

The Holy Grail of Analytical Instrumentation

Characteristics:

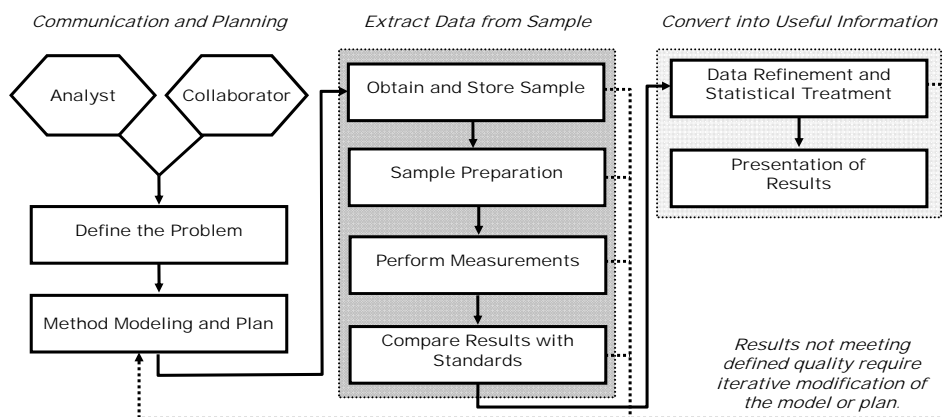
- Sensitive
- Selective
- Suitable for wide range of analytes
- Useable in a variety of environments
- Portable



Goals of CHEM 322

- Discuss factors that limit the application of instrumental methods.
- Identify some of the “tools” in the chemist’s toolbox.
- Explore principles by which these instruments operate.
- Identify advantages and limitations of each instrument.
- Gain hands-on experience using some of these tools.

The Analytical Process: “The Big Picture”



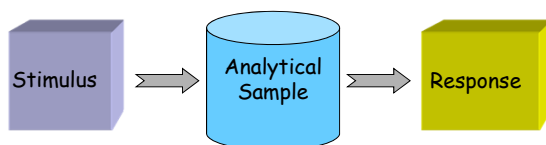
- The instrument is only a very small part of the picture.
- BUT, the choice of instrument influences each of the other steps

You Gotta Understand the Problem!

- Questions a good analytical chemist asks to define a problem:
 - What type of data is needed?
 - Qualitative: ID, Structure determination, etc.
 - Quantitative: What accuracy/precision is expected?
 - In what form is the sample?
 - How much sample will I have?
 - What other materials will likely be found in the sample?
- Based on the answers to these questions, the analysis can proceed.

Instrument Characteristics

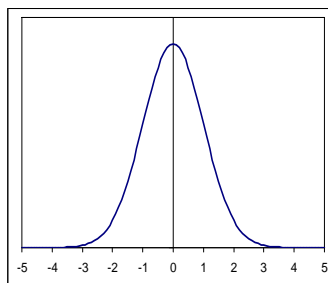
- Converting chemical/physical properties into information



- Stimulus: chemical, optical, electrical...
- Response: detectable effect of stimulus
 - Related to quantity of analyte present
- To understand the benefits and limitations of an instrument, you must understand this relationship.

Quantifying Instrument Performance: Figures of Merit

- Precision:
 - Definition:
 - Random errors
 - Review Statistics!



- Know how to calculate standard deviation, RSD, variance and what these quantities describe.

Foundations: Getting our Story Straight

- Analytical Technique vs. Analytical Method
- Procedure vs. Protocol
 - Guiding forces
 - SOP's
- Instrument vs. Machine
- The importance of method validation

Quantifying Instrument Performance: Figures of Merit

- Bias:
 - Definition:
 - Systematic errors
- Sensitivity
 - Definition:
- Detection Limit or LOD:
 - Definition:

Quantifying Instrument Performance: Figures of Merit

- Dynamic Range or LDR:
 - Definition:
- Selectivity:
 - Definition:

Keys to Understanding Instruments

- No Black Boxes!
- Think of key questions:
 - What chemical or physical phenomenon is the instrument probing?
 - What types of samples is the instrument best suited to handle?
 - What detection limits are reasonable and what limits detectability?
 - What steps do I need to take to ensure the best outcome for my measurements?
 - What does the output of the instrument tell me and how to I translate that into an answer to my question?