

Silver Nanoparticles in Medical Applications

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Researching Nano Silver

- **Why Study Nanotechnology in Society?**
 - To study the social risk perception and response to different applications of nanotechnologies.
- **Understanding Silver Nanoparticles**
 - Antibacterial Properties
 - Large Surface-to-Volume ratio
 - Environmental Protection Agency (EPA) regulations
- **Consumer Products:**
 - Water / Filtration
 - Clothes
 - Wound Applications
 - Electronic Devices



Research Goals

- **Global Value Chain**

- *“The full range of activities that are required to bring a product from its conception to its use and beyond. This includes activities such as design, production, marketing, distribution, and support to the final consumer...”*

www.globalvaluechains.org

- **Product Analysis**

- **Health Implications**

- What are the benefits and Who can benefit from them?

- **Environmental Impact**

- What happens at the end of the product's life?

- **Toxicological Studies**

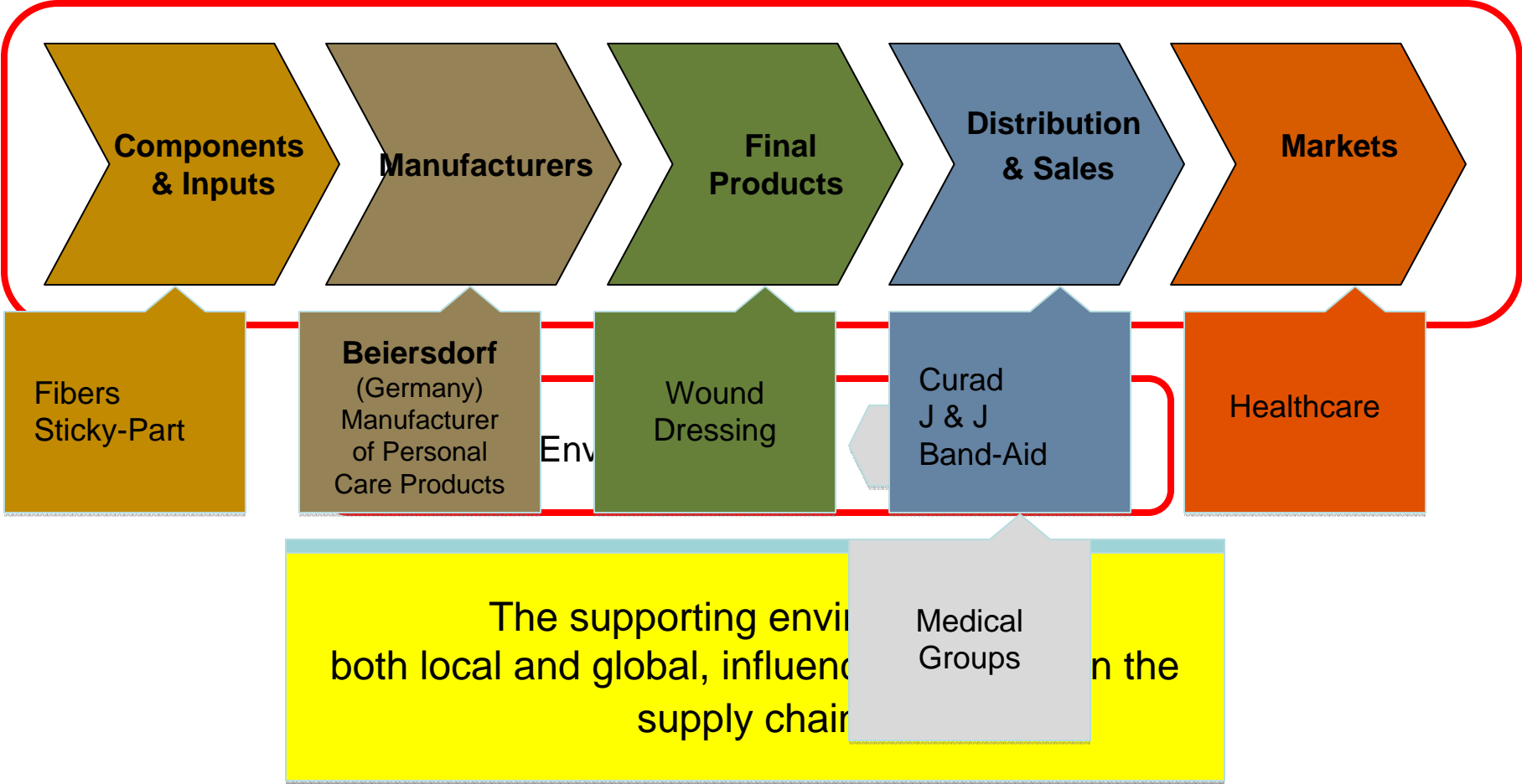
- What are the risks imposed to those handling and producing the material?

- Acute vs Chronic Exposure

- What are the regulations, if any, set forth in companies outside the US for outsourced products.

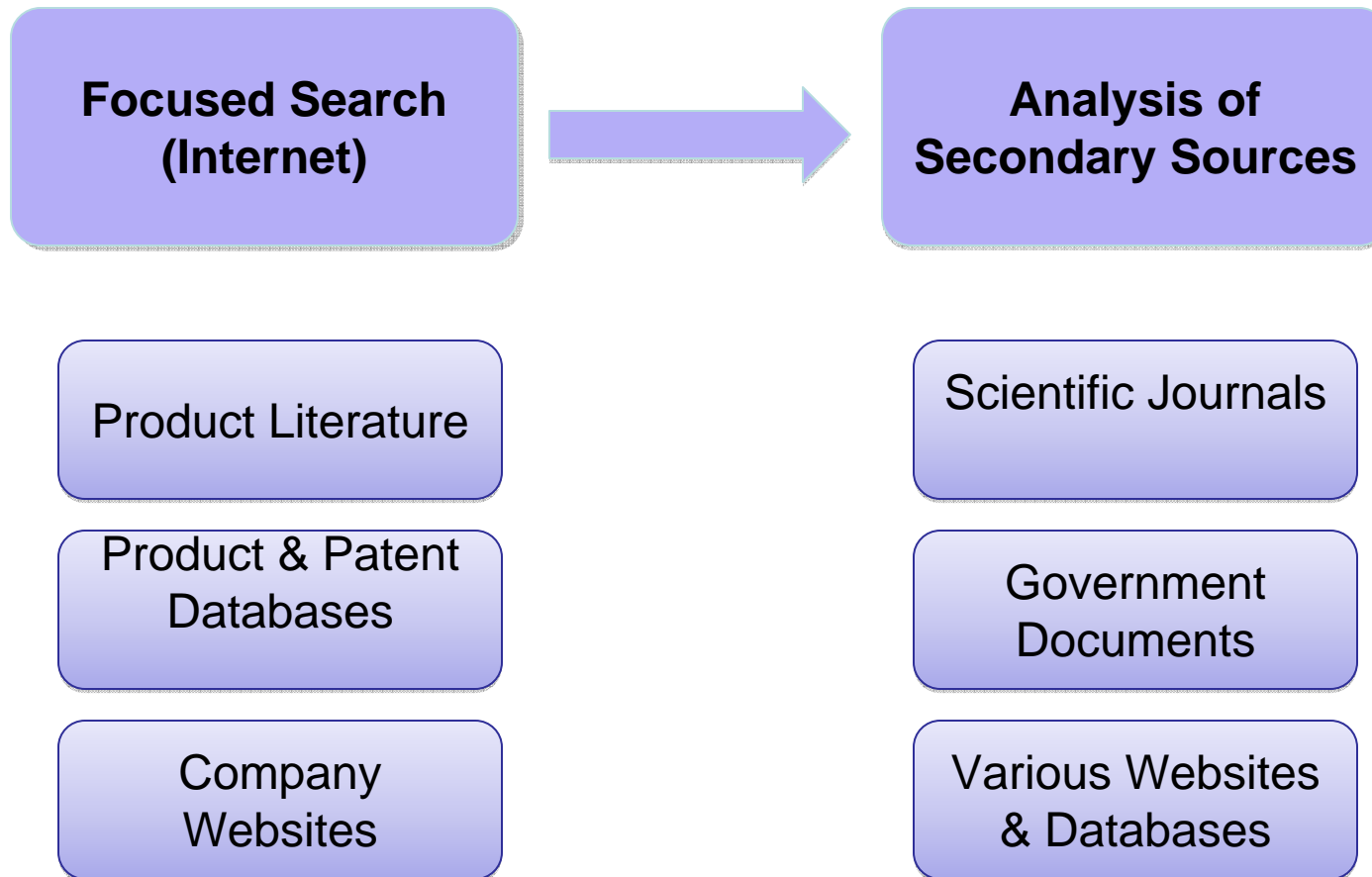
Creating a Global Value Chain

Supply Chain Model:

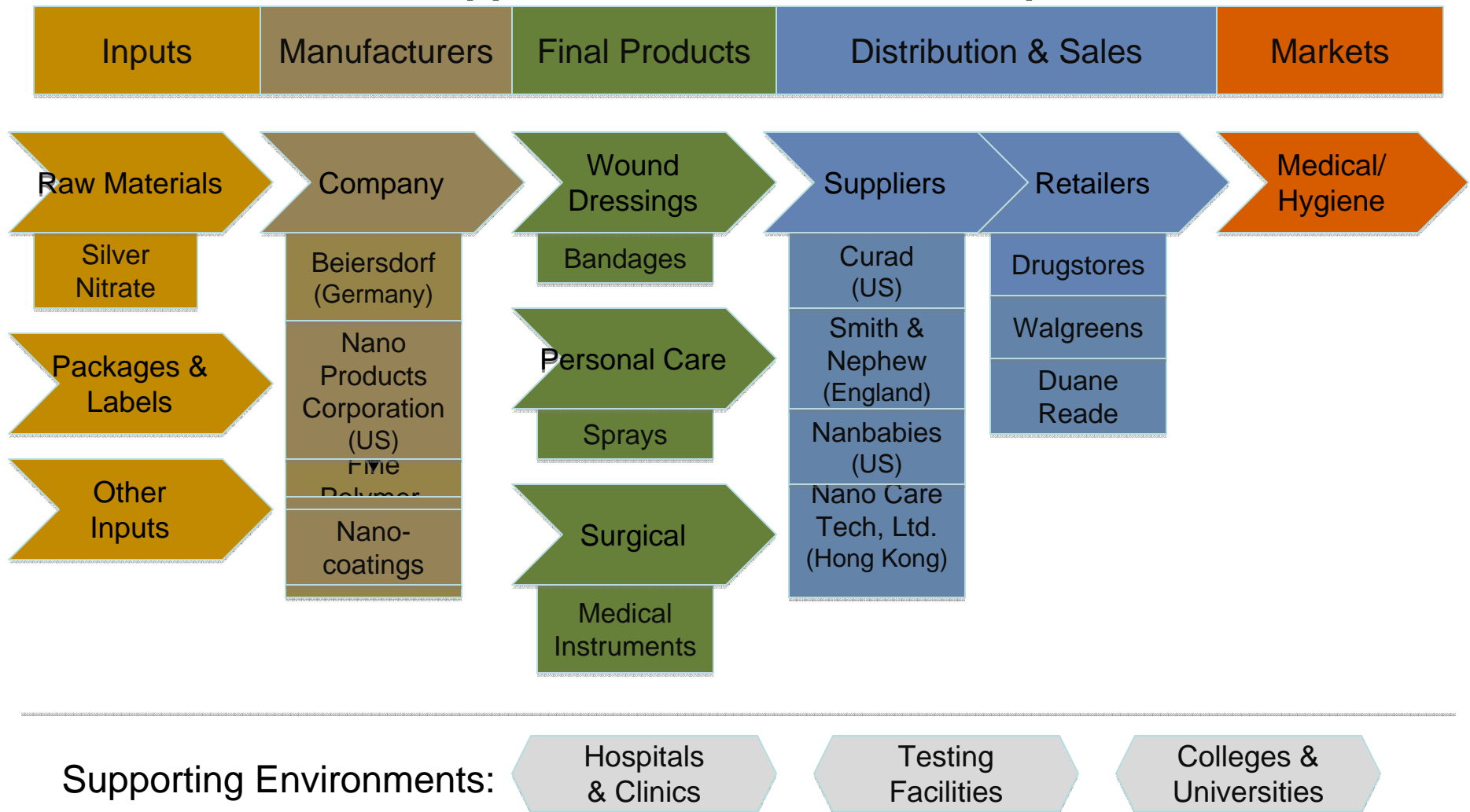




Methods for Data Collection



Global Value Chain for Medical Applications with Silver Nanoparticles





Silver Nanoparticles: A Safe Nanoproduct in Medical Applications?

Health Implications & Benefits:

- **Strong antibacterial effect** – Interferes with bacterial growth by disrupting the cell membrane and blocking the metabolism of the bacteria.
- Silver wound dressings are used in hospitals for patients with burns and infections that resist treatment.
- Has the potential to kill many deadly viruses and to prevent disease.
e.g., HIV, AIDS
- Available for individuals far from medical facilities.
e.g., Military Personnel, Travelers



Silver Nanoparticles: A Nanoproduct in Medical Applications

Toxicological Studies:

- Traditional belief is that silver is **relatively safe and non-toxic** to mammalian cells.
 - Low risk to consumers.
- Long term exposure studies are limited.
 - Exposure at the manufacturing level.
- **Organ accumulation** may cause possible adverse effects.
 - Liver (Rat Studies).
 - Depletes the antioxidant defense mechanism, which leads to ROS* accumulations.
 - Programmed cell death is a final result.
- Skin pigmentation known as *argyria* can occur with prolonged exposure.

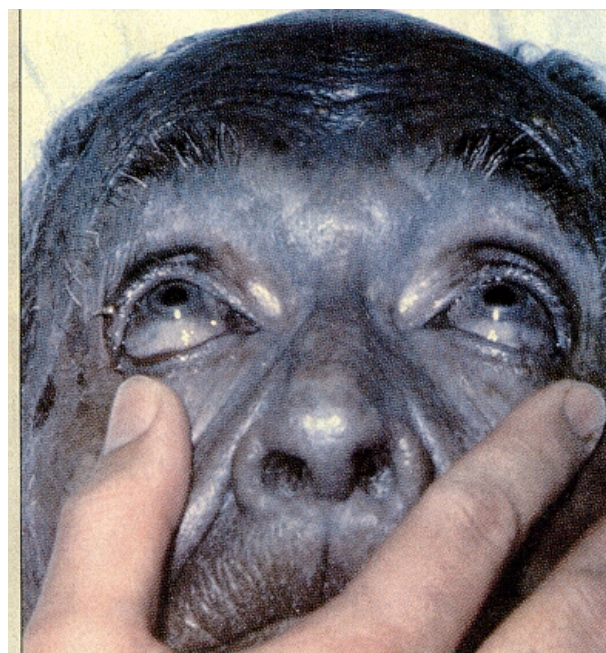
*Reactive Oxygen Species

Silver Nanoparticles: A Nanoproduct in Medical Applications

Argyria -
is a
condition
where the
skin turns
blue-grey
from use
of silver.



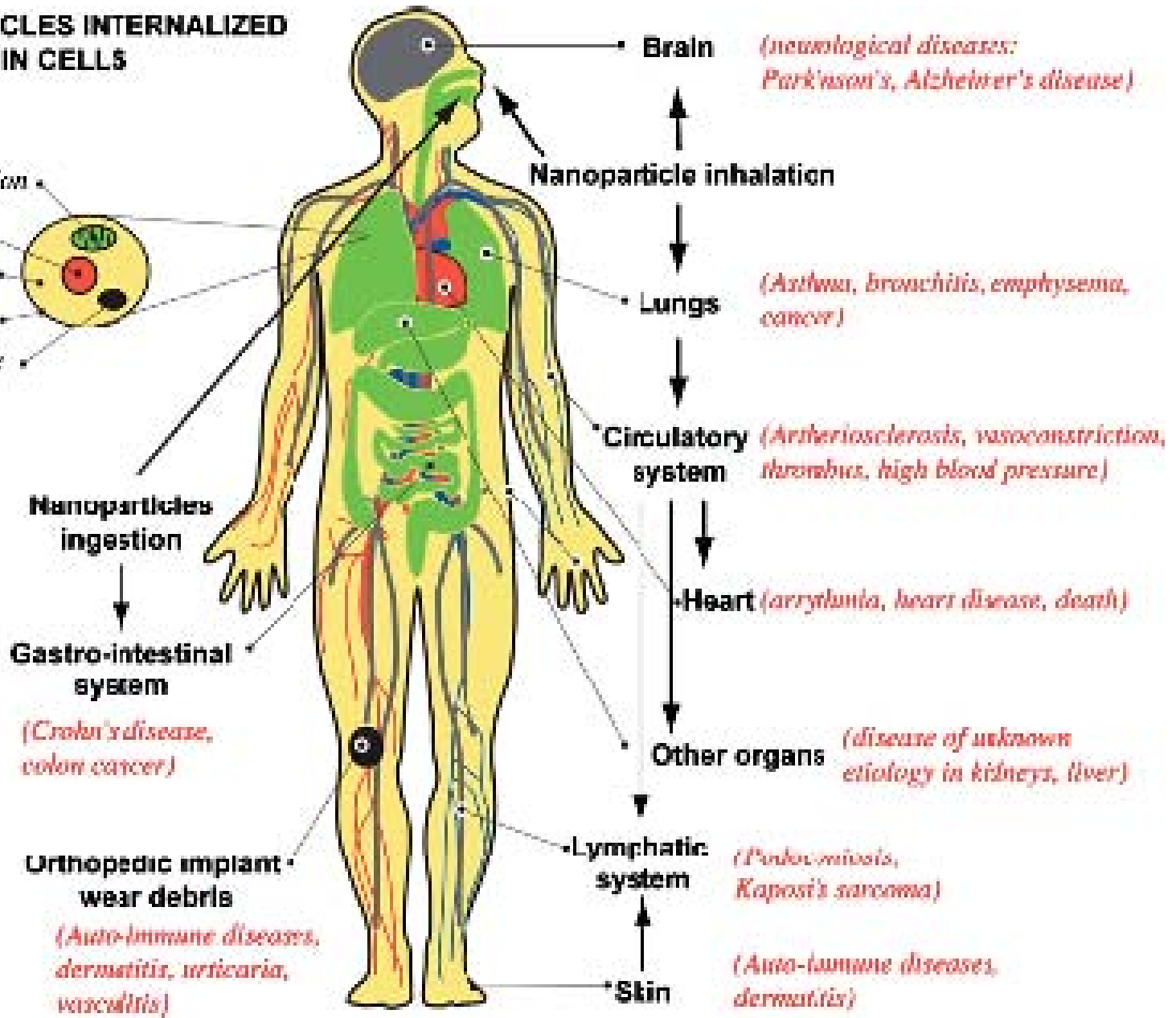
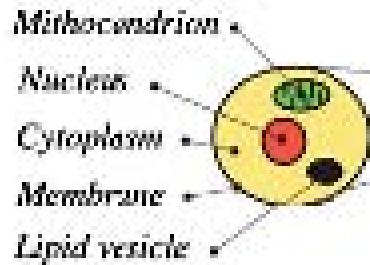
Stan Jones
US Senate Candidate



Paul Karason
Seen on Oprah

Pathways for Entry

NANOPARTICLES INTERNALIZED IN CELLS

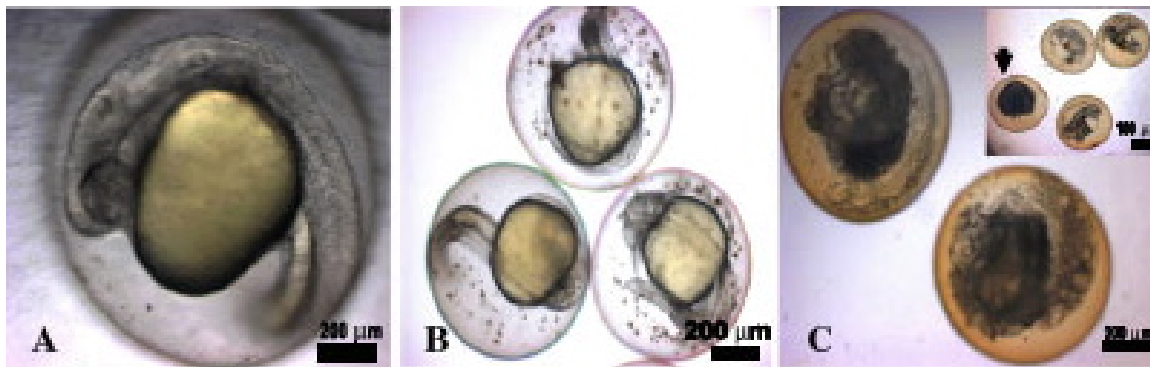




Antibacterial Hygienic Silver: Should the Environment Pay the Price?

Environmental Concerns:

- Silver nanoparticles may kill benign (good) bacteria that help destroy harmful bacteria.
 - This can hurt wastewater treatment facilities.
- Many types of bacteria live in lakes and streams. The silver may disrupt their aquatic ecosystem.
 - Zebra Fish Study.



(A) Normal zebrafish embryos which developed normally 24 hours post fertilization (hpf).

(B) Ag-BSA ($5 \mu\text{g per ml}$) treated embryos at 24 hpf.

(C) Dead embryos at 24-48 hpf. By P V Asharani.

CONCLUSIONS

- More research is needed that covers **long-term usage** of silver nanoparticles in humans.
- May be a **solution** to solve health concerns in developing countries and in areas where sanitation is a problem.

Future Concerns...

???

Will the benefits outweigh the risks?

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INSET

Erica Lively

Working Group 3

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THANK YOU

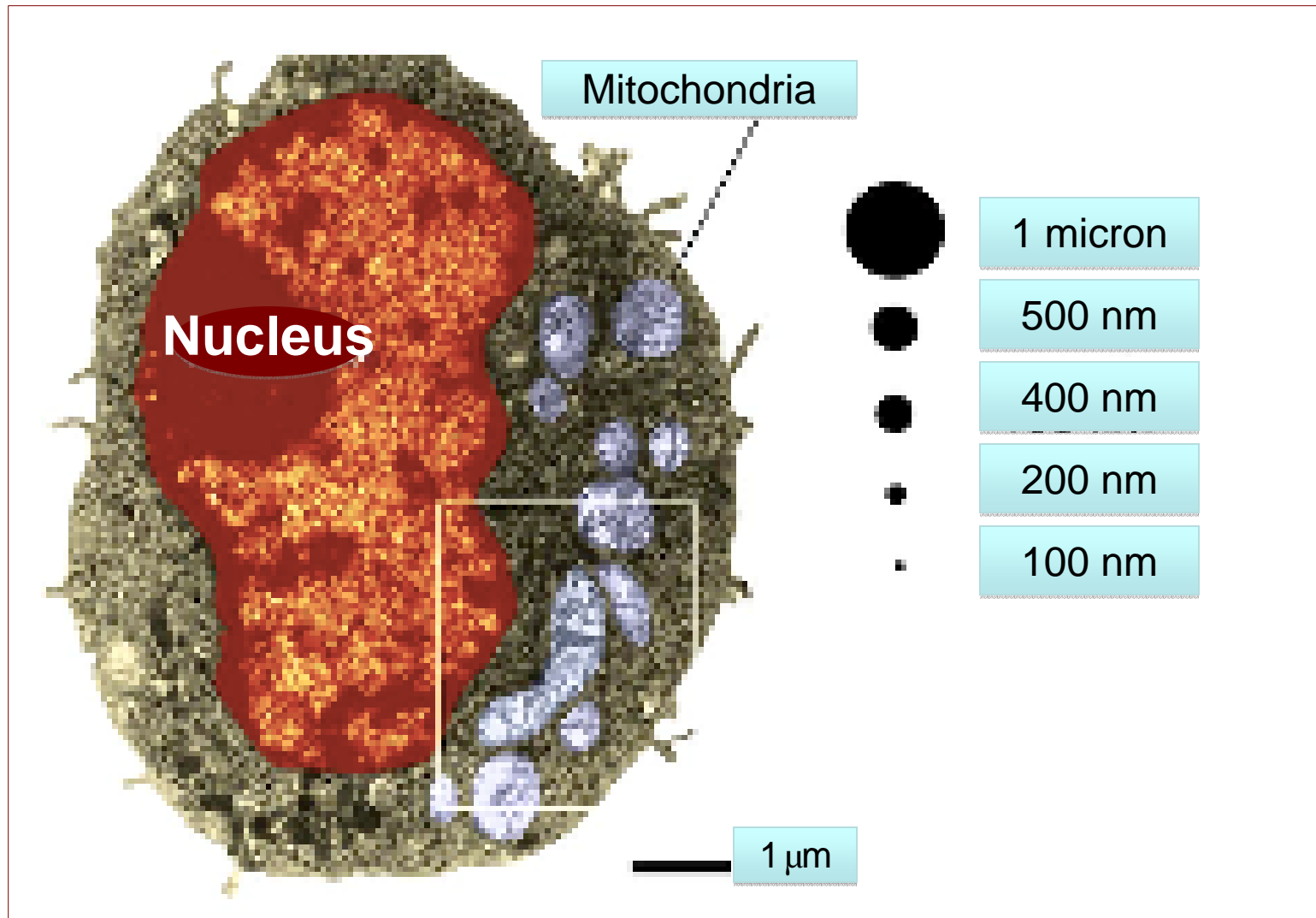
QUESTIONS . COMMENTS?

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RAT Macrophage Cell



Buzea, Pacheco, and Robbie: Nanomaterials and nanoparticles: Sources and toxicity. *Biointerphases*, Vol. 2, No. 4, December 2007. Comparison of rat cell size to nanoparticle size. Human macrophages are two times larger. TEM image reproduced with permission from *Environmental Health Perspectives* Ref. 238.

References

- Scientific Journals and Academic Literature
- Company Websites
- Blogs, Public Discussion Forums
- International Council on Nanotechnology (ICON) database
- Lux Report, 4th Edition, 2006
- Woodrow Wilson International Center for Scholars
- Government Sites and Documents

More Information...

- Of the more than **600 consumer products** that contain nano materials, about **20% contain silver particles.**⁺

⁺Woodrow Wilson International Center for Scholars.

Medical Nano Silver Products GVC

