

Upcoming Attractions

The Future of Molecular Biological Tools

State of remediation in the 1990's

Microbiology (1998), 144, 599–608

Printed in Great Britain

REVIEW ARTICLE

Bioremediation: towards a credible technology

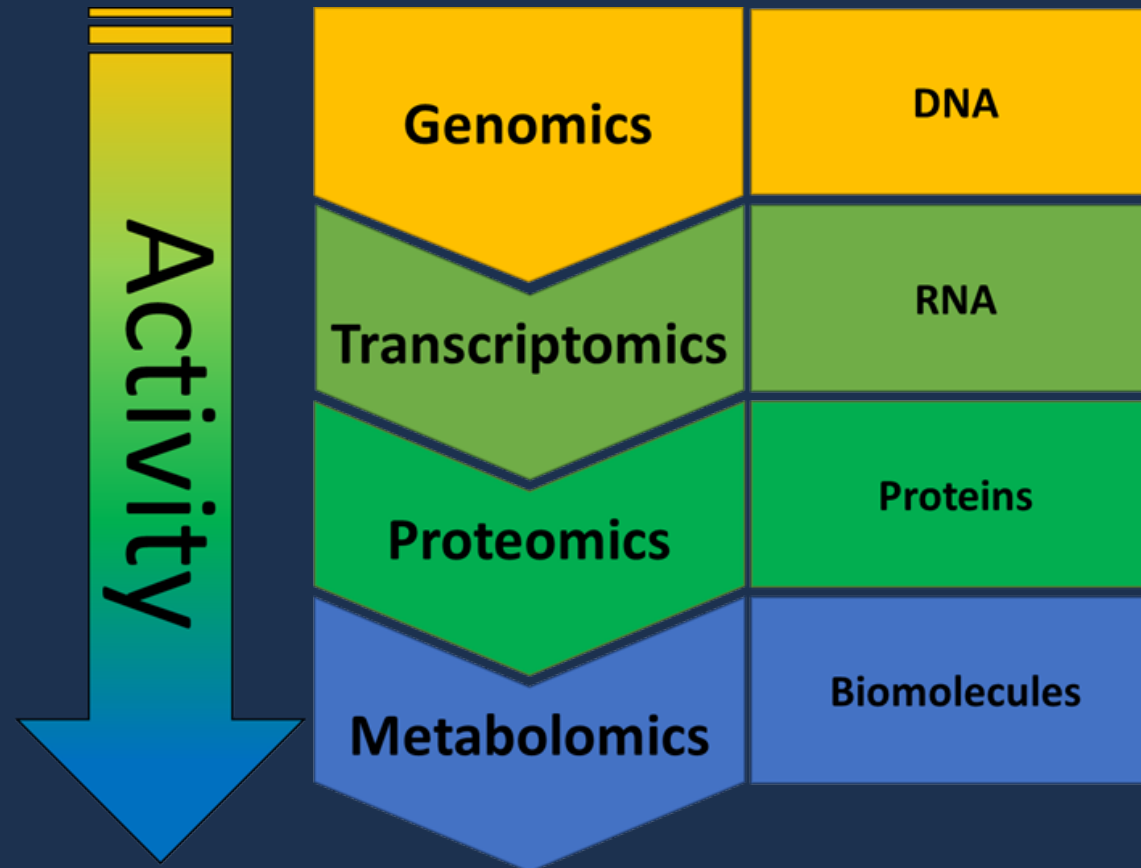
Ian M. Head

This past year, reports have raised expectations that the *in situ* biodegradation of chlorinated solvents and chlorinated aliphatic hydrocarbon contaminants in groundwater may soon become a reality. Both anaerobic reductive dehalogenation to non-chlorinated products and complete aerobic oxidation offer greatly increased promise for potential applications.

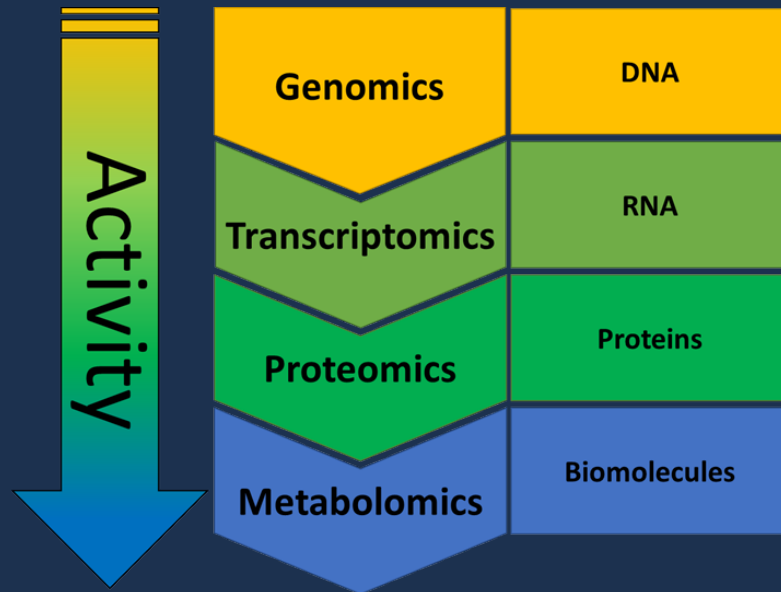
Current Opinion in Biotechnology 1993, 4:323–330



Analytes and Activity



Proteomics



- Proteomics – analysis of proteins from a biological sample
- Targeted: targeting specific proteins
- Metaproteomics: studying all proteins in microbial communities

Quantitative Proteomics and Quantitative PCR as Predictors of *cis*-1,2-Dichlorethene and Vinyl Chloride Reductive Dechlorination Rates in Bioaugmented Aquifer Microcosms

Mandy M. Michalsen, Fadime Kara Murdoch, Frank E. Löffler, John Wilson, Paul B. Hatzinger, Jack D. Istok, Larry Mullins, Amy Hill, Robert W. Murdoch, Charles Condee, and Katarzyna H. Kucharzyk*



Cite This: ACS EST Engg. 2022, 2, 43–53



Read Online

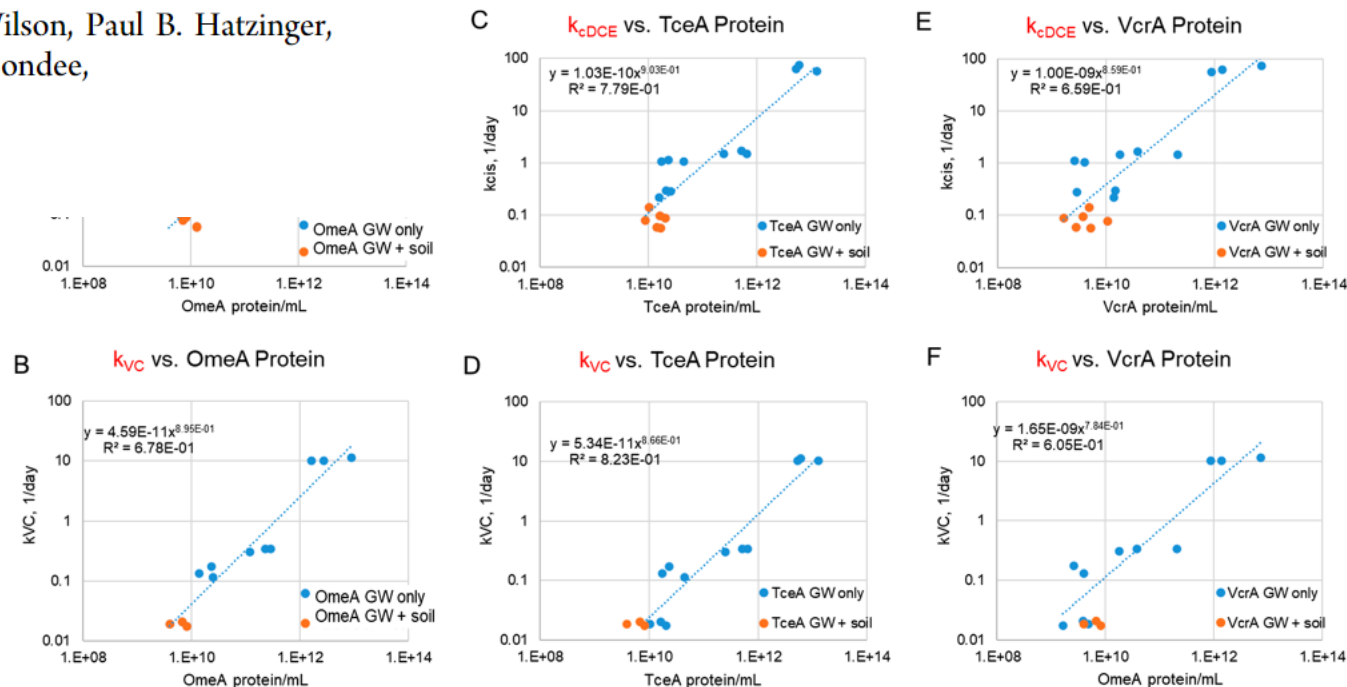


Figure 5. Rate coefficients vs biomarker abundances with treatments. Relationship between rate of cDCE and VC degradation is plotted for proteins: OmeA (panels A and B), TceA (panels C and D), and VcrA (panels E and F). Blue and orange symbols represent biomarker and rate coefficient results from groundwater-only microcosms and groundwater with aquifer solids microcosms, respectively.

Proteomics

Global Proteomics

- All proteins
- High end instrumentation
- Computational challenges
- Relative quantification
- Open approach
- Site specific database

Targeted Proteomics

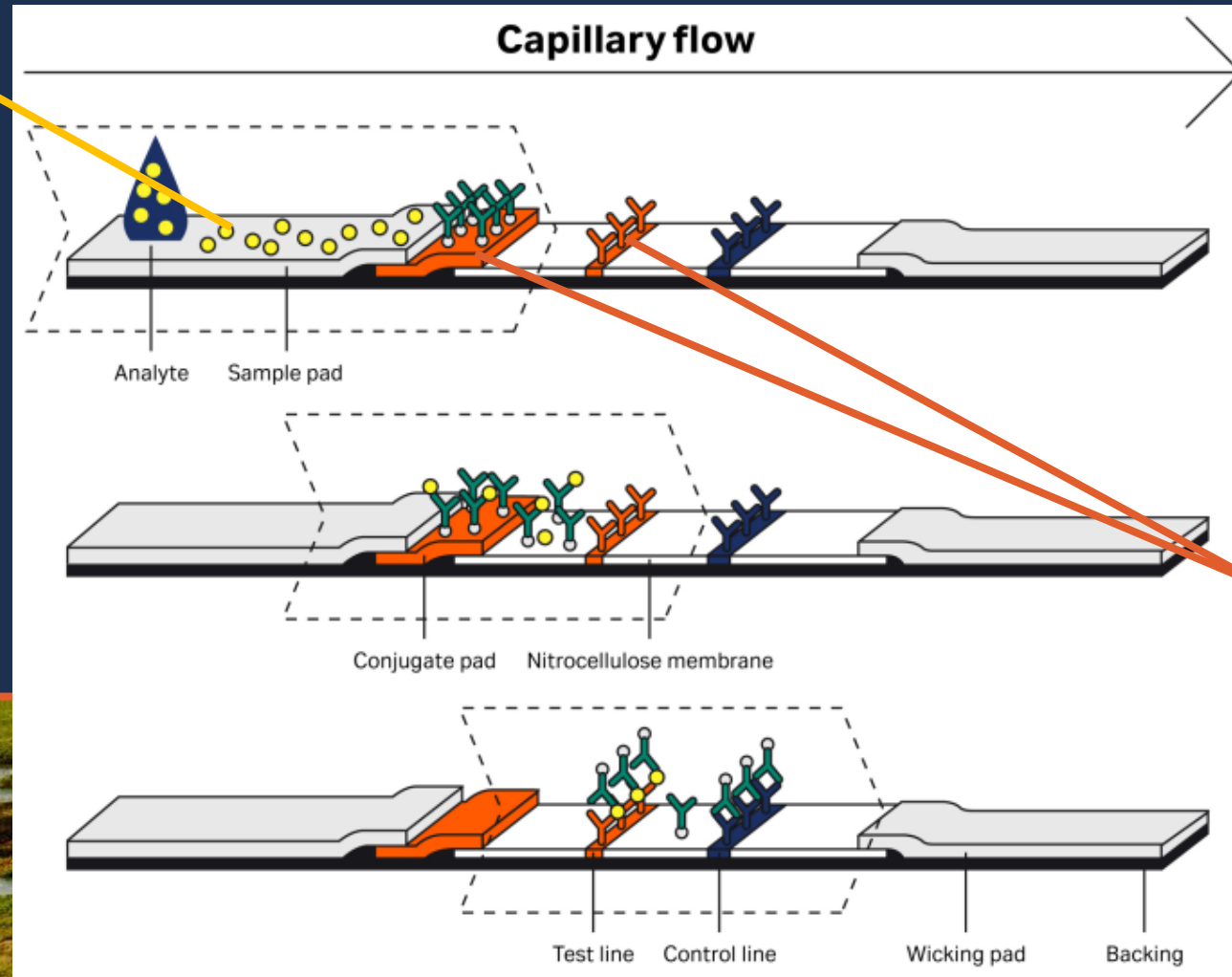
- Protein of interest
- Computationally easier
- Absolute quantification
- Closed approach
- Must have knowledge of allelic variation to avoid false negatives

To identify proteins, the peptide sequences must be matched to genes sequences



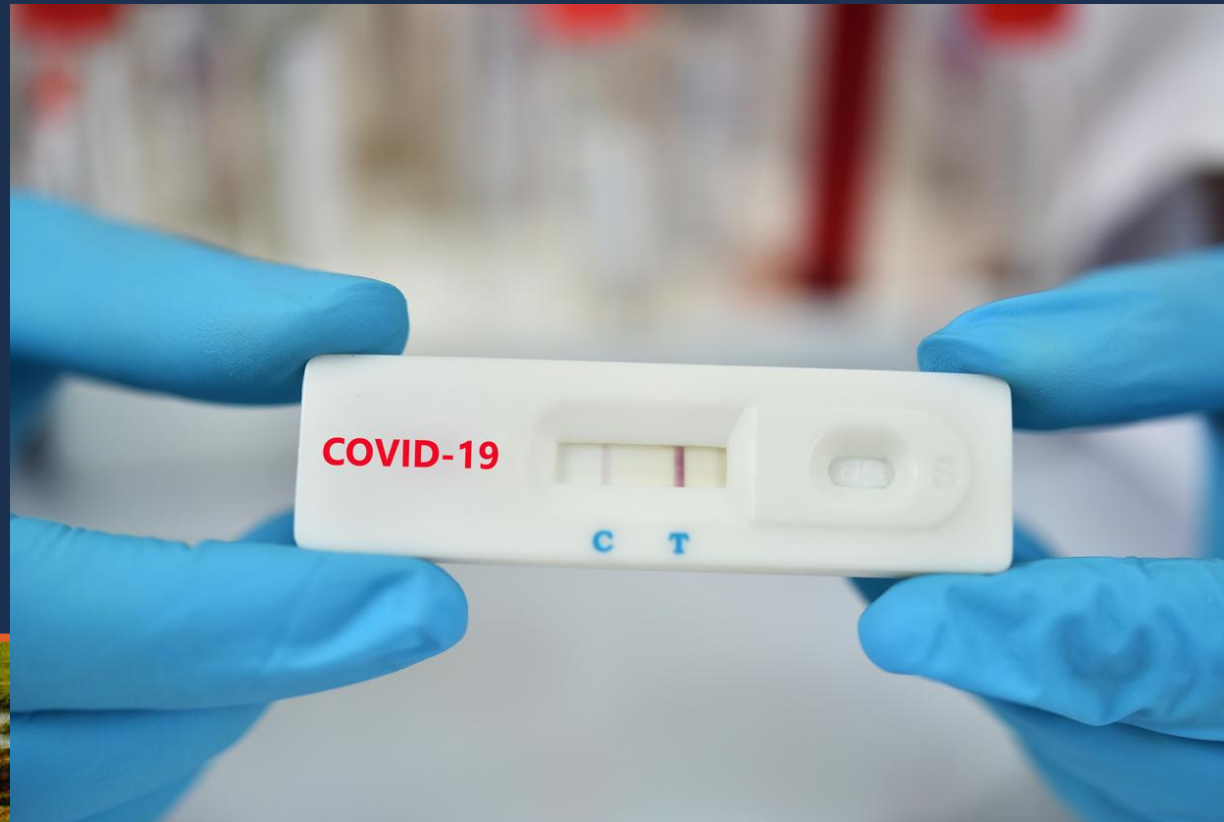
Immunoassay Rapid Tests

Proteins of interest



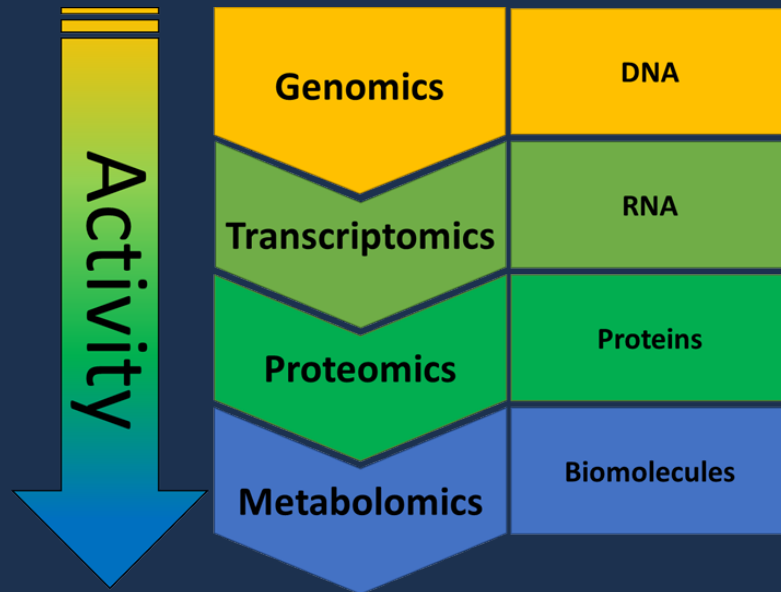
Antigens specific to the analyte

Immunoassay Rapid Tests



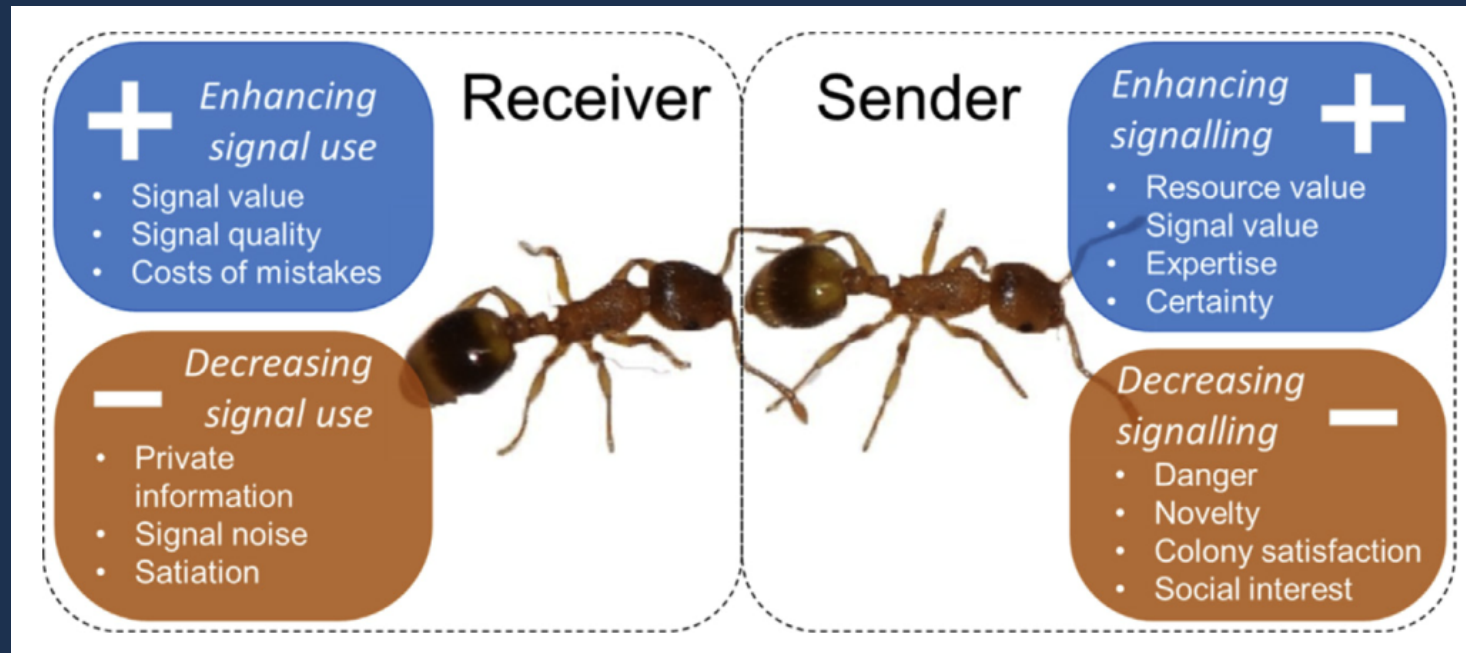
<https://www.cidrap.umn.edu/>

Metabolomics



- Metabolomics - analysis of thousands of small molecules from a biological sample
- Trends and patterns can be used to predict the health and activity of the entire microbiome
- Allows for a broad screening of reductive dechlorination potential

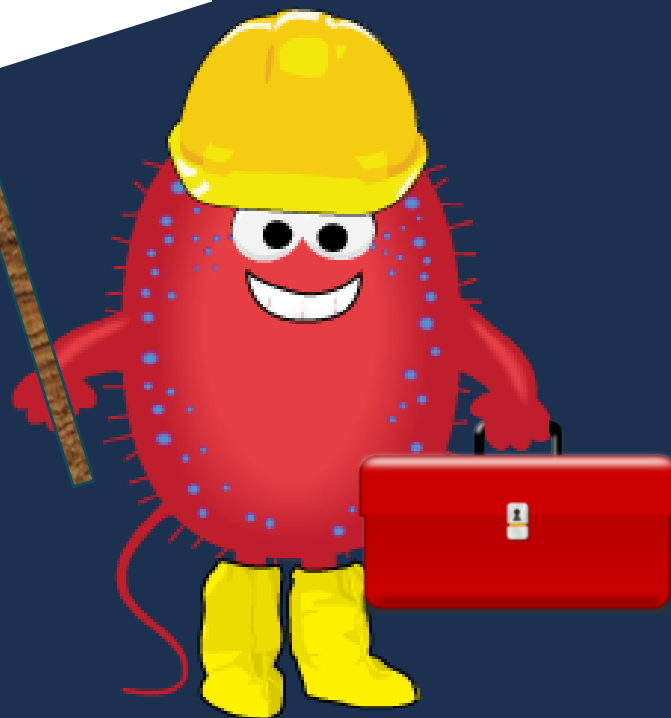
Metabolomics



C. Grüter, T. J. Czaczkes / *Animal Behaviour* 151 (2019) 207–215

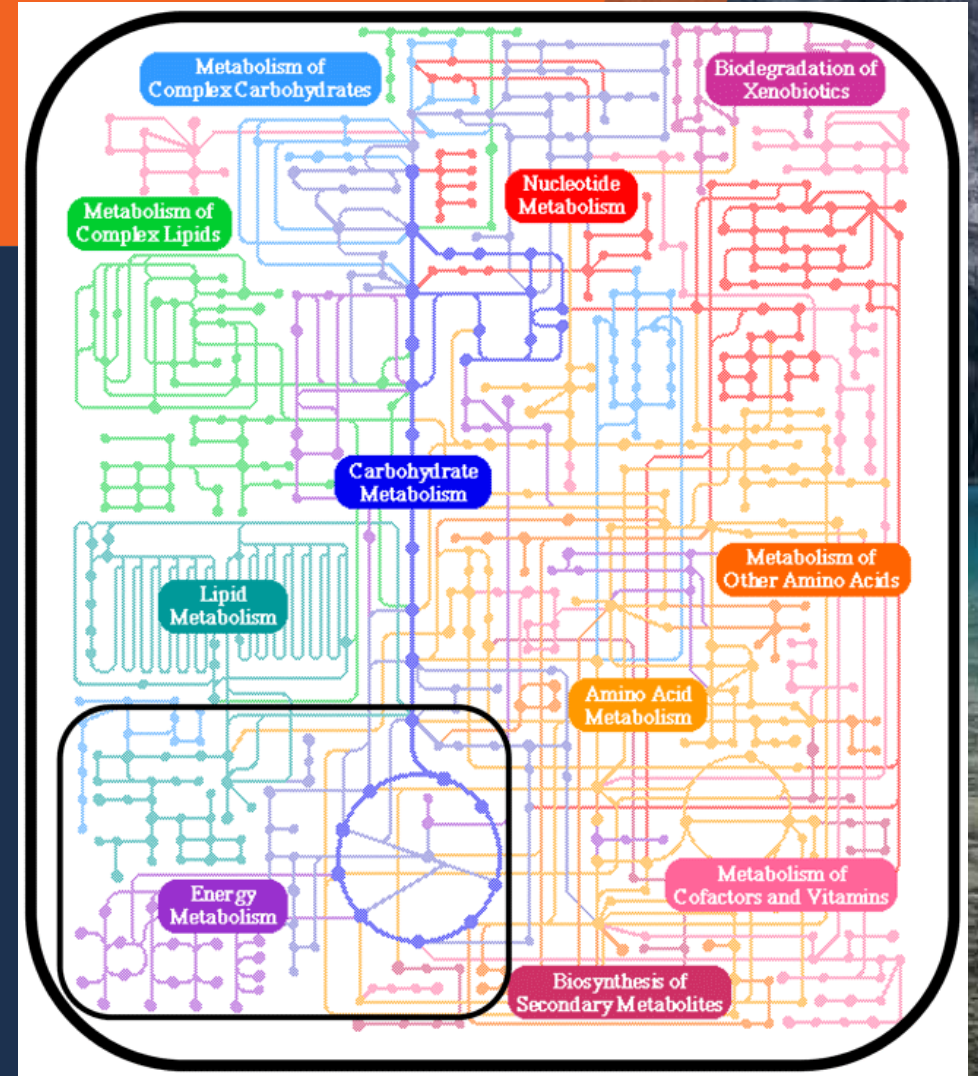
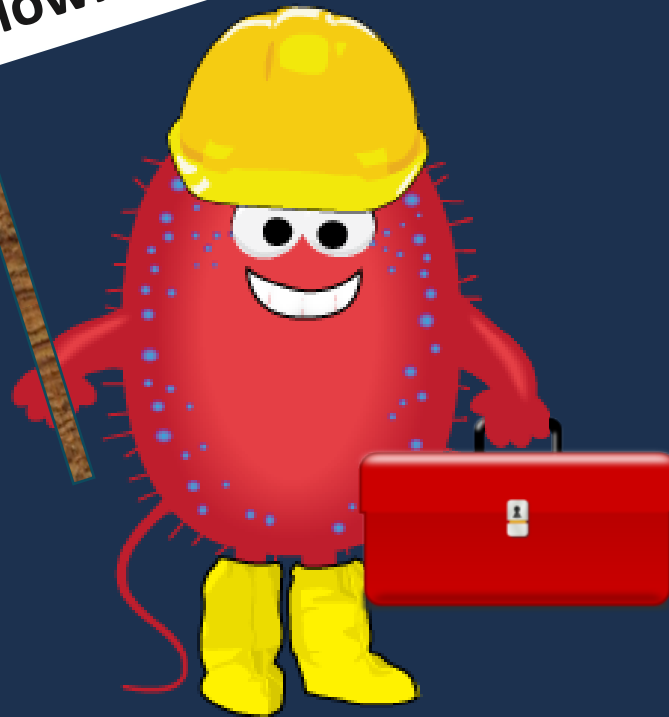
Metabolomics

Dehalobacter

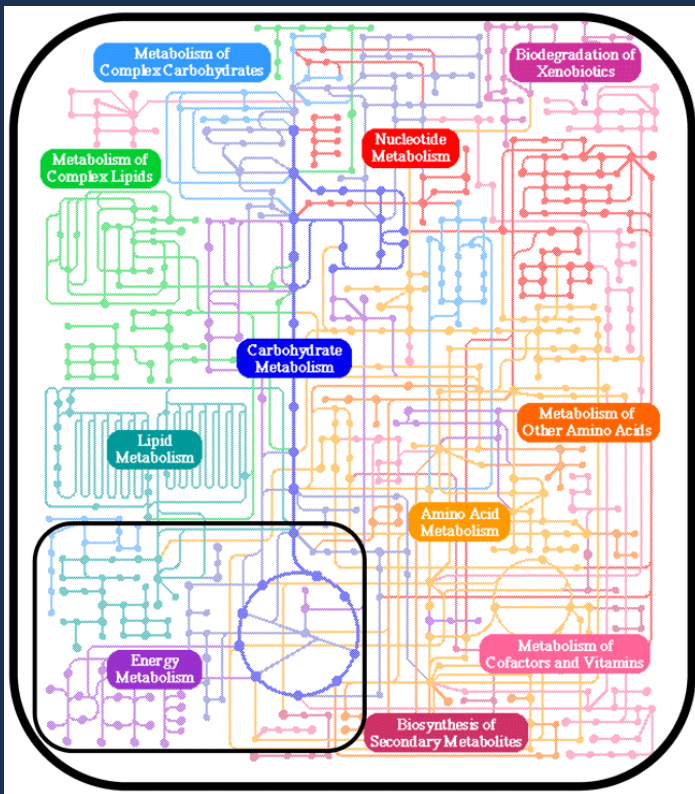


Metabolomics

I'm running low
on H₂ and my
activity is slowing



Metabolomics



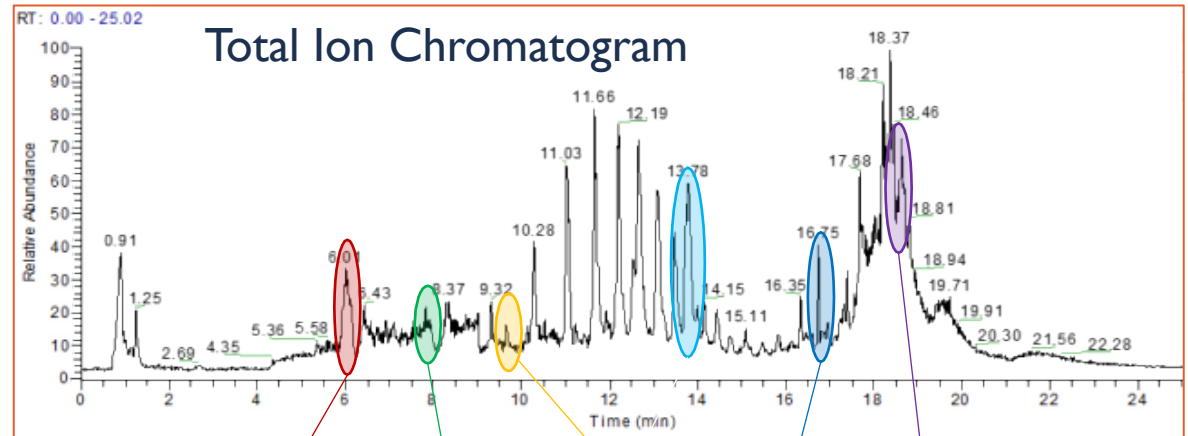
<http://www.urmc.rochester.edu/labs/Munger-Lab/>

- Systematic study of the unique chemical fingerprints as the result specific cellular processes.
- Metabolome: the collection of all metabolites in a biological cell, tissue, organ or organism.
- Metabolic profiling: instantaneous snapshot of the cell physiology.

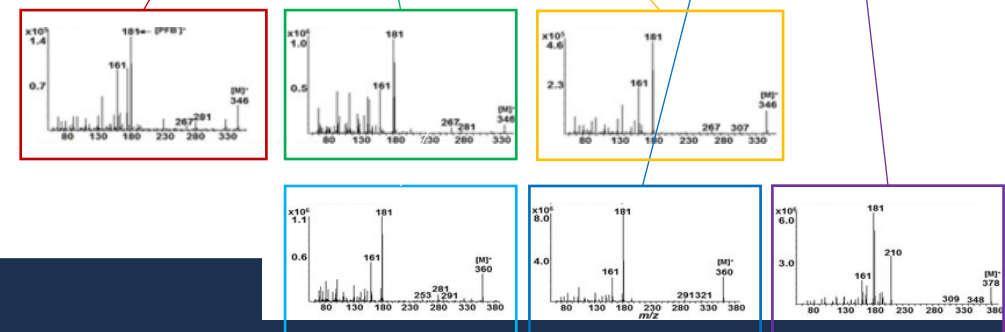
Metabolomics

- Analysis of all small molecules (MW<1100) within an environmental sample
- Comparison of the overall metabolic profile
- Statistical Analysis and pattern recognition
 - Predictive capabilities
 - Activity of key degraders

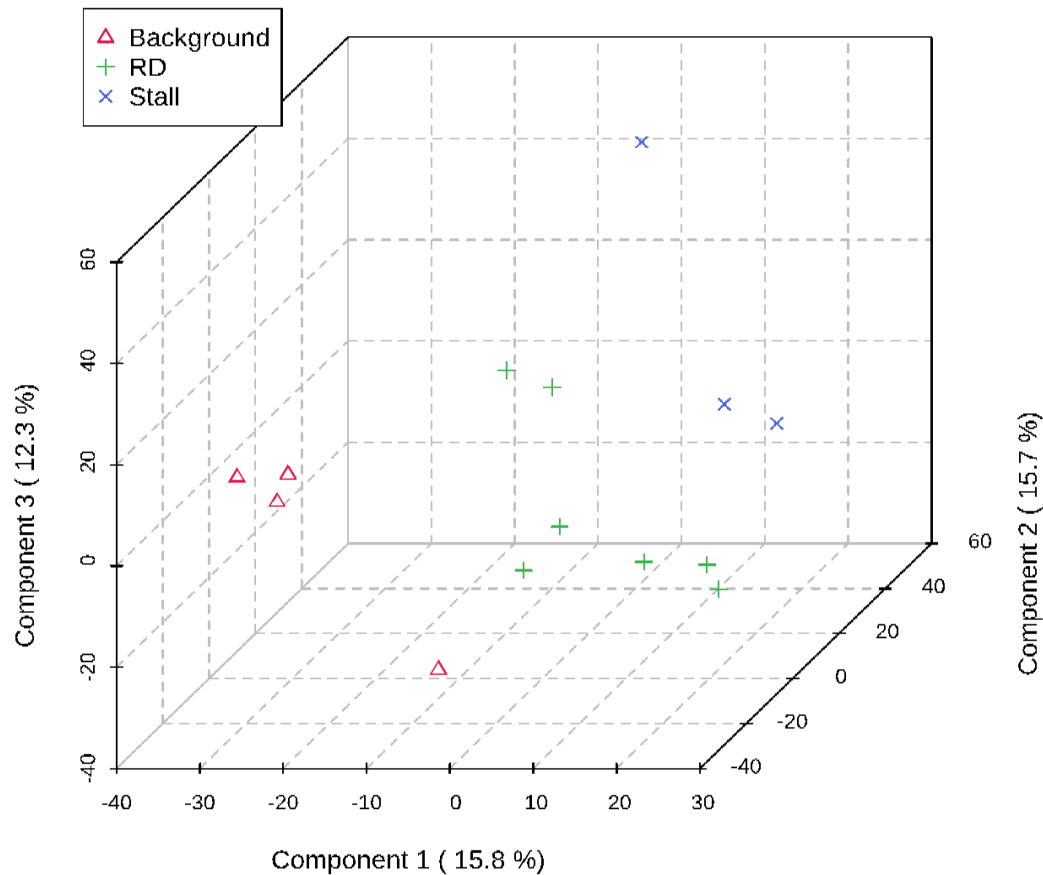
Thousands of features per sample



Extracted Ion Chromatograms



NIEHS SBIR Study



Metabolomics

- Closest to activity
- Modern instrumentation = lot of data that can be leveraged with statistical analysis
- More inclusive data (looking at entire microbiome) – potentially predictive
- Inexpensive to run, but costly instrumentation
- A lot of expertise and additional data required to identify chemical structure of metabolites
- Databases can be unreliable



MBT Considerations

Development & Availability



Cost



Data Intensity



Interpretation



Quantification



What about the data?

- Deep statistical analysis
- Data Mining
- Machine learning
- Artificial Intelligence



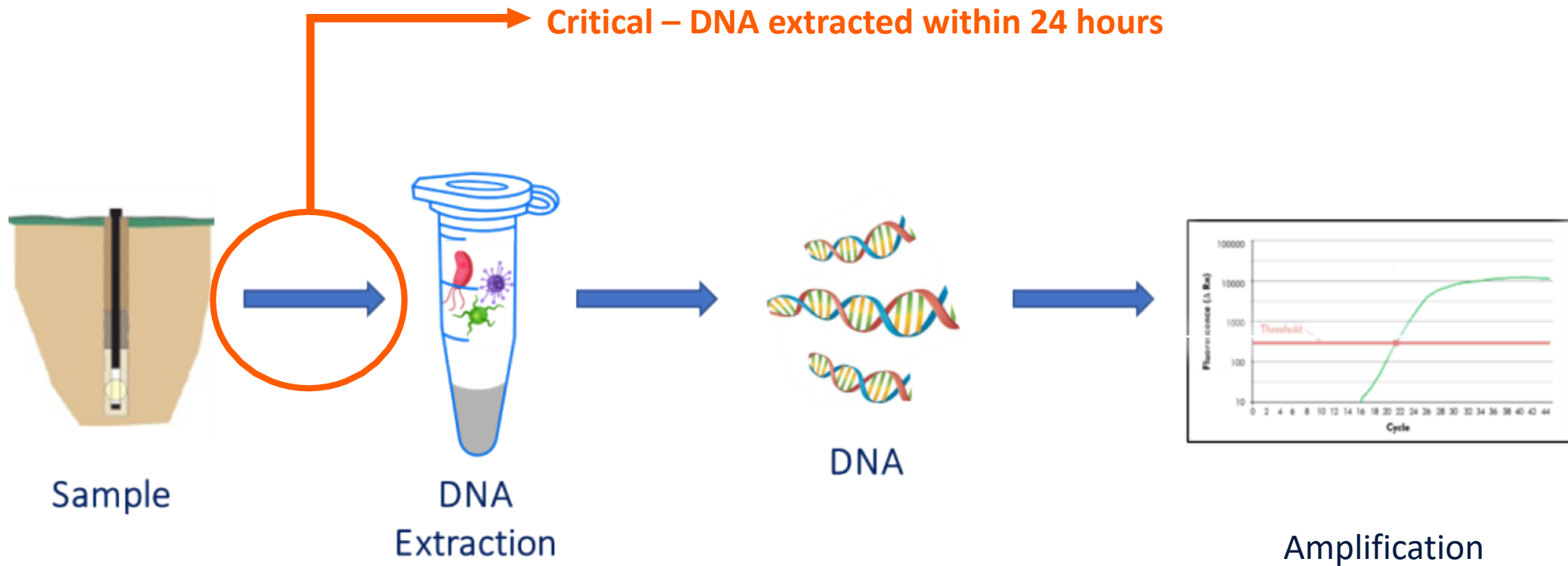


THE IMMEDIATE FUTURE: PORTABILITY

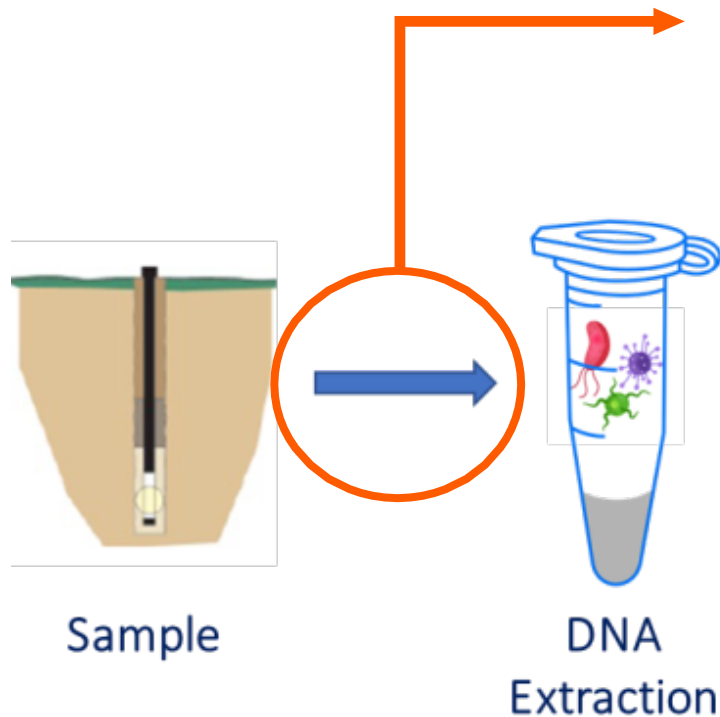
DNA Analysis



DNA Analysis



DNA Analysis



- What does this little arrow entail?
 - Stopping the sampling early enough to:
 - Obtain coolers
 - Obtain ice
 - Package samples
 - Travel to the nearest FedEx office before they close
 - (Hope you read their hours correctly)
 - Overnight the sample
 - (Hope that there are no shipping delays)
 - Do it again tomorrow

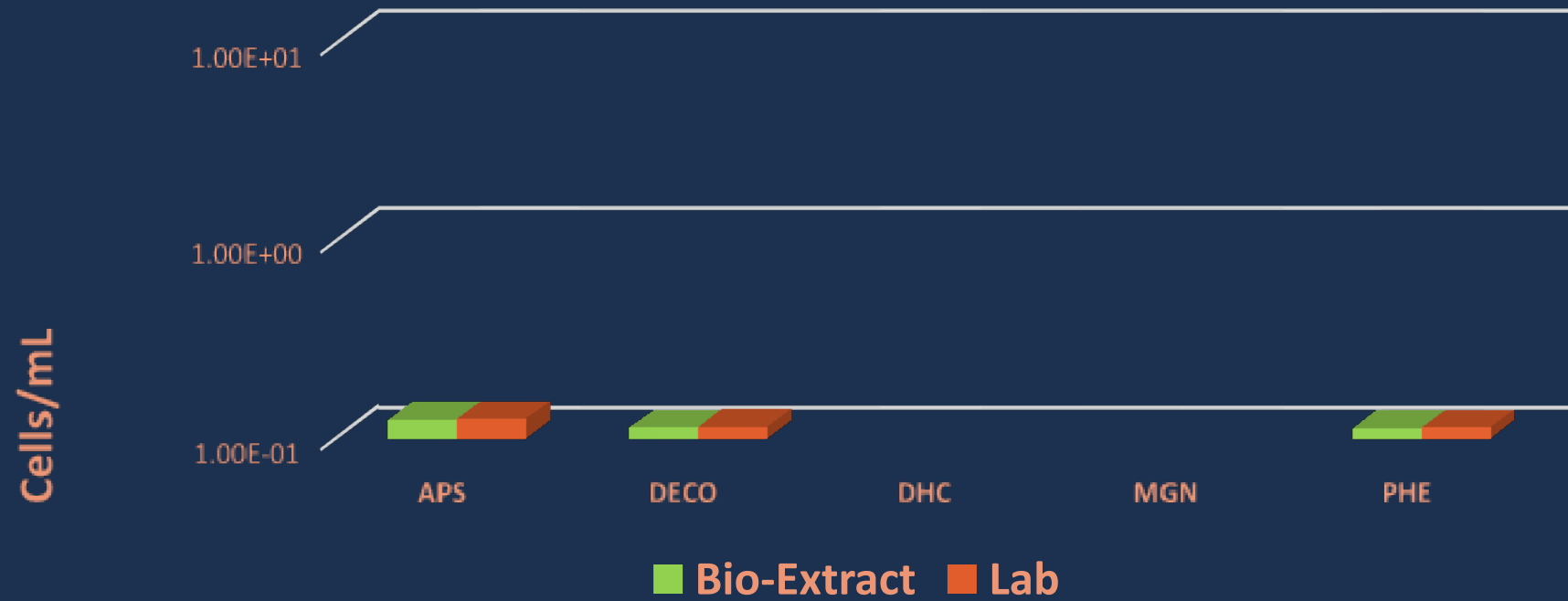
Bio-Extract™ Field Kit

- Field DNA Isolation: Isolate DNA on-site.
- Remote Sampling Flexibility: Sample confidently in difficult to reach locations.
- Enhanced Sample Integrity: Ensures better sample preservation during shipment.
- Resilience to Shipping Delays: Unaffected by delays unlike water or soil samples.
- Eliminates Daily Shipping: No need for daily shipping at the end of sampling days.



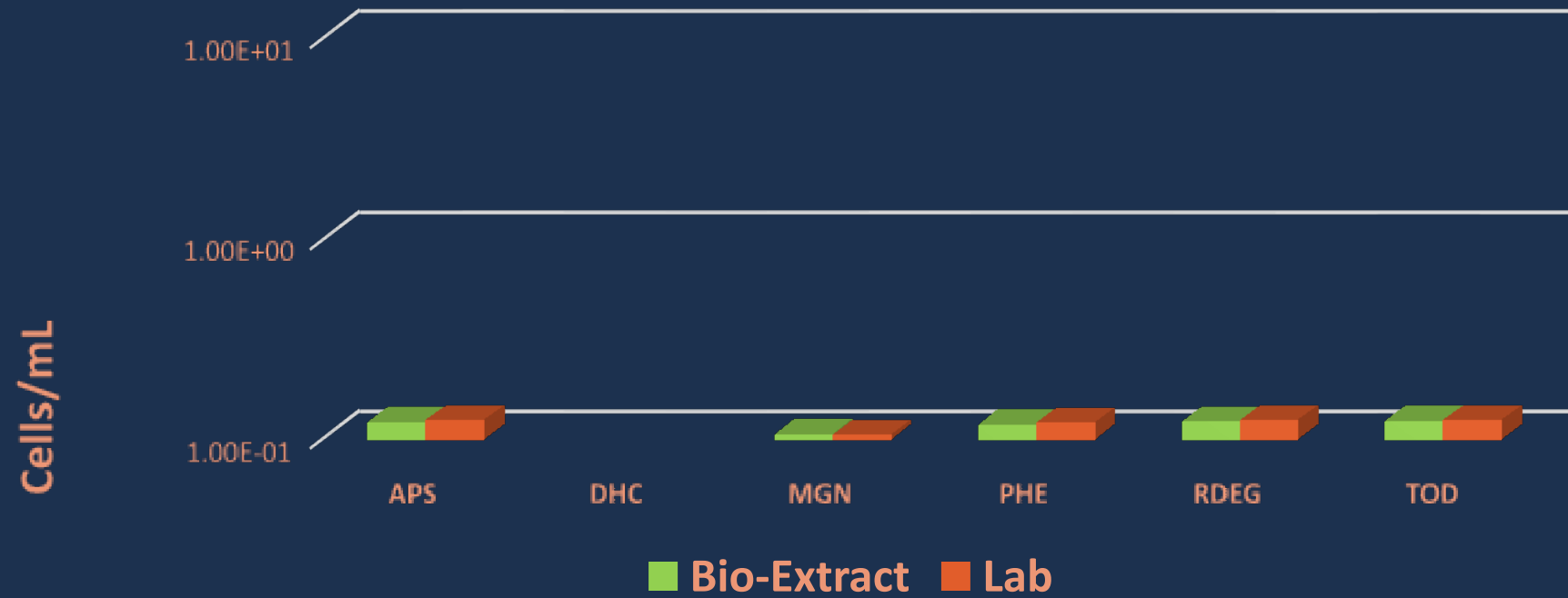
Field Data Validation

Sample A



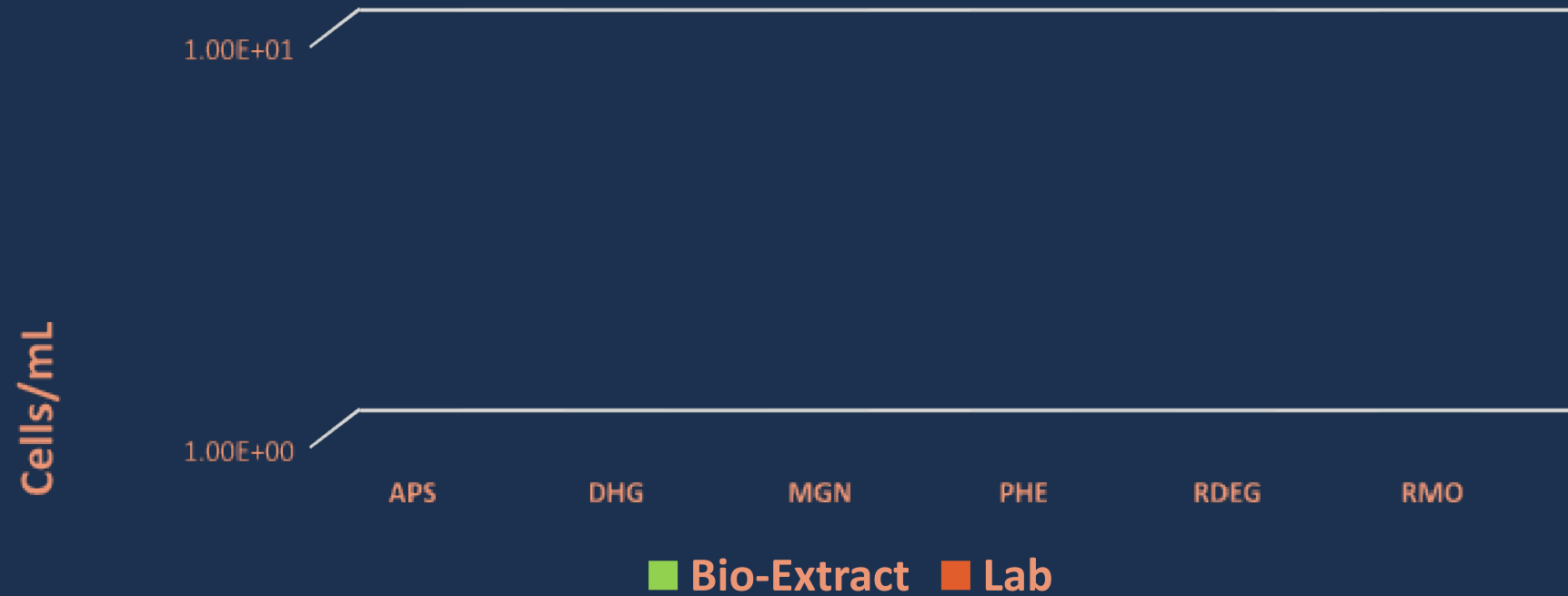
Field Data Validation

Sample B



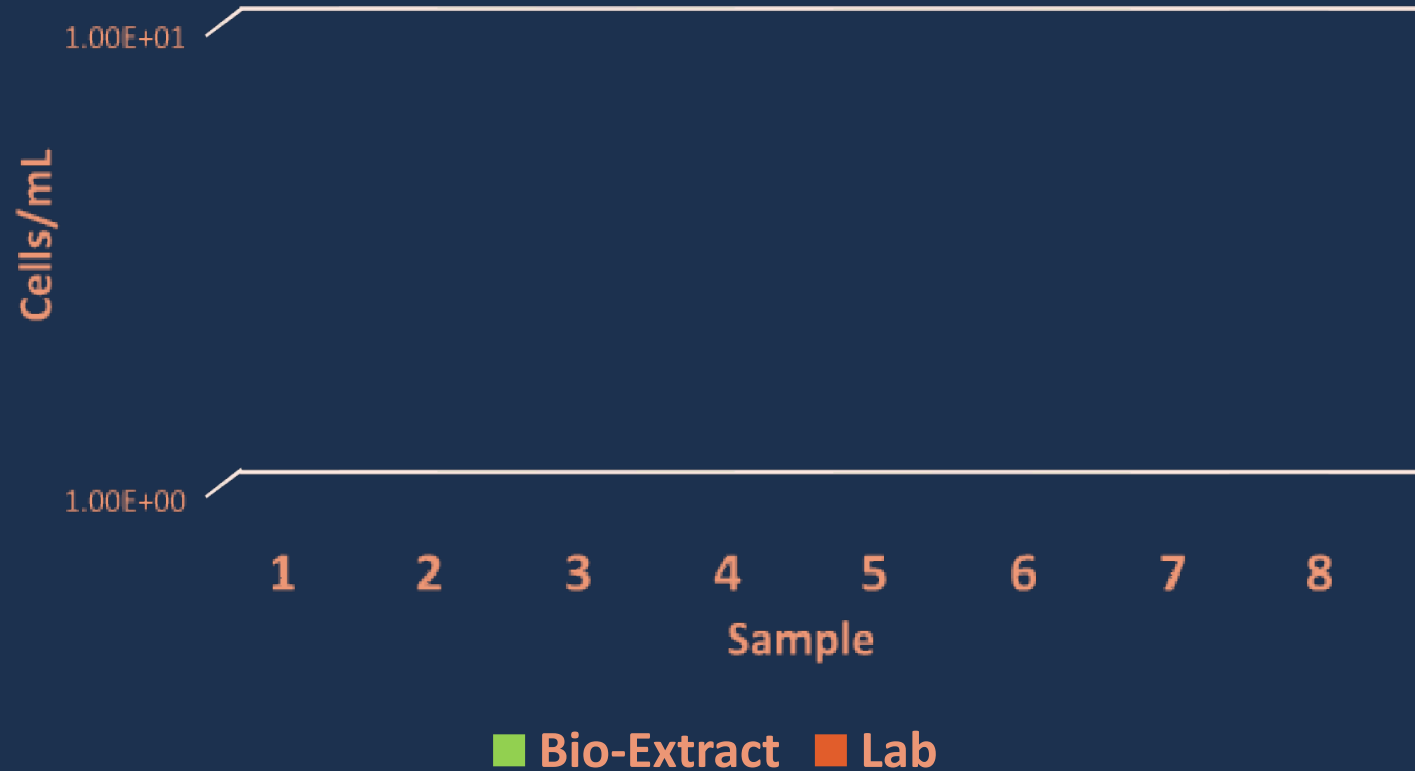
Field Data Validation

Sample C

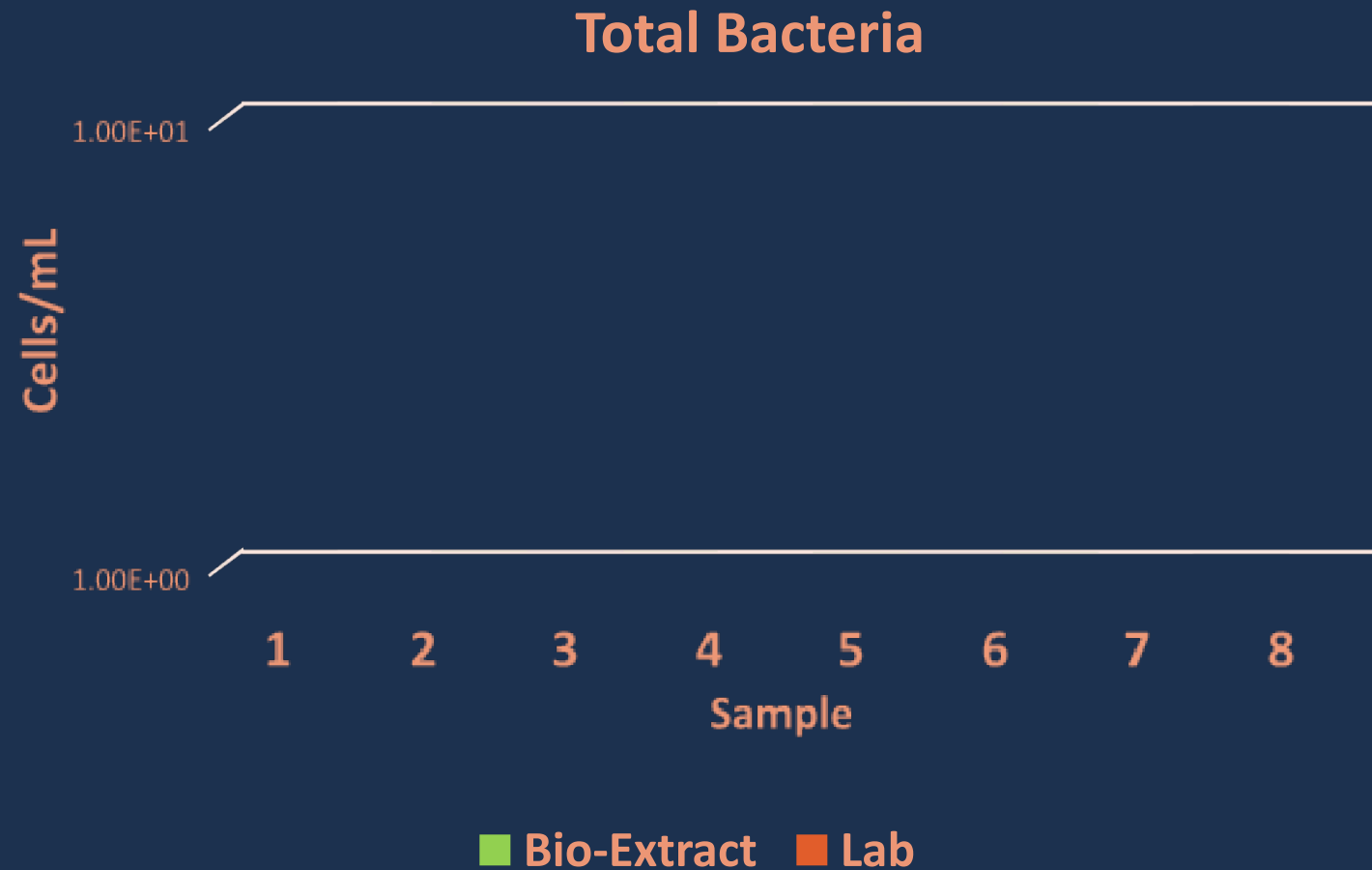


Comparison data

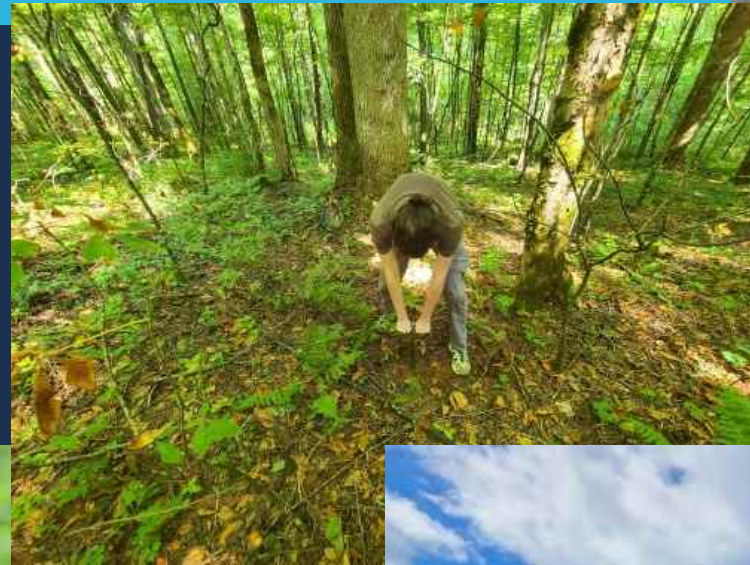
Sulfate Reducing Bacteria



Comparison data



Remote Sampling – Smokies Project



The Or Foundation

VOGUE
BUSINESS

SUSTAINABILITY

Who's shouldering the weight of fashion's microfibres problem?

New research from The Or Foundation suggests the Global South — where there's the highest concentration of the world's clothing waste — could be dealing with a heavy burden of microfibre pollution.

BY RACHEL CERNANSKY

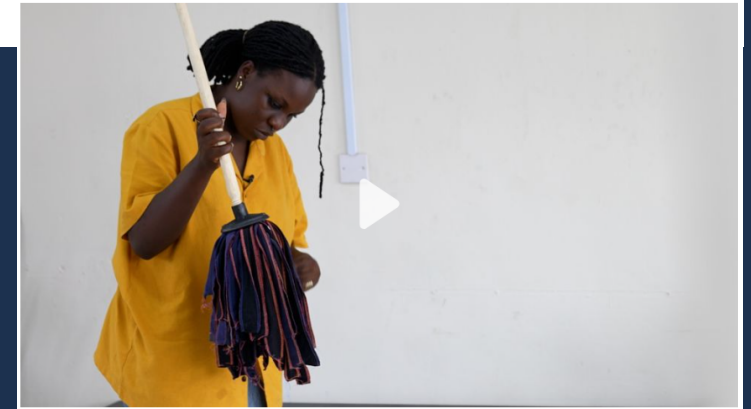
March 30, 2023



At one of the world's largest secondhand textile markets, discarded clothes are getting a new lease on life

By Jenny Marc, CNN

🕒 5 minute read · Updated 12:04 PM EDT, Mon August 14, 2023



THE OR FOUNDATION

Korle Lagoon



Korle Lagoon

'It's like a death pit': how Ghana became fast fashion's dumping ground

The Guardian

by [Sarah Johnson](#) in Accra



Korle Lagoon can be made clean in 5 years – The Or Foundation

— April 18, 2023 in News

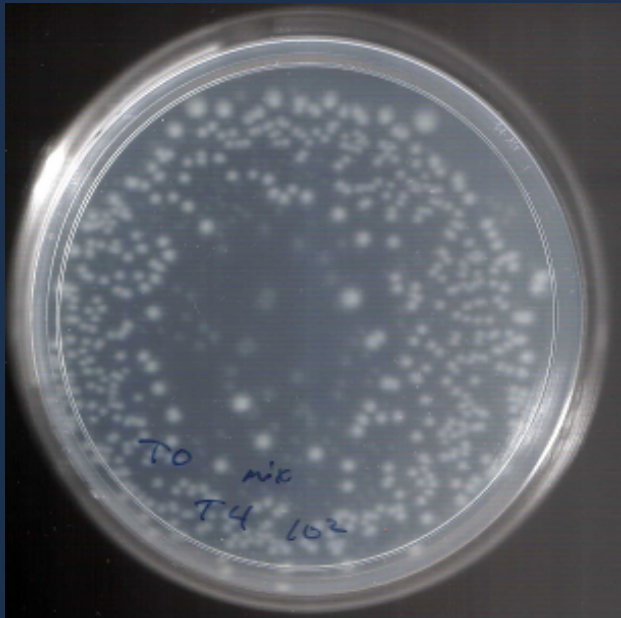


Solar Refrigerators



THE MICROBIAL REVOLUTION

Plate Count



PCR



qPCR



FieldQuant™ Field qPCR

- On-Site qPCR: Conduct qPCR in the field using MI's trusted assays.
- Ideal for Remote/Emergency Response: Suited for urgent scenarios and difficult to access locations.
- Rapid Reporting: Receive an MI report within 24 hours.
- Sample Screening Capability: Screen multiple samples to prioritize in-depth analysis.
- Flexibility: Analyze the samples you want whenever you choose to.



The FieldQuant™



Group	Use	Targets
Chlor-1	For anaerobic chlorinated solvent degradation.	DHC, VCR, TCE
Petro-1	For aerobic petroleum hydrocarbon degradation.	PHE, RMO, RDEG
MIC-1	For microbiologically influenced corrosion.	EBAC, APS, IRB



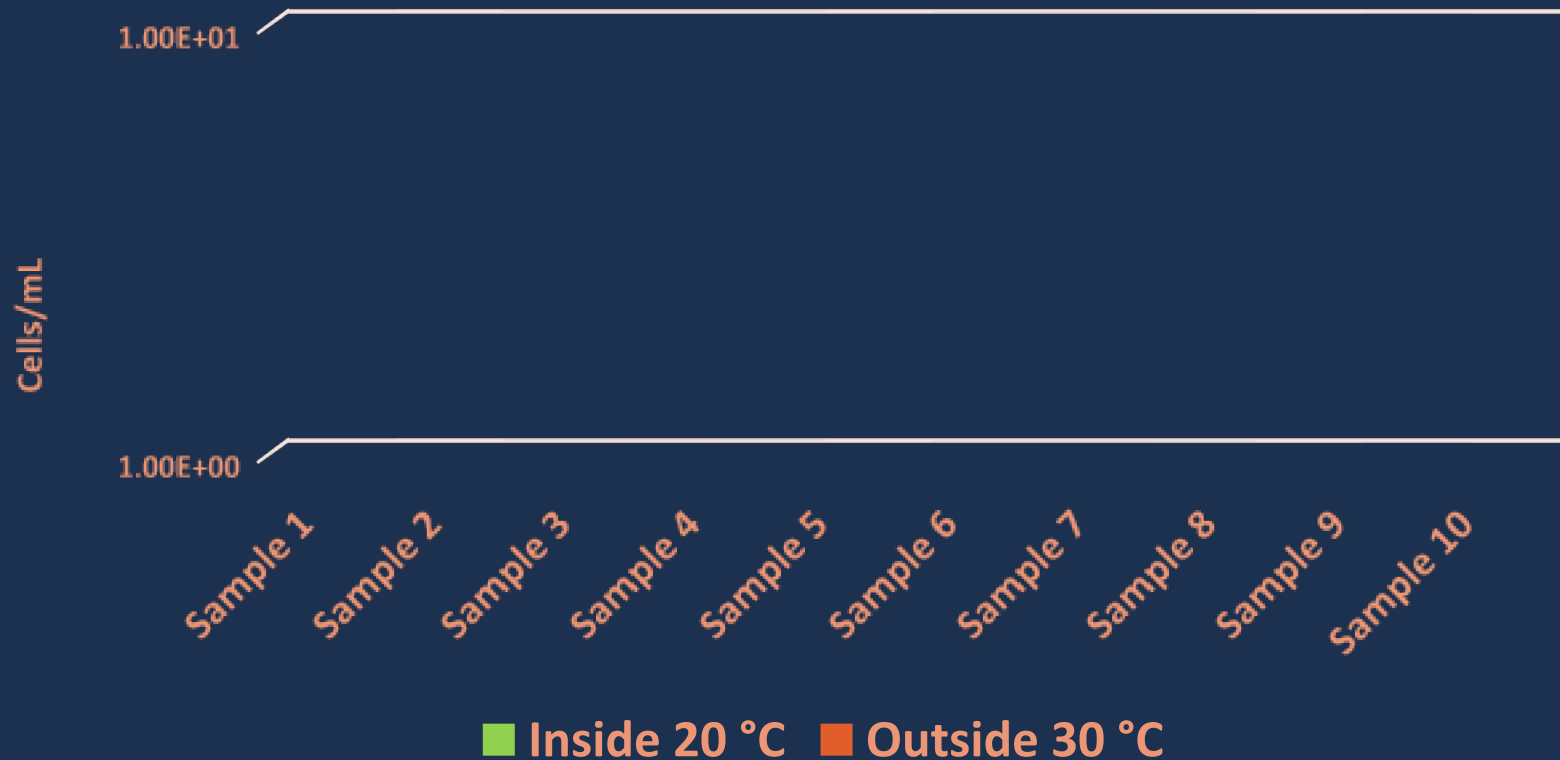
The FieldQuant™

- FieldQuant™
 - Isolate sample DNA using the Bio-Extract™ kits
 - Load the FieldQuant with isolated DNA samples and let it analyze while you grab dinner
 - Three samples at a time (~45 min per run)
 - Within 24 hours of analyzing all samples, you will receive a report with the microbial data
 - Ship the instrument back to MI, along with the isolated DNA for archiving/future analysis



FieldQuant Validation – Environment and Temperature

EBAC Inside vs Outside



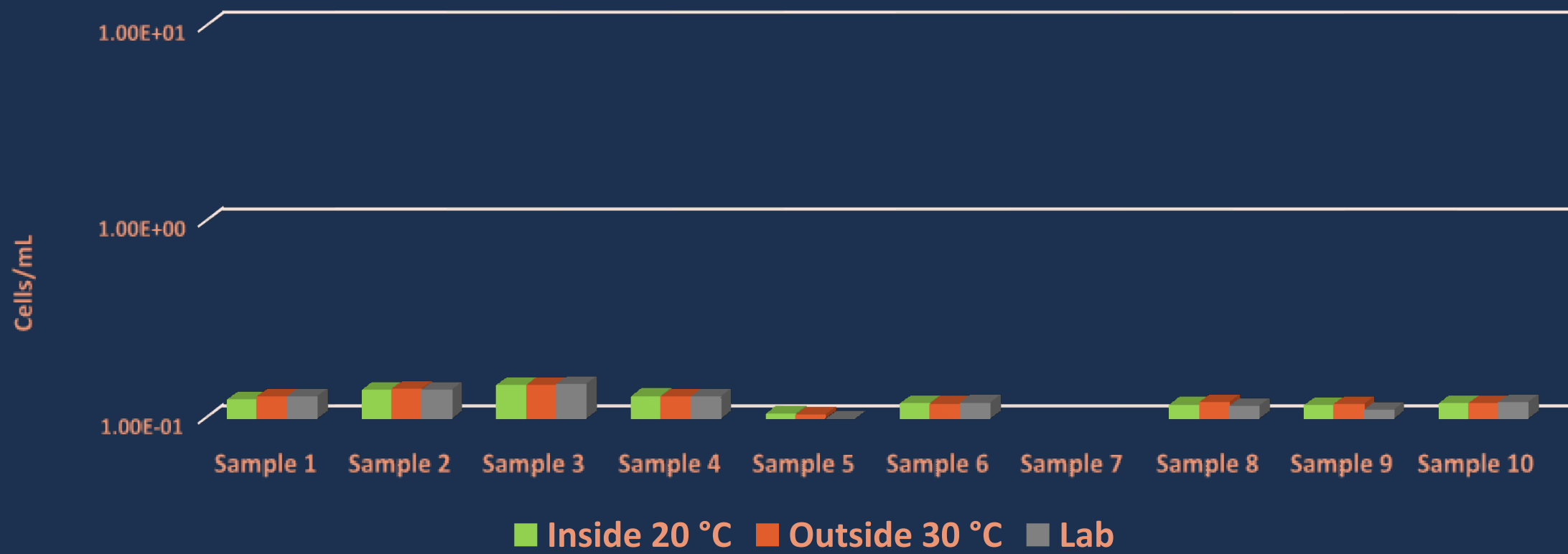
FieldQuant Validation – Environment and Temperature

SRB Inside vs Outside



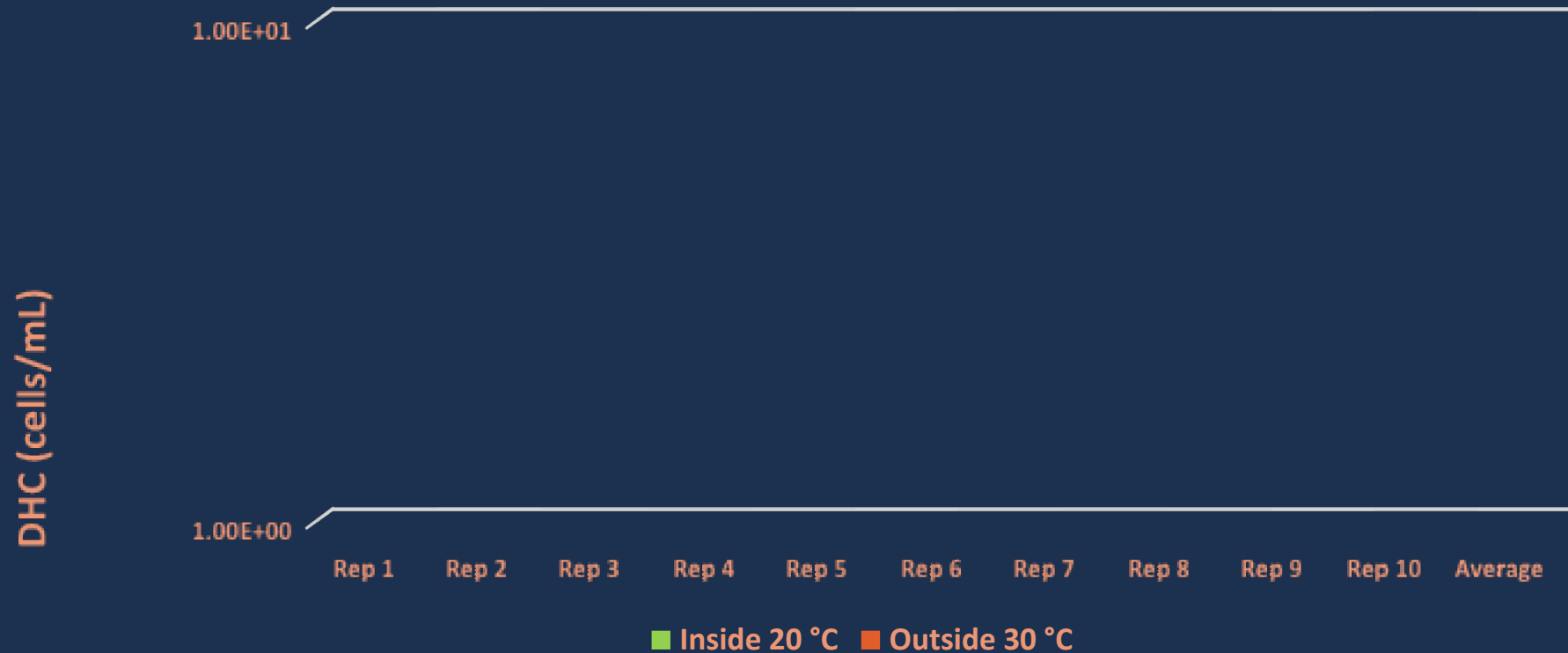
FieldQuant Validation – Environment and Temperature

DHC Inside vs Outside



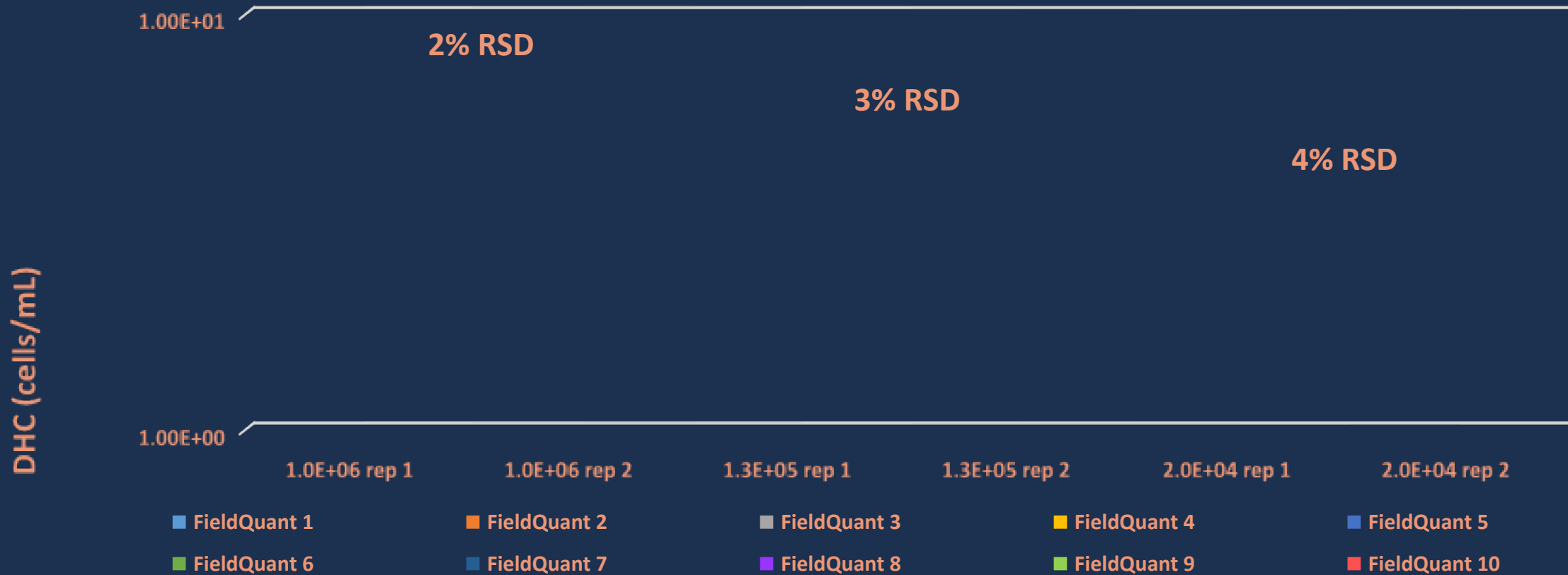
FieldQuant Validation – Consistency

Culture Dilutions – 4% RSD



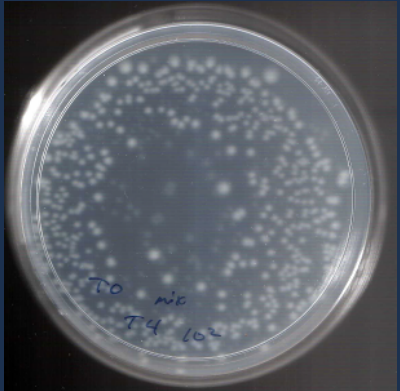
FieldQuant Validation – Precision

Precision - DHC Replicates



THE MICROBIAL REVOLUTION

Plate Count



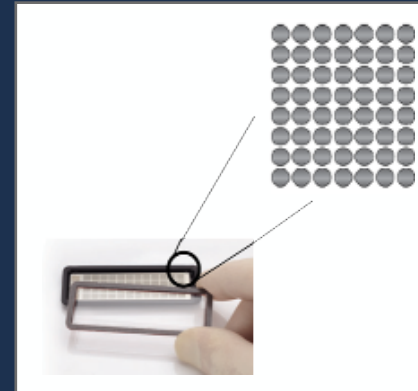
PCR



qPCR



QuantArray®



FieldQuant™





THANK YOU!

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