Predicting nanoparticle interactions in the body

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Researchers at North Carolina State University have developed a method for predicting the ways that nanoparticles will interact with biological systems - including the human body. Their work could have implications for improved human and environmental safety in the handling of nanomaterials, as well as applications for drug delivery.

Jim Riviere, Nancy Monteiro-Riviere, and Xin-Rui Xia were the three senior investigators who conducted this work. The trio published the results of their study in the journal *Nature Nanotechnology*. The goal of their work was to create a method for the biological characterization of nanoparticles -- a screening tool that would allow other scientists to see how various nanoparticles might react when inside the body.

"We wanted to find a good, biologically relevant way to determine how nanomaterials react with cells," Dr. Riviere explained. "When a nanomaterial enters the human body, it immediately binds to various proteins and amino acids. The molecules a particle binds with will determine where it will go." This binding process also affects the particle's behavior inside the body. For example, the amino acids and proteins that coat a nanoparticle change its shape and surface properties, potentially enhancing or reducing characteristics like toxicity or, in medical applications, the particle's ability to deliver drugs to targeted cells.

To create their screening tool, the team utilized a series of chemicals to probe the surfaces of various nanoparticles, using techniques previously

developed by Dr. Xia. A nanoparticle's size and surface characteristics determine the kinds of materials with which it will bond. Once the size and surface characteristics are known, the researchers can then create "fingerprints" that identify the ways that a particular particle will interact with biological molecules. These fingerprints allow them to predict how that nanoparticle might behave once inside the body.

"This information will allow us to predict where a particular nanomaterial will end up in the human body, and whether or not it will be taken up by certain cells," Riviere adds. "That in turn will give us a better idea of which nanoparticles may be useful for drug delivery, and which ones may be hazardous to humans or the environment."

This work is detailed in a paper titled, "An index for characterization of nanomaterials in biological systems" An abstract of this paper is available at the journal's Web site.

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