Nanomedicine in Healthcare Forum

Contact person: Brad Herring

Contact information: bradh@ncmls.org

General Description

Summary:

This forum explores nanotechnology-enabled medical technologies and their potential to transform health care, while considering the societal, ethical, environmental and economic impacts of this emerging technology.

This forum asks participants to consider and discuss two nanotechnology application scenarios and the possible opportunities, impacts, risks, and benefits. They will also have the opportunity to raise questions about the societal and environmental implications of nanotechnology to a panel of experts.

Forum participants will deliberate in small groups and create a group response to the overarching question, “Under what conditions should nanotechnology applications in medicine and personal care products be made available to the public? Why?”

Finally, each group will make a brief report to everyone on the group’s thoughts and recommendations.

Big idea:

Given the potential benefits as well as the unknown risks associated with nanotechnology, under what conditions should nanotechnology applications in medicine and personal care products be made available to the public? Why?

NISE Network Main Messages:

[X] 1. Nanoscale effects occur in many places. Some are natural, everyday occurrences; others are the result of cutting-edge research.
[X] 2. Many materials exhibit startling properties at the nanoscale.
[X] 3. Nanotechnology means working at small size scales, manipulating materials to exhibit new properties and create new devices.
[X] 4. Nanoscale research is a people story.
[X] 5. No one knows what nanoscale research may discover, or how it may be applied.

[X] 6. How will nano affect you?

Forums Overview

Introduction: The NISE Network:

The Nanoscale Informal Science Education Network (NISE Net) is a national infrastructure comprised of science museums and university based research centers collaborating to foster public awareness, engagement, and understanding of nanoscale science, engineering, and technology through establishment of a network that links science

museums and other informal science education organizations with nanoscale science and engineering research organizations. It is funded by a five-year cooperative agreement between the National Science Foundation and the Museum of Science – Boston and its core partners: the Exploratorium and the Science Museum of Minnesota.

Other subawardees have included: Oregon Museum of Science and Industry, Museum of Life and Science – Durham, New York Hall of Science, Sciencenter in Ithaca, Fort Worth Museum of Science and History, Cornell University, University of Wisconsin – Madison, the Materials Research Society, the Association of Science-Technology Centers, Inverness Research Associates, and Multimedia Research.

The goals for the NISE Net are to:

1. Engage the public with nanoscale science, engineering and technology through exhibits, programs, media, forums and other kinds of informal educational products;

2. Build a professional network of relationships, alliances, and professional development opportunities between museums and the research community; and

3. Generate essential new knowledge for learning about nanoscale science and engineering.

One of the primary goals is to engage the museum going public and other partner stakeholder groups by helping to bring nanoscale exhibits, programs, and media to as many informal science education venues as possible, with a specific target of 100 venues over the course of the grant. The NISE Net plans to reach this goal by building a network of relationships between informal science education organizations, nanoscience researchers, and professional associations that can work together to accomplish more than any single institution could do on their own.

Nano Public Forums Overview:

One focus of NISE Net's activity is the creation of nanoscale science, engineering and technology public forums that offer participants the opportunity to engage in thoughtful conversations about important issues regarding the potential societal, environmental and ethical implications of nanotechnology. They provide a vehicle for people of diverse views and backgrounds to deliberate on difficult issues and to seek a more comprehensive understanding of the topic.

The overall charge to the NISE Net Forums Team is to develop, test, and disseminate program models aimed at engaging adults and teenagers with informal educational experiences that incorporate discussion, dialogue, and deliberation around societal implications of nanoscale science, engineering and technology. The purpose of this manual is to provide information on how to engage members of the public in thoughtful conversations about important issues in nanotechnology.

The Forums Team (Figure 1) collectively has presented more than 30 forum programs and developed two program models (with different formats and topics) that have been tested at all five institutions, as well as a number of other forum program models implemented at only one or two sites. Going forward, the Forums Team plans to develop one more program model and to create dissemination packages for all three developed and tested programs. These program packages will be made available on nisenet.org along with information about other program models.

In addition to creating additional program models and distilling and posting the relevant knowledge about producing forum programs, work will be done in the remaining three years of the grant to expand the number of institutions with experience in presenting such programs.

Figure 1. Museum Collaborators in NISE Net's Forums Team

Museum	Contact
Exploratorium	Veronica Garcia-Luis
Museum of Science	David Sittenfeld
Museum of Life + Science	Brad Herring
Science Museum of Minnesota	Dave Chittenden
Oregon Museum of Science and Industry	Amanda Thomas
Evaluation Coordinator	
Museum of Science	Christine Reich

NOTICE: You're welcome to alter this program to suit your needs. In fact, we encourage it! Change it around, and if you find something that works let us know. Post your revisions on www.nisenet.org. You may also find it helpful to refer to the Forums Manual for more detailed information on hosting a forum.

Program Delivery

Agenda:

The following agenda is one example that you may find useful when designing your forum. Please feel free to modify it to meet your needs and requirements.

* Pre-survey (before the start of the forum) - *If the forum will be evaluated, have the participants fill out the pre-forum evaluation while they are waiting for the forum to begin.*

1. Welcome/Introduction – **5 minutes**
    - Have the moderator of the forum give an introduction to your museum/institution and to the format of the forum.
    - Introduction to the NISE Net and your role with the network if applicable.
    - Introduce speaker(s) – obtain presenter biographies before hand to use for introducing each presenter

2. Professional Speaker(s) Present Topic(s) – **40 minutes**
    - The first speaker should give an introduction to nanoscale science, engineering and technology and provide examples of nanomedicine applications either currently available or in the research and design phase (20 minute max).
    - The second speaker should discuss the societal, ethical and environmental implications aspect (20 minute max).

3. Q&A for any clarifying questions after each speaker – **5 to 10 minutes**

4. Introduce scenarios deliberation and review ground rules – **5 minutes**

5. Small Group Deliberation – **30-45 minutes**
    - Groups sit around a table to discuss color coded scenarios A & B and respond to the overarching question that has been placed on each table before the forum starts.

6. Individual or Group Reflection/Report Out – **10 to 15 minutes**

- Either have each group report to the whole group what they discussed during the group deliberation or ask volunteers to stand up and share with everyone what they discussed.

7. Whole Group Reflection/Report Out Questions-- **5 minutes**

    1. Is there anything that surprised you?
    2. Anything that made you think differently?
    3. Were there any points brought forward in your group that helped you to understand another perspective?
    4. Any particularly interesting points that your group identified?

* Post-survey (after the conclusion of the forum) - *If the forum is being evaluated, have the participants fill out the post-forum evaluation at this time.*

Program Length:

2:00 Hours

Cleanup:

Taking down the A/V equipment, bidding guests and speakers farewell, and cleaning up the space can take up to an hour. Satisfied speakers and participants tend to linger and continue to discuss the topic. This is to be expected with a forum. It is helpful to have someone cleaning up while at least one other person plays genial host.

Background Information for Speaker:

The following is a brief list of basic nanoscale science talking points intended to help presenters think about the kind of information they should include in their presentations. For information regarding societal and ethical implications of new and emerging nanotechnologies, please see the article Nanotechnology & Society: Ideas for Education and Public Engagement located in the appendix section of the Forums Manual.

- Nanoscale science is an emerging area of scientific research that encompasses many areas of study, including chemistry, biology, engineering, physics, and medicine.

- Nanotechnology will enable new advances in fields such as medicine, computing, and consumer products, and will likely have an effect on much of everyday life.

- Nanotechnology has to do with very small things, smaller than you can see with an ordinary microscope.
- A nanometer is very small, a billionth of a meter or 10^{-9} (for example, approximately 80,000 nanometers = width of human hair).
- Materials can have different characteristics at the nano scale (for example, gold particles change color the smaller they become).
- Along with the new benefits of nanotechnology may come risks that are currently unknown to our health, environment, and society.

Participant Materials

The following materials should be placed at each table before the forum gets underway. You may wish to highlight the overarching question by having it on its own sheet of paper and in the center of the table for everyone to refer to throughout the forum. Below you will find two scenarios that the participants will use during the group deliberation, the overarching question, and a set of resources for the participants to refer to throughout the forum.

Overarching Question:

Given the potential benefits as well as the unknown risks associated with nanotechnology, under what conditions should nanotechnology applications in medicine and personal care products be made available to the public? Why?

Scenarios:

Scenario A: Nanotechnology in Topical Personal Care Products

◆ Manufacturers currently use nano-sized particles of zinc oxide in sunscreen. This formula is as effective or better than traditional zinc oxide sunscreen, and the size of the particles makes the sunscreen invisible, sparing users the white-nose effect of traditional zinc oxide. This may encourage people to be more diligent about applying sun block for protection against skin cancer.

◆ In addition to sunscreens, a wide variety of topical lotions, cosmetics, hair conditioners,
anti-wrinkle creams, and similar products containing nano-sized particles to enhance their effectiveness are currently on the market.

Questions and contexts that may be useful for your group to consider:

What are the long-term impacts of these nano-sized particles on the body and the environment?

Do we know if nano-sized particles will be absorbed into the skin and accumulate more deeply inside tissues and cells because of their small size? If so, could they cause harm to those cells or tissues? What happens when these particles are washed off into the waste stream? Unlike food and medicine, topical cosmetics are not required to gain safety approval from the FDA prior to entering the market.

What kind of public disclosure is necessary?

There are no reporting regulations for nano-based cosmetics. This means that manufacturers can make any claim regarding nano-technology in their products. Should products with nano-sized particles be labeled differently?

Historical context: Many consumers are frustrated that GM (genetically modified) foods don't require labels, denying consumers the opportunity to make informed purchasing decisions. Others point out that those who do not want GM food can purchase organic. The same would be true with sunscreens—producers of sunscreens without nano-sized particles could voluntarily label their products as non-nano.

What are the consequences of not pursuing this technology?

One in five Americans will develop skin cancer during their lifetime. The costs, both social and fiscal, of skin cancer are enormous and some people argue that sunscreen is used more when it is invisible.

Scenario B: Nanotechnology in Diagnosis and Treatment in the Body

◆ In current research is a diagnostic technique that involves injecting nano-sized iron oxide particles into the bloodstream prior to an MRI (magnetic resonance imaging). The presence of the iron oxide nanoparticles serves to greatly enhance MRI ability to detect the spread of cancer from its point of origin to lymph nodes in the body. Human clinical trials show that this new technology substantially improves diagnosis in a range of pelvic cancers, including prostate, bladder, and cervical cancer. The body handles the iron nanoparticles in the same way as iron in vitamin and mineral supplements.

◆ Researchers are currently developing a variety of other novel solutions in medical diagnosis and treatment that involve internal use of engineered nano-sized particles. Injections of gold-coated silica nanoshells are being tested in mice. The nanoshells collect in tumor tissues. The nanoshells can be selectively heated when illuminated from outside the body with near infrared light. The heat destroys the tumor tissue.

Questions and contexts that may be useful for your group to consider:

What are the long-term impacts of nanoparticles in the body?

Iron oxide nanoparticles were thought to be safe, however, recent research has discovered that the particles can be toxic to nerve cells. Might there be longer-term effects that cannot be measured for many years? Can they accumulate in unintended places in the body?

Will the expense of the new technologies unfairly limit their use?

Some worry that any new medical technologies will be so expensive that they will further increase the cost of medical care and insurance. Others argue that early detection could greatly reduce the costs of treatment.

What are the consequences of not pursuing or delaying these technologies?

Earlier and more accurate detection of diseases like cancer will save money and lives. Localized treatment of tumors may spare patients the harmful side effects of radiation and chemotherapy. FDA approval processes, however, can take years, in order to address all issues that may be raised about a new medical procedure.

Group Reflection/Report Out Questions

1. Is there anything that surprised you?
2. Anything that made you think differently?
3. Were there any points brought forward in your group that helped you to understand another perspective?
4. Any particularly interesting points that your group identified?

Nanomedicine Glossary:

Nanometer – A unit of measurement equal to one billionth of a meter.

Nanoparticle – A small piece of matter composed of an individual element or a compound of elements, typically less than 100 nanometers in diameter. The term can refer to a wide range of materials, including the particulate matter expelled as car exhaust. Over the past two decades, engineered nanoparticles have been manufactured for commercial purposes, typically in order to take advantage of *quantum effects* (which are optical, electrical, or structural properties unique to the nanoscale, exhibited by nanomaterials smaller than around 100nm).

Nanoshell – Small particles, several hundred nanometers in diameter, manufactured using nanoengineering techniques, made up of a core material (usually silica) and a coating (usually gold).

Nanotechnology – Our growing ability to understand and manipulate atoms and molecules to fabricate materials, devices, and systems.

Targeted drug delivery – The ability to precisely direct a pharmaceutical agent to a desired location in the body, such as particular organs or specific cells.

Resources on Nanotechnology and Nanomedicine:

◆ KQED QUEST – excellent 10 minute video introduction to Nanotechnology
http://www.youtube.com/watch?v=S4CjZ-OkGDs
Corresponding educators guide:
http://www.kqed.org/quest/dfiles/106a_nanotechnologytakesoff.pdf

◆ Project on Emerging Nanotechnologies – ******also on Nanotechnology in general***
(Woodrow Wilson International Center for Scholarship)
http://www.nanotechproject.org/

◆ National Cancer Institute (NCI Alliance for Nanotechnology in Cancer) – *includes a general video about nanotechnology and cancer, as well as news articles*
http://nano.cancer.gov/

◆ "Remotely Activated Nanoparticles Destroy Cancer" by Kevin Bullis
Technology Review, January 2, 2007
http://www.technologyreview.com/Nanotech/17956/

◆ "The potential and the pitfalls of nanomedicine":
http://www.nanowerk.com/spotlight/spotid=1891.php
Follow-up articles:
http://www.nanowerk.com/spotlight/spotid=1975.php
http://www.nanowerk.com/spotlight/spotid=2113.php

• *Food & Drug Administration Faces Growing Number of Nanotech Medical Products (October 2006 report)*
http://www.nanotechproject.org/92/nanotech-knocks-on-fda

• *Brand New Public Opinion Polls on Nanotech Awareness, Trust and Food Products****
See News tab on website for September 25, 2007 webcast

• *Inventory of all consumer products using nanotechnology****
http://www.nanotechproject.org/44

Universal Design

The following features of the program's design make it accessible:

1. Repeat and reinforce main ideas and concepts.
2. Provide multiple entry points and multiple ways of engagement
3. Provide physical and sensory access to all aspects of the program. Visitors can touch, see and hear different elements of the program.

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