

I am Galya Orr, and I am the Capability Steward for the Cell Isolation and Systems Analysis, which we call CISA.

The purpose of CISA is to provide researchers an environment where they can use multiple tools to study one biological system. When we have all these tools under one roof, it really can support a systems biology approach, which can be much more powerful than if we use only one instrument here and there.

Users coming to CISA with a sample, they can start by isolating their samples into whatever category they would like to pursue and then take those isolates and do intensive analysis by microscopy or to start an array of 'omics analyses, starting with transcriptomics, proteomics, metabolomics, and, of course, use our data-intensive analysis to make sense out of all these data.

My name is Steven Wiley. I'm the Chief Biologist here at EMSL. One of the most exciting technical developments over the last few years is the ability to do very detailed profiling of the transcriptome, that is, the pattern of messenger RNA that's made from the genome of cells.

We've created a facility that allows us to not only look at the gene transcription, but to simultaneously look at the pattern of protein expression in cells. By looking at the pattern of genes and then protein expression we can look at the relationship between transcription and translation and then identify a unique signature, such as post-transcriptional regulation of proteins.

This is the first time that one can easily look at, on the global level, modifications of protein regulation in cells.

Beyond being able to pursue your research using multiple approaches, each approach that we provide is quite powerful. We provide a suite of fluorescence microscopy and spectroscopy tools that allow people to look inside the living cell from different angles.

We have a multiphoton confocal fluorescence microscope that is integrated with FLIM, fluorescence lifetime imaging. We also develop non-conventional approaches or techniques. One of them is the single-molecule fluorescence imaging, which allows us to detect individual fluorophores. Taking advantage of this single-molecule fluorescence imaging, we've developed the STORM, which stands for stochastic optical reconstruction microscopy, also known as PALM, photoactivated localization microscopy.

We have several ways to isolate specific cells from a mixed culture. One way is our flow cytometer, or the Influx. Using this instrument, you can isolate up to individual cells to start your analysis from a single cell. And this is helpful, we use this technique in order to isolate single bacterial cells and grow them and create a pure culture from a consortia, from mixed

cultures. And then we can farther take this culture for microscopy or transcriptomics analysis or proteomic analysis.

One of the projects we're really interested in doing is to identify microbes that are able to create biofuels from common organic material, like wood chips. And we know there are very complex microbial communities that can perform this function, but we don't know what are the microbes in those communities that actually do the conversion process. CISA will allow us to take these complex communities, break them down into their components, and analyze each of the components to determine which ones are responsible for this activity. This will provide a means to create new and enhanced methods to create biofuels.

My work on nanomaterial interaction with the living cell, which determines eventually the impact on human health, will enable the application of nanotechnology when we know how to do it safe. In the same line of thought, CISA can be used to study how a microorganism can help in sequestration of CO₂ or can help in production or opening new avenues for new energy sources.