How Safe Is Nanotechnology in Our Lives?

The NACK Center was established at the Pennsylvania State College of Engineering, and is funded in part by a grant from the National Science Foundation.

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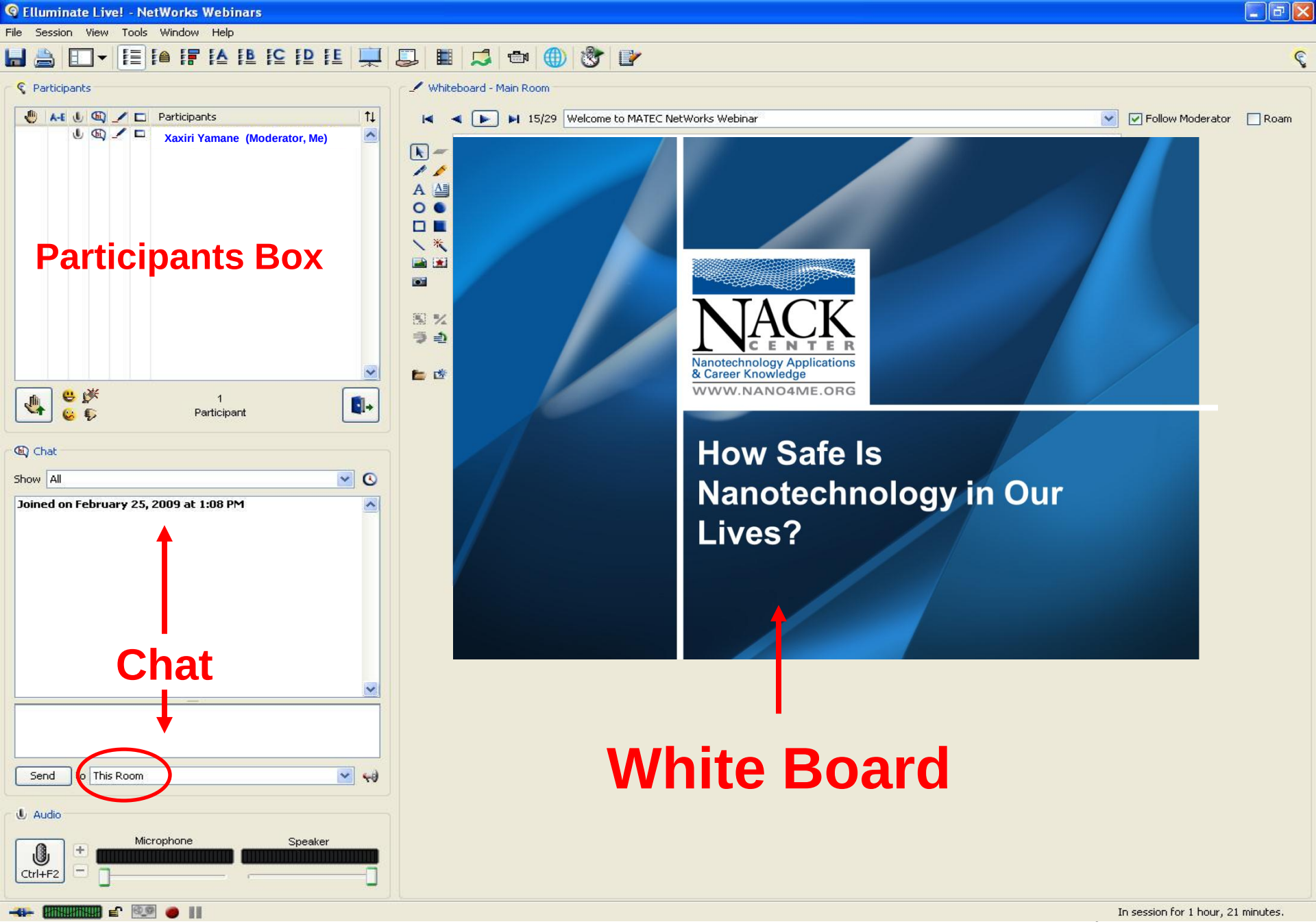
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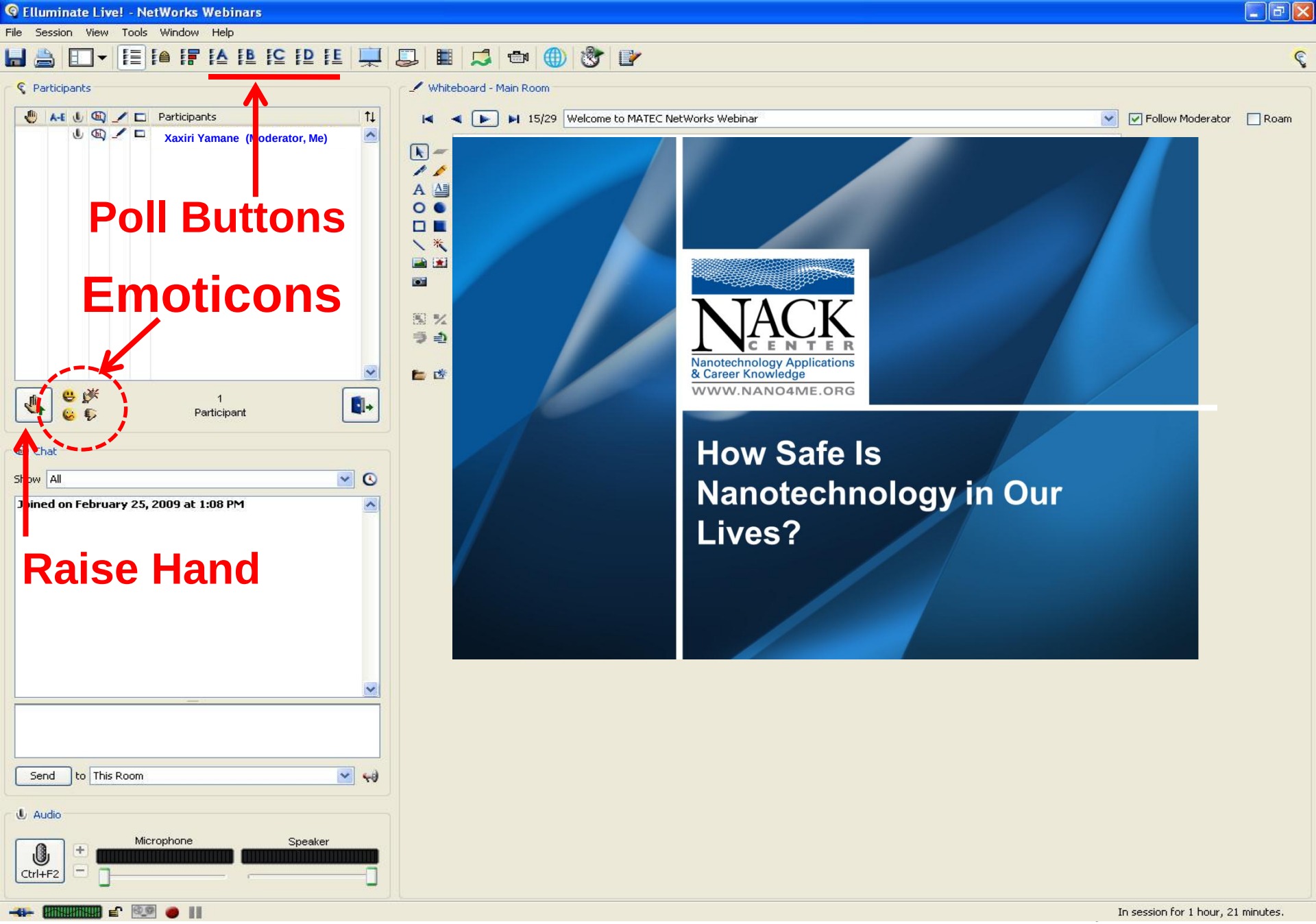
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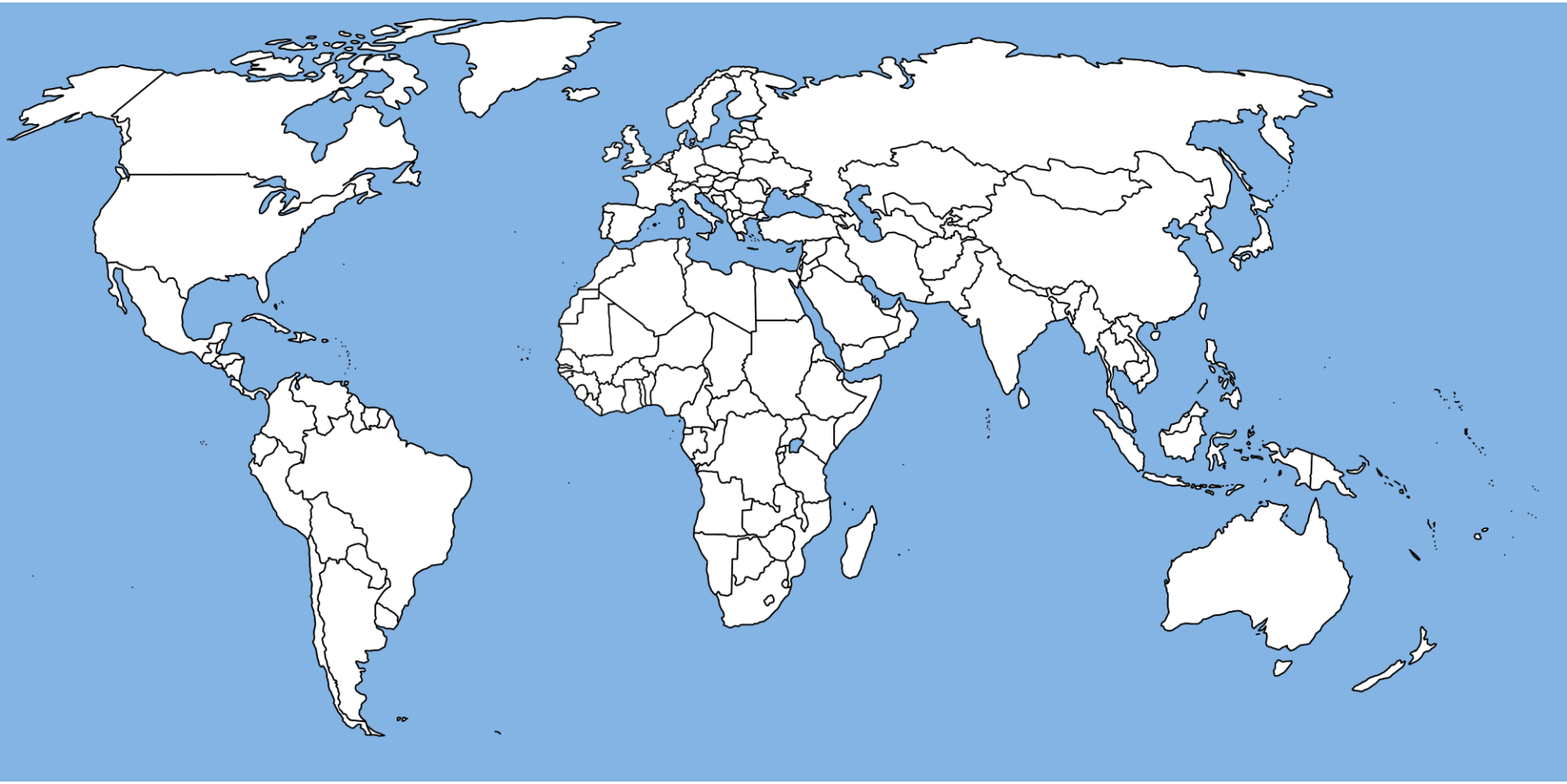
Where Are You Joining From?



Welcome to NACK's Webinar

How Safe is Nanotechnology in Our Lives?

Bob Ehrmann
Director of Nack

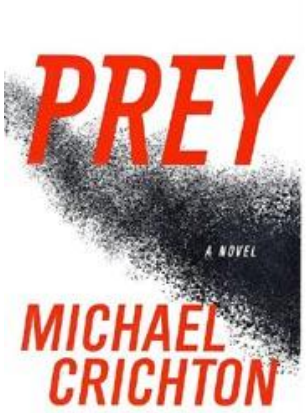
Deb Newberry
Director– Nano-Link
deb.newberry@dctc.edu

Objectives

- Examine society's approach for awareness of any new technology.
- Consider specific examples of nanotechnology in our lives today.
- Identify and analyze potential societal impacts.
- Discuss how we investigate, understand, measure, and visualize nanotechnology today.

POLL: When people wonder about concerns associated with socio and environmental aspects of nanotechnology they:

A:



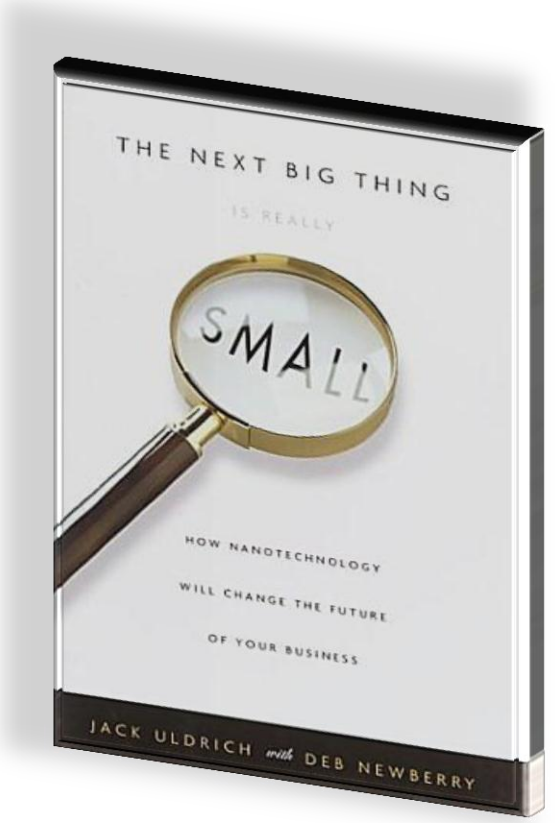
C:

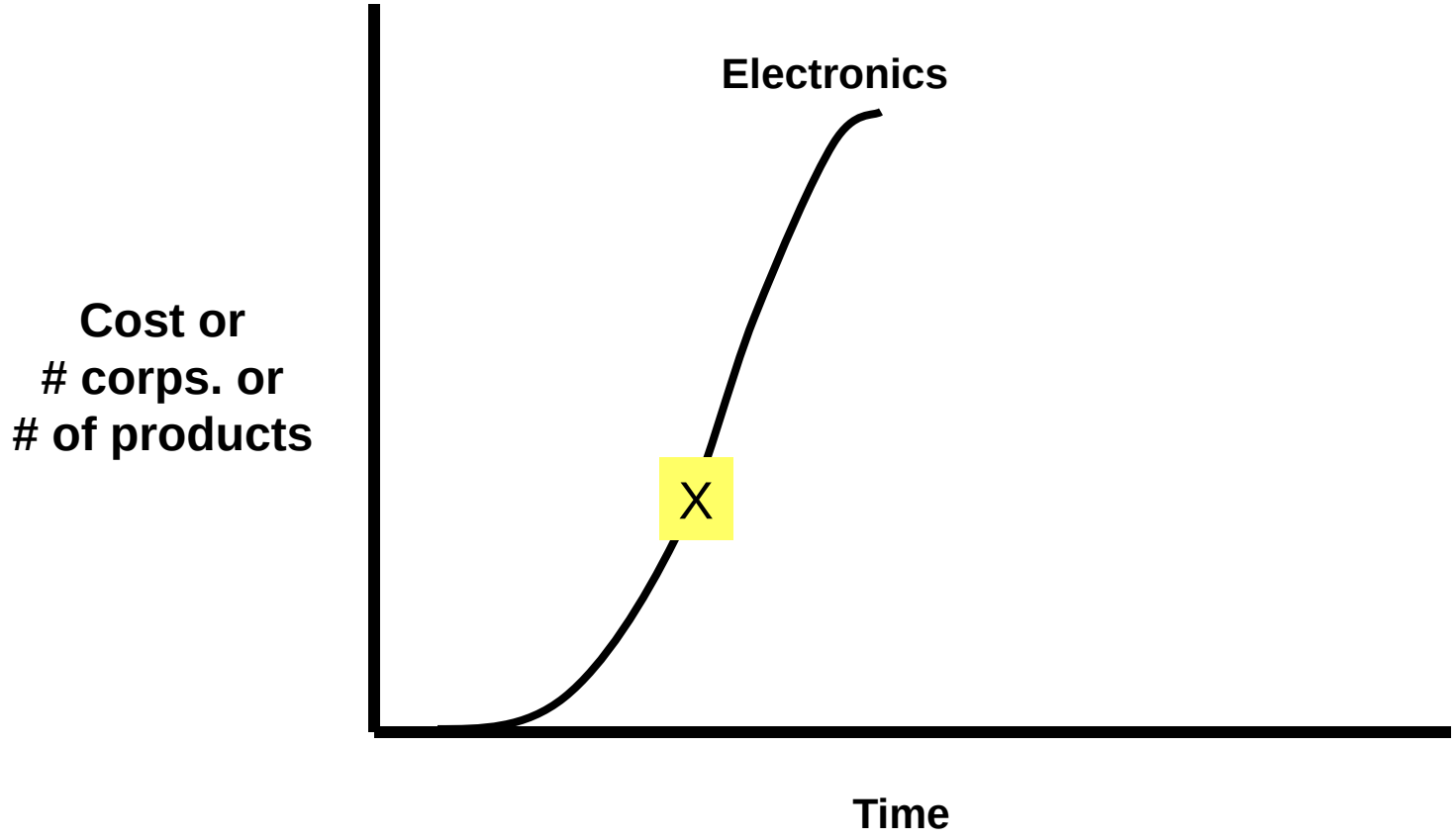
B:

D:

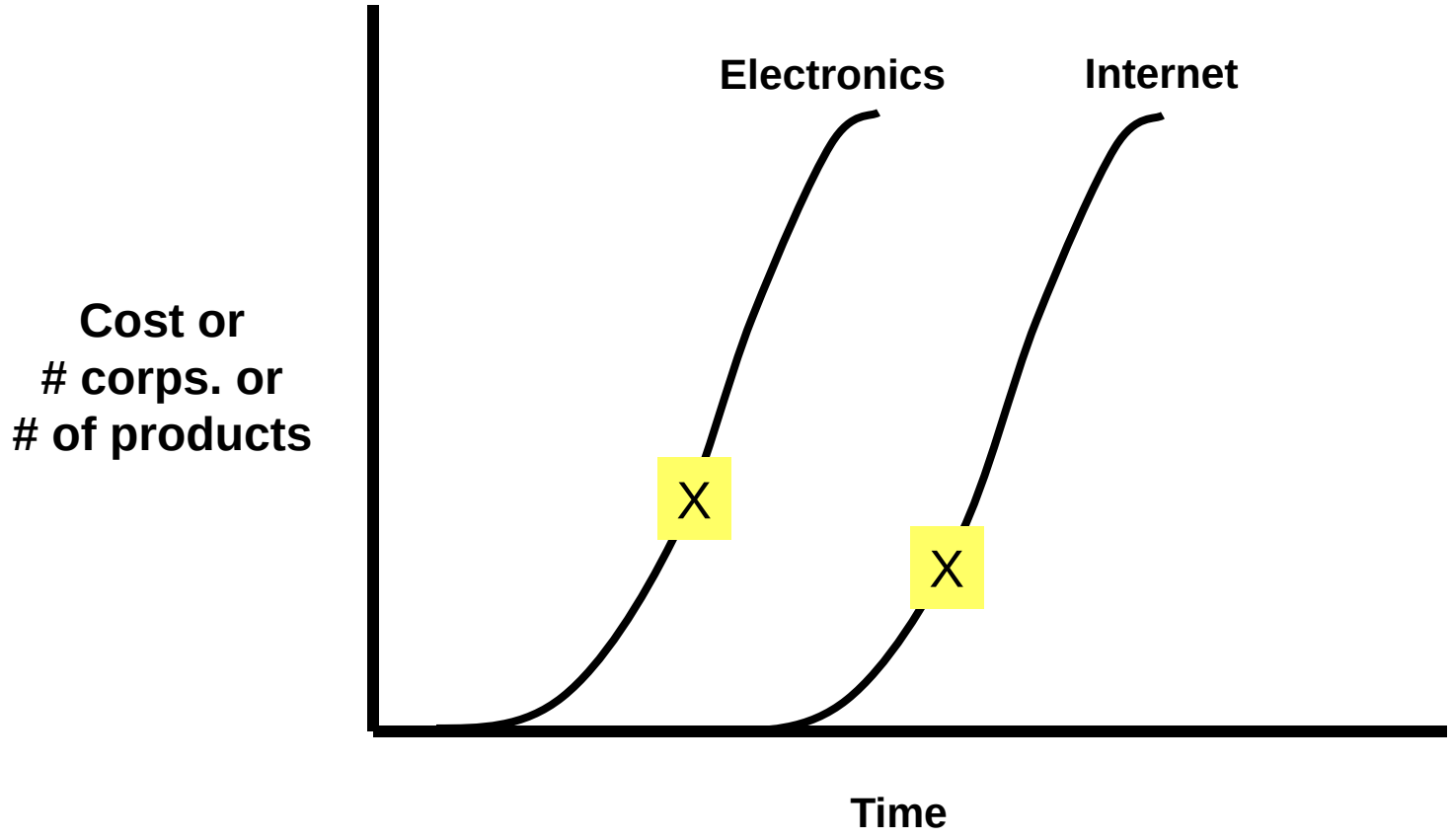
Nanotechnology in the World

- Lots of Government Money
- International Collaborations





Where or when in the development of this technology did the general public become aware of the technology?



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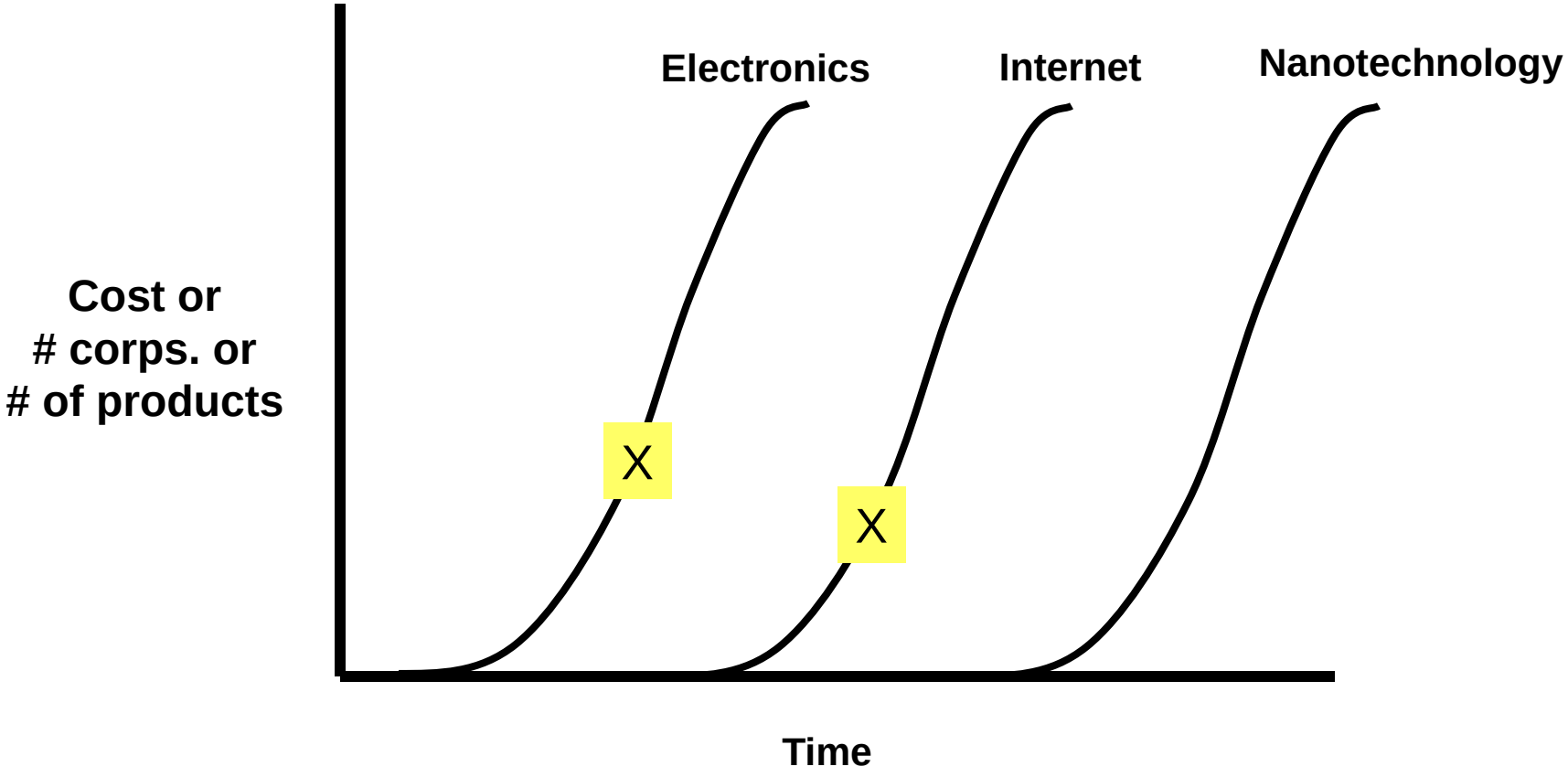

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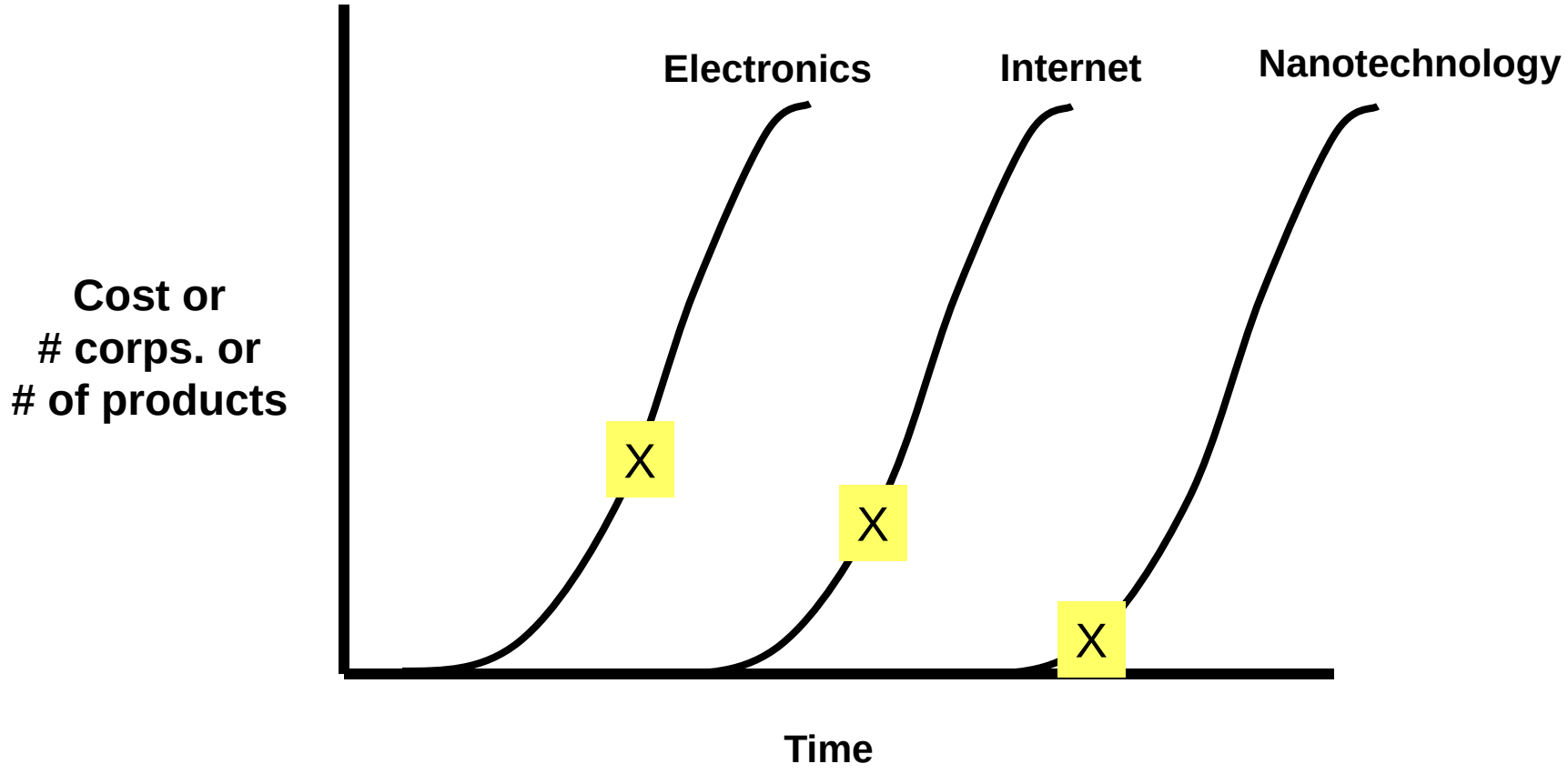


What is the impact of this early awareness?

Early Societal Awareness

- Given: Society is not aware of how early in the process they have been granted awareness.

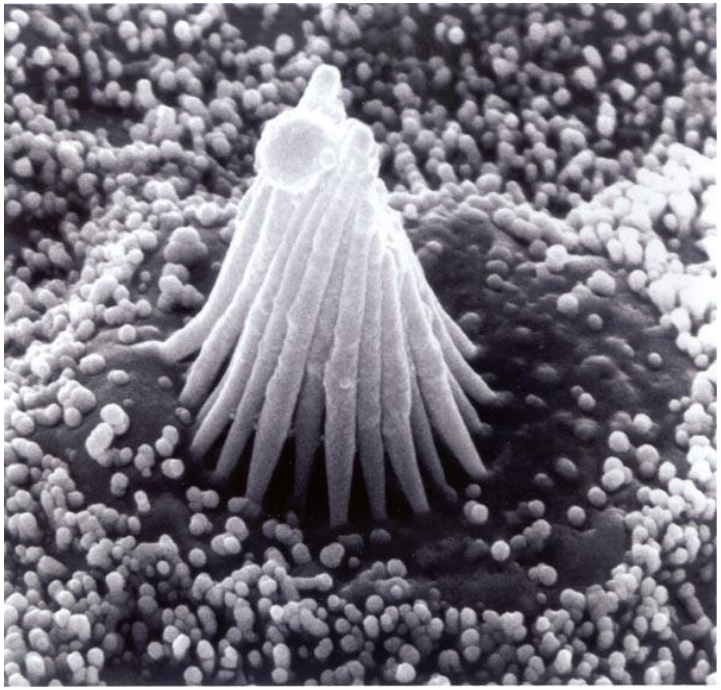
- Expectations (perhaps unrealistic):
  - Overnight cures
  - Money made now
  - Solve world problems

- Lack of Awareness: Science and research do not turn into applications, products and revenue overnight.

Societal Concerns

- Concerns:
  - Environment
  - Privacy
  - Terrorism

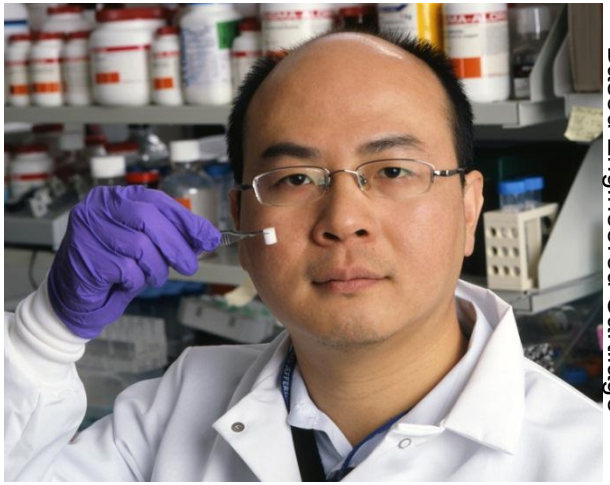
- The science is not to the point that some of these questions and concerns can be answered.



NIH Image, Hair cell of amphibian inner ear
Photo credit: A.J. Hudspeth, M.D, Ph.D.

But …

- The majority (my guess is 80%) of what is going on at the nano scale is research.
- Investigating, understanding, measuring, visualizing.
- We are using the tools of nanoscience to understand macro and micro forces and properties at the nano scale.
  - Adhesion
  - Friction
  - Thermal transfer
  - Fluid flow
  - Cellular and molecular interactions



NIH Clinical Center, Nanofiber Based Engineered Cartilage

However … This Understanding Will Lead To:

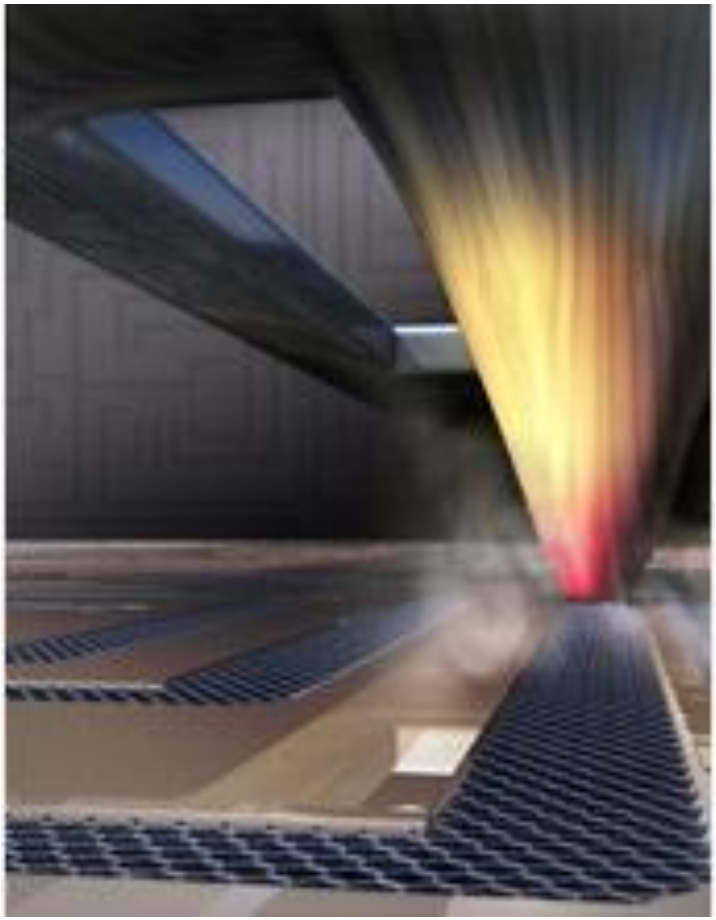
- Better lubricants
- Stronger lighter materials for transportation, construction
- Stronger coatings
- Antibacterial coatings for multiple applications
- Enhanced electronics (lower power, higher capabilities)
- Integrated, automated services
- Better sensors
- Faster product development (drugs, diagnostics, reliability assessment...)

Questions?

Please type all questions into the Chat Box

Some Considerations About NanoScience

- It is global
- Societal/public awareness
- One development can have multi-market applicability
- It is multi-disciplinary



Tip of an Atomic Force Microscope
NSF/University of Illinois

Nanotechnology Impacts are Many and Multi-faceted – Both Positive and Negative

Challenge: Measuring and predicting the societal and economic impacts of NT. (R. Colwell, Dec 2003)

Need to define the "tipping point" and the measurement method to assess where benefits outweigh the risks.

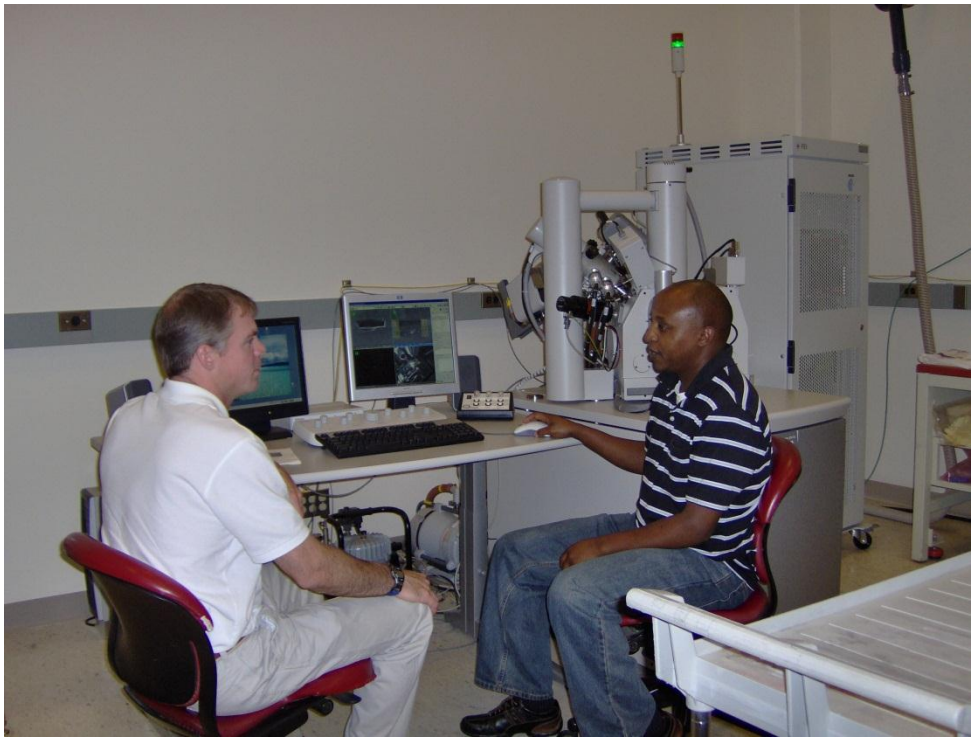


Image courtesy of Nano-Link

Benefits

“Every” Market Segment

- Electronics
- Medical diagnostics
- Small tech analysis and machines
- Lubricants and coatings
- Materials
- Construction
- Energy

Image courtesy of Nano-Link

Risks

Health

Environment

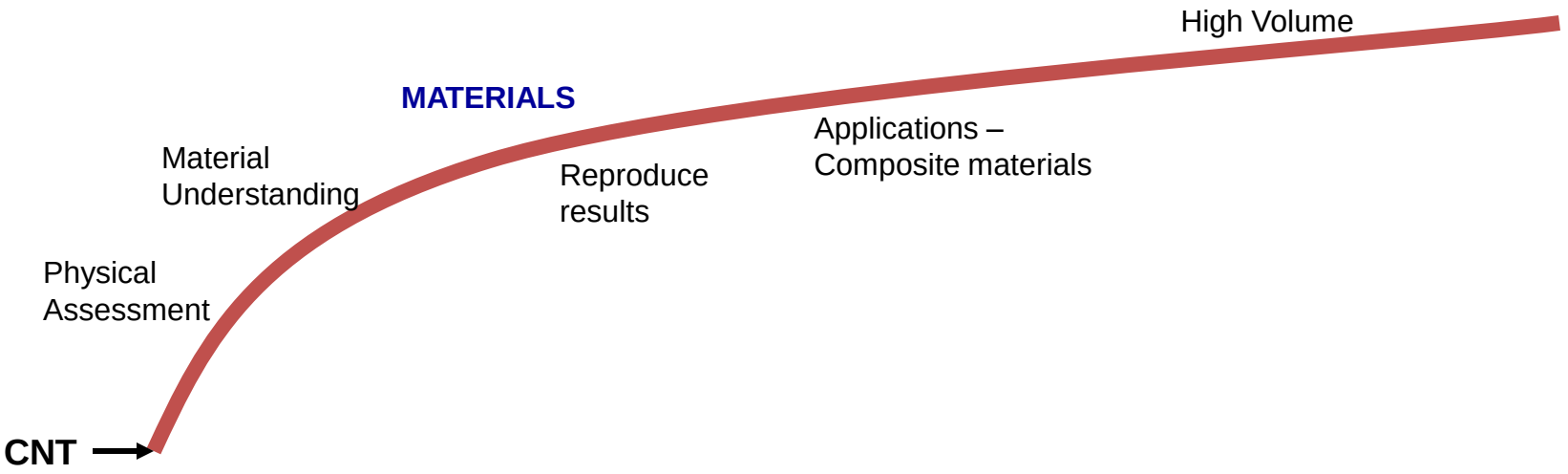
Security (Terrorism)

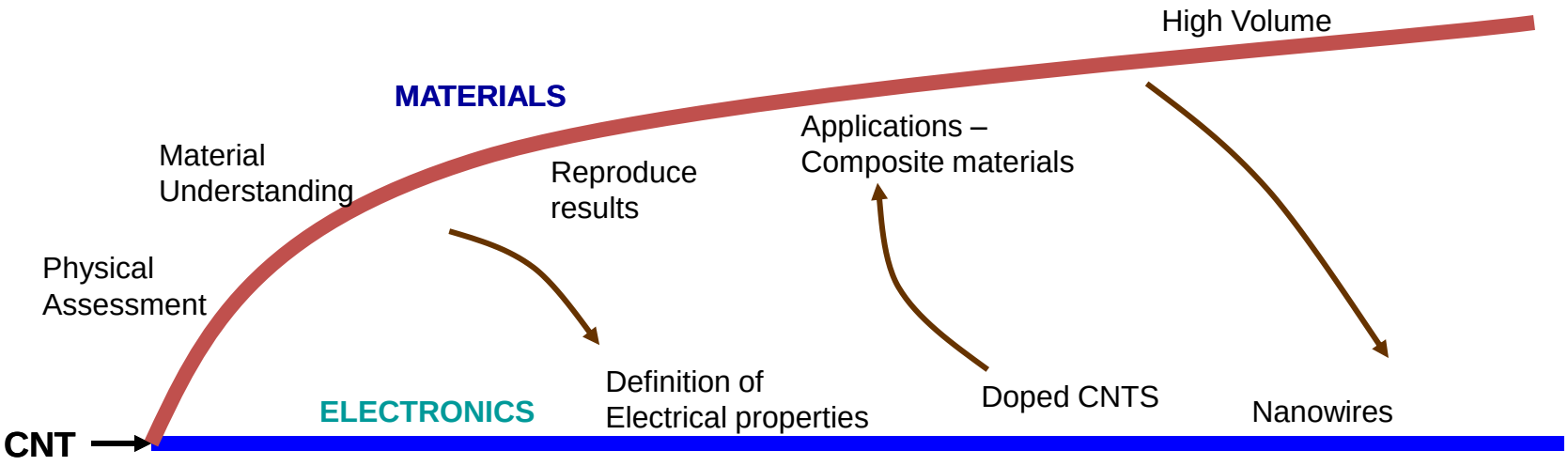
Some questions:

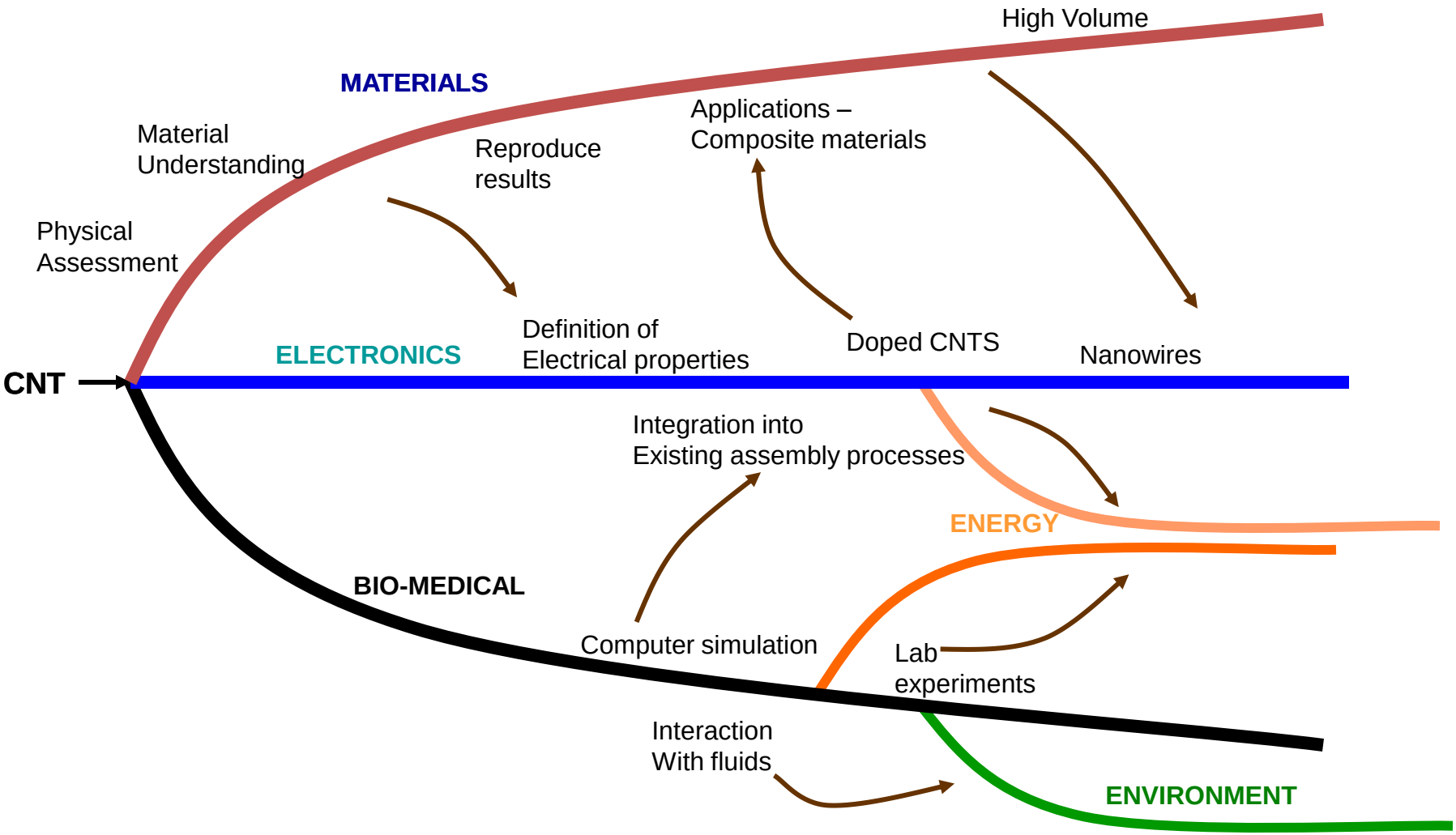
- What is the starting material?
- What is the longevity in system and environment?
- How much of it is there?
- What are the effects as we move up the food chain?
- What if someone uses it for evil?
- Have we thought of everything?

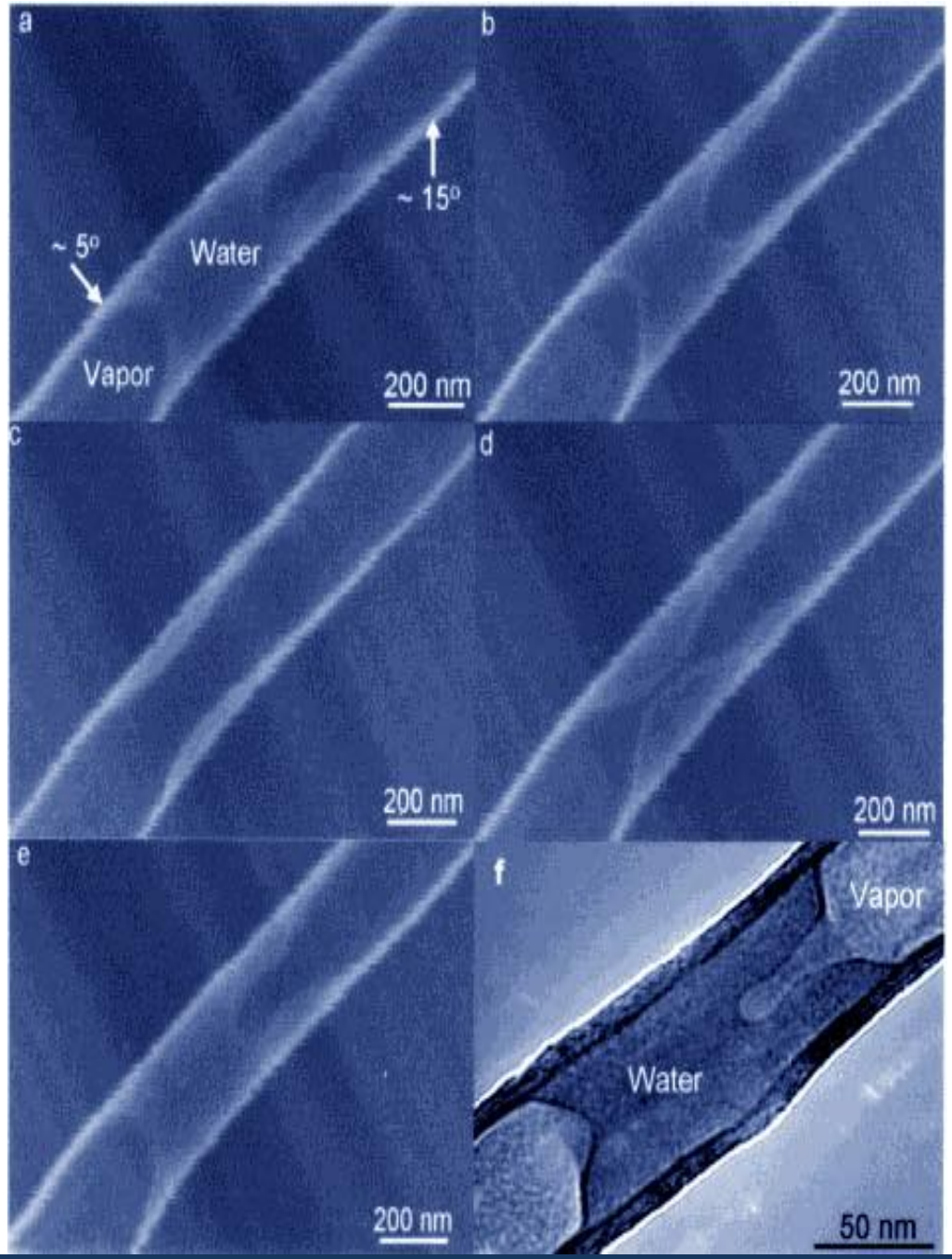
Other Issues

- Privacy
- Patents/Intellectual Property
- Regulation
- Public Awareness and Involvement
- Just Plain Uncertainty:
  - The multi-application ability of nanotechnology discoveries can go in many directions.
  - Complicates the analysis and trade-offs.
  - May also move the “balance” point.









Water in Nanotube
Source: Yury Gogotsi

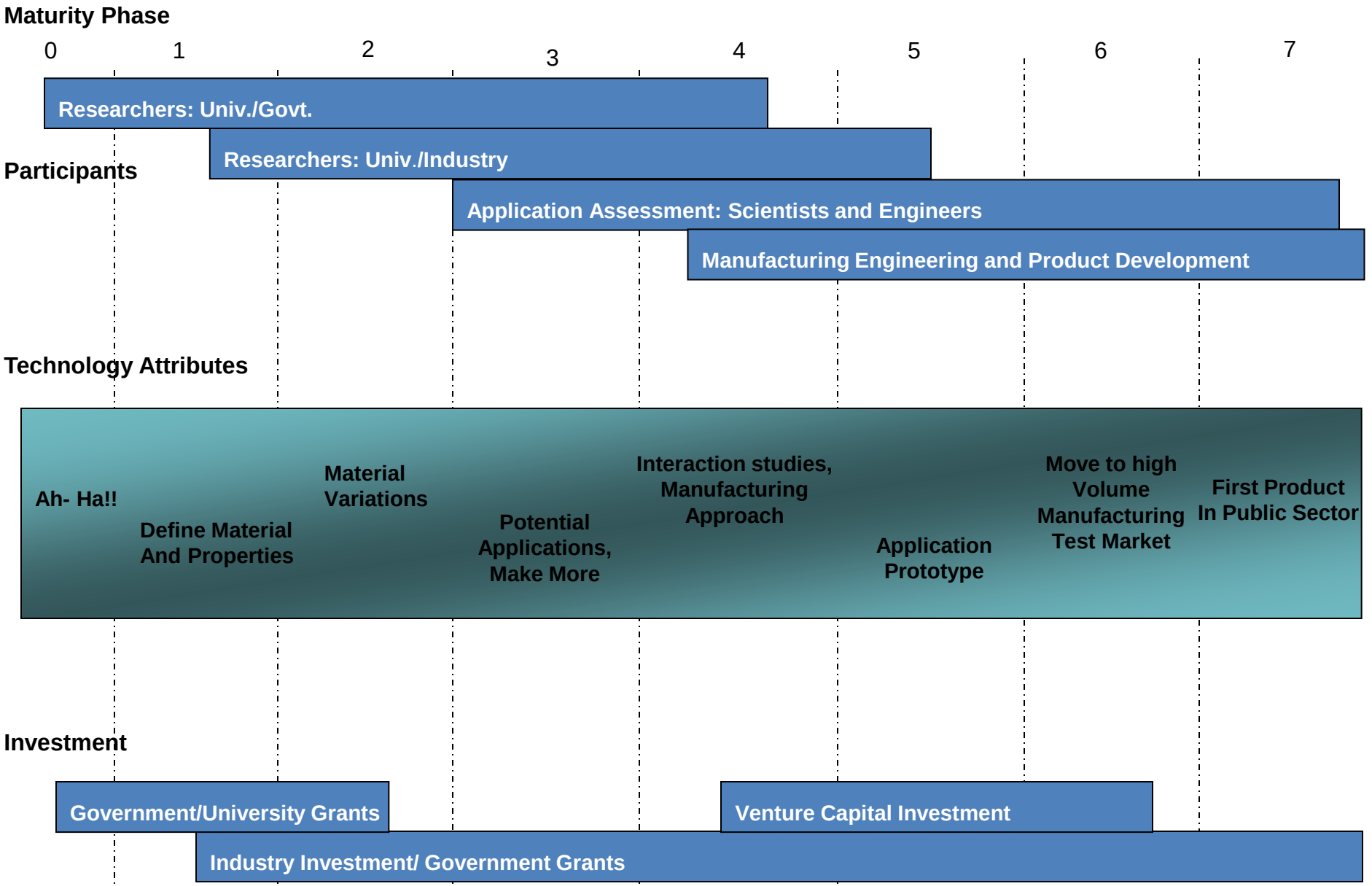
References:

Environmental Scanning Electron Microscopy Study of Water in Carbon Nanopipes
M. Pía Rossi, Haihui Ye, Yury Gogotsi, Sundar Babu, Patrick Ndungu, and Jean-Claude Bradley
Nano Lett.; 2004; ASAP Web Release Date: 15-Apr-2004; (Letter) DOI: 10.1021/nl049688u

Description:

The ability of the Environmental Scanning Electron Microscope (ESEM) to condense and evaporate liquids has enabled the in situ dynamic study of condensation, evaporation and transport of water inside carbon nanotubes. It has been possible to see liquid menisci inside straight, CVD-fabricated carbon nanotubes (CNTs) having disordered walls. From the measured contact angles, it is clear that these CNTs are hydrophilic. Complex meniscus shapes and slow liquid dynamics due to water confinement and strong interaction with tube walls have been observed.

The above ESEM images show the dynamic behavior of a water plug close to the open end of a nanotube. The meniscus shape changes when, at a constant stage temperature, the vapor pressure of water in the chamber is changed (a) 5.5 Torr, (b) 5.8 Torr, (c) 6.0 Torr, (d) 5.8 Torr and (e) 5.7 Torr, where the meniscus returns to the shape seen in (a). The asymmetrical shape of the meniscus, especially the complex shape of the meniscus on the right side in (a, e), is a result of the difference in the vapor pressure caused by the open left end and closed right end of the tube. (f) TEM image showing a similar plug shape in a closed CNT under pressure.



At Each Stage – Different Stakeholders Have Different Drivers and Societal Impact Issues

- Researchers:
  - IP/Publish work
    - Provides more money to the university
- Engineers/Industry:
  - Profit driven
    - Different levels of societal responsibility
- Investors:
  - Significant economic/societal impact
- Initial Users/Producers:
  - Can define attitudes and philosophies

Other Stakeholders

- Secondary Users
- Government:
  - Regulatory, initial support, public trust issue
- Military:
  - Initial support and uses
- Public:
  - Desire to participate
  - Level of knowledge issues

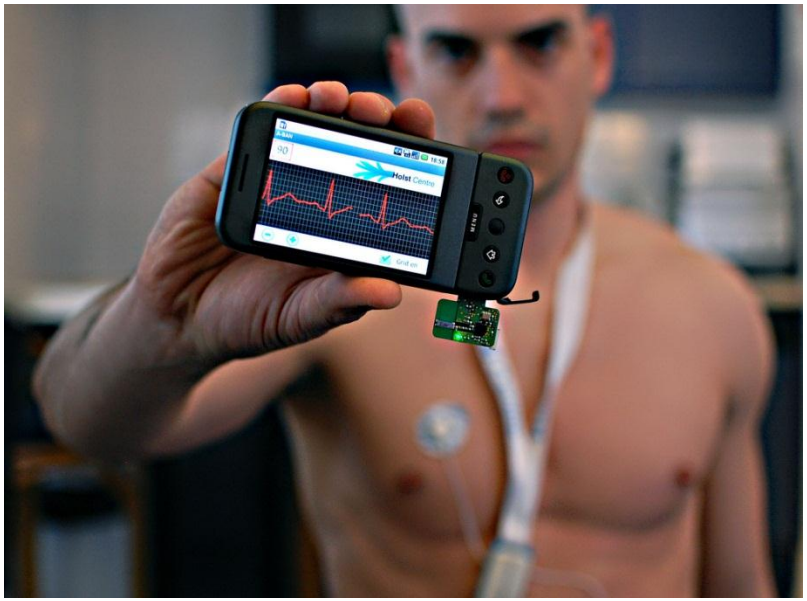
Nanotechnology Will Be Different… May be Better, May be Not

- The ball is already rolling, the elephant is discovered… the public is aware!

- Hype is mostly what our society (public) is aware of.

- Nanotechnology is visible:
  - Books
  - Movies
  - CNN, et. al.

- Societal Memory/Timing:
  - Nuclear power
  - GMOs



What Does It All Mean?

Speed of risk generation will always outpace speed of solutions or risk mitigation.

Who will control and benefit from the technology?

- Public perception that corporations benefit and public takes the risks.

CONSIDER SPECIFIC EXAMPLES OF NANOTECHNOLOGY IN OUR LIVES TODAY

Carbon Nanotubes (Raw Soot)

MATERIAL SAFETY DATA SHEET

1. Substance and Source Identification

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2300
Gaithersburg, Maryland 20899-2300

SRM Number: 2483
MSDS Number: 2483
RM Name: Single-Wall Carbon Nanotubes (Raw Soot)

Date of Issue: 14 November 2011

MSDS Coordinator: Mario Cellarosi
Telephone: 301-975-2200
FAX: 301-926-4751
E-mail: SRMMSDS@nist.gov

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

Description: This Standard Reference Material (SRM) consists of single-wall carbon nanotubes (raw soot). A unit of RM 2483 consists of 250 mg of carbon nanotubes in a glass bottle. SRM 2483 is intended primarily for use in evaluating chemical and instrumental methods of analysis of carbon nanotubes

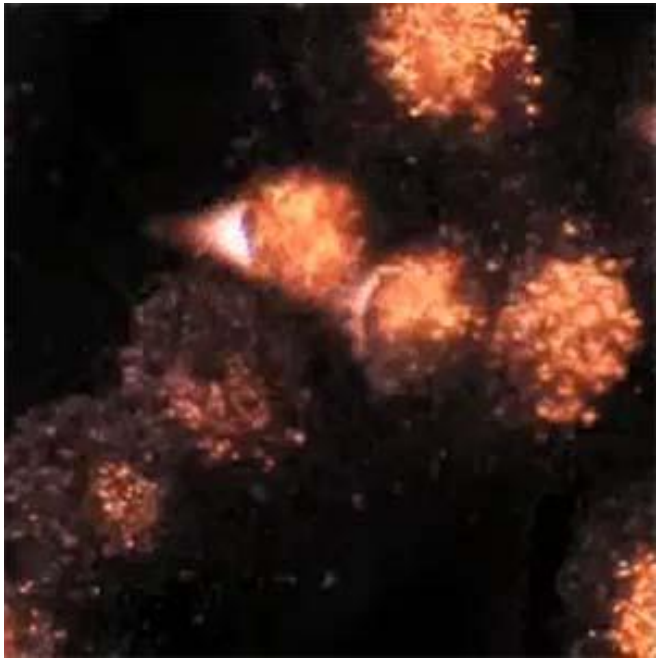
Substance: Single-wall carbon nanotubes.

Other Designations:

Carbon nanotubes, nanotubes, SWNT, SWCNT.

Nuclear Targeting of Gold Nanoparticles in Cancer Cells

Journal of the American Chemical Society



Taken from medgadget.com

(Kang, B., Mackey, M. A., & El-Sayed, M. A. (2010). Nuclear targeting of gold nanoparticles in cancer cells induces DNA damage, causing cytokinesis arrest and apoptosis. *Journal of the American Chemical Society*, *132*(5), 1517-9. American Chemical Society.)

DNA Base Pair Sequence for HcG

Image taken from Nanotechnology and Materials
NACK webinar presented by A. Kimmel

Does Nanotechnology Offer Athletes More Than A Sporting Chance?

From bicycles to swimsuits, nanotechnology can be used in almost every sport to improve the performance of competitors. So should governing bodies be concerned?

Guardian, May 8, 2012, Getty Images

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How Can We Better Serve You?

Whether you are joining us live or watching the recorded version of this webinar, please take 1 minute to provide your feedback and suggestions.

http://questionpro.com/t/ABkVkZLoh2ro

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www.matecnetworks.org

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sbarger@engr.psu.edu

Upcoming NACK Events – 2012

Aug 13-16: *Workshop*
Nanotechnology Course Resources II: Patterning, Characterization, and Applications

Sept 17-20: *Workshop*
Nanotechnology Course Resources I: Safety, Processing and Materials

Oct 1-4: *Workshop*
Nanotechnology Course Resources II: Patterning, Characterization, and Applications

Nov 13-15: *Workshop*
Hands-On Introduction to Nanotechnology for Educators

Visit www.nano4me.org for more details about these and other upcoming webinars and workshops.

Join Us in Denver

JULY 23-26, 2012

www.highimpact-tec.org

Thank you for attending the

NACK Center webinar

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