

Nanotechnology: A Discussion on Ethics

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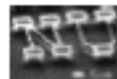
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Teacher's Guide

Developer: Erica Wilson
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Fundamental topic (and framework concept) that will be addressed in this lesson:
Nanotechnology and Science Ethics:

- Science and technology in local, national, and global challenges
- Science as a human endeavor
- Historical perspective
- Natural and human-induced hazards
- Population growth
- Personal and community health

Specific goal of the lesson: To engage students in discourse about significant topics in nanotechnology, and potential implications on individuals and society.

What are the strengths of the lesson?

- Students will be exposed to a new topic
- Concepts are interesting, accessible, and relevant to the students
- Discussions are grounded in scientific concepts
- Students will be given the opportunity to acquire scientific values and attitudes such as:
 - curiosity
 - openness to new ideas
 - acceptance of ambiguity
 - the ability to work cooperatively
 - the willingness to modify explanations in light of new evidence
 - taking intellectual risks

Related readings (fictional and nonfictional):

- Prey, Michael Crichton
- Nano, John Robert Marlow
- Nanotechnology and Homeland Security, Daniel and Mark Ratner
- The Next Big Thing is Really Small: How Nanotechnology Will Change the Future of Business, Jack Uldrich and Deb Newberry
- Engines of Creation: The Coming Era of Nanotechnology, Eric Drexler
- Nanotechnology: A Gentle Introduction to the Next Big Idea, Mark and Daniel Ratner
- Micromachines and Nanotechnology, David Darling

Main resource: This lesson plan was inspired by the Fred Friendly Seminar taping at the Museum of Science, Boston in November, 2006.

<http://www.learner.org/resources/series207.html>

Scenario 1: Grandpa and RFID

A few days ago your grandfather was going to the market and became disoriented. He got lost and ended up in Downtown Crossing. The police contacted you to bring him home. Since mom and dad both work long hours, Grandpa is your responsibility.

Now, Grandpa has been living in his house for about 50 years. His home has memories of your Grandma, who passed away almost 10 years ago. He doesn't want to be put in a nursing home. But how can we help him?

Technology has made great advancements. Grandpa could be implanted with a tiny device, no bigger than a grain of rice. It has GPS tracking, just like in your car. A chip reader in the doorway of his house can let you know when he's left his house. It could alert you if he's gone outside some geographic area, and might be lost. It could also tell you if Grandpa hasn't moved around inside the house all day and might be hurt.

It's small. No one's going to know he's wearing it. With this chip he can always be found, whether or not he asks for help.

Would you advise Grandpa to do this?

Ideas to facilitate discussion:

- You're at school all day, parents work full time, young and want to have fun
- Worried about Grandpa, concerned about his safety
- Implanting like an animal... dignity?
- Grandpa's autonomy (individuality) - Grandpa likes to go to Suffolk Downs with your Uncle... RFID allows no privacy
- Could the device be turned on and off??
- Who would have access to the info? Would it be abused? There is no law that prevents that company from sharing the info.
- Could the device be hacked??
- Long term health insurer would lower hefty prices – you're parents pay this
- Other possibilities?... home aids? (expensive) cell phone? ID card/bracelet?
- Poor use of police time to track down Grandpa

Extension:

Now flip the scenario..... mom and dad want to put the same RFID chip in you!!!! This will allow them to monitor your whereabouts when you aren't at home. They are too busy to constantly check on you, but want to make sure you're safe.

What do you think of this?

Scenario 2: The Bracelet

A well-dressed man approaches you and your friends in the mall. He is from a marketing research firm, and has a business deal for you. All you have to do is wear a bracelet during the day. The bracelet is pretty neat... you might even say you like it. In return, \$50 will be added to a debit card each month. This debit card can be used anywhere.

In addition, you will get discounts from the places you like to shop. Even better, when you walk into a store, the offers from that store pop up on your cell phone. In return, the company will collect marketing data about where you like to shop, etc.

It's nothing permanent. You can take the bracelet off at any time.

Do you decide to wear the bracelet?

Ideas to facilitate discussion:

- Is target marketing done to you or for you?
- What could that little piece of jewelry do? Read any RFID chip in any product that you pick up. Know where went through store, what you lingered near, what you picked up, and through debit card data, what you ended up buying.
- Again, who has access to the data? Would you???
- Where does this information end up? How does it get used? How long is it stored?
- If it is just to track data, do you have to give your SSN? Or even an accurate name?

Scenario 3: Terrorism

Unfortunately, events take place that make the events we've discussed so far seem trivial. There is another major terrorist attack on American soil. February 20th. This time the target was the MBTA. The death toll is over 500. Once again, America is reeling.

One of the most frustrating things about this attack is that the MBTA was considering implementing a rather sophisticated pre-screening system; something called Link Analysis. This would allow us to look back at a person's history... their places of residence, their travel itineraries, etc. By virtue of this powerful software, we could develop connections to known terrorists, or known criminals for that matter.

For typical individuals, when we run this software, it produces a 20 page long document. It goes back to their childhood. For some individuals the document runs 100 pages.

After this terrorist attack, the MBTA moves quickly to immediately adopt this Link Analysis system. Moreover, this new system makes use of the Government's REAL ID requirements. The REAL ID Act of 2005 says that all Americans who drive will be issued a uniform national driver's license. It will be both a card and an interconnected database that will have a whole host of information.

So, we've got a new system. All people entering a rail station will swipe their government ID. That information will be sent through a Link Analysis system to determine your risk level. The low risk people can immediately board.

Since you are a frequent passenger of the T, what are your thoughts on the new system?

Ideas to facilitate discussion:

- Right to privacy vs. right to life... How do we balance the legitimate need for safety with monitoring of our lives??
- It is not a constitutional right to ride the T... can choose not to ride.
- Blunt instrument - this kind of a system might flag people who are completely innocent but happen to live in an neighborhood where a known terrorist lives.
- Who exercises the judgement?
- Would you be reassured about riding the T?
- There is a larger implication of government monitoring....
- Is the info.guaranteed accurate in the first place??

Scenario 4: CCTV

Advances in technology have allowed Boston to put up cameras every few feet in the business, government, and retail districts. Cameras are started to be placed in some residential areas as well.

Nanotechnology has made information storage-free. We can take limitless amounts of information and search it.

Cameras will be on you at all times in these areas, along with motion detectors and other sensors. Sensors can detect not only motion, but also chemicals and vapors.

With a camera nearby we can see who is nearby, where they have been, and where they are going.

Would you want to live in an all-camera or a no-camera city?

Ideas to facilitate discussion:

- Deter predators and criminals (?)
- Don't want to be watched, or have the feeling that I might be watched. Will feel like I have to wear make-up and good clothes all the time.
- Then again... ATM cameras, jewelry store cameras, etc.
- Is it monitored real-time? Or taped?
- What are they doing with the information?? How long is it stored?
- London has this... but does it help?? Although it did help find the perpetrators after the bombings.
- Does this take away our freedom?

Extension:

We could use these cameras to battle drunk drivers. Is this micromanipulation?

Scenario 5: Government

In the aftermath of 2/20, the government is very motivated to get to the bottom of this. In fact, it's interested in looking at everyone to determine their movements, their purchases, their communications and try to solve who did this. There's a lot of data that they can choose from. There's telephone company records, Internet company records, credit card company records, banks, retailers, companies like the one collecting that marketing data from YOU wearing the bracelet. Even the company that keeps track of where Grandpa is with his RFID chip.

With nanotechnology, all of this technology is easily available, sortable, and searchable.

Over some time, when they pursue the 2/20 attacks, they learn that the attacks were not the work of religious extremists from overseas. It turns out to be some ultra-Columbine, youth-oriented plot executed by a group of primarily American born teens.

The information gathered by the marketing research firm, if cross-referenced with other data, would show that in the months leading up to 2/20, YOU purchased a book on Columbine, downloaded the movie Natural Born Killers, and was in a local café at the same time as one of the suspected organizers of the attacks half a dozen times.

What are your thoughts of being associated with this incident?

Ideas to facilitate discussion:

- Should the government have access to all this information in the first place?
- Will the government be able to keep up with the potential people to investigate??
- Have the people voted on this access?
- Don't forget... it also multiplies –geometrically- the mistakes that are made
- The more information that is stored, the more attractive it is to a hacker.
- Can technology successfully protect data as well? The Veteran's Association... (27 million veterans)

Homework Discussion Questions

Topic 1:

If nanoscience provides life-saving medical technology (curing cancer, for instance), but the cost is prohibitive for most ordinary people, should the government fund the use of the technology for everyone? Or how should the technology be used?

Topic 2:

If you could have experimental nanosubmarines (meant to monitor your health and fight off disease) inserted into your bloodstream, would you do it?

Topic 3:

It is pretty amazing to think that a lump of coal and a diamond are made of EXACTLY the same chemical: carbon. The ONLY difference is how the atoms are arranged. What would happen if we could manipulate the carbon atoms and manufacture diamonds as easily as M&M's?



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