

The Language of Uncertainty

In an analysis we make one or more quantitative or qualitative measurements with the intent of reporting on the presence of and the concentration of a specific analyte in a sample whose matrix is complex. We communicate the results of that analysis using terms, such as accurate and precise, whose specific contextual meanings are much narrower than the meanings reflected in their broader usage. For each of the questions below, prepare a brief written response that clearly and unambiguously explains your understanding of the scientific meaning of the underlined terms. The goal here is not to provide a textbook answer; instead, your responses will serve as a starting point for a group discussion of how we discuss the results of analytical work. Aim for conciseness in your responses—two to four sentences likely are sufficient in most cases—and feel free to draw on examples to illustrate your points.

1. A validated analytical method is *accurate*, *precise*, *reproducible*, *repeatable*, *sensitive*, and *selective*. How might you determine whether an analytical method meets these criteria?
2. Why is a *systematic error* harder to detect than a *random error*?
3. Under what circumstances can you describe a systematic error or a random error as *negligible*?
4. Under what circumstances can you describe the difference between two results as *significant*?
5. Can you use a quantitative analytical method to prove that an analyte is *absent* from a sample?
6. Can you use a quantitative analytical method to determine an analyte's *exact* concentration in a sample?

These questions are adapted from Tomlinson, J.; Dyson, P. J.; Garratt, J. *U. Chem. Ed.* **2001**, *5*, 16-23.