# Understanding Interactions of Engineered Nanomaterials with the Immune System

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Engineered nanoparticles may affect the innate or adaptive immune system; such interactions, in turn, could result in adverse outcomes or could potentially be exploited for therapeutic gain. The recognition or non-recognition of engineered nanomaterials by immune-competent cells may determine not only the toxic potential of such materials but also their biodistribution. However, understanding the physico-chemical properties that drive cellular interactions of nanoparticles remains a key challenge. Needless to say, particular attention should be paid to novel, adverse properties arising as a consequence of the nano-scale size. For instance, nanoparticles may escape immune surveillance and translocate to distal sites following entry into the body. In addition to particle size, other aspects including particle shape, and surface charge, may also play an important role for immune recognition and subsequent handling of nanomaterials.

When human subjects are deliberately exposed to engineered nanomaterials, for diagnostic or therapeutic purposes (or both), it becomes critically important to determine the ultimate fate of the nanoparticles: are engineered nanomaterials excreted from the body, or biodegraded by cells of the immune system, or do they bioaccumulate, thereby leading to potentially harmful long-term effects? The surface of nanoparticles can be modified using targeting moieties, etc but as these particles enter into a biological system, for instance via inhalation or injection into the bloodstream, it is likely that the surface of the particles is covered with biomolecules – proteins and lipids – that modify the properties of the nanoparticles and the way in which the particles interact with cells, including immune-competent cells. Moreover, the binding of proteins to nanoparticles may also induce modifications of the proteins. Understanding such nano-bio-interactions is critical for the safe application of nanoparticles in medicine.

## Further reading

[1] Fadeel B, Garcia-Bennett AE. Better safe than sorry: understanding the toxicological properties of inorganic nanoparticles manufactured for biomedical applications. Adv Drug Deliv Rev. 2010;62:362-74.

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[3] Shvedova AA, Kagan VE, Fadeel B. Close encounters of the small kind: adverse effects of man-made materials interfacing with the nano-cosmos of biological systems. Annu Rev Pharmacol Toxicol. 2010;50:63-88.