Massachusetts Nanotechnology Efforts

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NEWMOA HW Training Committee

Presentation Overview

- Why address nanotechnology?
- Project Goals & Approach
- Interaction & Education
- Nano waste questions

How did Massachusetts state govt get interested in Nanotechnology?

- MassDEP formed an internal Perchlorate Workgroup, culminating in first-in-the-nation drinking water and waste site cleanup standards for perchlorate in July 2006
- MassDEP then refocused Perchlorate Workgroup to an Emerging Contaminants Workgroup

Relevance of Emerging Contaminants?

- **> 85,000 chemicals commercially available in US.**
- **Improved analytical methods**
- **Biomonitoring studies indicate human exposure**
- **Potential effects on humans, aquatic species & wildlife?**

MassDEP Emerging Contaminant Project

- **Goals**
  - **To identify and assess public health and environmental problems associated with presently unregulated contaminants or contaminants that are not adequately regulated.**
  - **To recommend agency strategies for managing these compounds, “as feasible.”**

- **Outcome**
  - **MassDEP will identify new problems earlier.**
  - **Be more prepared.**

Emerging Contaminants Workgroup Participation

- Cross-MassDEP workgroup; centralizes focus
- Interagency deliberations (EEA, DPH, OTA, MWRA, DOL)
- Invited experts to meet on key issues
- Program Advisory Committees (air, water, waste) also consulted

MassDEP's EC Definition

Emerging contaminants (ECs) are Hazardous materials or mixtures (naturally occurring or manmade chemical, microbial or radiological substances) that have:

- a perceived or real threat to human health, public safety or the environment;
- no published health standards or guidelines;
- insufficient or limited available toxicological information or toxicity information that is evolving or being re-evaluated; or,
- significant new source, pathway, or detection limit information.

Approach To Address ECs

- Established a process to:
  - Identify emerging contaminants; and,
  - Screen emerging contaminants to set priorities.
- Recommend management strategies.

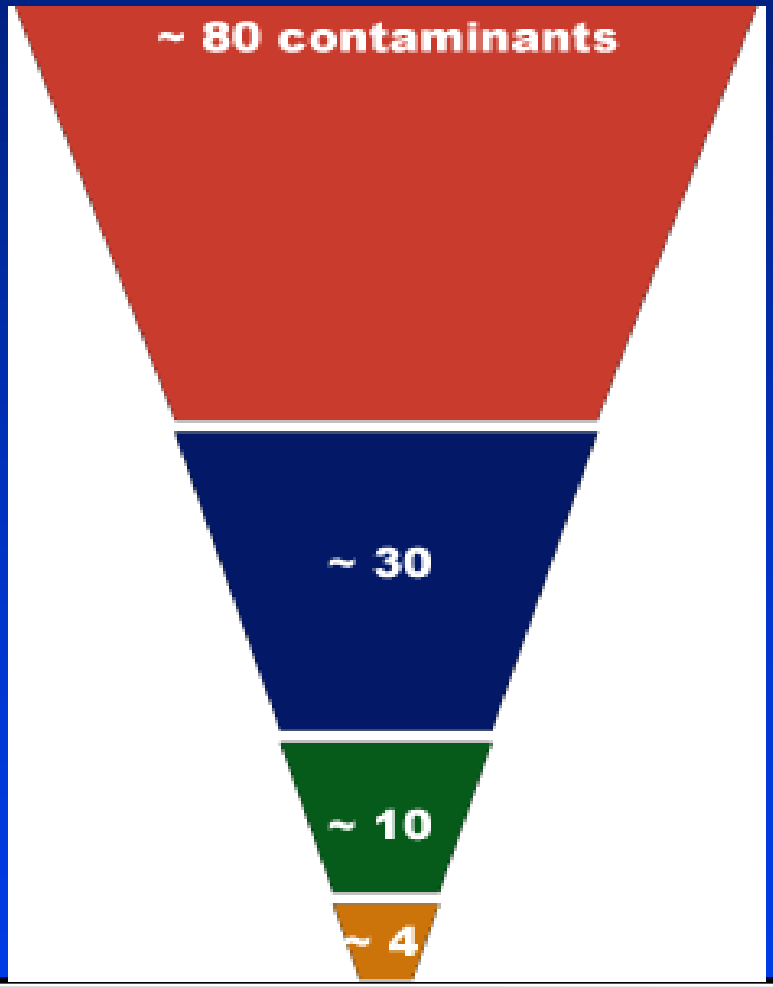
Process for Identifying Emerging Contaminants (ECs)

- Prepare a master list of ECs
  - Data base scans
  - Knowledge of workgroup members
  - Input from stakeholders
- Update the list every 6 months

Screening Process for Identifying Priorities

- Objective:
  - Consistent & transparent process
- Outcome:
  - Watch List: identify emerging contaminants that we need to maintain an awareness of
  - Recommend Priorities: priorities and strategies to manage them

Emerging Contaminant Screening Process



- Preliminary List
- Screen 1: Watch List
- Screen 2: Priority Emerging Contaminants List
- Short-term action

EC Priority List

- Pharmaceuticals and personal care products (PPCPs) & Endocrine disrupting compounds (EDCs)
- RDX (cyclotrimethylenetrinitramine)
- Tetrachloroethylene
- Nanoparticles
- Brominated flame retardants (PBDEs)
- Methyl tertiary butyl ether (MTBE)
- Trichloroethylene
- Tungsten
- Atrazine
- Bisphenol A

Nanotechnology

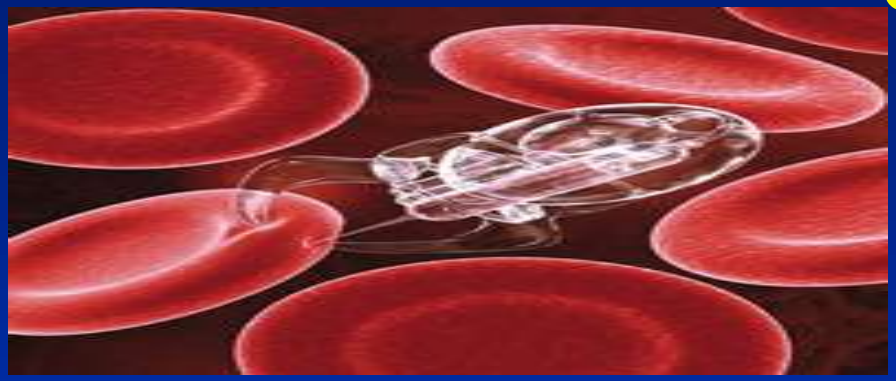
- The Next Industrial Revolution

What is nanotechnology?

- **Nanotechnology involves:**
  - **Research & development of nanomaterials on the scale of atoms and molecules.**
  - **Relies on the unique chemical and physical properties of chemicals in this small size range.**

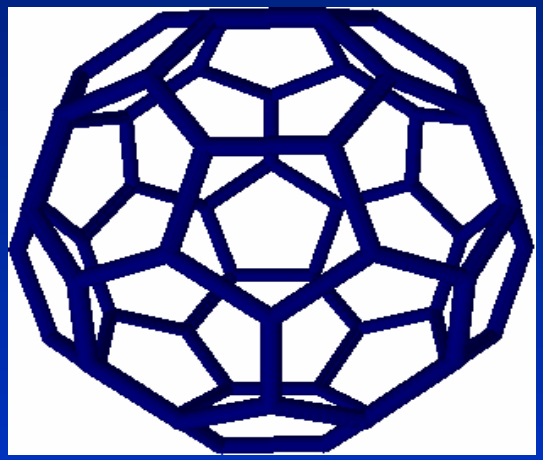
- **Applications in the commercial, medical, military, and environmental sectors.**

What is nanotechnology?



- A nanometer is one billionth of a meter (10^{-9} m).
  - 100,000 times smaller than the diameter of a human hair
  - 1000 times smaller than a red blood cell
  - Half the size of the diameter of DNA
- Nanotechnology typically deals with particles and structures larger than 1 nanometer, but smaller than 100 nanometers.

Intentionally Produced Nanomaterials



- **Carbon-based: hollow spheres, tubes, ellipsoids. Uses: Improved films and coatings, applications in electronics**
- **Metal-based: consumer products**
- **Dendrimers (polymers): Drug delivery**
- **Composites: Clays/auto parts, packaging materials, flame retardants**

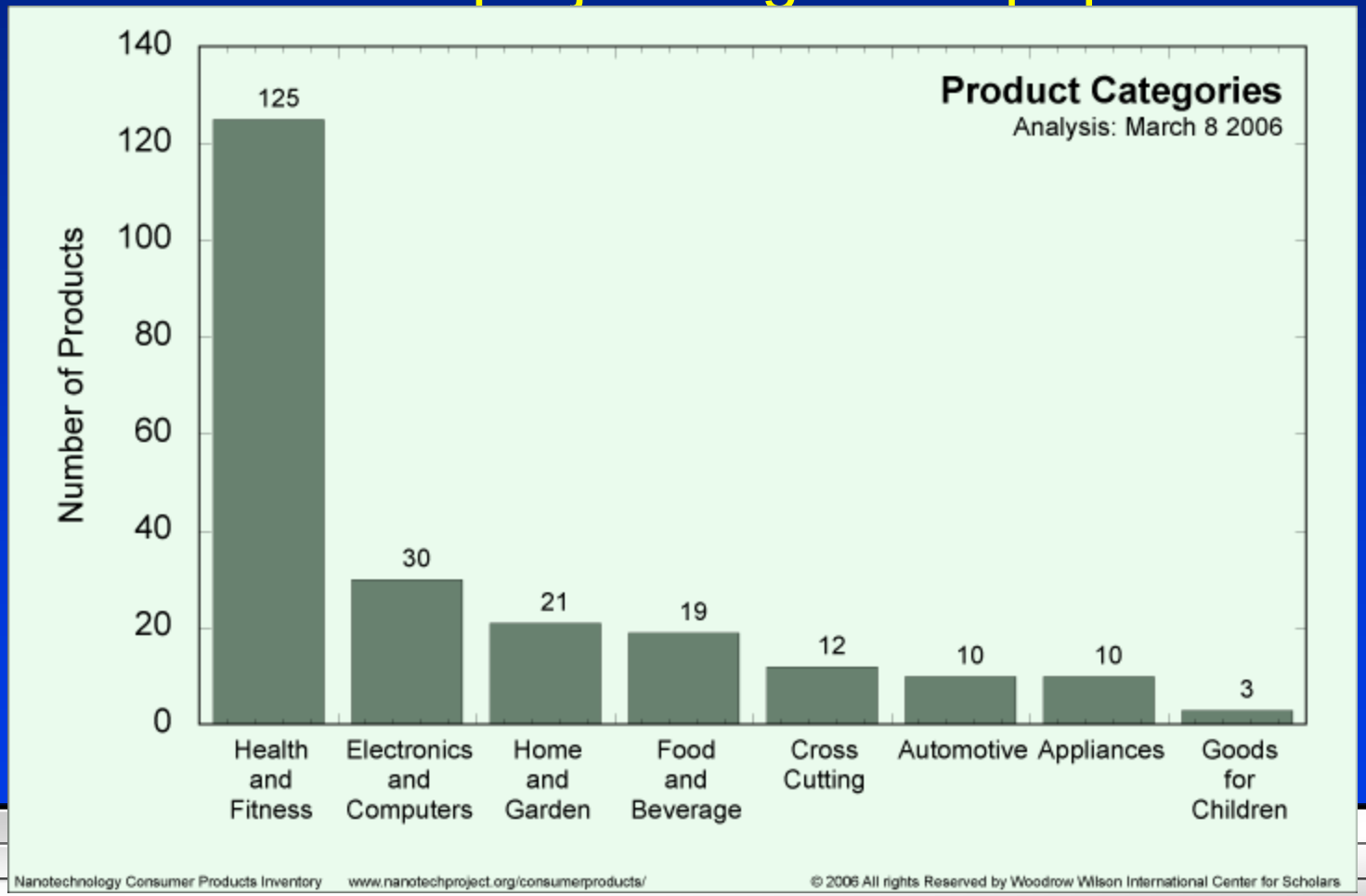
Nanomaterials

- **Novel electrical, catalytic, magnetic, mechanical, thermal and imaging features.**
- **Nanomaterials are stronger, more reactive, lighter, greater conductivity, flexibility.**
- **Over 300 consumer products currently on the market**

www.nanotechproject.org/consumerproducts

Woodrow Wilson searchable database of consumer products that contain nanomaterials

http://www.nanotechproject.org/index.php?id=44

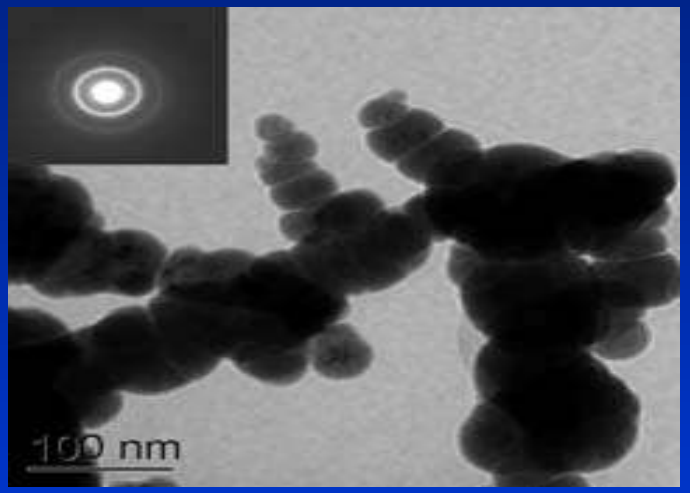


Examples of Products that Use Nanotechnology and Nanomaterials

Health & Fitness	Electronics	Home & Garden	Food	Other
-Wound Dressing -Antibacterial Socks -Stain resistant pants -Cosmetics -Sunscreen	-Computer displays -Games -Computer hardware	-Paint -Antimicrobial pillows -Stain resistant cushions	-Non-stick pans -Antimicrobial refrigerators	-Coatings Lubricants

Environmental Benefits of Nanotechnology

- **Remediation treatment**
- **Energy**
- **Fuel Additives - catalysts**



Safety Concerns

- **The small size of the materials makes a major difference in how the substances interact with biological systems, potentially posing new risks.**

- **Smaller surface size, increased surface area alter the properties and toxicity of chemicals.**

- **Toxicity Studies:**
  - **Inhaled carbon nanoparticles – readily absorbed and distributed**
  - **Potential disruption of DNA double helix**
  - **Brain damage in fish study (0.5 ppm for 48 hours)**
  - **Rat study – lung fibrosis**

Challenges

- The ability to develop nano products has advanced rapidly.
  - Total value of nanotechnology products:
    - »2004 - $13 billion
    - »2005 - $32 billion
    - »2006 - $50 billion
    - »2014 - ($2.6 trillion)

Challenges

- But, our understanding of the potential environmental, health and safety concerns has proceeded at a much slower pace.

- FY07 US Federal Nano-budget (total $1.2 billion)
  - **27% for DOD ($345 Million)**
  - **20% for DOE ($258 Million)**
  - **0.75% for EPA ($9 Million)**

Challenges

- How can we ensure that the potential benefits of nanotechnology be achieved while minimizing potential risks?

Massachusetts Interagency Committee on Nanotechnology

Formed April 2007

- Department of Environmental Protection (MassDEP)
- Department of Public Health (DPH)
- Division of Occupational Safety (DOS)
- Office of Business Development (MOBD)
- Office of Technical Assistance (OTA)
- Toxic Use Reduction Institute (TURI)

External Advisory Group

Formed September 2008

- Universities
- Environmental groups
- Business groups
- Consultants

Interaction & Education

- The Big Picture: Safe Development of Nanotechnology; November 15, 2007
  - http://www.mass.gov/dep/toxics/stypes/safenano.pdf
- Promoting the Safe Development of Nanotechnology in Massachusetts; January 29, 2009
  - http://www.mass.gov/dep/toxics/stypes/nanoproced.pdf
- Issue-Specific Meetings
  - Disposal of Nano material Wastes; April 7, 2009

Nano Waste Questions

- 1. What protocols should be used to keep nano waste out of indoor air in labs and manufacturing spaces, and out of the air and water released from buildings?
- 2. How do I reduce my generation of nano waste?
- 3. How can it be ensured that facility waste management staff are aware of which nano materials are being used, and where?
- 4. What parts of my waste stream should I consider to contain nano?
- 5. How do I dispose of nano materials mixed with non-hazardous materials?
- 6. What is the safest way to dispose of nano waste?
- 7. Does incineration destroy the nano component of nano waste?

Nano Waste Questions

- **8. Does a hazardous waste landfill capture the nano component of nano waste?**
- **9. Are there environmentally protective ways to dispose of nano waste in non-hazardous waste landfills?**
- **10. Can I solidify nano waste on-site?**
- **11. How should I package nano waste for shipment?**
- **12. How should I list nano materials and wastes on shipping manifests?**
- **13. How do I ensure safety and limit potential liability during shipping of nano waste, particularly with respect to traffic accidents and emergency responders and drivers of vehicles transporting nano waste?**
- **14. How do I ensure safety and limit potential liability in the case of a fire involving nano materials at my facility, particularly with respect to emergency responders?**

Nano Waste Challenges

- Current regs contain thresholds based on mass, but nano materials weigh little
- Does TCLP correctly assess toxicity characteristic?
- Woodrow Wilson International Center for Scholars, Project on Emerging Technologies: *Where Does the Nano Go?*

  http://www.nanotechproject.org/file_download/files/NanoEnd-of-Life_Pen10.pdf

For more information on MassDEP's Nanotechnology work:

http://www.mass.gov/dep/toxics/sourcest.htm#ec

or

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