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Revolutionising Biomanufacturing: AI powered bio-design.

Dr. Ahir Pushpanath, Technical Director
IndustryX Talk - 15th November 2024

Overpopulation and food insecurity

Health and aging crisis

Pollution and environmental degradation

Resource scarcity

Climate change

We are facing serious **GLOBAL** issues

「必要は発明の母」

“Necessity is the mother of invention”

The dependency on fossil fuels

As the backbone of industrial value chains, the chemicals sector powers global economic development, touching nearly every industry through its products and innovations.

McKinsey Report 2024

Industry 4.0 → Industry 5.0

Industry 5.0 Pillar of "Resilience" means moving away from our dependence on fossil fuels, especially for the chemical industry

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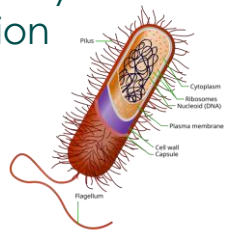
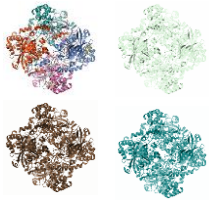
https://www.mckinsey.com/industries/chemicals/our-insights/a-new-operations-formula-for-the-chemicals-sector

Nature has already shown us the way

Billions of years of evolution





Renewable Feedstock → Desirable product

"Nature is a master chemist, conducting the most intricate chemical processes with precision and efficiency far beyond our current technological capabilities. The study of natural biosynthetic pathways offers chemists profound inspiration for synthetic processes."

— Baldwin, J. E., Nature as a Chemical Engineer: Inspirations for Chemical Synthesis, Nature Reviews Chemistry, 2004.

So, why **hasn't** the industrial world adopted biotechnology as #1?

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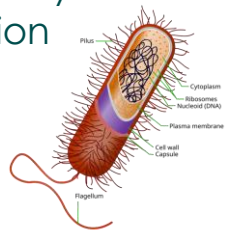
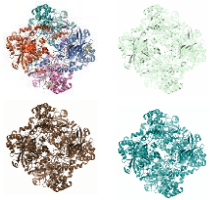
Nature hasn't evolved for industry

Billions of years of evolution





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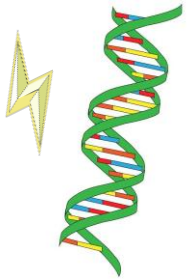

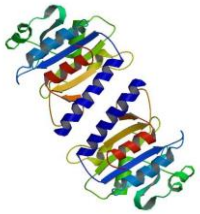

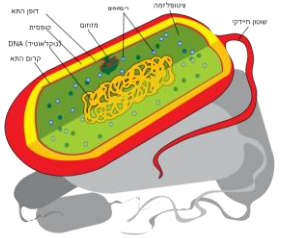

DNA **Protein** **Cell**

Mutation, Selection, Adaptation

Nature **has evolved** for survival, **not for** industrial chemistry!

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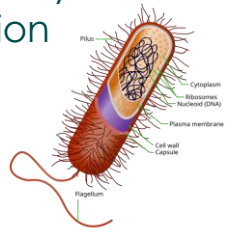
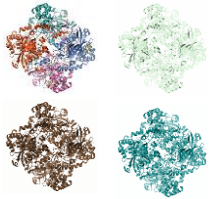
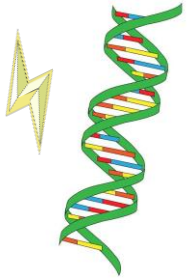
What if we could *evolve* biology?

Billions of years of evolution

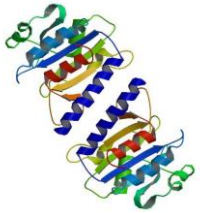




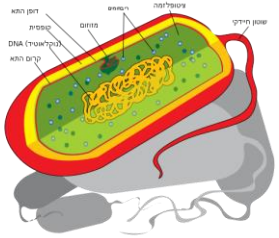
Renewable Feedstock → Desirable product



DNA



Protein



Cell

Mutation, Selection, Adaptation

"We can now evolve enzymes (and organisms) to perform industrial chemistry in a sustainable way, replacing polluting processes with greener, more efficient solutions that nature could not have imagined."

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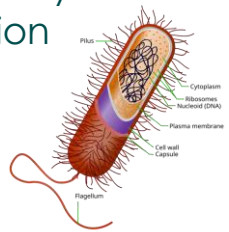
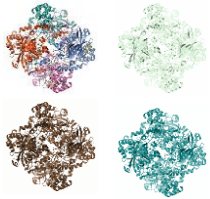
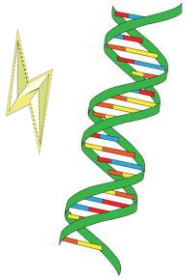
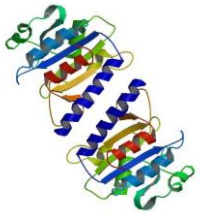
What if we could *evolve* biology?

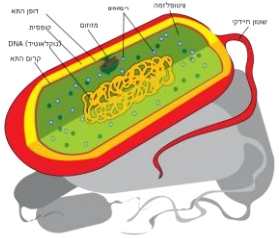
Billions of years of evolution











Renewable Feedstock → Desirable product

DNA **Protein** **Cell**

Mutation, Selection, Adaptation

"Directed evolution allows us to circumvent our profound ignorance of how sequence encodes function and instead use the power of biological diversity and selection to solve problems we don't know how to solve otherwise."

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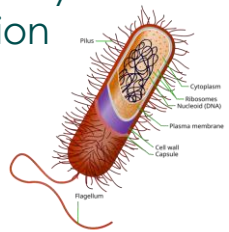
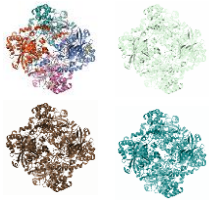
What if we could *evolve* biology?

Billions of years of evolution





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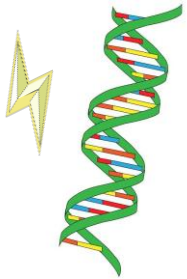

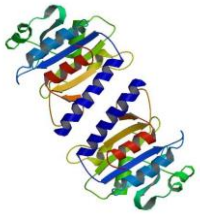

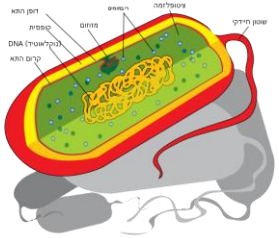

DNA **Protein** **Cell**

Mutation, Selection, Adaptation

From billions of years of evolutions to approximately **2 years** to develop a bio-solution

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Successful biomanufacturing examples

A few examples among many

Bulk chemicals (paper, textiles, plastics, rubber)

MITSUBISHI CHEMICAL GROUP

TATE & LYLE

BASF We create chemistry

DUPONT

Pharmaceuticals

MERCK

Pfizer

CODEXIS

Flavours & Fragrances

dsm-firmenich

Givaudan

Agrochemicals

BAYER

MONSANTO

CORTEVA

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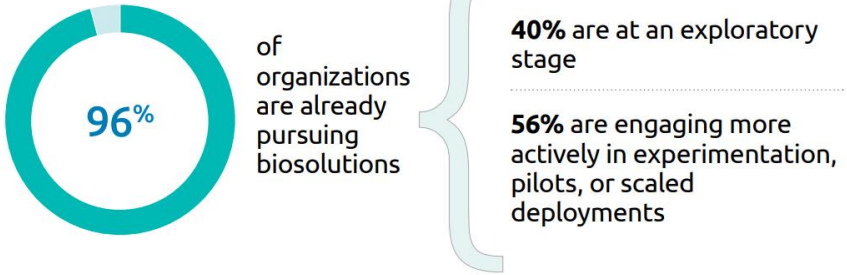
Companies want innovative biosolutions now

Survey of 1100 executives in large companies in 11 industries



Source: Capgemini Research Institute, Engineering biology survey, April–May 2024, N=1,100 corporate organizations.

Different approaches are needed

Strains of yeast in an Amyris fermentation room. Last year, the company declared bankruptcy, one of several major startups to falter.

BIOTECHNOLOGY

Synthetic biology startups face a 'reckoning'

Three big firms falter, but startups find niches in pharma and other small-volume markets

By **Robert F. Service**

It's been a rough go lately for synthetic biology's flagship companies, which genetically engineer microbes to produce

One problem for the companies that have faltered, Keasling argues, was mountains of investor cash that led to an overabundance of ideas and a lack of focus. Amyris, for example, created a pipeline of

and they bring in nearly half of the country's pharmaceutical company revenues.

Beyond pharma, synbio has also quietly worked its way into the fabric of modern manufacturing. For example, engineered

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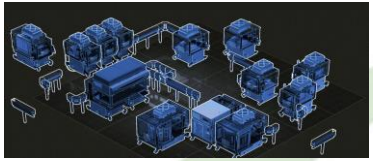
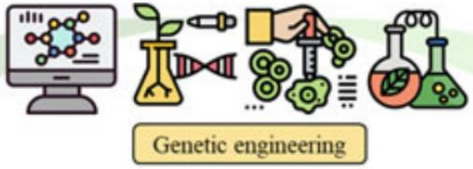
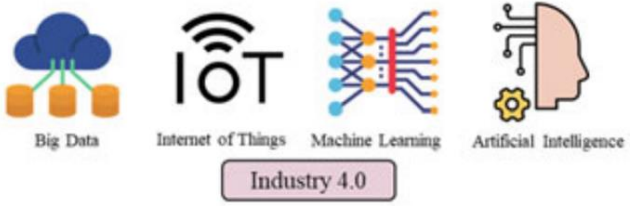
Source: Capgemini research institute (2023), *Science* (2024)

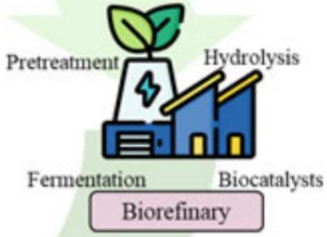
Synthetic biology converges with Industry 4.0

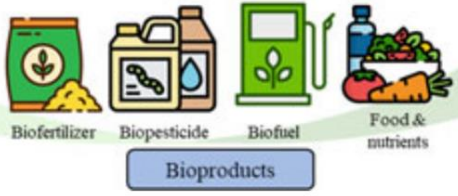




Can we shrink R&D time from 2 years to 2 months?







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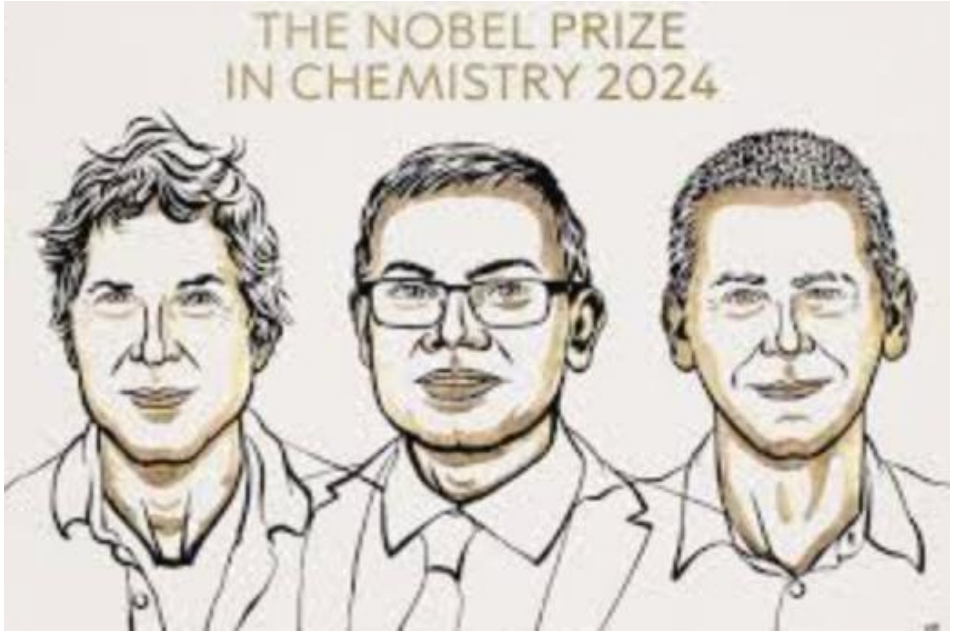
Sharma et al., 2024

AI has delivered “breakthrough” success in biology



Protein Structure prediction

Computational Protein Design

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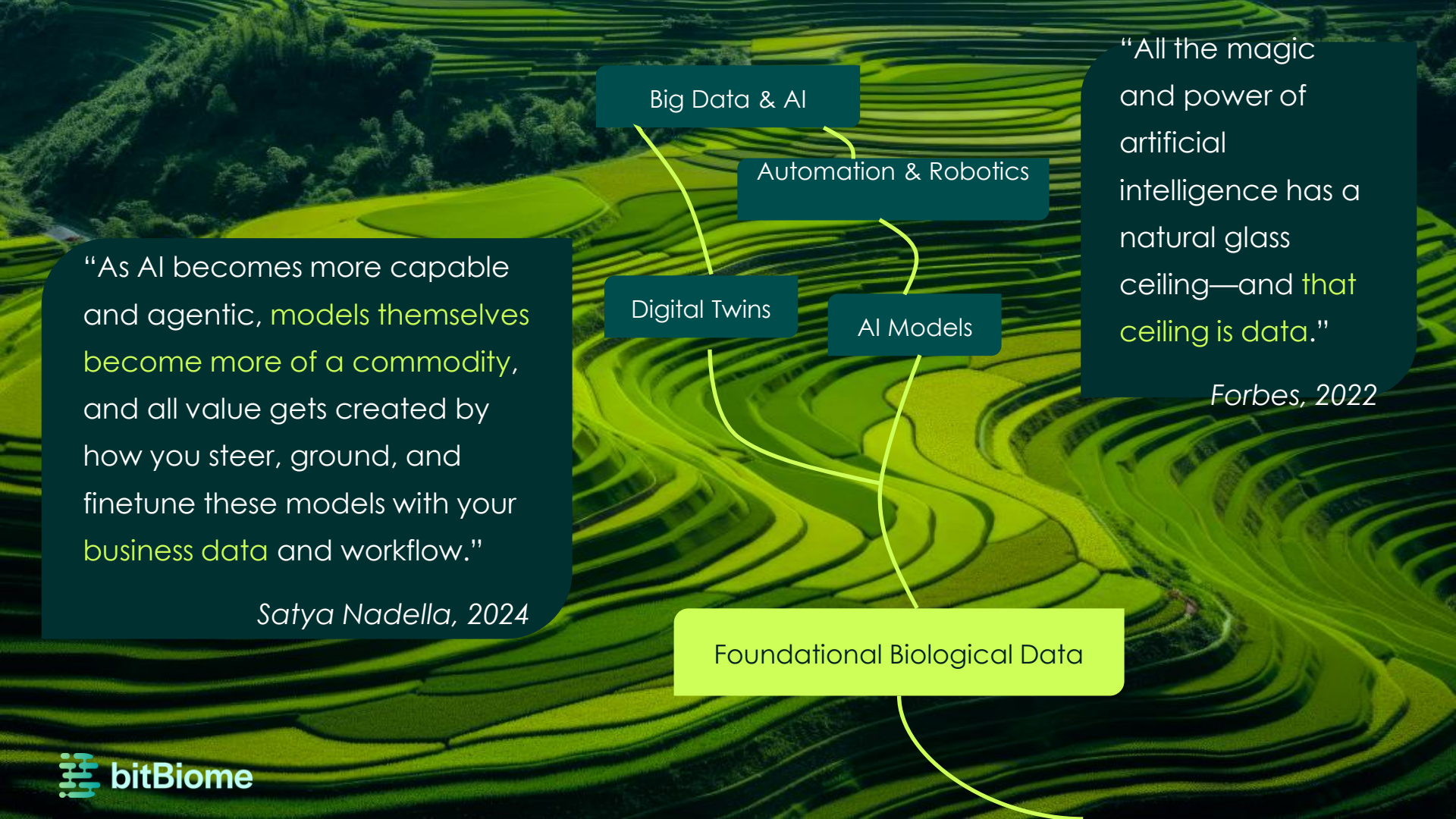
Big Data & AI
Automation & Robotics
Digital Twins
AI Models
Foundational Biological Data
"As AI becomes more capable and agentic, models themselves become more of a commodity, and all value gets created by how you steer, ground, and finetune these models with your business data and workflow."
Satya Nadella, 2024
"All the magic and power of artificial intelligence has a natural glass ceiling—and that ceiling is data."
Forbes, 2022
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Data is king in the age of AI-powered bio design

Sequence → **Structure** → **Function**

Need more high quality data!

Do we even **know** enough about microbes and their chemistry?

Has the existing biological data reached its glass-ceiling already?

Building the **largest**, **highest quality datasets** of microbes to fuel the latest bio-AI models

Microbes are the unsung heroes of the natural world

Microbes are everywhere

1 trillion
species

3.5 billion
years on earth

30 trillion USD
bioeconomy
by 2030

- White House

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Microbes are the unsung heroes of the natural world - but we barely know them

Microbes are everywhere

1 trillion
species

3.5 billion
years on earth

Less than
0.001%
identified

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Many have focused on technologies to harness 0.001% of their power…
What if we can access and use 100 %?
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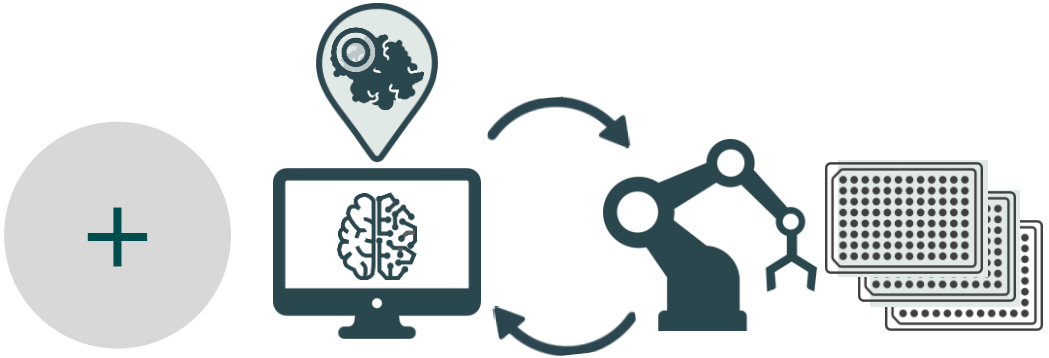
Understand the diversity of microbes and their chemistry - Solve the enigma of bio-design , usher in Industry 5.0

"The microbial world is a vast, untapped reservoir of genetic and metabolic diversity, holding immense potential for biotechnological innovation."



1. Massive repository of high quality microbial genetic data
2. Advanced robotics to test for industrial applicability
3. SOTA BioAI models

The **“Bio-revolution”** is within our reach!

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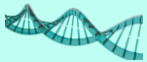
Our three technology pillars towards the bio-revolution



SEQUENCE

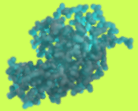
bit-MAP

The **one and only single-cell sequencing** for microbes that's 100x more efficient than conventional methods

CATALOG

bit-GEM

The **world's most diverse database**—2 billion sequences and growing—built on single-cell sequencing of microbes from natural samples



EVOLVE

bit-QED

Customized bio- and cheminformatics and AI-driven biological design.

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Biotech and industry leaders choose us

KEY CLIENTS AND PARTNERS

TWIST BIOSCIENCE

bluestem

AJINOMOTO

tok
東京応化工業株式会社
TOKYO OHKA KOGYO CO., LTD.

TEXAS
The University of Texas at Austin

Now ideas for wellness
meiji

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Think what you can do with biotechnology in your companies
A call to collaborate

DANONE
ONE PLANET. ONE HEALTH

dsm-firmenich

MOLSON COORS beverage company

novo nordisk®

MARS

Product Innovation
Enhanced Fermentation Processes
Microbiome Insights
Circular and Low-Carbon Packaging Innovations
Water Quality preservation
Upcycling Waste

Bio-based Polymers (LEGO already doing it!)

Sustainable Paints (BMW already doing it!)
made from bio-waste

LEGO

BMW

WHAT ELSE CAN WE DO TOGETHER FOR A SUSTAINABLE INDUSTRY 5.0?

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Thank you

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Technical Director, Biocatalysis at bitBiome