

## The Holy Grail of Analytical Instrumentation

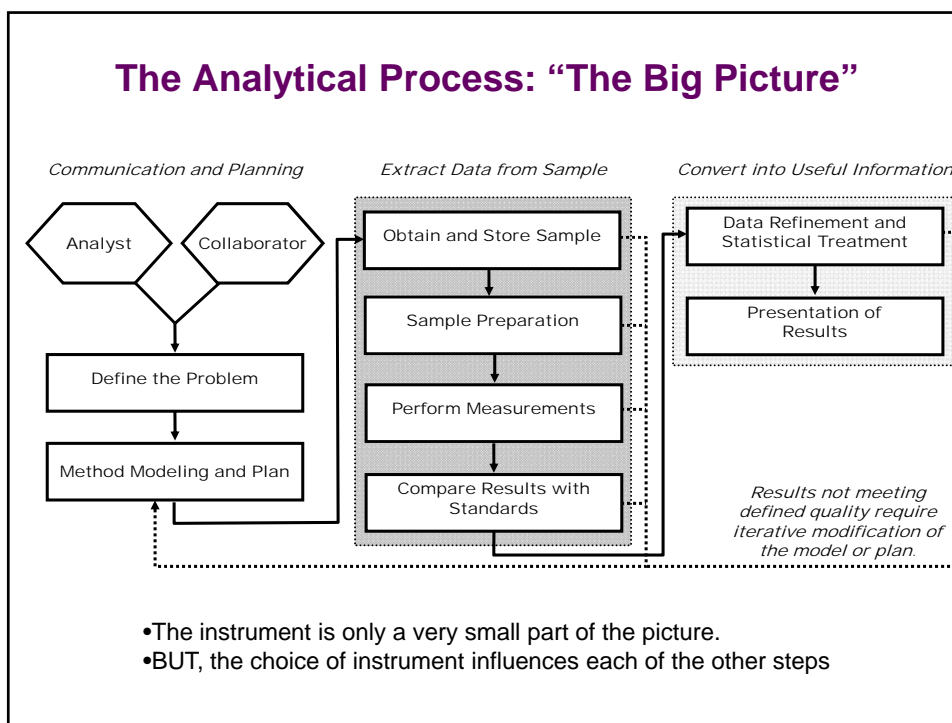
### Characteristics:

- 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.

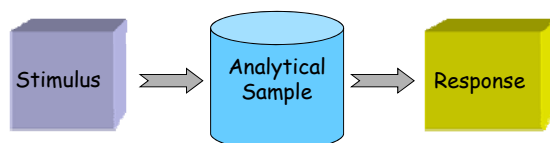


## You Gotta Understand the Problem!

- 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

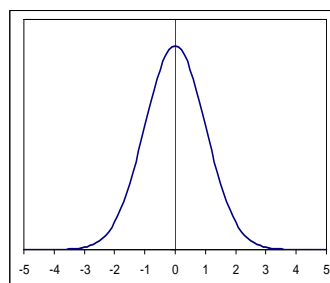
- Converting chemical/physical properties into information



- 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?