

# **NANOTECHNOLOGY**

**Maximizing the benefits  
Minimizing the risks**

**Andrew D. Maynard**

**Chief Science Advisor  
Project on Emerging Nanotechnologies**

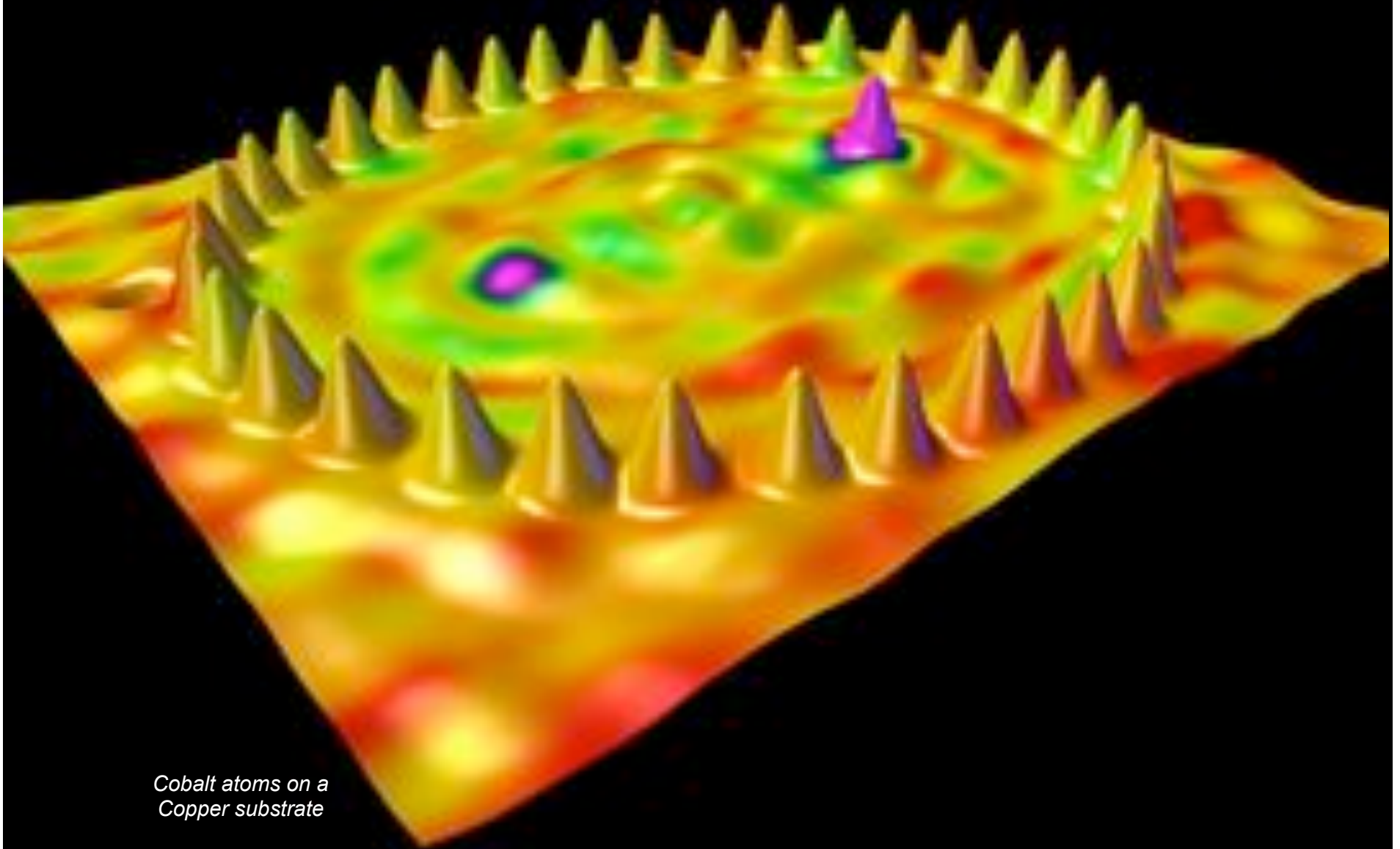
**Woodrow Wilson International Center for Scholars**

“A tsunami is unnoticeable in the open ocean - a long, low wave whose power becomes clear only when it reaches shore and breaks...

Nanotechnology has been around for two decades, but the first waves of applications are only now beginning to break. As it does, it will make the computer revolution look like small change.”

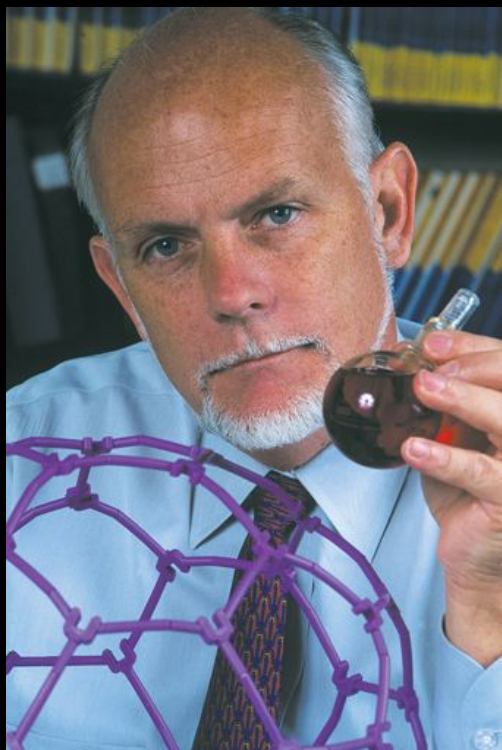
National Geographic, June 2006

H. C. Manoharan, C. P. Lutz, D. M. Eigler *Nature* 403, 512-515 (2000)  
[www.almaden.ibm.com/vis/stm/gallery.html](http://www.almaden.ibm.com/vis/stm/gallery.html)



*Cobalt atoms on a  
Copper substrate*

**Richard Smalley**  
Nobel Prize Winner, Chemistry (1996)



(1943 - 2005)

## Nanotechnology:

The art and science of building stuff that does stuff at the nanometer scale

# Getting a sense of scale

## Macro-scale

## Nano-scale

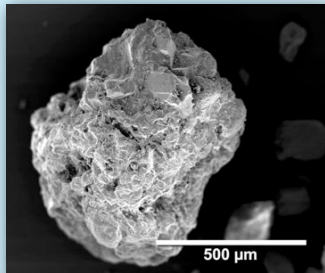
Child



1 m

10 cm

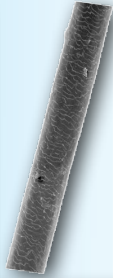
Volcanic dust



1 cm

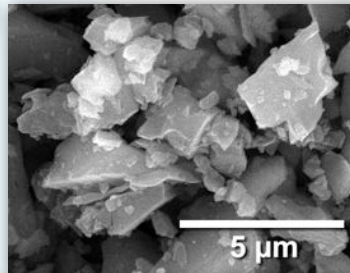
1 mm

Human hair



100 μm

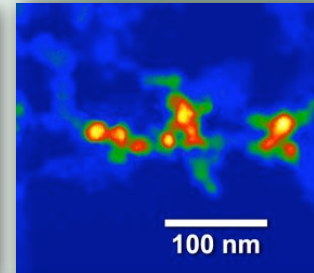
Respirable silica



10 μm

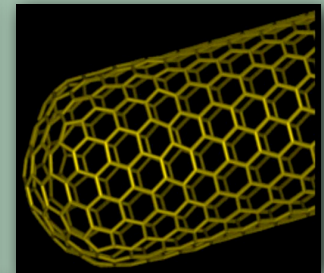
1 μm

Welding fume



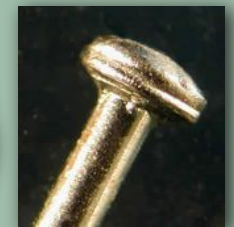
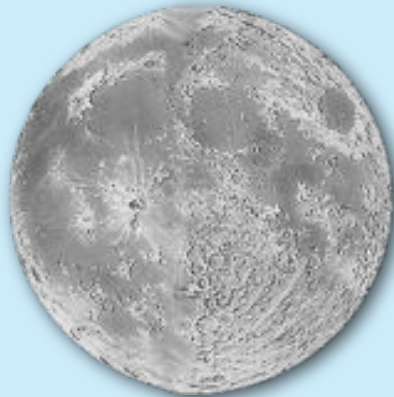
100 nm

Carbon nanotubes

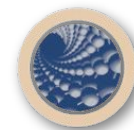


10 nm

1 nm



*Relative sizes*



## Personal Benefits

# Nanotechnology: The “I Wish” Technology

***I wish*** my sunscreen wasn't so unsightly



***I wish*** my socks didn't smell so much!



***I wish*** my tennis racquet was lighter and stronger



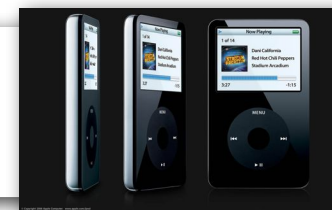
***I wish*** I could keep leftovers for longer, before they go off



***I wish*** spilt red wine would run off my pants without staining



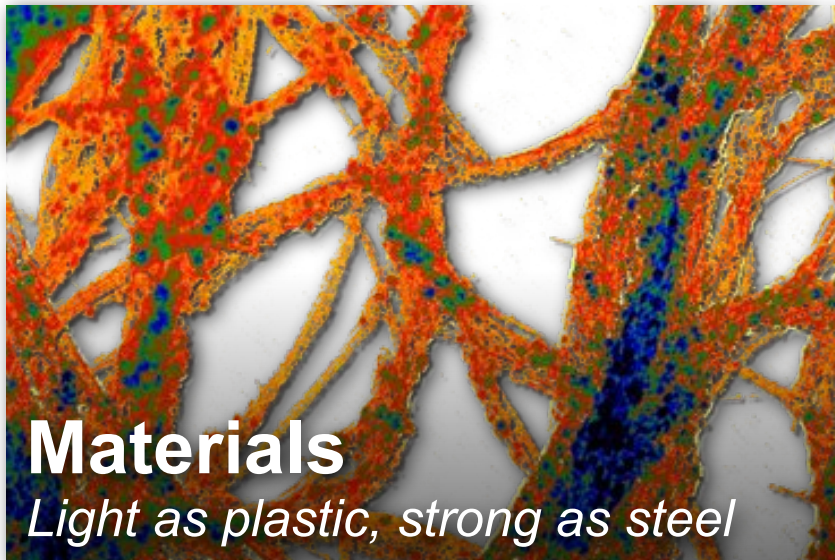
***I wish*** I could get more songs on my iPod



Nearly 400 listed nanotech consumer products: [www.nanotechproject.org/consumerproducts](http://www.nanotechproject.org/consumerproducts)

Societal Benefits

## Nanotechnology: Solving the world's problems



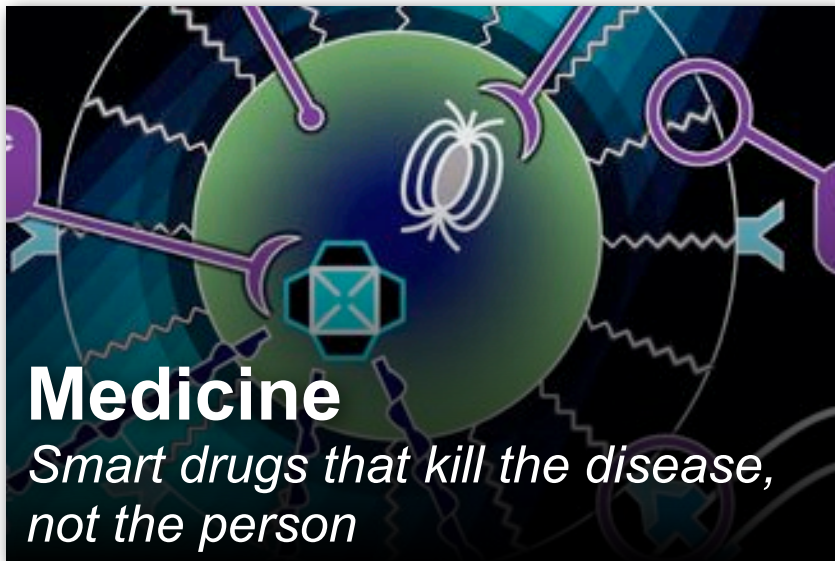
### Materials

*Light as plastic, strong as steel*



### Water

*Clean water any time, any place*



### Medicine

*Smart drugs that kill the disease,  
not the person*

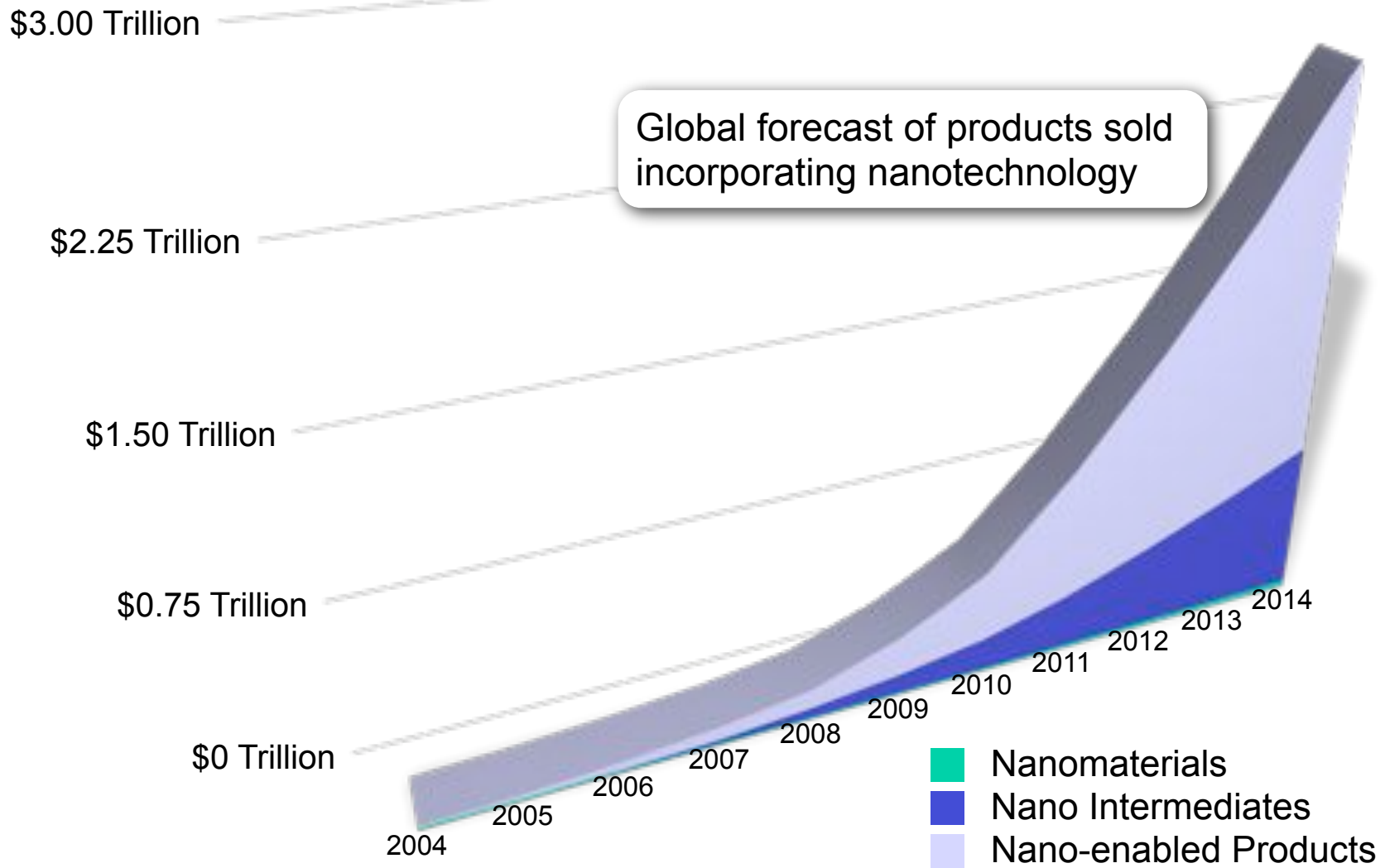


### Energy

*"PowerPlastic™ that converts light  
to energy - anywhere"*

## Commercial Benefits

# Nanotechnology: Projected worth of nanoproducts



Source: 2004 Lux Research Report: "Sizing nanotechnology's value chain"

**There's no such thing as a free  
lunch, and nanotechnology is no  
exception**

**Developing sustainable nanotechnologies**

**The Three R's:**

**RISK**

**RESPONSE**

**REGULATION**

# **RISK**

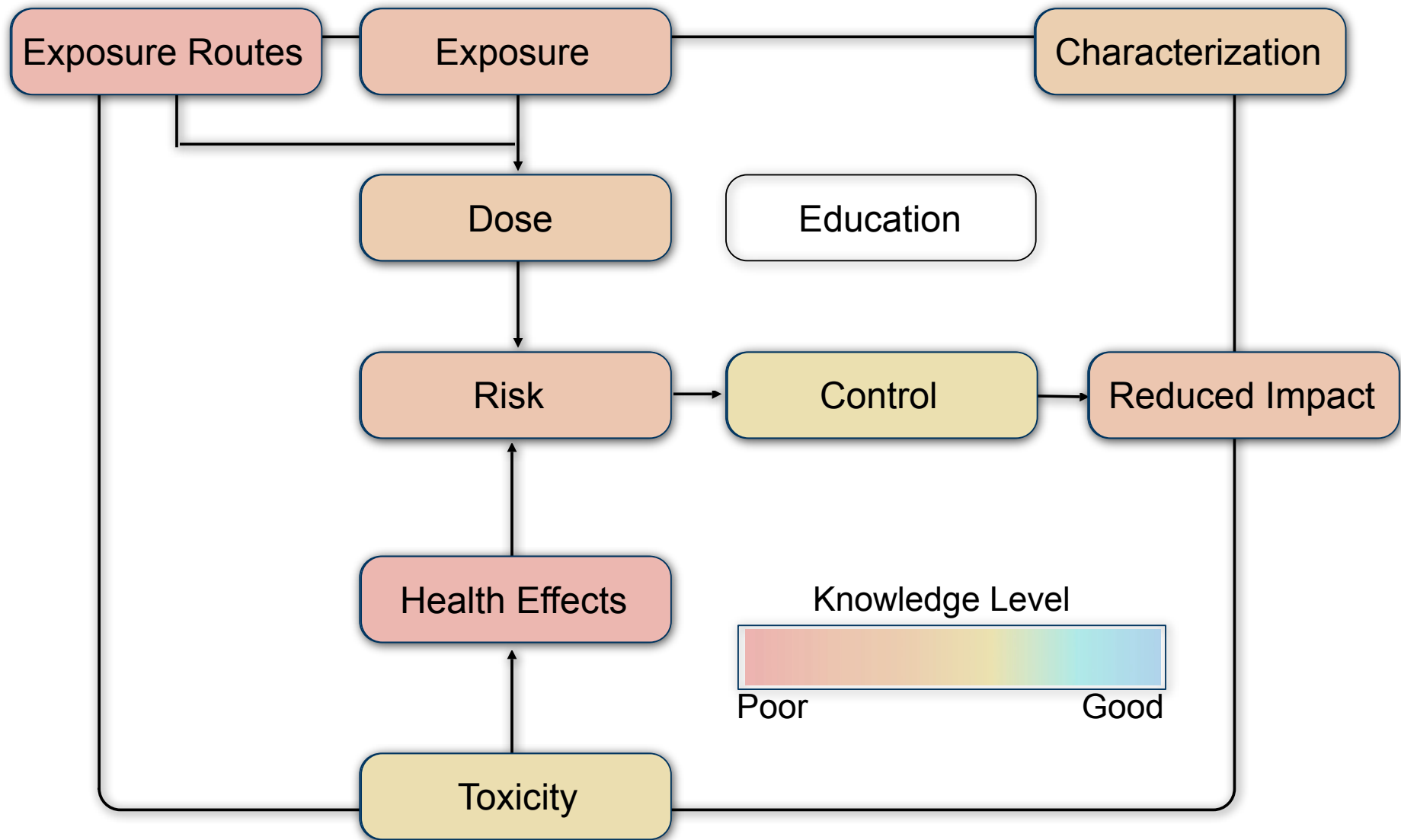
...of causing harm to humans  
and the environment

Nanotechnology uses our ability to  
manipulate the world at the nanoscale, to  
develop increasingly sophisticated materials  
and products that behave in **new and  
unexpected ways**

Things that behave in new and unexpected  
ways present **new risks**



# Addressing Potential Impact



# **RISK** Challenge

**Identifying, addressing and  
minimizing nano-specific risks to  
health, safety and the environment**

# RESPONSE

...of potential users and  
“beneficiaries”

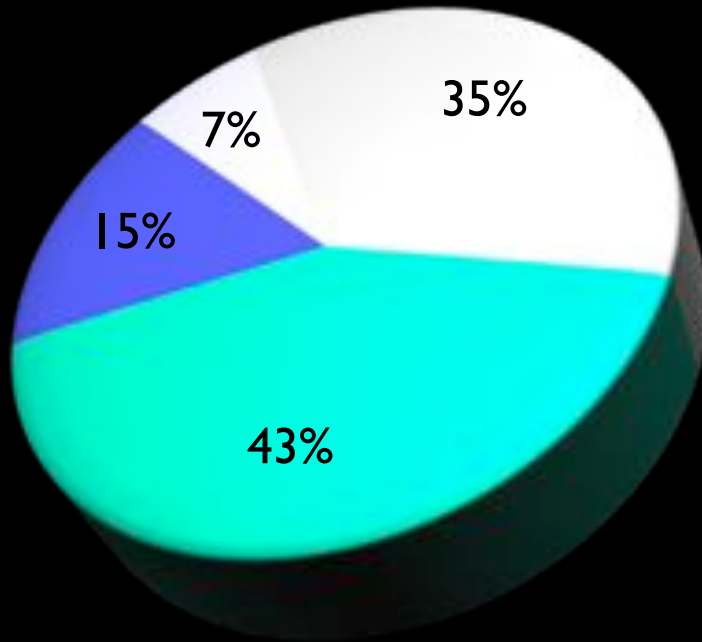


[www.chicagothong.org](http://www.chicagothong.org)

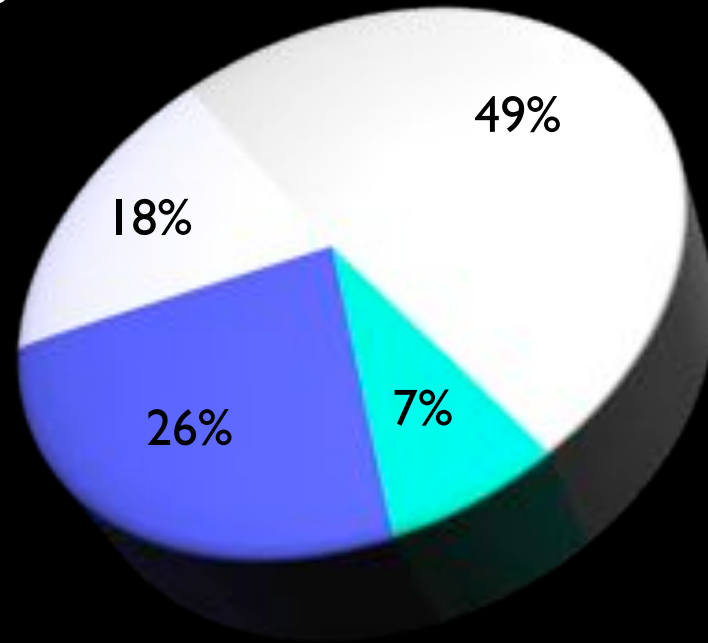
Topless Humans Organized for Natural Genetics (THONG)

# Public Opinion Poll: Attitudes Towards Nanotechnology

- Not Sure
- Benefits will outweigh risks
- Benefits and risks will be about equal
- Risks will outweigh benefits



**Initial impressions**



**Informed impressions**

**1014 adults polled**

Hart Research Associated, published September 2006  
[www.nanotechproject.org/77/Hart](http://www.nanotechproject.org/77/Hart)

RESPONSE **Challenge**

**Working with stakeholders and users  
towards mutually acceptable and  
beneficial nanotechnologies**

# REGULATION

Avoiding undue risk through  
appropriate oversight

**“Under-regulation will be a bigger  
threat than over-regulation”**

**Lux Research.**

Taking action on nanotech environmental, health and safety risks. May 2006

REGULATION **Challenge**

**Developing effective oversight which supports business and protects people and the environment, as nanotechnology becomes increasingly sophisticated**

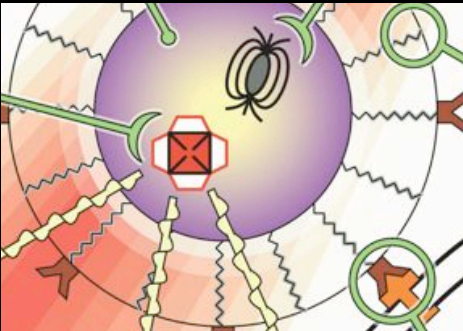
# NANOTECHNOLOGY

## Maximizing the benefits: Minimizing the risks



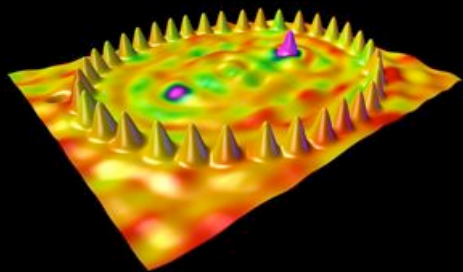
### Nano is Now

Nanotechnology offers the promise of benefits at the personal local and global scale



### Sustainable nano needs smart science

Underpinning nanotechnologies with multi-way conversations between scientists, policy-makers, producers and end users



### Nano without foresight will lead to a wreck

Nano will only deliver through innovative foresight and actions, including effective risk management, transparent stakeholder engagement and relevant oversight