

# Nanosolutions

Gain a grasp of what nano means by decreasing concentrations of a solution.

## Instructions

Students develop a sense of what *one billionth* is by incrementally decreasing the concentration of food coloring with water.

- 1 Explain that *nano* means “one billionth of.” A nanometer is one billionth of a meter; a nanogram is one billionth of a gram. Acknowledge that it is almost impossible to imagine dividing something up into 1 billion parts.
- 2 If completing this activity in groups, divide the class up and distribute materials. Otherwise, organize students so that everyone can see the following demonstration:
  - Arrange the test tubes in the stand. Place 10 drops of food coloring in the first test tube. This represents a pure substance.
  - In the second test tube, place 1 drop of food coloring and 9 drops of water. This solution has a concentration of 1 part food coloring in 10 parts solution.
  - Take 1 drop from the second test tube and place it in the third test tube. Mix in 9 drops of water. This solution is now 1 part in 100 of food coloring.
  - Next, take 1 drop from the third test tube and place it in the fourth, adding 9 drops of water (result: 1 part in 1,000). Then take 1 drop from the fourth test tube and place it in the fifth along with 9 drops of water (result: 1 part in 10,000). Repeat these steps through the rest of the test tubes. When you reach the tenth test tube, you will have 1 part in a billion.

## Materials

PER CLASS OR GROUP:

- Food coloring
- Water
- 10 test tubes in a test tube rack
- Dropper



## Engineering & Science Connections

-  To give a better idea of the nanoscale: a typical sheet of copy paper is 100,000 nanometers thick.

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-  1 nanogram of a substance is too small to be weighed on a scale, so scientists create solutions like this one to measure nanograms. They put a measurable amount of the substance in a solution and dilute it to a concentration of 1 part per billion. They then take one milliliter of the diluted solution and let the water evaporate. What remains is 1 nanogram of the substance.

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-  Nanotechnology is the science of measuring, modeling, and manipulating matter at the nanoscale in order to improve the properties of materials and products. For example, nanotechnology has been used to:
  - Make things like baseball bats and tennis rackets lighter and stronger
  - Make fabrics that are water-repellant or stain resistant
  - Make cleaners that can break up grease, remove odors, or purify water or air

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-  Some scientists are concerned that adding nanograms of substances to materials may affect people in unforeseen ways. Nanotoxicologists study the ways that nano-materials impact human health.

## Guiding Questions ?

How does the color change across the test tubes?

What does this activity tell you about whether water that is totally clear is truly pure?

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