NanoCenter

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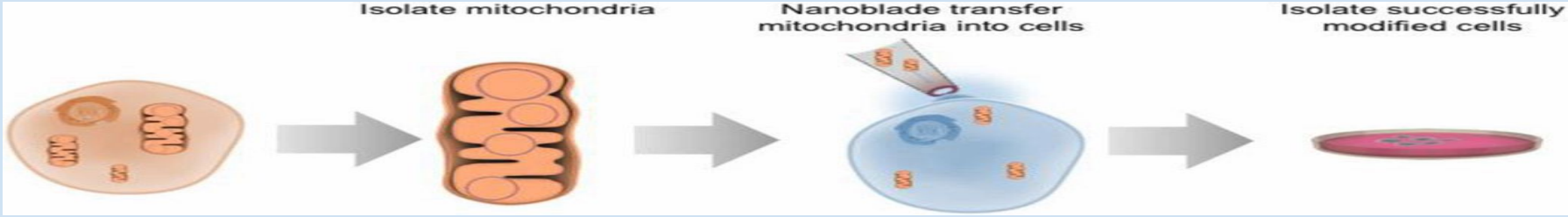
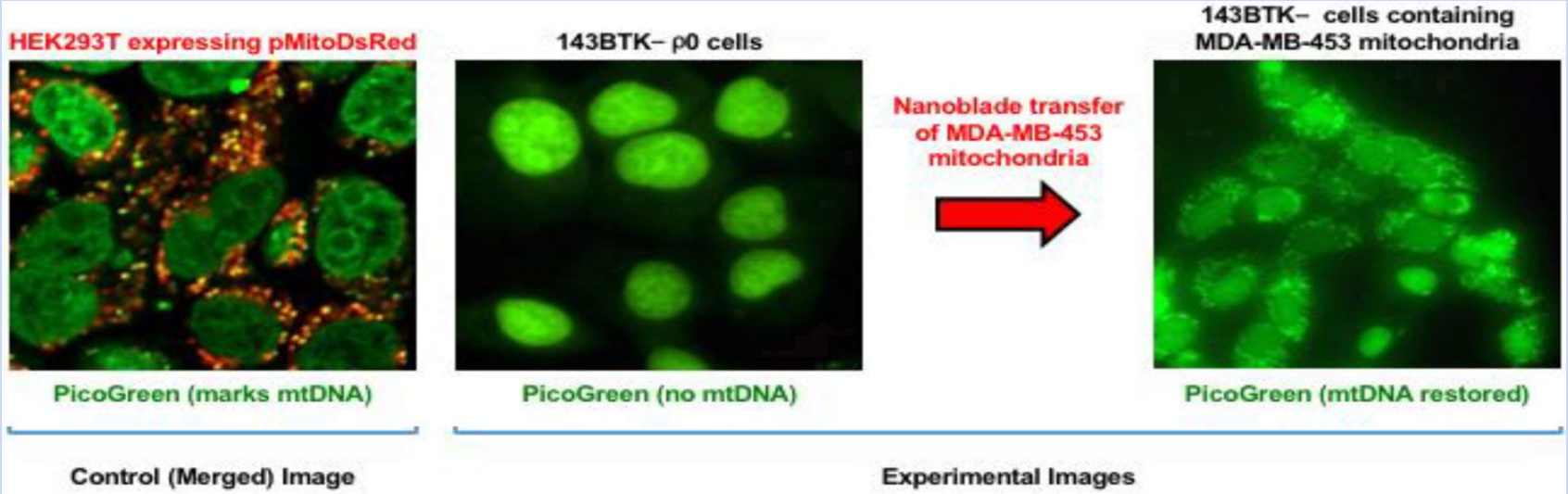
What? “A photothermal nanoblade couples a metal-tip-coated, wide-bore micropipette and a pulsed laser to induce a microscopic ‘explosion’ that cuts cell membranes, enabling the delivery of mitochondria.”[1]

How? “This team developed a method to transfer micro-meter sized mitochondria (“genetic material, conjugated quantum dots, and live intracellular bacterial pathogens”), into the cells of a mammal. They achieved high efficiency and cell viability. “They heated with a 532nm-wavelength non-damaging laser pulse.” This caused stress which made a tear in the cell wall, allowing them to drive into the cell with pressure, the cargo.



Mitochondria containing mitochondrial DNA (mtDNA) are isolated from a cell (MDA-MB-453) and transferred into another cell (143 BTK–ρ0) that lacks mtDNA and cannot respire. Cells that receive and replicate transferred mitochondria respire and were cloned from media lacking uridine.

1) http://spie.org/newsroom/6606-a-photothermal-nanoblade-rescues-mitochondria-function-in-human-cells (September 1, 2016)



“Cells with functional mitochondria contain mtDNA (the cells are stained with picogreen and appear yellow where they overlap with MitoDsRed). Cells that lack mtDNA do not stain with picogreen in the cytosol. Delivery of isolated mitochondria into cells by photothermal nanoblade produces rescue cells with speckled picogreen cytosolic staining, which indicates mtDNA replication.” http://spie.org/newsroom/6606-a-photothermal-nanoblade-rescues-mitochondria-function-in-human-cells

Nanotech can threaten mitochondria

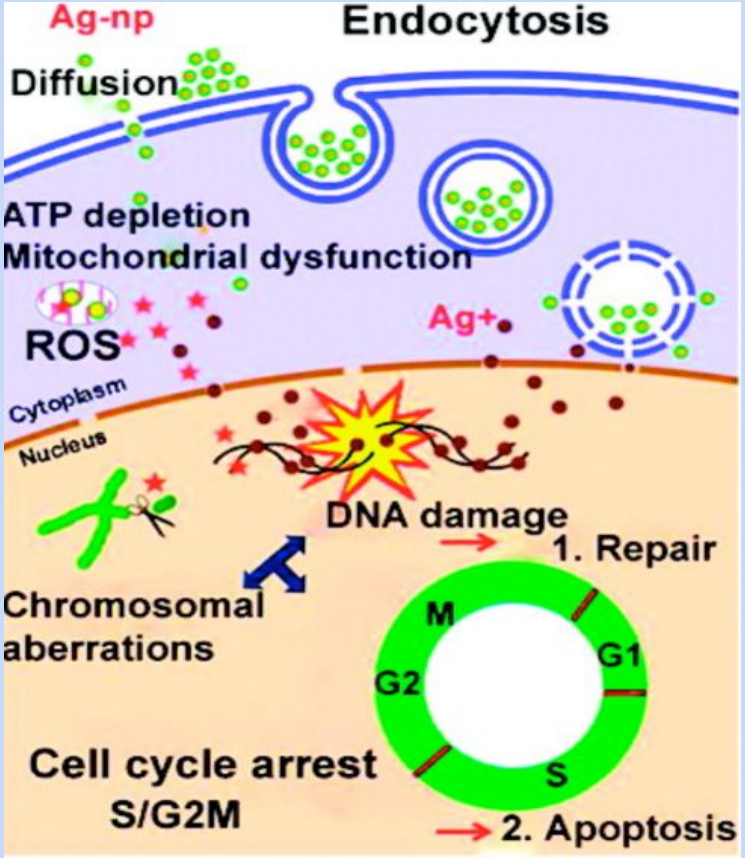
“Hypothetical mechanisms of silver nanoparticle (Ag-np) cytotoxicity.”

-”Ag-NPs can enter into the cell by diffusion or endocytosis. “

-”Once inside the cytoplasm, they can interfere with energy production in mitochondria and promote the generation of reactive oxygen species (ROS).”

-”ROS and Ag+ ions released from Ag-NPs may cross the nuclear membrane and cause DNA damage.”

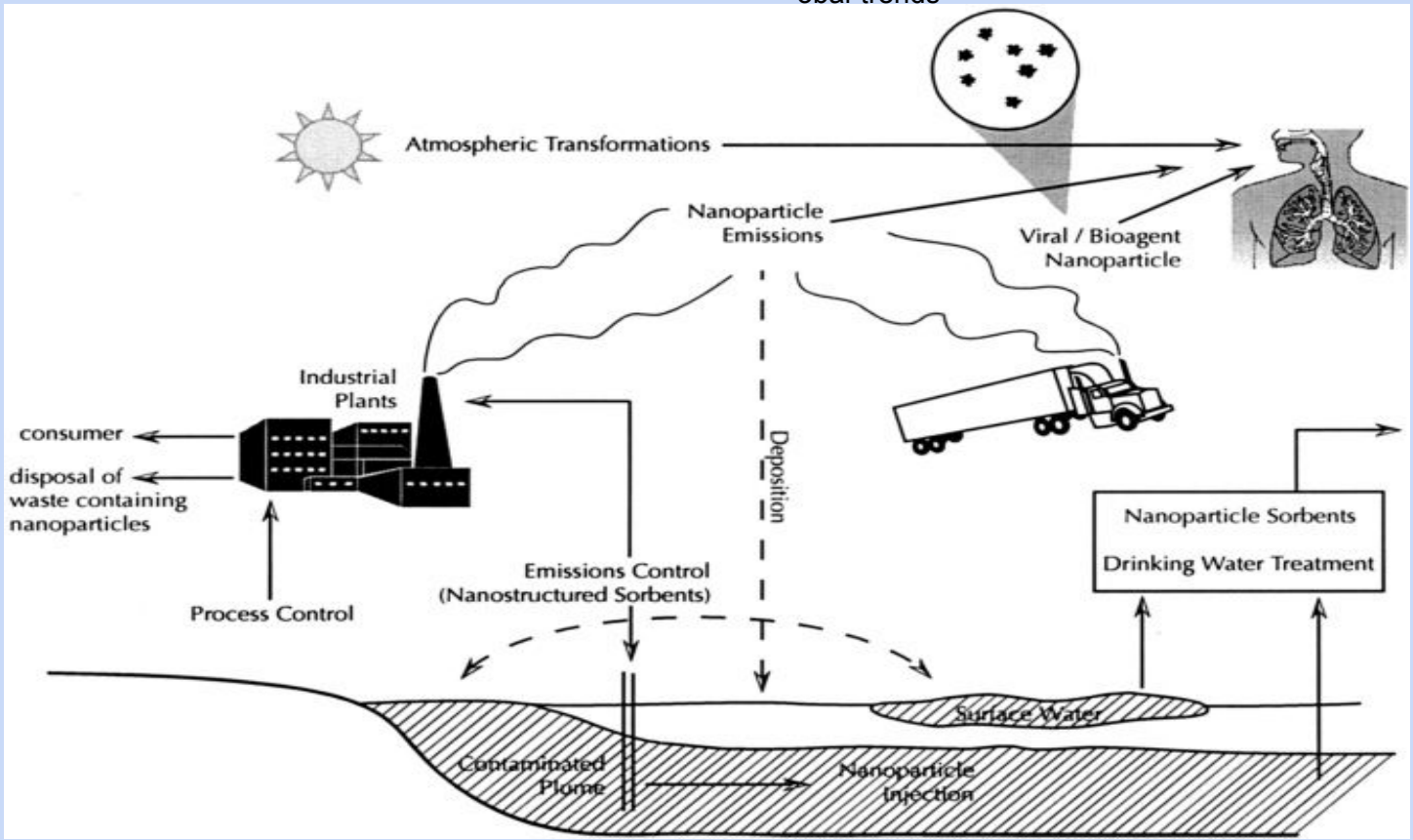
-”DNA damage can be either repaired or lead to irreversible chromosome damage or cell death (apoptosis)”



http://www.enea.it/it/pubblicazioni/EAI/anno-2012/n.-1-gennaio-febbraio-2012-1/approaching-the-responsible-use-of-nanotechnologies.-the-global-trends

Nanoparticles in the environment

http://www.enea.it/it/pubblicazioni/EAI/anno-2012/n.-1-gennaio-febbraio-2012-1/approaching-the-responsible-use-of-nanotechnologies.-the-global-trends



The Nanoparticle Paradox

Size -That which makes it able to escape the body, is also that which allows it to pass through barriers we don’t want them to.

“Experiments on the pulmonary exposure of rats demonstrate that:”

-”Ag NPs accumulate in the lungs, are able to translocate in other organs like liver, kidney, spleen, brain but they are also cleared by excretion.”

-”Ag NPs can cross the air-blood and blood-brain barriers, the blood carries the particles in the circulatory system .”

-”...particles accumulate in the filter organs, especially in the liver.”

-”...smaller particles have a larger ability for a widespread distribution, but also an increased possibility to pass through filter organs like liver and spleen, and be excreted.

Another Way Nanotech can save Mitochondria Directly (in vivo)

http://www.nature.com/mt/journal/v19/n8/full/mt201199a.html

““Schematic diagram illustrating mitochondrial macromolecule delivery via a series of membrane fusions using dual function (DF)-MITO-Porter. Complexed particles of cargos are coated with mitochondria-fusogenic lipid envelope (inner) and endosome-fusogenic lipid envelope (outer).”