



## Going “FAIR”

# Experiences from NanoFASE – NanoCommons TA

**Claus Svendsen, Marianne Matzke and Lee Walker**

**UK-CEH, Wallingford, United Kingdom**

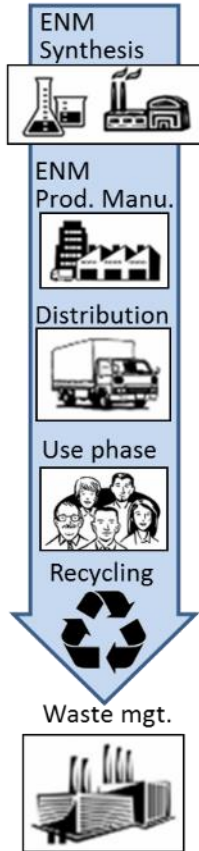
**Iseult Lynch and Anastasios (Tassos) Papadiamantis - University of Birmingham,**

**Christine Hendren, Mark Wiesner - Duke**

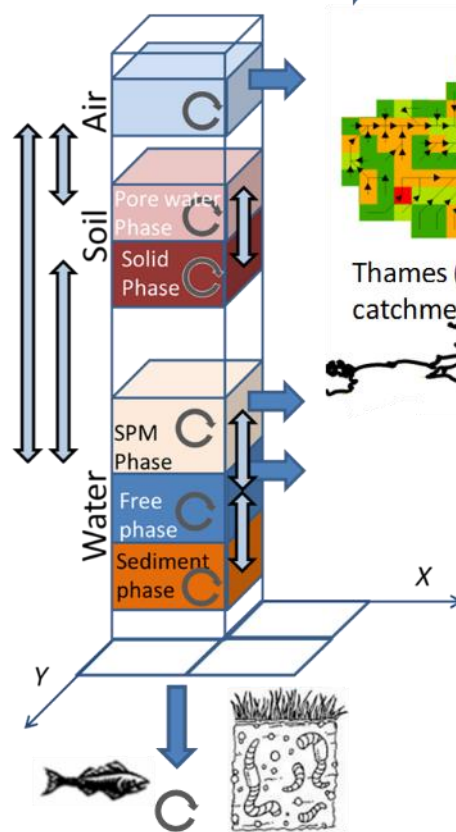
# Exposure assessment (of Nano) in the environment:

## How much is released, and where does **what** go?

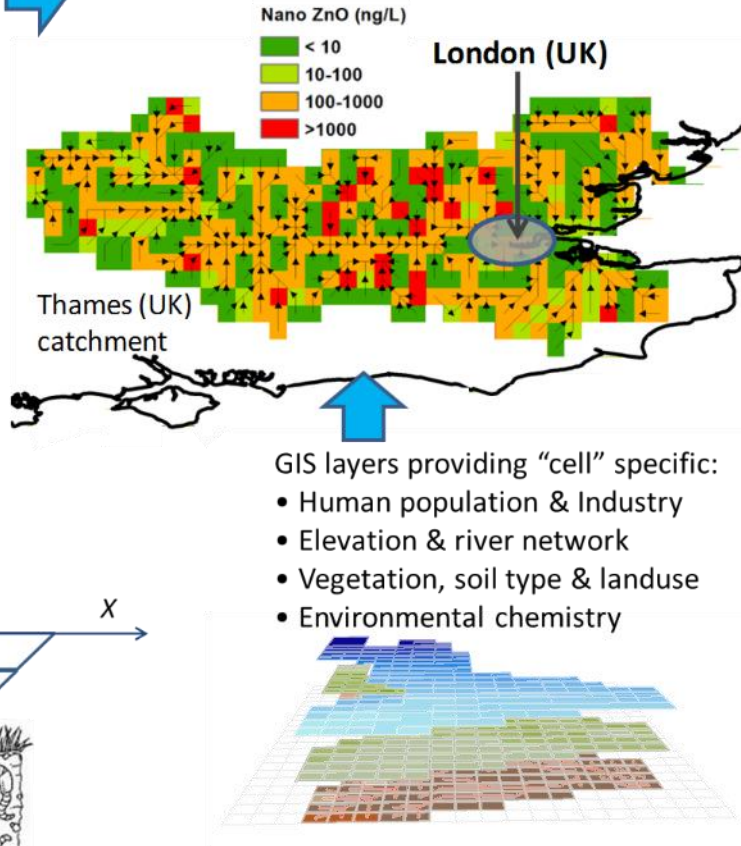
1) ENM enabled  
Product value chains  
& release pathways



2) Environmental  
„cell“  
reactors



3) Object-oriented multimedia fate models  
dynamically connecting “Environmental cells”



## The NanoFASE Approach

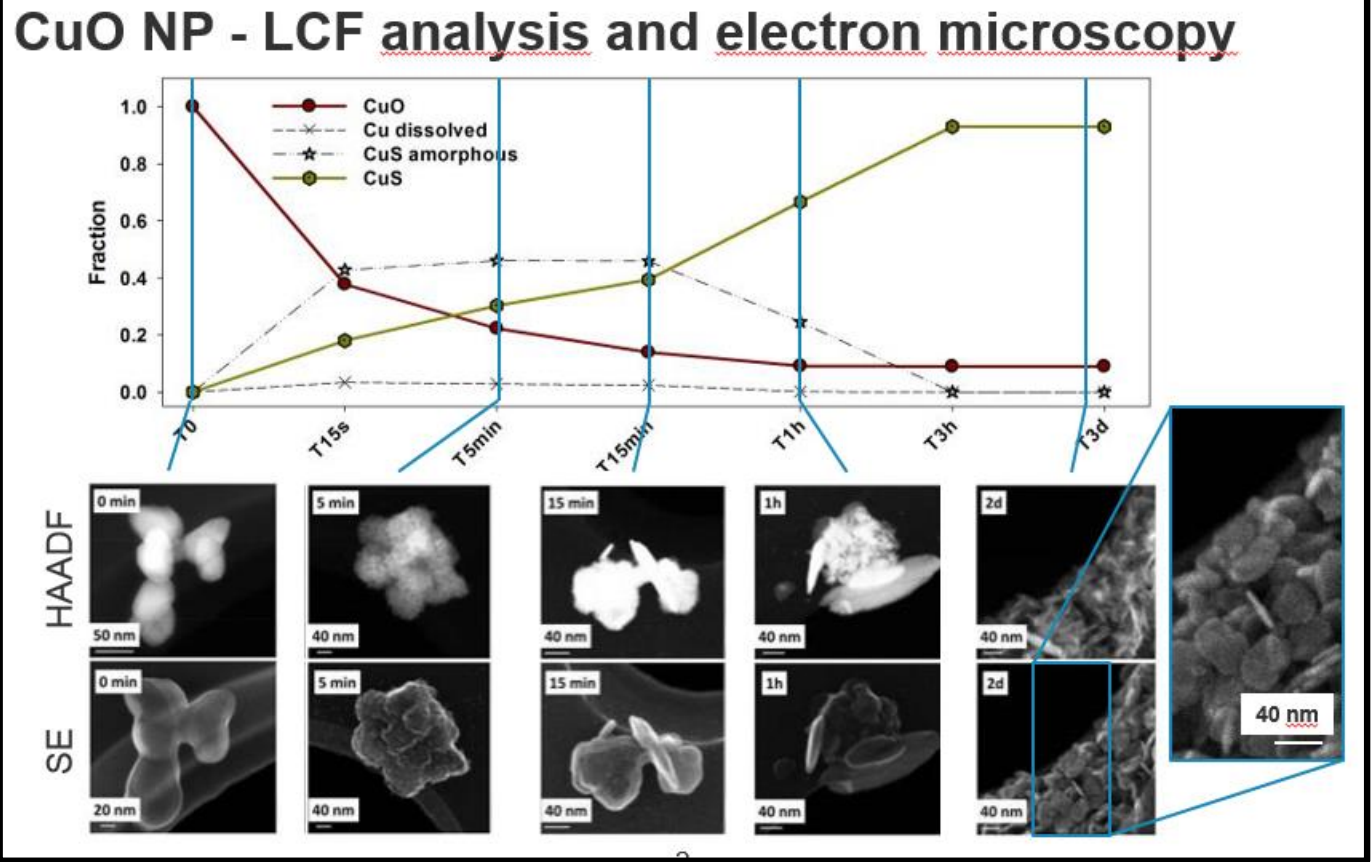
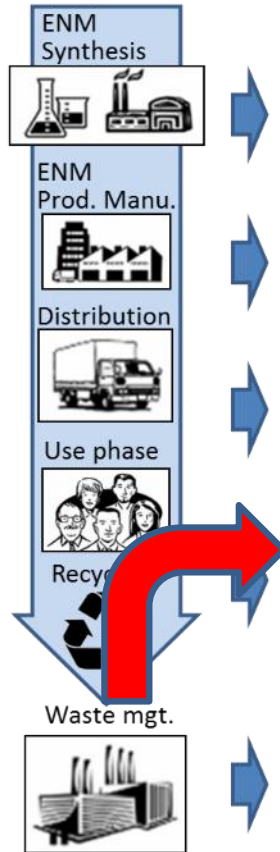
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## How much is released, and where does **what** go?

1) ENM enabled Product value chains & release pathways

2) Environmental „cell“ reactors

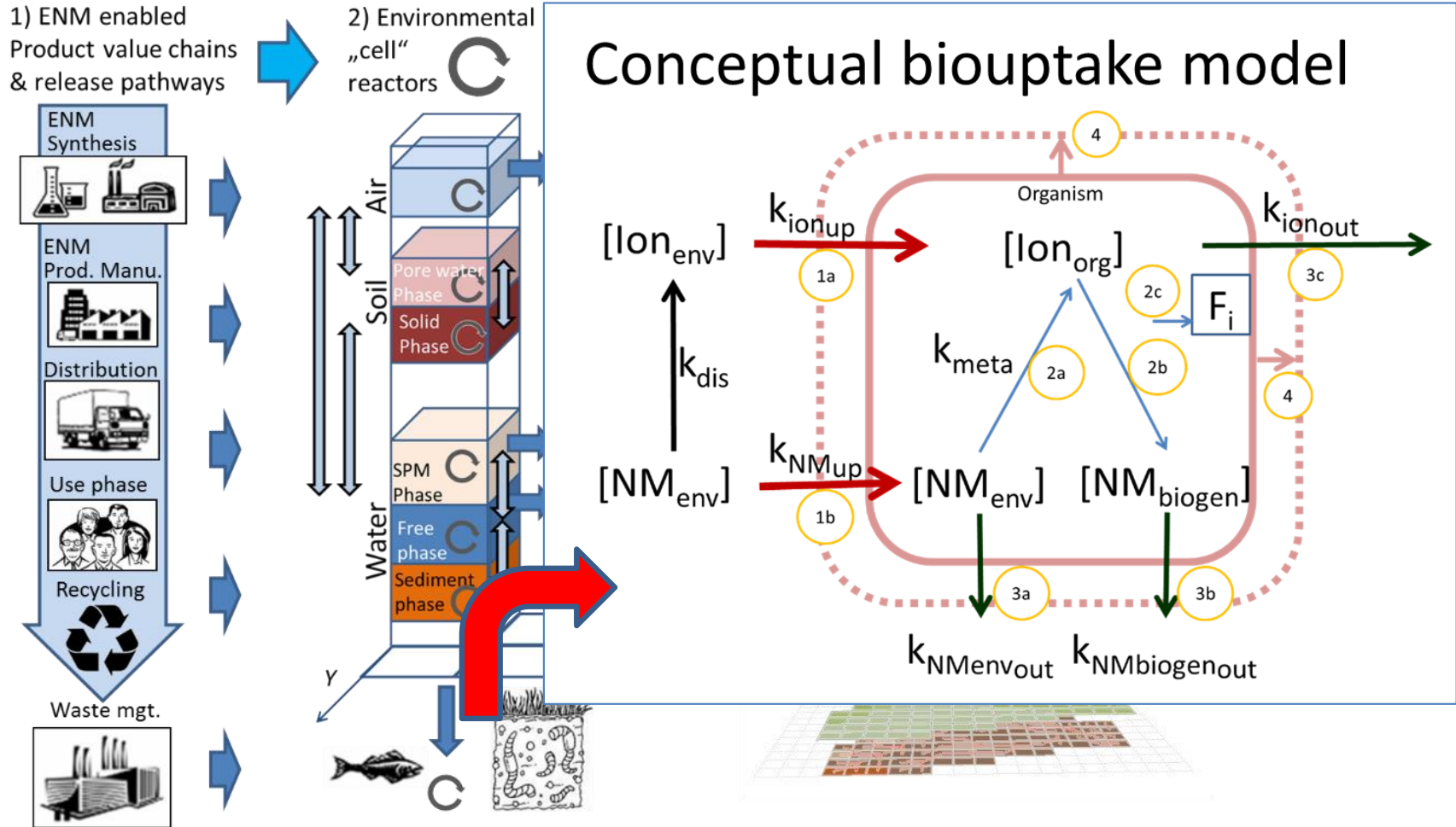
3) Object-oriented multimedia fate models dynamically connecting “Environmental cells”



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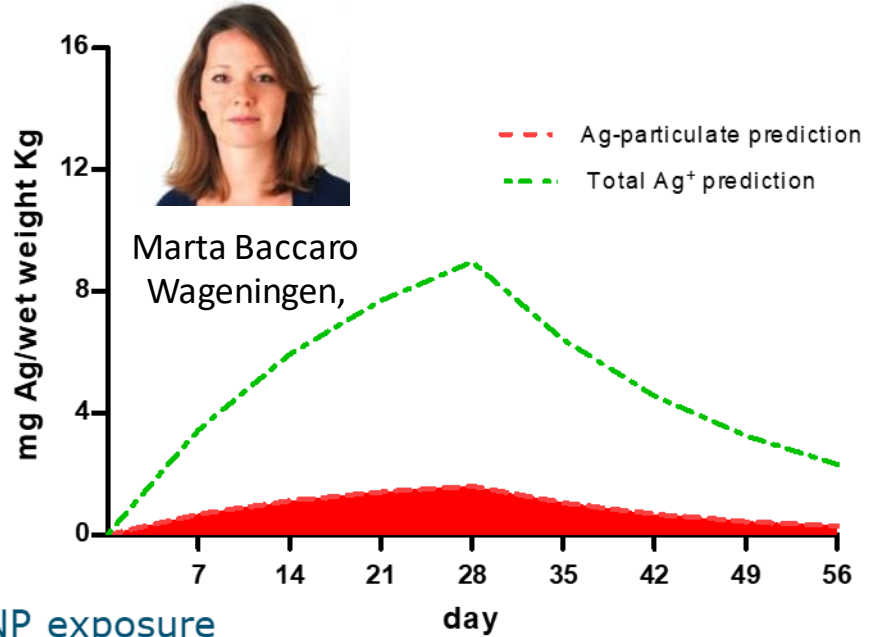
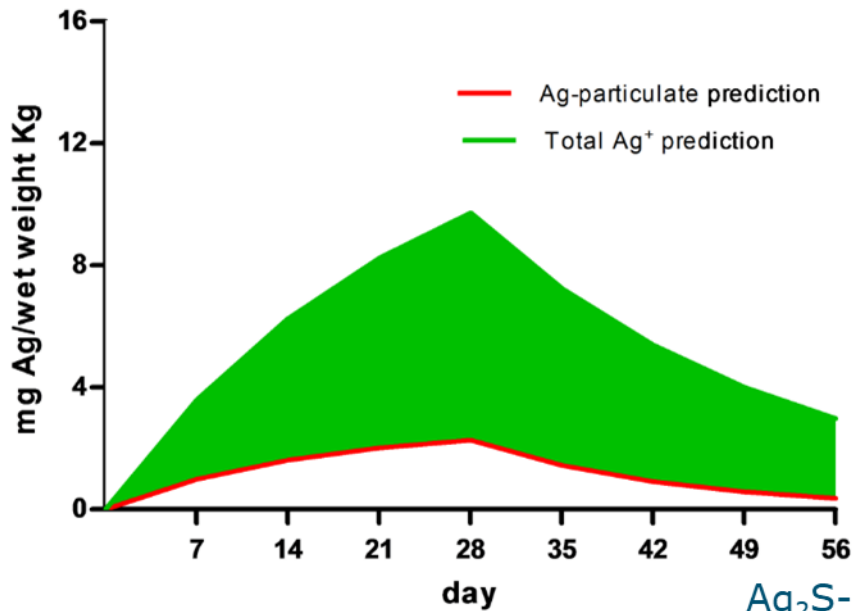


2) Environmental  
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Conceptual biouptake model

## Earthworm uptake (ions vs particulate)



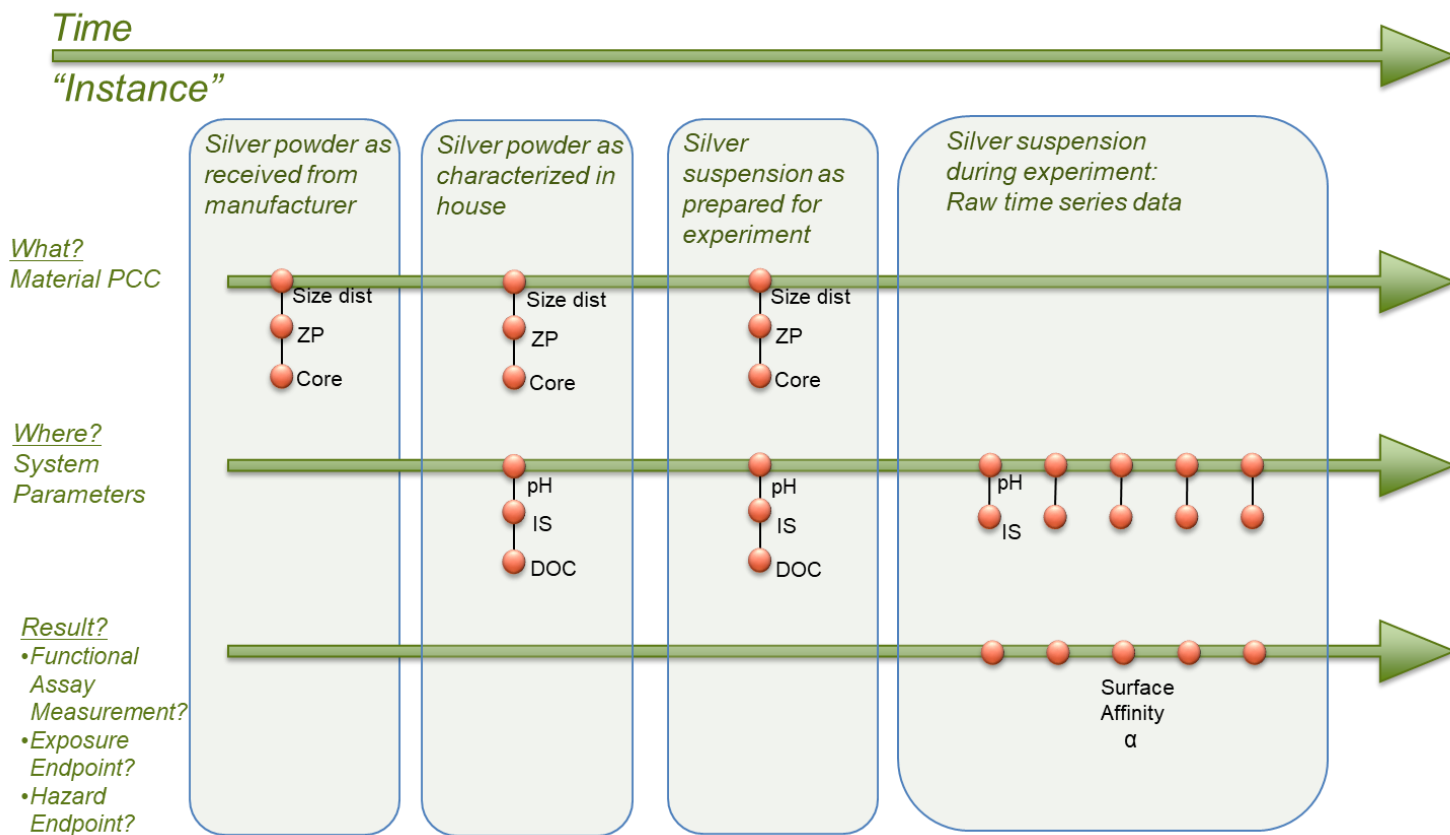
## The NanoFASE Approach

# Exposure - Nanomaterial fate in the environment:

## How did we plan to handle, share and store the data?

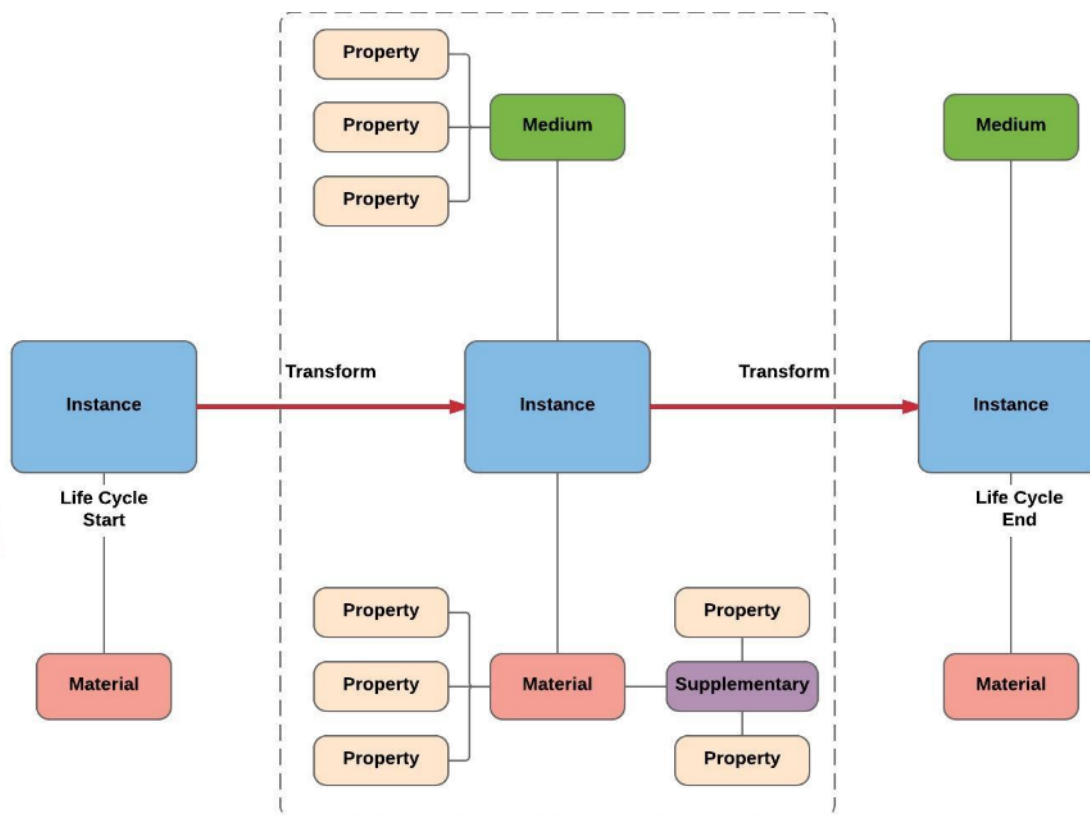
### On the NIKC Concept of "Instance"

### Temporally and Spatially Tracking the Path of a Study



# Exposure - Nanomaterial fate in the environment:

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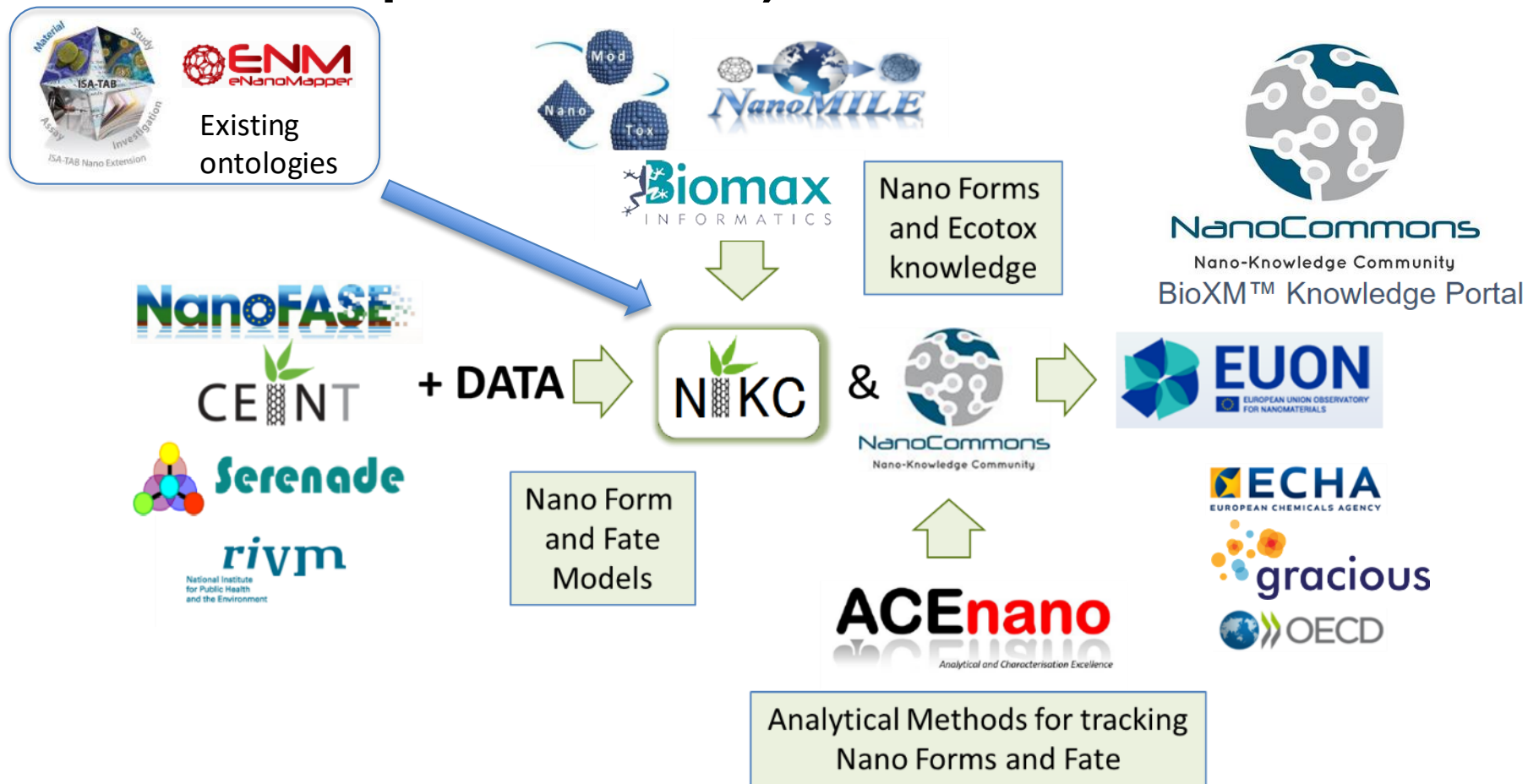


NanoCommons  
Nano-Knowledge Community



# Exposure - Nanomaterial fate in the environment:

## How did we plan to handle, share and store the data?





# NanoFASE “Clickable Framework” modules

The screenshot displays the NanoFASE website interface. At the top, the logo "NanoFASE" is prominent, followed by the tagline "Nanomaterial Fate and Speciation in the Environment". A search bar and social media icons (Twitter, Facebook, LinkedIn) are visible, along with a "Login" button. A dark navigation bar contains links for HOME, PROJECT, FRAMEWORK, TEAM, FACTSHEETS, LIBRARY, NEWS, EVENTS, DOWNLOADS, and CONTACTS.

The main content area is divided into several sections:

- Recent news:** A post titled "New NanoFASE research: A scientific insight on the impact of nanomaterials on living species" dated 08.14.2020. It mentions an international team of scientists publishing the first ever study on the impact of engine... Below this is a "Stakeholder Talks at NanoFASE Concluding Conference – Vienna, September 2019" dated 10.17.2019, thanking Water and Sediments lead Investigator Frank von der Kammer for hosting the N... A "See all" link is at the bottom.
- Highlights:** A central diagram titled "Are AgNO<sub>3</sub>, Ag NPs or Ag<sub>2</sub>S NPs bioaccumulative in trout?". It illustrates an "In vivo Dietary Exposure for 4 weeks plus 2 weeks recovery" process. The flow is: Food → Uptake, Target Organs and Body Distribution → Physiological Effects? → Clearance & Redistribution of the Body Burden? → Ecological Impact? → Dietary bioaccumulation potential ranked (AgNO<sub>3</sub> = Ag NPs > Ag<sub>2</sub>S NPs) → Clearance & Redistribution of the Body Burden?.
- Tweets:** A section titled "Tweets by @NanoFASE\_EU" showing a tweet from NanoFASE (@NanoFASE\_EU) dated 08/14/2020: "New NanoFASE-supported research: A scientific insight on the impact of nanomaterials on living species". It includes a retweet count of 1 and a "View on Twitter" link.
- Calendar:** A small "Calendar" section is visible at the bottom right of the main content area.
- NanoFASE publication by our University of Plymouth scientists selected as 'HOT article' in the journal Environmental Science: Nano:** A section highlighting a publication. The article title is "Dietary exposure to silver nitrate compared to two forms of silver nanoparticles in rainbow trout: bioaccumulation potential with minimal physiological effects" by NanoFASE scientists Nathaniel J. Clark, David Boyle, Benjamin P. Eynon and Richard D. Handy (University of Plymouth...). A "Read more" link is provided.

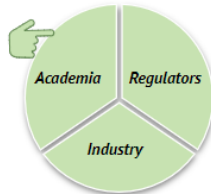
At the bottom, there are three clickable modules:

- NanoFASE Policy and Exploitation Factsheets:** Represented by an image of several factsheet documents.
- Exposure Assessment Framework:** Represented by a diagram of a framework with a yellow arrow pointing to it labeled "CLICK".
- EUON: EU Observatory for Nanomaterials:** Represented by the EUON logo.

# NanoFASE "Clickable Framework" modules

Welcome to the **NanoFASE Clickable Exposure Assessment Framework** for engineered nanomaterials (ENMs)! Find a message to stakeholders [here](#)

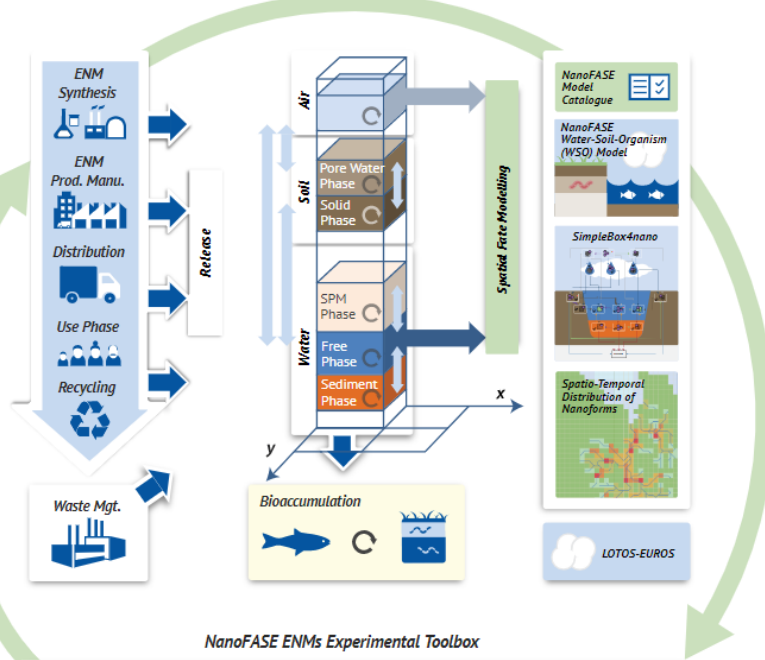
**Click below** to explore transformation and transport processes in manufacture, use, waste streams, air, soil or water / sediment, as well as uptake and accumulation in biota. Access protocols, characterisation data, and algorithms underlying the NanoFASE water-soil-organism dynamic environmental exposure model. Click here to access brief NanoFASE case studies, or to view the workflow for a tiered exposure assessment.



**ENM Enabled Product Value Chains and Release Pathways**

**Environmental Reactors and ENM Fate & Transformations**

**Dynamic Fate and Exposure Modelling for ENM Forms Entering the Environment**



**NanoFASE ENMs Experimental Toolbox**

- Synthesis of Test ENMs
- Dispersion & Exposure
- Characterisation
- Knowledge Base
- Protocols

Step 0 Step 1  
**CLICK**

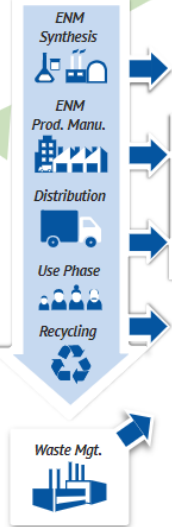
The screenshot shows the NanoFASE website with a navigation menu (FACTSHEETS, LIBRARY, NEWS, EVENTS, DOWNLOADS, CONTACTS) and a search bar. The main content area features a section titled "Environmental Speciation in the Environment" and "Uptake, Target Organs and Body Distribution". It includes a tweet from NanoFASE (@NanoFASE\_EU) and a calendar. The website also features a "Login" button and social media icons for Twitter, Facebook, and LinkedIn.

# NanoFASE Exposure Assessment Framework

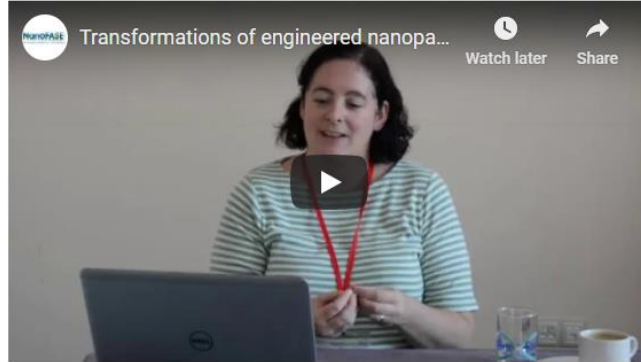
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## NanoFASE ENMs Experimental Toolbox



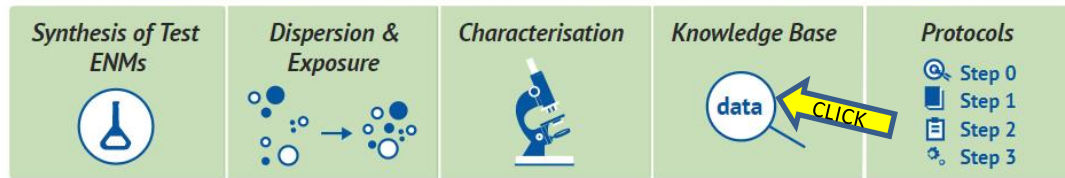
In order to be able to predict the behaviour of engineered nanomaterials (ENMs) in the environment, NanoFASE proposes a catalogue of environmental fate models. The model parameters are derived from experimental work relying in turn on sets of test ENMs synthesized specifically for the project, or acquired from industry partners or commercial suppliers. The ENMs used for NanoFASE provide very specific features to facilitate the conduct and interpretation of the experimental work, for example: labelling to track test ENMs against a high background of similar particles occurring naturally; test particles such as silver sulfide ENMs mimicking the transformations that ENMs undergo when released to the environment.

All NanoFASE ENMs were extensively characterised under the exposure conditions relevant for the measurement of ENM fate and behaviour as they move through the environmental 'reactors' of [air, water and sediment, soil](#), and/or [waste water treatment plants \(WWTPs\)](#) and in the relevant [biota](#). In the Clickable Framework, visitors can access detailed descriptions of procedures for dispersion and for characterisation, with links to existing (e.g. OECD) procedures, or to newly developed NanoFASE procedures including Functional Fate Assays to determine specific model parameters, such as [attachment efficiency](#) in soils.

Finally, all of the data generated within NanoFASE is captured in the NanoFASE Knowledge Base, linked to the relevant procedures, ontological terms, ENM characterisation, and relevant case studies, allowing intelligent searching of the data and development of predictive models.

Click on each of the images below for more details of these tools.

### NanoFASE ENMs Experimental Toolbox



## Tweets

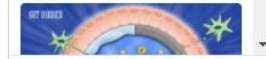
Tweets by @NanoFASE\_EU

**NanoFASE**  
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New NanoFASE-supported research

A scientific insight on the impact of [#nanomaterials](#) on living species

Read more:  
[nanofase.eu/news/2293\\_new-...#ENMs #nano #nanoscience #nanoparticles #biouptake](#)



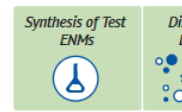
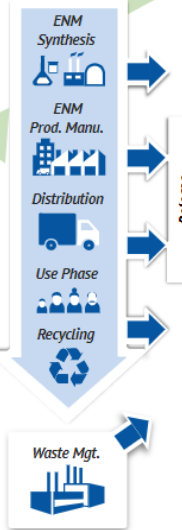
Embed View on Twitter

## Calendar

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**ENM Enabled Product Value Chains and Release Pathways**



## Knowledge Base

### Knowledge Base



At term the extensive experimental data collected and structured by NanoFASE will be rendered FAIR: Findable, Accessible, Interoperable, and Re-usable, across Europe and beyond. This implies both project-based efforts and participation in European or EU-US Communities of Research joint initiatives, such as [EUON](#) or the CEINT Nanoinformatics Knowledge Commons (NIKC).

Learn about NanoFASE contributions to [European nanosafety harmonisation and the European Union Observatory on Nanomaterials \(EUON\)](#).

The NanoFASE knowledge base embraces metadata, ontology and terminology, as well as experimental [protocols and procedures](#).

## Metadata

[NanoFASE uses the Biomax platform](#) for project traceability, managing nanomaterials stock, orders and data. The project used industry-produced nanomaterials for realism, and bespoke [synthesized particles](#) suitable for more controlled experiments. All the [studies](#) undertaken across the empirical work packages produce data to parameterise the NanoFASE fate and exposure [models](#). Partners used the NanoFASE-tailored Biomax platform to order the nanomaterials needed for their experiments. Material Safety Data Sheets, shipping and characterization data are all present in our Biomax portal for download. Templates were generated for data capture to facilitate the upload and preservation of all experimental data.

Through this centralized platform all NanoFASE partners are aware of which NMs are being used in which experiments across the consortium. University of Birmingham collaborated with the empirical work packages to enlarge the characterization templates, assembling descriptions and state-of-the-art images of pristine particles, as well as the protocols for how the data was generated. Together, these are intended to provide a resource capturing the great diversity of distinct information produced by our complex multimedia studies and to feed the modelling tools.

## Ontology and terminology

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Finally, NanoFASE's interdisciplinary approach to the science behind understanding the environmental fate of engineered nanomaterials highlights the need for meta-level integration of terminology and data. Technical words may have multiple meanings and a lack of harmonisation between scientific disciplines or even between projects can hinder the transfer of ideas between fields and potentially limit the efficient linkage and enhancement of data and knowledge. This issue has been addressed by e.g. [eNanoMapper](#) and the [Bioportal](#) by building a shared ontology of relevant terms. The NanoFASE Clickable Framework itself contextualizes important terms and concepts, improving access by making them easily searchable and cross-referenced throughout the website.

Up to now such ontological efforts within nano environment/health/safety research have mainly focused on the toxicological and material sciences fields. NanoFASE has worked closely with the US Center for the Environmental Implications of NanoTechnology (CEINT) to build the extra terminology for referencing the different issues and processes relevant to the environmental fate and transformation science we have done. This work will provide an exemplar and a template for the terminology used in future nano projects dealing with environmental fate and uptake.

## Data capture templates

NanoFASE has cooperated closely with the [CEINT Nanoinformatics Knowledge Commons \(NIKC\)](#) initiative. The NIKC is a custom cyberinfrastructure consisting of a data repository and associated analytical tools developed to visualize and interrogate integrated datasets. NanoFASE and other [NanoSafety Cluster](#) projects have demonstrated the capacity for global data entry to NIKC, expanded to include exposure related studies, and specifically exposure across the nano-enabled product value chain.

## Tweets

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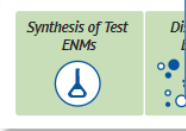
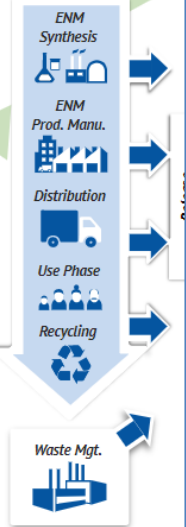
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NanoFASE mesocosm-generated datasets were deposited into the NIKC as a pilot project with a view to expanding these efforts to other studies carried out as part of NanoFASE. The efforts were accelerated through the development of data templates and curation of datasets in collaboration with the NanoCommons project, as well as several training seminars for NanoFASE researchers on data entry, led by CEINT (Duke University) and University of Birmingham. NanoFASE is working to ensure that this part of its legacy remains available to the field in the future, by collaborating closely with the [NanoCommons e-infrastructure](#).

The data capture template used by NanoFASE is presented\* with instructions in the form of two tutorials. One is a [visual/graphical manual](#), and the second is a [text-based manual](#) **CLICK** which contains all the analytical details of the process. The template and manuals were produced in a close **CLICK** transatlantic collaboration with [Cornell University](#) and drafted by Team Helium. The Summer 2019 version of each tutorial may be updated and refined going forward and will be uploaded to the NanoSafety Cluster website. The template and tutorials are intended to serve the entire nano environmental health and safety community worldwide.

## Contact



Anastasios (Tassos) Papadiamantis

[University of Birmingham](#)

## Data

NanoFASE consisting [NanoSafety](#) specifically

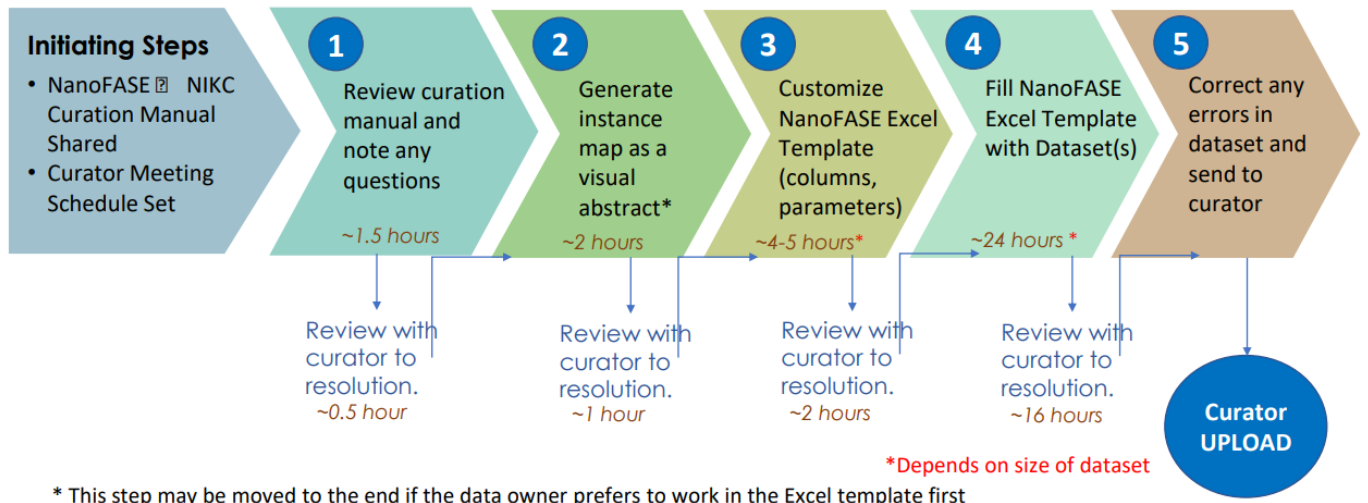
## Tweets

Tweets by @NanoFASE\_EU

# NanoFASE Exposure Assessment Framework

## The NanoFASE NIKC Curation Manual

## NanoFASE NIKC Curation Process



HEL

ENMS



NanoFASE consisting of NanoSafety specifically



HELIUM



# Nanomaterial fate in the environment – Methods and Data delivered



[www.NanoFASE.eu](http://www.NanoFASE.eu) (EU H2020 Proj. 646002)



HELIUM



*Thank you – Questions?*