

eNanoMapper solutions for FAIR sharing of nanosafety data

Egon Willighagen, Maastricht University

@enanomapper #nanotox2018

NanoTox 2018, Neuss/DE, 2018-09-20



Acknowledgements: eNanoMapper project

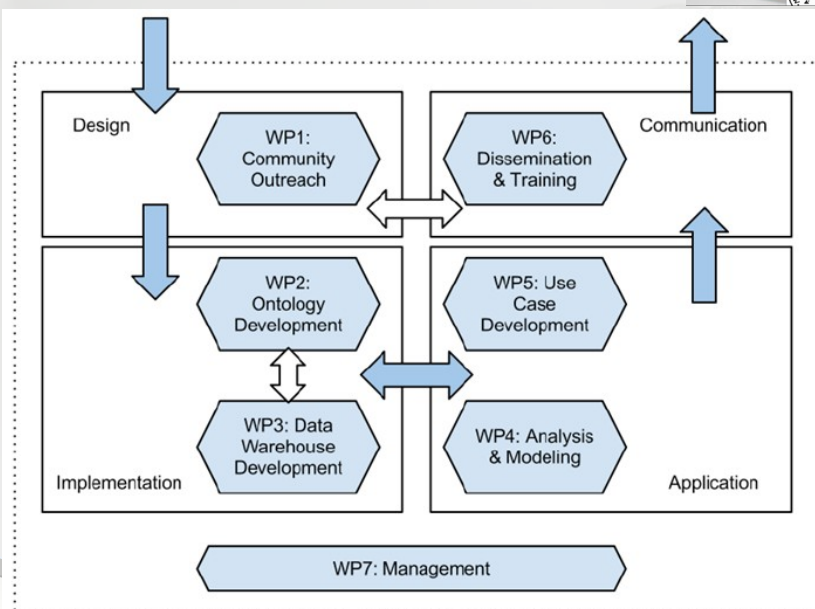


Key info

5 mEuro
(4 mEuro
funded by EC)

8/9 partners

3 years, ended
31 jan 2017



FAIR?

nature.com > scientific data > comment > article

SCIENTIFIC DATA



Altmetric: 454 Views: 31,944 Citations: 26

[More detail >>](#)

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The FAIR Guiding Principles for scientific data management and stewardship

Mark D. Wilkinson, Michel Dumontier [...] Barend Mons

Abstract

There is an urgent need to improve the infrastructure supporting the reuse of scholarly data. A diverse set of stakeholders—representing academia, industry, funding agencies, and scholarly publishers—have come together to design and jointly endorse a concise and measurable set of principles that we refer to as the FAIR Data Principles. The intent is that these may act as a guideline for those wishing to enhance the reusability of their data holdings. Distinct from peer initiatives that

doi:10.1038/sdata.2016.18

open
data
is about
MORE
THAN
DISCLOSURE
it must be
“Fair”

- Findable
- Accessible
- Interoperable
- Reusable



A FAIR-y eNanoMapper

- Findable
 - RDF at the core, identifiers for substances, compounds, and bundles (data sets)
- Accessible
 - website, API
- Interoperable
 - ontology, identifiers, standards
 - various formats, application-oriented
- Reusable? (*metadata useful...*)



eNanoMapper Ontology



Journal of Biomedical Semantics

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ABOUT

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eNanoMapper: harnessing ontologies to enable data integration for nanomaterial risk assessment

Janna Hastings , Nina Jeliaskova, Gareth Owen, Georgia Tsiliki, Cristian R Munteanu, Christoph Steinbeck and Egon Willighagen

Journal of Biomedical Semantics 2015 6:10 | <https://doi.org/10.1186/s13326-015-0005-5> |

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Received: 3 November 2014 | Accepted: 27 February 2015 | Published: 21 March 2015

Abstract

Engineered nanomaterials (ENMs) are being developed to meet specific application needs in diverse domains across the engineering and biomedical sciences (e.g. drug delivery). However, accompanying the exciting proliferation of novel nanomaterials is a challenging race to understand and predict their possibly detrimental effects on human health and the environment. The eNanoMapper project (www.enanomapper.net) is creating a pan-European computational infrastructure for toxicological data management for ENMs, based on semantic web standards and ontologies. Here, we describe the development of the eNanoMapper ontology based on adopting and extending existing ontologies of relevance for the nanosafety domain. The resulting eNanoMapper ontology is available at



eNanoMapper Ontology

metal oxide nanoparticle

- aluminium oxide nanoparticle
- cadmium(II) oxide nanoparticle
- cerium oxide nanoparticle
- copper oxide nanoparticle
- copper(II) oxide nanoparticle
- dioxygen trioxide nanoparticle
- iron oxide nanoparticle
 - dextran-coated iron oxide nanoparticle
 - hematite nanoparticle
 - iron (II,III) oxide nanoparticle
 - iron (III) oxide nanoparticle
 - magnetite nanoparticle
 - superparamagnetic iron oxide nanoparticle
- manganese (IV) dioxide nanoparticle
- molybdenum trioxide nanoparticle

transferase activity assay

gene expression assay

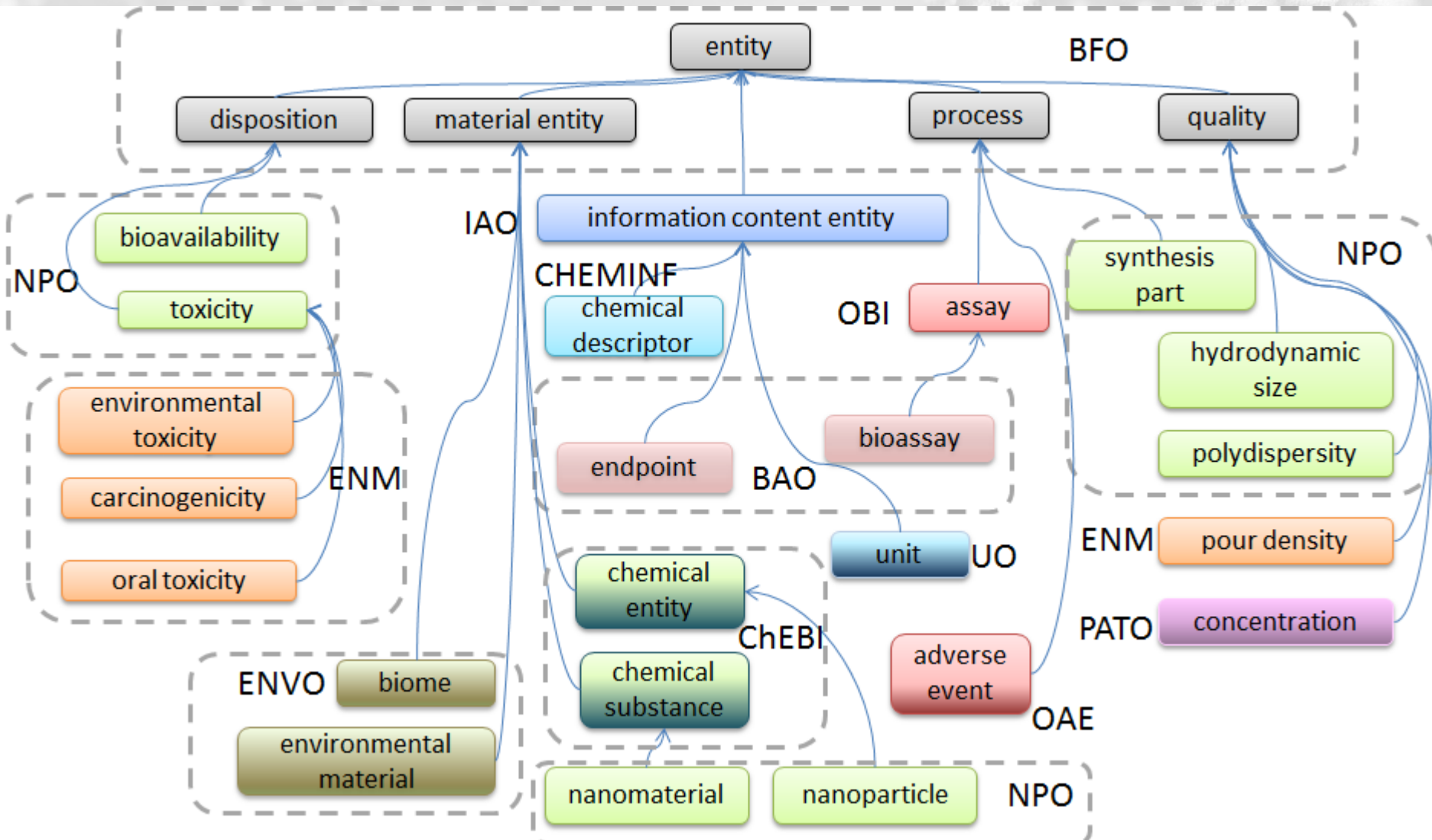
- reporter gene assay
- transcriptional response profiling assay

genotoxicity assay

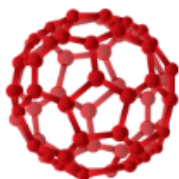
- DNA Damage Assay
- ion channel assay
- localization assay
- membrane potential assay
 - ion channel assay
 - mitochondrial membrane potential assay
 - nuclear membrane potential assay
 - plasma membrane potential assay
- metastasis assay
- organism behavior assay



eNanoMapper Ontology



User Guidance: OECD materials



eNanoMapper Ontology IR

eNanoMapper Working Draft 06 F

This version:

<http://specs.enanomapper.org/2017WD->

Latest published version:

<http://specs.enanomapper.org/oe.cd/>

Previous version:

none

Editor:

[Egon Willighagen, Maastricht University](#)

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2. The mappings

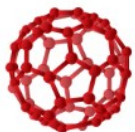
The below table gives the ontology IRIs for each of the JRC representative nanomaterials. The links provide the NanoParticle Ontology [[Thomas2011](#)] and ChEBI ontology [[Hastings2012](#)].

OECD nanomaterial	Code	Full Ontology IRI
cerium oxide nanoparticles	ENM_9000006	http://purl.enanomapper.org/onto/ENM_9000006
multi-walled carbon nanotubes	NPO_354	http://purl.bioontology.org/ontology/npo#NPO_354
single-walled carbon nanotubes	NPO_943	http://purl.bioontology.org/ontology/npo#NPO_943
dendrimers	NPO_735	http://purl.bioontology.org/ontology/npo#NPO_735
nanoclay nanoparticles	ENM_9000007	http://purl.enanomapper.org/onto/ENM_9000007
titanium dioxide nanoparticles	CHEBI_51050	http://purl.obolibrary.org/obo/CHEBI_51050
fullerenes	CHEBI_33128	http://purl.obolibrary.org/obo/CHEBI_33128
silicon dioxide nanoparticles	NPO_1373	http://purl.bioontology.org/ontology/npo#NPO_1373
zinc oxide nanoparticles	NPO_1542	http://purl.bioontology.org/ontology/npo#NPO_1542
gold nanoparticles	NPO_401	http://purl.bioontology.org/ontology/npo#NPO_401
silver nanoparticles	NPO_1892	http://purl.bioontology.org/ontology/npo#NPO_1892
iron nanoparticles	ENM_9000200	http://purl.enanomapper.org/onto/ENM_9000200
aluminium oxide nanoparticles	ENM_9000005	http://purl.enanomapper.org/onto/ENM_9000005

<http://specs.enanomapper.net/oe.cd/>



User Guidance: JRC Nanomaterials



eNanoMapper Ontology IRIs for the JRC representative industrial nanomaterials

eNanoMapper Working Draft 20 January 2018

This version:

<http://specs.enanomapper.org/2018/WD-jrc-20180120/>

Latest published version:

<http://specs.enanomapper.org/jrc/>

Previous version:

<http://specs.enanomapper.org/2017/WD-jrc-20170226/>

Editor:

[Egon Willighagen](#), [Maastricht University](#)

Author:

Jiakang Chang, [EMBL-EBI](#)

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Abstract

The [JRC representative industrial nanomaterials](#) are a series of nanomaterials used in the European nanos research [[Totaro2016](#)]. [eNanoMapper](#) is developing an ontology to be used as common language by this cor links the JRC materials to specific terms in the ontology and provides identifiers for each of them. The source <https://github.com/enanomapper/specifications>.

Status of This Document

NanoSafety
Cluster




JRC nanomaterial Code	Ontology IRI
JRCNM01000a	ENM_9000074 http://purl.enanomapper.org/onto/ENM_9000074
JRCNM01001a	ENM_9000075 http://purl.enanomapper.org/onto/ENM_9000075
JRCNM01002a	ENM_9000076 http://purl.enanomapper.org/onto/ENM_9000076
JRCNM01003a	ENM_9000083 http://purl.enanomapper.org/onto/ENM_9000083
JRCNM01004a	ENM_9000084 http://purl.enanomapper.org/onto/ENM_9000084
JRCNM01005a	ENM_9000077 http://purl.enanomapper.org/onto/ENM_9000077
JRCNM01100a	ENM_9000078 http://purl.enanomapper.org/onto/ENM_9000078
JRCNM01101a	ENM_9000086 http://purl.enanomapper.org/onto/ENM_9000086
JRCNM02000a	ENM_9000087 http://purl.enanomapper.org/onto/ENM_9000087
JRCNM02001a	ENM_9000088 http://purl.enanomapper.org/onto/ENM_9000088
JRCNM02002a	ENM_9000089 http://purl.enanomapper.org/onto/ENM_9000089
JRCNM02003a	ENM_9000090 http://purl.enanomapper.org/onto/ENM_9000090
JRCNM02004a	ENM_9000091 http://purl.enanomapper.org/onto/ENM_9000091
JRCNM02004b	ENM_9000092 http://purl.enanomapper.org/onto/ENM_9000092
JRCNM02101a	ENM_9000237 http://purl.enanomapper.org/onto/ENM_9000237
JRCNM02102a	ENM_9000238 http://purl.enanomapper.org/onto/ENM_9000238
JRCNM03300a	ENM_9000097 http://purl.enanomapper.org/onto/ENM_9000097
JRCNM03301a	ENM_9000098 http://purl.enanomapper.org/onto/ENM_9000098
JRCNM04000a	ENM_9000080 http://purl.enanomapper.org/onto/ENM_9000080
JRCNM04001a	ENM_9000081 http://purl.enanomapper.org/onto/ENM_9000081
JRCNM10201a	ENM_9000094 http://purl.enanomapper.org/onto/ENM_9000094
JRCNM10404	ENM_9000093 http://purl.enanomapper.org/onto/ENM_9000093
JRCNM62001a	ENM_9000095 http://purl.enanomapper.org/onto/ENM_9000095
JRCNM62002a	ENM_9000096 http://purl.enanomapper.org/onto/ENM_9000096
JRCNM62101a	ENM_9000079 http://purl.enanomapper.org/onto/ENM_9000079

<http://specs.enanomapper.net/jrc/>

Using the ontology

Recommendations based on the annotation of abstract 1511

Detection, quantification and identification of engineered nanoparticles at ppb-concentrations in complex media

 Parallel Session 1 - 15:15-15:30







Authors:  [0000-0002-8427-4206](https://orcid.org/0000-0002-8427-4206)

Materials: titanium dioxide nanoparticle ([CHEBI_51050](#), [search via eNanoMapper](#)) CHEBI_134403 ([CHEBI_134403](#), [search via eNanoMapper](#)) silicon dioxide nanoparticle ([CHEBI_50828](#), [search via eNanoMapper](#)) silver nanoparticle ([NPO_1892](#), [search via eNanoMapper](#)) gold nanoparticle ([NPO_401](#), [search via eNanoMapper](#))

Recommended abstracts

Same material

Other abstracts about **titanium dioxide nanoparticle**

-  [#1500: SAFETY-BY-DESIGN IN PRACTICE: METALLIC NANO INK...](#) Parallel Session 5 Thursday (12:15-12:30) [Guidebook](#)
-  [#1503: HOT SPOT RELEASE MAPPING OF NANOMATERIALS – A V...](#) Parallel Session 1 Tuesday (17:00-17:15) [Guidebook](#)
-  [#1521: On the Fast Track towards in vitro screening of...](#) Parallel Session 3 Wednesday (10:15-10:30) [Guidebook](#)
-  [#1523: MODIFYING THE MINIMUM INHIBITION CONCENTRATION...](#) Parallel Session 6 Thursday (11:00-11:15) [Guidebook](#)
-  [#1547: Exposure Assessment of GUIDEnano case studies...](#) Parallel Session 1 Tuesday (18:15-18:30) [Guidebook](#)
-  [#1552: GOODNESS OF DISTINCTION INDEX FOR PREDICTING HUMA...](#) Parallel Session 1 Tuesday (15:30-15:45) [Guidebook](#)

egonw.github.io/nmsa/



Download the ontology

Open in Protegé purl.enanomapper.org/onto/enanomapper.owl

The screenshot displays the Protegé ontology editor interface for the ontology `enanomapper` (IRI: `http://purl.enanomapper.org/onto/enanomapper.owl`). The interface includes a navigation bar with tabs for `Active Ontology`, `Entities`, `Classes`, `Object Properties`, `Data Properties`, `Annotation Properties`, `Individuals`, `OWLviz`, `DL Query`, `OntoGraf`, `SPARQL Query`, and `Ontology Differences`. A search bar is located in the top right corner.

The **Ontology header:** section shows the following information:

- Ontology IRI:** `http://purl.enanomapper.org/onto/enanomapper.owl`
- Ontology Version IRI:** e.g. `http://purl.enanomapper.org/onto/enanomapper.owl/1.0.0`

The **Annotations** section lists several annotations:

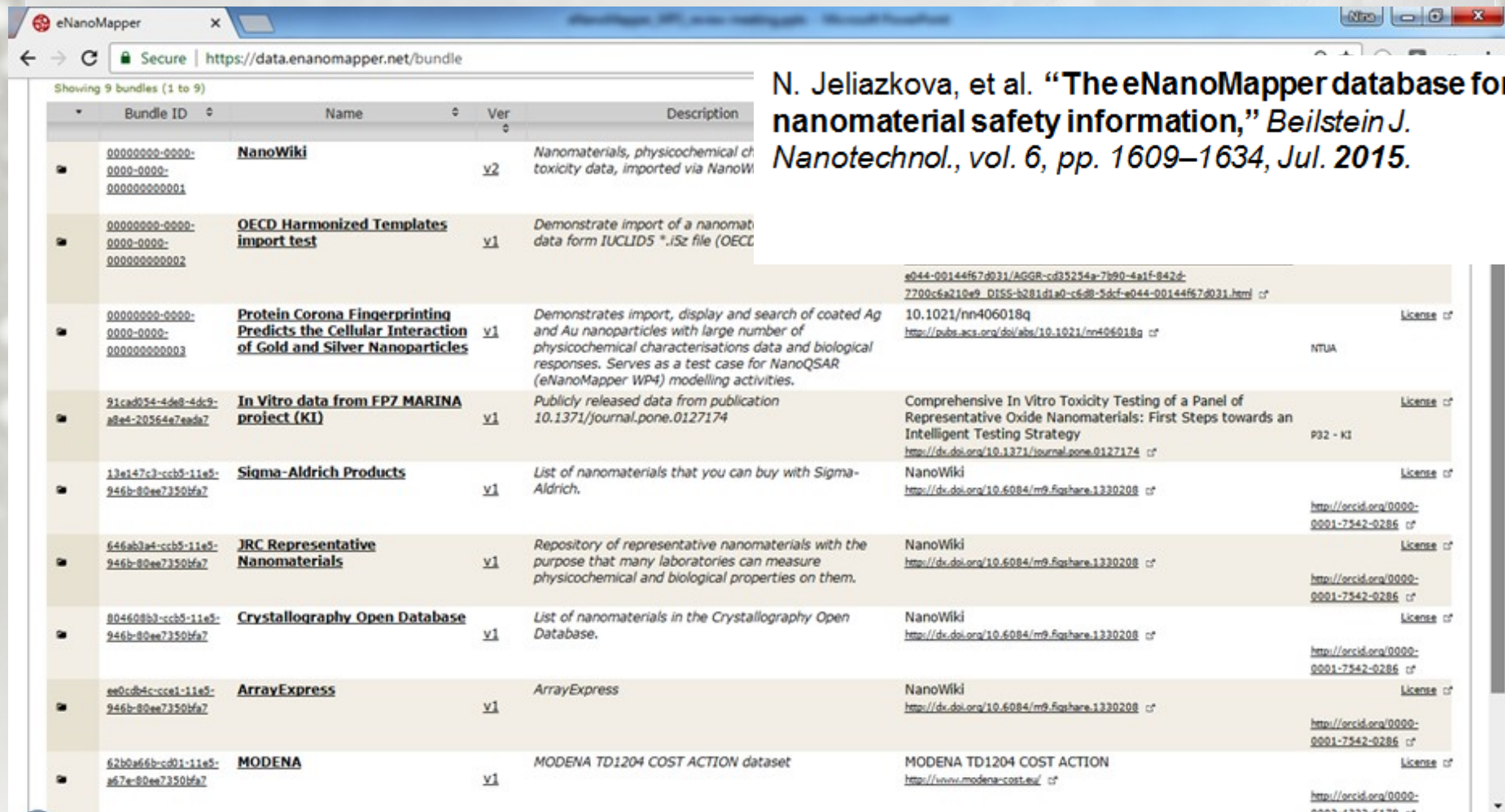
- Contributor:** Nina Jeliazkova
- comment:** The eNanoMapper project (www.enanomapper.net) is creating a pan-European computational infrastructure for toxicological data management for ENMs, based on semantic web standards and ontologies. This ontology is an application ontology targeting the full domain of nanomaterial safety assessment. It re-uses several other ontologies including the NPO, CHEMINF, ChEBI, and ENVO.
- license:** CC-BY 3.0 <https://creativecommons.org/licenses/by/3.0/>
- Contributor:** Gareth Owen
- Contributor:** Ianna Hastings

The **Ontology metrics:** section displays a table of metrics:

Metrics	Value
Axiom	48483
Logical axiom count	5910

The **Imported ontologies:** section shows the `Ontology imports` tab selected, with a `Direct Imports` section below it.

https://data.enanomapper.net



The screenshot shows the eNanoMapper web interface. The browser address bar displays "https://data.enanomapper.net/bundle". The main content area shows a table of data bundles. The table has columns for Bundle ID, Name, Ver, and Description. The bundles listed include NanoWiki, OECD Harmonized Templates import test, Protein Corona Fingerprinting Predicts the Cellular Interaction of Gold and Silver Nanoparticles, In Vitro data from FP7 MARINA project (KI), Sigma-Aldrich Products, JRC Representative Nanomaterials, Crystallography Open Database, ArrayExpress, and MODENA.

Bundle ID	Name	Ver	Description
00000000-0000-0000-0000-000000000001	NanoWiki	v2	Nanomaterials, physicochemical and toxicity data, imported via NanoWiki
00000000-0000-0000-0000-000000000002	OECD Harmonized Templates import test	v1	Demonstrate import of a nanomaterial data form IUCLIDS *.iSz file (OECD)
00000000-0000-0000-0000-000000000003	Protein Corona Fingerprinting Predicts the Cellular Interaction of Gold and Silver Nanoparticles	v1	Demonstrates import, display and search of coated Ag and Au nanoparticles with large number of physicochemical characterisations data and biological responses. Serves as a test case for NanoQSAR (eNanoMapper WP4) modelling activities.
91ca054-4de0-4dc9-a8e4-20564e7eedb7	In Vitro data from FP7 MARINA project (KI)	v1	Publicly released data from publication 10.1371/journal.pone.0127174
13e147c3-ccb5-11e5-946b-80ee7350bfa7	Sigma-Aldrich Products	v1	List of nanomaterials that you can buy with Sigma-Aldrich.
646ab3e4-ccb5-11e5-946b-80ee7350bfa7	JRC Representative Nanomaterials	v1	Repository of representative nanomaterials with the purpose that many laboratories can measure physicochemical and biological properties on them.
804608b3-ccb5-11e5-946b-80ee7350bfa7	Crystallography Open Database	v1	List of nanomaterials in the Crystallography Open Database.
ee0cd4c-ccc1-11e5-946b-80ee7350bfa7	ArrayExpress	v1	ArrayExpress
62b0a66b-cd01-11e5-a67e-80ee7350bfa7	MODENA	v1	MODENA TD1204 COST ACTION dataset

N. Jeliaskova, et al. "The eNanoMapper database for nanomaterial safety information," *Beilstein J. Nanotechnol.*, vol. 6, pp. 1609–1634, Jul. 2015.



European Union Nanomaterial Observatory



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Study finds knowledge gaps in risk assessment of nano pigments

7 September 2018

A new study, commissioned by the EU Observatory for Nanomaterials, found gaps in the current knowledge on the hazard and risk assessment of nano-sized pigments. The study identified 81 nano-sized pigments currently used in the EU market.

[More news](#) |  [RSS](#)

 Nano technology knowledge base

 Data and tools for the risk assessment of nanomaterials

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eNanoMapper

Filtering

- + Projects (45319)
- + Study providers (41991)
- + Nanomaterial type (45259)
- + Nanomaterial (34076)
- + Protocols (129027)
- + Method (81138)
- + TOX (84349)
- + P-CHEM (45132)

Search

Hits list

Selection

Export

< 1 2 3 ... 78 79 > displaying 1 to 10 of 789



JRCNM04001a (NM-401 (MWCNT 64.2 nm)) multi-walled carbon nanotube CORE (1): [Read more](#)

Results: P-CHEM.Crystalline phase, P-CHEM.Surface chemistry, P-CHEM.Particle size distribution (Granulometry), P-CHEM.Batch Dispersion quality, P-CHEM.Dustiness, P-CHEM.Specific surface area, TOX.Immunotoxicity, TOX.Cell Viability, TOX.Genetic toxicity in vitro, ECOTOX.Short-term toxicity to aquatic invertebrates, TOX.Repeated dose toxicity - oral, P-CHEM.Zeta potential, P-CHEM.Aerosol characterisation [more](#)

Substance Composition Study

[Add to Selection](#)

More on the web

An Assessment of Methods of Sampling and Characterizing Engineered Nanomaterials in the Air and on Surfaces in the Workplace
Source: [Irsst.qc.ca](#)

Spying on the virus: Development to increase effectiveness of viral cancer therapy
Source: [Medicalxpress.com](#)



eNanoMapper Docker (on OpenRiskNet)

eNanoMapper x +

Not secure | nanomaterialdb-test.prod.openrisknet.org/ambit/substance?page=0&pagesize=10

Home Search Data collections Data upload For developers Help Log in

Search nanomaterials by identifiers Name Identifier Reference NM type Search

Nanomaterials Advanced search Download

Showing from 1 to 10 in pages of 10 substances [Previous](#) [Next](#) Filter...

	Substance Name	Substance UUID	Substance Type	Public name	Reference substance UUID	Owner	Info
<input type="checkbox"/> - 1 - 📁	Polystyrene amine modified	ENM3-dcf88d62... 📁	ENM_9000008	-		2nd NanoSafety Forum for Young Scientists Data	
<input type="checkbox"/> - 2 - 📁	copper	ENM3-8aaa4347... 📁	ENM_9000016	-		2nd NanoSafety Forum for Young Scientists Data	
<input type="checkbox"/> - 3 - 📁	MWCNT-7	ENM3-a542e8e8... 📁	NPO_354	-		2nd NanoSafety Forum for Young Scientists Data	
<input type="checkbox"/> - 4 - 📁	Silver	ENM3-bfec06f... 📁	NPO_1892	-		2nd NanoSafety Forum for Young Scientists Data	
<input type="checkbox"/> - 5 - 📁	Carbon black Printex 90	ENM3-d796278f... 📁	NPO_707	-		2nd NanoSafety Forum for Young Scientists Data	
<input type="checkbox"/> - 6 - 📁	Manganese	ENM3-306d3338... 📁	ENM_9000073	-		2nd NanoSafety Forum for Young Scientists Data	

Help: Nanomaterials
The nanomaterials are considered a special case of substances . See [doi:10.3762/bjnano.6.165](https://doi.org/10.3762/bjnano.6.165) .

Searching data

The screenshot displays the eNanoMapper search interface. The search bar contains the term 'nanotube'. The results list includes:

- Multi-Walled Carbon Nanotubes (MWCNT), synthetic shape mono constituent substance [12.7 nm]**
P-CHEM. Specific surface area [DIN66132]
[more](#)
Material Composition Study
- STANFORD-ZLiuCR2008-02 carbon nanotube**
P-CHEM. Particle size distribution (Granulometry) The average length of SWNT-PTX was 106 nm with a standard deviation of 64 nm. [size] [2008]
[more](#)
caNanoLab
- STANFORD-ZLiuCR2008-01 carbon nanotube**
P-CHEM. Particle size distribution (Granulometry) Dynamic light scattering and hydrodynamic size of SWNTs before and after Ptx conjugation of 120.0 nm, respectively [size] [2008]
[more](#)
caNanoLab
- SNU-NJiaNL2007-01 multi-walled nanotube**
P-CHEM. Particle size distribution (Granulometry) [2007]
[more](#)
caNanoLab

The interface also features a left sidebar with 'Data sources (140)' and 'Nanomaterial type (153)' filters. A detailed view of a study is shown on the right, including a table of results:

Reference	Protocol	Endpoint	Result	Own	Reliability
(2011)	Transmission Electron Microscopy (TEM)	MASS MEDIAN DIAMETER	[3, 20] nm		2 (reliable with restrictions)
		MASS MEDIAN AERODYNAMIC DIAMETER	-		
	DISTRIBUTION_TYPE: imaging technique	PARTICLE SIZE_D90	12.7 nm		

<https://search.data.enanomapper.net>



Mapping the spreadsheet content into the data model

A	B	C	D	E	F	G
1	TEST RESULTS					
2						
3						
4	Replicate 1			Replicate 2		
5	T1	Titanium Dioxide	Average (ng/ml)	T1	Titanium Dioxide	
6		0	1.8925			
7		1	19.6985			
8		5	18.5207			
9		10	18.0280			
10		25	18.4153			
11		50	19.2965			
12		75	20.8867			
13		100	22.6964			

through JSON configuration

```
{
  "TEMPL": {
    "DATA_": {
      "PARAL": {
        "SUBSTANCE_RECORD": { ... }, // 7 items
        "PROTOCOL_APPLICATIONS": [
          {
            "PROTOCOL_TOP_CATEGORY": { ... }, // 2 items
            "PROTOCOL_CATEGORY_CODE": { ... }, // 2 items
            "PROTOCOL_GUIDELINE": { ... }, // 1 item
            "PROTOCOL_ENDPOINT": { ... }, // 4 items
            "RELIABILITY_STUDY_RESULT_TYPE": { ... }, // 2 items
            "CITATION_TITLE": { ... }, // 2 items
            "CITATION_YEAR": { ... }, // 2 items
            "CITATION_OWNER": { ... }, // 4 items
            "PARAMETERS": { ... }, // 12 items
            "EFFECTS_BLOCK": {
              "LOCATION": {
                "ITERATION": "ABSOLUTE_LOCATION",
                "IS_ARRAY": true,
                "TRIM_ARRAY": true,
                "SHEET_INDEX": 3,
                "COLUMN_INDEX": "B",
                "ROW_INDEX": 4
              },
              "ROW_SUBBLOCKS": "= TimePoints.size()",
              "COLUMN_SUBBLOCKS": "= Replicates",
              "SUBBLOCK_SIZE_ROWS": "= C.size() + 3",
              "SUBBLOCK_SIZE_COLUMNS": 4,
              "VALUE_GROUPS": [
                {
                  "NAME": "=Assay_endpoint",
                  "UNIT": "=Outcome_metric",
                  "START_COLUMN": 3,
                  "END_COLUMN": 3,
                  "START_ROW": 3,
                  "END_ROW": "=3 - 1 + C.size()",
                  "PARAMETERS": [
                    {
                      "NAME": "Time point",
                      "ASSIGN": "ASSIGN_TO_SUBBLOCK",
                      "COLUMN_POS": 1,
                      "ROW_POS": 2,
                      "MAPPING": "Time",
                      "UNIT": "h"
                    },
                    {
                      "NAME": "Replicate",
                      "ASSIGN": "ASSIGN_TO_SUBBLOCK",
                      "COLUMN_POS": 1,
                      "ROW_POS": 1
                    },
                    {
                      "NAME": "Concentration",
                      "ASSIGN": "ASSIGN_TO_VALUE",
                      "COLUMN_POS": -1,
                      "ROW_POS": 0,
                      "UNIT": "µg/ml"
                    }
                  ]
                }
              ]
            }
          ]
        ]
      }
    }
  }
}
```

https://apps.ideaconsult.net/enm_mapper/ui/uploadsubstance1

ENM NanoMapper

Search Nanomaterials OpenTox Help

Substances Import Single file upload

Import new substance(s)

File (.isz or .isd or .xls or .xlsx) No file chosen

JSON map for XLS/XLSX file No file chosen

Mapping the spreadsheet content into the data model

```
"CLO_0000031 EFO_0004443" : {  
  "ITERATION": "ABSOLUTE_LOCATION",  
  "SHEET_INDEX": 1,  
  "COLUMN_INDEX": "B",  
  "ROW_INDEX": 49,  
  "original" : "Cell line/Type - Supplier"  
},  
"OBI_0001911 BAO_0000114" : {  
  "ITERATION": "ABSOLUTE_LOCATION",  
  "SHEET_INDEX": 1,  
  "COLUMN_INDEX": "B",  
  "ROW_INDEX": 53,  
  "original" : "Cell culture conditions - Medium"  
},
```

JSON (JavaScript Object Notation) is a lightweight data-interchange format.



eNanoMapper RDF: semantic format

A dataset

A dataset is of type `void:DataSet` and has a title at this moment.

```
etox:dataset a void:DataSet ;
dct:title "NanoE-Tox RDF" .
dct:description "RDF version of the data from Beilstein J. Nanotech"
dct:license <https://creativecommons.org/licenses/by/4.0/> ;
dct:publisher "Egon Willighagen" .
```

A material

```
ex:NFYS16-M12 a obo:CHEBI_59999 ;
rdfs:label "NM-400" ;
npo:has_part ex:NFYS16-M12_core ;
obo:BFO_0000056 ex:NFYS16-M12_sizemg
dcterms:source ex:NFYS16 ;
dcterms:type enm:ENM_9000081 .
```

All materials are types (`rdf:type`) `obo:CHEBI_59999` and have the `npo:has_part` predicate and experimental measure

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Substances Import

Import new substance(s)

File eNanoMapper Turtle (.ttl) Choose File No file chosen Submit

Help: Simple upload Simple upload using eNanoMapper Turtle file upload Turtle upload W3C RDF Turtle format, see these eNanoMapper .ttl file examples

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Bundles Name Search

Nanomaterial bundles Download Help

Showing 1 bundles (1 to 1) First Previous 1 Next Last

Bundle ID	Name	Ver	Description	Source	License & Maintainer
00000000-0000-0000-0000-000000000001	NanoWiki	v5	Nanomaterials, physicochemical characterisations and toxicity data, imported via NanoWiki RDF dump	https://figshare.com/articles/NanoWiki_5/7075214 http://dx.doi.org/10.6084/m9.figshare.4141593.v1	License http://orcid.org/0000-0001-7542-0286

Display 10 bundles. Search:

Answering scientific questions ...

```
SELECT DISTINCT ?substance ?particleType
               ?experiment ?protocol ?value ?unit
WHERE {
  { ?assay a [ rdfs:subClassOf bao:BAO_0002167 ] . }
  UNION
  { ?assay a bao:BAO_0002167 . }
  ?assay dc:title ?experiment ;
    bao:BAO_0000209 ?mgroup ;
    bao:BAO_0002846 ?protocolRes .
  ?protocolRes dc:title ?protocol .
  ?mgroup obo:OBI_0000299 ?endpoint .
  ?endpoint obo:IAO_0000136 ?substanceRes ;
    sso:has-unit ?unit ;
    sso:has-value ?value .
  ?substanceRes rdfs:label ?substance ;
    dcterms:type ?type .
  OPTIONAL { ?type rdfs:label ?particleType }
  { ?substanceRes dcterms:type npo:NPO_1541 }
  UNION
  { ?substanceRes dcterms:type
    [ rdfs:subClassOf+ npo:NPO_1541 ]
  }
}
```

Which metal oxides (*NPO_1541*) show a form of genotoxicity (*BAO_0002167*)?

substance	particleType	experiment	protocol	value	unit
Gerloff2009 NM2	titanium oxide nanoparticle	DNA in Tail	Fpg-2Dmodified Comet Assay	6.0	%
Gerloff2009 NM2	titanium oxide nanoparticle	DNA in Tail	Fpg-2Dmodified Comet Assay	5.0	%
Gerloff2009 NM2	titanium oxide nanoparticle	DNA in Tail	Fpg-2Dmodified Comet Assay	8.0	%
Gerloff2009 NM2	titanium oxide nanoparticle	DNA in Tail	Fpg-2Dmodified Comet Assay	3.0	%
TiO2	titanium oxide nanoparticle	DNA in Tail	Fpg-2Dmodified Comet Assay	6.0	%
TiO2	titanium oxide nanoparticle	DNA in Tail	Fpg-2Dmodified Comet Assay	5.0	%
TiO2	titanium oxide nanoparticle	DNA in Tail	Fpg-2Dmodified Comet Assay	8.0	%
TiO2	titanium oxide nanoparticle	DNA in Tail	Fpg-2Dmodified Comet Assay	3.0	%
ZnO	zinc oxide nanoparticle	DNA in Tail	Fpg-2Dmodified Comet Assay	23.0	%

Application Programming Interface (API)

compound : Chemical structures search

Show/Hide | List Operations | Expand Operations | Raw

GET /query/compound/{term}/{representation} Exact compound search

GET /query/similarity Similarity search

GET /query/smarts Substructure search

substance : Substance search

Show/Hide | List Operations | Expand Operations | Raw

GET /query/substance/facet Search substances by study owner

GET /query/substance/reference Search substances by reference structures

GET /query/substance/related Search substances by related structures

GET /query/substance/study/experiment/{term} Search substances by protocol application parameters

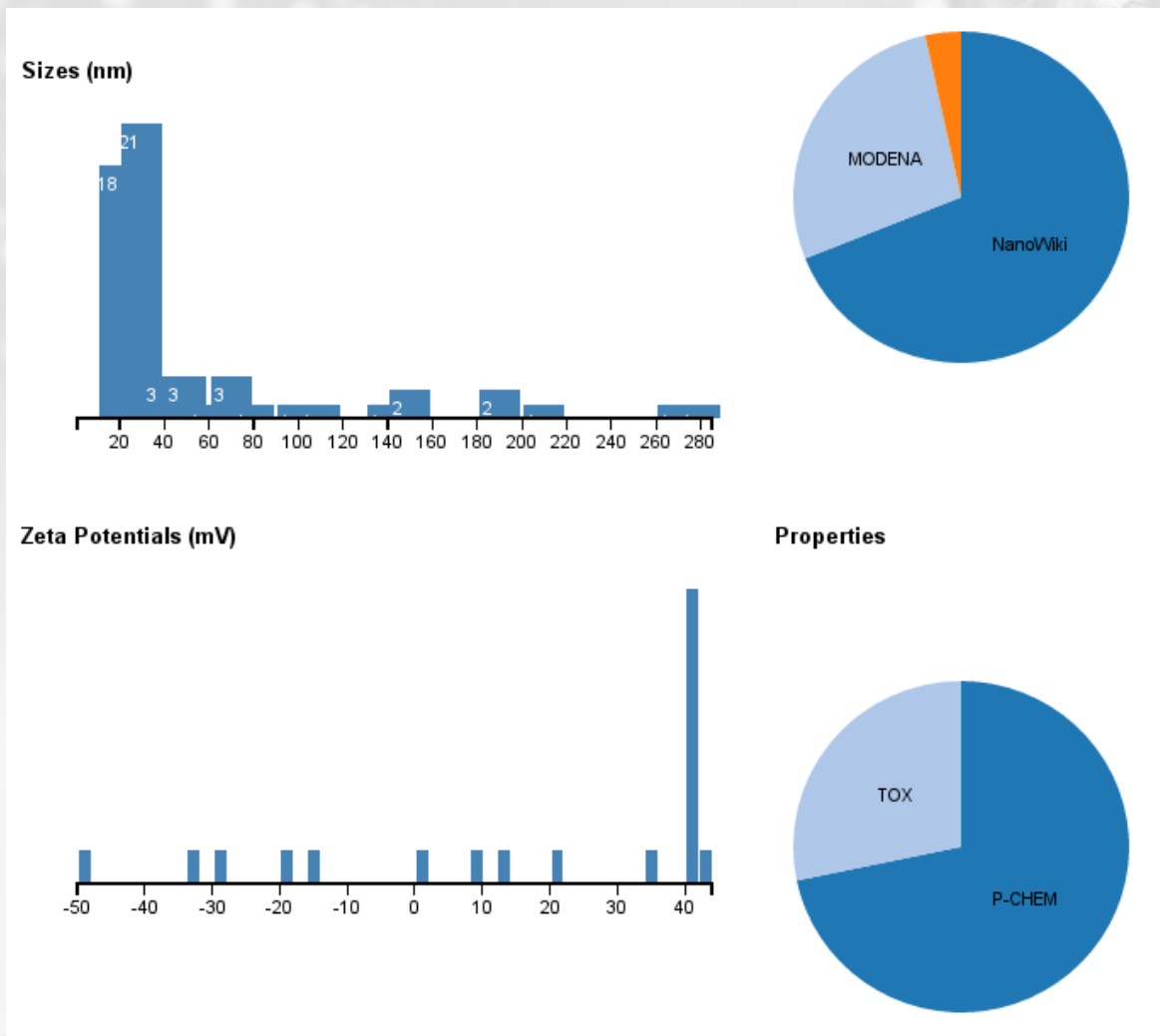
GET /query/substance/study/owner/{term} Search substances by study owner

GET /query/substance/study/protocol/{term} Search substances by study protocol parameters

GET /query/study Search endpoint summary



Javascript library (ambit.js + d3.js)



egonw.github.io/enmSummaries/



Reusable: (bio)schema.org

Google Dataset Search Beta

Search for Data Sets



Try [boston education data](#) or [weather site:noaa.gov](#)

schema.org

Google Structured Data Testing Tool

<https://apps.ideaconsult.net/enmtest/bundle/f7306348-807e-4fd9-b11b-cb6b1c1361e0>

NEW TEST

```
1 <!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4.01//EN"
2 "http://www.w3.org/TR/html4/strict.dtd">
3 <!--[if lt IE 7 ]><html class="ie ie6" lang="en"
4 xmlns="http://www.w3.org/1999/xhtml"> <![endif]-->
5 <!--[if IE 7 ]><html class="ie ie7" lang="en"
6 xmlns="http://www.w3.org/1999/xhtml"> <![endif]-->
7 <!--[if IE 8 ]><html class="ie ie8" lang="en"
8 xmlns="http://www.w3.org/1999/xhtml"> <![endif]-->
9 <!--[if (gte IE 9)|(IE)]><!--><html lang="en"
10 xmlns="http://www.w3.org/1999/xhtml"> <!--<![endif]--><head>
11 <!-- Basic Page Needs
12 ----- -->
13 <title>eNanoMapper</title>
14 <meta name="robots" content="index, follow"><META NAME="GOOGLEBOT"
15 CONTENT="index, FOLLOW">
16 <meta charset="utf-8">
17 <meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
18 <meta name="description" content="AMBIT">
19 <meta name="author" content="IdeaConsult Ltd.">
20 <meta http-equiv="X-UA-Compatible" content="IE=edge" >
21 <!-- Mobile Specific Metas
22 ----- -->
23 <meta name="viewport" content="width=device-width, initial-scale=1,
24 maximum-scale=1">
25 <!-- CSS
26 ----- -->
27 <link rel="stylesheet"
28 href="https://apps.ideaconsult.net/enmtest/style/skeleton/base.css"
29 type="text/css">
```

Dataset

All (1)

Dataset

0 ERRORS 0 WARNINGS ^

ID: <https://apps.ideaconsult.net/enmtest/bundle/f7306348-807e-4fd9-b11b-cb6b1c1361e0>

@type	Dataset
@id	https://apps.ideaconsult.net/enmtest/bundle/f7306348-807e-4fd9-b11b-cb6b1c1361e0
url	https://apps.ideaconsult.net/enmtest/bundle/f7306348-807e-4fd9-b11b-cb6b1c1361e0
version	1
publisher	
@type	Organization
name	enanomapper
distribution	
@type	DataDownload
contentUrl	https://apps.ideaconsult.net/enmtest/bundle/f7306348-807e-4fd9-b11b-cb6b1c1361e0? media=application%2Fjson



User Guidance: Tutorials and ELIXIR TeSS

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Type

Project

Keywords

Nanotechnology, toxicology,
Ontologies, Databases

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eNanoMapper

eNanoMapper developed a computational infrastructure for toxicological data management of engineered nanomaterials (ENMs) based on open standards, ontologies and an interoperable design to enable a more effective, integrated approach to European research in nanotechnology. eNanoMapper supports the collaborative safety assessment for ENMs by creating a modular, extensible infrastructure for transparent data sharing, data analysis, and the creation of computational toxicology models for ENMs. eNanoMapper was funded by the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 604134.

[Materials \(4\)](#)[Events \(0\)](#)[Activity log](#)

Showing 4 materials.

Entering and analysing nano safety data

Tutorial that covers various aspects of working with the eNanoMapper database. It discussed searching, adding, and downloading data from an eNanoMapper database.

Keywords: ontologies, enanmapper

Adding ontology terms

The eNanoMapper journey continues

Our solutions are Open Source, use Open Standards, and some data we extracted from literature is Open Data.

github.com/enanomapper/

enanomapper.net

enanomapper.github.io/tutorials/

@enanomapper



OpenRiskNet
RISK ASSESSMENT E-INFRASTRUCTURE

