

New liquid chromatography and mass spectrometer opens research doors for local students

BY ALFRED HU
PHOTOS COURTESY OF ASDRP

Aspiring Scholars Direct Research Program (ASDRP) is a non-profit organization in Fremont that provides opportunities for high school students to participate in high level novel scientific research projects. "ASDRP is involved in original scientific research. Not science fair, not simple experiments that one might find in a classroom - we are involved in real R&D... Every year we serve

school researchers, and in 2019, we became the first to provide a Fourier-Transform Infrared (FT-IR) spectrometer."

In August of 2020, ASDRP procured a Liquid Chromatography and Mass Spectrometer, or LCMS, from Pharmout Laboratories, an organization in Fremont that provides bioanalytical technologies to pharmaceutical and bioresearch companies. Spectrometers are used in many fields and vary in scope, mechanism and information they reveal

mass spectrometer where the molecules are converted into ions (negative or positive charged particles caused by adding or removing an electron). The mass-to-charge

At ASDRP, students are working on several noteworthy projects with the LCMS. One is synthesizing novel inhibitors of the L-Cathepsin enzyme, which is used by the Covid-19 virus to enter a host cell.

ratio of these ions is analyzed and they are separated according to their mass-to-charge ratios (for example by accelerating them and deflecting them through an electric or magnetic field) and used to identify compounds in a mixture or to characterize new compounds to be produced.

This LCMS cost over \$200,000 and is a thermo scientific LTQ-XL mass spectrometer outfitted with a Thermo Surveyor UV detector and high-performance liquid chromatography (HPLC) with a computer-controlled autosampler. "The instrument is the first of its kind for high schoolers, and to our knowledge, this is the only LCMS in the world that is dedicated for high schoolers. It is of the same specification as what one might find in a large university or pharma/biotech company," ASDRP leadership said. "It is a lot of fun to bring state-of-the-art scientific research to the hands of high schoolers."

The instrument can be used by synthetic chemists for small molecule characterization, biologists for biomarker discovery and bioanalytical experiments, and biochemists for analysis of metabolites or for drug delivery/release research. The LCMS can also be applied to environmental monitoring such as in pollution control, food processing and even the cosmetics industry. One important use of the mass spectrometer, especially during the Covid-19 pandemic, is its application in bioaerosol detection. A single bioaerosol particle is blasted apart with a laser and the molecular fragments are immediately analyzed to determine particles' molecular composition and thus facilitate virus detection.

At ASDRP, students are working on several noteworthy projects with the LCMS. One is synthesizing novel inhibitors of the L-Cathepsin enzyme, which is used by the Covid-19 virus to enter a host cell. The LCMS is used to see whether or not the inhibitors are binding to the target protein and thus preventing the virus from entering. "The LCMS offers a way for us to understand how our inhibitors bind to the L-Cathepsin enzyme, which is very important as that determines whether or not this binding is reversible or not. We want our compound to irreversibly bind to the L-Cathepsin enzyme," one student said.

Other projects include working on inhibitors to fight the HIV virus and synthesizing analogs of the antibiotic penicillin. "We plan to make different analogs that could potentially work better than penicillin itself. The LCMS will help us with characterization of our molecules and making sure that we have the right molecules before we test them on different strains of bacteria," another student said. Students find motivation on working in a friendly atmosphere on real life projects with state-of-the-art advanced tools, as ASDRP allows them to experiment with different technologies and helps them pursue their interests in their future careers as researchers.

One student stated, "In the future, I hope to continue conducting research in the field of organic chemistry which would involve many different instruments including the LCMS in order to characterize molecules. Since in the future, synthetic routes may be longer and more complicated, the LCMS can serve to characterize intermediate products in the synthetic pathway. As a result, by having the chance to work with the LCMS in high school, I am equipped with the knowledge about how the instrument works, how to prep samples, and how to analyze spectra earlier on, preparing me for a career involving research."

Learn more about ASDRP at:
www.asdrp.org

hundreds of research students, some of whom come from underprivileged or underrepresented backgrounds," says a representative from ASDRP.

To make these opportunities possible, ASDRP provides students with research mentors and \$2M worth of sophisticated research equipment for use in research laboratories. "In 2018, we became the first research institution to bring a nuclear magnetic resonance (NMR) spectrometer [Nanalysis NMRReady 60MHz] to our high

Spectrometers are used in many fields and vary in scope, mechanism and information they reveal about a sample or phenomenon. They can be used in astronomy to measure radiation and can use magnetic fields to study the structure of a molecule.

about a sample or phenomenon. They can be used in astronomy to measure radiation and can use magnetic fields to study the structure of a molecule.

An LCMS separates a liquid mixture into components and transfers them to the

