gender equality and new technologies

nanotechnology

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This Fact Sheet will explain what nanotechnology is, explore its potential promises and risks, some of the reasons it matters for gender equality and identify ways it can be addressed.

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What is Nanotechnology?

'Nanotechnology' literally means technology that is very small. One nanometer is one-billionth of a meter or the width of about 5 atoms. 'Nanotechnology' refers to technology that takes place at this very tiny, sub-atomic level in robotics, chemistry, physics, information and communication technology, and molecular biology. Why is nanotechnology so revolutionary? Because at the nano-scale all matter is the same. All things, both living and non-living, are constructed of atoms.

The nano-scale sparks so much interest because when a substance is artificially created, structured atom by atom, it can have different or enhanced properties compared with the same substance as it occurs naturally, including increased chemical reactivity, optical, magnetic, or electrical properties. Nanotechnologies aim to exploit these properties to create devices, systems, and structures with new characteristics and functions. For example, researchers hope to construct from the very 'bottom' (that is to say, atom by atom) a substance as strong as diamond, but more flexible and far less expensive. It would also be possible to manufacture a substance in the shape and size needed such as a thin string as strong as steel.

In the long term, manipulating matter and creating substances at the nano-scale will allow scientists to build 'nanobots' (nano-sized robots). They would be used for 'self-assembly', where materials assemble themselves from the 'bottom up'. Medical nanobots, made of a few molecules, could hypothetically be designed to perform different tasks such as repairing blood vessels, destroying cancer cells or constructing nerve tissue atom by atom in order to end paralysis.

Another area of intense investment, research and development is nano-biotechnology, the merging of living and non-living at the nano-scale. For example, one U.S. researcher has genetically engineered rapidly growing viruses (living) to grow nano-scale wires (non-living) by producing and assembling tiny tubes of carbon.[1]

Appropriate technology for women?

- ✓ *Effective and cheap water purification systems*. One researcher is working to design a water filtration system on the nano-scale that is so efficient, it only lets water molecules through it.
- ✓ *Foods that can change nutrient or flavour content when needed*. Similarly, filters can be created to screen out toxins or adjust flavours, and packaging to sense when the food inside is spoiling and alert the customer.
- ✓ *More effective vaccines, drug delivery and disease diagnosis*. The ability to assemble nano-scale particles that could be targeted at certain parts of the body or certain viruses in the blood. Estrasorb, a skin lotion which delivers estrogen, is one of the first pharmaceuticals on the market to use nano-particle drug delivery, with particles so small they can be absorbed through the skin.
- ✓ *Highly efficient, cheap solar cells*. This could make solar power economical and diminish our dependency on coal, oil, and nuclear fuel and fuelwood.
- ✓ *Clean up the environment*. To clean up oil spills, imagine a scrubber built from tiny nanotubes that could manipulate the atoms in an oil spill to render it harmless.

Nanotechnology already

Until some of the grand promises of nanotechnology are reached, consumers in some countries can benefit from products already available:

- ✓ Several **sunscreens** on the market take advantage of the fact that zinc oxide is transparent when made on the nano-scale. Zinc oxide protects against UV rays and is normally white or opaque.
- ✓ **Tennis balls** containing incredibly strong carbon nano-tubes have double the life of normal tennis balls.
- ✓ **Spray vitamins** absorb directly into the skin, faster and more evenly than taking a vitamin orally.
- ✓ Thin **films and protective coatings** like those found on computer screens or sunglasses.
- ✓ **Stain and wrinkle-resistant fabric** like Nano-care, which uses billions of nano-sized whiskers to create an invisible cushion of air above the cloth. The cushion smoothes wrinkles and liquids roll off easily.

The dreams of humanity

> "Computers will be orders of magnitude more powerful, materials will be remarkably light and strong, medical technology will be able to heal and cure in cases that today would be abandoned as completely hopeless, the environment would be restored – in short, many of the material dreams of humanity can be fulfilled."
>
> *– Ralph Merkle, Nanotechnologist*

The promises and potential of nanotechnology seem infinite – from manufacturing and information and communications technology, to weapons and surveillance, energy and environment, pharmaceuticals and medical technologies.

The next industrial revolution?

> "We believe that nanotech is the next great technology wave … the nexus of scientific innovation that revolutionizes most industries and indirectly affects the fabric of society. Historians will look back on the upcoming epoch with no less portent than the Industrial Revolution."
>
> *– Steve Jurvetson, venture capital investor*

How long before nanotechnology is used to cure disease, eliminate pollution, and slow aging? No one really knows.

Where is the money?

- USD 8.6 billion will be spent on nanotechnology research and development in 2004, more than double the amount spent in 2003.
- Over half of 2004 nanotech spending will be by governments: USD1.6 billion from the U.S., USD1.3 billion from Europe, and USD1.6 billion from Asia.
- By 2015, nanotechnology will be a USD1 trillion global market; some people think this mark will be reached much earlier – by 2011.
- Half of the world's pharmaceutical industry will be based on the use of nanotechnologies by 2010.[2]

What are the potential risks?

THE ENVIRONMENT AND THE HUMAN BODY

Nano-sized particles tend to behave differently than their larger-sized counterparts. They might for example be more conductive, reactive, mobile, toxic, or even be a different color. What could happen in our bodies and environments if the new nanoparticles were released?

The effects of these extremely small, synthetic particles on the environment and health are unknown. The size of the particles means they could pass the barriers of skin into our bodies. Tiny nano-particles could also be extremely toxic. Insurance companies have already expressed their concern about the risks of these particles in the environment and for health.

SECURITY

The increase in nanotechnology-based weapons could destabilize the world's power structures, because the manufacture of these weapons will be much less expensive and faster, and the weapons themselves will be much smaller than anything available today. For example, 'smart bullets', created by adding sensing and computer technology to bullets, would allow them to navigate with greater precision. Materials are also in development to make soldiers' uniforms capable of providing exterior

support when a soldier is injured or tired and that could use tiny sensors to constantly monitor the soldier's health.[3]

Many worry about the development of nano-weapons of mass destruction and their use by hostile governments or terrorist groups. In addition, the ETC Group, an international advocacy group, worries about the future of food security: new nanotech applications "will extend the reach of industrial agriculture and alter the way our food is grown and produced, processed, packaged, and even eaten."[4]

Why should we care?

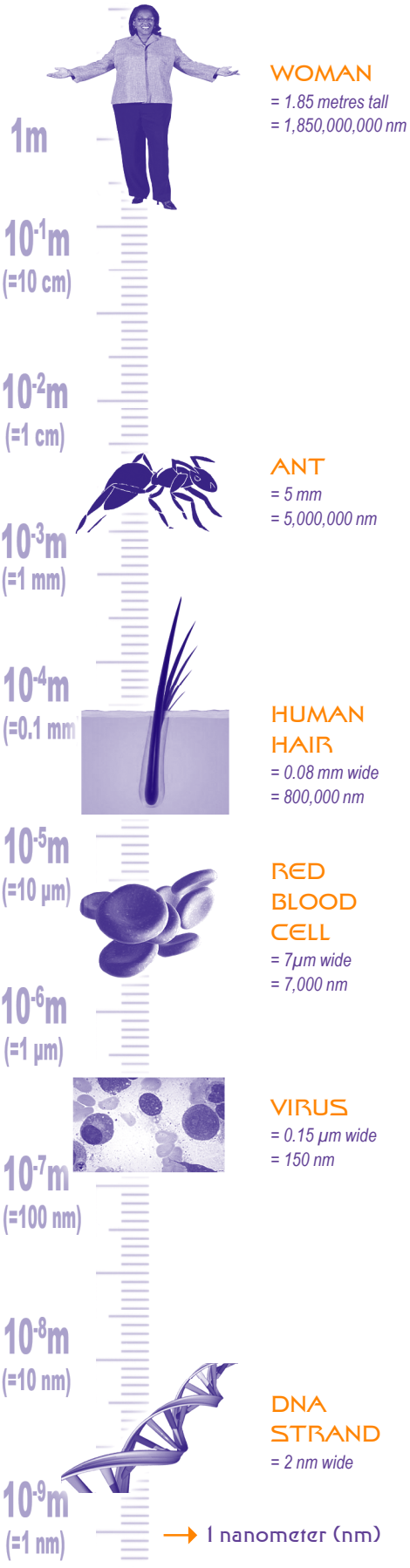
The nanotech revolution could produce an even greater gap between rich and poor, widening a 'nano-divide' between countries with advanced nanotechnologies and those without. This gap will get even bigger if nanotechnology is used for profitable consumer products rather than applications that might have a dramatic, positive effect on the world, specifically on problems of poverty in developing countries.

Additionally, the widening gap will be further exacerbated if nanotechnology completely revolutionizes manufacturing. As manufacturing becomes smaller, cheaper, and requires less raw material because materials can be created from scratch, "commodity markets will be turned upside down, threatening the poorest and most vulnerable workers who do not have the economic flexibility to respond to a sudden demand for new technical skills and/or different raw materials."[5] Countries around the world, not just in the North, are recognizing the importance of nanotechnology for future economic development.

South Africa is already focusing its nanotech research on improving its position in mining and its existing industry, realizing in order to stay competitive it needs to develop nanotechnology to add value to their natural resources like gold, titanium and so on.[6] But many countries could lose their industries in raw materials and mining, textiles, and food and agriculture. The location of raw materials could become irrelevant — a huge shift in the world economy.

If manufacturing changes so drastically that electronics or textiles are made in small facilities or laboratories in the North, it will become possible to imagine a completely re-ordered economic world. Rather than advocating for worker's rights in *maquiladoras*, women's rights advocates could have an entirely new situation to deal with if all the manufacturing became nano-sized. Manufacturing jobs would become high-tech jobs and that could be done from anywhere.

How small is nanotechnology?



notes

[1] Angela M. Belcher, "Ordering of Quantum Dots Using Genetically Engineered Viruses," Science 296 (5569) 892–895 2002.
[2] Michael Kanellos, "Nanotech sees big funding increase," 15 August 2004, cnetnews.com.
[3] Barnaby J. Feder, "Defense Department expands nanotechnology research", New York Times, 8 April 2003.
[4] ETC Group, "The Precautionary Prince II", News Release 11 July 2004. <http://www.etcgroup.org>
[5] ETC Group, "26 Governments Tiptoe Toward Global Nano Governance: Grey Governance?", 30 June 2004.
[6] "Nanotechnology – the next big thing is very, very small", Science in Africa, November 2003. <http://www.scienceinafrica.co.za> The first conference on Nanotechnology in South Africa, NANO AFRICA 1, was held in Stellenbosch on 7 April 2004.

Some developing countries believe they must get in the nanotechnology game in order to be part of the 'next industrial revolution'. India's new President A.P.J. Abdul Kalam, for example, focused on nanotechnology as a new technology that has wider applications compared to information technology and is likely to touch everyone. He has proposed forming a joint public-private action plan and committing enormous resources to ensure India's place in the nanotechnological future.

> "ETC Group is concerned about the potential for emerging technologies to destabilize the economies of poor countries in the Global South, which could imperil the livelihoods of workers and basic producers everywhere."

What to do?

Both the risks and benefits of these technologies are enormous. Both must be paid close attention. Society must figure out how to guarantee the benefits are maximized for all and the risks are minimized.

If the promises of nanotechnology are realized, medical and engineering capabilities will allow us to cure, fix, or provide technological assistance for the disabled, for example. If disability is seen as a technological issue rather than a social one, will the disabled be further marginalized?

For the poor, nanotechnology could bring benefits, like water purification, cheap energy, and accessible medical treatments, but will these be the focus of research? We have seen the trend in the pharmaceutical industry spending very little tackling the problems of the poor when there is profit to be made in consumer products, thanks to globalization of trade and patent regimes. How can we ensure that new nano-technologies are harnessed for justice not just profit?

Despite all the investment in nanotechnology by governments, there has been very little regulation or investigation into environmental and ethical issues. Nanotechnology has the potential to drastically change our world. In order to ensure gender equality and social justice, a number of things are needed:

✓ Much **more involvement** of individuals, civil society, and governments in the debates — we must learn about what is happening and anticipate how we can ensure these technologies benefit all.

✓ Far **more information** on the effects of nanosized particles in our bodies and environments;

✓ **Safety regulations** ensuring protection from the potentially harmful effects of nanotechnology (none currently exist);

✓ A **precautionary approach** in developing the technologies, focused on proving that they are not harmful before introduced;

✓ A **global approach** — given the realities of globalization and the potential global effects of nanotechnologies;

✓ A **justice approach** to ensure that these technologies can be harnessed for the benefit of all.

✓ Ensure that **gender equality and women's human rights** are supported by asking early on:

- What are the effects of these nanotechnologies on women's bodies and reproduction?
- What are their effects on women's work?
- How can women's rights be supported by these technologies, if at all?
- What do we need to know about these technologies to guarantee women's rights are not undermined?

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