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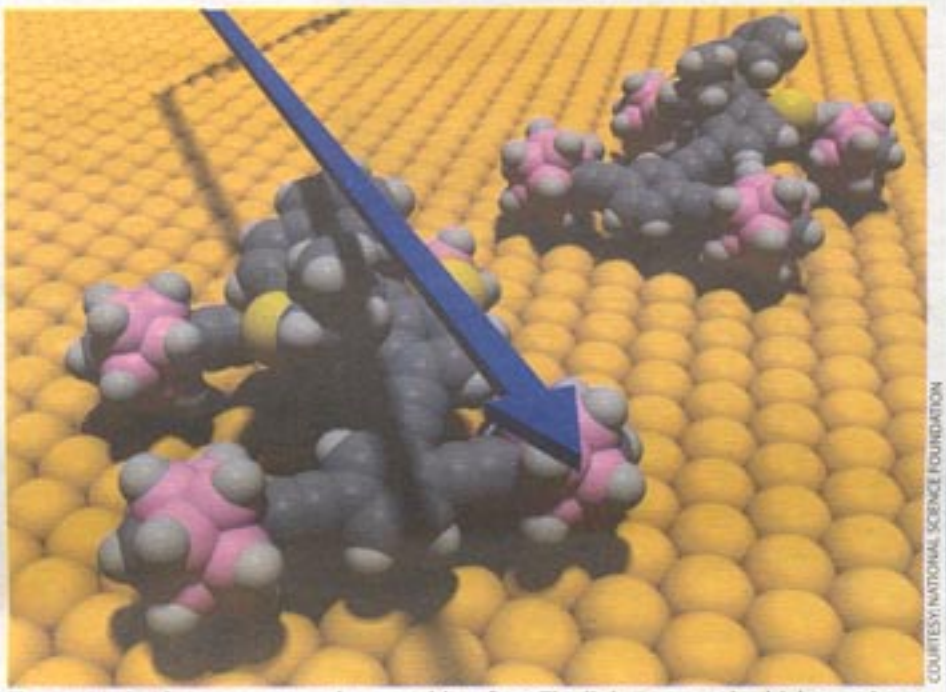
Science at the Nanoscale

In 2006, *Washington Post* reporter Valerie Strauss wrote in "Teaching the Notion of Nanotechnology" (December 19) that "scientist Robert P.H. Chang of Northwestern University had no trouble persuading education officials in Mexico to introduce the burgeoning field of nanotechnology to schools there, but it's been a far tougher sell in the United States." But educators nationwide now are ready to teach about nanotechnology, which futurists are calling "the next major scientific revolution."

This sea change is reflected by the fact that middle schoolers competing in this year's National Engineers Week Future City Competition™ are writing about how nanotechnology will monitor their self-created city's structures and systems to keep its infrastructure healthy (see *www.eweek.org*).

Teaching nanoscience has inherent challenges. Nanotechnology combines physics, chemistry, biology, mathematics, engineering, and technology, and scientists use extraordinary tools in working at the nanoscale, such as the Scanning Tunneling Microscope, that teachers need to understand.



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Two motorized nanocars travel on a gold surface. The light-powered vehicle consists of just 169 atoms and is a test transport system that could one day deliver molecular cargo for nanoscale construction.

Sources for Teaching Materials

Fortunately, the National Science Foundation (NSF) has funded the Nanoscale Informal Science Education (NISE) Network (*www.nisenet.org*), which develops programs to engage schools in nanoscale science. The online NISENet Lab features a NanoHome that allows you to "explore some of the implications of nanotechnology, both good and bad," so that you can help your students reach informed conclusions. You can also listen to *Small Talk*, a podcast series about nanotechnology, hosted by Stephanie Chasteen of the Exploratorium's Teacher Institute and featuring leading scientists.

NISE will present a session at NSTA's National Conference in Boston on March 28. Use the Session Browser at *www.nsta.org/conferences/2008bos* to learn more about it and 22 other sessions on nanoscale science (locate all 23 by using the keyword "nano").

In addition to teaching about the field, educators are also creating and field testing materials. Biological Sciences Curriculum Study (BSCS) needs high school physical and biological science teachers to field test a two-chapter unit focusing on fundamental science principles behind nanotechnology in April and May. Participants must attend a two-day orientation workshop at BSCS in April, for which BSCS will pay all lodging, travel, and meal expenses. Teachers will receive a stipend following the field test.

BSCS staff will make site visits to selected schools to observe the field-testing process. Learn more and apply at *www.bscs.org/fieldtest*.

NISE highlights the following exhibits on its website:

- It's a Nano World, a traveling museum exhibit, acquaints children ages 5–8 with the biological wonders of the nano world. Visit *http://itsananoworld.org* for the tour schedule and resources for teachers and students.
- The Lawrence Hall of Science's NanoZone exhibit "introduces basic nanoscale and nanotechnology science" to students ages 8–14. At *www.nanozone.org*, teachers will find activities and correlations to national and California science standards. Students can play games,

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watch videos, do hands-on activities, meet scientists, and get answers to their nanotech questions.

- Too Small to See, a traveling museum exhibit, offers students ages 8–13 activities like moving an atom and building and manipulating a molecule. Check the resources section of *www.toosmalltosee.org* for nano-related links for teachers and students.

- Strange Matter, a traveling exhibition devoted to materials science, was developed by the Ontario Science Centre and presented by the Materials Research Society with NSF support. See *www.strangematterexhibit.com/teachers.html* for a teachers guide for grades 5–8, online activities, demonstrations, and curriculum connections.

- The Molecularium—a musical digital-dome experience of states of matter, atoms, and molecules—is an informal education effort of Rensselaer Polytechnic Institute's NSF-funded Nanoscale Science and Engineering Center for Directed Assembly of Nanostructures. Access *www.molecularium.com* for educational posters, a standards-aligned teachers guide for elementary educators, and hands-on activities. Kids can also visit the online Nanolab.

- Other useful websites include those of the National Nanotechnology Initiative (a federal R&D program) at *www.nano.gov/html/edu/eduteach.html* and Rice University, which has a NanoKids site *(http://cohesion.rice.edu/naturalsciences/nanokids)*.

The NSTA Learning Center recently presented two 90-minute web seminars: *Nanoscale Science: Activities for Grades 6–12* and *Nanoscale Science: Tiny Science, Big Ideas*. Web seminars are free and archived at *http://learningcenter.nsta.org*.

At the web page for the NSTA Press book *Nanoscale Science: Activities for Grades 6–12*, you'll find a podcast with the authors, who introduce the concepts students need to understand nanoscale science. This and the following materials are available through the NSTA Science Store *(http://store.nsta.org)*.

At the high school level, the December 2006 issue of *The Science Teacher* had "Small Science" as its theme. Get a quick peek at this theme from the corresponding issue of the e-newsletter *Science Class: http://science.nsta.org/enewsletter/2006-12/member_high.htm*.

Science Scope, NSTA's middle school journal, offered "Putting Nano-Tex to the Test" (September 2005), which discusses how to introduce students to the everyday applications of nanotechnology and have them evaluate a product using detailed observations and experimentation.

The activity in "Nanomedicine: Problem Solving to Treat Cancer" (*Science Scope*, November 2006) was developed to expose students to issues surrounding cancer treatment using an inquiry-based approach.

Elementary teachers can benefit from "It's a Small World After All." This article from the October 2005 issue of *Science and Children* follows a fifth-grade class building science-process skills while exploring nanotechnology.

"A Course in Nanotechnology for Nonscience Majors" appeared in the September 2006 issue of the *Journal of College Science Teaching*. This paper describes a nonscience majors' course in which chemical concepts provide background to the study of this field.

See NSTA Recommends at *www.nsta.org/recommends* for teacher-written reviews of nanotechnology materials. You can export this information to an Excel spreadsheet and share it with your colleagues. ●