NACK NETWORK Building College-University Partnerships for Nanotechnology Workforce Development

NCI Southwest

The National Nanotechnology Initiative with a focus on Resources for Educators

Friday, September 16, 2016

Click here to watch the webinar recording

The National Nanotechnology Initiative
with a focus on Resources for Educators

Lisa E. Friedersdorf, PhD

Deputy Director,
National Nanotechnology Coordination Office

September 16, 2016

NACK Network Webinar

Poll #1

How familiar are you with the National Nanotechnology Initiative?

a. Very familiar

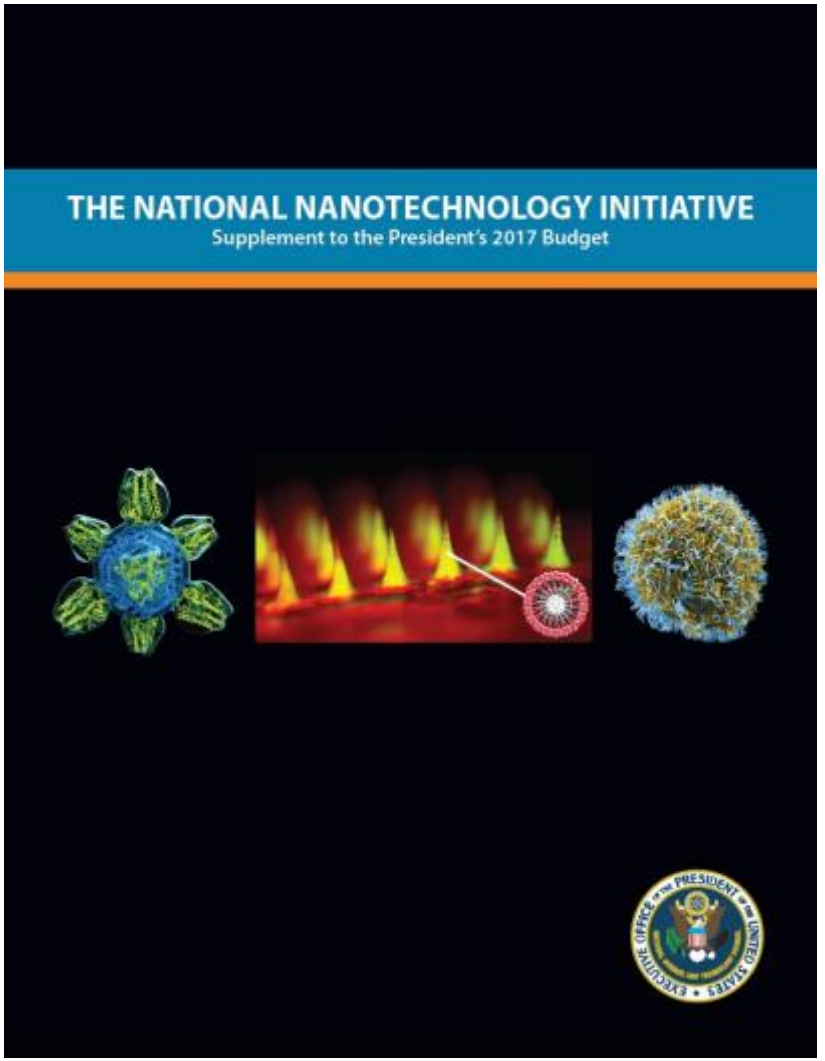
b. Somewhat familiar

c. Unfamiliar, tell me more

National Nanotechnology Initiative (NNI)

- Launched in 2000
- Collaborative R&D to advance understanding and control of matter at the nanoscale
- 20 Federal Departments and Independent Agencies
- 2017 budget: $1.4 billion
  - Cumulative ~$24 billion investment since 2001

A coordinated initiative, NOT a distinct funding program.



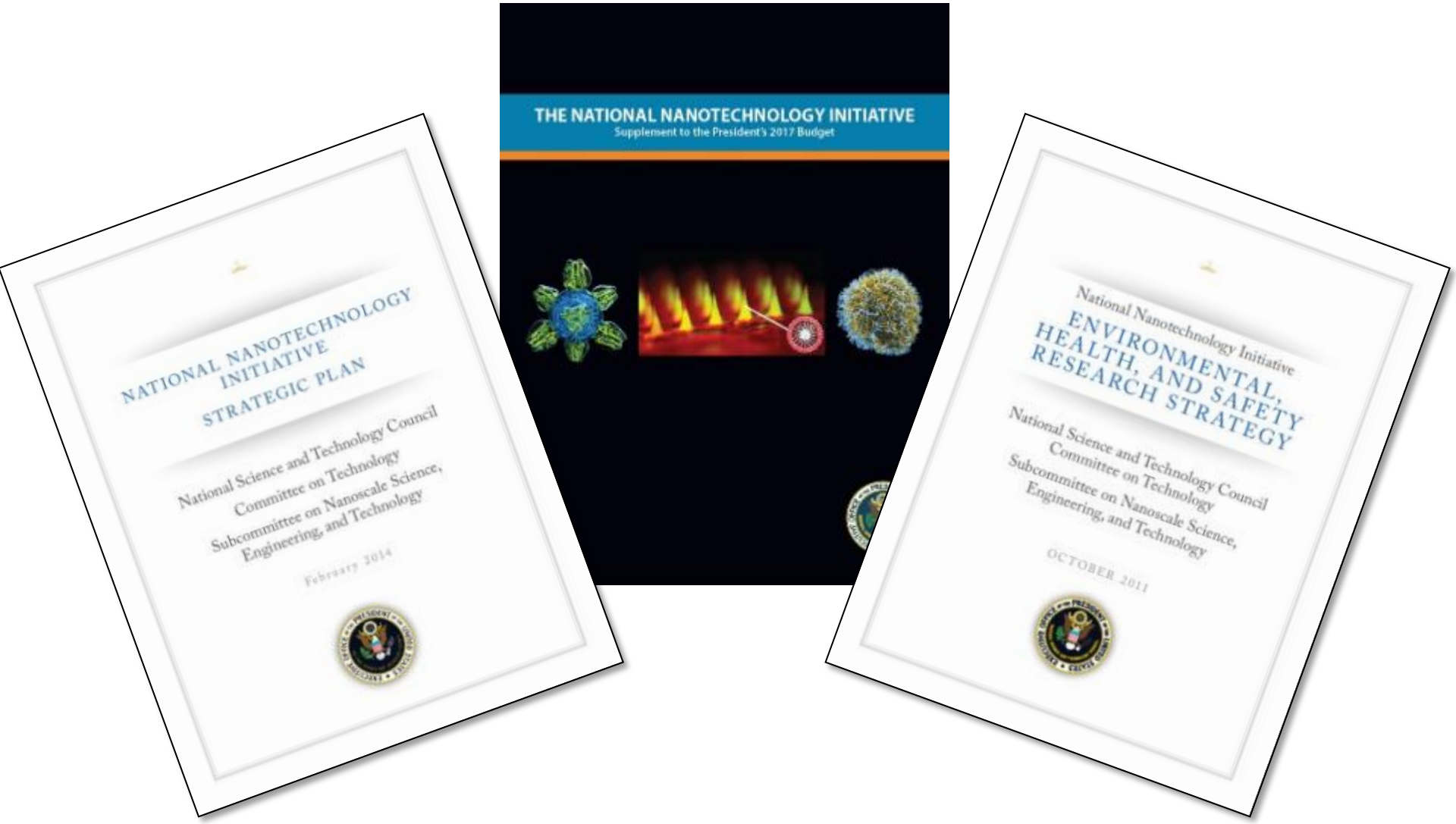
National Nanotechnology Initiative

Vision: A future in which the ability to understand and control matter on the nanoscale leads to a revolution in technology and industry that benefits society.

Goals:

- Advance world-class nanotechnology R&D
- Foster the transfer of new technologies into products
- Develop and sustain physical, cyber, and human infrastructure
- Support responsible development of nanotechnology.

Key NNI Documents

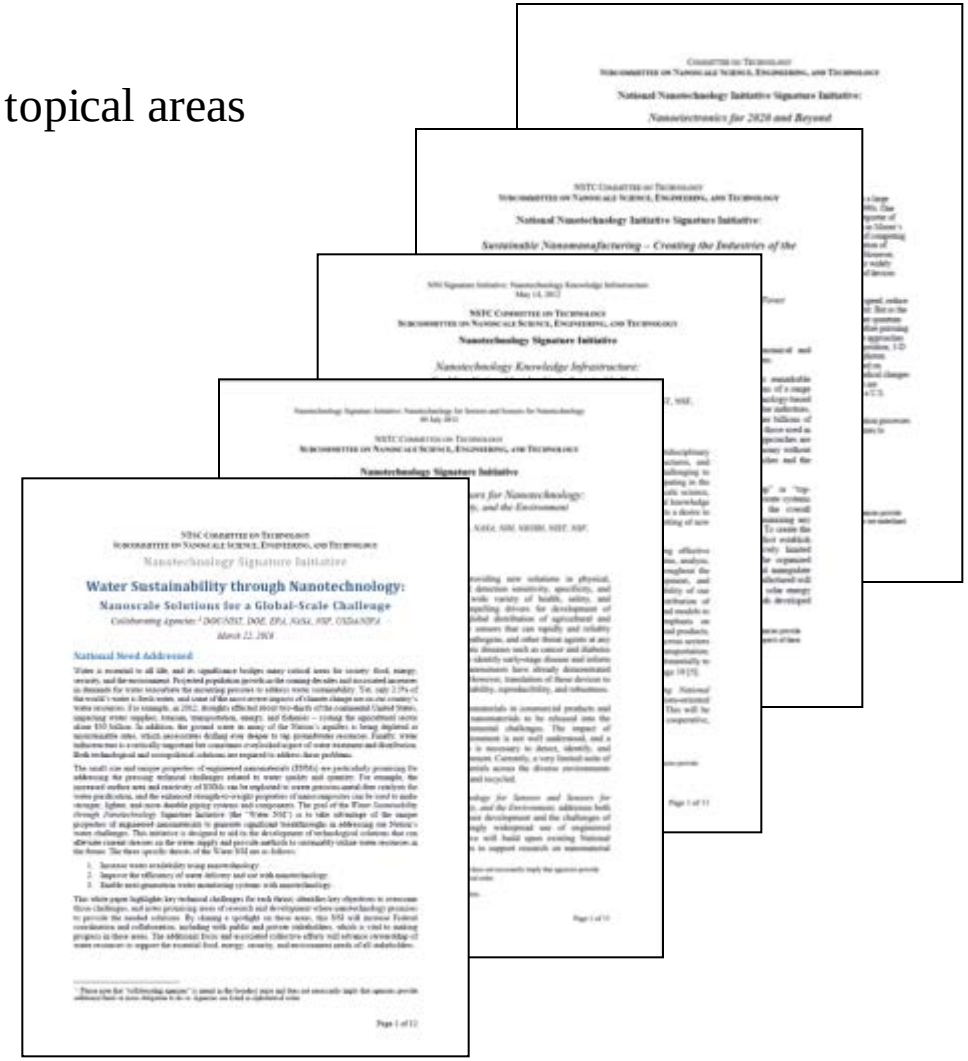


Guidance Documents on the Safe Use of Nanotechnologies

Examples of Guidance Documents Developed by NNI Agencies

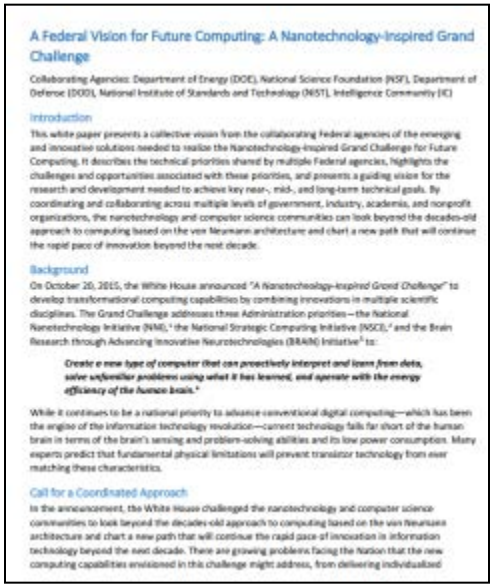
The NNI's Nanotechnology Signature Initiatives

Intended to be dynamic; topical areas rotate/evolve over time.



Grand Challenges

Create a new type of computer that can proactively interpret and learn from data, solve unfamiliar problems using what it has learned, and operate with the energy efficiency of the human brain



A Federal Vision for Future Computing: A Nanotechnology-Inspired Grand Challenge

Collaborating Agencies: Department of Energy (DOE), National Science Foundation (NSF), Department of Defense (DOD), National Institute of Standards and Technology (NIST), Intelligence Community (IC)

Introduction

This white paper presents a collective vision from the collaborating Federal agencies of the emerging and innovative solutions needed to realize the Nanotechnology-Inspired Grand Challenge for Future Computing. It describes the technical priorities shared by multiple Federal agencies, highlights the challenges and opportunities associated with these priorities, and presents a guiding vision for the research and development needed to achieve key near-, mid-, and long-term technical goals. By coordinating and collaborating across multiple levels of government, industry, academia, and nonprofit organizations, the nanotechnology and computer science communities can look beyond the decades-old approach to computing based on the von Neumann architecture and chart a new path that will continue the rapid pace of innovation beyond the next decade.

Background

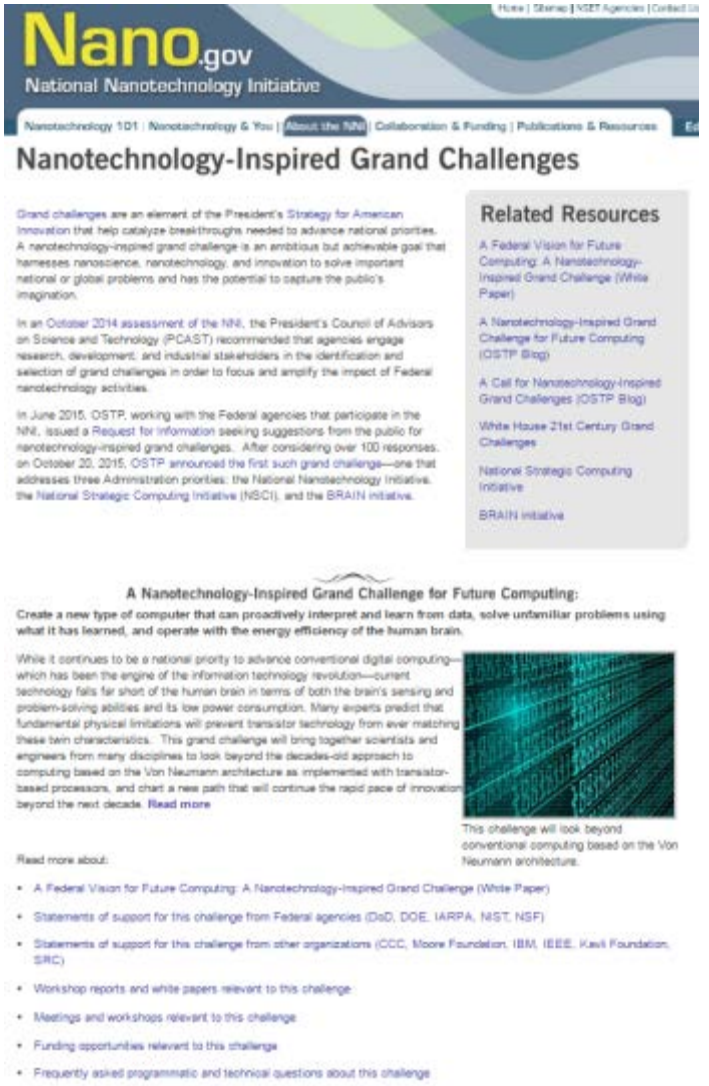
On October 20, 2015, the White House announced *"A Nanotechnology-Inspired Grand Challenge"* to develop transformational computing capabilities by combining innovations in multiple scientific disciplines. The Grand Challenge addresses three Administration priorities—the National Nanotechnology Initiative (NNI),[1] the National Strategic Computing Initiative (NSCI),[2] and the Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative[3] to:

> ***Create a new type of computer that can proactively interpret and learn from data, solve unfamiliar problems using what it has learned, and operate with the energy efficiency of the human brain.***

While it continues to be a national priority to advance conventional digital computing—which has been the engine of the information technology revolution—current technology falls far short of the human brain in terms of the brain's sensing and problem-solving abilities and its low power consumption. Many experts predict that fundamental physical limitations will prevent transistor technology from ever matching these characteristics.

Call for a Coordinated Approach

In the announcement, the White House challenged the nanotechnology and computer science communities to look beyond the decades-old approach to computing based on the von Neumann architecture and chart a new path that will continue the rapid pace of innovation in information technology beyond the next decade. There are growing problems facing the Nation that the new computing capabilities envisioned in this challenge might address, from delivering individualized



Nano.gov
National Nanotechnology Initiative

Nanotechnology 101 | Nanotechnology & You | About the NNI | Collaboration & Funding | Publications & Resources

Nanotechnology-Inspired Grand Challenges

Grand challenges are an element of the President's Strategy for American Innovation that help catalyze breakthroughs needed to advance national priorities. A nanotechnology-inspired grand challenge is an ambitious but achievable goal that harnesses nanoscience, nanotechnology, and innovation to solve important national or global problems and has the potential to capture the public's imagination.

In an October 2014 assessment of the NNI, the President's Council of Advisors on Science and Technology (PCAST) recommended that agencies engage research, development, and industrial stakeholders in the identification and selection of grand challenges in order to focus and amplify the impact of Federal nanotechnology activities.

In June 2015, OSTP, working with the Federal agencies that participate in the NNI, issued a Request for Information seeking suggestions from the public for nanotechnology-inspired grand challenges. After considering over 100 responses, on October 20, 2015, OSTP announced the first such grand challenge—one that addresses three Administration priorities: the National Nanotechnology Initiative, the National Strategic Computing Initiative (NSCI), and the BRAIN Initiative.

Related Resources

- A Federal Vision for Future Computing: A Nanotechnology-Inspired Grand Challenge (White Paper)
- A Nanotechnology-Inspired Grand Challenge for Future Computing (OSTP Blog)
- A Call for Nanotechnology-Inspired Grand Challenges (OSTP Blog)
- White House 21st Century Grand Challenges
- National Strategic Computing Initiative
- BRAIN Initiative

A Nanotechnology-Inspired Grand Challenge for Future Computing:

Create a new type of computer that can proactively interpret and learn from data, solve unfamiliar problems using what it has learned, and operate with the energy efficiency of the human brain.

While it continues to be a national priority to advance conventional digital computing—which has been the engine of the information technology revolution—current technology falls far short of the human brain in terms of both the brain's sensing and problem-solving abilities and its low power consumption. Many experts predict that fundamental physical limitations will prevent transistor technology from ever matching these twin characteristics. This grand challenge will bring together scientists and engineers from many disciplines to look beyond the decades-old approach to computing based on the Von Neumann architecture as implemented with transistor-based processors, and chart a new path that will continue the rapid pace of innovation beyond the next decade. Read more

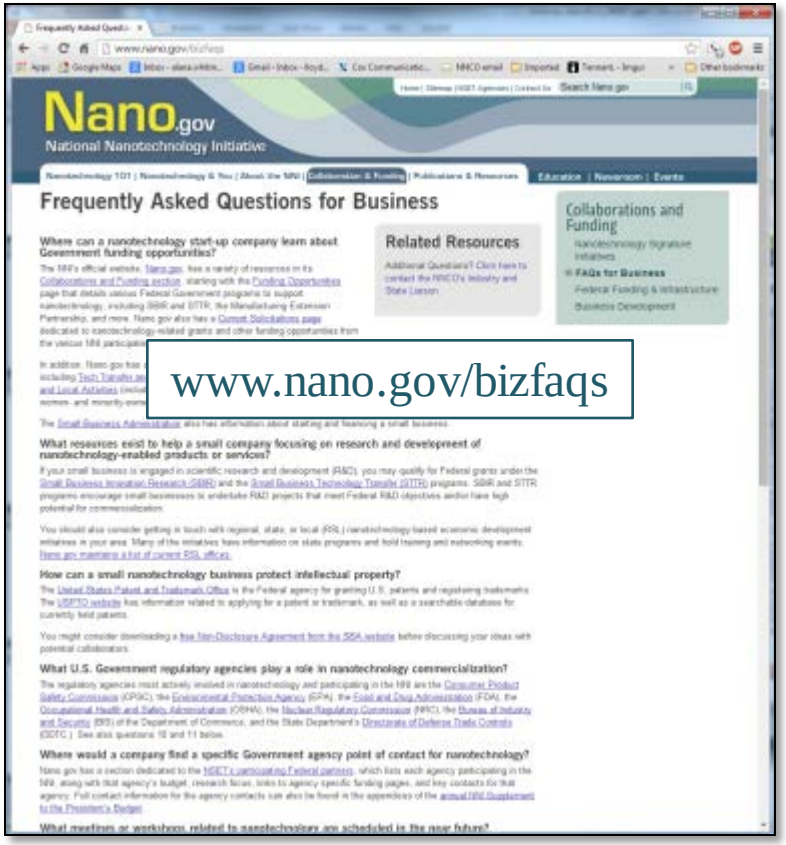
This challenge will look beyond conventional computing based on the Von Neumann architecture.

Read more about:

- A Federal Vision for Future Computing: A Nanotechnology-Inspired Grand Challenge (White Paper)
- Statements of support for this challenge from Federal agencies (DoD, DOE, IARPA, NIST, NSF)
- Statements of support for this challenge from other organizations (CCC, Moore Foundation, IBM, IEEE, Kavli Foundation, SRC)
- Workshop reports and white papers relevant to this challenge
- Meetings and workshops relevant to this challenge
- Funding opportunities relevant to this challenge
- Frequently asked programmatic and technical questions about this challenge

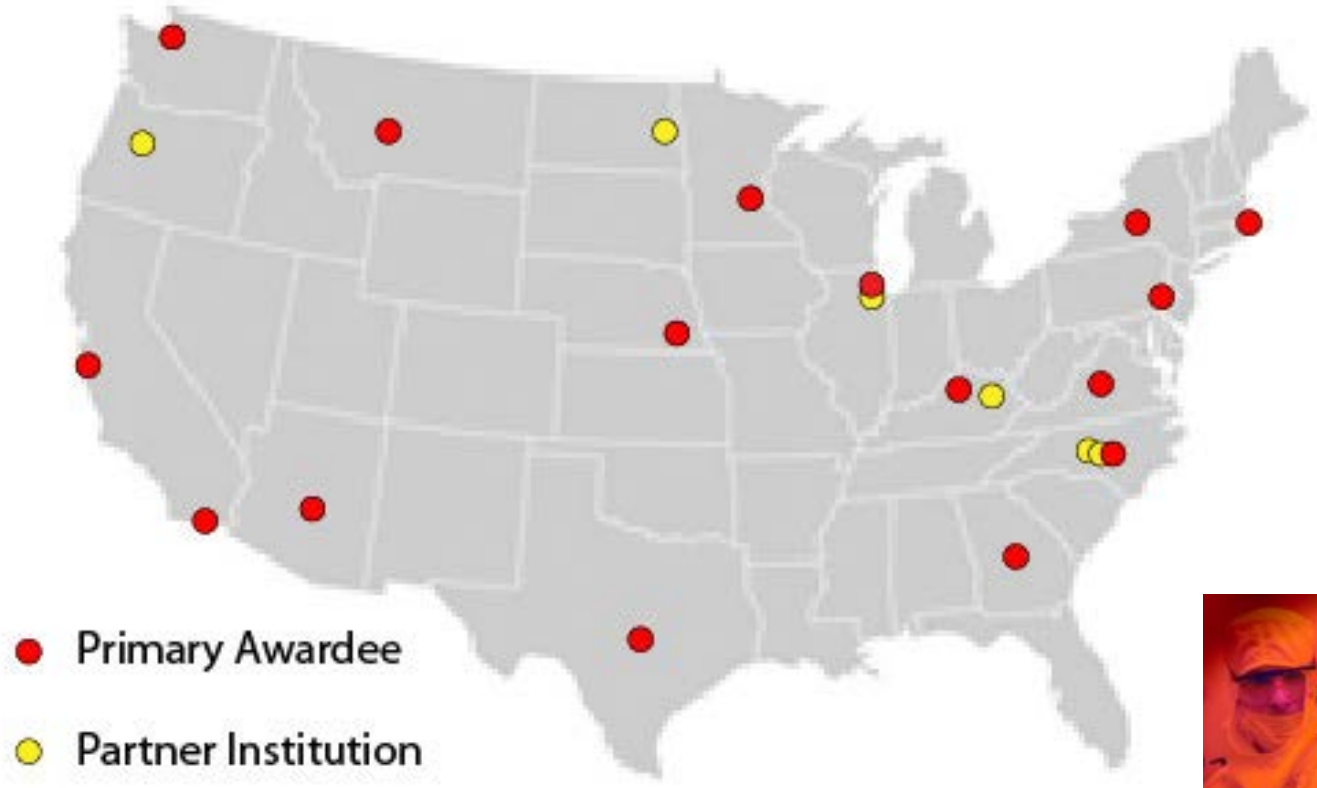
NNI Resources for Industrial Stakeholders

- The NNCO has a dedicated liaison, Dr. Mike Kiley
  mkiley@nnco.nano.gov



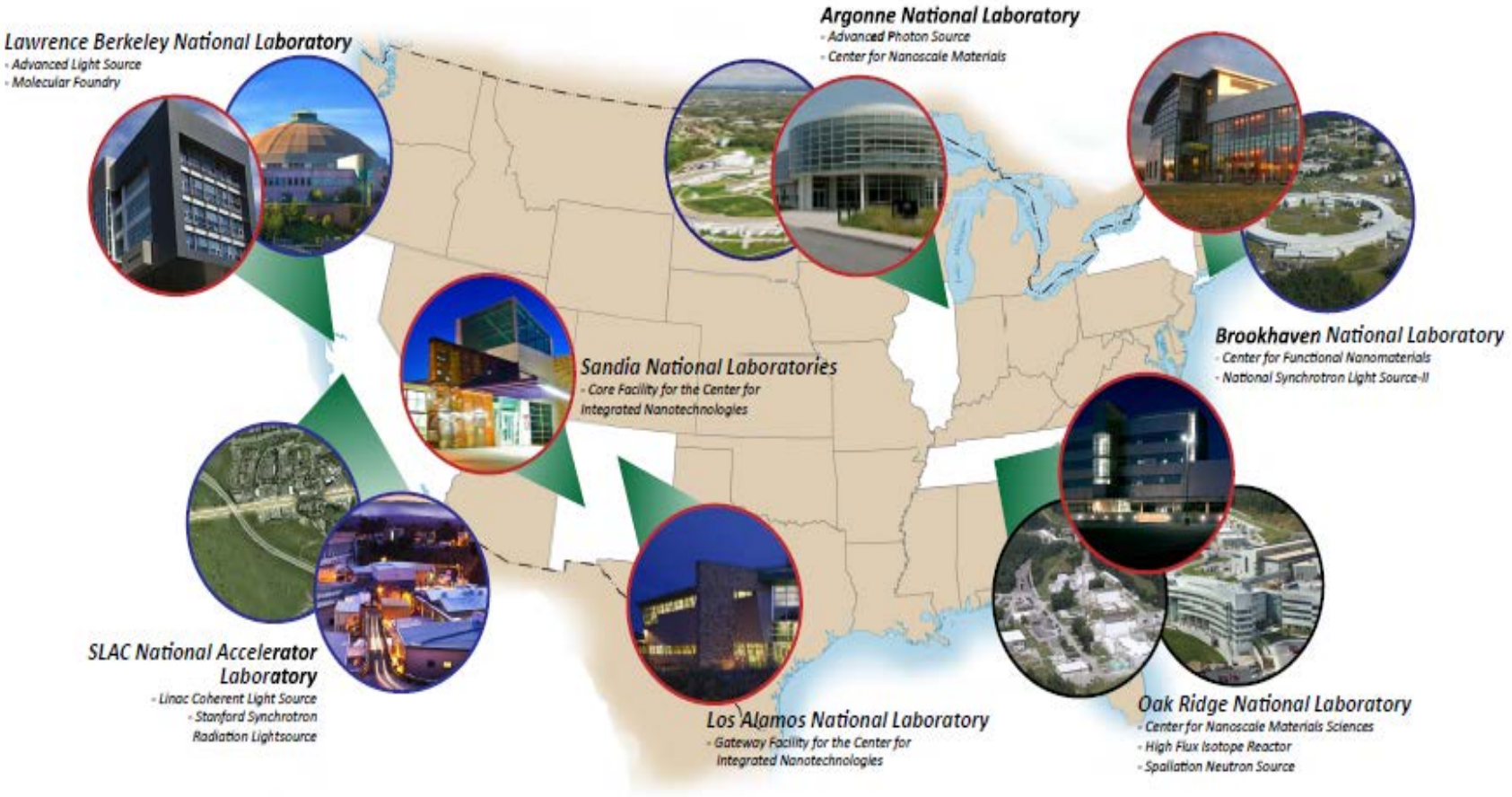
NSF User Facility Network

National Nanotechnology Coordinated Infrastructure (NNCI)



Dan Sears, the University of North Carolina at Chapel Hill

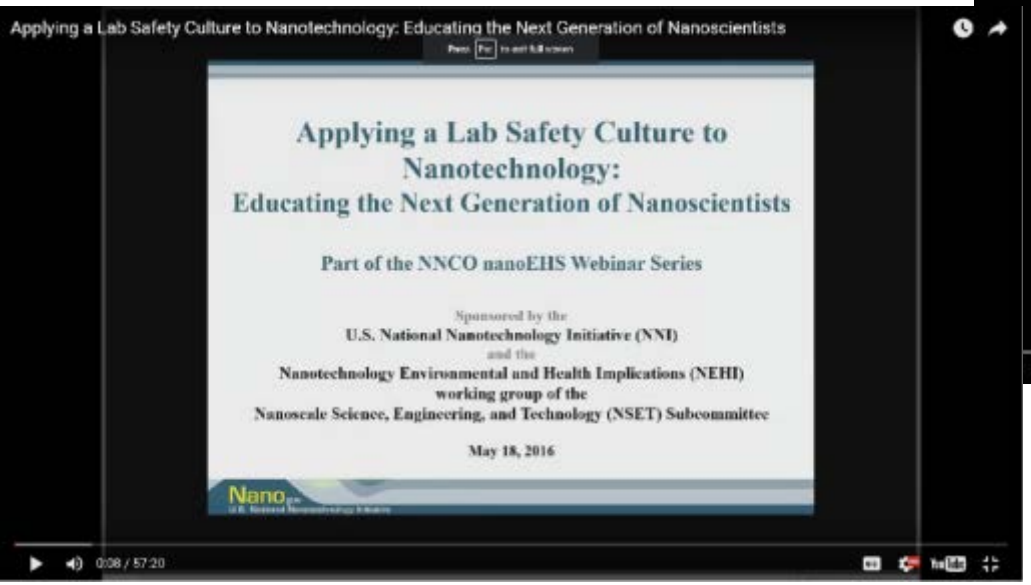
Unique research facilities *and* scientific expertise for ultra high-resolution characterization, synthesis, fabrication, theory and modeling of advanced materials

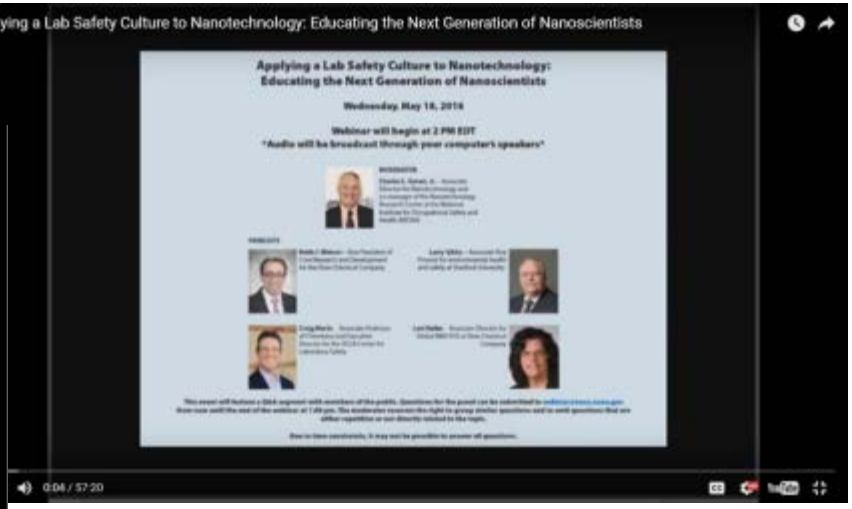


Engaging Community- Webinars

Small and Medium Sized Enterprise Series best practices, insurance, etc.

Lab safety





http://www.nano.gov/node/1620

Education and Outreach

NNCO Outreach
Shared resources
Contests

- Image
- Video
- Superheroes!

Networks

- Teachers
- Students

Poll #2

At what level do you teach?

a. Elementary

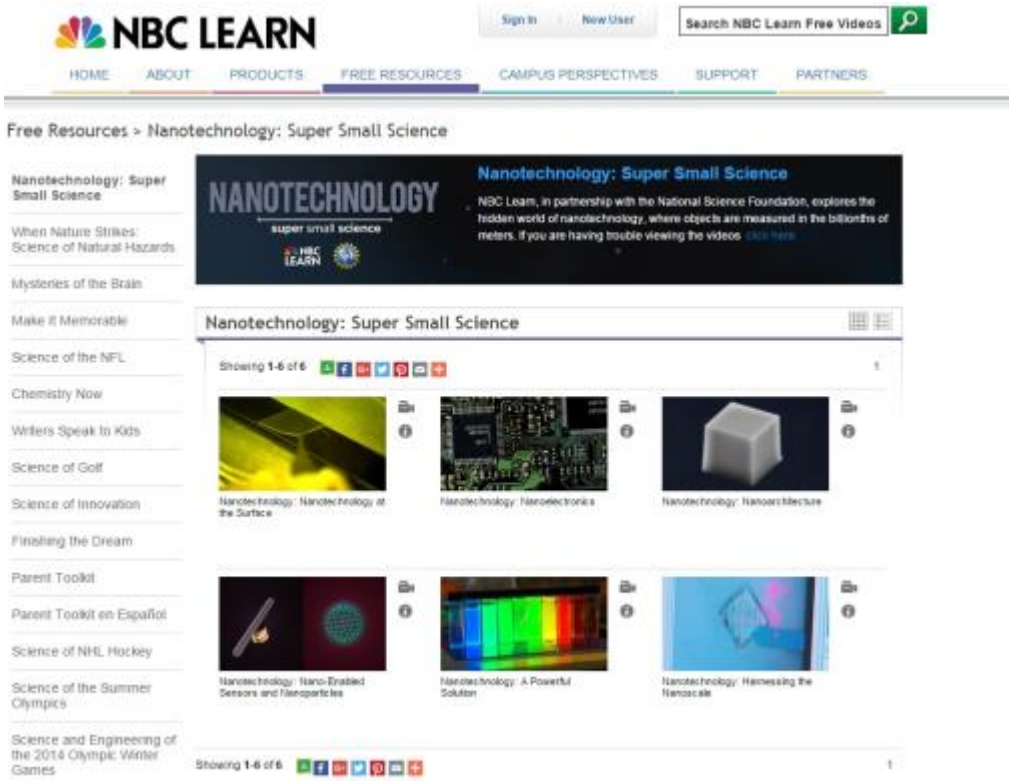
b. Middle School

c. High School

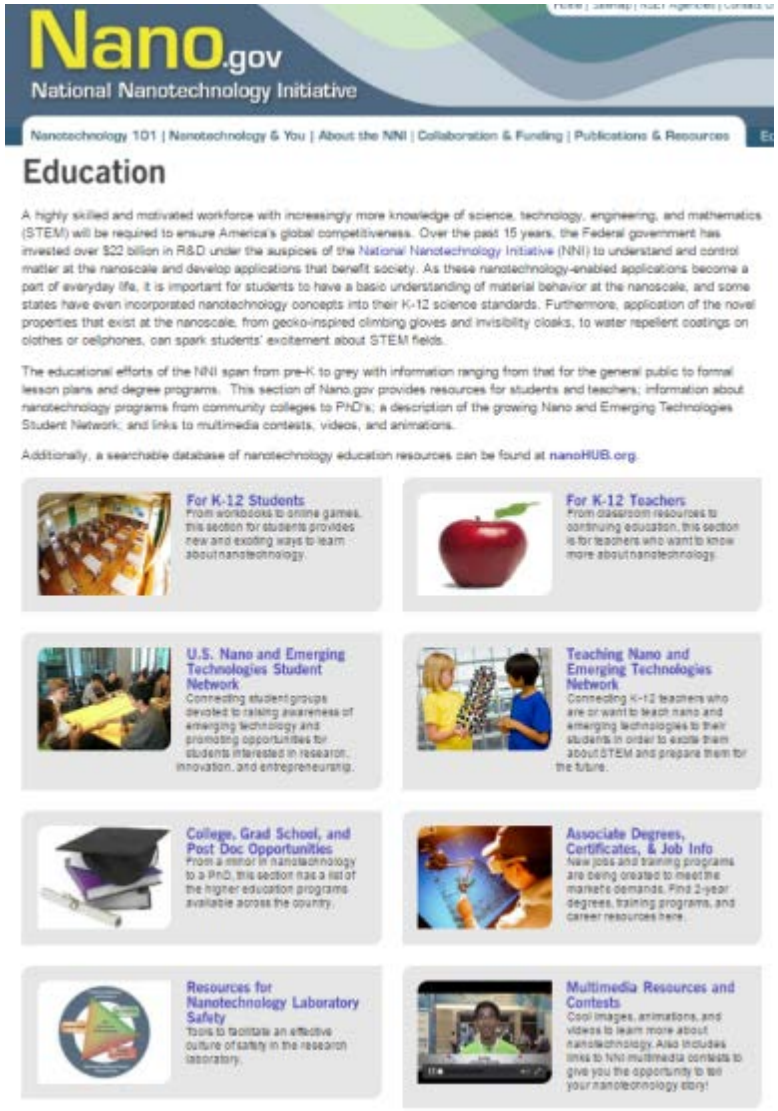
d. Community College

e. Undergraduate

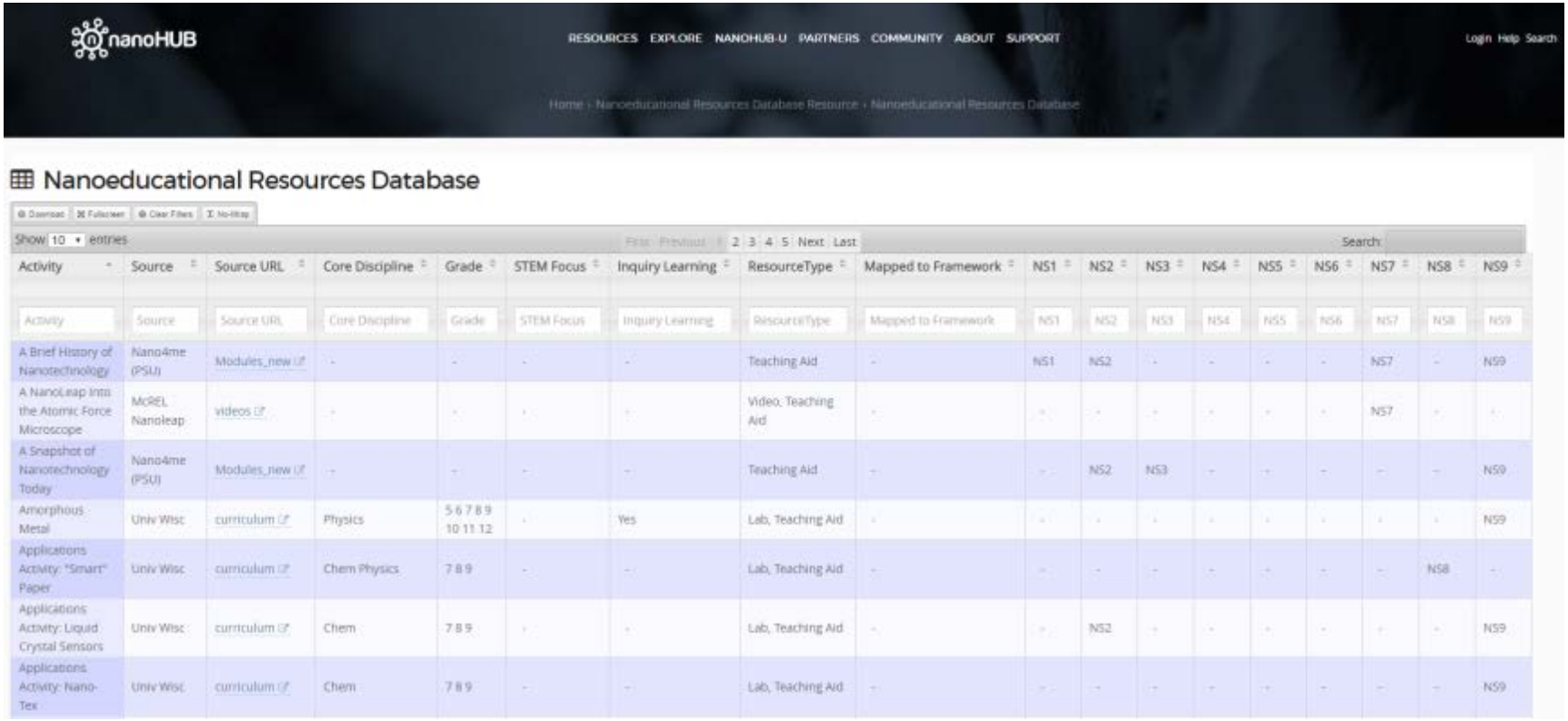
Education and Outreach



Resources for Teachers and Students



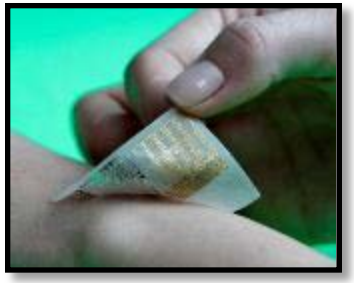
Resources for Instructors



https://nanohub.org/publications/118

Teaching Nano and Emerging Technologies Network

Are you using nano and emerging technologies to excite your students about STEM?



The network connects teachers so they can

- Share best practices;
- Exchange ideas for activities and examples;
- Promote local area events; and
- Connect with like-minded teachers from across the country

Nano Education Resource Portal nanohub.org/publications/118

Search database by

Source organization ***Grade level***
Inquiry-based learning ***Core discipline***
Standards mapping ***Type of resource (video, lab, etc.)***
Topic ***STEM Focus***
"The Big Ideas of Nanoscale Sci & Eng"

U.S. Nano and Emerging Technologies Student Network

Networked student groups

- raise awareness of current research;
- build an interdisciplinary community;
- facilitates connections between students, faculty, and industry;
- and enable each club to leverage resources and activities

Student Leaders Conference

- Showcase student groups and research
- Share best practices
- Opportunity to network with experts from industry, government, and academia

nanoed@nnco.nano.gov


NSF AND NNI PRESENT A COMPETITION:
GENERATION NANO
SMALL SCIENCE, SUPERHEROES


PRESENT DAY
BOOM

Follow the Competition at: #GenNano

Nano.gov
National Nanotechnology Initiative

Who	High school students
What	A written entry, a 90 sec video, and 2-3 page comic strip introducing the superhero and the student's nanotechnology-enabled mission
When	October 5, 2016 – January 31, 2017, EST
Where	nsf.gov/GenNano
Why	To promote early interest in science, technology, engineering and mathematics (STEM) and nanotechnology and win cash prizes
More questions?	Contact the Generation Nano Team at gennano@nsf.gov

Poll#3

What is your favorite application of nanotechnology to highlight with your students?

a) Electronics (smart phones, displays/TVs)
b) Medicine (drug delivery, detection, tissue regeneration)
c) Energy (photovoltaics, batteries/fuel cells, wind turbines)
d) Environment (remediation, water treatment)
e) Food and Agriculture (sensors, precision farming)

The Future is Here

http://www.techandinnovationdaily.com/2013/06/05/p2i-water-repellent-nano-coating/

TiO_2 UV absorbers

http://www.bmc-racing.com

http://www.smt.sandvik.com/nanofilm

nAg

Nanofilm

Zyvex Marine

Eddie Bauer NanoTex

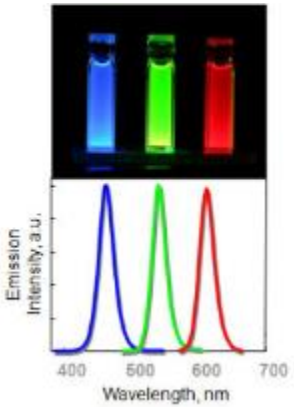
UltraTech

Nanoelectronics

Quantum Dots now in Mass Market Applications

Consumer electronics already ‘nano’

QD Vision’s Color IQ Technology



CdSe quantum dots

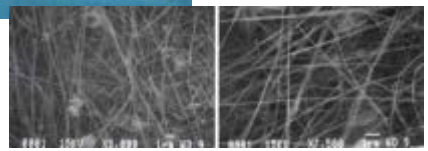
Nanosys

Sony Bravia LED TV

Samsung SUHD TV using Nanosys quantum dots

RipeSense.co.nz

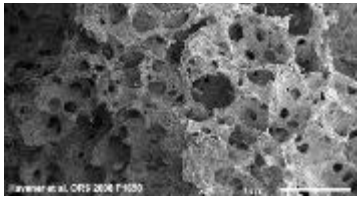
timestrip.com



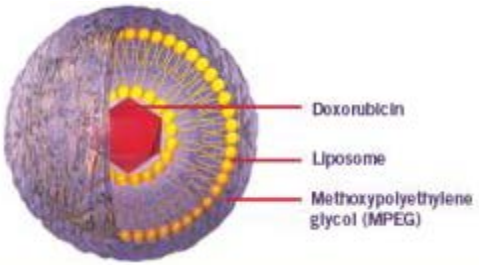
Nanofiber Wound Dressings
Bowlin, VCU
FASTCLOT

3M's FilTek® restorative dental

Acute lymphoblastic leukemia (ALL)
Sigma-Tau Pharmaceuticals



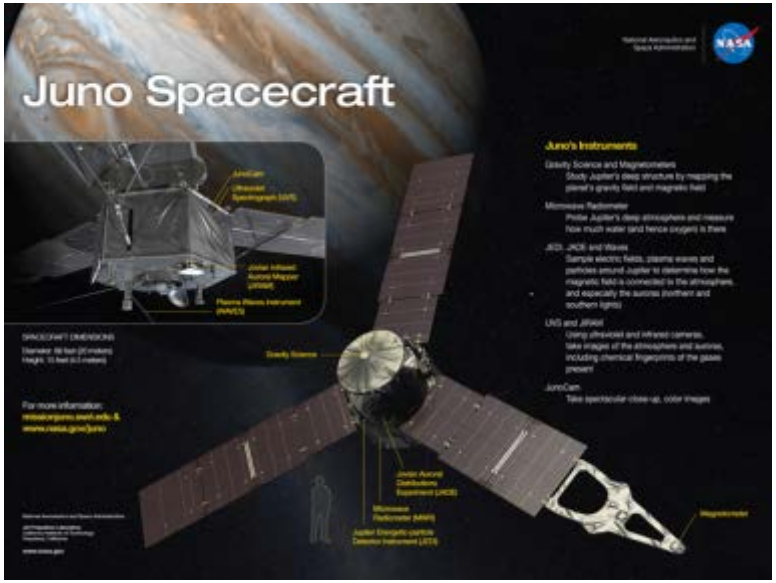
Stryker's Vitoss Bone Graft Substitute



Caelyx

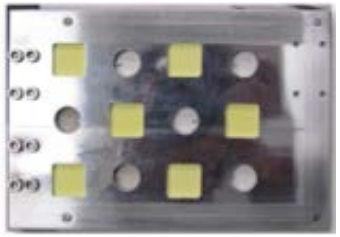
Nanosphere

Nanotechnology has made it into Space



CNT Nanocomposites for Charge Dissipation

Silica Aerogels



Polyimide Aerogels

CNT "Electronic Nose"

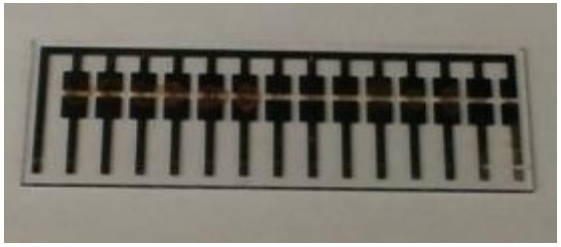
Many of the current applications of nanotechnology improve existing products.

Easton Stealth CNT Bat

Future applications, however, will exploit the novel properties of nanomaterials and enable entirely new products.

Food & Agriculture

MIT

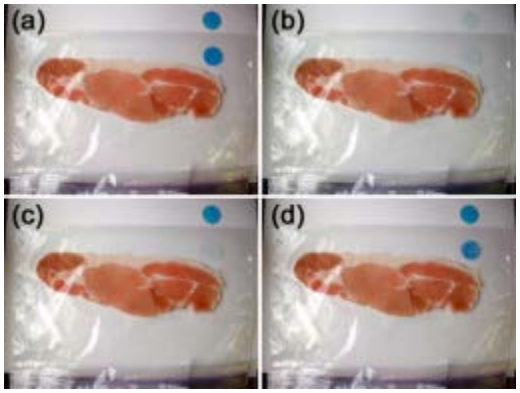


UV-blockers
(ZnO, TiO_2)

Antimicrobials
(AgNPs, MONPs)

Sensing Applications
(QDs, AuNPs, etc.)

O_2 Sensing



A. Mills, *Chem. Soc. Rev.* 34 (2005) 1003.

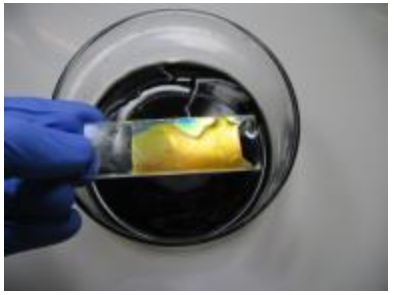
High Barrier Plastics
(Nanoclay, Graphite, etc.)

Anti-Counterfeiting Inks
(Semiconducting NPs)

Processing Aids
(TiN)

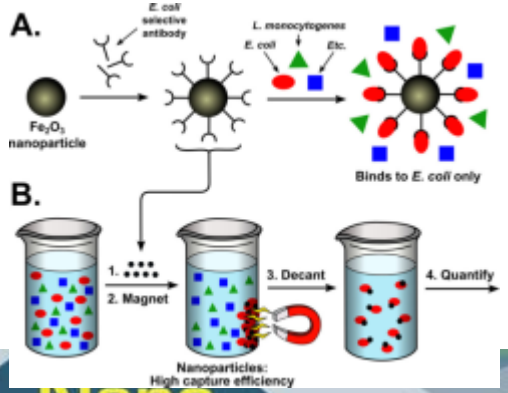
Courtesy of T. Duncan, FDA

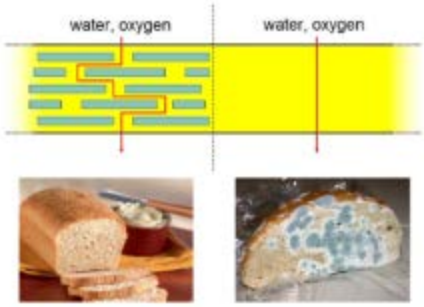
Photonic gel for smart packaging



Rice & MIT

Nano-Immunomagnetic separation (IMS)

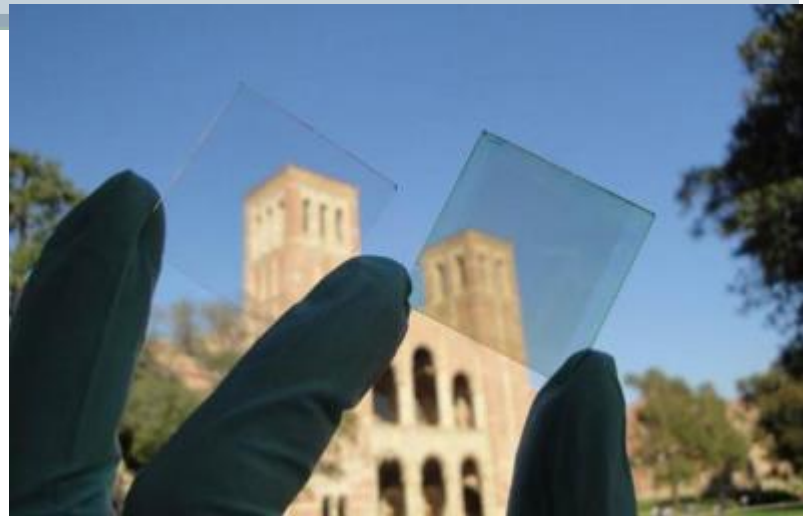




Duncan, *J. Colloid Interf. Sci.* 363 (2011) 1-24.

Duncan, *J. Colloid Interf. Sci.* 363 (2011) 1-24.

Energy

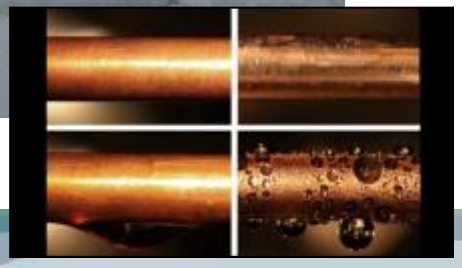


Power Felt

http://www.complex.com/art-design/2012/07/ucla-researchers-develop-window-glass-that-collects-solar-energy

http://news.wfu.edu/2012/02/22/power-felt-gives-a-charge/

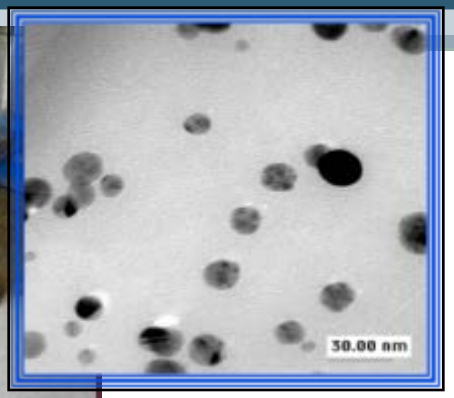
Adaptive Textiles Technology with Active Cooling and Heating, ATTACH



https://newsoffice.mit.edu/2015/graphene-coating-more-efficient-power-plants-0529

ARPA-E project at UCSD

Water



Point of Use Water Treatment

Smith, UVa

http://spectrum.ieee.org/nanoclast/semiconductors/nanotechnology/nanoparticle-sensor-detects-mercury-at-levels-a-million-times-below-current-technology

Bacterial Removal System Using CNT Clusters
University of Arkansas
http://theinstitute.ieee.org/technology-focus/technology-topic/purifying-water-with-nanotech

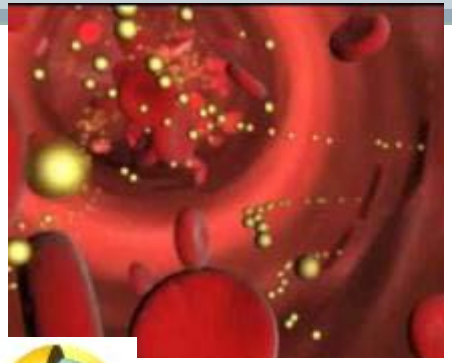
The Drinkable Book
Point of use water treatment.
http://pagedrinkingpaper.com/the_drinkable_book/

Rice
http://www.youtube.com/watch?v=OCKyMn-2edo

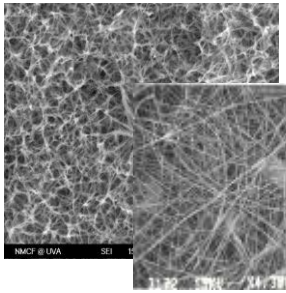
Nanosponges soak up oil again and again
http://phys.org/news/2012-04-nanosponges-oil.html

Medicine

CNN: Will Nanotechnology Allow You to "Swallow the Doctor?"
http://edition.cnn.com/2015/01/29/tech/mci-nanobots-eth/index.html

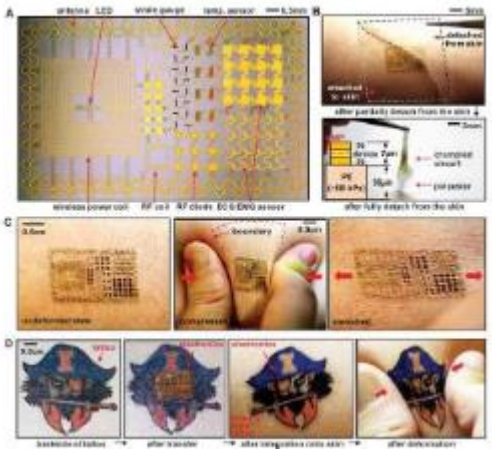


NanoSpectra Biosciences



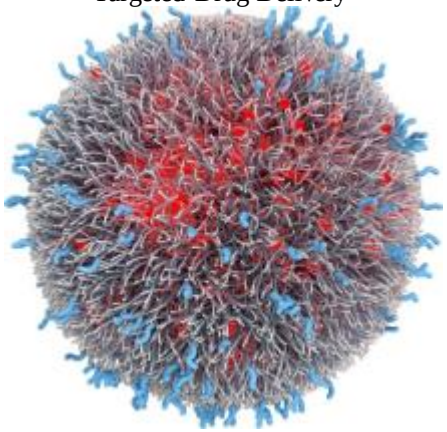
Tissue Scaffolds
Nair, UVA

Artificial ACL-
Northwestern



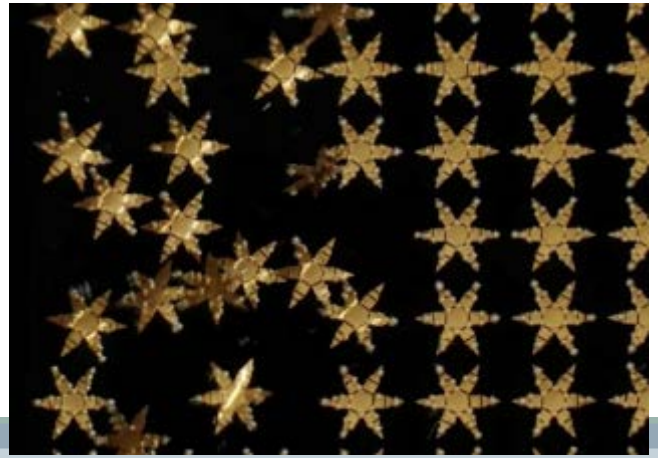
http://rogers.matse.illinois.edu/files/2011/eesscience.pdf

Targeted Drug Delivery



Bind Theraputics

Nano Star Robots perform non invasive biopsies

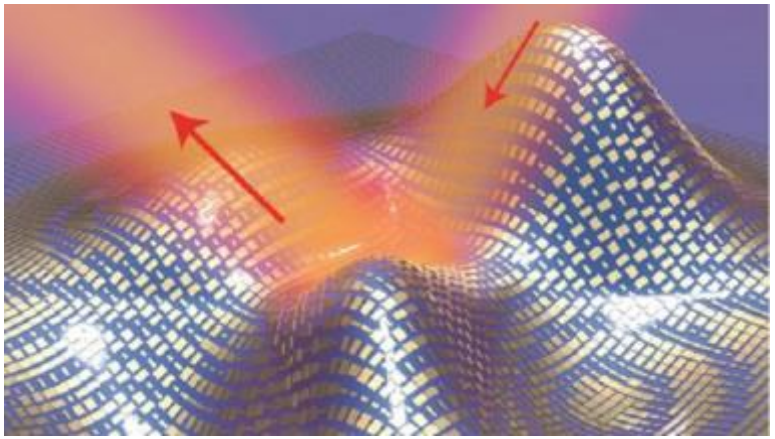


http://techcrunch.com/2015/06/10/nanometer-sized-robots-can-now-take-colon-biopsies/

Superheroes & magic enabled by nanotechnology

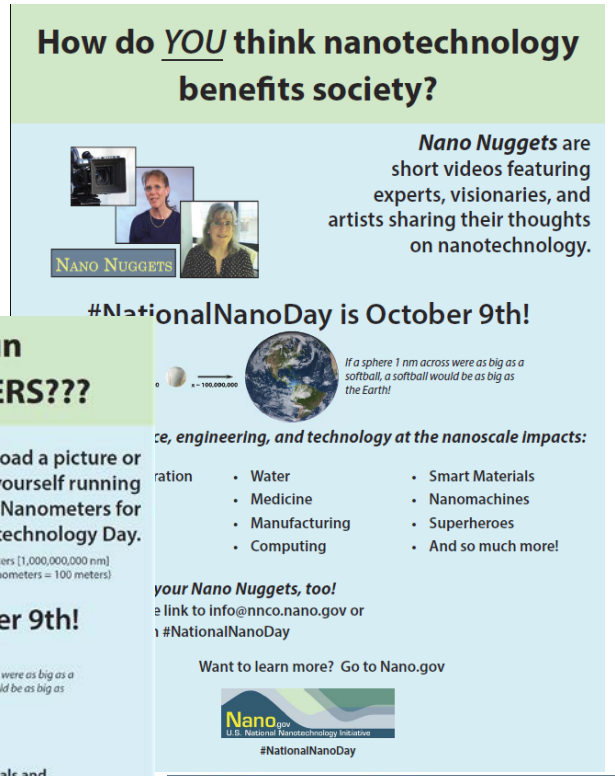
Stanford University

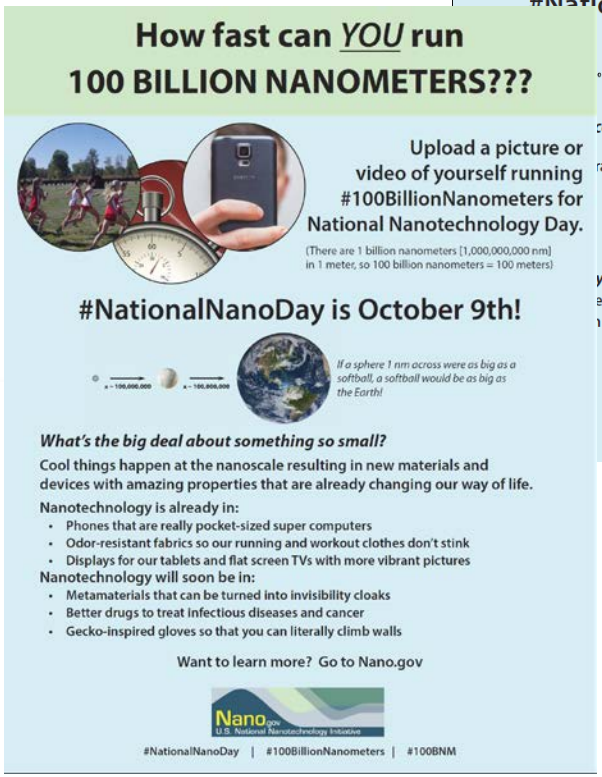
Nano-Thin Invisibility Cloak Makes 3D Objects Disappear



DOE Berkeley Lab and UC Berkeley

National Nanotechnology Day! October 9th





Tell us what you are doing for National Nanotechnology Day!

NNI 2.0 Depends on You

The promise of nanotechnology can only be achieved through community involvement. We want to hear from you.

How to engage?

- Webinars
- Workshops
- Respond to RFIs
- Contact NNCO

Thank you.

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Thank You!

Thank you for attending the
NACK Network & NCI-SW webinar

Please take a moment to complete our survey