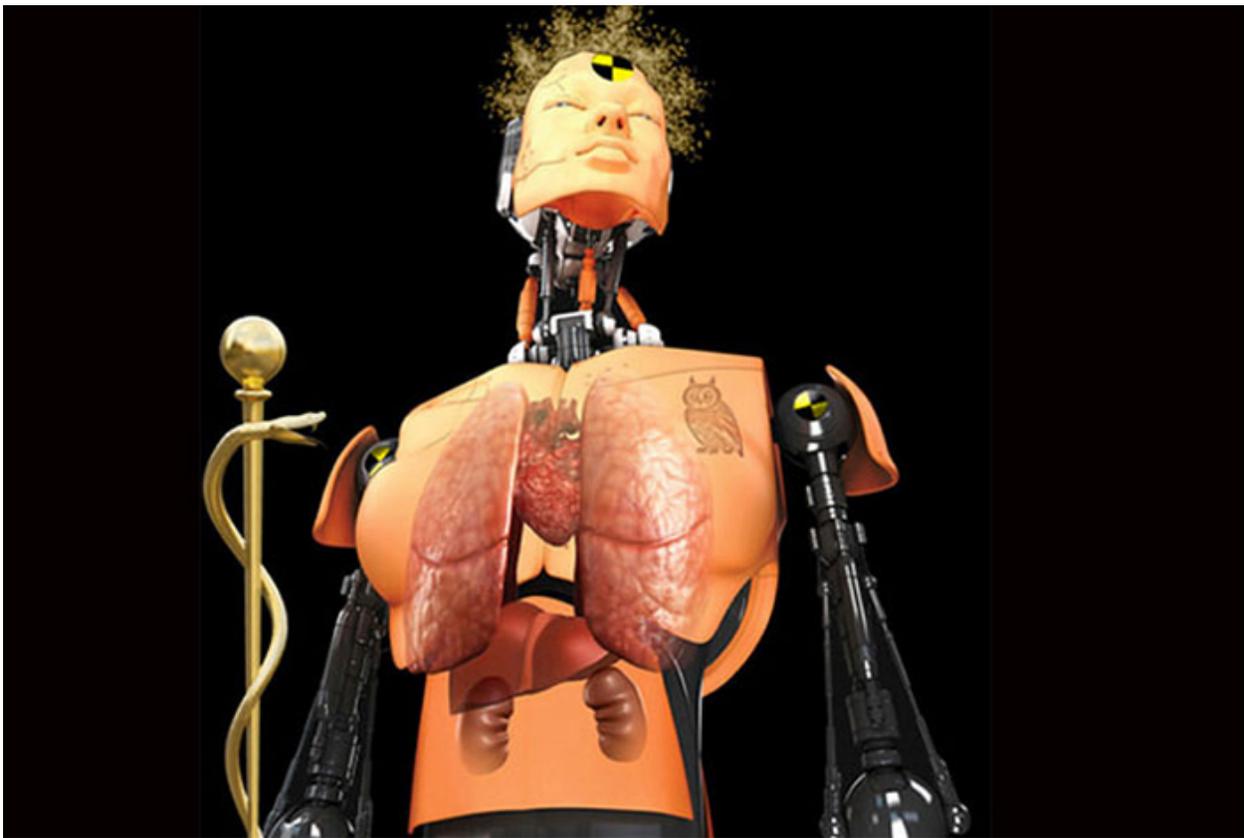


World eyes ATHENA Project as medical students transition to studying surrogate organs

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The ATHENA team, led by scientist Rashi Iyer, is building a lung that breathes, a heart that pumps, a liver that metabolizes and a kidney that excretes, right here in Los Alamos. The constructed organs will be connected by a tubing infrastructure similar to the human blood vessel system. Each organ component will be about the size of a smartphone screen, and the whole ATHENA “body” of interconnected organs would fit neatly on a desk. The team has demonstrated successful integration of the liver organ construct into the ATHENA system, which replicates how the body delivers blood to its smallest blood vessels, the capillaries. The researchers next plan to connect the liver and the heart, followed by the lung and finally the kidney.

This miniaturized human model for testing pharmaceuticals and toxic materials may seem futuristic and impossible. However, finding alternatives to toxicity testing on animals and studying anatomy with cadavers has never been more important as

scientists continue to raise questions about the effectiveness of animal response to drugs, and cadavers are in ever-increasing short supply.

Possibly even more important is the opportunity to screen new drugs quickly and efficiently and get them to market in a short amount of time. “By creating a holistic dynamic system that more realistically mimics the human physiological environment than static human cells in a dish, we can understand chemical effects on human organs as never before,” Iyer said.

In addition to successfully shrinking the organ platform, collaborators from Vanderbilt University have introduced another important innovation in the form of a highly specialized instrument called an ion mobility-mass spectrometer, which can simultaneously detect and identify different biological molecules. The spectrometer represents an unprecedented ability to interrogate the system and obtain valuable data.

With this ion mobility-mass spectrometer, the ATHENA team has been able to monitor the liver cells’ response to different dosages of a well-known liver toxin: the drug acetaminophen.

“We could actually see what the acetaminophen is doing to the liver cells,” said John Wikswa, director of the Vanderbilt Institute for Integrative Biosystems Research and Education (VIIBRE) at Vanderbilt University. “In the beginning, we saw an increase in the drug and its metabolites. Then, over the next 24 hours, we recorded a steady increase in tryptophan as acetaminophen began to interfere with normal liver metabolism. After that, we saw decreased production of bile acid, a clear indication that something was going very wrong with the liver, as expected when exposed to seriously high doses of acetaminophen, and a decreased ability to detoxify penicillin.”

According to Iyer, this rich level of detail confirms that the ATHENA organ platform, coupled with mass spectrometry technology, can provide a more sensitive and effective method for screening both new drugs and toxic agents than is available today.

The ATHENA project is funded by the Defense Threat Reduction Agency (DTRA) and represents a five-year, \$19 million multi-institutional effort. Lead scientist Iyer is directing work on the lung and kidney organs, as well as integration and validation of the organs in the perfusion platform—all of which will be executed at Los Alamos National Laboratory. The Laboratory, in collaboration with CFD Research Corporation (a technology company based in Huntsville, Alabama), will develop a blood mimic to sustain the four devices.

The Laboratory is advancing global knowledge of pharmaceutical testing—research that has infinite applications—with the science currently being conducted right here in Los Alamos.

Related Resources:

- [Surrogate Organ Developed for Toxicity Testing](#)

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