

# Contra Costa County – Hazardous Materials Commission

## May 25, 2017



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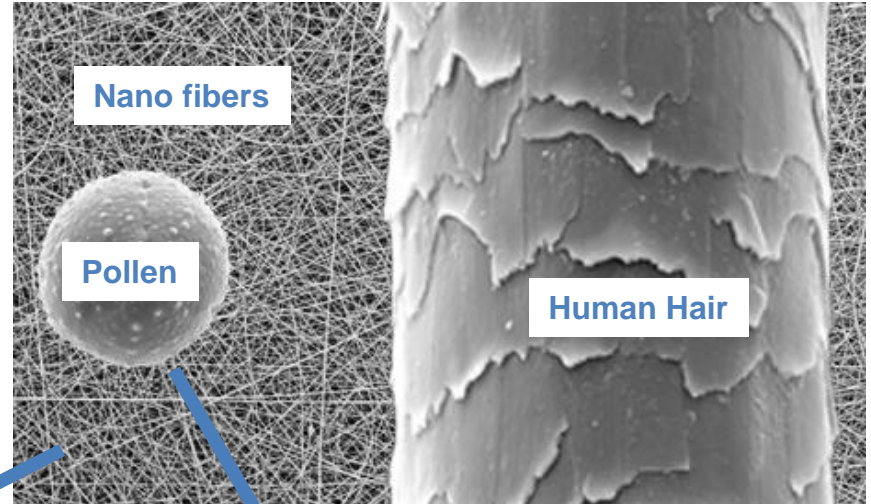
## Engineered Nanomaterials and Public Health

- The Nano Scale
- ENM in the US and CCC
- Product Lifecycle
- Biological Effects/Toxicity
- Regulatory landscape
- Data Gaps and Uncertainties
- Summary and Opportunities

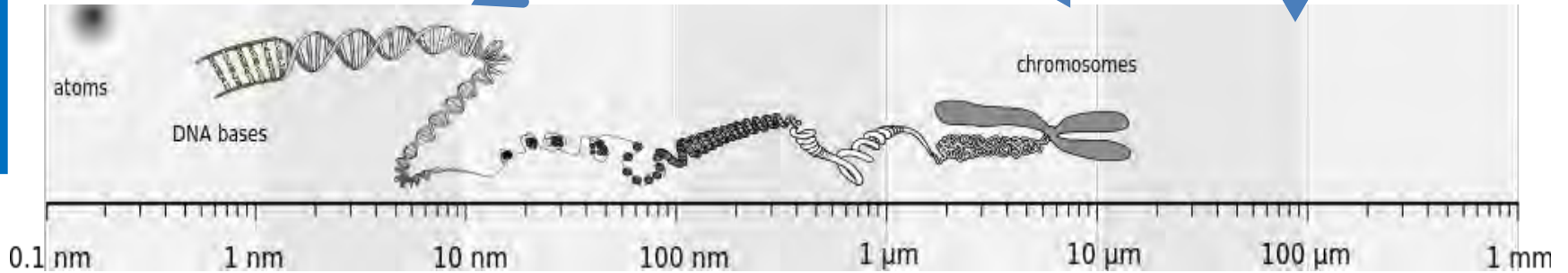


# The Nano Scale

| Nano Materials (Ultrafine PM: < 100 nm) |  |                                      |
|---|--|--------------------------------------|
| Naturally occurring                     | Incidental                                       | Engineered                           |
| ocean spray<br>friction<br>erosion      | combustion<br>laser printers<br>welding<br>fumes | designed<br>properties/<br>functions |



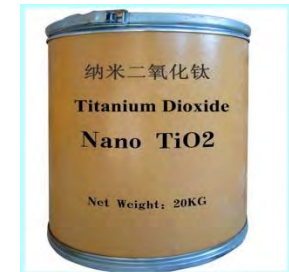
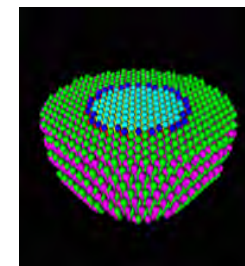
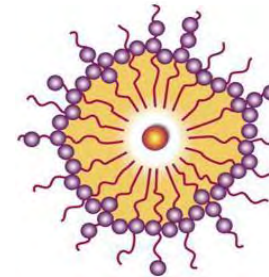
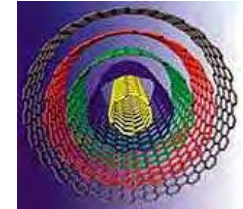
[www.elmarco.com](http://www.elmarco.com)



← nano range →

# ENM: Unique Properties...due to Quantum Effects

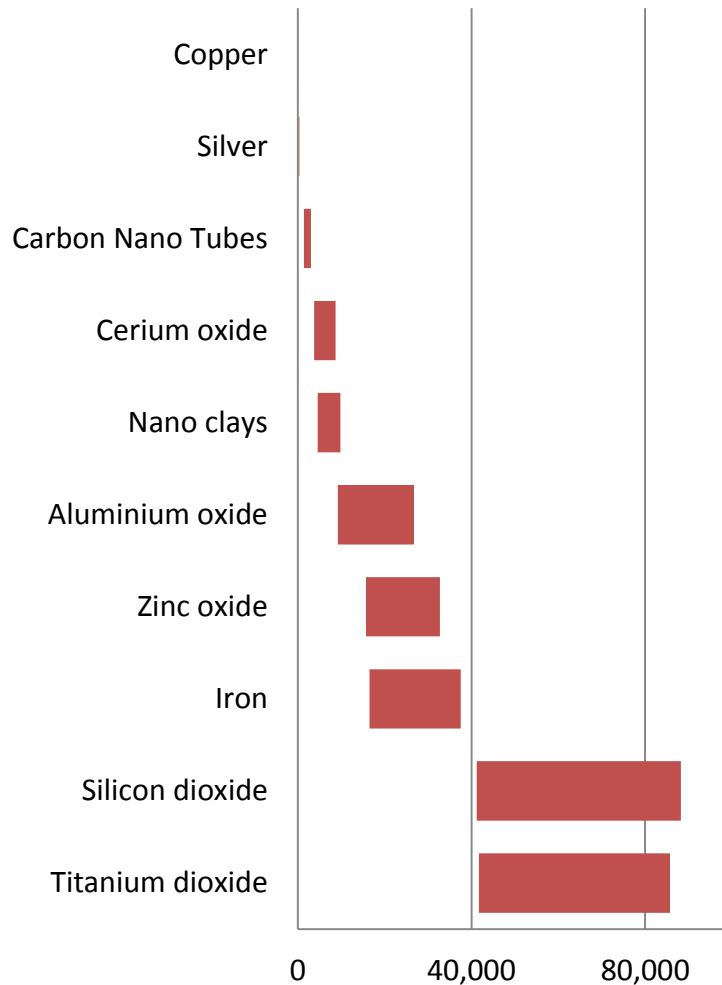
- **Nano properties  $\neq$  macro properties**
- **Surface area / gram**  
(VERY large!)
- **Size, size distribution**
- **Shape**  
(tubes, rods, wires, spheres, sheets,...)
- **Composition**  
(organic, metal, hybrid)
- **Surface modification**  
(charge, hydrophilic, lipophilic, magnetic,...)
- **Agglomeration**
- **Protein corona**



... leading to amazing applications of ENMs, including public health applications!  
We all want the benefits of this technology..... but not the unintended consequences.

# Engineered Nano Materials in the US (estimates!)

**Nano materials produced in US**  
(metric tons/yr, 2010, low and high estimates)



**US: 50% of world-wide production US**  
Total production is in US:  
134,000 – 158,000 tons/yr

## Major uses

> **1600 consumer products**  
> **487 construction products**

- Coatings, paints, pigments (textiles)
- Personal care products
- Electronics, optics
- Energy, environment
- Catalysts
- Automotive
- Medical

Sources:

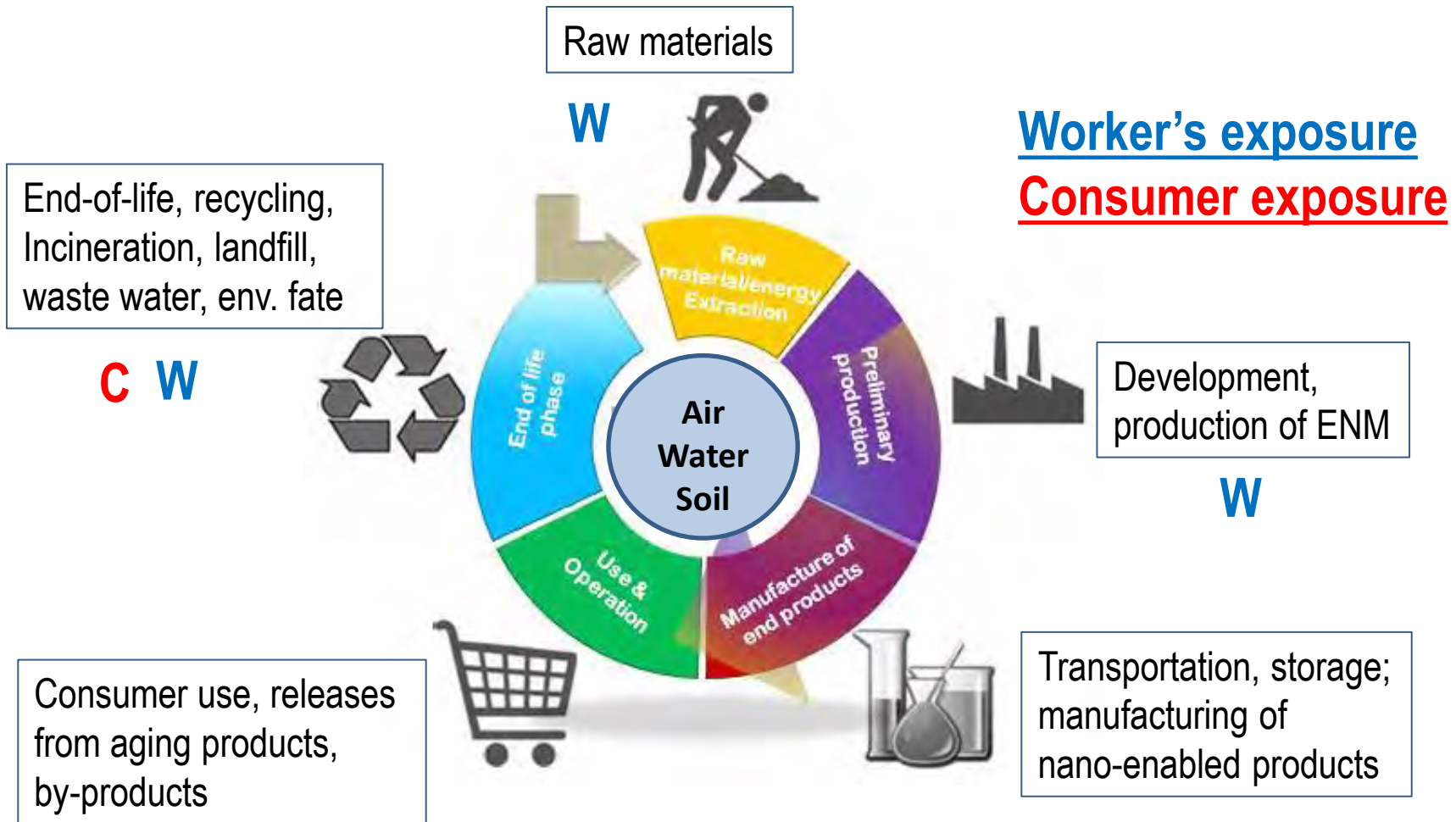
A Keller, A. Lazareva, ES&T Lett, 2014, 1, 65-70

<http://www.nanotechproject.org/>

<http://www.nano.elcosh.org>



# Product Lifecycle



**C** Exposures to humans & releases into the environment:  
**UNKNOWN !**

# Accidental Release

Source: Nowack et al, Env. Sciences Europe, 2014, 26:2

Nano TiO<sub>2</sub> spill, France, 2011  
Each bag 1500 lb of nano TiO<sub>2</sub>



# ENM: Observed Biological Effects

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- **Local**

Absorption through membranes, accumulation in lung

- **Systemic**

Translocation, blood-brain barrier, placenta, reproductive effects

- **Acute**

Reactive Oxygen Species, inflammation, mutations

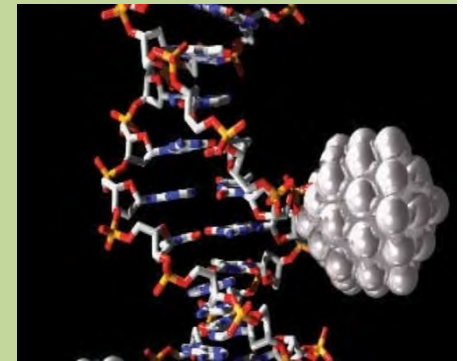
- **Chronic**

Animal studies: fibrosis (CNT); asbestos-like effects, possibly carcinogenic to humans (IARC – 2B); lung tumors (TiO<sub>2</sub>); in vitro: transformation of lung cells



# ENM: Difficulties in Assessing Toxicity

- Nano toxicity  $\neq$  macro toxicity
- Few standard methods
- Dose metrics (NOT mg/kg bodyweight):  
reactivity, surface area, particle number, ...?
- Appropriate toxic endpoints?
- Impurities, endotoxins in commercial ENM
- Poor reproducibility of published research
- Lack of published negative data
- ID worker cohorts?
- ID Sensitive Subpopulations?



# Regulatory Landscape

No legal framework specific to nano-scale materials

- Feds **regulate by product**: chemicals, consumer products, pesticides, foods, drugs, medical devices, cosmetics, hazardous waste, etc.
- **Definitions** do not differentiate between nano- and “regular” chemicals.
- Example of federal law: **Toxic Substances Control Act**  
Update on Reporting Rules (5/12/2017)?
- Local level? Worker’s RtK? Community RtK?

Berkeley’s “Manufactured  
Nanoscale Materials Health  
and Safety Disclosure  
Ordinance” (BNO)  
2006

**NIOSH Guidance:**

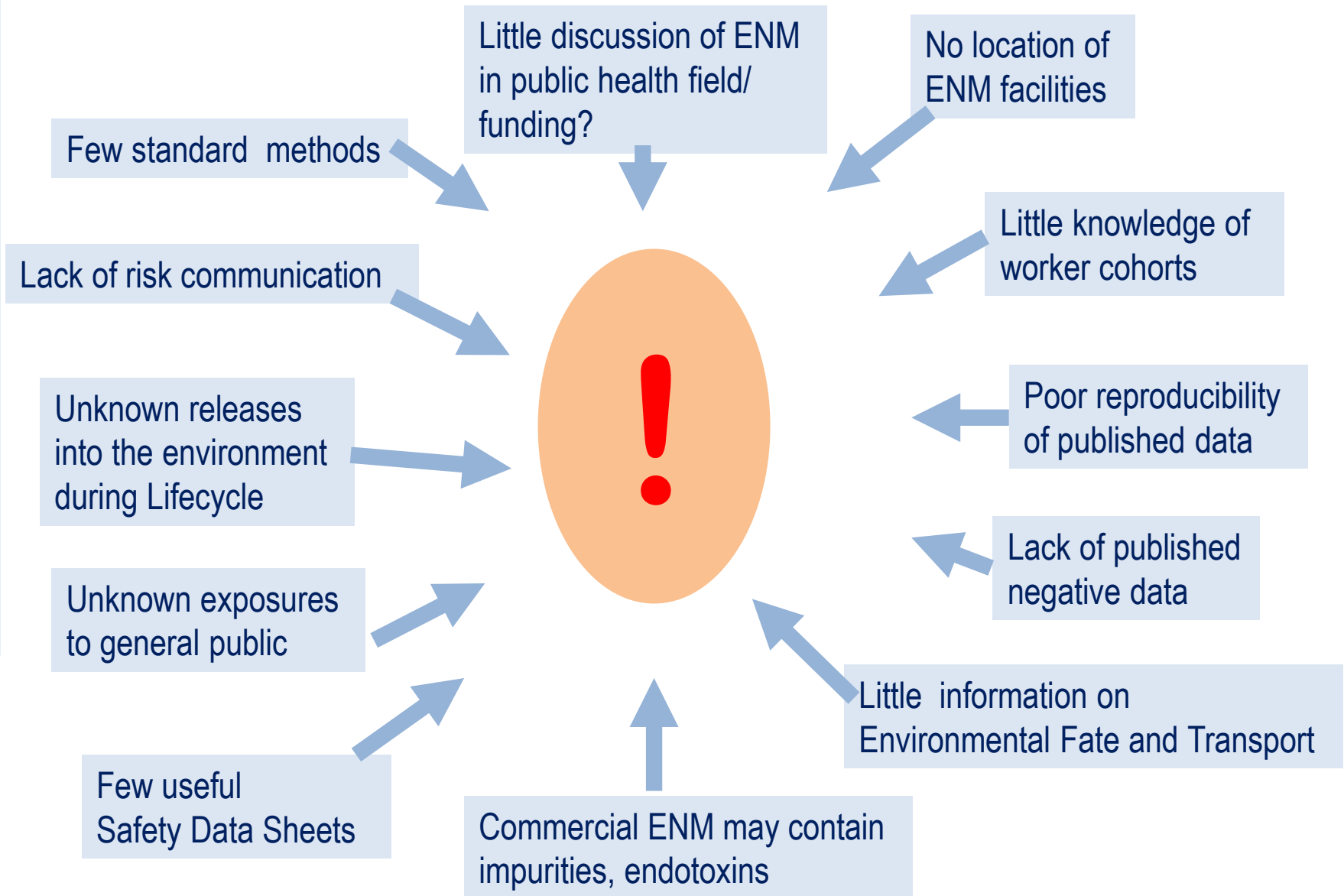
**REL nano TiO<sub>2</sub>: 300 µg/m<sup>3</sup> (potential occ. carcinogen)**

**REL CNT/CNF: 1 µg/m<sup>3</sup> (effects similar to asbestos)**

(REL: Recommended Exposure Limit)

**DoE: Registry for nano workers (DoE O 456.1)**

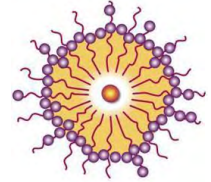
# ENM: Data gaps and uncertainties !



# Summary and Opportunities

- Great potential for beneficial uses!
- Large gaps in data, knowledge, infrastructure, especially toxicology, environmental fate
- Increasing number of products
- Unknown exposures to consumers and workers
- Unknown releases into the environment

## Unknown consequences for Public Health

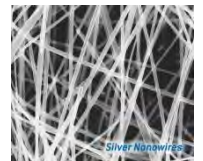


### Opportunities for local activities:

- Identify local facilities and exposed populations
- Prepare locally (emergency response, Workers RtK, Community RtK)
- Communicate with public

## Thank you!

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# ENM Resources

- Nano EHS: Communities of Research : [www.us-eu.org](http://www.us-eu.org)
- National Nanotechnology Initiative: [www.nano.gov](http://www.nano.gov)
- NIOSH: <http://www.cdc.gov/niosh/topics/nanotech/>
- NIOSH - eLCOSH nano (Construction Materials): <http://nano.elcosh.org/>
- NIOSH: Good NanoGuide: <https://nanohub.org/groups/gng>
- USEPA: <http://www.epa.gov/chemical-research/research-evaluating-nanomaterials-chemical-safety>
- USEPA Exposure Assessment Tool:  
<http://www.epa.gov/expobox/exposure-assessment-tools-chemical-classes-nanomaterials>
- NIH: <http://www.nih.gov/research-training/nanotechnology-nih>
- Woodrow Wilson Center: [www.nanotechproject.org/](http://www.nanotechproject.org/)
- Nanomaterial Registry: <https://www.nanomaterialregistry.org/>
- Denmark: <http://nanodb.dk/en/>
- France: <https://www.r-nano.fr/?locale=en>
- EU: <http://www.nanosafetycluster.eu/> and <http://www.nanopartikel.info/en/>
- Literature Checklist: <http://www.nanopartikel.info/en/nanoinfo/methods/991-literature-criteria-checklist>

