Information Technology

• Electronics
• Cell Phones

• I-Pods
• Computers
From Computers to Cellphones, GPS to Bluetooth, WiFi to SmartCards.

How can small science help us communicate across big distances?

http://www.beststuff.com/images/articles/112106a1.jpg
How Big Is Nano?

A 6' man is 1.62 meters tall or 2 billion nanometers or 2,000,000,000,000 nm

A strand of DNA is ~2 nm wide

100 µm
Medication delivery system

350 nm
Nanostructure

14 nm
Quantum corral

5-20 nm
Nanoshells

10 nm
Bio motor

2 nm
Atomic handwriting

This is one nanometer!
The Scale of Things – Nanometers and More

**Things Natural**

- Dust mite 200 μm
- Ant ~5 mm
- Human hair ~60-120 μm wide
- Fly ash ~10-20 μm
- Red blood cells with white cell 2-5 μm
- DNA ~2-12 nm diameter
- Atoms of silicon spacing ~10s of nm

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**Microworld**

- 1 nm
- 100 nm
- 10 μm
- 1 mm
- 10 mm

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**Nanoworld**

- 0.1 nm
- 10 nm
- 100 nm
- 1 μm

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**The Challenge**

- Fabricate and combine nanoscale building blocks to make useful devices, e.g., a photosynthetic reaction center with integral semiconductor Savage.

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**Things Manmade**

- Head of a pin 1-2 mm
- Micro-Electro-Mechanical (MEMS) devices 10-100 μm wide
- Pollen grain
- Red blood cells
- Zone plate x-ray “lens” Outer ring spacing ~35 nm
- Self-assembled, Nature-inspired structure Many 10s of nm
- Nanotube electrode
- Carbon buckyball ~1 nm diameter
- Carbon nanotube ~1.3 nm diameter

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**Quantumcorral of 48 iron atoms on copper surface positioned one at a time with an STM tip**

**Coral diameter 14 nm**

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How small would you want your digital camera, cellphone and MP3 player?

Of course, with nanotechnology they will potentially be more precise and faster, too.

On the next page you’ll read about a nano-innovation for transistors, important electronic components.
We all use electronics which are getting more powerful even as they get smaller. This constant increase in computing power is called Moore’s Law. Nanotechnology is making sure that Moore’s Law continues for generations. Today’s transistors are just 100-200 nanometers wide and getting smaller. In 1998, scientists made a transistor from a single carbon nanotube!
Imagine fabric that has the ability to generate electricity. It can even recharge portable, wearable electronic devices such as mobile phones, iPods or any other MP3 players that requires a low-level of power.

If the fabric is made into a shirt, it could collect power when the wearer is walking slowly or even from a slight breeze. This nanogenerator could definitely be a simple and economical way to generate electricity from physical movements!
"If you think about a structure of gold dots on a DNA strand, it's like a wire with a whole bunch of tiny cuts in it. In order for electrons to travel down a nanoparticle chain, they have to jump or tunnel from one particle to the next. As a result, these nanochains have different properties than a wire would have. That's why you can make transistors out of them."

This tunneling behavior, a feature of quantum physics, is a problem for other manufacturing techniques but helps at the nanoscale.

Jim Hutchison, patent holder #6,872,971

A Nano-Transistor
Gold nanoparticles surrounded by organic, carbon-based, shells self-aligned along a strand of DNA.

http://duckhenge.uoregon.edu/io/article.php?id=236
And More Gold

Mechanical engineers at Berkley used an ink that contains nano-particles of gold to print the electronic structures.

These can be used for a variety of things:

• Field-effect transistor (Transistors which use electric fields to control conductivity in semi-conductors),

• Radio frequency identification (RFID) tags,

• Thin-film photovoltaics or flexible sensors.

http://www.thecareerengineer.com/engineering-news-archive/Electronics/
Scientists are building semiconductors one atom at a time using magnetism.
Lighter Lightweights

As the price goes down on higher capacity nanochips (presently used in the i-pods), we may see them showing up in lighter and lighter lightweight laptops.

http://www.mapnewsworld.com/story/51569.html
http://www.digitalworldtokyo.com/entryimages/2006/11/061101_Vaio_Type_G.jpg
New Displays

And it's not just the chips inside computers that use nanotechnology. The displays on everything from iPods and cellphones to laptops and flatscreen TVs are shifting to organic light-emitting diodes (OLEDs), made from plastic films built on the nanoscale. You'll be able to read the screen even in direct sunlight!

Look for flexible displays, too! Each pixel is supported by its own transistor. Imagine! Speaking of flexible…
Nanotechnology has made thin, flexible, full-color, electronic paper display screens possible. There could be a lot of advantages to this. No more environmental impact to trees, and distribution costs could be slashed.
More about Screens

I’m not sure we’re ready for the hammer test, but that may not be far away!

There are new protective nano-coatings available, super-thin and super-strong. Nanoparticles will enhance scratch-resistance on all your electronic devices.

Those better-protected screens are going to get clearer over the next few years, too. One way to get clear, bright and good contrast in the screens is to use carbon nanotubes to shoot electrons at the screen.

http://www.industryweek.com/ReadArticle.aspx?ArticleID=12240
http://store.apple.com/Catalog/uk/Images/TP953_screen1.jpg
Flexible Cellphones

Nanotechnology has started working on the material to make futuristic cellphones. Your phone will be able to be transformed into any shape you need. This new material could make your cellphone flexible, transparent and self-cleaning surfaces.

Helping Save Lives with Nanotechnology

Nanoscience is helping develop the technology to send medical images using cellphones.

This potentially could bring medical imaging to the ‘three-quarters of the world’s population which has no access to ultrasounds, X-rays, magnetic resonance images, and other medical imaging technology.’

http://blogs.zdnet.com/emergingtech/?p=908
Scientists are working on radio-frequency shielding coatings for use in buildings to take care of that problem. Nanomaterials in paint could keep cell phone waves out of the theater. It can shield wireless networks, too, which will make networks more secure.

Next will come shielding coatings on the devices themselves to prevent electromagnetic emissions. No more buzzing when you get close to other electronic devices and may be healthier, too.

http://www.industryweek.com/ReadArticle.aspx?ArticleID=12240
An Earpod Nano?

It might be just around the corner!

- Nano-optic components will soon be in your CD and DVD players, too.
- And we’re on our way to high-speed, conductive ink that can be used for electronics circuitry. These circuits will be 500 nanometers to 2 microns thick and printed on plastic. Your devices will be lighter, thinner, smaller.

http://www.industryweek.com/ReadArticle.aspx?ArticleID=12240
http://www.impactlab.com/2008/05/08/nanotech-venture-capital-is-out-of-sync-with-returns/
Nano-Batteries

There's a constant balancing act between increasing battery life and decreasing size and weight. You also need to choose between optimizing for energy bursts, like your camera flash, constant flow, like your laptop, or try to get both, as in a cell phone with a flash camera.

A new type of lithium-ion battery developed for battery-powered power tools may be the nano-key. Companies are claiming battery life as much as 10x greater than presently and they can handle the power bursts. They even recharge in about 10 minutes.
DNA Computers

DNA computers are like traditional computers in that they use transistors and store information in bits.

But DNA computing uses DNA instead of the traditional silicon-based computing technology. It uses many different molecules of DNA to try many different possibilities at once.

They’re faster and smaller than traditional computers. But that isn’t the most nanocomputer!

http://theultimaterenaissance.wordpress.com/2008/05/28/quantum-computer-the-revolution/
Quantum Computers Use Nanotechnology

In an even smaller quantum computer, information is stored as qubits (quantum bits).

These computers compute differently, too. Quantum computers, using quantum mechanisms, can be devised and built to perform operations with this data.

Learn more about nanotechnology and quantum mechanics challenges at this link.
Smart Cards Get Smarter

Nanotechnology is improving smart cards.

A smart card has a microchip in it which makes it 'smart'. It provides not only memory capacity, but computing capability as well and thus the chip is capable of processing data.

Though they’re the size of credit cards, they can hold a great deal of information, like your medical history for doctors, pharmacists and even paramedics in an emergency. Unlike magnetic strips on credit cards, these memories won’t wear out.

"At least these Smart Cards gives you something to read whilst you're waiting 2 hours for the next bus."

http://portal.fciconnect.com/electrical-connector/flexible-circuits-for-customized-applications.htm
http://ewh.ieee.org/r10/bombay/news5/SmartCards.htm
Planning Your Presentation

1. What can be done to maximize the chances that humans will benefit from, rather than be harmed by these new developments?

2. If we can develop these technologies, should we? Why?

To prepare for your presentation, answer these questions using reference materials which can include the websites linked to this webquest:

http://media.washingtonpost.com/wp-dyn/content/photo/2007/02/15/PH2007021502068.jpg
http://www.presentationalspeaking.com/images/pic_2.jpg
1. Might these nanotechnology developments in information technology infringe on human rights?

2. Could any of them decrease privacy of individuals?

3. Could the use of nanotechnology for information technology have unwanted and negative environmental effects?

4. What economic impact could the use of nanotechnology in information technology have on producers, consumers, and other industries? Might they be negative or positive?
What About Your Rights?

If so, are these developments more important than

• Your privacy?
• Your rights as a citizen?
• Your rights as a human being?

Are the answers somewhere in between?
The general website page linked at the bottom of this page are a good place to start looking for more information. It is full of nanotechnology sites related to multiple areas including yours. After exhausting these resources you may also wish to use your search engine and appropriate key words and phrases to find more information.

General websites link
If you would like help breaking down your research into steps, click on the help button for an outline.