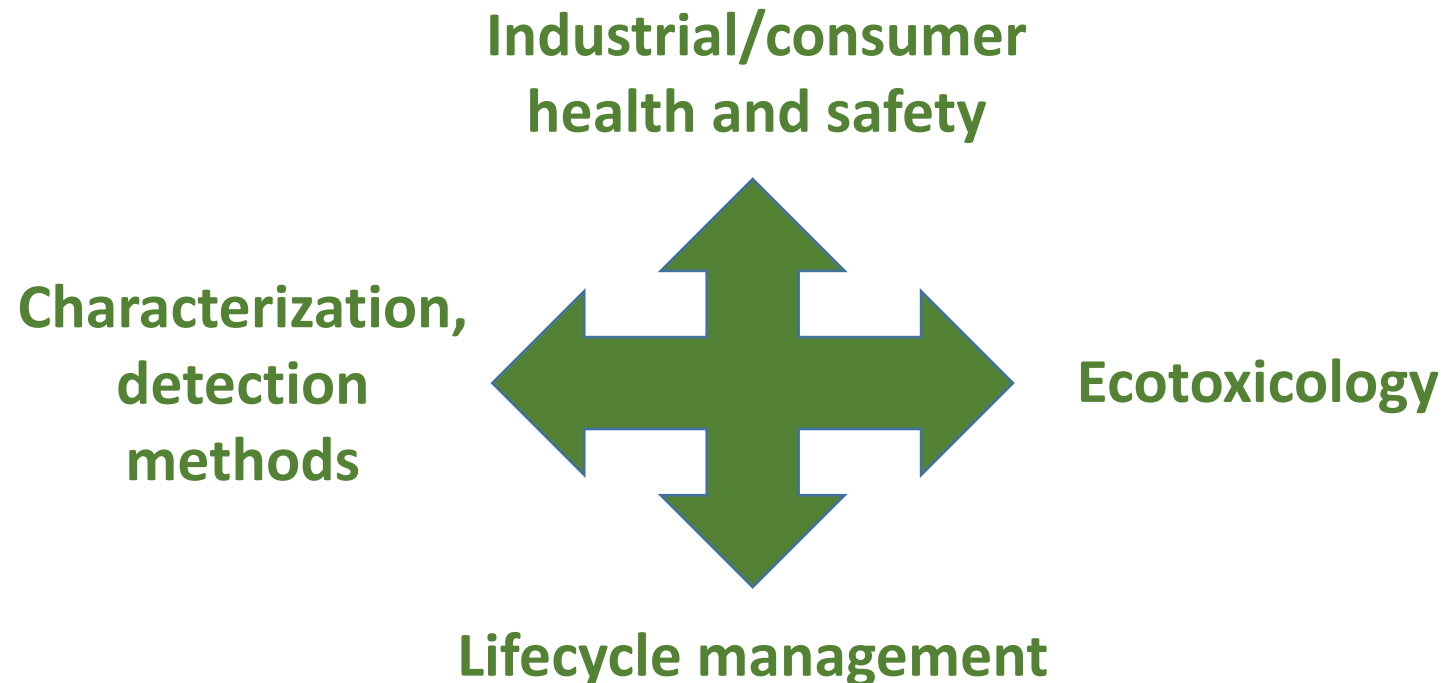


- **WHAT IS THE BATTERY OF SKILLS NEEDED FOR NANOTOXICOLOGY ASSESSMENT?**
- **WHICH TECHNOLOGIES ARE NECESSARY TO PERFORM A COMPLETE STUDY ON NANOSAFETY?**



- **WHAT IS THE BATTERY OF SKILLS NEEDED FOR NANOTOXICOLOGY ASSESSMENT?**
- **WHICH TECHNOLOGIES ARE NECESSARY TO PERFORM A COMPLETE STUDY ON NANOSAFETY?**



MANY AND HIGHLY COMPLEX



**INTERACTION BETWEEN RESEARCH
INSTITUTIONS-MANUFACTURING INDUSTRY
IS NECESSARY**



- **WHAT IS THE BATTERY OF SKILLS NEEDED FOR NANOTOXICOLOGY ASSESSMENT?**

JRC SCIENCE FOR POLICY REPORT

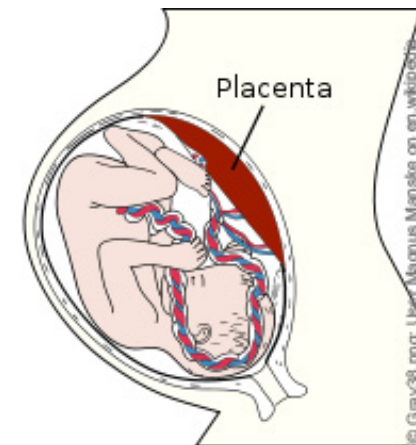
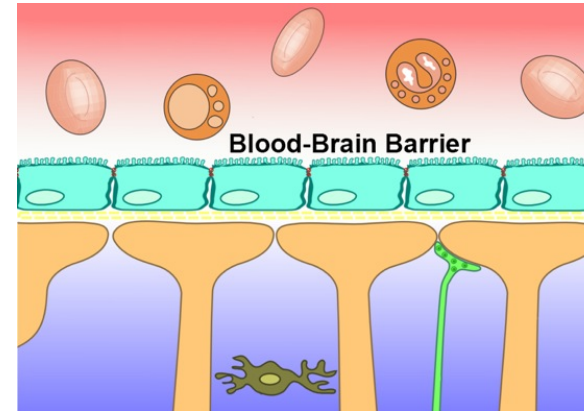
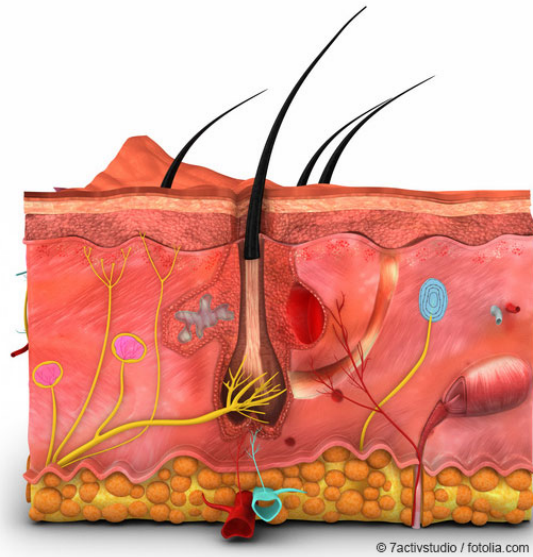
Accelerating progress in the Replacement, Reduction and Refinement of animal testing through better knowledge sharing



The 3Rs states:

- Replacement (with nonanimal models)**
- Reduction (of animal numbers)**
- Refinement (to decrease animal suffering)**

It is critical to assess the **health impacts of nanoparticle exposures** for all routes when considering **exposures to both occupational workers and consumers, plus the environment**



COMPLEXITY

Animals

Mus musculus



Danio rerio



Plants

Arabidopsis thaliana



Triticum aestivum



Vicia faba

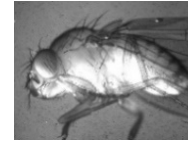


Invertebrate

Caenorhabditis elegans



Drosophila melanogaster

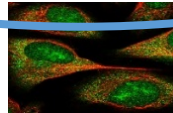


Daphnia magna



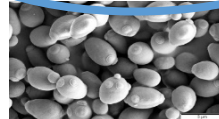
Higher eukaryotic cell lines

Mammalian cell lines

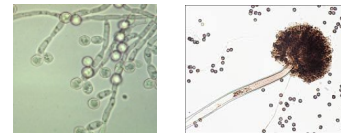


Eukaryote, unicellular/pluricellular

Saccharomyces cerevisiae

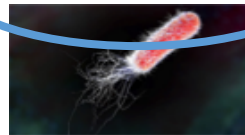


Other fungi

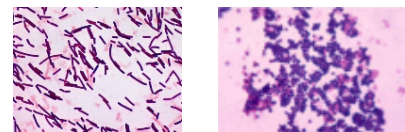


Prokaryote

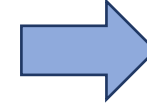
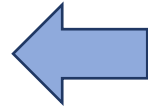
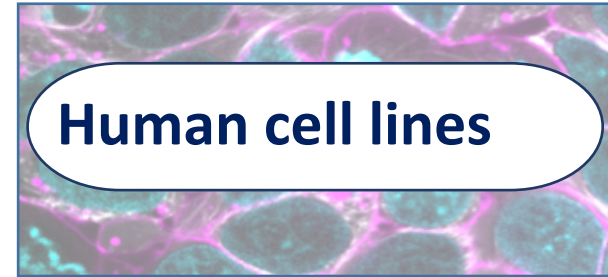
Escherichia coli



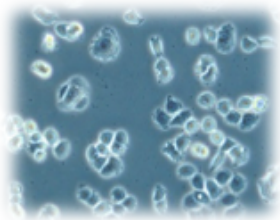
Other bacteria



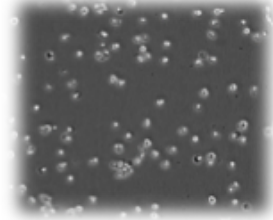
Assessment of nanoparticles safety at ICCRAM



Human breast adenocarcinoma cells (MDA-MB-468)



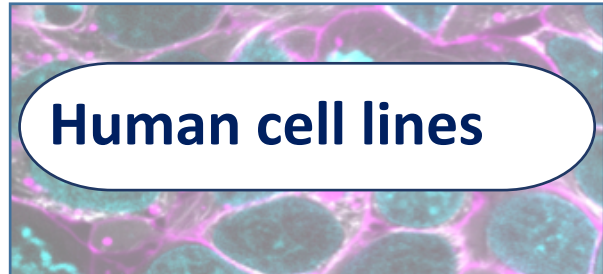
Mucoepidermoid carcinoma cells from human lungs (NCIH292)



In Vitro Tumor Models : Immortal cell lines

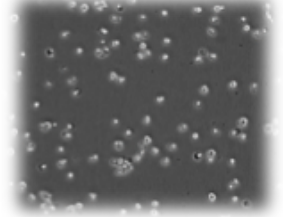
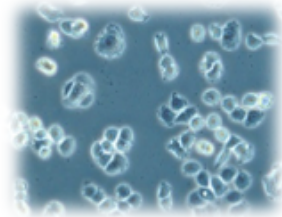
- Cost effective
- Known structure and molecular organization
- Easy to use
- Bypass ethical concerns (3Rs principle)
- Pave the way for more complex studies

Assessment of nanoparticles safety at ICCRAM



Human breast adenocarcinoma cells (MDA-MB-468)

Mucoepidermoid carcinoma cells from human lungs (NCIH292)

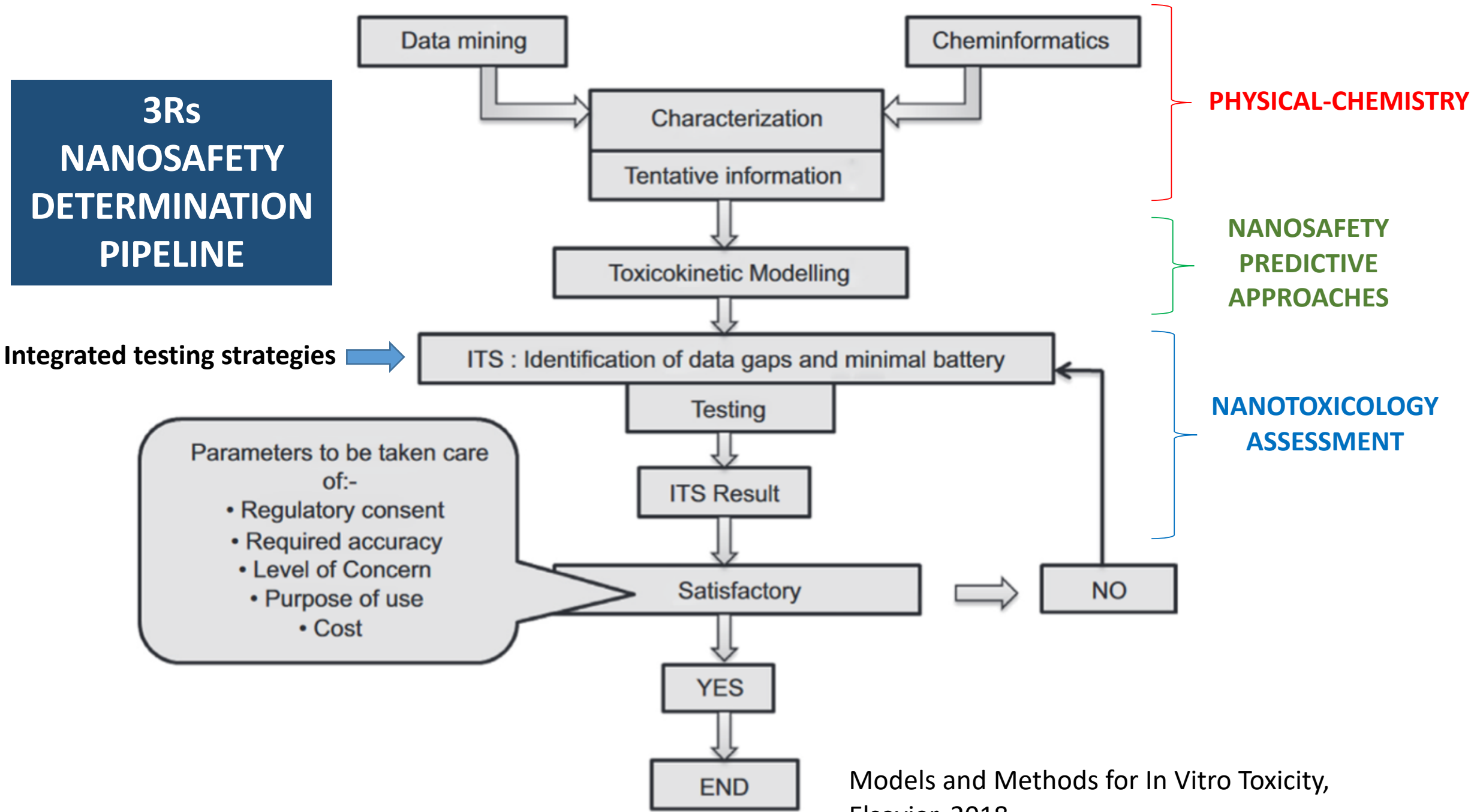


In Vitro Tumor Models : Immortal cell lines

METHODS FOR *IN VITRO* TOXICOLOGY

- ❑ Cell viability assays
- ❑ Membrane integrity/Oxidative stress (ROS)/DNA damage
- ❑ Intracellular location studies
- ❑ General cellular response

3Rs NANOSAFETY DETERMINATION PIPELINE



Models and Methods for In Vitro Toxicity,
Elsevier, 2018

Geographical distribution of knowledge sources with 3Rs relevance

