roadmap' has been proposed by Donald Tomalia[2] and the International Standards Organization[3] is also working on a nomenclature system. Current naming methods are too simple and do not identify the physical and chemical properties of the nanomaterials. We have proposed an alphanumeric code to express a few of the nanomaterial's properties as a non-bias way to compare biological data[4]. This code represents the chemical class, size and shape, core chemistry, ligand chemistry, and solubility of a nanomaterial, but these parameters could be easily adjusted. To compare biological data from different laboratories, all nanomaterials that undergo biological examination should be characterized on the basis of how the nomenclature code is defined.

Beyond the nomenclature system, mapping the physical and chemical properties of nanomaterials to biological responses is complex and most studies capture only a snapshot of an interaction. The simplest study involves a cell, a biological environment and nanoparticles. Because each of these components is dynamic, they are similar to moving targets. For example, cells could be in different mitotic states or spread differently; the media and/or serum compositions change constantly; and the size, shape, aggregation and surface chemistry of nanomaterials may also vary during the experiment. Trying to establish a correlation between these three parameters is difficult because minor changes in each parameter can lead to a different outcome. Because the details of many studies are not reported, or the properties of the materials and/or biological system are not characterized, or are not a principal focus in the published manuscript, the outcomes may appear to be different between studies but in reality, each researcher may be capturing a different aspect of a similar interaction. The devil is in the detail and sometimes these details are lost in the published study.

As a next step, the nanotechnology research community must agree on a nomenclature system that is descriptive of the nanomaterial property, and agree on standardized protocols for measuring biological responses *in vitro* and *in vivo*. A database repository should be created so researchers can organize the biological data within a nomenclature system, analyse and compare the results from different laboratories. Like the genomics, proteomics and crystallography communities that went through a period of data accumulation for the creation of large datasets, the nanotoxicology community should do the same. It is when large amounts of data are accumulated that we can start to map network interactions and draw conclusions. ❐

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Leave the policing to others

To the Editor — The current interest in ensuring that nanomaterials are characterized and reported on more completely (Editorial, *Nature Nanotech.* **7,** 545; 2012) is a most welcome sign of the development of the field. In a number of applications, there is also a growing awareness of the need to synthesize and ultimately manufacture nanomaterials in a more reproducible way for nanotechnology to deliver its potential. Furthermore, after some early uncertainty, the nanosafety community is now increasingly mobilized to improve the quality of reporting of studies related to the impact of nanomaterials on living organisms and the environment. These most important efforts are being supported by a number of specialized journals, as well as international programmes (for example, the Organisation for Economic Co-operation and Development, the European Union NanoSafety Cluster and others).

However, in my opinion, the field has a critical need for other types of support. This new and exciting arena of science is still in its early days and we are still discovering the paradigms that govern the interactions of nanomaterials with living organisms and the environment. It is primarily in this arena of uncovering the principles that *Nature Nanotechnology* can and should contribute. There is little doubt that authors in this journal will wish to maintain the highest standards of reporting. The fact that radically new findings can emerge means that the authors themselves will often best understand the most appropriate aspects of characterization for their work. *Nature Nanotechnology* is recognized in the broader domain of scientific discovery, and its readership and impact are key assets to the whole community in promoting this emerging area of science. Indeed, as suggested in your Editorial a number of common parameters should be included in all papers (although as we learn more they may continue to evolve) but the choice of some key characterization parameters will have to be based on their particular relevance to the study itself. ❐

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Standardizing data

To the Editor — To rationally design nanomaterials with improved efficacy and safety it is critical to understand and exploit the physicochemical properties that cause a biological response[1]. Data mining and computer simulation are important for deriving information about the behaviour of nanomaterials, but the datasets needed to support such studies are sparse and stored across a variety of repositories and resources. The need for more coherence and structure in the conduct of nanotechnology research has been suggested before[2] and was highlighted in your recent Editorial[3]. However, the lack of common reporting standards and non-

uniformity of information reported are also significant barriers to data sharing and re-use. The Nanotechnology Working Group (Nano WG) of the US National Institutes of Health National Cancer Informatics Program has been focused on addressing these issues.

The Nano WG — which includes representatives from over 20 organizations including government agencies, academia, industry, standards organizations and alliances — has developed 'ISA-TAB-Nano'[4,5], a general framework for representing and integrating diverse types of data related to the description and characterization of nanomaterials using spreadsheet or TAB-delimited files. Nanoparticle characterization studies have many of the same challenges as omics-based (metabolomics, genomics and functional genomics, for example) assays such as high data volume and variety, multiple experimental end points, and complex protocols and study samples. Therefore, ISA-TAB-Nano is based on the 'ISA-TAB' format developed and used by the ISA Commons[6] to share datasets in a diverse set of life sciences and in particular omics data. The ISA-TAB-Nano extension uses the three primary files of ISA-TAB — investigation, study and assay (ISA) files — as well as an additional file called the material file.

Delivering a community-driven specification for nanotechnology data is only the first phase of the process. To be useful, ISA-TAB-Nano must be implemented in tools and by databases to assist researchers in reporting their data while shielding them from unnecessary complexity. Our next step is to extend the open source ISA software suite to provide user-oriented tools for the collection, curation and storage of data that is compliant with the ISA-TAB-Nano specification. Future work will also focus on using the ISA-TAB-Nano format to support emerging standards in the characterization of nanomaterials in biological research[7,8]. ISA-TAB-Nano development is a community-driven effort and we welcome new contributions, collaborations and expertise. ❐

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