

Georgia Institute of Technology/IEN/NNIN List of nanotechnology multi-media resources and books for educators

This list is up to date as of 06/2014 and is not all inclusive. The resources included are intended to help educators in their search for suitable materials for the classroom or to learn more about nanoscale science and engineering.

Multimedia Sources:

AFM-Atomic Force Microscope: Shows how an AFM works

http://www.parkafm.com/AFM_guide/how_afm_works.php

AFM workshop materials from the University of Washington

http://depts.washington.edu/nanolab/NUE_UNIQUE/Lab_Units/NUE_UNIQUE_LAB_rev07.pdf

American Chemical Society: Education resources including some nano lessons.

(<http://www.acs.org/content/acs/en/education/resources.html>)

Apples to Atoms Lesson: collection of lessons on nanoscience concepts.

http://community.nsee.us/index.php?option=com_content&view=article&id=102:apples-to-atoms

Azonano: Video with discussion of how ferrofluid works.

<http://www.azonano.com/nanotechnology-video-details.aspx?VidID=160>

Binghamton University Libraries: Guide to nanotechnology internet resources; a comprehensive list compiled in 2011 by librarian Jill Dixon.

<http://www.istl.org/11-winter/internet1.html>

Carbon:

The following sites can be used for properties of carbon allotropes:

*Wikipedia – <http://en.wikipedia.org>

Diamonds – <http://nature.berkeley.edu/classes/eps2//wisc/Lect6.html>

Graphite Properties Page by John A. Jaszczak –

<http://www.phy.mtu.edu/~jaszczak/graphprop.html>

Properties of Carbon and C60 – <http://www.creative-science.org.uk/propc60.html>

Fullerene, C60 - <http://www.ch.ic.ac.uk/local/projects/unwin/Fullerenes.html>

Physical Properties of Carbon Nanotubes – <http://www.pa.msu.edu/cmp/csc/ntproperties/>

Graphene – includes an introduction - <http://www.graphene-info.com/>

Carbon Based Computers: Podcast about carbon based computers.

http://www.nsf.gov/news/mmg/mmg_disp.jsp?med_id=75200&from=

The above is an example of news briefs that can be found at NSF Multimedia Gallery at:

<http://www.nsf.gov/news/mmg/?s=4&page=1>

CDC Resource: Focus on safety issues and concerns.

<http://www.cdc.gov/niosh/topics/nanotech/>

Center for Advanced Materials & Nanotechnology: Lehigh University resource page including a link for K-12.

<http://www.lehigh.edu/nano/>

Center for Affordable Nanoengineering of Polymeric Biomedical Devices at Ohio State University: Lessons that can be used in high school classrooms.

<http://nsec.osu.edu/educationoutreach>

Center for Nanoscale Science at Pennsylvania State University: Resources for educators including nano activities for kids.

<http://www.mrsec.psu.edu/education/>

Chemeddl: Online tutorials provide ways for students to visualize organic molecules, translating them from "flat" molecules to manipulatable 3-D structures.

<http://www.chemeddl.org/resources/stereochem/threed1.htm>

Cleanrooms:

Dr. Mike Deal of Stanford University leading a remote cleanroom tour of Georgia Institute of Technology's Institute for Electronics & Nanotechnology cleanroom facility.

http://www.mcrel.org/nanoleap/remote_access/cleanroom.asp

A view inside the cleanroom at Institute for Electronics & Nanotechnology at Georgia Institute of Technology.

<http://cleanroom.ien.gatech.edu/cameras/>

Concord Consortium-Molecular Literacy Project and Molecular Workbench:

Interactive simulations and lessons for biotechnology and nanotechnology.

Error! Hyperlink reference not valid. <http://mw.concord.org/modeler/>

Cornell University Center for Materials Research: Teacher resources & lending library of experiments

<http://www.ccmr.cornell.edu/education>

Cosmic View: "Cosmic View: The universe in 40 jumps"

<http://www.vendian.org/mncharity/cosmicview/pages/page35.html>

DiscoverNANO at Northwestern University: Nano101, nano history, and lessons.
<http://discovernano.org/>

Dragonfly TV- Nano and Nanosphere: Videos on nanotechnology with games, activities and interviews with scientists.
<http://www.dftvpress.org/index.html>
<http://pbskids.org/dragonflytv/nano/index.html>

Engineering –Go for It!: Lessons, activities, resources on engineering including nanotechnology.
<http://teachers.egfi-k12.org/>

Duke University’s Center for Environmental Implications of Nanotechnology: Includes Nano2Earth high school curriculum published by NSTA.
<http://www.ceint.duke.edu/>

Ferrofluid: Explains what ferrofluid is and how it works.
<http://mrsec.wisc.edu/Edetc/background/ferrofluid/index.html>

Foresight Institute: think tank and public interest organization focuses on technologies including nanotechnology.
<http://www.foresight.org/>
Student resources such as institutes that give nano degrees, research, and Internships
<http://www.foresight.org/cms/resources/58>

GeckoMan: A nanotechnology forces game from Northeastern University.
<http://www.northeastern.edu/chn/geckoman/>

How Big are Things?: Paper cube you can print for comparing sizes.
<http://www.vendian.org/howbig>

Institute for Chemistry Education at University of Wisconsin-Madison: Lessons for the K-12 science classrooms & after school groups as well as online course for teachers.
<http://ice.chem.wisc.edu/>

Inspire STEM Education by Hitachi: A website from our education partner, Hitachi, HTA. Contains information primarily related to **scanning electron microscopy** (SEM)
<http://www.inspirestemeducation.us/>, lesson plans, and information on how you can BORROW a SEM for the classroom. The site also has a cartoon-type booklet on SEM which is free to download (registration required)
<http://www.inspirestemeducation.us/tools/science-is-fun/>

Institute of Nanotechnology: Lots of great nanoscale images.
<http://www.nano.org.uk/images.htm>

Intel: Videos and curriculum related to computer chips, clean rooms, technology , etc.
<http://www.intel.com/museum/onlineexhibits.htm>
<http://educate.intel.com/en/thejourneyinside>

Kavli Foundation: In depth interview with Dr. George Whitesides of Harvard University (50 minutes long). In this special interview, Professor Whitesides discusses nanoscience. He describes how nanoscience may change our society forever, as well as the way we think about the small scale. He also points out several observations about our current technologies and where nano-technologies may lead us.
<http://www.kavlifoundation.org/nanoscience-george-whitesides>

Materials World Modules and National Center for Learning and Teaching in Nanoscale Science & Engineering: Instructional materials & video broadcasts
<http://www.nclt.us>
<http://www.materialsworldmodules.org/>

Matter of Scale from UC Santa Barbara:

- Of Mice and Elephants: A Matter of Scale -- Good overview of the development of scaling laws in the 1980s and 1990s, including an extension from the animal world into the plant world. Nice discussion of the universality of these laws revealing underlying pattern and structure.
- The link From the Small to the Huge, how body size and energy consumption differ on this site goes to a picture of a log-log graph and elephant comparing the metabolic rates of mammals which shows that bigger mammals are more efficient in energy consumption.
- The link, *Like an Ant, Only Bigger?*, strength vs. proportion on this site goes to a picture of Superman and an explanation from DC Comics that Superman's strength comes from different scaling laws on his home planet of Krypton.
http://hep.ucsb.edu/courses/ph6b_99/0111299sci-scaling.html

McREL:

NanoLeap high school units and resources.

Physical science unit from McREL that connects nano to forces and interactions.

<http://www.mcrel.org/nanoleap/ps/index.asp>

Chemistry unit on nanoscale materials and their properties

<http://www.mcrel.org/nanoleap/chemistry/index.asp>

Library of resources that include videos, animations, interactives, remote access.

<http://www.mcrel.org/nanoleap/multimedia/index.asp>

Multi-Scale graph of objects that you can sort by size

http://www.mcrel.org/nanoleap/multimedia/nanosize_me.swf

NanoExperiences: NanoEx is a hands-on, minds-on, career-creating opportunity! Learn cool, real-world nanoscience and technology. Build important relationships.

Uncover your own strengths and potential in the workforce. Develop key job skills. Have fun doing it!

<http://www.nanoexperiences.org/>

MegaPenny Project: The MegaPenny Project aims to help by taking one small everyday item, the U.S. penny, and building on that to answer the question: "What would a billion (or a trillion) pennies look like?" Site provides a nice concrete anchor for students' conceptions of quantity. <http://www.kokogiak.com/megapenny/default.asp>

Miami Science: Powers of Ten activities.

<http://www.miamisci.org/ph/lpextend1.html>

Molecular Expressions Exploring the world of Optics and Microscopy: (from Florida State University and the National High Magnetic Laboratory: Web site that has size and scale video *Secret Worlds: The Universe Within*. Includes interactive Java-powered virtual microscopes, information about microscopes, and a gallery of images. They have an online guidebook for teachers on the resources available on the website. These virtual microscopes explore specimen focus, illumination intensity, magnification, and translation---operating essentially in a manner that is identical to real-life microscopes.

<http://micro.magnet.fsu.edu/primer/virtual/virtual.html>

Molecularium: Teacher Guide & "Kid's site" about the atomic world—From Rensselaer Polytechnic Institute.

<http://www.molecularium.com/>

Has teacher resource guides for grades K-4 and also Molecules to the Max for grades 5-8.

<http://nanospace.molecularium.com/>

MRSEC at University of Wisconsin-Madison: A variety of kits and resources focused on nanoscale science and engineering, including societal and environmental issues.

<http://education.mrsec.wisc.edu/modules/index.html>

Nano Dictionary: Dictionary of nano terms - including visuals.

<http://nanodic.com/>

NanoHUB: Online simulations for nanotechnology <http://nanohub.org/>

Also includes high school and middle school resources.

<http://nanohub.org/groups/ms>

<http://nanohub.org/groups/hs>

National Institute of Standards & Testing: Nanotechnology portal with a variety of links for resources. <http://www.nist.gov/nanotechnology-portal.cfm>

Nano4Me: NACK's (Nanotechnology Applications and Career Knowledge) mission is to provide quality Resources to K-12 & Post-Secondary educators. Nano4me Resources are free for registered users.

<http://nano4me.org/educator-resources.php>

NanoKids: The NanoKids™ educational outreach program is dedicated to increasing public knowledge of the nanoscale world and the emerging molecular research and technology that is rapidly expanding internationally. Based on actual anthropomorphic molecules synthesized in the laboratory, the NanoKids™ visual concept utilizes universally recognized forms exhibiting human characteristics to instruct, motivate, and entertain.

<http://www.nanokids.rice.edu/>

Nano-Link: Provides nanotechnology resources and classroom materials.

<http://www.nano-link.org>

NanoMission: NanoMission(TM) is a cutting edge gaming experience which educates players about basic concepts in nanoscience through real world practical applications from microelectronics to drug delivery. Must register to play games such as Nanomedicine or Nanoscaling. <http://nanomission.org/>

Nanooze: NNIN's online science magazine for grades 5-8 which includes games, interviews and additional information in three languages – English, Spanish, and Portuguese. The print versions of the magazines can be ordered for free for the classroom <http://www.nanooze.org>

Nanopinion: European Union resources for educators.

<http://www.nanopinion.eu/en/education>

Nanoreisen: A virtual discovery journal into the worlds of micro-and nano-cosmos.

<http://www.nanoreisen.de/>

Nanoscience Instruments: Downloads, scanning probe microscope animation gallery, online simulations,

<http://www.nanoscience.com/applications/education/>

NanoSense: Lesson plans and activities designed for teaching nanoscience at the high school level. Units that include Size Matters, Clear Sunscreen, Clean Energy, Fine Filters

<http://nanosense.sri.com/>

NanoSonic: A coloring book based on SEM images – free to download.

<http://www.nanosonic.com/664/nanotechnology-coloring-book.html>

NanoTecNexus: Bringing together business and education.

<http://nanotecnexus.org/k-12/>

Nano-World: Swiss virtual site. Has a site where you can see inside a nano lab at

<http://www.nano-world.org/nano/en>

Nanowerk: Resources and an Introduction to Nanotechnology

<http://www.nanowerk.com/>

NanoYou (European Union): Nano for Youth is a project funded by the European Commission's Seventh Framework Programme that aims to increase young people's basic understanding of nanotechnologies (NT) and to engage in the dialogue about its ethical, legal and social aspects (ELSA).

<http://nanoyou.eu>

Nanozone at the Lawrence Hall of Science: Interactive games, videos, scale, and meet a scientist—in the Nanozone!

<http://nanozone.org>

National Cancer Institute: Resource information on nanotechnology in cancer treatment.

<http://nano.cancer.gov/learn/>

National Nanotechnology Initiative: NNI is the overarching program encompassing all U.S. government nanotechnology activities. This site has an Education Center link which provides information for K-12 students and teachers.

<http://www.nano.gov>

<http://www.nano.gov/education-training/k12>

<http://www.nano.gov/education-training/teacher-resources>

National Nanotechnology Infrastructure network (NNIN): NNIN's Educational Portal has a searchable database of K-16 lessons written primarily by teachers and tested in their classrooms. Access to *Nanooze* and other information is also at the site. Links to NNIN sites and site education pages can be accessed.

<http://www.nnin.org/education-training>

NASA: Research in nanotechnology supported by NASA

<http://www.nasa.gov/centers/ames/research/technology-onepaggers/nanotechnology-landing.html>

Voyage of the Nano-Surgeons -NASA-funded scientists are crafting microscopic vessels that can venture into the human body and repair problems – one cell at a time.

http://science.nasa.gov/headlines/y2002/15jan_nano.htm

Nature: Web site where you can get current research in nanoscale science and engineering.

<http://www.nature.com/nnano/index.html>

Next Big Future: Covers current news about nanotechnology

<http://nextbigfuture.com/>

New Scientist: Graphic showing objects down to the nanoscale.

<http://www.newscientist.com/movie/nanotechnology-interactive>

NIOSH Safety & Health Topic: Nanotechnology: Online resource data

<http://www.cdc.gov/niosh/topics/nanotech/>

NISENET: A national community of informal science educators and researchers dedicated to fostering public awareness, engagement, and understanding of nanoscale science, engineering, and technology. Numerous activities, videos, visualizations, including materials for NanoDays an annual event of the nano-education community,

<http://www.nisenet.org/>

NSF: (National Science Foundation) NSF website that shows discoveries in the area of nanoscience.

http://www.nsf.gov/discoveries/index.jsp?prio_area=10

Oklahoma Nanotechnology Education Initiative: K-12 resources including family and consumer science lessons.

<http://www.okcareertech.org/about/initiatives/oklahoma-nanotechnology-education-initiative>

PBS Learning Media: Has 60 nanotechnology-related items in its resources. **Error!**

Hyperlink reference not valid. **Nova Making Stuff Series (2011):** Hour-long video series on how nanotechnology is making stuff stronger, smaller, cleaner, and smarter.

<http://www.pbs.org/wgbh/nova/tech/making-stuff.html>

How Small Is A Nanometer? (You Tube NanoNerds):

http://www.youtube.com/watch?v=o2aas8P_jgY

Powers of Ten:

From the "Time" portion of the website (at 10^{19} seconds), LINKS BETWEEN LARGE AND SMALL 10^{19} seconds is 300 billion years or 100 times the age of the Moon--a time period far beyond our realm.

<http://www.powersoften.com/>

Powers of Ten

<http://www.wordwizz.com/pwrsof10.htm>

Powers of Ten

Relates pH to powers of 10 (an example of a logarithmic scale).

<http://www.miamisci.org/ph/hextend1.html>

Powers of Ten

Students create mathematics manipulatives to explore powers of ten.

<http://www.miamisci.org/ph/lpextend1.html>

Project on Emerging Nanotechnology at Woodrow Wilson International Center:

This site contains many resources related to society and the safe development of nanotechnology. The site also has a list of currently available consumer products.

<http://www.nanotechproject.org/>

Rice University CBEN: Professional development course for teachers -

Nanotechnology for Teachers <http://cben.rice.edu/teacherprograms.aspx>

<http://cben.rice.edu/education/resources.aspx>

Scale Diagram: A length scale diagram

<http://www.alcyone.com/max/physics/orders/metre.html>

Scale of Things Chart : Free downloadable chart from the US Department of Energy

<http://science.energy.gov/bes/news-and-resources/scale-of-things-chart/>

Scales and Timelines: A variety of scales and timelines including geological, evolutionary and cosmological

<http://www2.astro.psu.edu/users/niel/scales/scales.html>

Scaling the Universe to Your Desktop:

Scaling the Universe to your Desktop -- Jumps by three orders of magnitude to develop a sense of relative scale within those three orders of magnitude, then links from one jump to the next larger or smaller. "Rooms" each contain objects spanning 3 orders of magnitude within them. http://www.vendian.org/envelope/dir1/scaling_to_desktop.html

Scanning Electron Microscope: (SEM)

Photography captured through scanning electron microscopes showing small structures.

<http://vimeo.com/5108749>

Other useful sites for exploring the operation of an SEM:

<http://education.denniskunkel.com/Java-SEM-begin.php>

<http://micro.magnet.fsu.edu/primer/java/electronmicroscopy/magnify1/>

<http://school.discoveryeducation.com/lessonplans/interact/vemwindow.html>

<http://legacy.mos.org/sln/SEM/>

Scanning Probe Microscopy: (STM) Video showing how a scanning tunneling microscope works. http://wn.com/Scanning_Tunneling_Microscope

Journey to the Nanoworld video about scanning probe microscopy.

www.youtube.com/watch?v=WiFgwB_BADE

Scientific American: The online Scientific American site provides current nanotechnology news through an RSS feed.

<http://www.scientificamerican.com/search/?q=Nanotechnology>

ScienceCentral: Information and videos on current research, including nanotechnology.

<http://www.sciencentral.com>

Sciencedaily (Nanotechnology): The latest news in research.

http://www.sciencedaily.com/news/matter_energy/nanotechnology

Science Museum UK Online: Information about nanotechnology and how scientists are using it to improve our daily lives. Includes an interactive game.

<http://www.sciencemuseum.org.uk/antenna/nano/>

Self- Assembly: Shows examples of self-assembly by capillary forces, electrostatic forces, and magnetic forces.

<http://www.math.udel.edu/MECLAB/Projects/SelfAssembly/selfassembly1.htm>

Silicon Run Productions: DVDs for sale on microelectronics and nanotechnology

<http://www.siliconrun.com/>

Size and Scale: Interactive size and scale chart.

<http://learn.genetics.utah.edu/content/begin/cells/scale>

Size and scale: Resources for teaching size and scale including a size and scale cube.

<http://www.vendian.org/howbig/>

Southwest Center for Microsystems Engineering (SCME): Center resource MEMS which has learning modules and kits for sale.

<http://scme-nm.org/>

Stanford Center on Polymer Interfaces and Macromolecular Assemblies -EDKIT: Curricula explore the concept of characterization, and the development of scientific tools. Five part unit that has evaluation instruments.

<http://www.stanford.edu/group/cpima/education/EDKIT/html/probemain.htm>

Teach Engineering: Search the database for over 35K-12 lessons related to nanotechnology. <http://www.teachengineering.org/>

Technyou: Lessons from an Australian site. Nano lessons include Properties, Personal Care, Space elevator, Memory Shape Alloy, Investigating Forms of ?Carbon, Scale and measurement, The Nanotechnology Scale, Glass, Social Issue, Textiles, Performance Materials, Scale and new Technologies, Critical thinking, Gold, health and medicine.

<http://technyou.education.csiro.au/>

The Nanotechnology Group Inc.: Consortium for global education in nanotechnology with links to resources and information.

<http://www.tntg.org/>

TryNano: Resources, lessons, general information.

<http://www.trynano.org/resources.html>

University of California LA: California Nanosystems Institute: High School nanoscience program with lessons. Contains experimental units that include Biototoxicity, Photolithography, Self-Assembly, Solar Cells, Super Capacitors, Super Hydrophobic surfaces, Water Purification (no longer has public access; must request access)

<http://cnsi.ctrl.ucla.edu/nanoscience/pages/>

University of California/San Diego: 30-minute online video on nanoscience.

<http://www.ucsd.tv/getsmall/>

University of Illinois at Urbana-Champaign: CEMMS: Online labs that include nano-silver, gold and investigating chocolate.

<https://nano-cemms.illinois.edu/materials>

University of Massachusetts: Nanotechnology summer institute for teachers as well as resources and modules online.

<http://www.umassk12.net/nano/>

University of Nebraska-Lincoln: Lesson plans for high school teachers.

<http://mrsec.unl.edu/teachers>

University of Wisconsin: Project engages adults in weighing the benefits and risks of nanotechnology in areas such as health care, energy, and defense.

<http://ice.chem.wisc.edu/NanoDecisions/index.html>

Web site uses interactive tutorials to introduce middle school and high school students to current chemistry and engineering research.

<http://ice.chem.wisc.edu/TSTS.html>

USDA: Nanotechnology at the USDA.

<http://www.csrees.usda.gov/nanotechnology.cfm>

Vega Science Trust, England: Videos on a range of science topics including nanotechnology & how it will change the world. Includes interviews with Nobel Prize winners

<http://www.vega.org.uk/>

<http://www.vega.org.uk/video/programme/3>

Virtual Lab-University of Virginia: Interactive animations on nanotechnology related topics including Atomic Force Microscopes, Scanning tunneling Microscopes, Transistors, Integrated Circuits, CD/DVD Players, DNA

<http://virlab.virginia.edu/VL/home.htm>

Nanotechnology Books

Alice in Nanoland by Leigha Horton and Stephanie Long

And the Band Played On by Randy Shilts

Careers in Nanotechnology by Corona Brezina

How Much is a Million? By David Schwartz

How nanotechnology Will Change Hair Styles by Rama Ramesh and Mark Tomassori (EBook)

How Small is Nano?

http://www.nisenet.org/sites/default/files/HowSmallIsNano_Text_May10.pdf- book online

Lenny Cyrus, School Virus by Joe Schreiber

MEMS Nanotechnology for Kids by Marlene Borne (out of print)

Micromachines by David Jefferies

Microscopes and Magnifying Lenses by Janice Van Cleave

My Sister's Keeper by Jodi Picoult

NANO. The Emerging Science of Nanotechnology by Ed Regis

Nanoethics: The Ethical and Social Implications of Nanotechnology Fritz Allhoff, Patrick Lin, James Moor, John Weckert, Mihail C. Roco

Nanofuture: What's Next for Nanotechnology by J. Storrs Hall, 2005

Nano-Hype by David Berube

Nanoscience Science: Activities for Grades 6-12 by Gail Jones (NSTA Press)

Nanosystems: Molecular Machinery, Manufacturing and Computation by K. Eric Drexler

Nanotechnology: An Introduction by J. Ramsden

Nanotechnology by Jacqueline (EDT) Langwith

Nanotechnology DeMystified, by Linda Williams and Wade Adams

Nanotechnology for Dummies by Booker and Boyson, 2005

Nanotechnology: Basic Science and Emerging Technologies by Mick Wilson

Nanotechnology: A Gentle Introduction to the Next Big Idea by Mark and Daniel Ratner

Nanotechnology: Principles, Applications, Implications and Hands on Activities-book on line-http://ec.europa.eu/research/industrial_technologies/pdf/nano-hands-on-activities_en.pdf (European book that is an introduction to nanoscale science)

No Small Matter-Science on the Nanoscale by Felice Frankel and George Whitesides

Powers of Ten: A flipbook by Charles and Ray Eames

Radial Abundance: How a Revolution in Nanotechnology will Change Civilization by K. Eric Drexler (Published 5/7/2013)

Spaghetti and Meatballs for All! by Marilyn Burns

The Big Ideas in Nanoscale Science and Engineering: Guidebook for Secondary Teachers by Stevens et al (NSTA Press)

The Dance of Molecules by Ted Sargent

The Immortal Life of Henrietta Lacks by Rebecca Skloot

Understanding Nanotechnology (Scientific America)

Created by Joyce Allen, Georgia Institute of Technology 2014