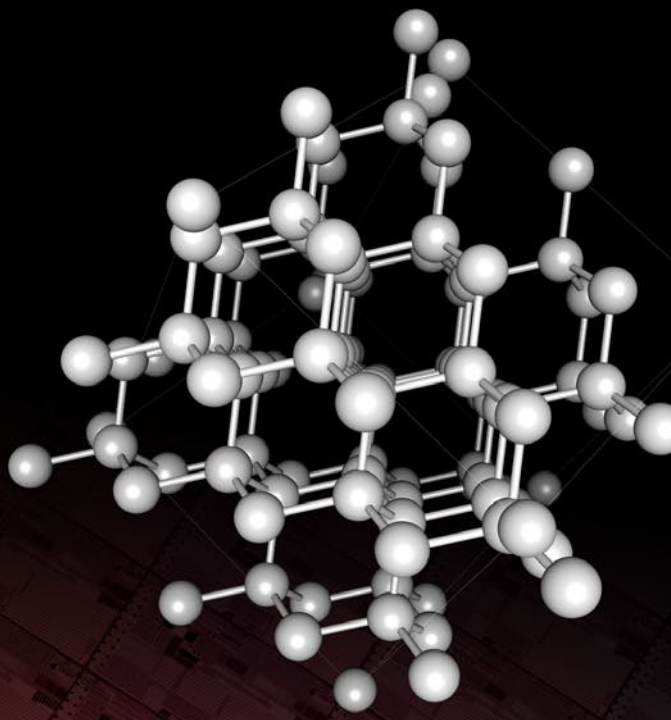
ISSUE 2 • 2009 www.nanooze.org

NANOOZE

SPECIAL EDITION!

NANOOZE: THE EXHIBIT



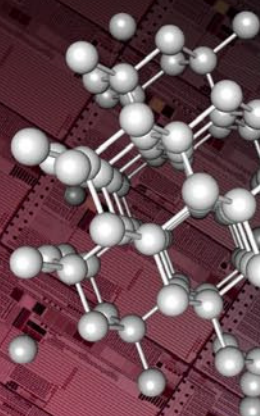
AN INTERVIEW WITH DON EIGLER

THE 4 IMPORTANT THINGS TO KNOW ABOUT NANOTECHNOLOGY

HOW LONG IS A PIECE OF DNA?

CAN NANOTECHNOLOGY HELP COMBAT CANCER?

THE FUTURE OF CLEAN ENERGY



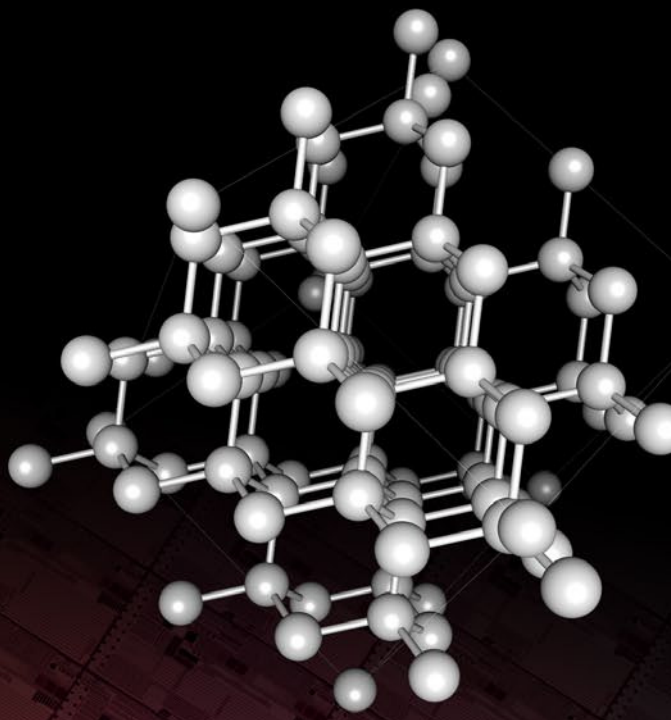
GET NANO with *NANOOZE: THE EXHIBIT*

ISSUE 2 • 2009 www.nanooze.org

NANOOZE

SPECIAL EDITION!

NANOOZE: THE EXHIBIT



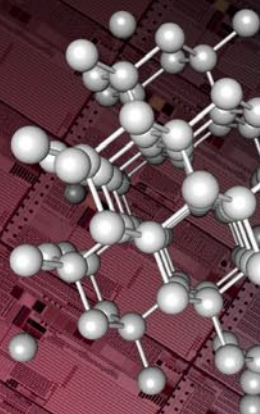
AN INTERVIEW WITH DON EIGLER

THE 4 IMPORTANT THINGS TO KNOW ABOUT NANOTECHNOLOGY

HOW LONG IS A PIECE OF DNA?

CAN NANOTECHNOLOGY HELP COMBAT CANCER?

THE FUTURE OF CLEAN ENERGY



ALL ABOUT THE THINGS TOO SMALL TO SEE

Welcome to Nanooze!

What is a Nanooze? (Sounds like nah-news.) Nanooze is not a thing, Nanooze is a place to hear about the latest exciting stuff in science and technology. What kind of stuff? Mostly discoveries about the part of our world that is too small to see and making tiny things using nanotechnology. Things like computer chips, the latest trends in fashion, and even important stuff like bicycles and tennis rackets. Nanooze was created for kids, so inside you'll find interesting articles about what nanotechnology is and what it might mean to your future. Nanooze is on the Web at ***www.nanooze.org****, or just Google "Nanooze"—you'll find interviews with real scientists, the latest in science news, games and more!*

How can I get Nanooze in my classroom?

Copies of Nanooze are free for classroom teachers. Please visit ***www.nanooze.org*** *for more information or email a request for copies to* ***info@nanooze.org****.*

NANOOZE The Exhibit

Build a Carbon Nanotube *(above),* ***Dissolve a Crystal*** *(left), and* ***Build a Molecule*** *(below), three of the exhibits you can experience at* ***Nanooze: The Exhibit****.*

Let's Get Nano!

What is it like to hang out with atoms and molecules? Well, you do it every day, because all things are made of atoms. But to really hang out with atoms and molecules, you need to go on a fantastic voyage and here is your chance. *Nanooze: The Exhibit* is an interactive exhibition currently touring the country. The exhibit was created by folks at Cornell University with support from the National Science Foundation who is making the tour possible.

To get ready for any kind of trip, you need to pack a few things, mainly ideas to keep in your head. For this trip remember that:

- All things are made of atoms
- At the nanometer scale, molecules are in constant motion
- Molecules have size and shape
- Molecules in their nanometer-scale environment have unexpected properties

The first thing that you need to do to begin this voyage to the world that is too small to see is get small, get nano. You start off at the macroscale, the place where we all live and hang out. But common objects like a butterfly wing, an oyster shell, a dragonfly wing, or a computer chip become exciting and complex when you zoom in 100—1,000,000 —better yet—1,000,000,000 times. And when you get there, what you find out is that these molecules are moving around, making them hard to see and even harder to do something with. During your visit to the world that is too small to see you can even grab a molecule and stretch it out, then let go and see what happens.

It's one thing to see things that are too small to see, but it's more fun to *make* things that are too small to see. At *Nanooze: The Exhibit*, you can put together atoms and form different molecules, then take a look at the different shapes. Or you can take the atom transporter challenge where you match your skills at moving atoms just like nanoscientists do.

Remember, *Nanooze: The Exhibit* is traveling around the country. To see if it's going to be near you, check out **www.nanooze.org**.

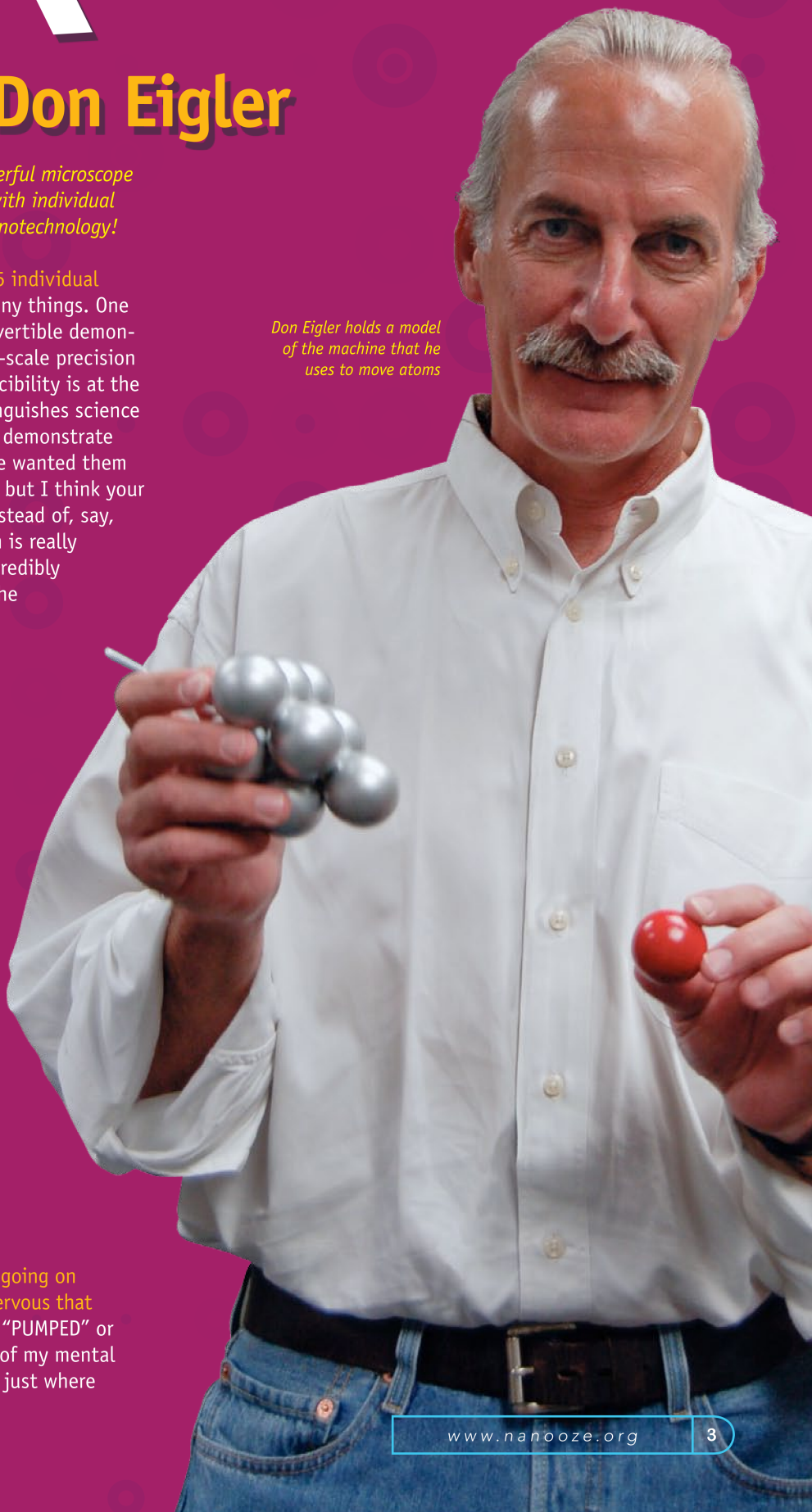
Q&A with Don Eigler

In 1989, Don Eigler and his team at IBM used a powerful microscope they built as a tool to spell out the letters "I-B-M" with individual atoms. It was one of the most important feats in nanotechnology!

You and your colleagues spelled out I-B-M using 35 individual atoms. What were you thinking? I was thinking many things. One of the things I wanted to achieve was an incontrovertible demonstration that we could position atoms with atomic-scale precision over and over again. I have long held that reproducibility is at the very core of experimental science. It is what distinguishes science from pseudo-science. So I wanted a way to clearly demonstrate that we could reproducibly put the atoms where we wanted them to go. Writing out "I-B-M" accomplished this goal, but I think your question is more along the lines of why "I-B-M" instead of, say, "A-T-O-M" or "M-O-M." The answer to that question is really very simple: payback time. I was (and still am) incredibly beholden to the company, and the individuals in the company, that gave me a job when I needed one, and then provided me with every opportunity and resource I needed to achieve professional success. Writing out "I-B-M" with xenon atoms was a way of providing return on the investment. But even more, there was a sense of loyalty and pride that this was an IBM accomplishment.

Was it hard to do? Did you have to spend late nights in the lab? The actual writing of "I-B-M" took 22 hours with a few breaks. Sometimes I would get a letter finished and then mess it up and have to go back and position the atoms again. Nowadays it would take about fifteen minutes. Was it hard? The 22 hours were as delightful as I imagine the first flight of the Wright brothers at Kitty Hawk [North Carolina] must have been. The hard part was the five years of work (two after completing my Ph.D. and working in a university, three at IBM) pioneering low-temperature Scanning Tunneling Microscopy. As for late nights…I have spent countless late nights in the lab. Comes with the territory.

So you do this work but you really can't see what is going on until you look at it under a microscope. Were you nervous that it might not work? Not nervous at all. "STOKED" or "PUMPED" or "AMPED" would be a more appropriate description of my mental state. It is always exciting to see the atom appear just where you intended to place it.



Don Eigler holds a model of the machine that he uses to move atoms