Education and Outreach: Nanotechnology Activity Guides

Technology and Public Policy

Audience: Middle to high school
Time Needed: 60+ minutes (activity can be stretched over multiple days)

Objectives:

- To help students understand the relationship between technology and society
- To help students understand how public policy decisions are made

Related Wisconsin Model Academic Science Standards:

- *A.12.3* Explain why decisions regarding the use of technology are dependent on the situation, application, or the perception of the group using it
- *B.8.8* Identify major scientific discoveries and technological innovations and describe their social and economic effects on society
- *B.12.10* Select instances of scientific, intellectual, and religious change in various regions of the world at different times in history and discuss the impact those changes had on beliefs and values
- *B.12.15* Identify a historical or contemporary event in which a person was forced to take an ethical position, such as a decision to go to war, the impeachment of a president, or a presidential pardon, and explain the issues involved
- *C.8.7* Locate, organize, and use relevant information to understand an issue of public concern, take a position, and advocate the position in a debate
- *C.8.8* Identify ways in which advocates participate in public policy debates
- *C.12.8* Locate, organize, analyze, and use information from various sources to understand an issue of public concern, take a position, and communicate the position
- *C.12.9* Identify and evaluate the means through which advocates influence public policy, and identify ways people may participate effectively in community affairs and the political process
- *D.8.4* Describe how investments in human and physical capital, including new technology, affect standard of living and quality of life
- *D.12.1* Evaluate technologies based on various sources of information
- *D.12.4* Explain and evaluate the effects of new technology, global economic interdependence, and competition on the development of national policies and on the lives of individuals and families in the United States and the world
- *G.8.3* Illustrate the impact that science and technology have had, both good and bad, on careers, systems, society, environment, and quality of life
- *G.12.3* Analyze the costs, benefits, or problems resulting from a scientific or technological innovation, including implications for the individual and the community

- *G.12.4* Show how a major scientific or technological change has had an impact on work, leisure, or the home
- *H.8.3* Understand the consequences of decisions affecting personal health and safety
- *H.12.2* Evaluate proposed policy recommendations (local, state, and/or national) in science and technology for validity, evidence, reasoning, and implications, both short and long-term
- *H.12.3* Show how policy decisions in science depend on social values, ethics, beliefs, and time-frames as well as considerations of science and technology
- *H.12.4* Advocate a solution or combination of solutions to a problem in science or technology

Activity Materials:

- Introductory pictures
- Scenario fact sheet - "Welcome to Nanoville!"
- Group identity worksheets - Environmentalists, Industry and Local Businesses, Health and Safety Workers, Residents, and Nanocomposite Manufacturers
- Poster paper and markers for each group of students

Activity Instructions:

This activity involves students in a mock legislature, defined to be any decision-making body consisting of elected representatives. Students will be asked to consider the effects of using nanotechnology on different segments of society, and then decide as a class whether or not nanotechnology should be used. A suggested scenario and group roles are included in the supplementary materials, but the instructor should feel free to make modifications and additions to the activity as appropriate for the class.

Opening Discussion (5-10 min.):
Show students the pictures of the sheep, the space shuttle, the cell phone, and the junk e-mail. Ask students to brainstorm what all of these things have in common. Explain that all of these pictures represent areas of science and technology that have been affected by, or could be affected by public policy and law - cloning, the space program, cell phone use while driving, and regulation of junk email.

Begin a group discussion on the roles society, law, and politics have played in determining the path of science and technology in the past, and in recent history. Technology helps to shape society, and society often shapes technology through laws and regulations. Elaborate on the examples given in the pictures, or use examples from history if you feel it helps to illustrate the point.

Introduce the idea of the legislative process. In the United States, citizens elect people to represent them in lawmaking bodies. These representatives must balance the wishes of the people they serve with their own personal views and the views of any organizations they support. Representatives turn those views of what the government should do into bills - suggested laws. The bills are first sent to committees for study, and then brought to a vote before the entire lawmaking body. Students should understand that they will play lawmakers, who will first study a bill in committees, present their findings, and then vote on the bill.

Introduce and explain nanocomposites. (See article, "Nanocomposites: Coming Soon to a Store Near You"). Outline the role-playing scenario for the students. (See handout, "Welcome to Nanoville!" for details of role-playing scenario.)

Group Preparation (10-15 min.):
Divide students into committees of 3-5 people each. These committees will each study the effect the law would have on one particular group in society. Students will be provided a worksheet with questions they should discuss and answer. The teacher should review each committee's worksheet upon completion. After receiving educator approval, committees should summarize their conclusions from the worksheet and make a poster outlining the points they think are the most important.

Group Presentations (15-30 min.):
Each group will show its poster to the class and make a brief oral presentation on what they discussed. As an alternative, have the students debate their positions.

Wrap-up Discussion (10-15 minutes):
Bring the class back together and ask students to vote the way they believe someone in their role would vote. Then lead a discussion on the outcome of the vote, how the vote will affect scientific research on nanocomposites, the major issues brought up during the presentations, and what the students learned about the relationship between science/technology and society/law/politics.

Required Background Information:

Nanotechnology is currently a hotbed of speculation and scientific research. The prefix "nano" means "one billionth of," as in a "nanometer" is one billionth of a meter. The field of nanotechnology is broad, including virtually everything that deals with manipulating particles on the scale of nanometers - on the molecular or atomic level. Current applications of nanotechnology include uses as frivolous as fabric that cannot be stained and as ubiquitous as LED lighting. Nanotechnology has the potential to improve dramatically the storage and processing of information; the development of nano-engineered sensors that might allow for early tumor detection; the creation of new materials that are stronger and lighter than existing ones; and the increase in energy efficiency of solar cells. Nanotechnology could potentially allow for the development of a continuous, unmanned presence outside the solar system.

Supplemental Materials:

- Handout: [Introductory Pictures](#) (pdf)
- Handout: [Student Identity Sheets and Worksheets](#) (doc)
- Handout: [Nanocomposites Article](#) (doc)
- [Teacher's Guide](#) (doc)

References:

- Buchholz, K. Nanocomposite debuts on GM vehicles. *Automotive Engineering International Online*.- http://www.sae.org/automag/material/10-2001/index.htm
- Composites - http://www.psrc.usm.edu/macrog/composit.htm
- Current Nanotechnology Applications. *Nanotechnology Now* - http://nanotech-now.com/current-uses.htm
- The Future of Automotive Plastics. *PR Newswire* - http://www.scprod.com/gm.html

- Leaversuch, R. Nanocomposites Broaden Roles in Automotive, Barrier Packaging. *Plastics Technology Online* - http://www.plasticstechnology.com/articles/200110fa3.html
- Thermoplastics - http://www.psrc.usm.edu/macrog/plastic.htm

Authors:

IPSE Interns: Nancy Karuri, Yvonne Kao

IPSE Leadership Team: Wendy C. Crone, Amy Payne, Greta Zenner, and Tom Derenne

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