

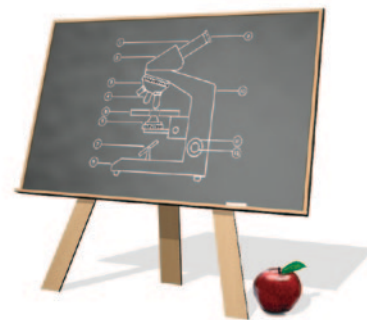
Microscopy Education

Nanotechnology for Kids

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MSA's Project MICRO (Microscopy In Curriculum - Research Outreach) supports education about the microworld for middle school students. This effort includes a curriculum manual for teachers, volunteers to help in classrooms, and advice and support in an extensive web page on MSA's site: <http://www.microscopy.org/ProjectMICRO>. That page includes a reviewed listing of over 150 children's books, other media, and websites about microscopy and the microworld. Nanotechnology isn't microscopy, but it certainly is part of the microworld. Nano machines and nanoscale science have an exciting future that will have a major effect on all our lives, but we already have the beginnings of nanophobia appearing in the popular press. Fear thrives on misinformation. Caution is reasonable and appropriate, but fear, fueled by ignorance and by science fiction thrillers like Michael Crichton's bestseller *Prey* that feature nanomachines gone wild, is not. Uninformed fear may make the controversies over topics like genetic engineering and stem cell research seem tame by comparison. Facts and understanding are the antidote, so it's important that children's books about the nanoworld have started to appear.

This brief list contains all the books that MICRO has been able to find; if you are aware of others, please contact Project MICRO Coordinator Caroline Schooley at schooley@mcn.org. The same information is available on the MICRO web page as a searchable database. It has become difficult to list "real" book prices in these reviews; internet competition has made most publishers' list prices theoretical. Use your favorite search site, particularly if you want a single copy.

For the Primary Grades

The best answer to the question "how can we explain nanotechnology in the primary grades?" is *don't do it!* Young children in grades 1-3 must first explore beyond their unaided eyes with magnifying glasses and low-power dissecting scopes, to develop a sense of scale; without that foundation, nano dimensions will make no more sense to them than the mega-figures of our federal budget make to us. For more advice, see the Project MICRO website, <http://www.microscopy.org/ProjectMICRO>.

Wells, R.E. 1995

What's Smaller Than a Pygmy Shrew?

32 pgs, 10x7", paperback, ISBN 978-0-80758-838-3 \$6

Albert Whitman & Co., www.albertwhitman.com

Understanding the nanoworld begins with an understanding of scale. This is a well-written "powers of ten" book, illustrated with engaging line drawings on every page. It starts with a shrew and progresses to insects, protozoa in a water drop, and bacteria. The next leap is to water molecules, followed by atoms and subatomic particles. Educators at the University of Wisconsin have produced a good classroom teaching module based on this book. It emphasizes scale and relative size; you can get a PDF at <http://mrsec.wisc.edu/Edetc/modules/MiddleSchool/PygmyShrew/index.html>.

This book has been translated as "*¿Hay Algo Mas Pequeño Que Una Musaraña?*" (ISBN 84-261-3031-3; see the MICRO booklist);

the pair of books can be a valuable bilingual teaching aid. Very few Spanish language books are available to help English-learners to acquire a science vocabulary. **Recommended.**

Harmer, A. 2005

Nanotechnology for Grades 1-6+: Introducing Nan and Bucky dog

36 pgs, 8.5x11", paperback. ISBN 1-4208-1903-8 \$15-24

Authorhouse, www.authorhouse.com

The only things that justify the author's claim that this privately published book is useful in the primary grades are the cute pictures and simple, chatty text. It begins with buckyballs and uses them to develop a sense of scale, but there are distracting detours into geodesic domes, DNA, and an advanced transmission electron microscope. There's misuse of words (e.g., a bond intersection in a buckyball is called a helix). The confusing text includes, for example, a meter-to-nanometer scale summary that uses a school bust to illustrate "one meter" and a 1.75 cm penny to illustrate "one cm". Upper elementary students will learn much more from one of the middle school books.

Middle Grades

"Middle grades" is a deliberately vague classification. Some of these brief books will work for upper elementary students, and others have enough content for high school.

Bourne, D. 2007

MEMS & Nanotechnology for Kids

30 pgs, 7x10", hardbound. ISBN 978-0-9795505-0 \$10-25

Bourne Research LLC, www.bourneresearch.com

Bourne reverses the sequence used in other similar books. After a brief discussion of scale, she proceeds to currently used MEMS (Micro-Electro-Mechanical-Systems) and follows that with the nanomaterials that make them possible. She knows her audience; photos show teens using the extremely popular Wii game controller, a Segway, and an electric guitar. It's very well written, and all of the photos are excellent. But it's desktop-published, and those photos are too small to produce the dramatic effect that they deserve. **Recommended** for grades 5-10.

Darling, D. 1995

Micromachines and Nanotechnology: the Amazing World of the Ultrasmall

64 pgs, 7x9", hardbound. ISBN 0-382-24953-4 \$5

Dillon Press

The '95 publication date of this book makes it almost "ancient history," but it's still worth reading. The approach is historical, starting with Renaissance clockworks. The STM (scanning tunneling microscope) is explained. There's good speculation about the future of nanotech (including possible hazards), but no mention of carbon nanotubes and other fullerenes. There's a glossary, bibliography, and index. Middle & high school.



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Fritz, S. 2003

Nanotechnology: Invisible Machines

8.5x8.5", hardbound. ISBN 978-1-5834-0368-X
Smart Apple Media

This title is already out of print, and MICRO is unwilling to buy a used review copy at the current \$40 price quoted on the web.

Jefferis, D. 2006

Micro Machines: Ultra-Small World of Nanotechnology

32 pgs, 8.5x11", paperback. ISBN 978-0-7787-2873-3 \$9
Crabtree Publishing Co., www.crabtreebooks.com

This well-designed book is part of Crabtree's "Science Frontiers" series. There is no discussion of scale; sizes of micro machines are given by analogy (to human hair, for example). Speculation about future nano machines is illustrated with good drawings and photos. Hazards get attention; Michael Crichton's science fiction bestseller *Prey* and other fears are discussed. Grades 4-8.

Johnson, R. L. 2006

Nanotechnology: cool science

48 pgs, 7x10", paperback. ISBN 978-0-8225-2111-3 \$8
Lerner Publications, www.lernerbooks.com

The introduction of this middle school book ends with "So what is nanotechnology? It's something that is going to affect your life in a big way." It's clearly written, with a friendly style, and well illustrated. But it's a bit "over-designed"; the many sidebars and captions interrupt the main text. There are a lot of exciting "what if" examples, and possible problems are discussed. There's a glossary, an adult bibliography, website list, and an index. The other five titles in the "cool science" series are probably worth investigating: Cryobiology, Genetic Engineering, Life on the Edge, Robotics, and Satellites. **Recommended.**

Maddox, D. 2005

Nanotechnology

48 pgs, 6x10", hardbound. ISBN 1-4103-0530-9 \$9-25
Thomson Gale/Blackbirch Press, www.gale.com/blackbirch

A historical approach is used to discuss scale, and a good distinction is made between "top-down" (miniaturization of existing machines) and "bottom-up" (construction from atoms) approaches to nanotechnology. Pioneers are discussed; Feynman, Drexler, Smalley, and Fuller are featured. There aren't many examples of current uses of nanotech. There's a glossary, brief website list, and index. It's part of a ten volume "Science on the Edge" series; see the publishers' website.

High School

The following teacher's manual is a clear winner; it isn't likely to have significant competition soon. Some of the "middle grades" books can provide supplemental text.

Jones, M.G., Falvo, M. R., Taylor, A. R., & Broadwell, B. P.

2007 Nanoscale Science: Activities for Grades 6-12

153 pgs, 8.5x11", paperback.
ISBN 978-1-93353-105-2 NSTA Press \$25

Order as # PB192X1 from www.nsta.org/store or
800-277-5300

Nanotechnology is beyond the imaging capabilities of student light microscopes, but an understanding of what it's all about is of increasing importance for students. The National Science Teachers Association has published an excellent teacher's manual on the subject. It begins by making a distinction between nanoscience (e.g., viruses, DNA) and nanotechnology; that's important. There are 20 investigations, with detailed instructions and copyable student worksheets. The materials

lists are complete and include ordering information for exotica like ferrofluid and stain-resistant nanoparticle-treated fabric. There is much emphasis on size and scale, which also will help students with their light microscopy. Model making of things like viruses and buckyballs take them off the printed page into the 3rd dimension, making them easier to understand. One chapter even has the class construct a very clever model of an atomic force microscope! **Recommended.**

Books for Adults

If you're a teacher, classroom volunteer, or a parent guiding a child's exploration of the nanoworld, you may want to prepare yourself to answer questions. Background is available on the web, but one of these two introductory books can be a useful reference.

Booker, R. & Boysen, E. 2005

Nanotechnology for Dummies

361 pgs, 7x9" paperback. ISBN 0-7645-8368-9 \$25 Wiley

The "for Dummies" series is a reliable source of information for the intelligent reader who lacks specialized knowledge. This is a particularly good one; even high school chemistry and physics aren't assumed. It's comprehensive; there's a survey of currently used nanomaterials and discussion of a wide range of potential applications. Regrettably, possible hazards get little attention. Students considering a nanotech career will find the chapter on educational opportunities helpful. A glossary and a detailed index make it easy to use. The website list is short; a Google search will be needed for specific topics. **Recommended.**

Williams, L. & Adams, W. 2007

Nanotechnology Demystified

343 pgs, 7x9" paperback. ISBN 978-0-07-146023-1 \$20
McGraw-Hill

The "Demystified" series competes with "for Dummies"; the content is similar, but the style is a bit different. Over 50 pages of this book are used for self-tests on content; some readers will find that useful, but some won't. Similar space is devoted to information for potential investors. That said, it's still a good introduction to the field, with clear text and excellent diagrams. There's a bibliography, website list, and index.

Websites

Nanotechnology is developing so rapidly that any book will be out of date as soon as it is published. Websites can be kept current; here's a reviewed starter set:

Nanotech education:

<http://www.scienceinschool.org/2008/issue10/nanotechnology> http://www.nnin.org/nnin_k12scanning.html; <http://nanozone.org/index.htm>; <http://www.sciencemuseum.org.uk/antenna/nano/>

Nanotech links:

<http://www.nanoscience.cam.ac.uk/schools/links.html>

Nanotech video for K-6:

<http://www.youtube.com/watch?v=LFoC-uxRqCg>

Online magazine:

<http://www.nanooze.org/english/about.html>

Workbook in English or Spanish:

<http://nanokids.rice.edu/index.cfm>; <http://mrsec.wisc.edu/Edetc/EnEspanol/index.html>

Pygmy shrew lessons (see book by Wells):

<http://mrsec.wisc.edu/Edetc/modules/MiddleSchool/PygmyShrew/index.html>

Pennies for scale:

<http://www.kokogiak.com/megapenny/default.asp>

Games:

<http://www.nanoquest.ie/home.html>; <http://www.nanomission.org/>;

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



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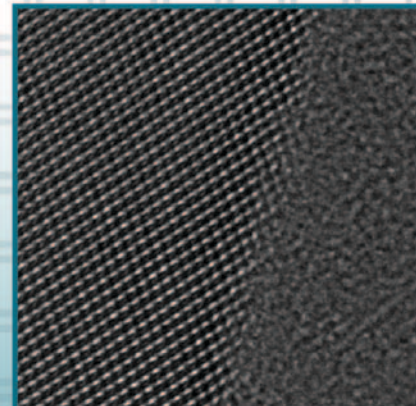
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