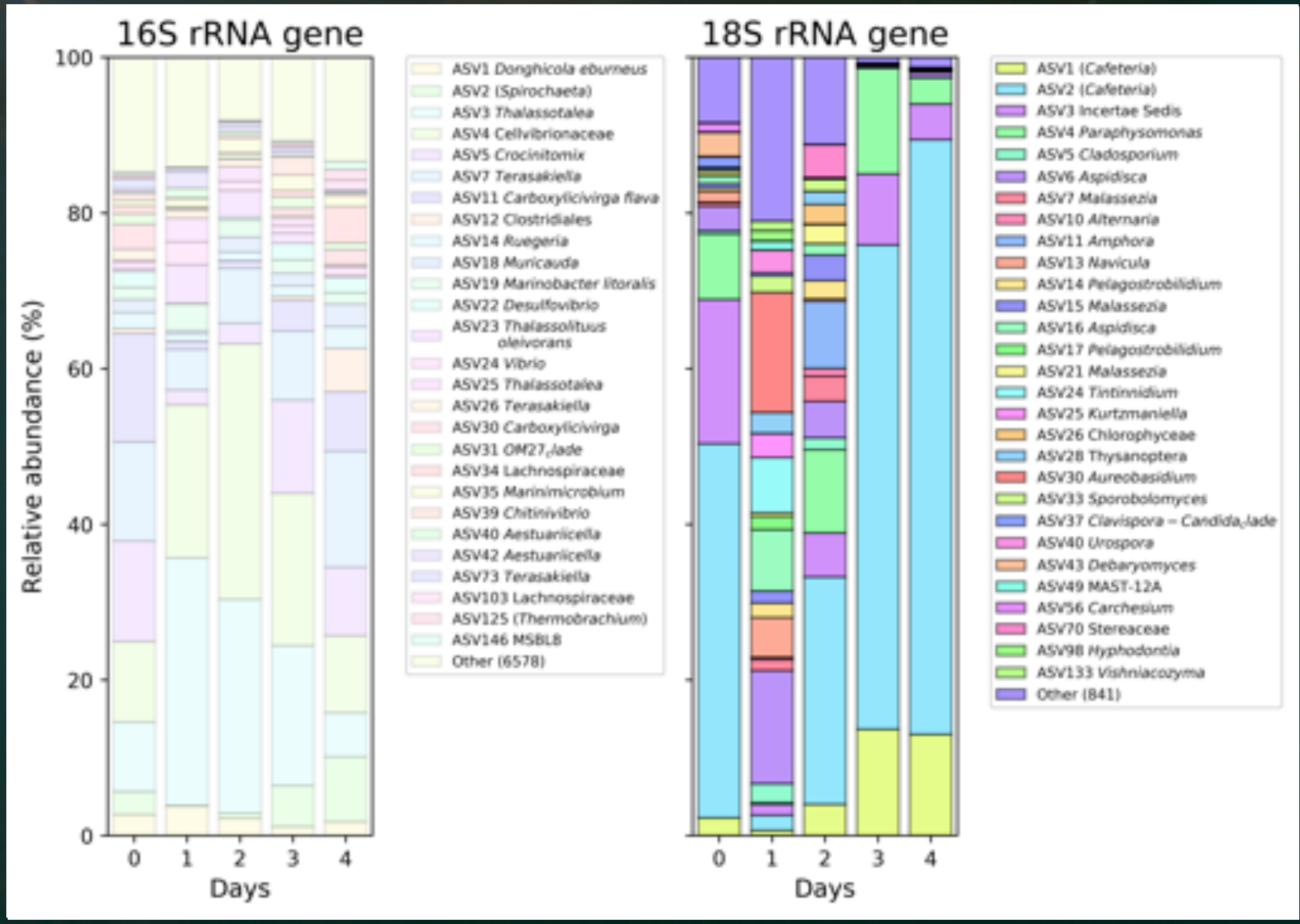

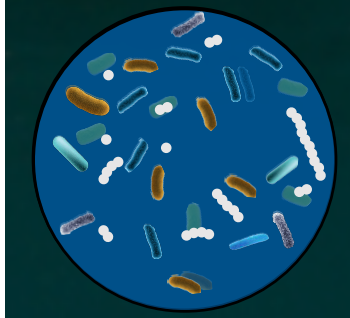

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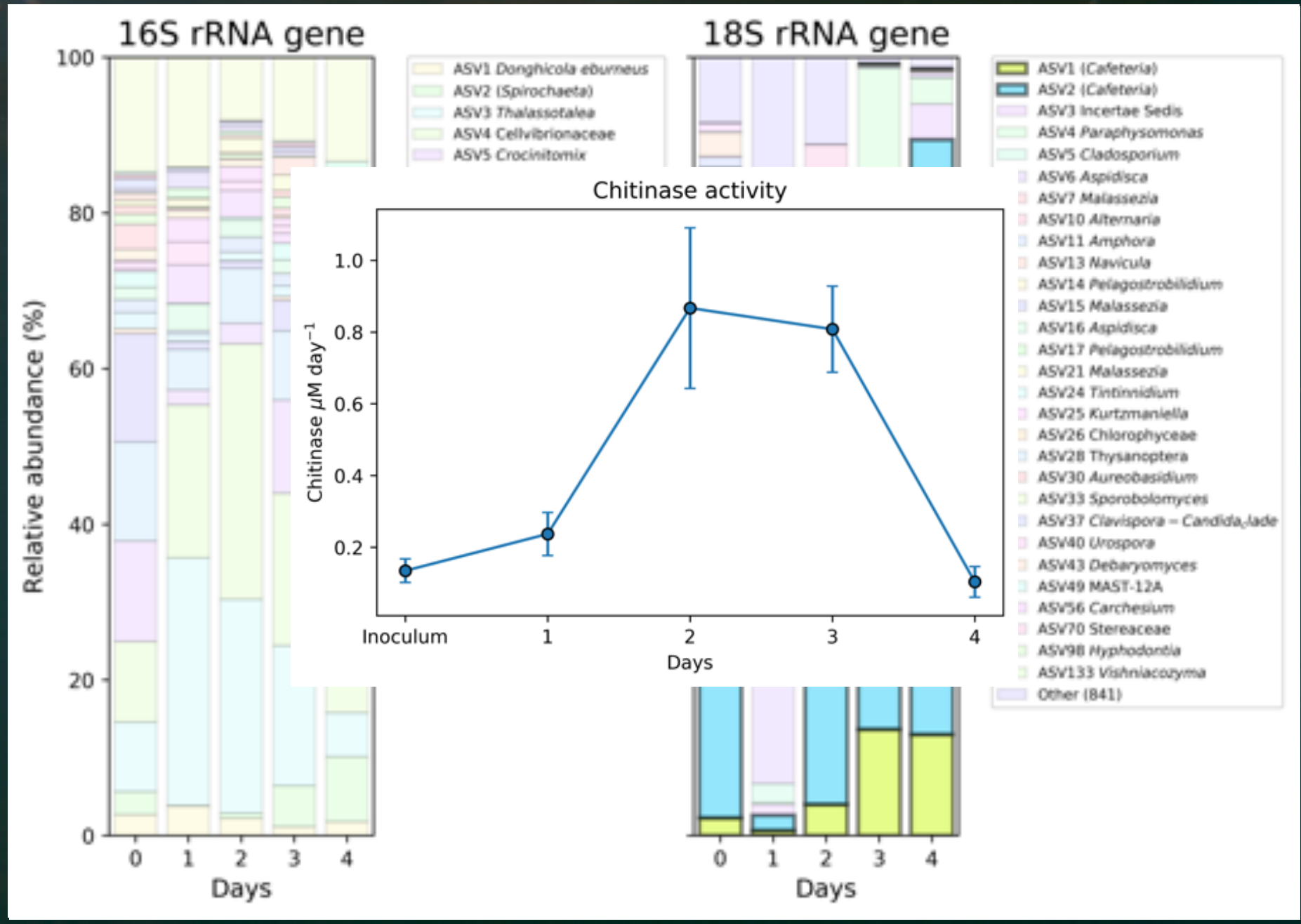

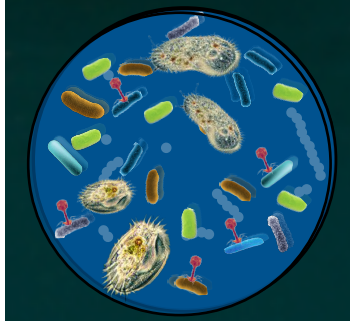

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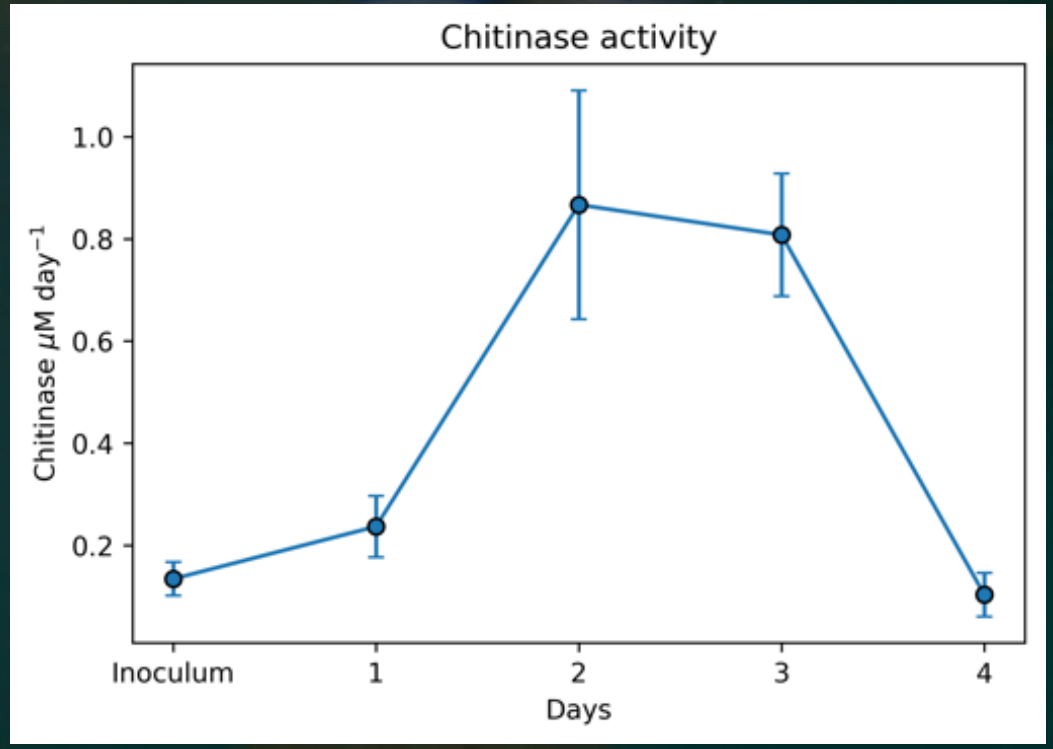

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Chitin

Microbial community composition good indicator of degradation ability

PET

?

AIMS

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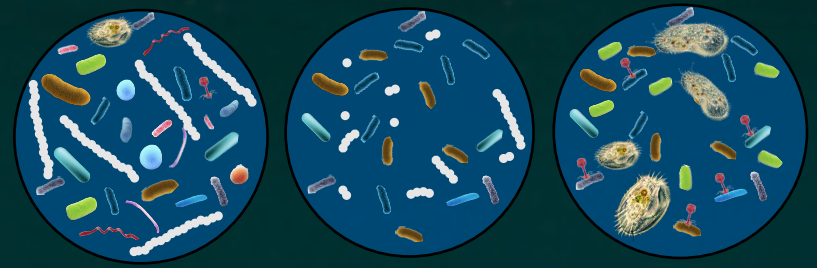
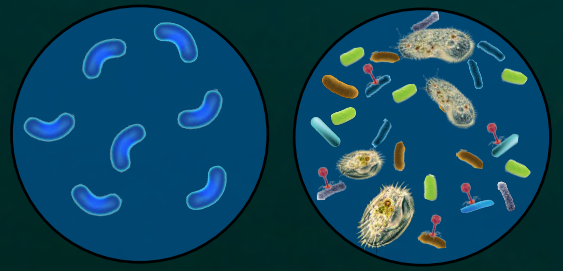
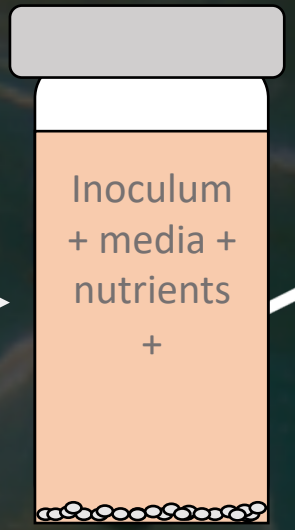
2. Do we see a pattern of microbial community succession, as we do with chitin?



3. Is the community better at degrading PET than an individual organism?



2. PET COMMUNITY SUCCESSION



Incubate six weeks

- **PET (powder)**
- **Weathered PET (powder)**
  - 80˚C for 6 months
- **Low crystallinity PET (pieces)**
  - Planktonic and biofilm
- **BHET**
  - Breakdown product
- **No Carbon**

Sample (day):

1 | 3 | 7 | 14 | 21 | 30 | 42

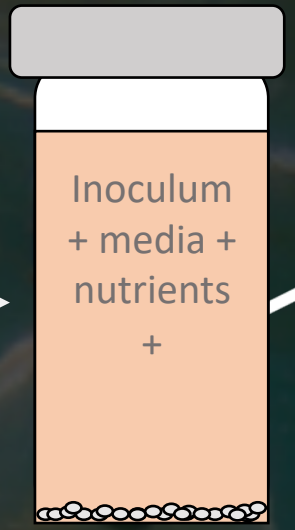
→ Prokaryotic community analysis

- 16S rRNA gene MiSeq amplicon sequencing

→ Metabolomics

- LC/MS for PET breakdown products

2. PET COMMUNITY SUCCESSION



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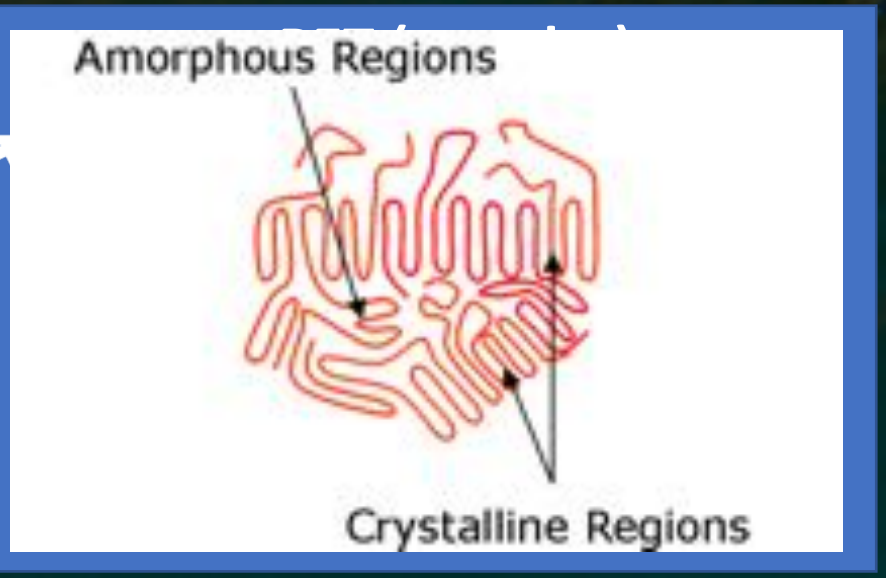

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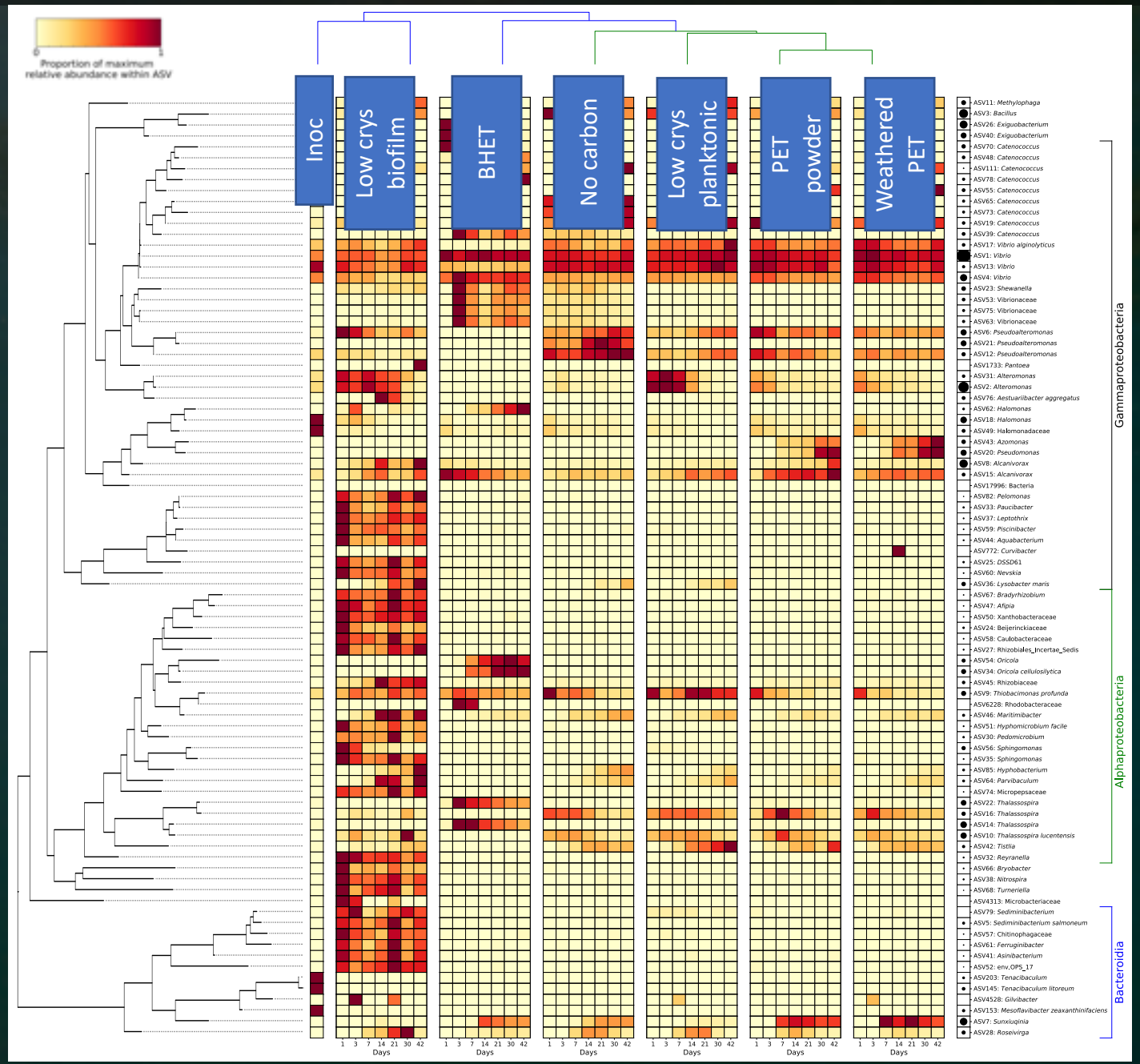

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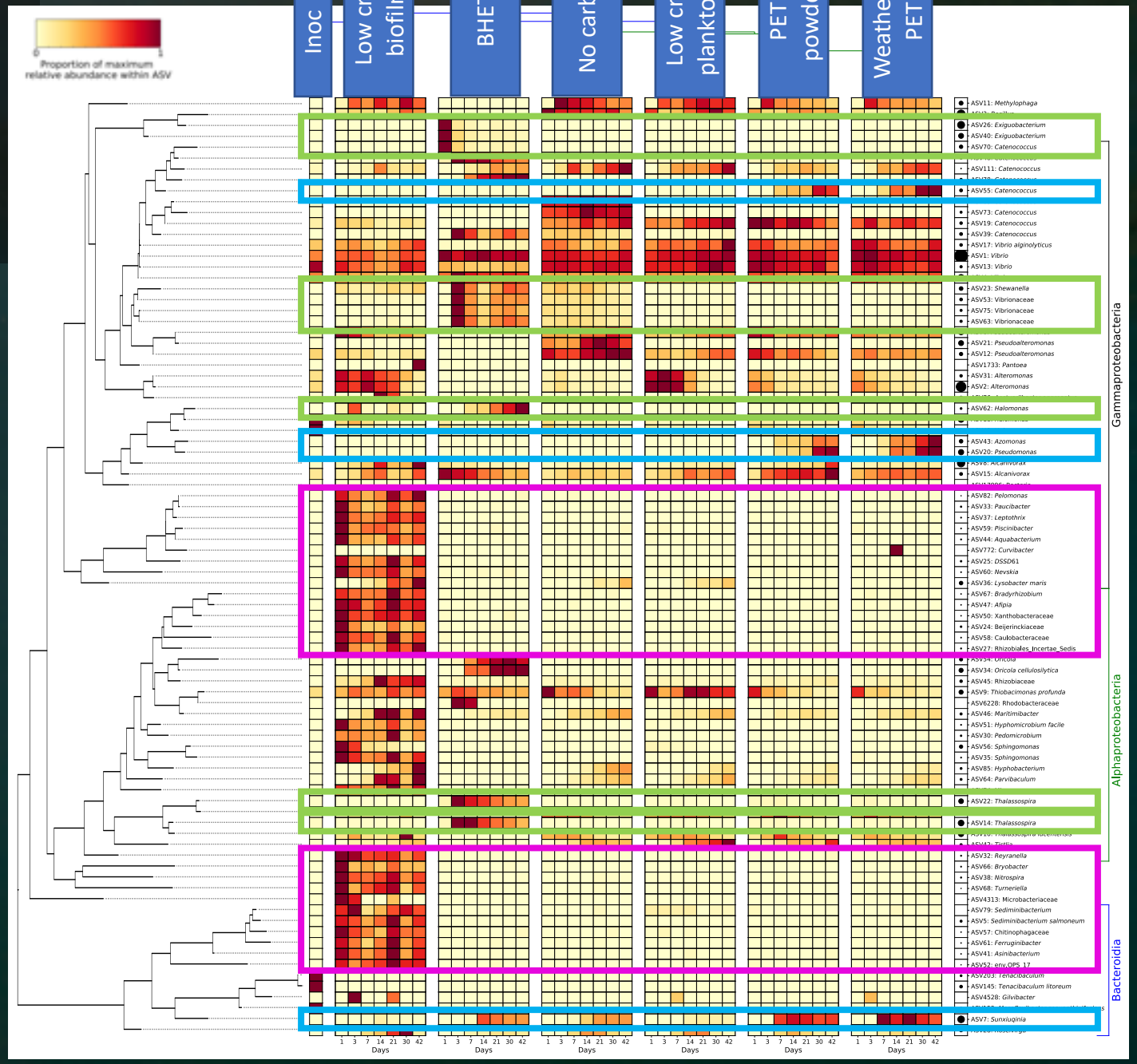

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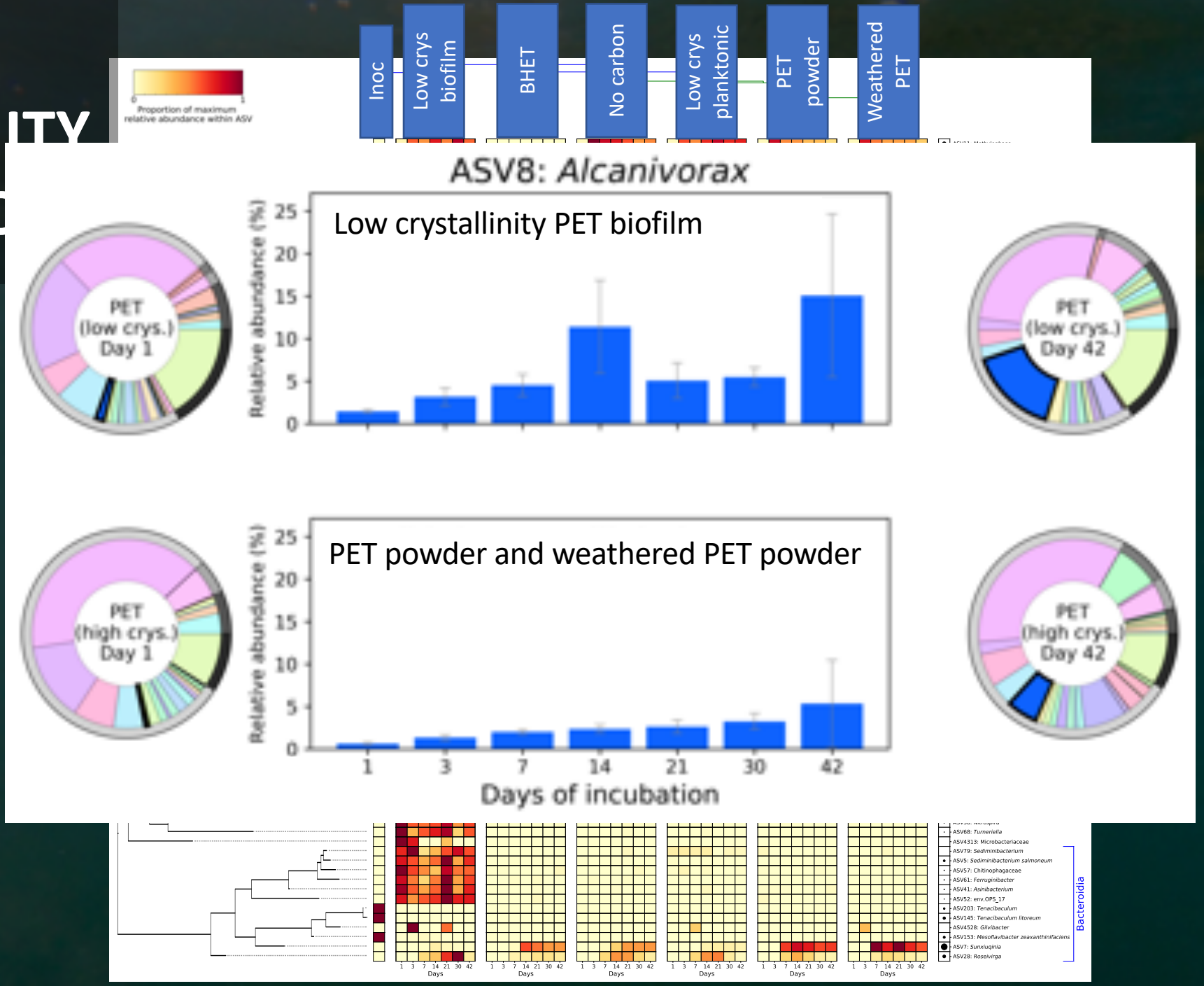

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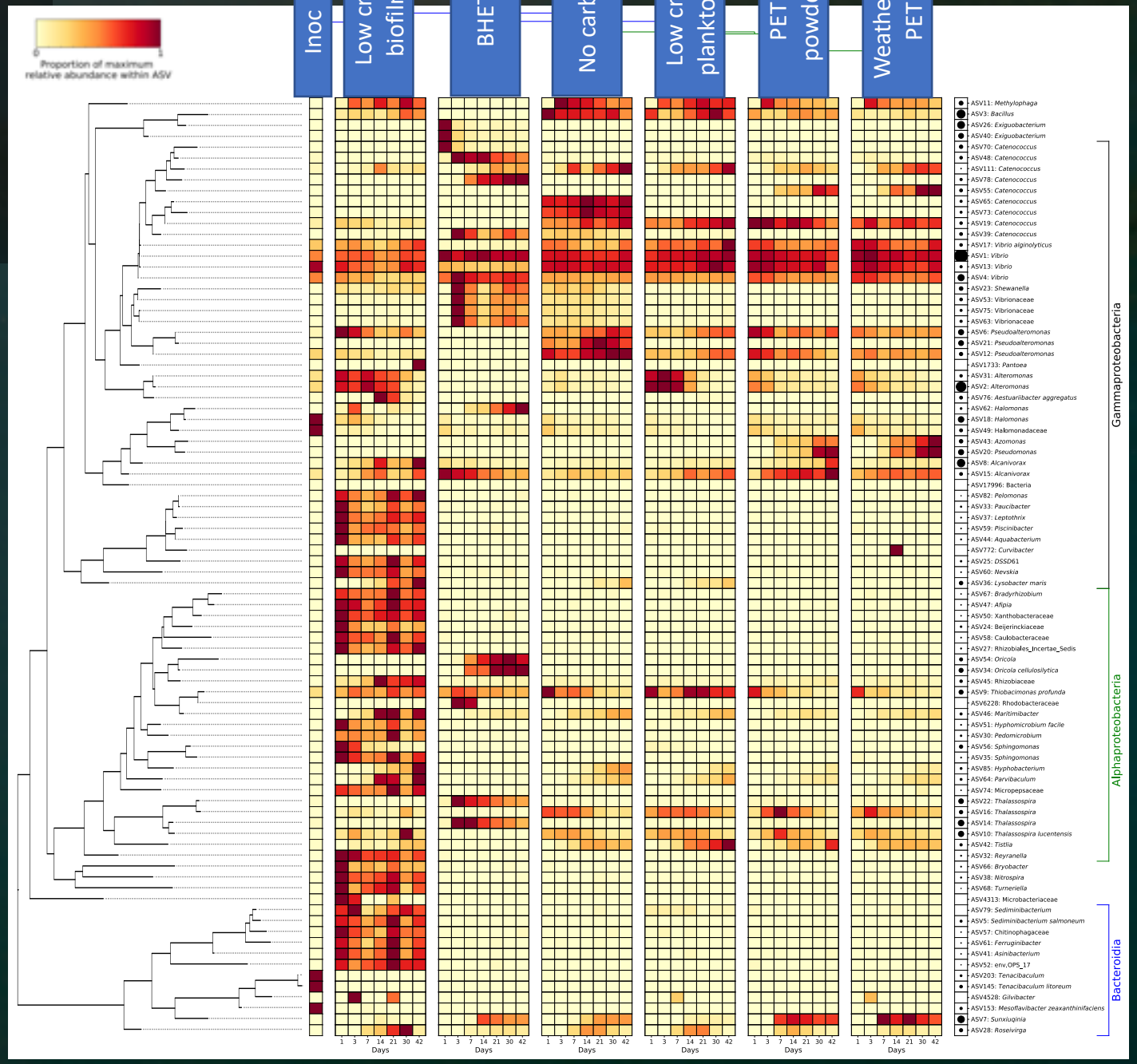
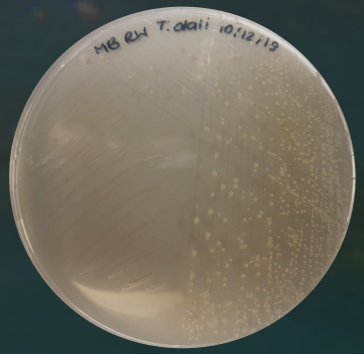


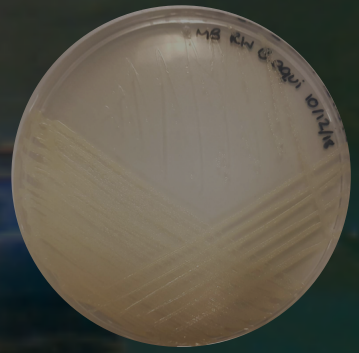
3. COMPARISON WITH ISOLATES



Thioclava sp.

(Alphaproteobacteria)

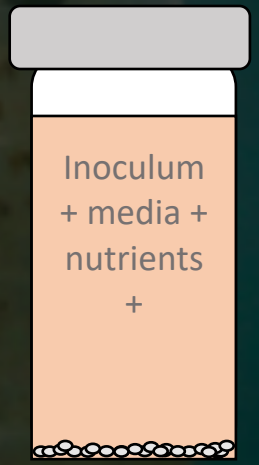
- Has enzymes similar to *I. sakaiensis* (Betaproteobacteria) PETase



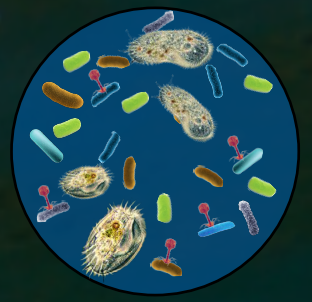
Bacillus sp.

(Bacteroidetes)

- Not similar to *I. sakaiensis*



- Low crystallinity PET pieces
- PET powder
- Weathered PET powder
- No carbon

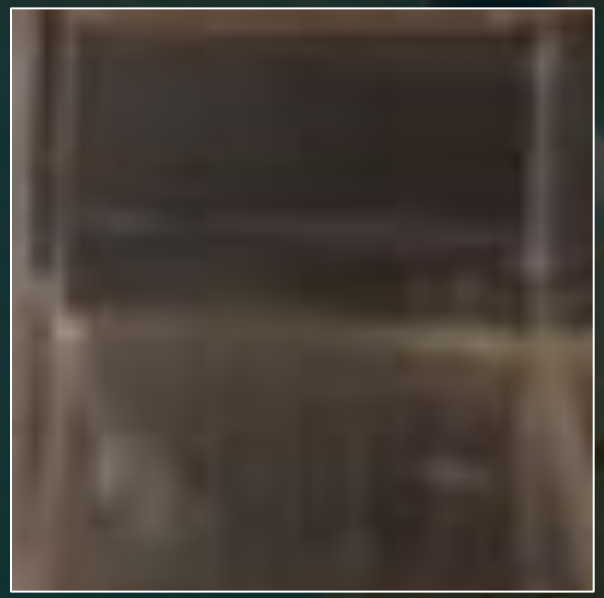


Community

- Same community as used for PET succession experiment

3. COMPARISON WITH ISOLATES (preliminary)

Control



Thioclava sp.

Bacillus sp.

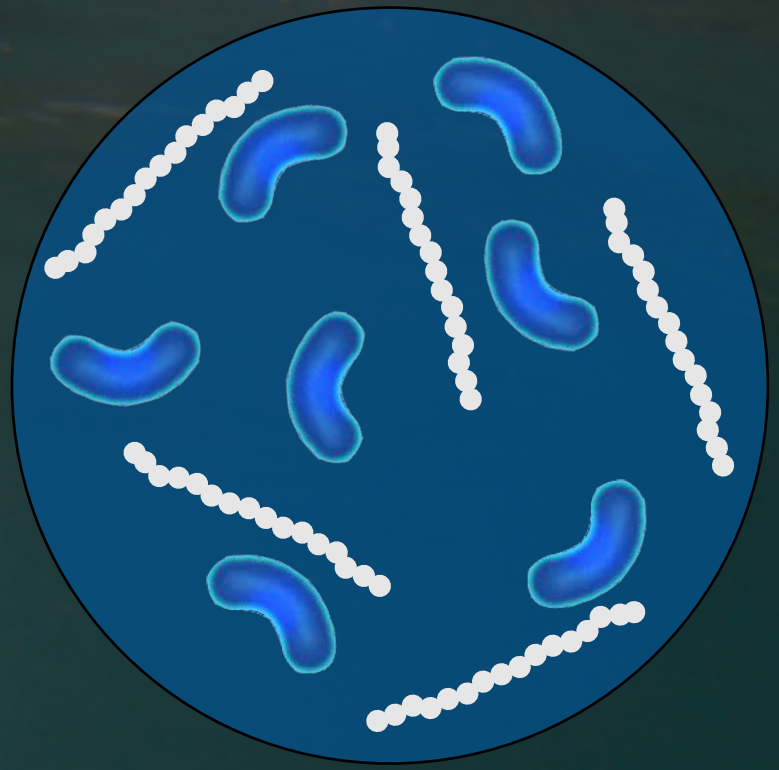
Community

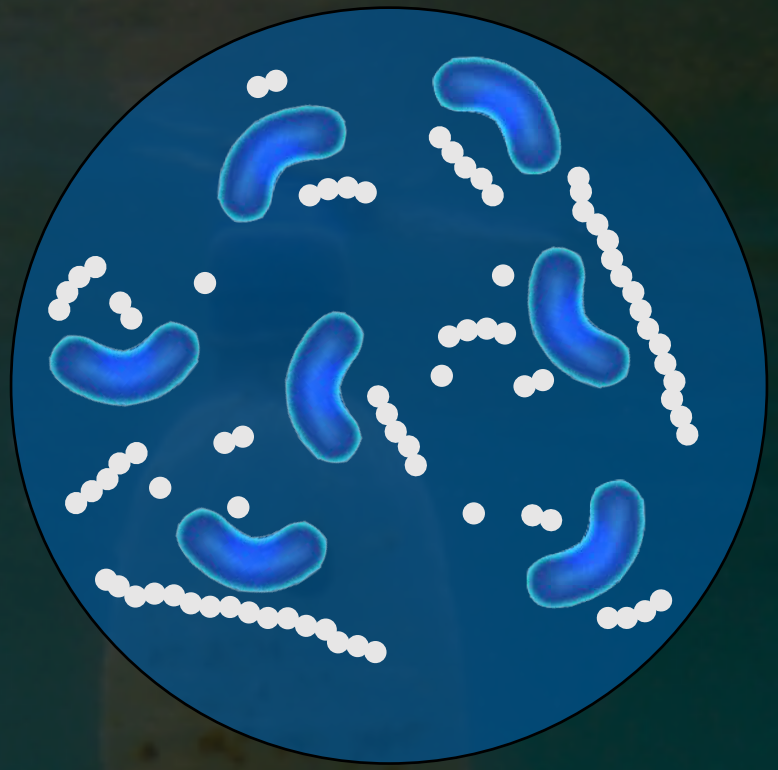
3. COMPARISON WITH ISOLATES (preliminary)

*Values shown here are normalised to no carbon controls

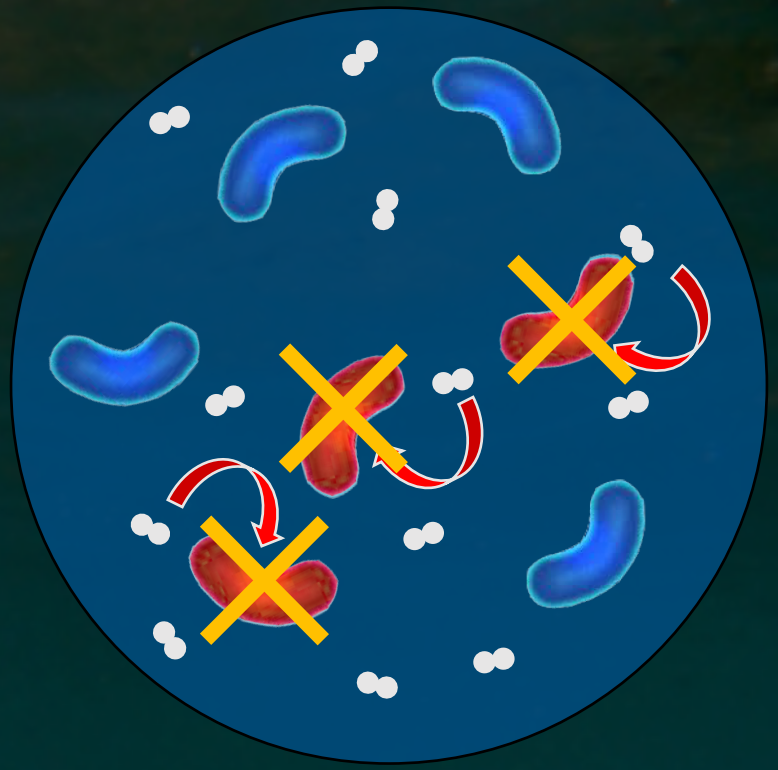
SUMMARY

ISOLATE



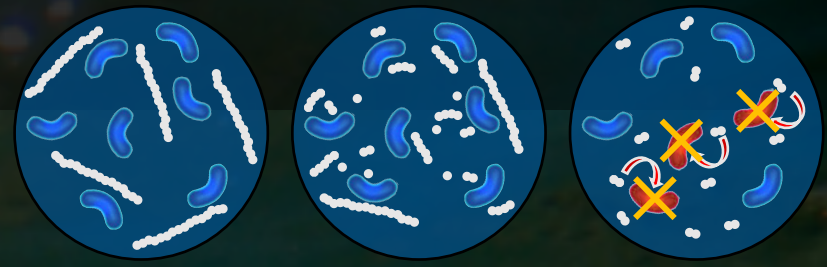


Degradation to intermediates and end products

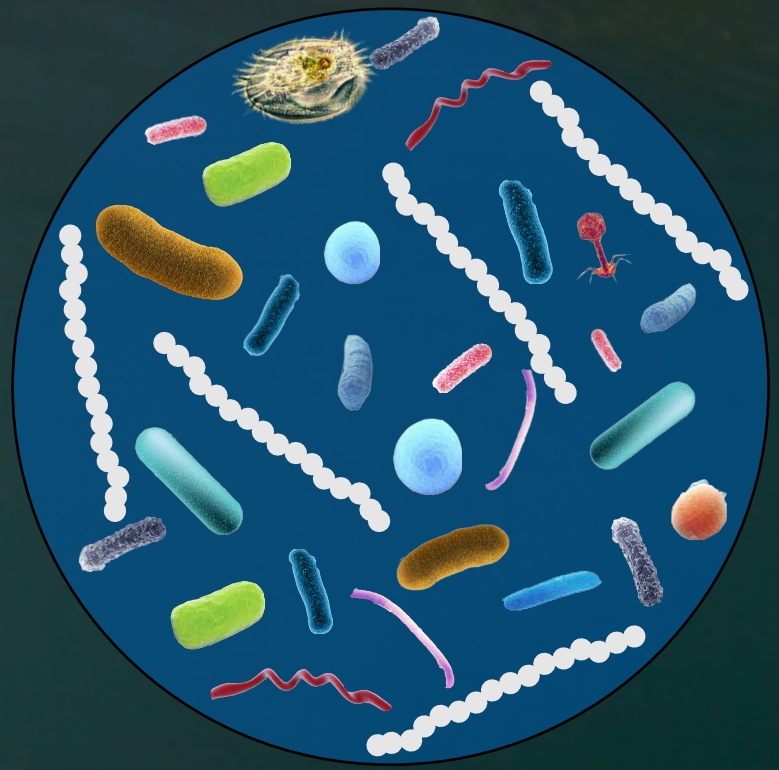


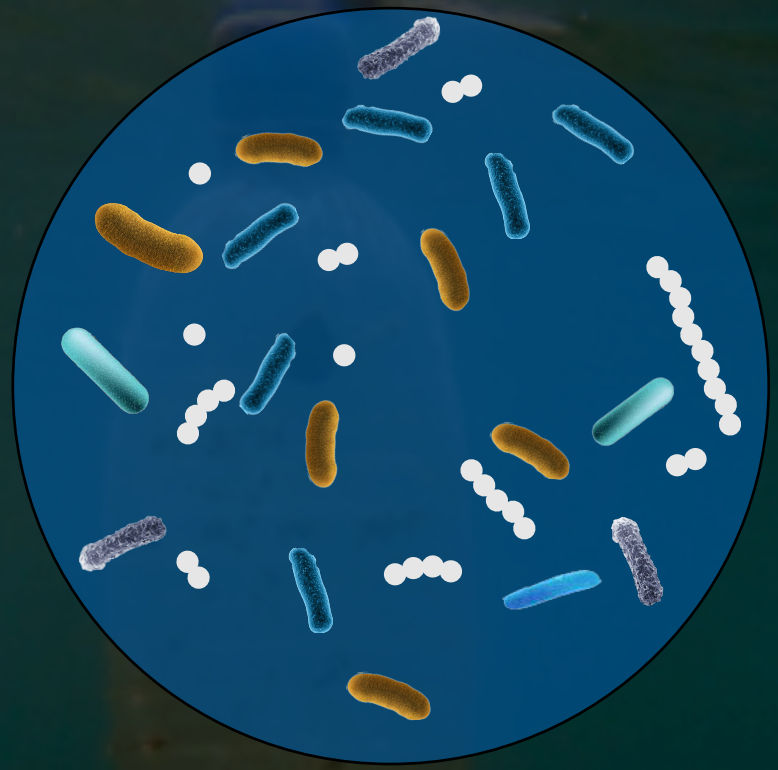
Buildup of toxic end products

SUMMARY

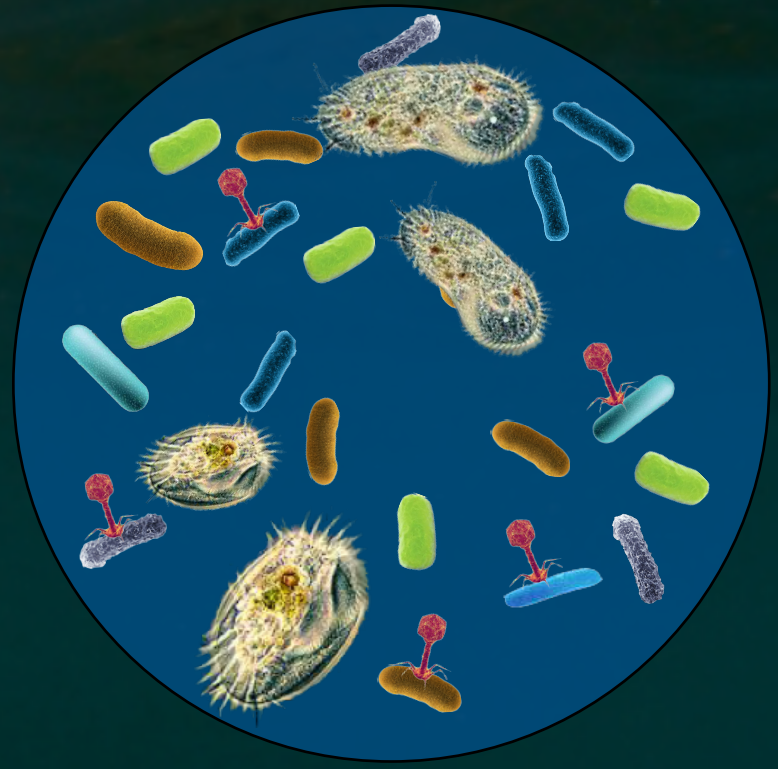


COMMUNITY





Enrichment of members that can degrade

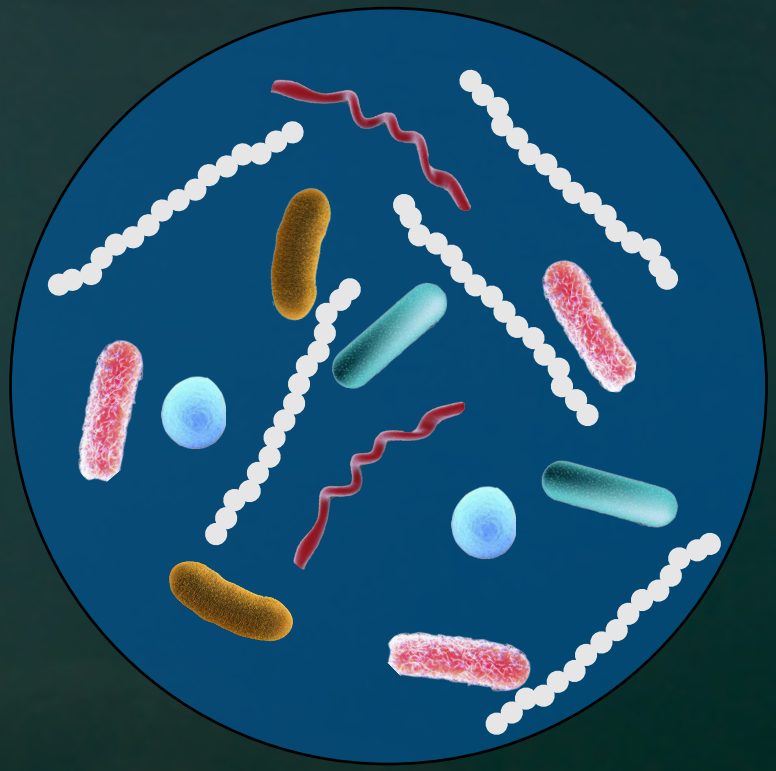


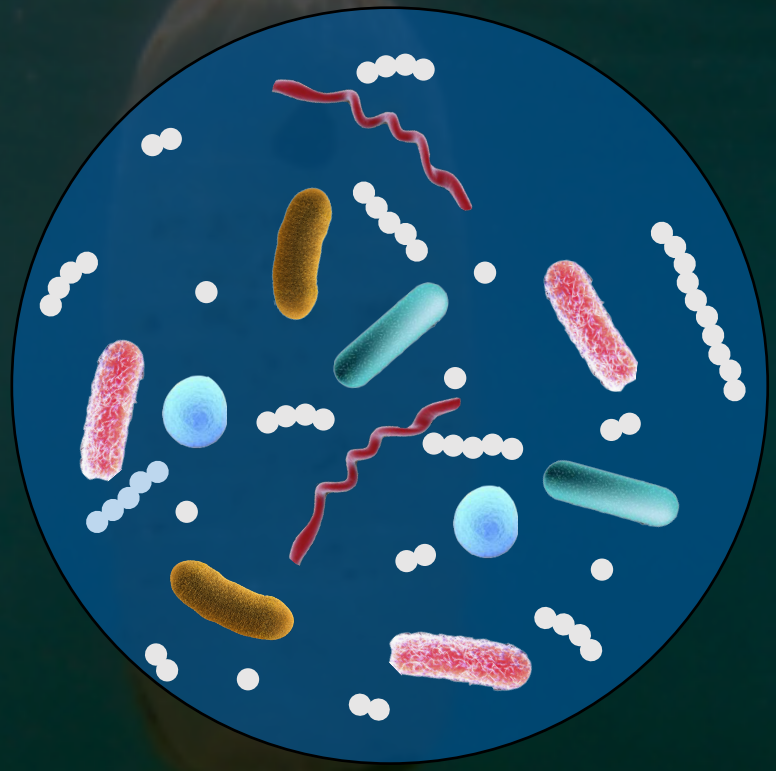
Community succeeded by:

- Cheaters
- Grazers
- Viruses

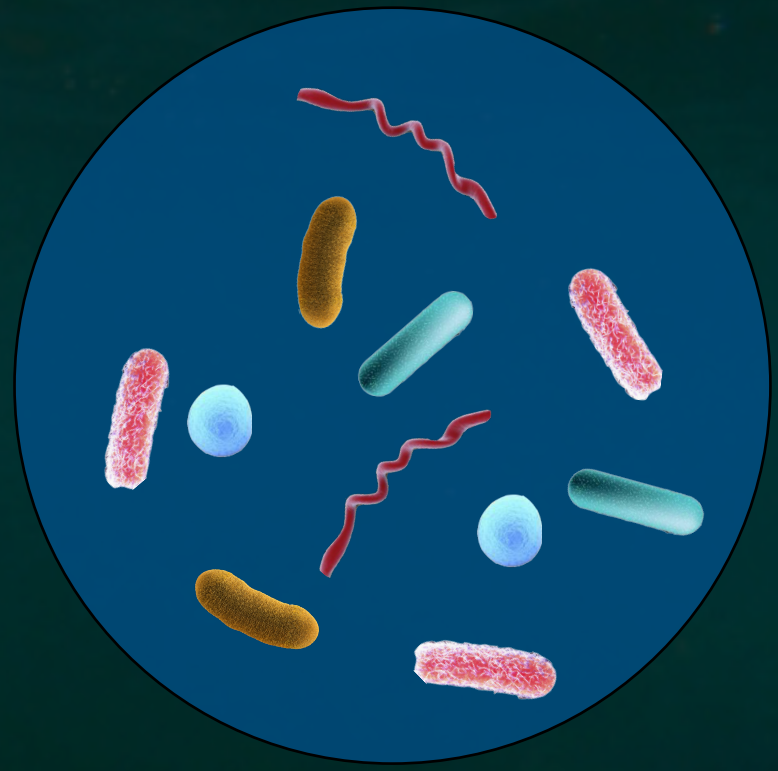
SUMMARY

SYNTHETIC COMMUNITY





Degradation of PET



No community succession

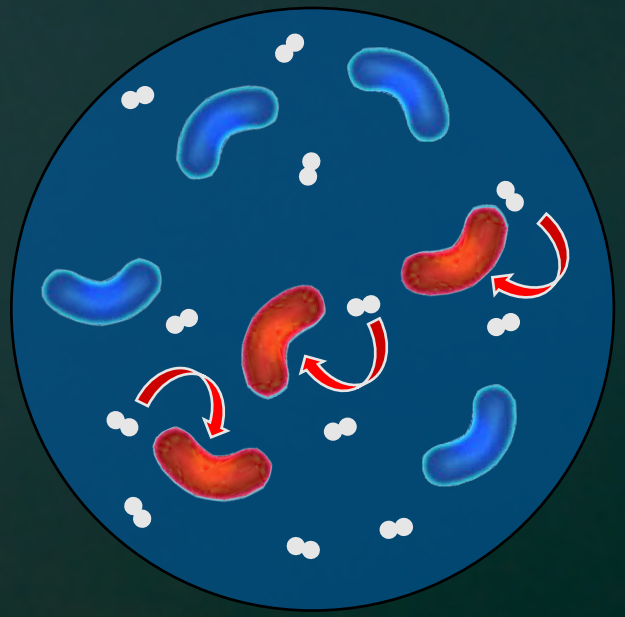
FOOD OR A FREE RIDE?

1. Is a marine microbial community capable of degrading poly(ethylene terephthalate) (PET)?
2. Do we see a pattern of microbial community succession, as we do with chitin?
3. Is the community better at degrading PET than an individual organism? Is a marine microbial community capable of degrading poly(ethylene terephthalate) (PET)?

FOOD OR A FREE RIDE?

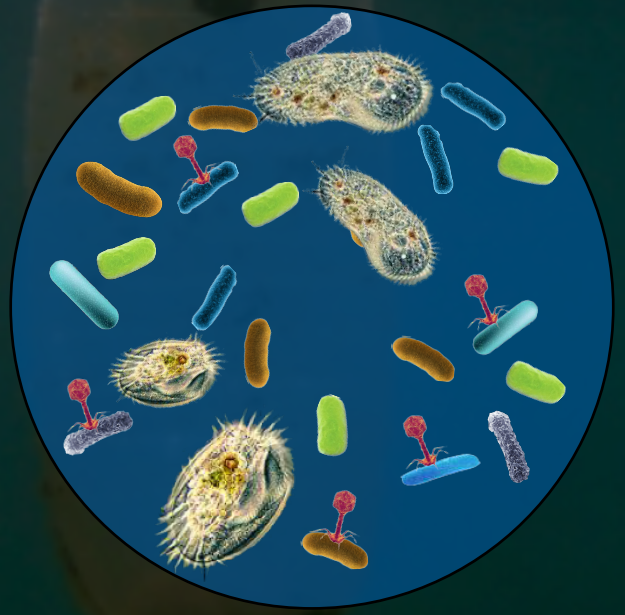
- Determination of PET breakdown products from community succession
- Proteomics with PET isolates to determine enzymes used
- Determine degradation achieved by community and isolates

ISOLATE



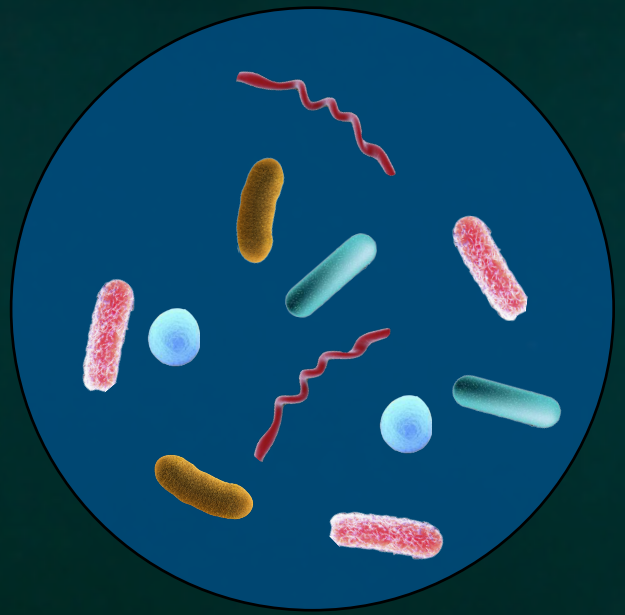
Build up of potentially toxic intermediates

COMMUNITY



Overrun by cheaters, grazers and viruses

SYNTHETIC COMMUNITY



Complete degradation

ACKNOWLEDGEMENTS

Supervisors: Joseph Christie-Oleza

Matthew Gibson

Christie-Oleza group:

MIBTP Midlands Integrative Biosciences Training Partnership

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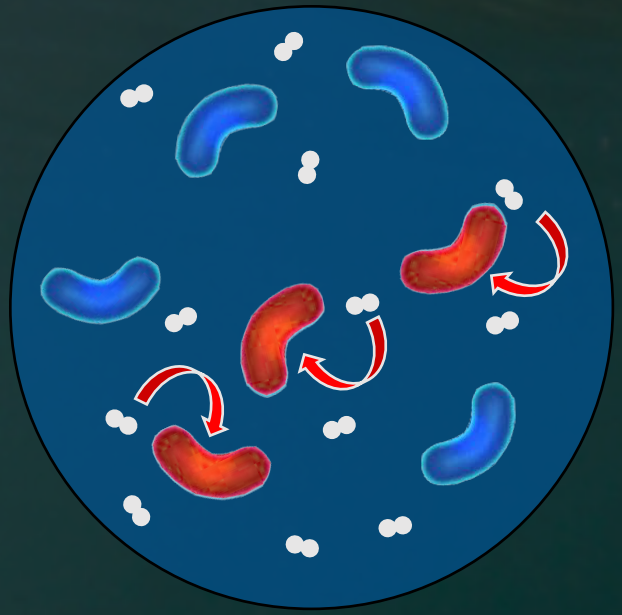
Thanks for listening!
Questions?

ISOLATE



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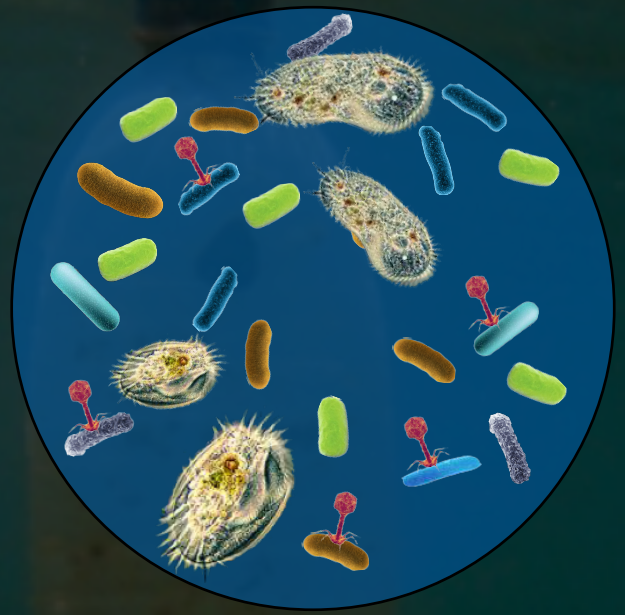

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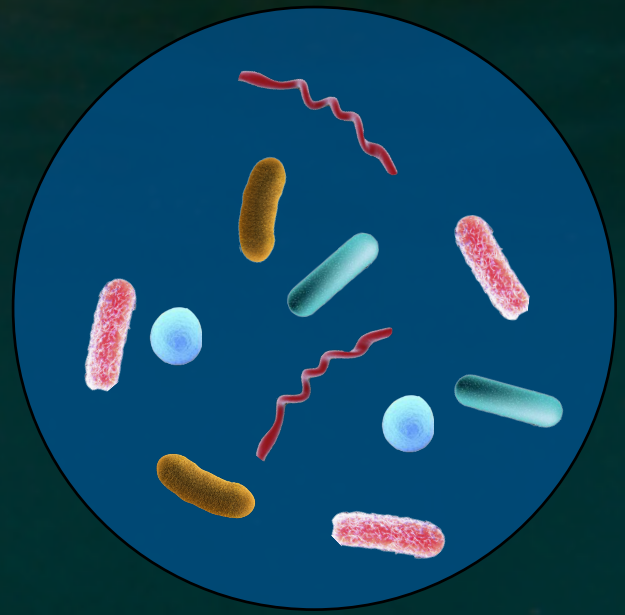

Complete degradation

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