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# **New exposures and prevention: NANOPARTICLES and NANOFIBRES**

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# Content

- **What is nanoparticles&nanofibres**
- **Properties**
- **Exposure routes**
- **Health effects**
- **Control&Prevention**

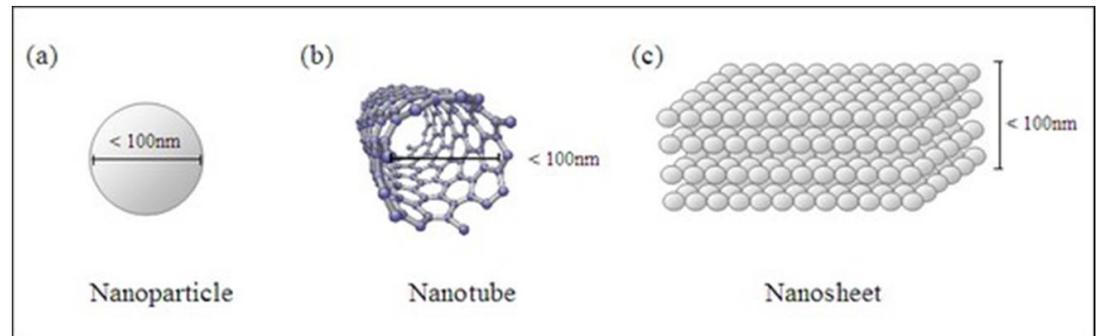
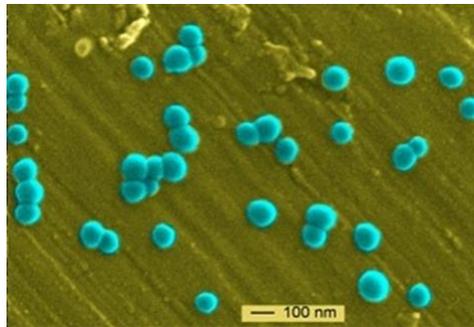
# Latvian folk preverb

- A small wrestler overthrows a big chase
- Mazs cinītis gāž lielu vezumu



# What is nanoparticle

- A nanoparticle - particle with at least one dimension less than 100 nm.



- "Ultrafine particles" (UFP) are synonymous with nanoparticles and range between 1 and 100 nm in size, as opposed to "fine particles" sized between 100 and 2,500 nm and "coarse particles" ranging from 2,500 to 10,000 nm.

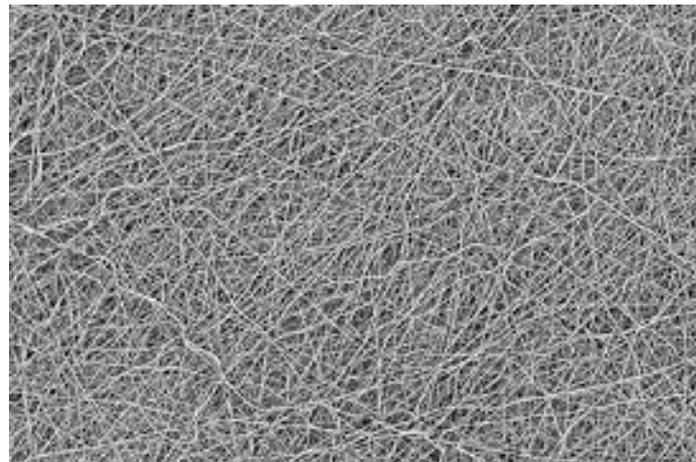
# What is nanofibre

- Nanofibre: an engineered particle with one or more dimensions measuring between 1 and 100nm, having an aspect ratio of 3:1 or greater.

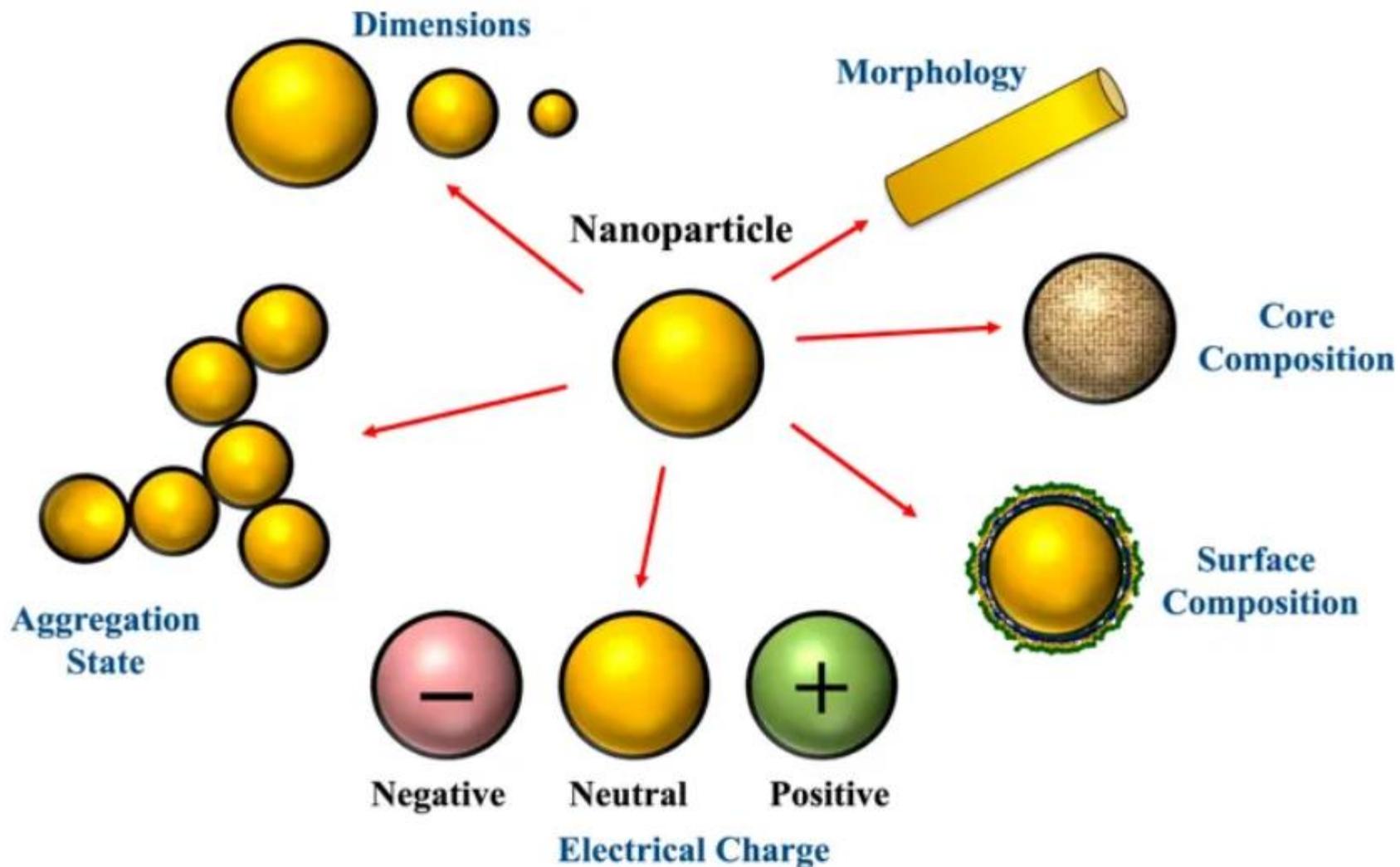
Nanotube: hollow nanofibre

Nanowire: flexible nanofibre, often electrically conductive

Nanorod : rigid nanofibre

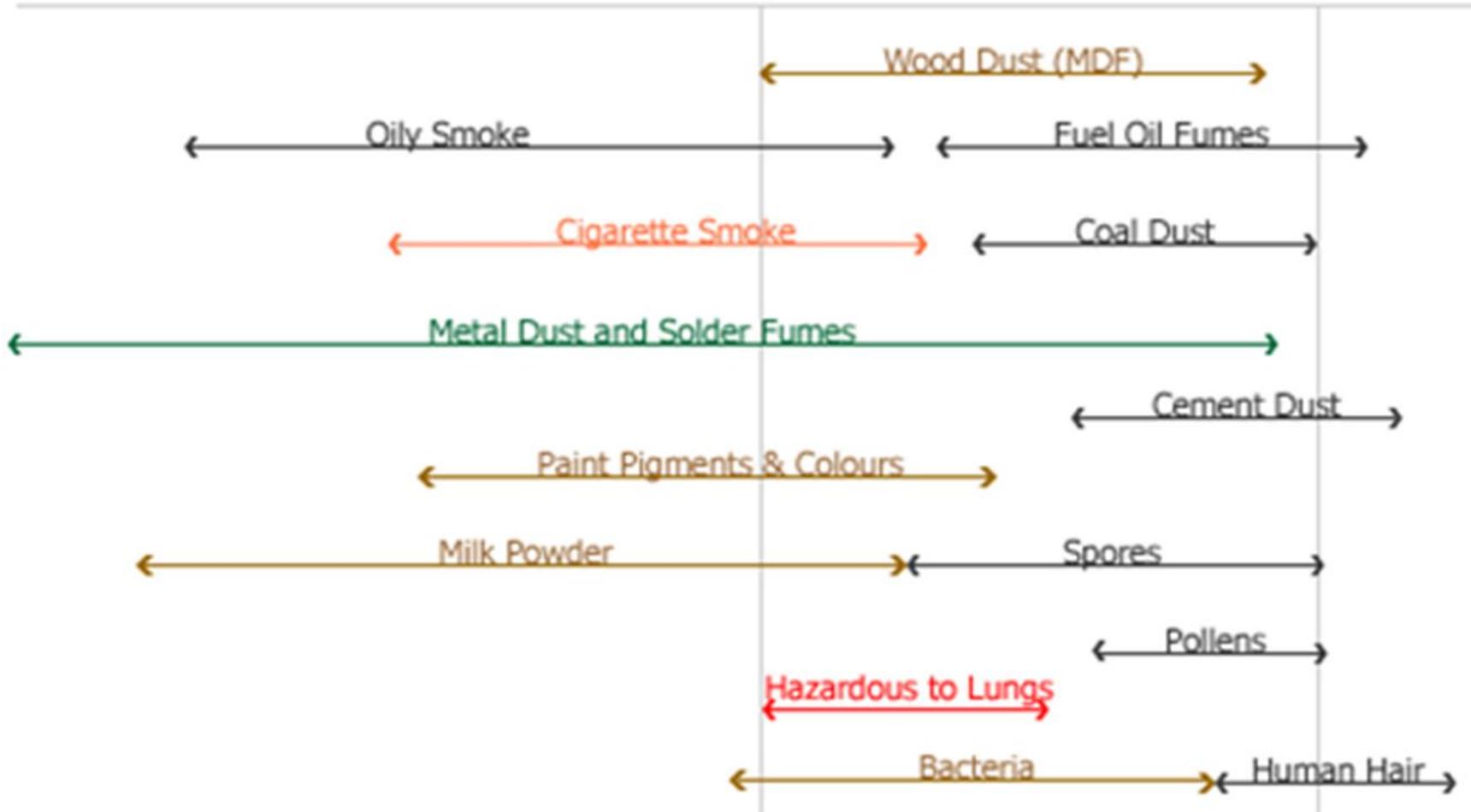


# Properties



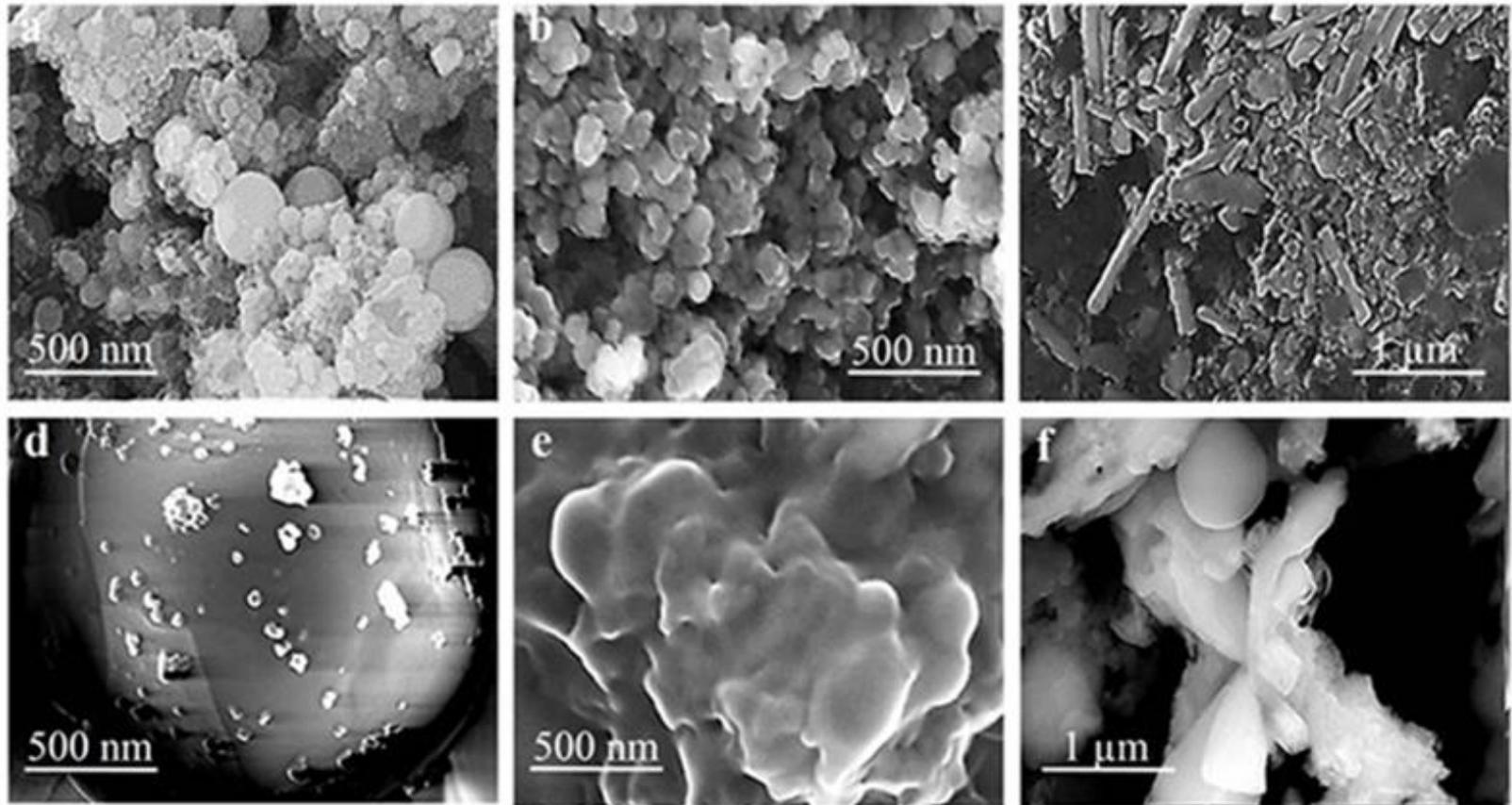
# Size

0.001, 0.002, 0.004, 0.006, 0.008, 0.01, 0.02, 0.04, 0.06, 0.08, 0.1, 0.2, 0.4, 0.6, 0.8, 1.0, 2.0, 4.0, 6.0, 8.0, 10, 20, 40, 60, 80, 100, 200, 400, 500



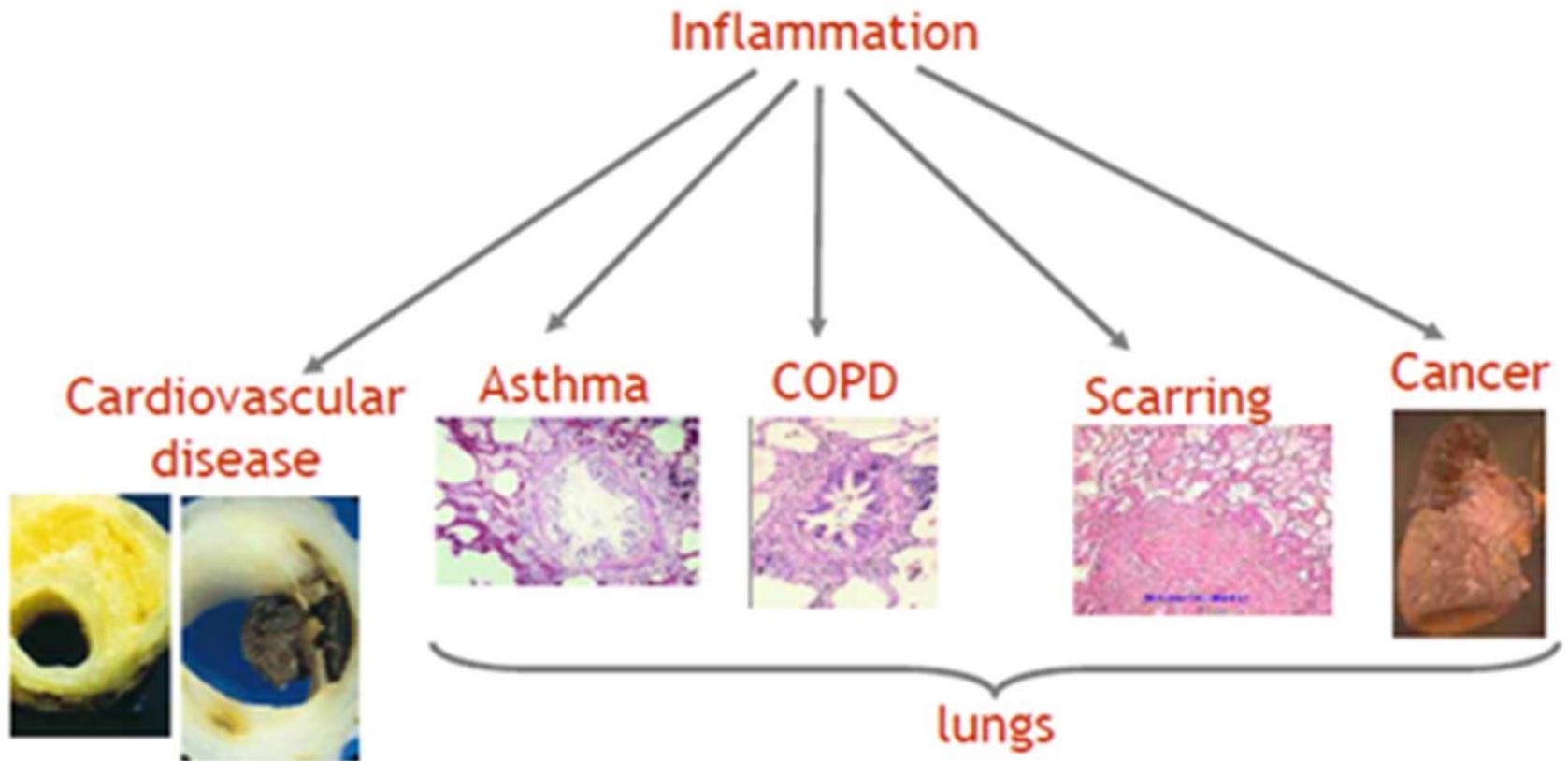
Fall Velocity [cm/s]	Duration of fall from a height of 1 m [min]	Particle Size
0.00006	500 hrs.	• 0.1 $\mu\text{m}$
0.006	5 hrs.	• 1 $\mu\text{m}$
0.6	3 mins.	• 10 $\mu\text{m}$
15	6 s	• 50 $\mu\text{m}$

# Shape



Picture 3. Dust particles by their chemical composition and shape (a - silica, b - iron oxide, c - zinc oxide, d - organic dust with iron oxide inclusions, f - organic dust, silica spheres and sodium chloride crystals)

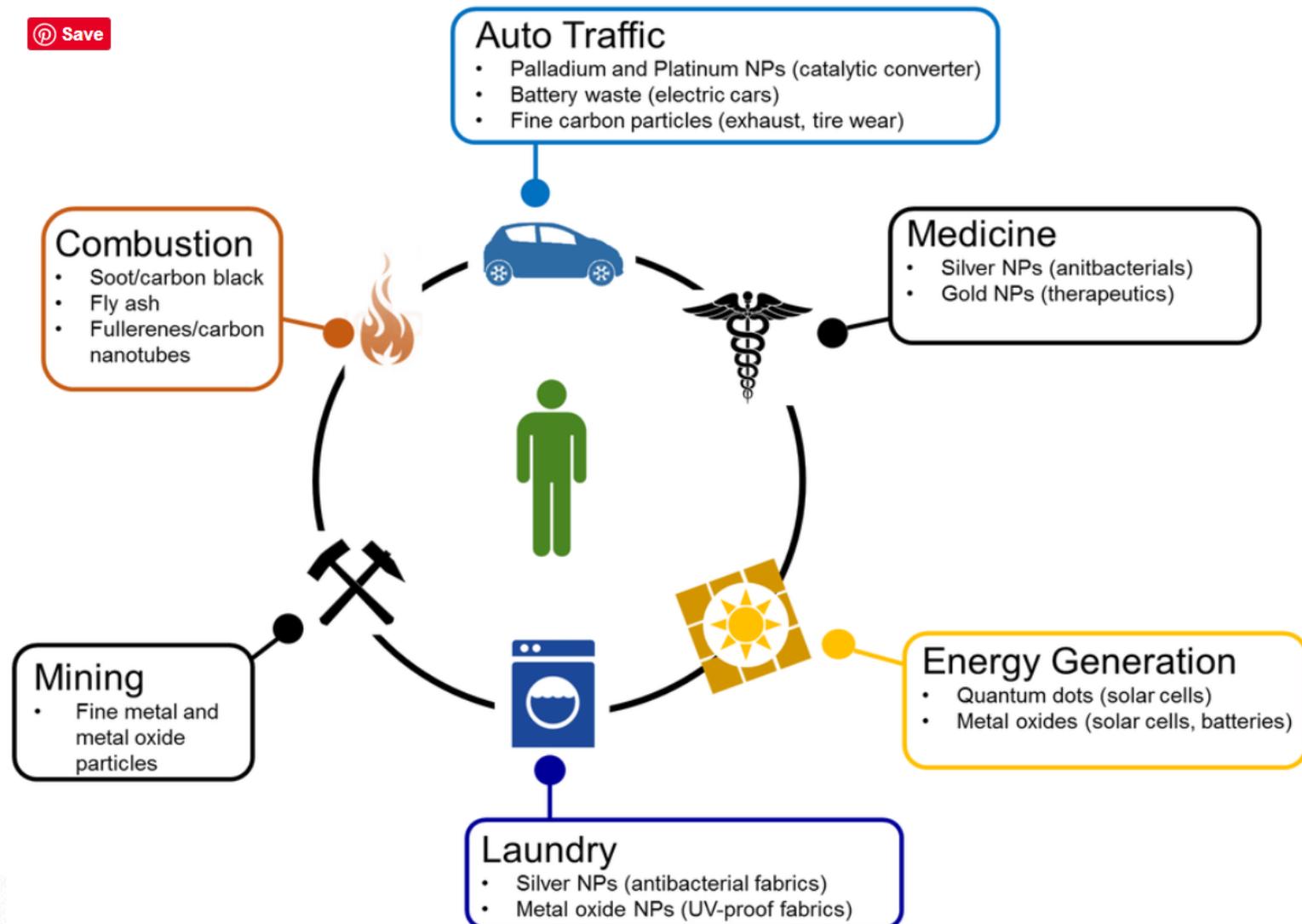
# Health effects

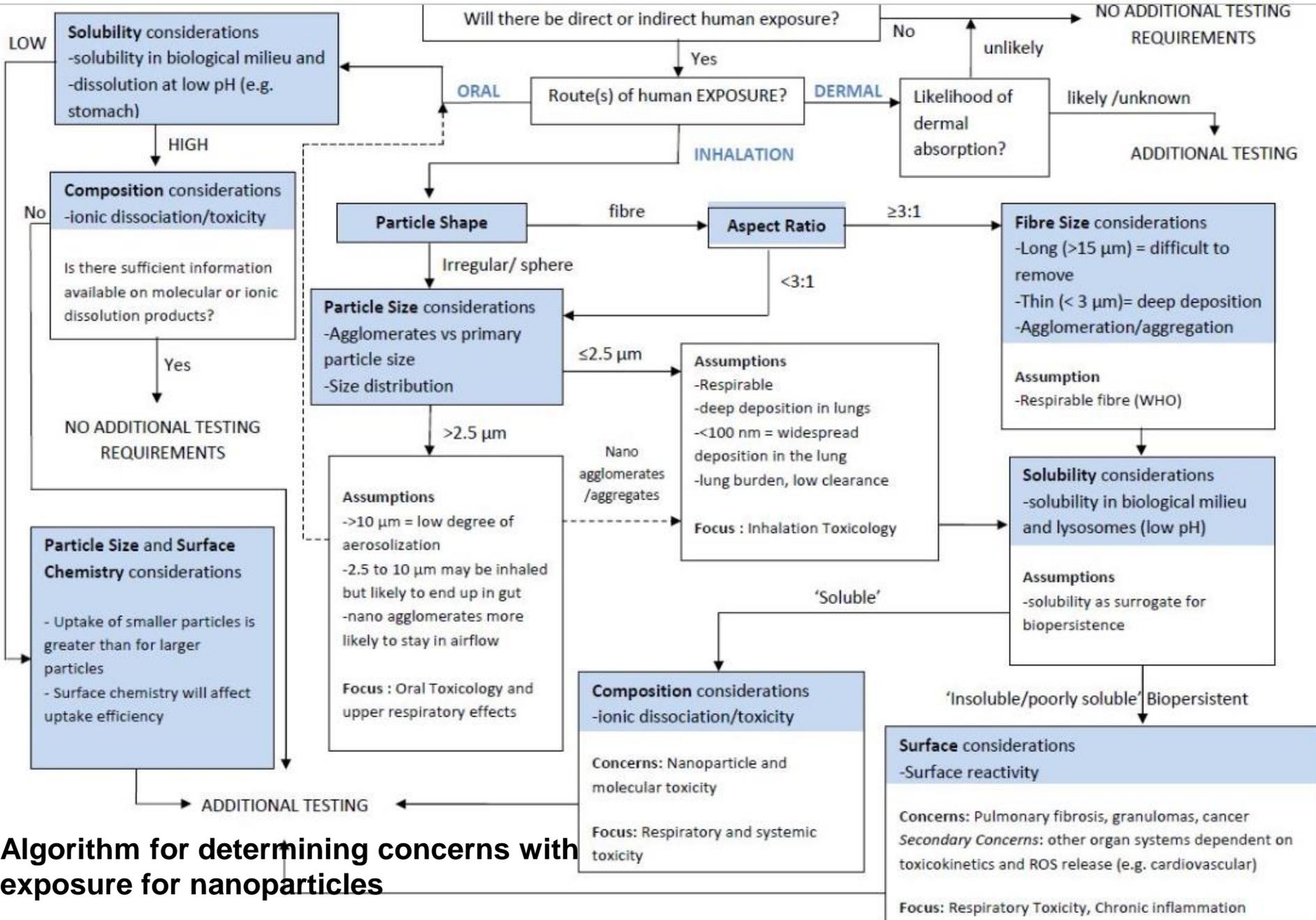


# Exposure

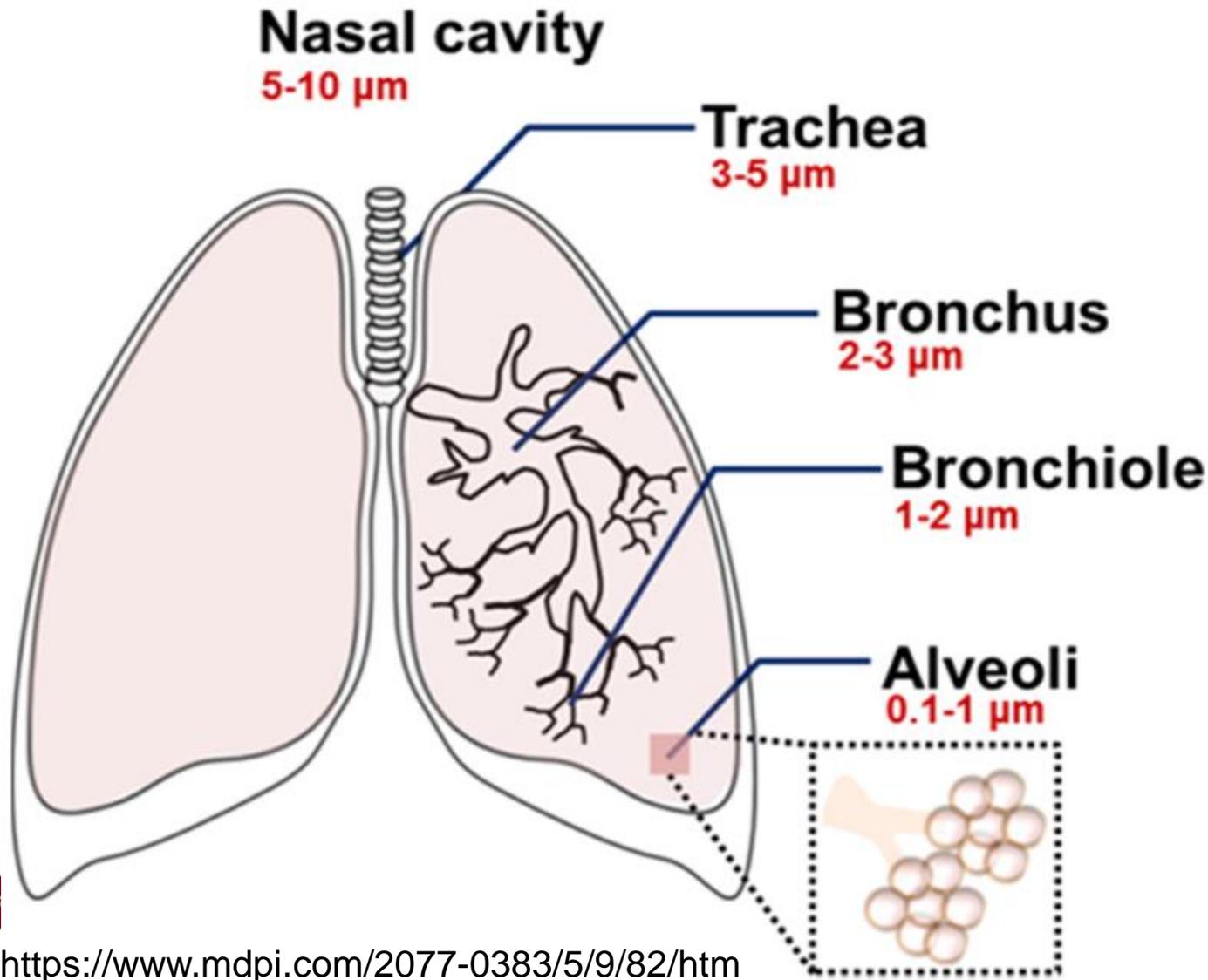
- Nanoparticle (natural): a particle that is not manufactured, for example, volcanic ash emissions, forest fire particles, nano-sized liquid droplets (ocean, rain, etc.).
- Nanoparticle (incidental): a “background” particle that is not meant to be produced, a by-product of industrial processes, for example, diesel or other vehicle exhaust emissions, welding fumes.
- Human-made nanoparticles

# Pathways by which human-made nanoparticles (NPs) are released into the environment



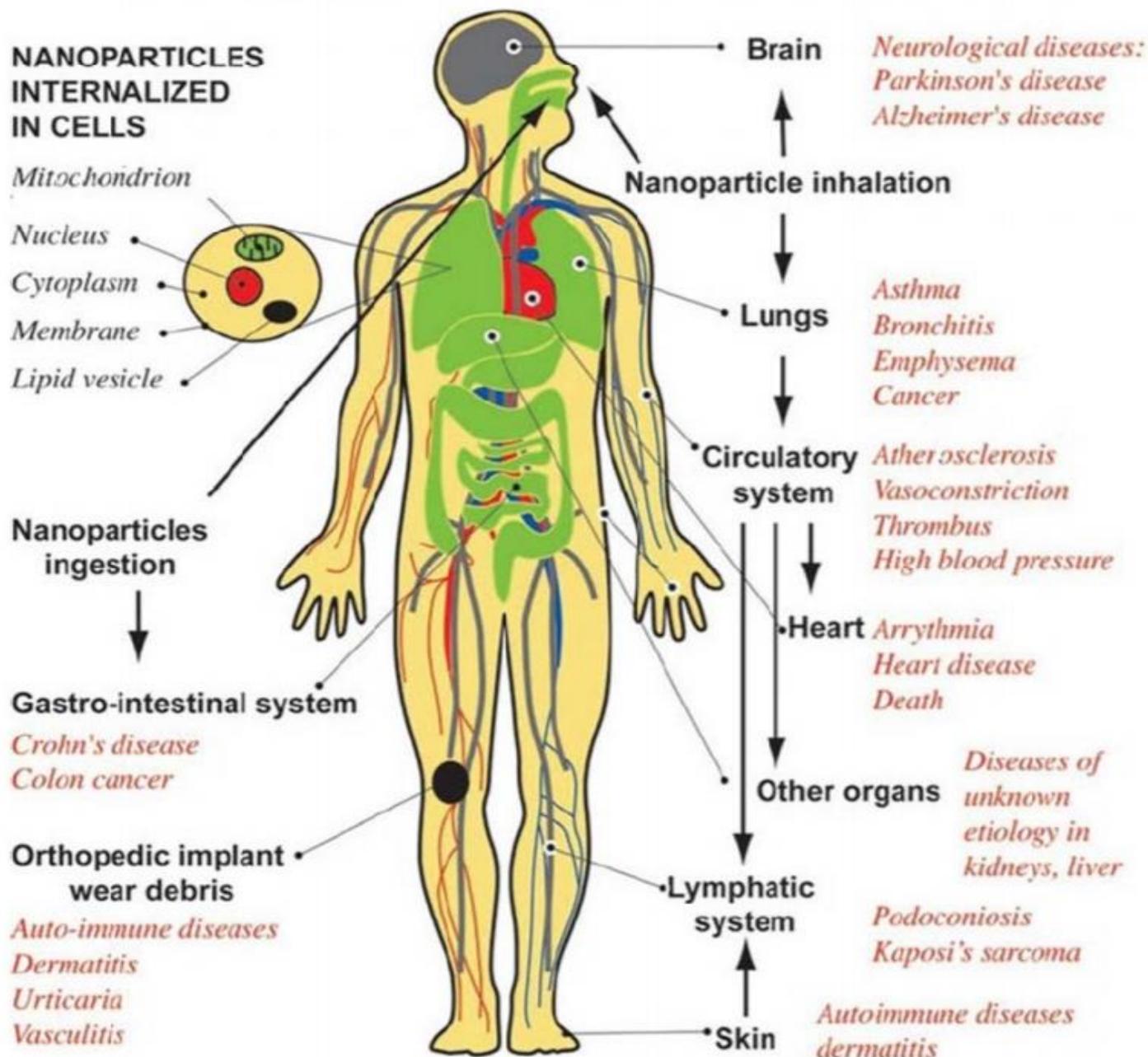


# Size-dependent regional deposition of micro- and nanoparticles within the respiratory system after the inhalation



# DISEASES ASSOCIATED TO NANOPARTICLE EXPOSURE

C. Buzea, J. Pacheco, & K. Robbie, *Nanomaterials and nanoparticles: Sources and toxicity, Biointerphases 2 (2007) MR17-MR71*



# Types of exposure limits

- Threshold limit value-time weighted averages: occupational exposure limit for a full 8-hour shift
- Threshold limit value-short term exposure limit: occupational exposure limit for a 15-min period in an 8-hour shift
- Threshold limit value-ceiling limit: peak occupational exposure limit at any given time over an 8-hour shift

**BUT WHICH PARAMETER SHOULD BE MEASURED:**

- **MASS?**
- **NUMBER/COUNT?**
- **SURFACE AREA?**

# Nano reference values for 4 classes of manufactured nanomaterials

Class	Description	Density	Nano reference values (8-hour time-weighted average)	Examples
1	Rigid, biopersistent nanofibers for which effects similar to those of asbestos are not excluded	Not available	0.01 fibre centimetre <sup>-3</sup>	single-walled carbon nanotube or multi-walled carbon nanotube or metal oxide fibres for which asbestos-like effects are not excluded
2	Biopersistent granular nanomaterials in the range of 1-100 nanometers	>6000 kilogram meter <sup>-3</sup>	20000 particles centimeter <sup>-3</sup>	Silver, gold, cerium (IV) dioxide, cobalt (II) oxide, iron, iron oxides, lanthanum, lead, antimony pentoxide, tin dioxide
3	Biopersistent granular and fibre form nanomaterials in the range of 1-100 nanometers	<6000 kilogram meter <sup>-3</sup>	40000 particles centimeter <sup>-3</sup>	Aluminum oxide, silicon dioxide, titanium nitride, titanium dioxide, zinc oxide, nanoclay carbon black, fullerene, dendrimers, polystyrene nanofibers with excluded asbestos-like affects
4	Non-biopersistent granular nanomaterials in the range of 1-100 nanometers	Not available	Applicable occupational exposure limit	Examples: fats, sodium chloride

# Prevention

- Elimination of a hazardous chemical substance from the workplace.
- Substitution of the substance with another substance that is less toxic to health.
- Isolation of the substance in closed chambers or rooms.
- Engineering/processing controls such as ventilation or design/process modification.
- Administrative controls such as shift rotation or access restriction.
- Personal protective equipment such as respiratory or skin protection.

# Thank you for your attention!

