

What is Nano?

The Big Idea

1. Objects in our everyday life span a large range of sizes, from the cells that make up our bodies to the stars in the galaxy.
2. Nanoscale objects are too small to see and follow a different set of physics rules than we are used to.
3. Nanoscale structures are present in nature, and once scientists had the tools to study them, they could apply their properties to everyday items.

Background

This activity will demonstrate what nanoscale is in comparison to everyday objects as well as demonstrate how nanotechnology is applied in the natural and technological world. The prefix “nano” means one billionth of or 1×10^{-9} .

Nanotechnology deals with matter having dimensions between one and one hundred nanometers. Things at this scale include atoms and molecules, which are the basic building blocks of our world. When working with things at this scale, there is a different set of rules than are generally used. Because of this new set of rules, called *quantum mechanics*, nanoparticles do not behave like a larger lump of the same stuff.

Nature has already figured out how to use nanoscale ideas in order to adapt to the environment. Nanotechnology is the application of these “rule breaking” properties to our lives.

Materials

Demonstration – Tiny Ruler

Paper ruler (see *Resources* section)
Safety scissors
Meter stick

Demonstration – Powers of Ten

Powers of Ten Cards (see *Resources*)
Laptop and projector

Demonstration – Lotus Leaf Effect

Nasturtium leaves/plants
Beaker with water
Pipettes/droppers
Paper towels
Aluminum trays

Demonstration – Magic Sand

Magic Sand (see *Resources*)
Regular sand
Plastic cups
Beaker with water
Pipettes/droppers
Paper towels
Aluminum trays

Demonstration – Nanofabrics

Nanofabric swatches (see *Resources*)
Plain fabric swatches
Beaker with water
Pipettes/droppers
Paper towels
Aluminum trays

Demonstration – Nano Products

Nano product envelopes
Other nano products (see *Resources*)

Procedure

To prepare **before** the session:

1. Print out and cut enough paper rulers for each participant family.
2. Prepare projectors for “Zoom into a Lotus Leaf” program on laptops.
3. Prepare nasturtium, magic sand and nanofabric demonstrations. **For each demo**, have an aluminum tray set out with the items inside to catch errant water. Fill beakers with water. Set out pipettes or droppers. Have paper towels handy.
 - a. For magic sand demo, fill one plastic cup halfway with magic sand, and another with plain sand. Have sand boards made up as well.
 - b. For nanofabrics, have swatches of plain and nanofabric set up for each demo.
 - c. For lotus leaf effect, have nasturtium plants on hand.
4. Place 5 random Powers of Ten cards up in front of the room as size guides.
5. Be familiar with the various Nano-products. Information cards are present with each product.

During the session:

1. Hand out a Powers of Ten card to each family that comes to the door.
2. Introduce yourself and the other guides.
3. Introduce the first concept: *size and scale*. Going around the room ask each child/family to place their Powers of Ten card on the board in an appropriate spot. (Bigger than and smaller than the guide cards). Explain that scientists use the metric scale to measure size. The universe has objects that are very big (football fields, planets, stars) and it also has objects that are very small (lady bugs, fleas, cells)... Ask participants if they have heard the term “nano” and in what context. Accept and acknowledge all relevant answers.
4. Introduce the second concept: *nano is too small to see*. Using the paper rulers, which are 20 cm in length, ask the participants to cut them in half, describe this as 10 cm, which is just a *tenth* of a meter. Have them cut at the 1 cm mark; now this is *one hundredth* of a meter. Ask them to try to cut the ruler on a 1 mm mark; explain that this is *one thousandth* of a meter. At this point it will be very difficult to cut pieces smaller. Explain to them that 1 nanometer would be *one thousandth of one thousandth of* the millimeter long piece that they have in front of them! Ask the participants if they think it is easy to sense (see, manipulate, etc.) things of this size scale. What would be the problems with using nanoscale things? Acknowledge and accept all relevant answers.
5. Use the “Zoom into a Lotus Leaf” program. Show that everyday things have very useful properties, and some of these properties are because of things that are in the nanoscale. Explain that special tools are necessary to be able to see these nanoscale structures. Until these tools were created by engineers and scientists, we could never see everything that was there. Explain how taking clues from nature and applying them to technology we can mimic properties and make everyday life better.
6. Allow the families to do the demos of the nasturtium leaves and the nanofabric and magic sand. Explain that by studying the nanostructure of the nasturtium and lotus leaves, scientists found a way to make different products waterproof.
7. Allow the families to browse through the Nano-product envelopes and answer any questions.

Resources

All the demonstrations and general information about nanoscale used here can be found via the Nanoscale Informal Science Education Network. www.nisenet.org

A lending library of nanotechnology labs, activities, demonstrations, products, books and DVDs are available through the NNIN at the University of California at Santa Barbara. Go to www.nanotech.ucsb.edu and click on the Education tab and K-12 Teachers.

“Tiny Rulers”

http://www.nisenet.org/catalog/programs/exploring_size_-_tiny_ruler_nanodays_08_09_10

“Powers of Ten”

http://www.nisenet.org/catalog/programs/exploring_size_-_powers_ten_game_nanodays_2011_2012

“Zoom into a Lotus Leaf”

http://www.nisenet.org/catalog/media/zoom_lotus_leaf

“Lotus Leaf Effect”

http://www.nisenet.org/catalog/programs/lotus_leaf_effect

“Magic Sand”

http://www.nisenet.org/catalog/programs/exploring_products_-_nano_sand_nanodays_2011

“Nano Fabrics”

http://www.nisenet.org/catalog/programs/exploring_materials_-_nano_fabrics

“Nano Products”

<http://www.nanotechproject.org/inventories/consumer/browse/categories/>