

Nanotechnology Educator Guide

A resource for using QUEST video, audio, blogs and maps in the classroom

QUEST SUBJECTS

Life Science
Biology
Health
Environment

Earth Science
Geology
Weather
Astronomy

Physical Science
Physics
Chemistry
Engineering

CA SCIENCE STANDARDS

Grade 5

Physical Sciences

1. (a - f) types of matter formed through combinations of atoms

Grade 7

Physical Sciences

6. (a, c, d) nature of light and principles underlying lenses

Grade 8

Chemistry of Living Systems

3. (a, b, c) structure of atoms and molecules

Periodic Table

7. (c) properties of substances

Grades 9-12

Physics

3. (c) internal energy of an object

Electric and Magnetic Phenomena

5. (f) magnetic fields

Atomic and Molecular Structure

1. (a, g) using the periodic table to identify elements

Chemical Bonds

2. (d) random movement of atoms

Organic Chemistry

10. (a) formation of polymers

QUEST MEDIA FOR TEACHING ABOUT NANOTECHNOLOGY

Read and comment on the blogs for these stories by clicking on the story link and clicking on the blog post link below the video/audio.

Watch **Nanotechnology Takes Off** - 10:28 minutes

<http://www.kqed.org/quest/television/nanotechnology-takes-off>

- What's 100,000 times thinner than a strand of hair? A nanometer. Discover the nanotech boom in Berkeley, where researchers are working to unlock the potential of nanoscience to battle global warming and disease.

Watch **The World's Most Powerful Microscope** – 10:18 minutes

<http://www.kqed.org/quest/television/the-worlds-most-powerful-microscope>

- The \$27 million electron microscope at Lawrence Berkeley National Laboratory has the ability to make images to a resolution of half the width of a hydrogen atom, making it the most powerful microscope in the world. Also, see a selection of the amazing atomic-scale images from the Transmission Electron Aberration-Corrected Microscope (TEAM) microscope at <http://www.kqed.org/quest/slideshow/web-extra-images-from-the-worlds-most-powerful-microscope>

Watch **Macro Concerns in a Nano World** – 9:42 minutes

<http://www.kqed.org/quest/television/macro-concerns-in-a-nano-world>

- At 10,000 times smaller than the width of a human hair, you can't see nanoparticles, but you can find them in everyday products like sunscreen and clothing. But environmental and health concerns are mounting about exposure to nanomaterials, sparking a growing debate about their possible regulation.

Watch **Solar City: The Future of Nanosolar** – 3:44 minutes

<http://www.kqed.org/quest/television/solar-city-the-future-of-nanosolar>

- Hoping to leave today's silicon solar cells behind, the Palo Alto-based Nanosolar is creating paper-thin solar panels harnessing nanotechnology, a product that could revolutionize solar power.

TOPIC BACKGROUND

Nanotechnology is the science of building materials and devices from single atoms and molecules. This emerging interdisciplinary science combines chemistry, engineering, biochemistry and materials science. It's big—on a really small scale.

Researchers have been working on understanding how matter changes if you alter the sizes of the individual molecules that constitute an object. Their research is helped by powerful microscopes, such as the TEAM microscope at Lawrence Berkeley National Laboratory, which can visualize the atomic structure of matter like never before. Scientists have discovered that materials on an atomic and molecular scale behave very differently from larger objects. Manipulating the unique properties of these atoms allows scientists to create products like stain-resistant fabrics or sunscreen that blocks ultraviolet light.

Nanomaterials are already providing the means to develop faster, lighter and more efficient materials for a range of purposes, from solar panels that more efficiently capture and convert the sun's energy to more effective water filtration devices. However, nanomaterials are still relatively new and untested, and concerns are growing about the potentially damaging effects of these materials on human health and ecological safety.

Additional Resources:

Nanotech Risks: <http://www.sciencedaily.com/releases/2008/05/080527091910.htm>

Applications of Nanotech -- Cancer Research:

<http://www.pbs.org/wgbh/nova/sciencenow/3209/03-canc-flash.html>

VOCABULARY

Nanotechnology

the study of the control of matter on an atomic or molecular scale

Electron

subatomic particle that carries a negative charge

Nanomaterials

applications that are smaller than a one-tenth of a micrometer in at least one dimension.

Carbon nanotubes

carbon molecules with a unique structure and ability to bond with each other

Nanometer

unit of measure equal to one billionth, or 10^{-9} of a meter

Electromagnet

type of magnet where the magnetic field is produced using an electrical current

Refraction

change in direction of a wave when passing from one medium to another

Spherical Aberration

optical effect caused by increased refraction of light through a spherical lens, resulting in an imperfect image

Polymer

a compound consisting of repeatedly linked subunits

Indium rare, silvery-white metal chemically similar to aluminum or gallium

INTRO QUESTIONS

- What is the smallest object you can see with your naked eye?
- What do scientists use to see objects that are too small to view with the naked eye?
- What are atoms composed of?
- Pick a material (for example, cotton) and list as many of its properties as you can.

FOCUS QUESTIONS

- What are nanomaterials?
- Why do smaller-sized atoms behave differently from their larger counterparts?
- How does the TEAM electron microscope work? How does it correct spherical aberration?
- What are some of the current applications of nanotechnology?
- Why are some people concerned about the potential health and safety hazards caused by nanomaterials?

For all media see:

- Segment Summary Student Sheet
http://www.kqed.org/quest/downloads/QUEST_SegSum_StudentSheet.pdf
- Personal Response Student Sheet
http://www.kqed.org/quest/downloads/QUEST_PersResp_StudentSheet.pdf

LESSON PLANS and RESOURCES from PBS, TEACHERS' DOMAIN and NPR

NOTE: Resources from the Teachers' Domain collection require a fast and free registration.

National Nanotechnology Infrastructure Network

http://www.nnin.org/nnin_edu.html

The National Nanotechnology Infrastructure Network (NNIN) provides curriculum resources and activity guides for teaching about nanotechnology.

A Nanotube Space Elevator Teachers Domain

<http://www.teachersdomain.org/resource/oer08.sci.engin.systems.elevator/>

This video adapted from **NOVA ScienceNOW** explores the potential of carbon nanotubes, whose strength and unique properties make them useful for a variety of applications, including an elevator from Earth to the Moon.

How Small Am I? The Science of Nanotechnology PBS Teachers

<http://www.pbs.org/newshour/extra/teachers/lessonplans/science/nanotechnology.html>

This lesson plan uses games and investigations to introduce students to relative sizes of objects in the nanoworld.

Dragonfly TV Nano Dragonfly TV

<http://pbskids.org/dragonflytv/parentsteachers/nano.html>

This **DragonflyTV** series showcases ordinary kids conducting extraordinary inquiry-based investigations aided by science museums and university research labs nationwide.

Nanozone Lawrence Hall of Science

<http://www.nanozone.org/index.htm>

UC Berkeley's Lawrence Hall of Science presents basic nanotechnology concepts and information to an 8- to 14-year-old audience.

Angela Belcher: Building Tiny Living Batteries Scientific American

<http://www.sciam.com/article.cfm?id=angela-belcher-building-t>

A profile of Professor Angela Belcher of MIT, who is developing nanoscale bio-batteries using tiny virus cells.

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The Bay Institute
www.bay.org

California Academy of Sciences
www.calacademy.org

Chabot Space and Science Center
www.chabotspace.org

East Bay Regional Park District
www.ebparks.org

Exploratorium
www.exploratorium.edu

Girl Scouts of Northern California
www.girlscoutsnorcal.org

Golden Gate National Parks Conservancy
www.parksconservancy.org

The J. David Gladstone Institutes
www.gladstone.ucsf.edu

Lawrence Berkeley National Laboratory
www.lbl.gov

Lawrence Hall of Science
www.lawrencehallofscience.org

Monterey Bay Aquarium
www.mbayaq.org

Monterey Bay Aquarium Research Institute
www.mbari.org

Oakland Zoo
www.oaklandzoo.org

The Tech Museum of Innovation
www.thetech.org

UC Berkeley Natural History Museums
<http://bnhm.berkeley.edu/>

U.S. Geological Survey
www.usgs.gov

MORE EDUCATIONAL RESOURCES FOR USING QUEST MULTIMEDIA TO ENHANCE 21ST CENTURY SKILLS IN TEACHING AND LEARNING

Why Use Multimedia in Science Education?

<http://www.kqed.org/quest/downloads/QUESTWhyMedia.pdf>

- Read about the importance of using multimedia in the 21st century science classroom.

How to Use Science Media for Teaching and Learning

<http://www.kqed.org/quest/downloads/QUESTMediaTips.pdf>

- A collection of tips, activities and handouts to actively engage students with multimedia.

Science Multimedia Analysis

<http://www.kqed.org/quest/downloads/QUESTMediaAnalysis.pdf>

- Give your students the tools to recognize the purposes and messages of science multimedia.

Create Online Science Hikes with Google Maps

http://www.kqed.org/quest/files/download/52/QUEST_ExplorationCreation.pdf

- Do you like the science hike Explorations on the QUEST site? Use this place-based educational guide to create similar science-based maps with youth.

OTHER WAYS TO PARTICIPATE IN QUEST



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89.3 FM Sacramento
Mondays at 6:30am and 8:30am



WATCH

KQED Channel 9
Tuesdays at 7:30pm

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