Education and Outreach: Nanotechnology Activity Guides

NanoSolutions

Audience: Middle and high school students
Time Needed: 15-20 minutes

Objectives:

- To illustrate the idea of "nano", or "one billionth", through decreasing concentrations of a solution

Related Wisconsin Model Academic Science Standards:

- *C.4.2* Use the science content being learned to ask questions, plan investigations, make observations, make predictions, and offer explanations
- *C.4.4* Use simple science equipment safely and effectively, including rulers, balances, graduated cylinders, hand lenses, thermometers, and computers, to collect data relevant to questions and investigations
- *D.4.4* Observe and describe changes in form, temperature, color, speed, and direction of objects and construct explanations for the changes

Activity Materials:

- Food coloring
- Ten test tubes and a test tube rack
- Droppers

Activity Instructions:

Introduction (2 minutes)
Explain to students that the prefix "nano-" means "one billionth of". A nanometer is one billionth the length of a meter. A nanogram is one billionth as heavy as a gram. It's very difficult to divide an object into one billion pieces. However, we can create a solution that has a concentration of one part of food coloring in a billion parts of solution. One part per billion is equivalent to one nanogram per milliliter.

Creating Solutions (5-10 minutes)
Arrange the ten test tubes in a stand. Place ten drops of food coloring in the first test tube. This represents a pure substance. In the next test tube, mix one drop of food coloring and add drops of water. This solution now has a concentration of one part food coloring in 10 parts solution. Take one drop from the second test tube and put it in the third test tube and mix with nine drops of water. This solution now has 1 part in 100 of food coloring. Keep repeating this process. When you reach the tenth test tube you will have 1 part in a billion.

Final Discussion (3-5 minutes)

Ask students to note how the color changes across the ten test tubes. The color should gradually decrease in intensity and become more and more transparent. The more the solution looks like pure water, the less concentrated it is.

Since we aren't able to weigh out a single nanogram on a balance, scientists prepare solutions similar to the one you just made to measure out nanogram amounts. They take a measurable amount of a substance, put them into a solution, and then dilute the solution until it reaches a concentration of one part per billion. If they take one milliliter of the dilute solution and let the water evaporate, they will be left with one nanogram of the substance

Required Background Information:

Students should be familiar with the idea of concentrations and be comfortable working with fractions.

Supplemental Materials:

- Student Worksheet (doc)

References:

- Materials Research Science and Engineering Center, UW-Madison - http://mrsec.wisc.edu/
- Nanobiotechnology Center, Cornell University - http://www.nbtc.cornell.edu/
- National Nanotechnology Initiative - http://www.nano.gov/centers.htm
- NanoScale 9100 - http://www.rjlg.com/NVR2.html

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