NSTA Web Seminar:
NanoScale Science

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NanoScale Science

NanoScience and the Future

Presenters:

Gail Jones, NCSU
Mike Falvo, UNC-CH
Amy Taylor, NCSU
Overview

In Part One of this seminar you will:

Review characteristics of nanoscale materials and behavior
• Examine how nanotechnology will present new challenges to privacy
• Consider the ethics of new uses of nanotechnology
  – Sensors
  – Labels
  – Medical applications
  – Tracking
• Weigh the risks and benefits of nanotechnology
Overview....

In Part Two of this seminar you will:

– Examine how nanoparticles can be used to address environmental issues
– Learn about the potential benefits and risks of nanoparticles on the environment
– Evaluate the potential risks of nanoparticles as environmental pollutants.
NanoScale Science: Quick Review

• Materials that exist at the nanoscale— one billionth of a meter

• Properties of nanomaterials are different at this tiny scale…
  – Gravity has little effect
  – Materials are sticky, shaky, and the environment is bumpy…
Too Little Privacy: Ethics of Nanotechnology
Nanotechnology

Advances allow us to create:

• unique and tiny labels for manufactured materials
• tiny sensors that can detect specific molecules
• tiny machines
Razors

• 2003- Gillette Company reported it was purchasing millions of tiny NanoBlock Circuits and putting them on razors.

• These circuits use radio waves to transmit information.

• The tags transmit information for about 3 feet.

• The goal: identify thieves from stealing razors from stores.
What If?

What if someone driving by your home could detect:
• The type of shampoo you used?

Vote now...using the poll buttons...

Yes (√) or no (X)

Is this a good idea or not?
In the Future

Engineers are creating increasingly smaller sensors that can be used for a variety of purposes.

Consider how these tiny sensors may alter our world.

How could tiny sensors be of benefit?
Our lives are already monitored

Cameras track your movement on highways.
Cameras follow you in stores.
Hidden microphones capture your conversations on the street.

*Do these technologies make our lives safer?*
*Do the benefits for safety outweigh the risks to loss of privacy?*

**Vote now….**
Smile emoticon for benefits greater than risks
Frown emoticon for risks outweigh benefits
Nano Sensors

- Could monitor sales
- Could track sales
- Could indicate thefts
- Could signal inventories

What if you could track food from the farm to your mouth—would this be a good idea?

What if you could label and monitor money flow—would this be a good idea?

What if you could label and monitor explosives and ammunition—would this be a good idea?
Nano Sensors

A growing area of nanotechnology is the creation of medical sensors that can be injected.

Take a vote -- is this a good idea?

Vote now...using the poll buttons...

Yes (✓) or no (✗)

Is this a good idea or not?
Potential uses of nano-sized sensors:

- Monitor the blood sugar of diabetics
- Track your nutrients- send alarms for high fat levels
- Signal if you lack calcium or selected vitamins
- Monitor your temperature or blood pressure
- Signal viral infections
- Locate blood clots
Medical Sensors

What are the challenges to creating and using nano-sized medical sensors?

- Manufacturing machines this small in mass.
- Tracking sensors in the body-- which tissues, cells, and organs can be crossed?
- How does the body eliminate nano-sized sensors?
- Are there privacy issues involved in remote sensing of health issues?
- Could remote health sensing influence your insurance?
Nano Travel

One of the ideas proposed is to use nanoscience to create smart paints, sidewalks and ceilings that could monitor movement.

Are there times you want to monitor people, pets, and materials?

A grandfather with Alzheimer’s disease? A pet? A terrorist?

What rules would be needed to ensure safety, privacy, and freedom?
Let’s pause for two questions from the audience
Societal Implications of Nanoscience

• Great strides…
  – Cures for cancer?
  – New drug delivery?
  – New Nanoproducts?
  – Nanolabels?
  – Packaging?
  – Clean toxins from environment?

• Benefits!
  – At what cost?
  – Two sides of every debate…
Do benefits of nanotechnology outweigh possible risks?

Use a clip art to vote!

<table>
<thead>
<tr>
<th>BENEFITS</th>
<th>RISKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</table>
Can you think of a nanoparticle that is not man made?

YES  NO

If you voted yes, then type an example below....
Natural Nanoparticles

- Viruses
- Smog
- Coal dust
- Sea spray
- Ash (fires and volcanoes)
- Terpenes (plants)
- Clouds
- Mineral composites
Nanotechnology and the Environment

- Invisible engineering
- Products built atom by atom
  - Particles reactive due to their size
- Engineered with specific chemical and biological functionality
- Diffuse quickly in environment
  - Surface area to volume
- Ethical Implications
Fate of the nanoparticles?

• How many of you would use a product made of nanoparticles even if the fate of those particles was not known?

Vote now…using the poll buttons…

Yes (√) or no (X)
Questions to ponder?

- Where do free nanoparticles end up?
- What about decomposing products made of nanoparticles?
- Could nanoparticles self assemble in nature?
- Proper management of these particles is necessary for the protection of environment and human health!
What percentage of Earth’s surface is comprised of water?

Use your clip art to indicate your answer:

24 % 55 % 70 %

MANY SOURCES OF POLLUTION....
Nanoparticles that eat pollution?

• Cleaning a polluted waterway
• Iron nanoparticles can significantly reduce trichloroethylene (TCE) levels.
• Development of ‘Nanorust’ (Colvin, Rice University)
• New ‘nano’ water filters
• Global issue
Promise or Peril?

- Activity to engage students about nanotechnology and environment
- Brainstorm with students other ways nanoparticles could help environment
Nanosensors and the environment

Students simulate using nanosensors to detect harmful materials.
Unknown Risks!

- One study investigated the harmful effects of synthetically produced buckyballs on fish.
- These particles can destroy lipid cells, a major component of brain tissue.
Let’s pause for two questions from the audience
Nano Education

Educate your students about the potential advancements that are likely to arise from Nanotechnology.

Invite them to join the conversations that are taking place around the globe about risks and benefits.
In Summary

• In this session you have learned about
  – Potential new uses for nanotechnology
    Sensors (medicine)
    Tracking (inventory, explosives, people)
  – Potential benefits and threats to the environment
    Water and sewage treatment
    Air and water filters
  – Risks and benefits to future uses of nanotechnology
NanoScale Science Education Research Group

http://ced.ncsu.edu/nanoscale/

Ideas for Teaching NanoScale Science

Free software

Research about Scale

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