



Exploring Measurement—Solutions

Try this!

1. Can you sort the six solutions of grape drink, from the most concentrated to the most dilute? Use your eyes to look at the color, and your nose to sniff the scent.
2. How many containers could you get in order? When could you no longer tell the difference among the bottles?



What's going on?

Using your eyes, it's pretty hard to sort the bottles past the third bottle, which is one part grape drink per 100 parts water. But using your nose, you might even be able to detect a whiff of scent in the fifth bottle, which is one part grape drink per 10,000 parts water.

Many people find that they can detect differences in concentration better with their nose (smelling) than with their eyes (seeing). Our sense of smell allows us to experience nanometer-sized things (scent molecules, or *esters*) that are too small to see with our eyes.

How is this nano?

A nanometer is a billionth of a meter. That's very, very small—too small to see with just your eyes. We can use our sense of smell to explore the world on the nanoscale, because we can smell some things that are too small to see.

Nanoscale science focuses on the building blocks of our world, atoms and molecules. Scientists use special tools and equipment to detect and manipulate tiny, nanometer-sized particles.

In the field of nanotechnology, scientists and engineers make new materials and tiny devices. Nanotechnology allows them to make things like smaller, faster computer chips and new medicines to treat diseases like cancer.





Exploring Measurement—Solutions

Learning objective

A nanometer is a billionth of a meter.

Materials

- Flip-top squeeze bottles filled with grape drink solutions
- Laminated sheet of white paper (optional)

Preparing the solutions

A set of five solutions bottles is needed for this activity. If you'd like the final solution to be one part per billion, however, you should make a set of ten. The first bottle in your set should be filled with full strength grape drink (prepared from a powdered mix). Each subsequent bottle should be diluted with water by a power of ten:

Bottle 1: Full strength grape drink

Bottle 2: 10% solution

Bottle 3: 1% solution

Bottle 4: 0.1% solution

Bottle 5: 0.01% solution (one part per ten thousand)

Bottle 6: 0.001% solution

Bottle 7: 0.0001% solution

Bottle 8: 0.00001% solution

Bottle 9: 0.000001% solution

Bottle 10: 0.0000001% solution (one part per billion)

Notes to the presenter

SAFETY: Flush eyes with water immediately if solution gets in them. The solutions are nontoxic, but visitors should not taste them.

Visitors should be advised to flip the caps open and squeeze the bottles gently as they sniff them.

If your tabletop is colored, it will be easier for visitors to sort the rectangular bottles by color if they place them on a laminated sheet of white paper.

Credits and rights

This activity was adapted from: "Nanotechnology Activity Guides: NanoSolutions," developed by the National Science Foundation-supported Internships in Public Science Education (IPSE) Educator Resources, Materials Research Science and Engineering Center on Nanostructured Materials and Interfaces at the University of Wisconsin-Madison. The original activity is available at: mrsec.wisc.edu/Edetc/IPSE/educators/activities/nanoSolutions.html



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