

## Nanoscience Interactive Learning Module for NanoArt K12 Program

*The Introduction of NanoArt for Kids requires the inclusion of interactive learning modules of the visual elements for different age groups to understand the science of the very small universe that can only be viewed through very powerful microscopes. Since the nanoscience has not been introduced in many schools globally, this module contains links to a few selected sites where the children can explore either on their own, or with parents/teachers to expand their knowledge base before attempting to create their NanoArt project.*

### **Size Matters: Macro (Cosmos) to Quarks (100 Attometers)**

*Any Age: Interactive Visual with controls to pause - when you get down to the leaf on the tree, the next power of 10 will be the nanoscale view of the leaf. You can pause and go back and forth to let the child see the differences in the visuals of a leaf that they would not see with their normal vision.*

**Secret Worlds: The Universe Within** - Soar through space starting at 10 million light years away from the Milky Way down through to a single proton in Florida in decreasing orders of magnitude (powers of ten). This tutorial explores the use of exponential notation to understand and compare the size of things in our world and the universe, and provides a glimpse of the duality between the macroworld around us and the hidden microworld and sub-atomic world within.

<http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/index.htm>

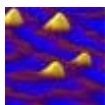
### **Virtual Electron Microscopy**

Any Age: Interactive Visual with controls  
Interactive Java Tutorials

### **Virtual Scanning Electron Microscopy**

Award-winning electron microscopist Dr. Dennis Kunkel has produced a series of interactive Java tutorials that explore various aspects of virtual Scanning Electron Microscopy (vSEM). Visitors can adjust the focus, contrast, and magnification of microscopic creatures viewed at thousands of times their actual size. Use the tutorial below to discover how specimens such as insects, dust motes and more, appear when magnified in the virtual SEM.

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



### **SPM Animation Gallery**

Animation gallery of 3D rendered SPM images - from carbon atoms to buckyballs to polymer surfaces.

Any age: <http://www.nanoscience.com/education/gallery.html>



Interactive site

Ages 8-14

**The Nanozone** [www.nanozone.org](http://www.nanozone.org) is designed for students ages 8 though 14 and explores the basics of nanotechnology with interactive games, videos and comics. The site also features interviews with scientists and teacher classroom materials for lessons on nanotechnology.

### **Nanooze Magazine**

Ages:8-14

Available in English, Spanish and Portuguese, this online publication provides games, current news and a link to scientists for motivation. It is geared for upper elementary and middle school level.

<http://www.nanooze.org>



**The Molecularium™ Project** is an entirely new way to learn. Our mission is to excite audiences of all ages and sizes to explore science in the world around them.

<http://www.molecularium.rpi.edu/>

Credit: Rensselaer Polytechnic Institute

### **Interactive Kid's Site**

Ages 5-8

The Molecularium family of products and educational tools brings the nanoscale universe to life in any situation. Zoom into the molecular level, build molecules from atoms, and explore states of matter in the Nanolab of our interactive Kid's Site. The experiments, activities and songs included in our Teacher's Resource Guide are free and fun for your home, classroom or museum.

<http://www.molecularium.rpi.edu/kidsite.html>

### **University North Carolina, Chapel Hill**

Ages: Middle School, High School

We are exploring ways for students to explore nanotechnology along side of scientists. Middle and High School students have used a special tool known as a nanoManipulator to explore properties of viruses. The nM allows students to investigate nanometer-sized objects and receive visual and haptic (involving the sense of touch) feedback. In this research, students use the nM to investigate the role of multiple representations (visual or haptic) on the learning of scientific concepts of students with varying cognitive, affective, motivational, and sociological characteristics. It also examines the cognitive and affective outcomes on students' perceptions of the nature of science and scientists.

<http://www.cs.unc.edu/Research/nano/ed/index.html>

## **Virtual Lab, UVA, Virginia**

Age: Middle School, High School,

"The "UVA Virtual Lab" is an NSF sponsored science education website bringing microelectronics, nanotechnology, and the underlying science to college and pre-college students, as well as members of the general public. It replaces math and jargon with intuitive 3D animations. Microelectronics presentations explain how semiconductors and transistors work, and how they are fabricated in both university labs and billion dollar factories. Nanoscience presentations describe alternate forms of nanocarbon, the process of DNA self-assembly, and the inner workings of instruments used to see at the nanoscale (such as SEMs, AFMs and STMs). These pages link back to basic science presentations on electricity, magnetism and electrical circuits, including "X-ray vision" simulations of common classroom experiments and apparatus. Overall, the website contains over fifty presentations on micro and nanoscience, each illustrated with dozens of virtual reality animations."

UVA Virtual Lab Website: [www.virlab.virginia.edu](http://www.virlab.virginia.edu)

## **"Hands-on to Introduction to Nanoscience" class website**

Age: Middle School, High School

"Under NSF sponsorship, this class was developed to introduce early undergraduates to nanoscience and nanotechnology: The theme "In nanoscience, Newton's sensible laws are replaced by the weirdness of quantum mechanics. The consequences" First, electrons begin to act like waves - but because all waves are similar, experiments with light and water waves offer insights into electron behavior. Second, at the nanoscale one can no longer use light-based image microfabrication to make things directly. Instead, one has to design the parts so they know how we want them to finally come together (the ultimate example of this self-assembly is the DNA - synthesis of protein). And finally, to confirm that things worked the way we planned, we need new instrumentation to see things at the nanoscale (such as scanning tunneling and atomic force microscopes). The class website provides a full set of PowerPoint lecture notes covering these topics (including figures, animations, readings and lists of demonstration equipment). It also includes full guides to student laboratory use of miniaturized STMs and AFMs. Both lectures and labs make use of 3D animations provided by the sister "UVA Virtual Lab" website focusing on microelectronics, nanotechnology, and their underlying science."

[http://www.virlab.virginia.edu/Nanoscience\\_class/Nanoscience\\_class.htm](http://www.virlab.virginia.edu/Nanoscience_class/Nanoscience_class.htm)

## **Nanoscience Teaching Resources**

As a part of their "UVA Virtual Lab" and "Hands-on Nanoscience" curriculum development efforts, University of Virginia faculty are working with state public school teachers to develop K-12 nanoscience teaching resources. This includes an ongoing effort to identify materials already posted on, or available through, the World Wide Web. Their growing list, complete with descriptions and categorized by the type of teaching material, can be viewed at:

[http://www.virlab.virginia.edu/Nanoscience\\_class/Nanoscience\\_K12\\_teaching\\_resources.htm](http://www.virlab.virginia.edu/Nanoscience_class/Nanoscience_K12_teaching_resources.htm)

## **Virtual Lab tools/experiments for teachers/students**

Age: Middle School and High School

### **Virtual Lab: Scanning Tunneling Microscope**

[http://www.virlab.virginia.edu/VL/easyScan\\_STM.htm](http://www.virlab.virginia.edu/VL/easyScan_STM.htm)

### **Virtual Lab: Atomic Force Microscope**

[http://www.virlab.virginia.edu/VL/easyScan\\_AFM.htm](http://www.virlab.virginia.edu/VL/easyScan_AFM.htm)

### **Virtual Lab: Scanning Electron Microscope**

<http://www.virlab.virginia.edu/VL/SEM.htm>

### **Virtual Lab: Scanning Probe Microscope**

[http://www.virlab.virginia.edu/VL/SPM\\_operation.htm](http://www.virlab.virginia.edu/VL/SPM_operation.htm)

### **Virtual Lab: Piezoelectric Crystals**

[http://www.virlab.virginia.edu/VL/SPM\\_piezoelectric.htm](http://www.virlab.virginia.edu/VL/SPM_piezoelectric.htm)

### **Virtual Lab: Nanocarbon**

<http://www.virlab.virginia.edu/VL/Nanocarbon.htm>

### **Virtual Lab: DNA**

[http://www.virlab.virginia.edu/VL/DNA\\_close\\_up.htm](http://www.virlab.virginia.edu/VL/DNA_close_up.htm)

### **Virtual Lab: Semiconductor Crystals**

[http://www.virlab.virginia.edu/VL/Semiconductor\\_crystals.htm](http://www.virlab.virginia.edu/VL/Semiconductor_crystals.htm)

## **UW-Madison Wisconsin MRSEC:**

Ages: Middle School, High School

**A good way to get started exploring the nanoworld is to go to the ...**

UW-Madison Wisconsin MRSEC website at:

<http://www.mrsec.wisc.edu/edetc/index.html>

<http://mrsec.wisc.edu/edetc/cineplex/index.html>

## **UK - Learning Nanotechnology: NanoMission - Action adventures in the Nanoworld.**



**NanoMission™ the world's first scientifically accurate interactive 3d learning game based on understanding nanoscience and nanotechnology.**

Ages: 12-18

More... <http://www.playgen.com/home/content/view/30/26/>

The players are challenged in imaginative environments that promote learning about: Molecular Building, Nanoimaging, Creation of Nanodevices, Nanomedicine, Quantum Behavior, Manipulating Electrons and Nanomaterials.

Primarily focused on 12-18 age range - the game is also a valuable and fun way to learn about nanotechnology irrespective of age. Available online for the PC and through retail for PlayStation Portable.

Founded in 2001 by gaming industry experts, PlayGen is a London based game development studio with a strong and growing track record in developing serious games for training and learning purposes. See <http://www.playgen.com>

### **Germany**

Age: All ages

**NanoReisen - NanoJourney** - Adventures beyond the decimal.

Takes you on an interactive video trip from the world of matter to the nanocosmos

<http://www.nanoreisen.com/english/index.html>

### **Sample Videos for Educators**

Age: All ages

CytoViva has agreed to provide their gallery of video images for our University and K-12 educators. We are pleased to partner with this excellent company to bring quality nanoscale images into the classrooms of the future as an important resource. *Not to be used for Commercial publishing.*

<http://www.nanonews.tv/documents/50.html>

### **National Nanotechnology Coordination Office Brochure**

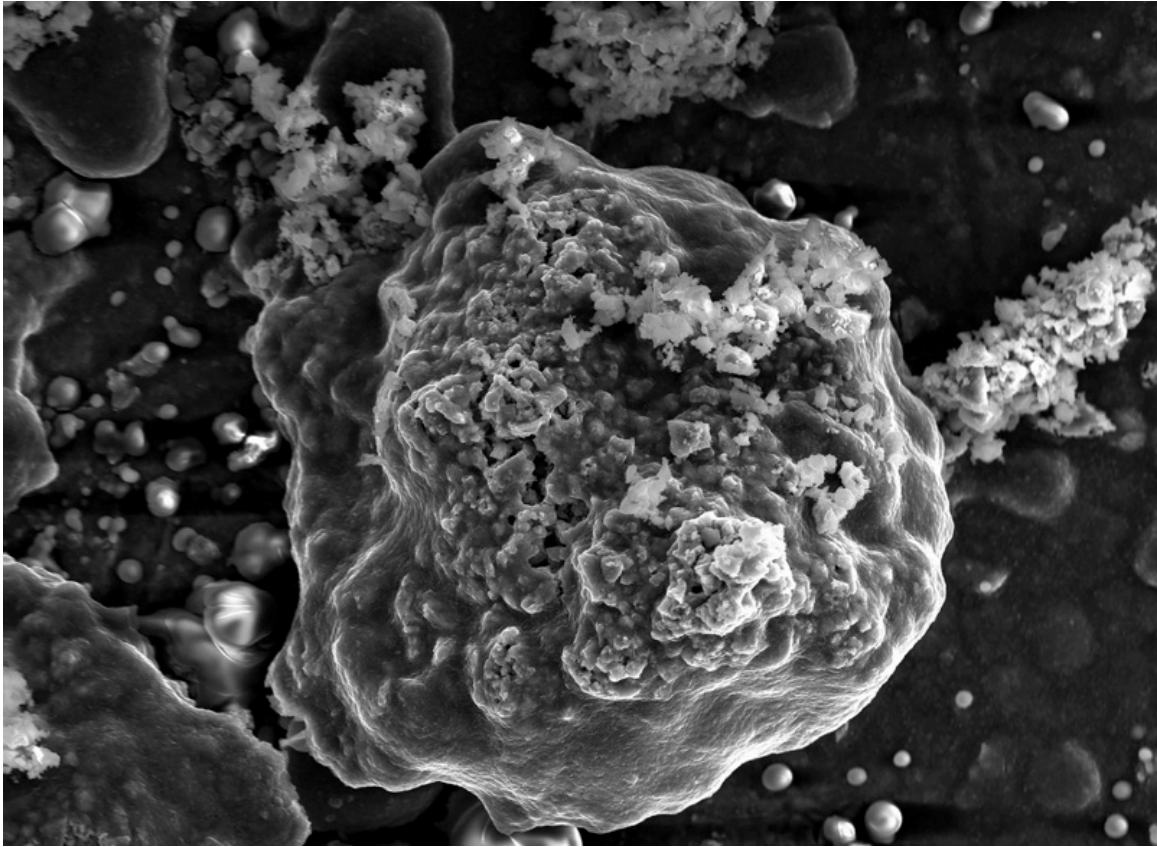
**Age: High School and Adults**

[Download PDF "Big Things from a Tiny World"](#)

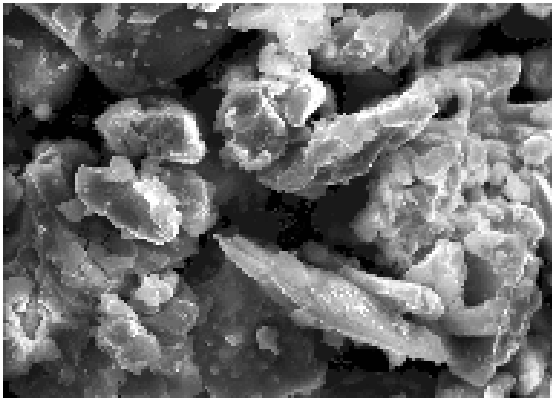
## **Black and white scans provided by nanoart21.org for NanoArt K12**

You can download separate jpegs of the scans at

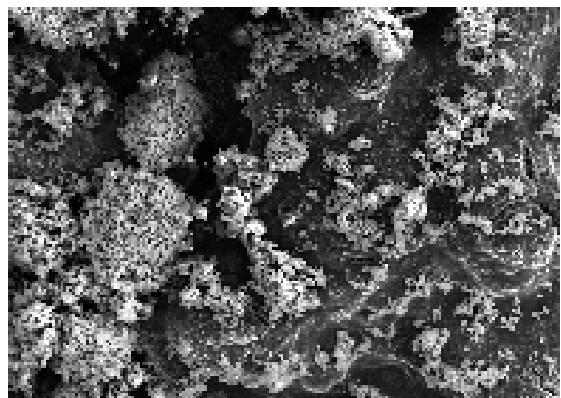
<http://www.nanoart21.org/html/contact.html>



**nanoflower**



**micro and nano**



**nanocrystals**