Guidance for Nanoparticles used in biological research (including use as either as a carrier or as payload)

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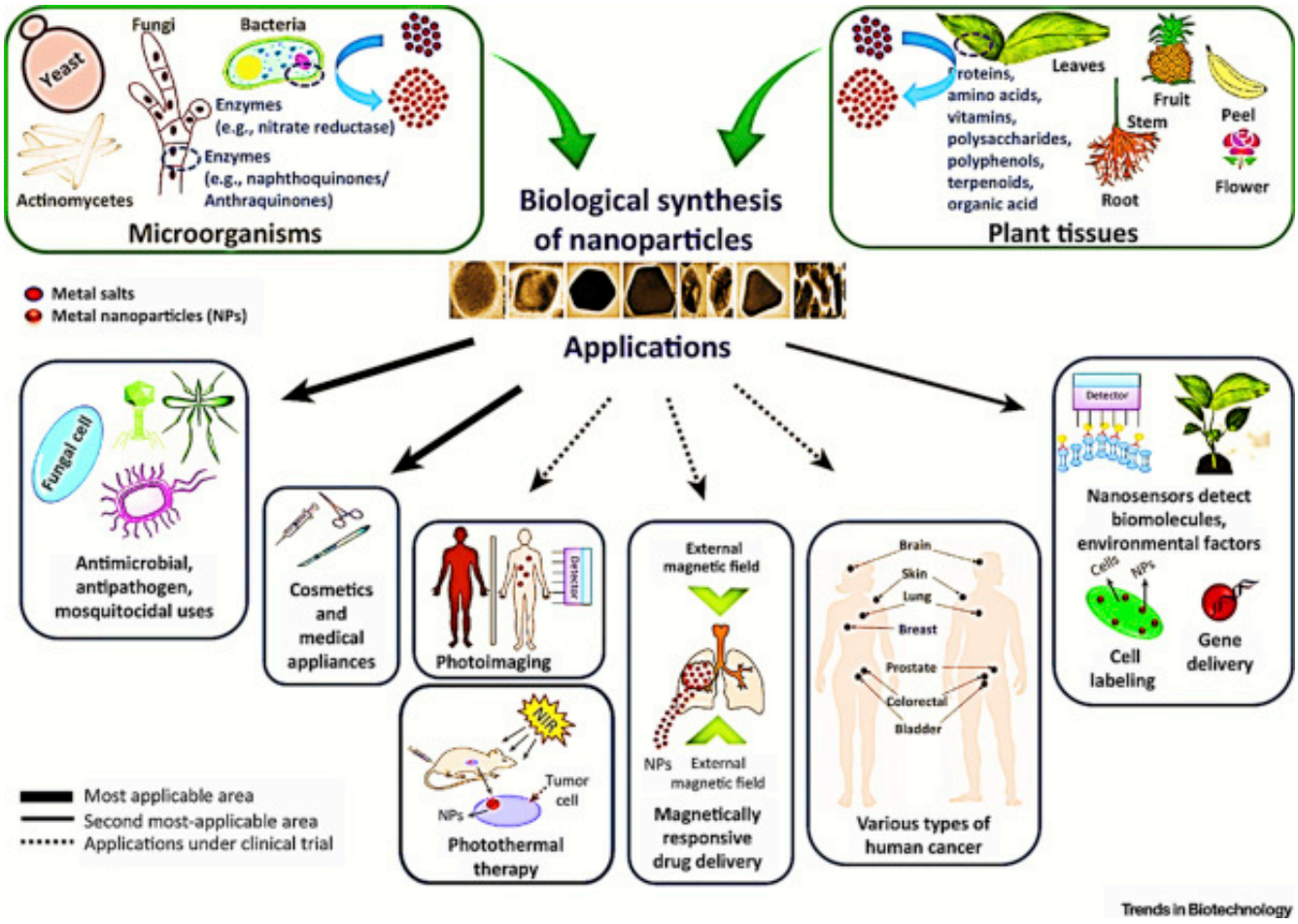
Definition

Nanoparticles are being used more frequently in biological research and present unique hazards. Nanoparticles are 1-100 nm, but ultrafine particles, tubules and fibers up to 500nm are often included in this category. Uses for nanoparticles are increasing rapidly as are the related hazards.

Examples of Uses

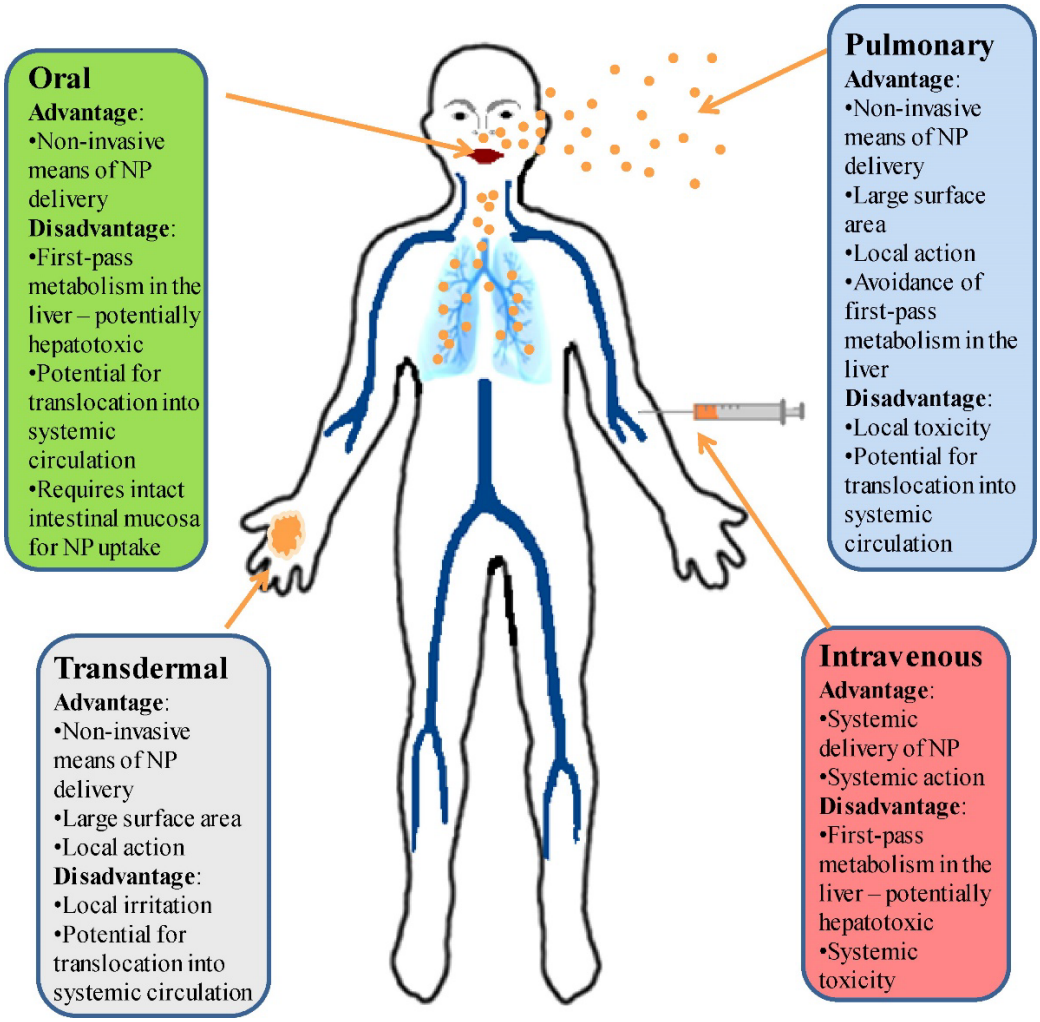
- Consumer Products: Titanium dioxide (TiO2) and Zinc oxide (ZnO) nanoparticles in sunscreen and cosmetics
- Agricultural uses: distribution of antibiotics, minerals, metals in feeds
- Biological research: wound healing, immunostimulation, cancer research
- Nanoparticles for drug delivery: Coronavirus vaccines, chemotherapies



https://www.sciencedirect.com/science/article/pii/B9780128144275000159

Elements Contributing to Risk

- Nanomaterials may enter the body through inhalation, ingestion, or dermal contact.
- Due to their small size, nanoparticles and other nano-objects can reach organs and parts of biological systems which are not normally accessible by larger particles.
- Unintended delivery of drugs, radiation, or other hazardous materials



https://www.sciencedirect.com/science/article/pii/S1748013211001137

Risk Assessment

The Office of Biosafety encourages Investigators to contact us directly to assist in doing a thorough risk assessment.

Information that will be useful for risk assessment include:

1. Name of the nanoparticle.

2. Source of the nanoparticle. For example: created in own laboratory, received from a collaborator, purchased.

3. Description of nanoparticle components (starting product): Please describe the individual components of the nanoparticle. Please consider the following questions in your response and provide the information that is relevant to your research:
   - What is the concentration of each starting material?
   - What are the carrier, payload, targeting agent and other components?
   - What is the state of each component? (powder, liquid, gelatinous, gaseous, other)
   - Is the component or final product purchased or received by your lab ready-made? What is the concentration range or ratios of starting materials when producing the nanoparticles: carrier, payload, targeting agent (e.g., antibody, peptide, protein) or other?
   - How does it enter the cell?
   - What are other associated elements in its makeup?
   - How does the carrier and payload interact/connect?

4. Preparation of nanoparticle (steps): Please describe the steps in the preparation of the nanoparticle. Please consider the following questions in your response and provide the information that is relevant to your research:
   - What are the steps? (mixing, heating, sonicating, pipetting, reconstituting, dilute, aliquot)
   - What is the containment at each step? (bench, fume hood, BSC, other)
   - Are there any special considerations in choice of location for each step? (Why perform the step on the bench? Why perform the step in the fume hood?)

5. Description of nanoparticle as used (final product): Please describe the final nanoparticle product. Please consider the following questions in your response and provide as much information as possible relevant to your research:
   - What is the administration method? (injection, oral, transdermal, inhalation, ...)
   - What is the concentration/load/dose?
   - Is there containment during administration?
   - Are there any general special considerations? (What increased risks are associated with the final product? Is the final product of less or greater risk than the components and why? Does the final product have special features that impact a change of risk?)
   - What are the risks of using the final product and how are the risks mitigated?
   - Is the final product purchased or received by your lab ready-made?

6. Description of what the nanoparticles does (after use/administration): Please describe what the nanoparticle does. Please consider the following points in your response and provide as much information as possible relevant to your research:
   - Please indicate if the nanoparticle spreads in the body post administration. If yes, please indicate the location. If unknown, please state this.
   - Please indicate if the nanoparticle is shed or excreted. If yes, please indicate how it is shed or excreted. If unknown, please state this.
   - Please state the intended target of the nanoparticle and if known, please include information on any off-target hits.

7. Any additional information that may be relevant for risk assessment.
8. Assumed the biosafety level (containment) for this nanoparticle.

Health Risk Mitigation

For Health Assessment with Occupational Health and/or Respirator Guidance

See the Environment, Health & Safety page for Nanoparticles

Helpful Hints

- Check with Chemical Safety to see if there is a safer option before ordering
- Check with Occupational Health regarding risks and mitigation steps before ordering
- Before starting work think carefully about what kind of accident could occur (i.e., spill, needle stick) and ways to mitigate the risks such as extra PPE, restricting access to the area while in use, posting caution signs, extra training, limiting use to senior personnel
- Where inhalation risk exists, and it is possible, dissolve powder into a solution and store aliquots
- Use as small of an amount as possible to accomplish the goal
- Ensure experienced personnel are well trained before using (Do not have undergrads weigh/prepare nanoparticles)

Adding Nanoparticles to ARROW

Link to KB doc for addition in ARROW

1) Overview: Under Layman's Description, add a sentence or two describing the intended work with nanoparticles.
2) Description of Locations: Add the room(s) where nanoparticle work will occur. Under "Room Use", select "Other" and write in "Nanoparticle work" under "Room Use-Other Details".
3) Nanoparticles: Complete according to the above Hazard Assessment with OBS
4) Containment: Describe precautions that will be used to contain the nanoparticles to desired areas (e.g., fume hoods, BSC, clean box, powder weighing station). Use of BSC should be discussed with the BSC Certification Program Manager in advance. If nanoparticles will be used outside containment, describe extra precautions employed as risk mitigation in the "Biological Materials Outside of Containment" section.
5) PPE: After consultation with Occupational Health, add a separate entry for PPE that will be worn.
6) Disinfection/Inactivation: Record the process that chemical safety and biological safety advise for this mixed used material in the "Disinfection/Inactivation-General" table. In the bottom box, "Other Material Inactivation", name the nanoparticles to be used. In the following box, "Other Material Disinfection/Inactivation Details", record the process.
7) Signage: Specify hazard communication for materials handled- OBS/Chemical Safety sign
   Signs made by OBS- Caution sign "Nanoparticles in Use"
8) Emergency Response: Add information on steps to take should an accident or potential exposure occur, or nanoparticles spilled/released into the environment in the "Emergency Response-Special" section. Include medical steps to take, information to give medical personnel and instructions to submit within 24 hours the form "First Response for Biological Exposure or Release Event" https://ehs.wisc.edu/first-report-of-biological-exposure-or-release-event/. After consultation with Occupational Health, record relevant information in the "Occupational Health Considerations" section. In the "Lab Specific Training" section, record additional training that will be given to personnel working with nanoparticles.
9) Research Description: Describe the work to be done with nanoparticles, the risks, and the risk mitigation steps.

Signage

A caution sign for working with Nanoparticles on the bench is available. This sign should be posted during active work to caution others entering the room and/or inform others of additional PPE required to enter room during active work on the bench.

https://mappingignorance.org/2013/06/05/nanohazards/

Possible signs:
https://www.google.com/search?q=Nanoparticle+caution+sign&rlz=1C1GCEB_enUS931US931&tbm=isch&source=iu&ictx=1&fir=3GuC-kRlLHw3iM%252C7KVwOu3h8ZWB6M%252C_&vet=1&usg=AI4_-kQ7mSGwU0zjRrth6Clc3mgSgqBBZw&sa=X&ved=2ahUKEwiksY7o3_TxAhVUCs0KHbjMDq0Q9QF6BAgqEAE#imgrc=3GuC-kRlLHw3iM