

Drinking Water Systems: methods and applications

Next Generation Sequencing Mini Conference 2018:

The Embassy of the Federal Republic of Germany

May 14, 2018

Washington, DC

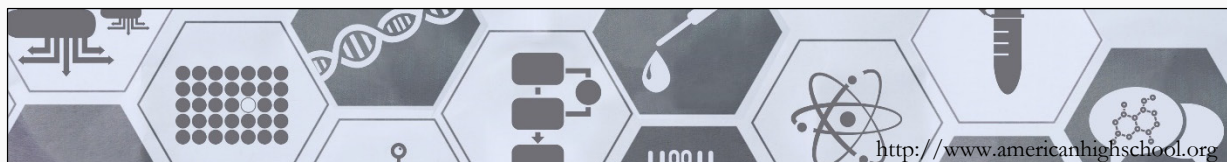
Vicente Gomez-Alvarez, Ph.D.

Drinking Water Systems Branch

Office of Research and Development



DISCLAIMER: *The views expressed in this presentation are those of the author and do not necessarily represent the official positions and policies of US EPA. Any mention of products or trade names does not constitute endorsement or recommendation.*

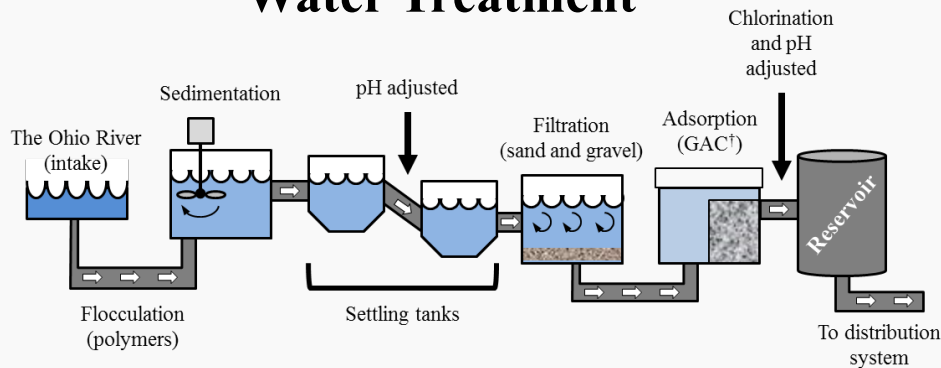


The **Office of Research and Development** (ORD) is the scientific research arm of EPA, whose leading-edge research helps provide the solid foundation of science and technology for the Agency.

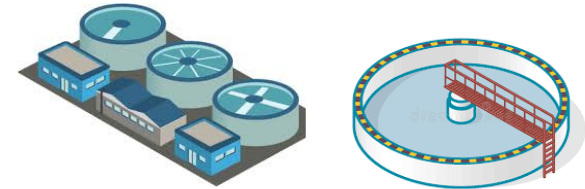
In particular, the **Water Systems Division** (WSD in NRMRL) develops and evaluates strategies and technologies to reduce the risks associated with chemical and microbial contaminants in drinking water systems.



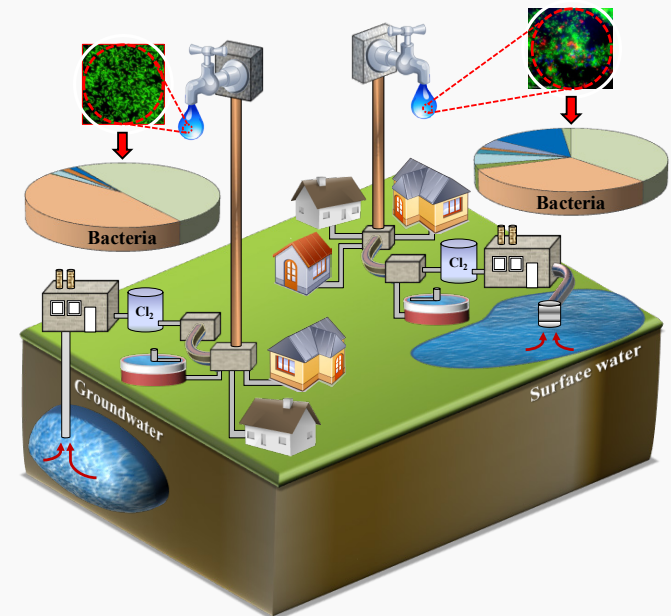
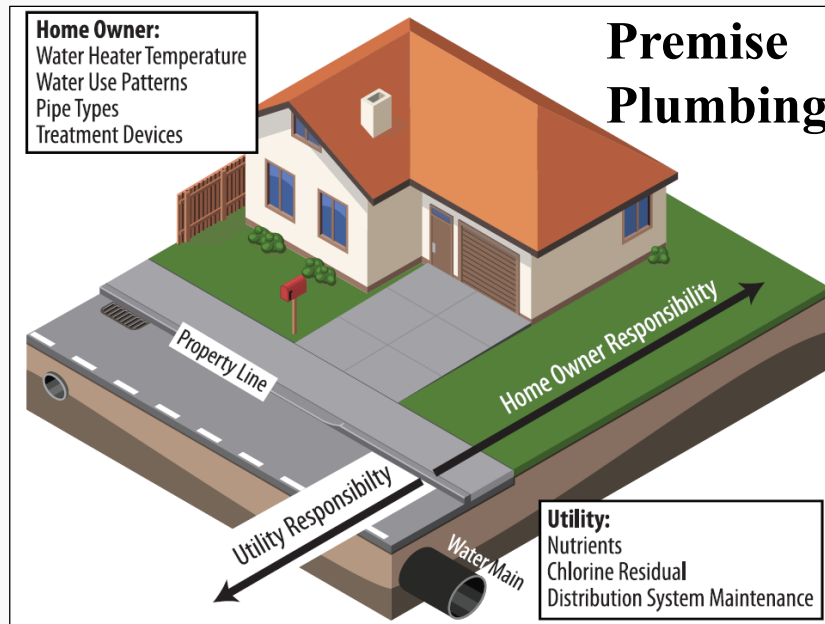
Water Treatment



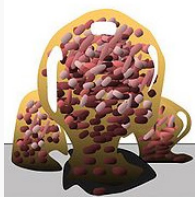
Wastewater Treatment



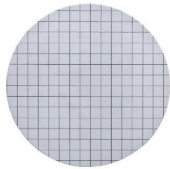
Distribution System



DWDS Sampling



Biofilm



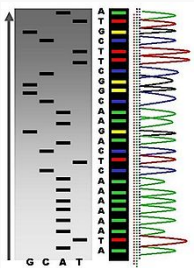
Bulk water



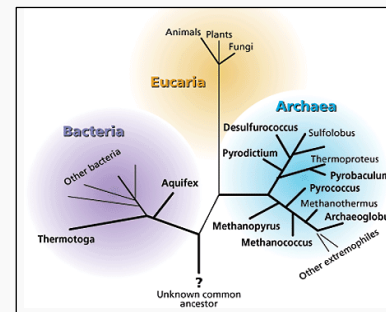
Template



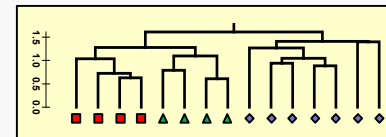
DNA/RNA



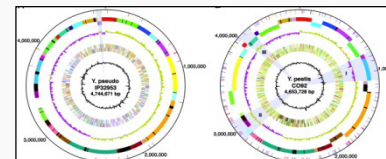
Sequencing



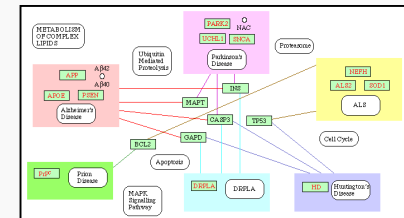
TAXONOMIC PROFILE



COMMUNITY PROFILE



PAN-GENOME



METABOLIC PROFILE



TARGET GENES/
BIOMARKERS

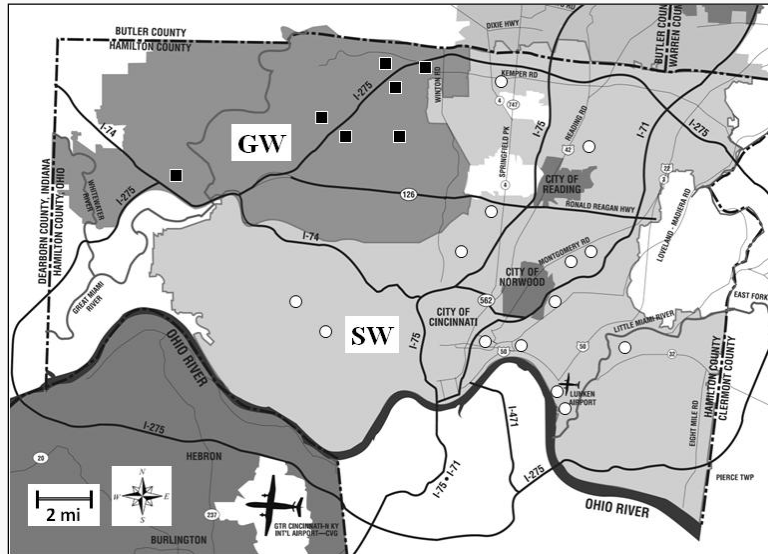


NGS: research applications (case studies)



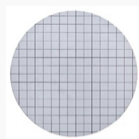


NGS APPLICATION: taxonomic profile



Distribution System. Service area map with sampling site locations.

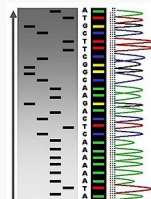
Exp. Design



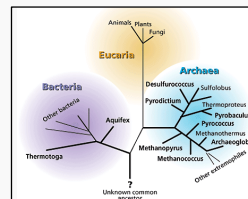
Bulk water



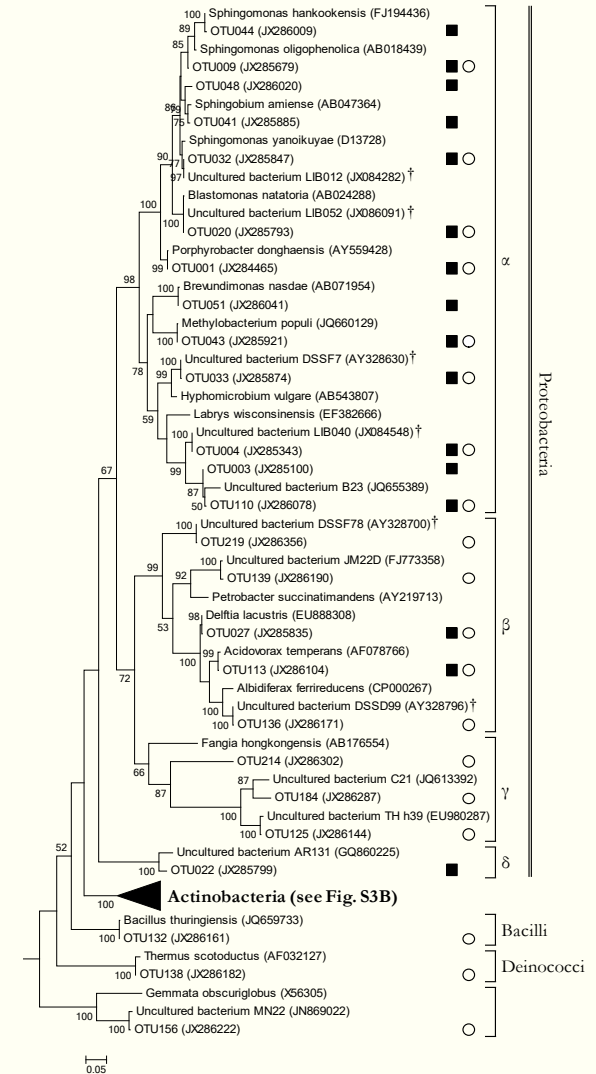
DNA



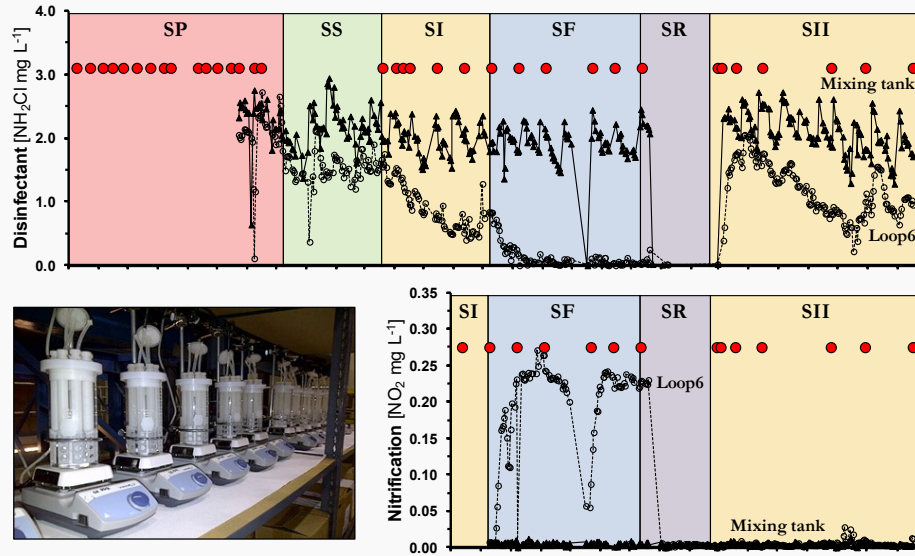
Sequencing



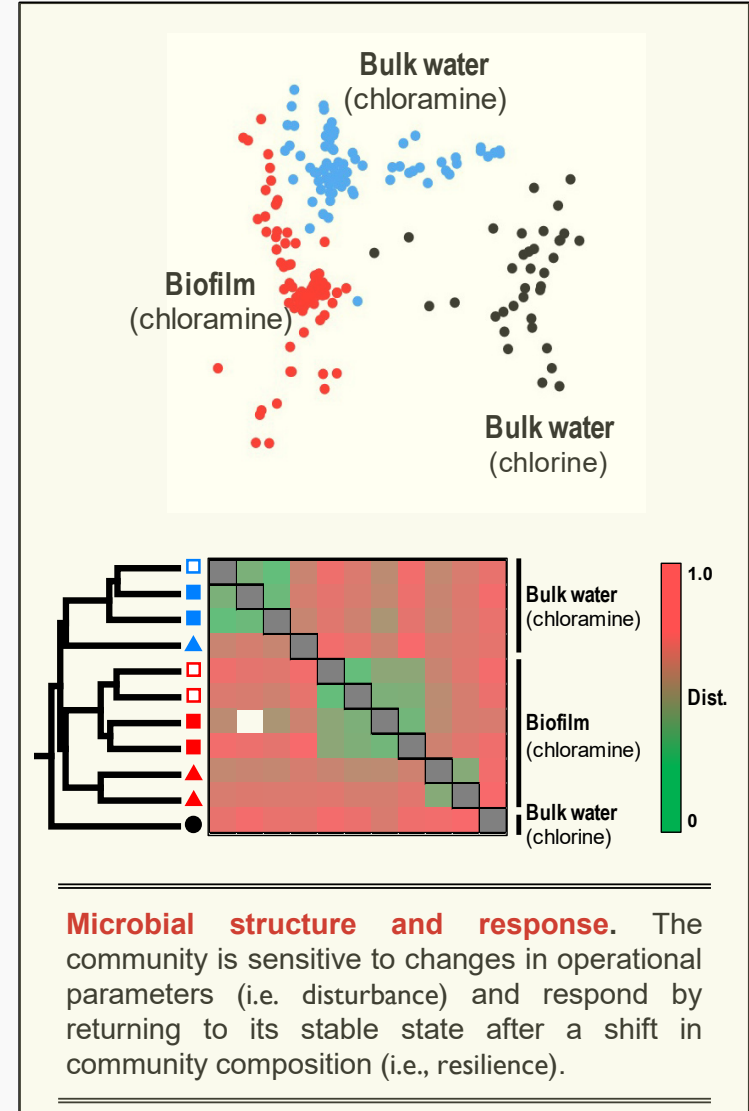
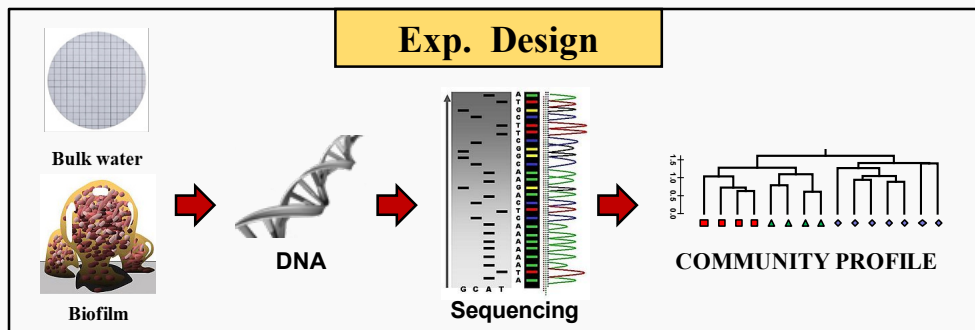
TAXONOMIC PROFILE



NGS APPLICATION: community profile

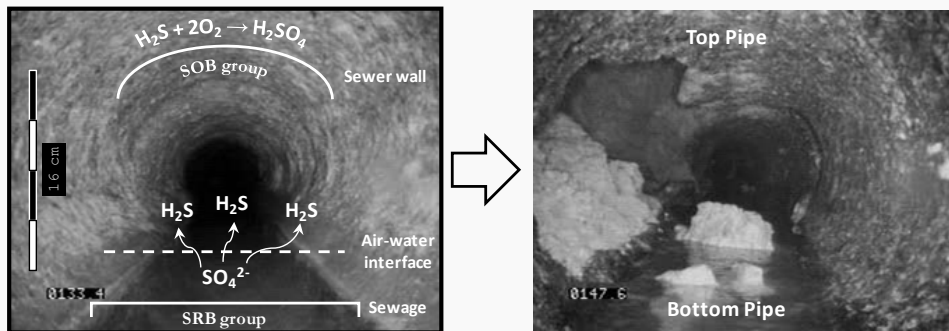


Operational details. Organized into five distinct operational schemes

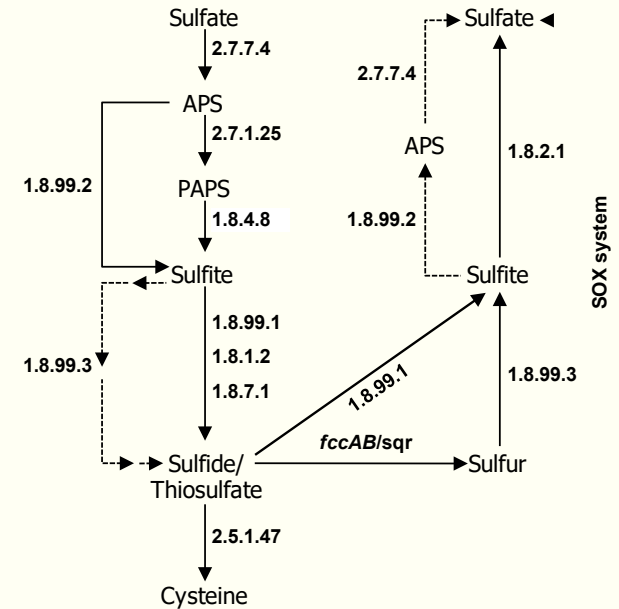


Microbial structure and response. The community is sensitive to changes in operational parameters (i.e. disturbance) and respond by returning to its stable state after a shift in community composition (i.e., resilience).

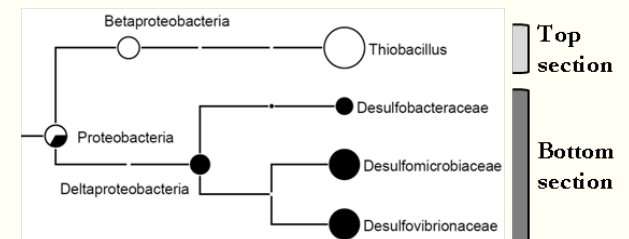
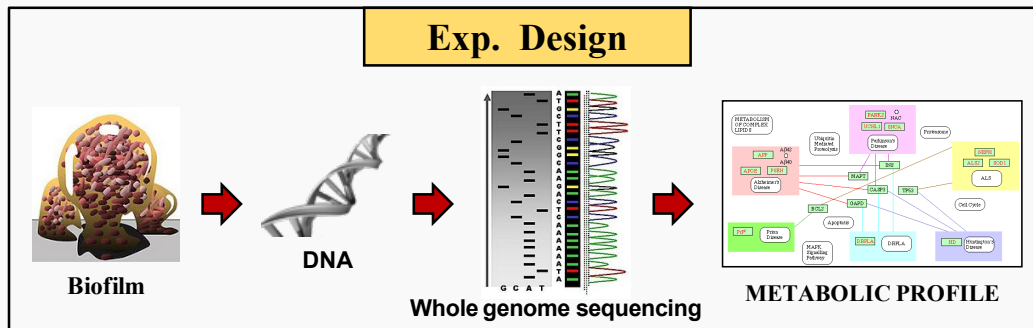
NGS APPLICATION: **metabolic profile**



Biofilm. Samples were harvested from crown (top) and invert (bottom) sections of a concrete corroded wastewater pipe.



The Sulfur metabolic pathway.

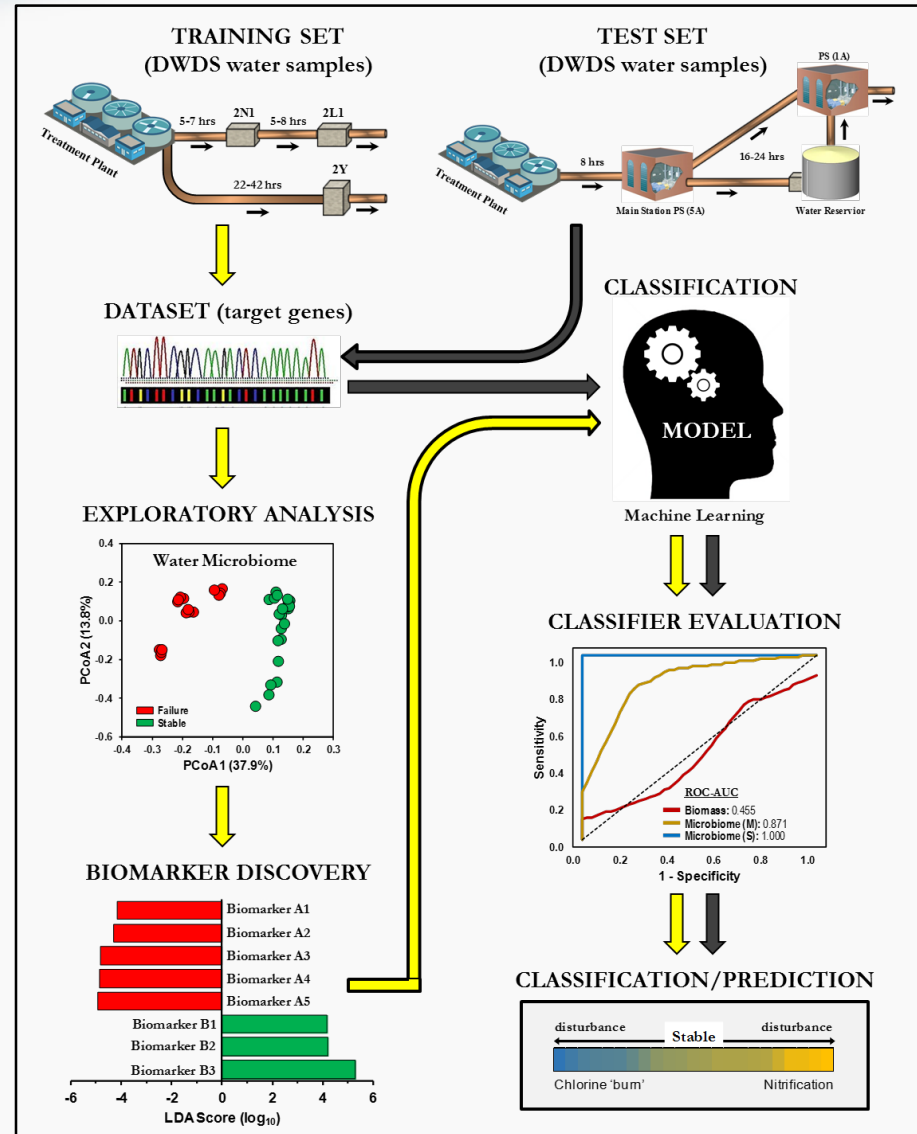
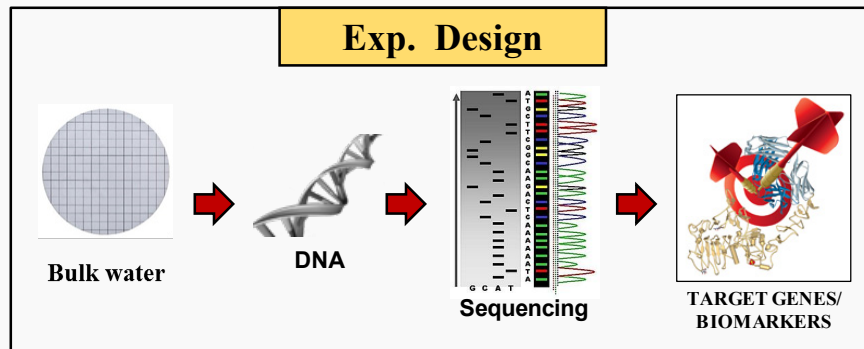


Taxonomy and relative abundance of Sulfur-related proteins.

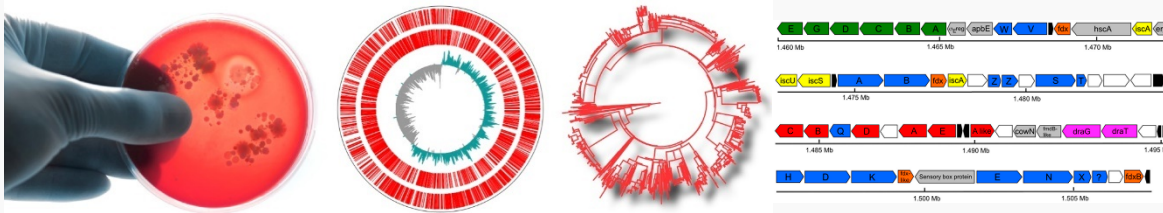
NGS APPLICATION: **biomarkers**



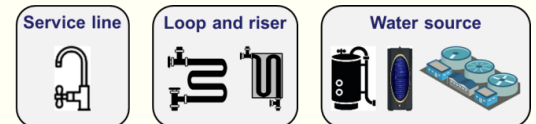
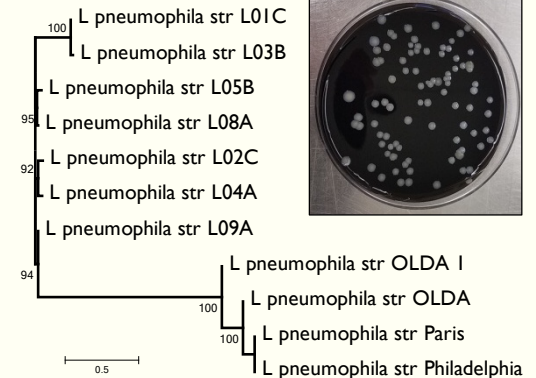
Public Health. Water sources, potential threats and protection.



NGS APPLICATION: genome analysis

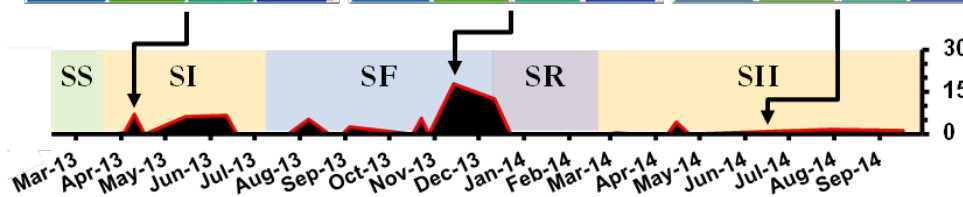
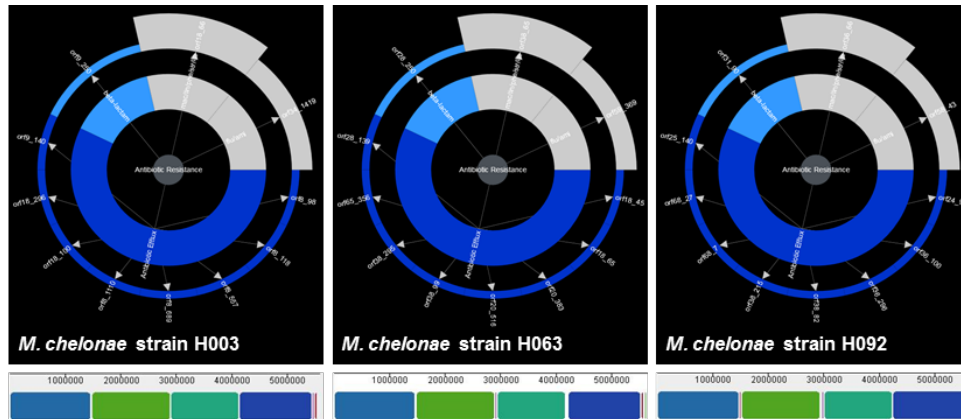


Pan-Genome of *L. pneumophila*



Core genes	(99% <= strains <= 100%)	3001
Soft core genes	(95% <= strains < 99%)	0
Shell genes	(15% <= strains < 95%)	269
Cloud genes	(0% <= strains < 15%)	13
Total genes	(0% <= strains <= 100%)	3283

Genome Analysis. Core genes of isolates and representative strains.



Genome stability. Members of the dominant population maintained the same genomic structure (including a core assemblage of ARGs).

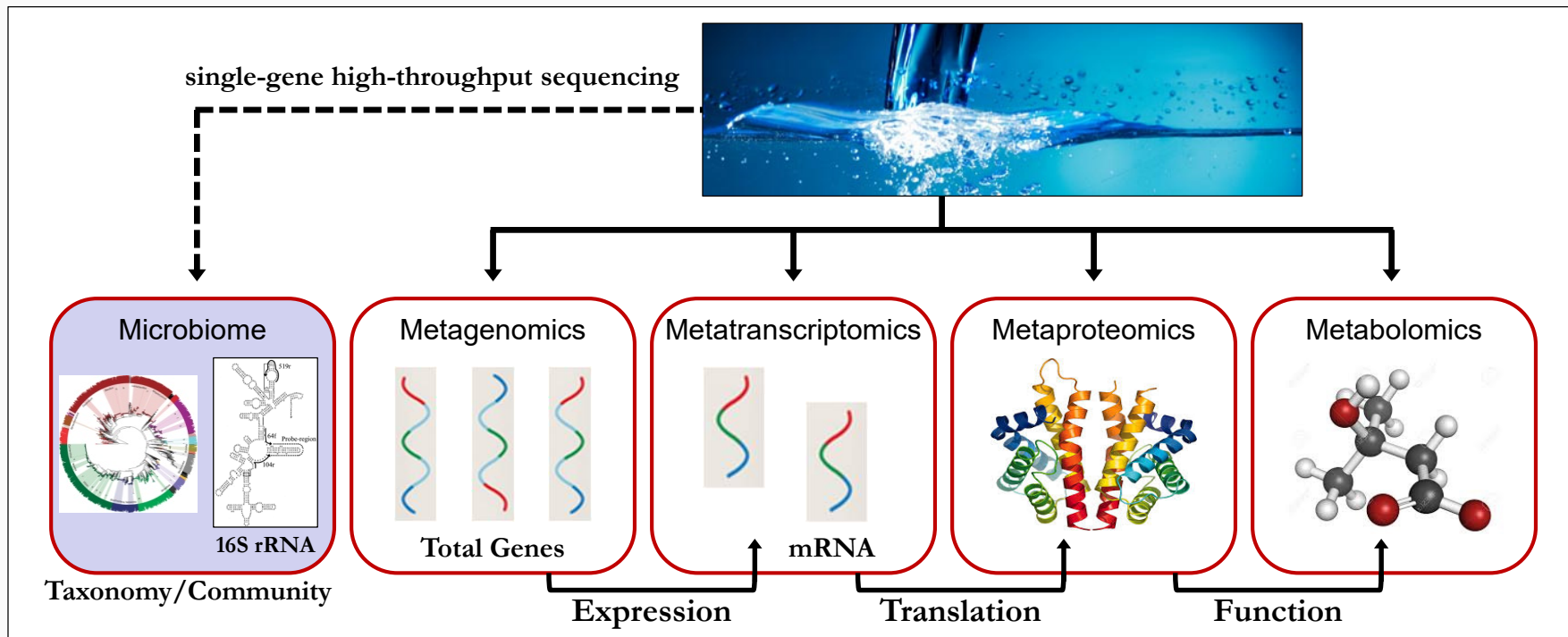


Biofilm: future directions in research



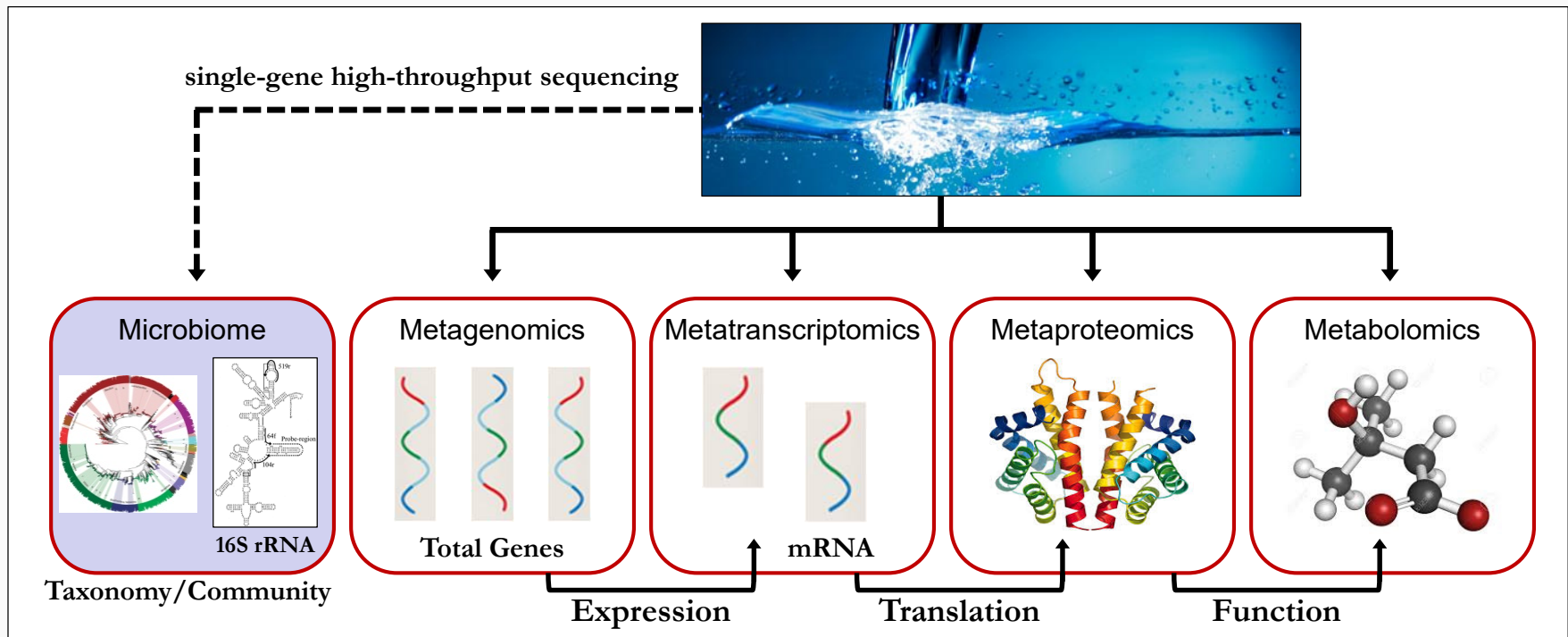
*“Microbial ecology is currently undergoing a revolution... ..the rapid accumulation of **molecular data** is uncovering vast diversity, abundant uncultivated microbial groups and novel microbial functions.”*

Ingerson-Mahar and Reid (2012) *American Academy of Microbiology*, pp13.



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*“Like any other technique, their value is not determined by their engineering or technical brilliance or their cost but rather by their ability to help us test **scientific theory** and address **scientific questions**.”*



“The field of microbial ecology is at a stage where it is necessary to move beyond describing which groups are present, and start to design studies upon which experimentation and modeling of community establishment, succession, stability and function can be carried out...”

Ingerson-Mahar and Reid (2013) *American Academy of Microbiology*, pp13.

Think before you sequence

JAMES I. PROSSER

“A hypothesis generated by a descriptive study lacks value, and does not increase understanding, unless it is tested by experiment.”



Exploring Earth's dark matter

JANET K. JANSSON



“The discovery of a microbial species with potentially novel functions would be just as interesting as the discovery of a star.”



Adapted from Myrold (2015) *What do 'omics do best?*

USEPA COLLABORATORS

Stacy Pfaller

Dawn King

Randy P. Revetta

Claudine Curioso

Jorge W. Santo Domingo

Megan Berberich

Laura Boczek

Adin Pemberton

Mark Rodgers

APTIM personnel

Pegasus personnel

Carolyn Carter



THANK YOU
FOR
YOUR
ATTENTION!
ANY QUESTIONS?