EMSL

Capabilities Series

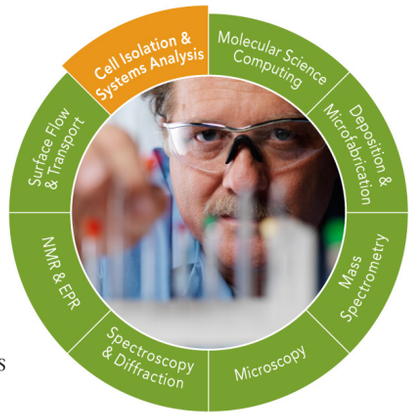
Cell Isolation & Systems Analysis

EMSL's Cell Isolation and Systems Analysis (CISA) instruments are part of an unparalleled collection of capabilities designed to support research that integrates both experimental and computational tools. In particular, CISA instruments foster advances in systems biology and systems microbiology research that benefit from the integration of genomics, transcriptomics, proteomics, metabolomics, and imaging approaches. CISA tools enable novel, fundamental research in EMSL's Science Themes of Biological Interactions and Dynamics, Geochemistry/Biogeochemistry and Subsurface Science, as well as Science of Interfacial Phenomena. Specific research topics include:

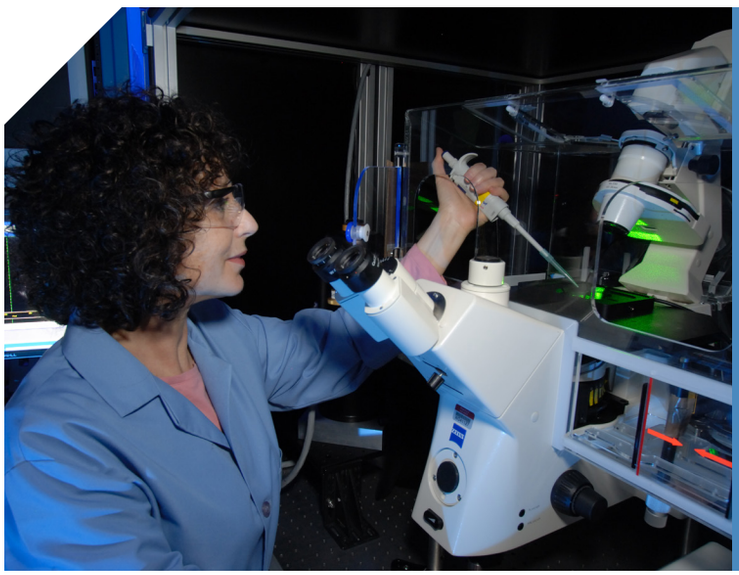
- Bioenergy/biofuels – making strides toward alternative energy sources based on microbial and plant biology systems
- Environmental remediation – understanding and tailoring biological systems to return contaminated areas to their natural state
- Network and communities science – revealing the dynamic structure-function relationships critical to protein networks in human, animal, plant, and microbial cells, cell communities, and whole organisms
- High-throughput data interpretation – reaching meaningful conclusions from 'omics datasets using effective and novel data storage, assimilation, and visualization tools.

CAPABILITY DETAIL

EMSL offers scientific users:



- Applied Biosystems SOLiD™ platforms for massively parallel, next-generation sequencing for whole-transcriptome analysis
- Complementary tools and techniques for proteomics studies that may be conducted using the resources that are part of EMSL's Mass Spectrometry capability and for metabolomics studies using EMSL's NMR and EPR capability
- Cell culture micro-bioreactors with multiple, independently controlled culture chambers
- Laser-capture micro-dissection microscopy; free-flow electrophoresis; and the Influx, a flow cytometer/cell sorter specialized for microbial cells
- Fluorescence microscopy/spectroscopy tools that allow deep insights into living cells, including a multi-photon microscope that seamlessly integrates nonlinear two-photon excitation, laser-scanning confocal microscopy, and fluorescence lifetime imaging in one fully automated upright system
- Leading-edge, high-resolution transmission and scanning electron microscopes, such as a cryo-TEM and dual-beam FIB/SEM.



WHY CELL ISOLATION AND SYSTEMS ANALYSIS AT EMSL?

- EMSL provides Cell Isolation and Systems Analysis tools within the context of an integrated problem-solving environment that supports all facets of systems biology research under one roof.
- In-house customization of tools and techniques at EMSL fosters significant advances in 'omics research as well as high-spatial and high-temporal resolution microscopy studies.
- EMSL offers sophisticated data interpretation methods to help researchers reach meaningful conclusions from data-dense 'omics results and by integrating data types across analysis systems, including 'omics, microscopy, and molecular modeling.

ABOUT EMSL

EMSL, a U.S. Department of Energy national scientific user facility located at Pacific Northwest National Laboratory, provides integrated experimental and computational resources for discovery and technological innovation in the environmental molecular sciences to support the needs of DOE and the nation.

EMSL's distinctive focus on integrating computational and experimental capabilities as well as collaborating among disciplines yields a strong, synergistic scientific environment. Bringing together experts and an unparalleled collection of state-of-the-art instruments under one roof, EMSL has helped thousands of researchers use a multidisciplinary, collaborative approach to solve some of the most important and complex national scientific challenges in energy and environmental sciences.

To learn more about EMSL, the science conducted at EMSL, as well as the instruments and expertise available to users, visit www.emsl.pnnl.gov.

BECOME AN EMSL USER

Researchers are invited to access the world-class capabilities and collaborate with the internationally recognized experts at EMSL via its peer-reviewed proposal process. To submit a proposal, follow the five steps outlined on the EMSL website (www.emsl.pnnl.gov) under User Access. Current and potential EMSL users are encouraged to respond to Calls for Proposals, which are announced each spring. However, unique research proposals that fall outside the Calls for Proposal focus may be submitted at any time.

Applicants are encouraged to submit proposals for use of EMSL's capabilities with an emphasis on integrating computational and experimental tools. In general, most users whose open research proposals are accepted may use EMSL resources free of charge. Open research is loosely defined as science and engineering research for which the resulting information is published and shared broadly within the scientific community.

GALYA ORR, Ph.D.

Capability Lead, Cell Isolation & Systems Analysis

galya.orr@pnnl.gov

509-371-6127

PNNL-SA-70680

CISA RESEARCH HIGHLIGHTS

Tiny Bug, Big Family Tree

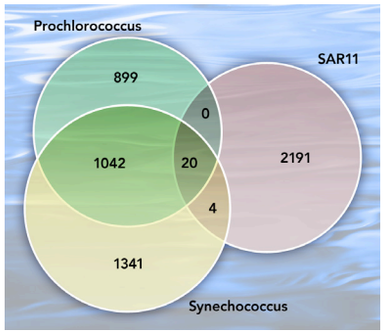
Shewanella, shown here in a high-resolution microscopy image, boasts a surprisingly diverse genome and proteome.

EMSL resources helped show the power of integrated 'omics in a study published in the *Proceedings of the National Academy of Sciences* and highlighted in *Nature*. Using complete genomic sequences, proteomic profiles, and physiological data from ten closely related *Shewanella* bacteria strains, researchers related genotype to phenotype in more detail than ever before. The team's analysis offers the scientific community a new perspective on defining bacterial species and genera. Importantly, the study revealed that *Shewanella* genomes and proteomes are surprisingly diverse; that in some cases genome and proteome variation among strains correlates positively to the level of environmental adaptation, or specialization; and that specialization may occur over a short period of time. The team was also able to tease apart the effects of ecology and evolutionary divergence in terms of genomic and proteomic profiles.

EMSL users: Georgia Institute of Technology, Josephine Bay Paul Center for Comparative Molecular Biology and Evolution, PNNL, University of Texas, Michigan State University, University of Southern California, Argonne National Laboratory

Konstantinidis *et al.* 2009. *PNAS* 106(37):15909-15914.

Survival Mode



A large proportion of the peptides detected in samples from the Sargasso Sea were unique to *Prochlorococcus*, *Synechococcus*, or *SAR 11* (*Peligobacter ubique*) – one of the most abundant organisms on Earth.

Microbial communities heavily influence biogeochemical cycles, affecting the concentrations of elements such as carbon—and therefore the greenhouse gas, carbon dioxide—in the Earth's air, water, and soil. Using data analysis and experimental mass spectrometry tools at EMSL, researchers conducted the first qualitative assessment of protein expression in microbial communities from the Sargasso Sea. The team found that these organisms survive in their harsh environment by actively uptaking the limited nutrients dissolved in the waters that surround them. Such studies have the potential to relate microbial community proteomes to global processes.

EMSL users: Oregon State University, PNNL, and the University of California

Sowell *et al.* 2009. *ISME Journal* 3:93-105.

EMSL | Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965
U.S. DEPARTMENT OF ENERGY