Microbiomes in Transition

Pacific Northwest NATIONAL LABORATORY

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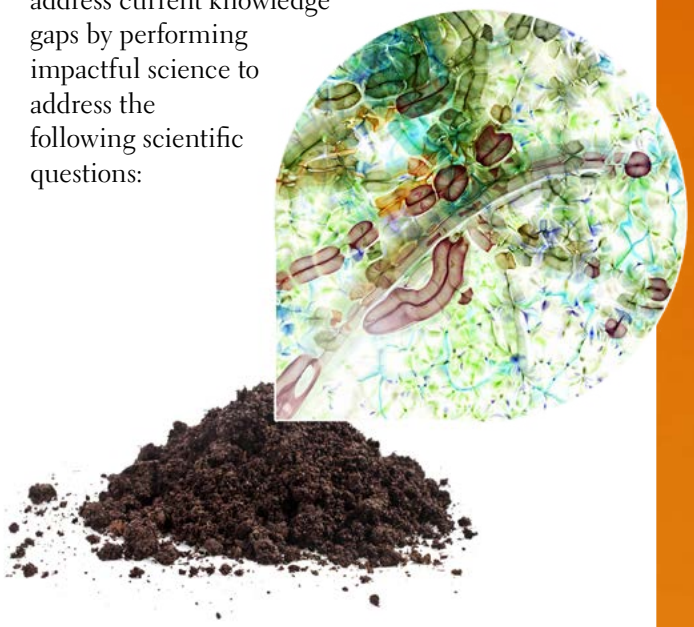
PNNL SCIENTISTS LEADING INITIATIVE TO UNDERSTAND EARTH'S MICROBIOMES

Nearly every habitat and organism on Earth contains a diverse collection of microorganisms, called microbiomes. Microbiomes play important roles in our world, among them carbon and nutrient cycling, pollutant degradation, plant growth promotion, and cause and prevention of disease. However, very little is known about the properties of microbiomes because of the lack of sufficient tools to properly understand their functional roles.

Scientists in Pacific Northwest National Laboratory's Microbiomes in Transition (M*in*T) Initiative are performing state-of-the-art research to address key knowledge gaps in microbiome understanding. Such capabilities will enable scientists to understand, predict, and ultimately control key processes carried out by microbiomes.

Understanding the Impact of Microbiomes

A single gram of soil, about the size of a teaspoon, contains more than a billion microorganisms, representing tens of thousands of species, the majority of which have never been isolated. This example illustrates the tremendous challenge of studying Earth's microbiomes. M*in*T aims to address current knowledge gaps by performing impactful science to address the following scientific questions:



- What are the impacts of perturbations – such as climate change – on key processes carried out by microbiomes?
- What are the impacts of changes in microbial community metabolic processes on ecosystem function, resilience, and sustainability?
- What are the hallmarks of a microbiome in transition, and what are the functional implications?

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Scientists at PNNL are studying microbiomes to better understand their functions and how key functions are perturbed by change. Examples of environmental perturbations that can impact microbiomes in nature include climate change and exposure to pollutants.

State-of-the-art technologies and computation facilities at PNNL enable better understanding of the impact of perturbations on key roles carried out by microbiomes.

State-of-the-Art Science and Technology

M*in*T will focus on key biosystems where microbiomes play important but poorly defined roles. We will leverage expertise and state-of-the-art technologies at PNNL, including bioscience expertise across the Laboratory, PNNL's Marine Sciences Laboratory at Sequim, and the Environmental Molecular Sciences Laboratory (EMSL), a Department of Energy Office of Science User Facility, to address key knowledge gaps. These technologies include multi-omics, imaging, and computing.

Focus Areas

To address microbial challenges, M*in*T is organized into three research and development areas:

- **Environmental Microbiomes.** The focus is on ecosystems impacted by changes in hydrology caused by climate change. These include wetlands in boreal areas and coastal marine and river systems. In turn, this knowledge will enable better predictions of the impacts of climate change on ecosystem sustainability.
- **Exposure Science.** The focus is on understanding how exposure to environmental agents, including radiation, chemicals, and drugs, impact the human microbiome and its metabolic functions. In turn, this new knowledge provides a mechanistic understanding of how changes in the microbiome contribute to individual susceptibility to environmental exposures.
- **Computational Biology.** The focus is on gaining an understanding of the complex interactions and metabolic networks that function in microbiomes. We are applying our expertise in computational biology, bioinformatics, and statistics to develop new approaches to analyze increasingly large microbiome datasets, and to build models to capture and predict their behavior.

For more information contact

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