Hot Topic Discussion

The Data Quality Dialogue in Nano-Bio Research

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nature nanotechnology

PERSPECTIVE

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Minimum information reporting in bio–nano experimental literature

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Studying the interactions between nanoengineered materials and biological systems plays a vital role in the development of biological applications of nanotechnology and the improvement of our fundamental understanding of the bio–nano interface. A significant barrier to progress in this multidisciplinary area is the variability of published literature with regards to characterizations performed and experimental details reported. Here, we suggest a 'minimum information standard' for experimental literature investigating bio–nano interactions. This standard consists of specific components to be reported, divided into three categories: material characterization, biological characterization and details of experimental protocols. Our intention is for these proposed standards to improve reproducibility, increase quantitative comparisons of bio–nano materials, and facilitate meta analyses and in silico modelling.

Source: Faria, M., et al. Nature Nanotechnology (2018)

An Important Dialogue

MENU

nature nanotechnology

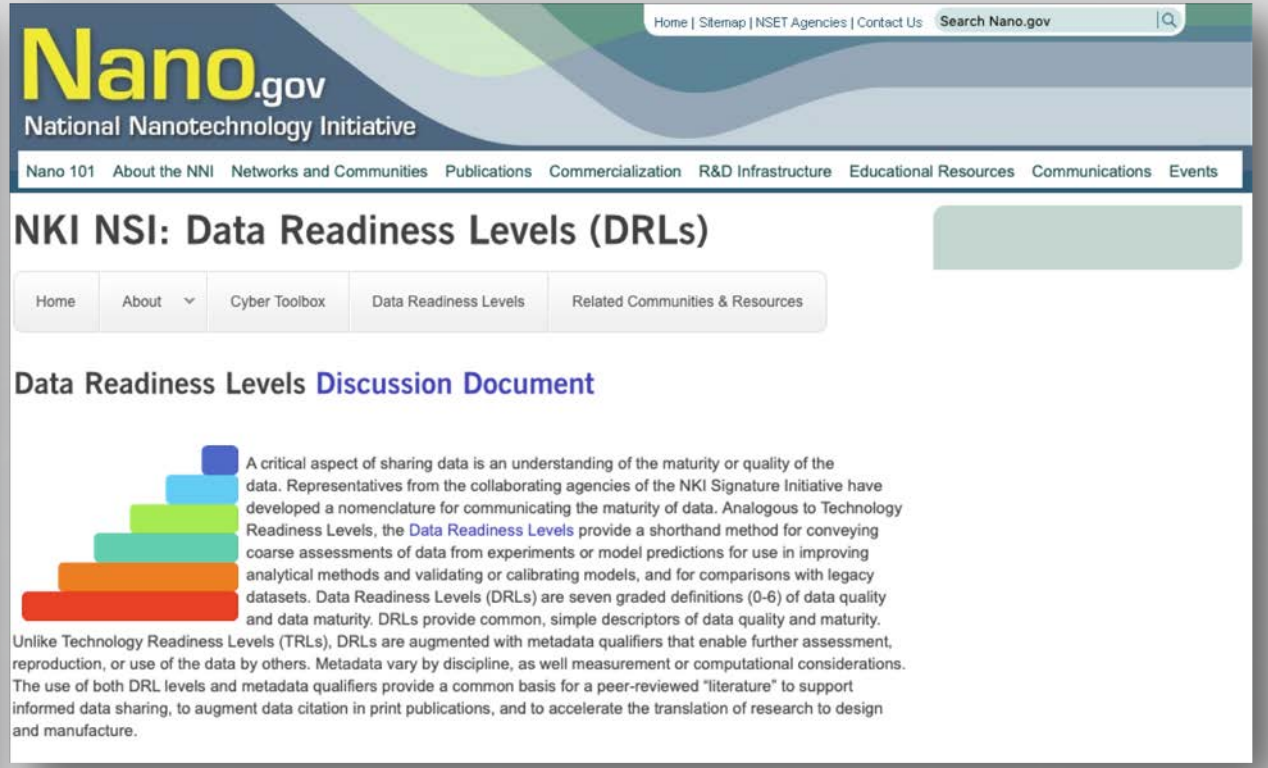
Editorial | Published: 19 August 2012

Join the dialogue

Nature Nanotechnology **7**, 545 (2012) | Download Citation

The nanotoxicology community should implement guidelines on the types of information that are required in their research articles to improve the quality and relevance of the published papers.

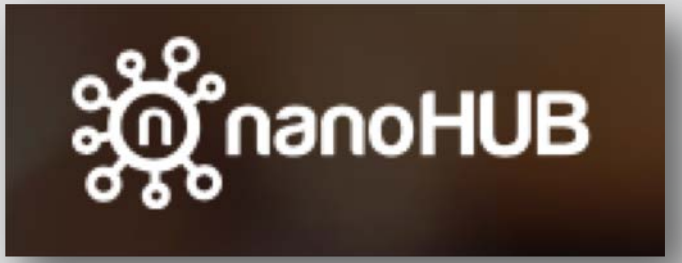
In the past decade, the number of published papers in the field of nanotoxicology — the study of the toxicity, and environmental, health and safety issues of nanomaterials — has grown by nearly 600% (ref. 1). Most of these papers report *in vitro* studies that examine the toxicity of various nanomaterials. The studies are performed by delivering a certain amount of nanomaterial onto cells growing at the bottom of a culture plate and measuring how they respond. So much seems to have been done — using different model systems and nanomaterials — and yet, there are grumbles throughout the literature about the slow progress[2], misconceptions in and of the field[3], and proposals on what the community needs to do as a whole for the field to progress faster[4]. One thing is at least clear for now: few studies offer consistent results that are of value, and it is difficult to compare studies because they are often carried out using poorly characterized nanomaterials and arbitrary experimental conditions.



Sources: Nature Nanotechnology (2012) & the National Nanotechnology Initiative

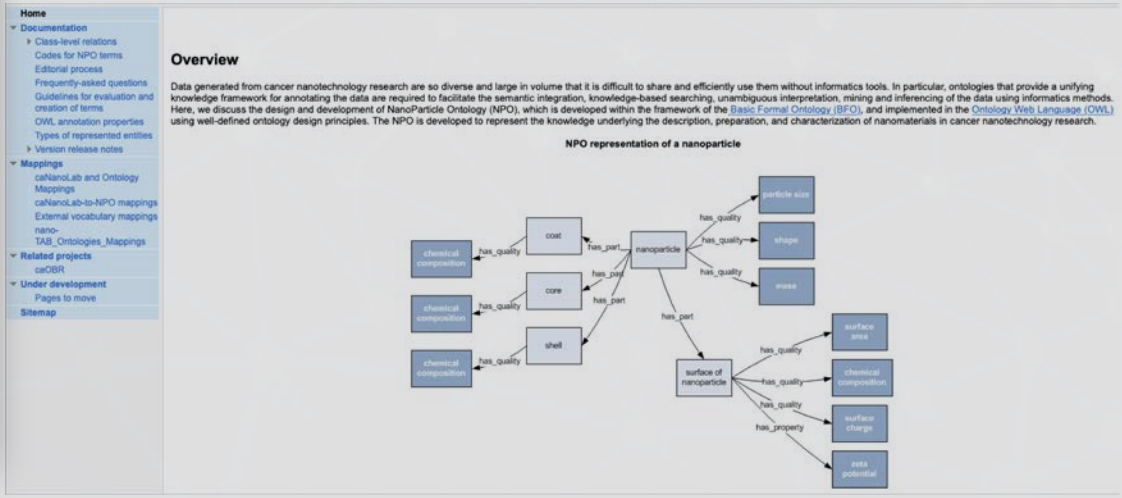
Creating a Toolbox for Nano Data

caNanoLab portal at NIH



Nanomaterial Registry

Nanoparticle Ontology for Cancer Nano Research

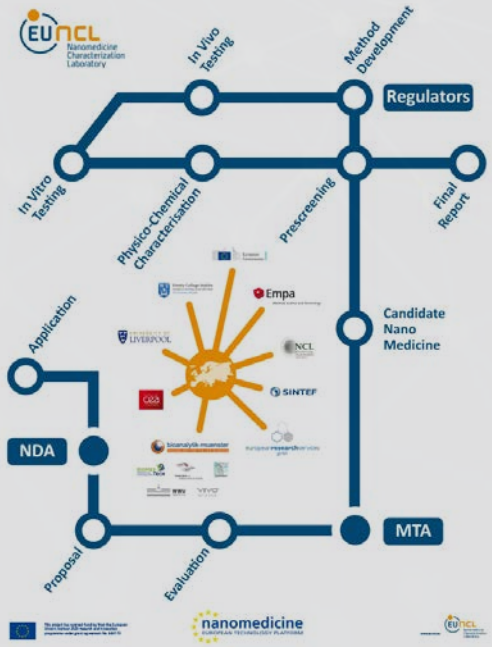


Sources:
https://cananolab.nci.nih.gov/caNanoLab/#/, https://www.nanomaterialregistry.org
http://www.nano-ontology.org, http://nanoparticlelibrary.net, and http://nanohub.org

Efforts to Support Translation

NCL
Nanotechnology
Characterization
Laboratory

EUNCL
Nanomedicine
Characterisation
Laboratory

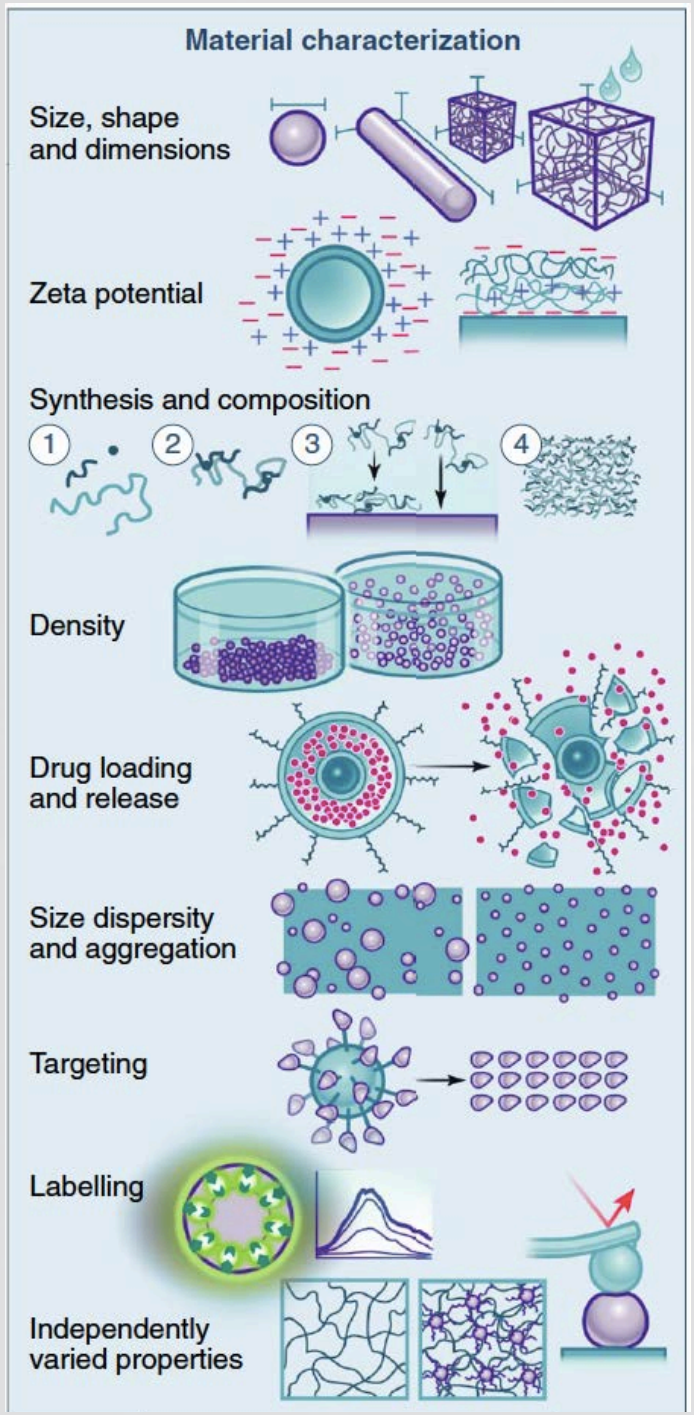


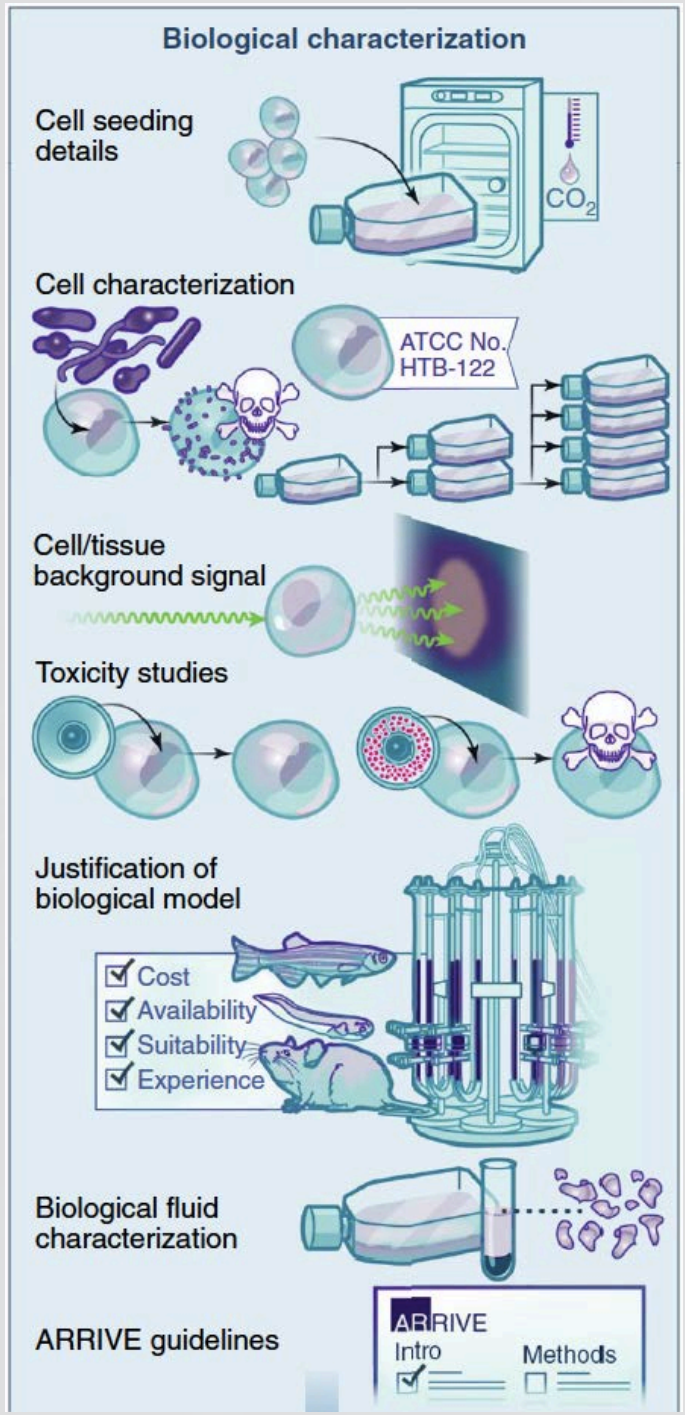
Sources:
https://ncl.cancer.gov and http://www.euncl.eu

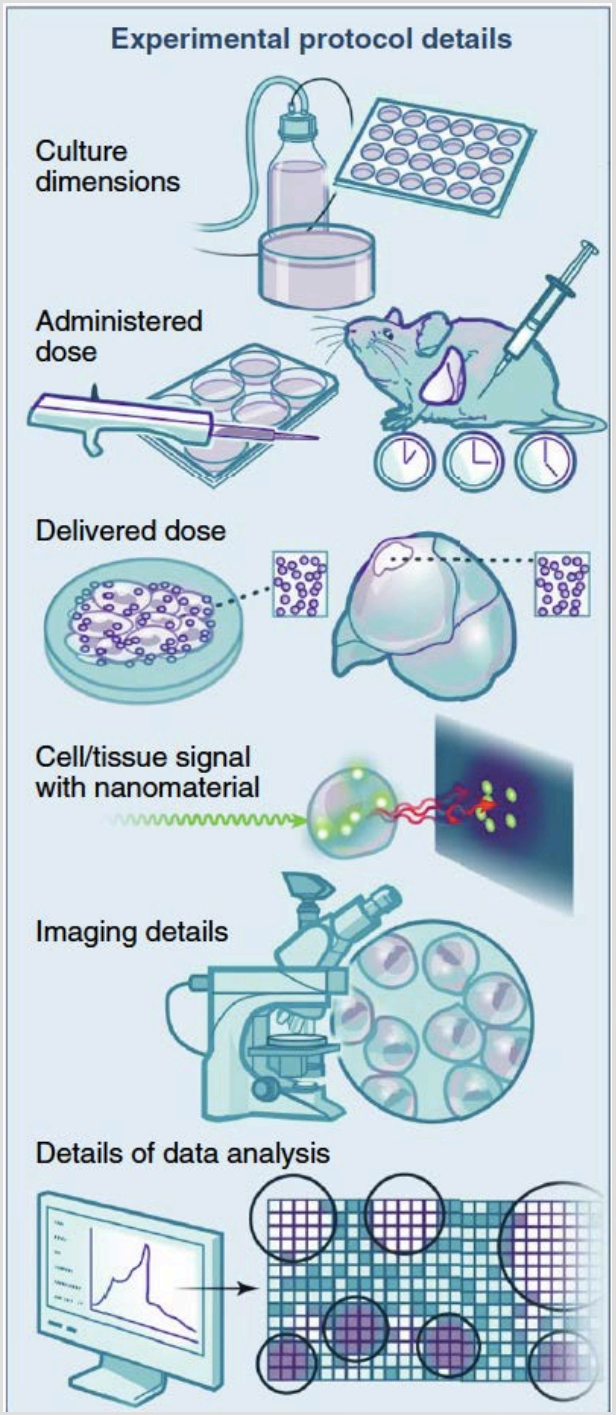
Minimum Information Reporting In Bio-nano Experimental Literature (MIRIBEL)

- Minimum information reporting in **three** categories: **material** characterization, **biological** characterization, and details of **experimental protocols**.
- Development of MIRIBEL guided by:
  - Reusability (compare new data with previous results)
  - Quantification (quantify/benchmarked assessment of results)
  - Practicality (proposed parameters in MIRIBEL are accessible to the majority of researchers)
  - Quality (reproducibility/reliability of data)

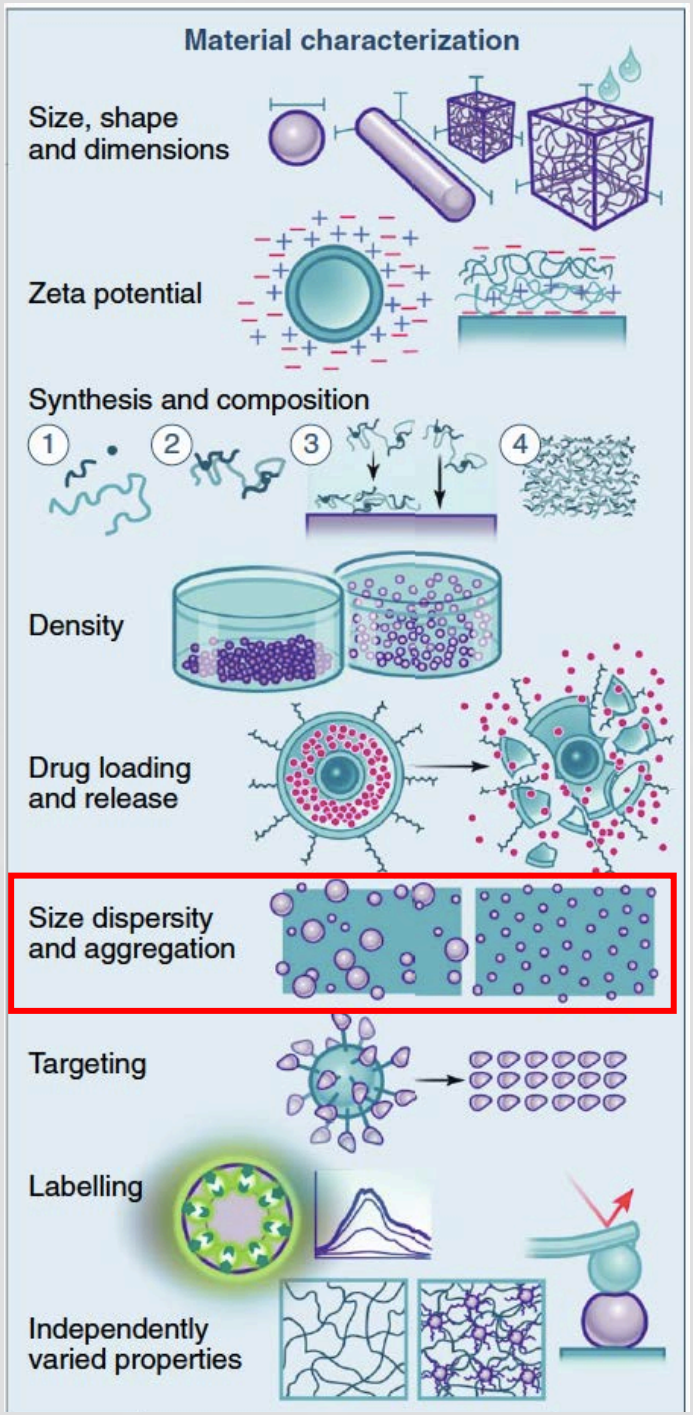
Source: Faria, M., et al. Nature Nanotechnology (2018)

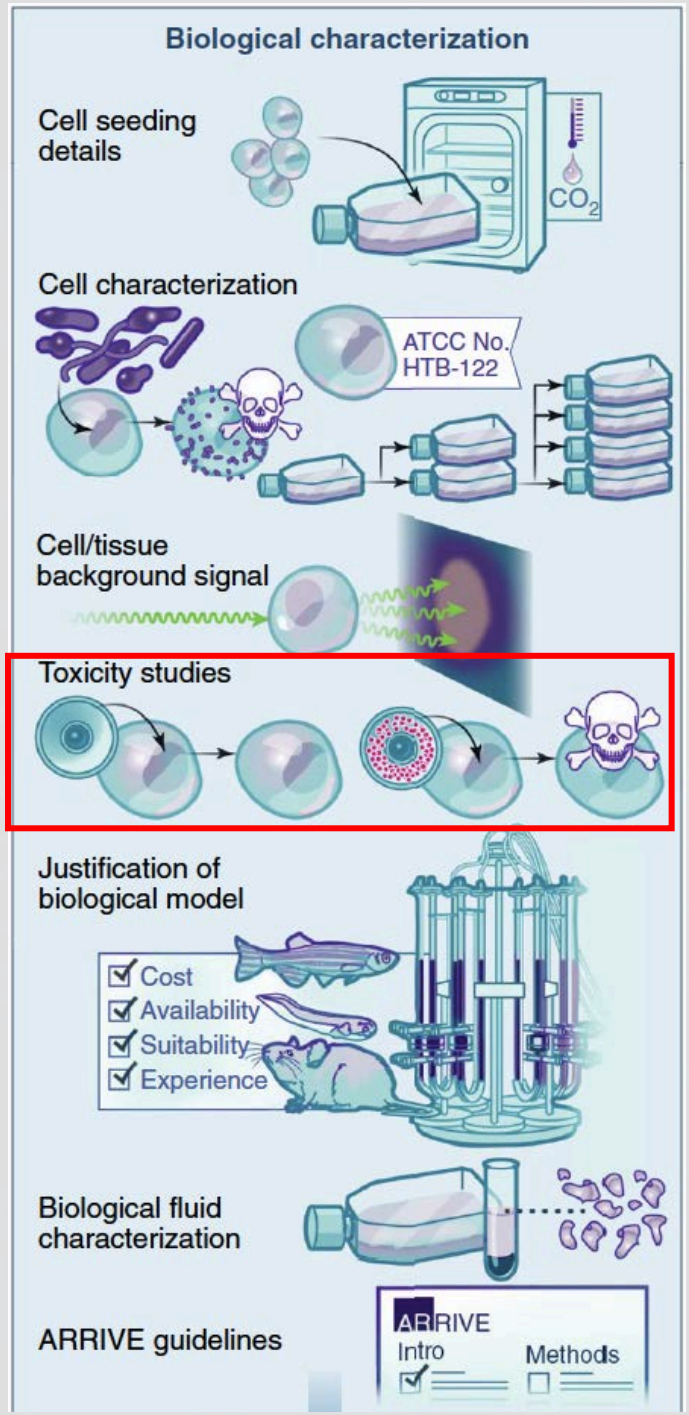


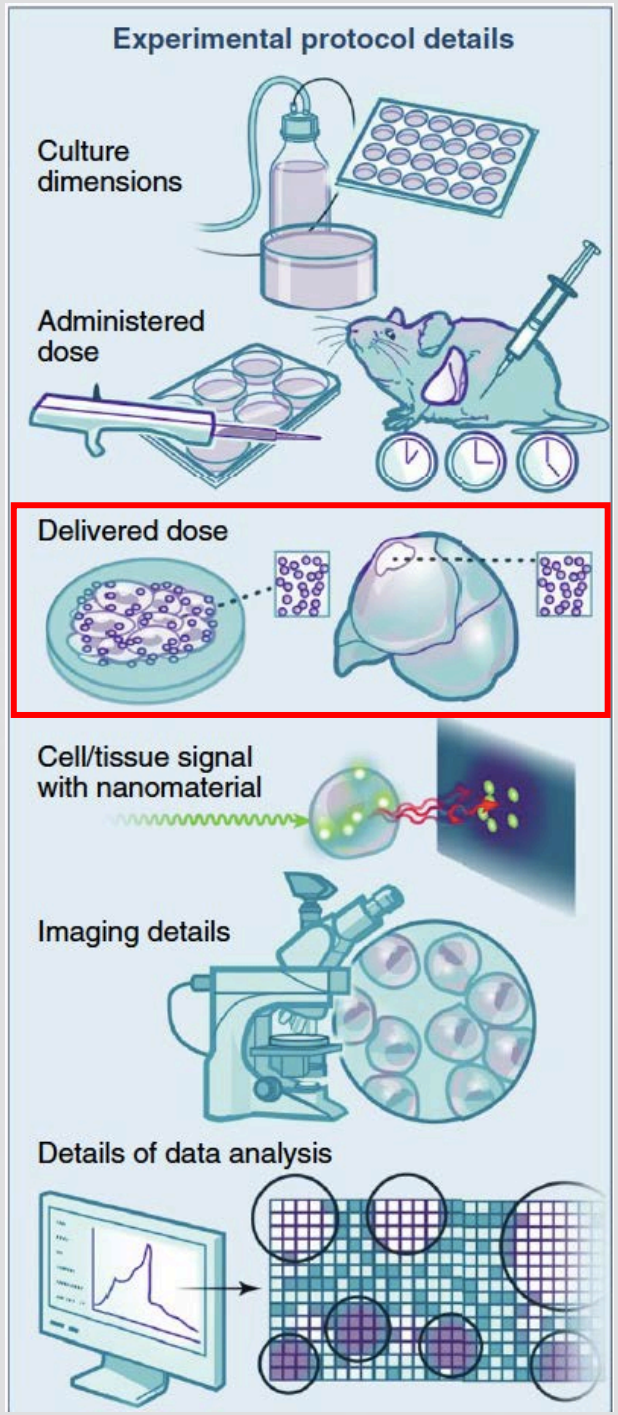




Source: Faria, M., et al. Nature Nanotechnology (2018)







Source: Faria, M., et al. Nature Nanotechnology (2018)

A Checklist for Life Sciences Articles

- In Jan 2015, Nature introduced a checklist to improve transparency in data reporting.
- Nature sent surveys to 5,375 researchers who had published in a Nature journal between July 2016 and March 2017.
- Of the 480 who responded, 49% thought that the checklist had improved the quality of research published in Nature (15% disagreed); 37% thought the checklist had improved quality in their field overall (20% disagreed).

editorial

Joining the reproducibility initiative

We are introducing a checklist for life sciences articles starting in January 2015 in order to improve transparency in reporting.

In April 2013, *Nature* announced new editorial measures to improve the consistency, transparency and quality of reporting in life sciences articles[1]. These measures, which are now implemented in all of our sister life sciences journals, include removing length restrictions in the methods section to ensure key methodological details are reported, examining statistics more closely and encouraging deposition of data in public repositories. Key to this initiative is a checklist[2], which serves to prompt authors to disclose in their submissions all the information necessary for others to reproduce the work, and to guide referees to consider these issues during peer review. Importantly, many journals, including ours, are now united in this drive to improve reproducibility[3].

We welcome working with communities to create customized checklists as appropriate.

Beginning in January 2015, we will start asking authors of all life sciences submissions that are sent out for peer review to complete relevant portions of the same checklist (available at http://www.nature.com/authors/policies/checklist.pdf), and will make the document available to referees during review. On acceptance of the paper, editors will work with authors to ensure all the key methods-related information is indeed contained in the final manuscript. To this end, like other participating journals, we will relax our word limits in the methods section as necessary to accommodate all the essential details.

The checklist is not exhaustive (and not meant to be onerous). It is intended to ensure good reporting by reminding authors to describe in sufficient detail the important experimental designs and methods that are often reported incompletely but are crucial for others to interpret and replicate the work. For example, authors are required to report parameters such as sample size, number and type of replicates, standards or reference used, definition and justification of statistical methods, precise characterization and description of key reagents and materials used and their potential variability, and what criteria were used to include or exclude any data. To improve statistical robustness of papers, we will ask the same pool of consultant statisticians used by our sister journals to examine certain papers, at the editor's discretion and referees' suggestion.

There is of course no single way to run an experiment. Exploratory research, for example, might not always be done with the same statistical rigour as hypothesis-testing studies, and not all laboratories may have the means to perform the level of validation required. There is, however, no good reason for not reporting in full how a study was designed, conducted and analysed. We appreciate that some communities might find a checklist containing requirements specifically relevant to their field to be more useful, and we welcome working with these communities to create customized checklists as appropriate.

The checklist also includes a section on data deposition, which consolidates our existing policies on the availability of data and materials, aimed at increasing transparency[2]. Under these policies authors are "required to make materials, data and associated protocols promptly available to others without undue qualifications" as a condition for publication. We will prompt authors to deposit datasets in community-endorsed public repositories, and to provide the raw data in tabular format for figures and graphs presented in the paper. These source data will be made available for readers who are interested. To enhance reusability of datasets deposited in public repositories, authors can publish data descriptors in metadata journals such as *Scientific Data* (which is a part of Nature Publishing Group). Publishing such metadata, which describe how the data are collected and formatted, facilitates the discovery, reuse, linking and mining of the data. Furthermore, we will encourage authors to use open resources such as Protocol Exchange to share detailed methods and reagent descriptions, which can be linked back to their primary research article.

There is no good reason for not reporting in full how a study was designed, conducted and analysed.

The nanoscience and nanotechnology community does not have a comprehensive public repository dedicated to the field. There are, however, nano-specific options such as the recently developed nanomaterials registry[4] and the cancer nanotechnology laboratory portal[5], which are funded by the US National Institutes of Health, and we will be encouraging authors to deposit data in repositories. We recommend that authors choose repositories that provide expert curation to ensure the data are discoverable and can be linked to the paper (examples include Dryad and Figshare). Over time, it might be valuable for the the nanoscience community to create public repositories for sharing actual nanomaterials.

Tackling these issues is a long-term endeavour and a journey that requires the commitment of all those involved, from funders, institutions and researchers to editors and publishers. Experiences of the new practice at our sister life sciences journals have been positive — editors and referees find the checklist useful. Although there has been a slight delay in manuscript processing times in the initial stages, while authors and referees became more familiar with the requirements, the practice has quickly become routine. By implementing these steps, we hope to further improve the clarity and quality of papers appearing in our journal.

References

1. *Nature* **496**, 398 (2013).
2. http://www.nature.com/authors/policies/availability.html
3. *Nature* **515**, 312 (2014).
4. http://www.nanomaterialregistry.org/Default.aspx
5. https://cancerlab.nci.nih.gov/ca50nocl.ab/

NATURE NANOTECHNOLOGY | VOL 9 | DECEMBER 2014 | www.nature.com/naturenanotechnology 949

Sources: Nature Nanotechnology (2012) & Nature (2018)

What Does the Checklist Look Like?

Discussion Questions

- Question 1: Do you think that the suggested checklist is a valuable tool for the field and, if so, whether it should be modified?

Discussion Questions

- Question 2: What role should journals take in improving data quality?

Discussion Questions

- Question 3: Do you have any personal anecdotes to share related to this issue?

Discussion Questions

- Question 4: Any other thoughts on how to improve participation in these surveys?