



## *Societal Implications / Activity: Alternative Scenarios*

### ***Alternative 1: Replicating Nanobots***

1) Offer the following scenario – a group of researchers at XXX has recently succeeded in creating a working nanobot – a nano-sized robot that is capable of performing many different tasks. These tasks can include constructing materials or devices on the atomic level. By allowing millions of these nanobots to work at the same time, almost anything might be built from the raw materials provided in special containers or in the ordinary environment. However, the time, effort, and cost required to make a single nanobot, let alone millions, are prohibitive – tens of thousands of atoms must be put together in just the right way. Luckily, these nanobots are capable of making copies of themselves. Thus, starting with only a few original robots, within a short period of time, you can have millions or billions at work, building whatever you want them to. Because of its massive implications, Congress has convened a special panel to discuss whether and how self-replication should be used. Participants have been asked to address the following questions:

- Should nanobots be allowed to build copies of themselves?
- Who should decide how to limit self-replication?
- How should such limits be enforced?

2) Students will then gather into groups representing different segments of society to discuss these questions. Each group will represent one of the following:

- Federal Government (Executive Branch) – The EPA will probably want to draft legislation forbidding the ability of nanobots to self-replicate and, given the threat involved, to assume a regulatory or oversight role, keeping track of the design of nanobots, their manufacture, and use. The Defense Department would probably also be very concerned about the use of self-replicating nanobots as a weapon of some kind – they may push for making construction of all *civilian* self-replicators illegal. Legislators will probably also want such legislation, probably on the same idea as the prohibition of human cloning. However, there may be reluctance to give – and pay for – strict regulation or to make the consequences of violating any prohibition very strict. Instead, the word of manufacturers will be relied on.
- Manufacturer – Most likely, the potential makers of nanobots will want to endow them with some sort of self-replication ability, otherwise the cost of producing nanobots individually will become too great. They would have little interest in allowing free replication in the environment, and would promise to make nanobots out of special materials so that they could only build copies of themselves when the right combination of elements (non-naturally occurring, ideally) is present.
- Environmentalists – Environmental organization will almost certainly call for strict legislation prohibiting self-replication with stiff penalties for violation. Given the potentially catastrophic repercussions of an accident or loss of control – nanobots eating whole ecosystems – and the probability that any such problem would increase exponentially over time, they would also likely call for close supervision of nanobot manufacturers. Unlike the government, they will show little willingness to trust corporations to police themselves.
- Artificial Life Defense League – This is a small group that has recently been catapulted into the news. They are claiming that self-replication defines life, and so nanobots that can build themselves are actually living things (a claim strongly rejected by environmentalists). This entitles nanobots to certain innate rights – particularly the right to survive.
- Researchers – Scientists and engineers understand the dangers of self-replication and are willing to circulate and sign an agreement among themselves to not construct nanobots with the ability to self-replicate or to make self-replication possible only under a narrow set of circumstances (only when certain very rare elements are present,

for instance). But there may be strong opposition to any actual legislation which may interfere with the freedom of scientific research.

**\*\*NOTE\*\*** The Identity Sheets provided for this lab will need to lay out the whole gray goo problem. It may also be worthwhile to emphasize somewhere the possibility that nanotechnology might someday blur or erase the line between the living and non-living worlds, between works of technology and works of biology.

### ***Alternative 2: Artificial Intelligence***

1) Offer the following scenario – recent advances in nanotechnology have lead to increasingly powerful computers. The capacity of cutting edge machines is on the verge of surpassing the ability of the human brain. This power has allowed the development of artificial intelligences – computer programs that appear to be able to think and act like human beings. A Milwaukee firm called XXX has succeeded in creating such an artificial intelligence that seems to have the intellectual capacity of an ordinary adult and is planning to market their creation. Before this happens, Congress has convened a special task force to discuss the implications of artificial intelligences. They have asked participants to consider the following questions:

- Should artificial intelligences be allowed?
- What sort of civil rights should AI's have, if any?
- Should new laws be passed to protect AI's?

2) Students will then gather into groups representing different segments of society to discuss these questions. Each group will represent one of the following:

- Federal Government – Different elements of the government may have very different opinions on this one. Once such programs, that may raise questions about whether they can vote or whether they are entitled to protection under the law (is erasing one murder, for instance?). On the other hand, they have countless applications, including military uses, and there would be elements that would not want to dismiss them out of hand.
- Artificial Life Defense League – As above, this organization would be in strong support of allowing AI's to exist and granting them all the rights that any other person would have. Their contention would be that AI's are a form of intelligent life that, like humans, come in the form of a complex machine.
- Ordinary People – Like the government, ordinary people are likely to see things from a number of different perspectives. AI's might be a great help in certain tasks – they could become personal assistants. But they might also take jobs away from people in certain areas, particularly since they might work for nothing, twenty four hours every day. (There are some interesting comparisons to be made here with immigration or with the relocation of factories to places where labor is much less expensive, if desired.) Finally, ordinary people might bring up the issue of religion and concerns over the apparent creation of living, intelligent things.
- Researchers – It's likely that researchers of various kinds would like to see AI's, at least on a limited basis. They can certainly help to shed light on the workings of the human mind, and might become research tools themselves. But this does not mean releasing them into the ordinary world, which involves all sorts of complications. There is the problem of whether AI's would be covered by current regulations on human testing, and there may be a variety of opinions among researchers on that one.
- AI Manufacturer – I suspect any manufacturer of AI's would likely take the “common sense” position that, regardless of behavior, AI's are really just machines and don't need to be treated in any special way.

**\*\*NOTE\*\*** As in the above case, there is an underlying theme here that nanotechnology might make it harder to tell the living from the non-living worlds.



### ***Alternative 3: Nanobots in the Brain***

1) Offer the following scenario – a Milwaukee firm has recently developed a working nanobot that can operate inside the human body, fighting disease, repairing organs, and monitoring vital processes. A version of these nanobots has been designed to operate in the brain, and open up the possibility of repairing neurological damage. But it also appears that such robots might also be able to alter the brain as well as prepare it. In particular, nanobots might be able to place knowledge directly into the brain (or eliminate it), just like data can be written or erased on a computer disk. The firm is hoping to begin marketing these robots, programmed to provide a variety of kinds of knowledge in the near future. Before this happens, Congress has called together a special panel to discuss the use of these nanobots. They have asked its members to consider the following questions:

- Should such knowledge-carrying nanobots be allowed?
- If so, under what circumstances?
- What kinds of knowledge can they carry?
- Should they be available to everyone, the same way that public schooling is?

2) Students will then gather into groups representing different segments of society to discuss these questions. Each group will represent one of the following:

- Teachers – Clearly, I suspect that most teachers would not want to see such nanobots come into wide use. Many of them would be out of jobs, though people who couldn't afford these nanobots would still need to learn in the “old-fashioned” way. And they may express some suspicion that learning in such a way isn't really learning – that you may have knowledge but not understanding. Finally, they may envision a world where learning and knowledge becomes undervalued and taken for granted.
- Students – At least at first, most students will probably think this sounds like a good idea. They would be able to learn anything they wanted with virtually no effort. However, it's likely that such nanobots won't be cheap, which means that less affluent students won't be able to use them. That raises issues of fairness and also of increased separation between rich and poor.
- Federal Government – As above, various voices and agencies within the government may have some very different takes on this issue. Certainly the DEA and NIH may worry about the long term neurological effects of use, particularly if they become a habit. Certainly addiction seems a real possibility. And if knowledge can be added, it could likely also be erased, which opens the possibility of harm, if these things fell into the wrong hands.
- Nanobot Manufacturer – The manufacturer of these bots is likely to stress the convenience they offer and their ability to make people equal by giving them access to the same kinds of knowledge. They also have R&D expenditures to get back.
- Psychologists – Some psychologists might worry about the development of a society where people are treated more like machines than as human beings. There's also the potential problem of addiction, and of personality changes (or damage) that might result from acquiring so much knowledge so quickly. The human brain is designed to learn in a slow fashion and to incorporate information slowly. Finally, as a profession that requires years and years of training, I imagine most psychologists might frown on the possibility of someone knowing as much as they do after an hour or so. It certainly threatens their professional position.

### ***Alternative 4: Environmental Nanobots***

1) Offer the following scenario – a new company has recently developed several types of environmental nanobots. Within the next few years, the city of Milwaukee plans to release them in the air. Environmental nanobots can fight pollution; however, they also can be programmed to monitor people's activity. Thus, the Wisconsin State Government has gathered together representatives from a number of different areas to help answer some important questions.



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These include:

- Should the environmental nanobots be used at all?
- Should their use be limited (only areas with high pollution)?
- Who will pay for the nanobots (Government, all companies in Milwaukee, only companies generating excessive pollution)?
- Should nanobots be allowed to monitor people's activity, and if so, who controls the information gathered by the nanobots?

2) Students will then gather into groups representing different segments of society to discuss these questions. Each group will represent one of the following:

- Government Officials in Milwaukee (including lawmakers and regulators)
- Government Officials in Waukeshau (including lawmakers and regulators)
- Environmentalists
- Companies in Milwaukee (including small businesses not generating a lot of waste and companies largely contributing to high pollution levels)
- General public (which should include people of varying ages and social classes)
- Environmental Nanobot Manufacturers

### ***Alternative 5: Performance-Enhancing Nanobots***

1) Offer the following scenario – a new company in Milwaukee has recently developed several types of medical nanobots. Within the next few years, the president of the Milwaukee Bucks plans to use the nanobots to treat their athletes. These medical nanobots can fight disease, repair organs, and collect medical information about the body. However, the National Basketball Association has some concerns about a team using nanobots and has gathered together representatives from a number of different areas to help answer some important questions. These include:

- Should the medical nanobots be used at all?
- Should their use be limited (players with serious injuries vs players with simple sprains)?
- Who will pay for the nanobots (The NBA, the Milwaukee Bucks, individual players, the fans through increased ticket prices)?
- Who gets to control the information that nanobots can gather?

2) Students will then gather into groups representing different segments of society to discuss these questions. Each group will represent one of the following:

- Presidents or general managers of various NBA teams
- Athletes on the Milwaukee Bucks
- Athletes on other NBA teams
- General public (which should include people of varying ages and social classes)
- Medical Nanobot Manufacturers

### ***Alternative 6: Black Box Nanobots***

1) Offer the following scenario – One day we might be able to manufacture things, starting at the atomic or molecular level, right in our own homes. Instead of throwing things into the garbage and filling up landfills, we instead would toss unwanted objects, be it eggshells or last season's blouse, into a black box. Inside the box nanobots would disassemble the "garbage" into molecules or atoms and create a storage of fundamental molecular or atomic building blocks. When we wanted something new, instead of going to store and spending more money, we would simply tell the black box what we wanted [how?]. The nanobots in the black box would draw from their supply of building blocks and create the desired object. The ultimate in recycling technology! Before such devices are made available, Congress has convened a special panel to discuss their implications. The following questions may be considered:

- Should black boxes be allowed?



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- What happens to businesses?
- What about affordability and social stratification?
- How do you make sure that the nanobots remain under the control of their owners?
- Should you regulate what people create?

2) Students will then gather into groups representing different segments of society to discuss these questions. Each group could represent one of the following:

- Black Box Manufacturers
- General Public (as both consumers and workers)
- Government
- Traditional Businesses
- Environmentalists

### ***Alternative 7: Nanobots in Space***

1) Offer the following scenario – Nanobots might help us explore outer space and inhabit another planet or moon. We would send nanobots to the planet to collect data, then, once we know about the planet, we would send different nanobots back to the planet to make it habitable for humans.

In considering these possibilities, the following questions might be addressed:

- Should we inhabit space at all?
- What kind of government and laws would there be? Would we follow the same system(s) that we do on earth? Would 'space' be its own country?
- How does it work for different countries?
- How would people view earth, i.e., not worry so much about its condition?
- What about supplies, etc.? Would people still need resources from earth?
- What kinds of interactions would exist between space inhabitants and earth inhabitants?

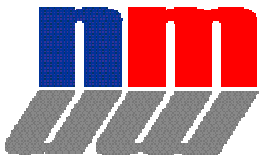
2) Students will then gather into groups representing different segments of society to discuss these questions. Each group could represent one of the following:

- Environmentalists
- General Public
- Government
- Scientists – Earth and Space
- Businesses

### ***Authors***

IPSE Interns: Lauren Sammel, Greta Zenner, Dan Thurs

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



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