Laboratory Techniques 100:

Back To Basics

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April 29,2015

QA/QC for Environmental Measurement

- What is quality assurance (QA)?
  - Broad plan to maintain quality in all aspects of analysis
  - Establishes the need for quality control (QC)

QA for Treatment Assessment

- Need for consistency
  - The goal is to make data reproducible over time & place
  - Is your treatment process meeting your requirements?
  - Is your analytical result indicating an operational problem or an error in testing?
  - How can you tell?
  - Why is standardized measurement so important?

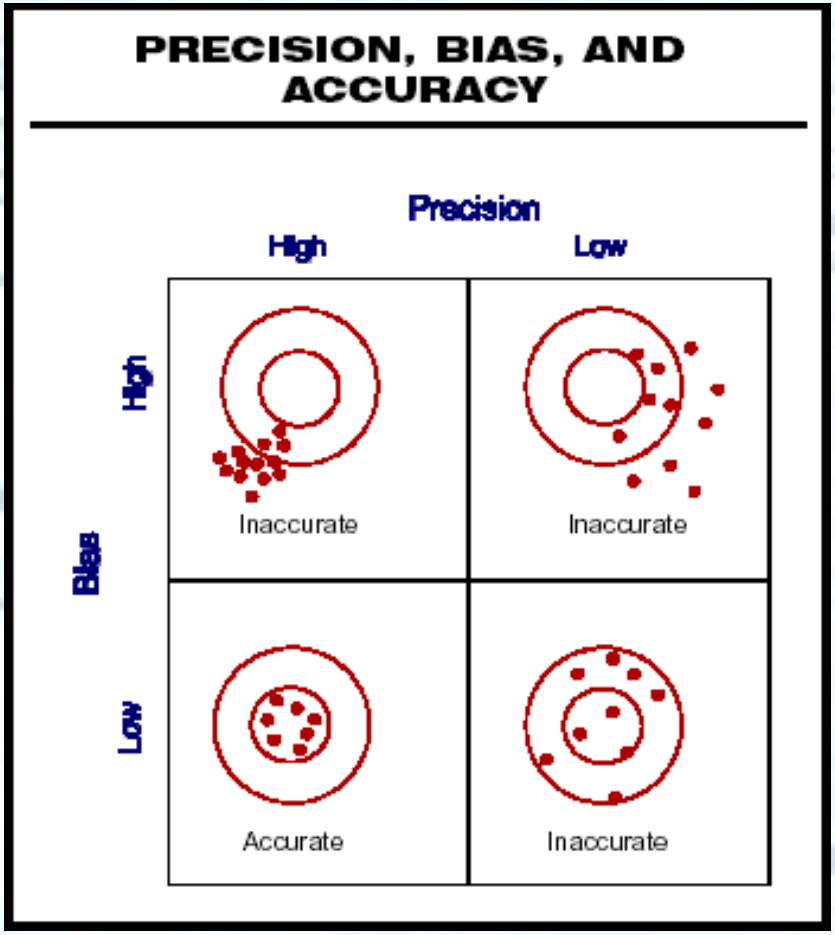
QA/QC: Data objective and key concepts

- **Successful data collection and analysis is dependant upon**
  - Precision
  - Accuracy
  - Representativeness
  - Completeness
  - Comparability

Key concepts of QA/QC:

- **Precision –**
  - degree of agreement there is between repeated measurements of the same characteristic
  - can be biased – meaning there is a consistent error in the results
- **Accuracy –**
  - measures how close data results are to a true or expected value – does not allow for bias

Key concepts of QA/QC: Accuracy



http://www.epa.gov/owow/monitoring/volunteer/qappexec.html

- **accuracy = (average value) – (true value)**
  - precision represents repeatability
  - bias represents amount of error
- **low bias and high precision = statistical accuracy**

Examples of Points of Entry for Analysis Precision, Bias, & Accuracy Errors

- Sample Preservation and Hold Times
- Water Source
- Standards
- Equipment Drift
- Method Selection
- Calibrations
- Glassware Selection
- Contamination
- Calculation Errors
- Personnel

Everything Required for an analytical method can potentially introduce error….

The pH Analysis Example

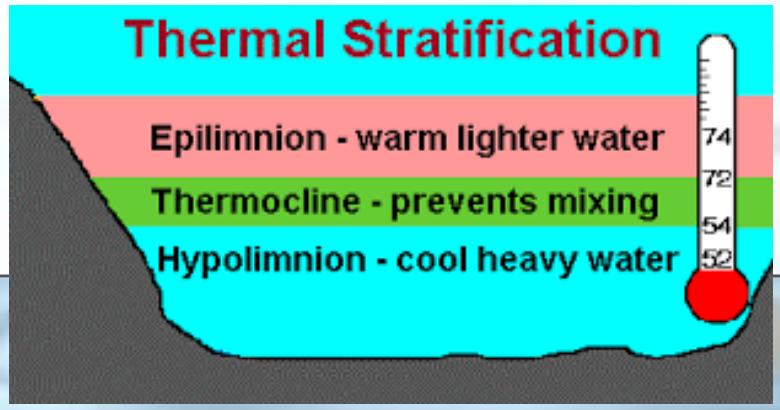
- Sample Collection (Grab)
  - Glassware / Sample Contamination
  - Analysis Hold Time
- Equipment
  - Probe
  - Stirrer / Stir Bars
  - Beakers
- Calibration
  - pH Buffers
  - Slope
  - Duplicates / Unknowns / Tolerance
- Sample Analysis
  - Analysis Interference (color, turbidity, oxidants, reductants, high salinity (high sodium samples require special electrodes)
  - Analysis Temperature (Thermometer Calibrations)
  - Dilutions if Required

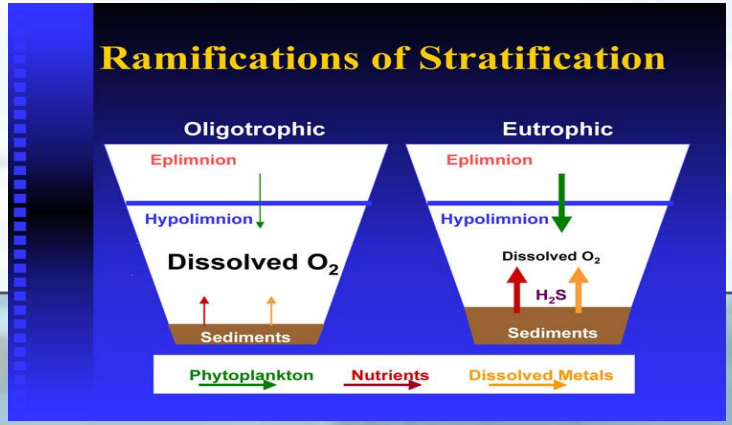
Key concept QA/QC: Representativeness

- Representativeness -
  - Measurements actually represent the true result at the time a sample was collected.
  - Representative data results in repeatability
  - (Flow vs Time Proportioned Sampling)

Key concepts of QA/QC: Completeness

- **Completeness -** the design of a data collection plan to accurately assess the conditions and make determinations about your process
  - Sampling Locations (Stratified Matrix)
  - Sample Times (Numbers of samples collected over a set period of time
  - Ensure Data is accurate over the entire span of the sampling period (recalibration, validations, checks) to avoid "unusable" data





Key concepts of QA/QC: Comparability

- Comparability –
  - The extent to which data can be compared between sample locations or periods of time
  - Process Control
  - Seasonal Limits
  - Seasonal Changes in Water Chemistry

QC = Technical Activities Used to Control Error

- QC can be considered the "HOW" of the QA process
- Applicable to field, lab and office procedures

We were just as surprised by the test results as you. We're still scratching our heads over it.

Where is QC applicable?

- **Quality control is applicable in all aspects of a project including:**
  - Field data collection and sampling
  - Laboratory analysis and processing
  - Data evaluation and assessment
  - Reporting and project documentation

QC provides steps that ensure data will meet defined standards of quality with a standard level of confidence

Field Collection and Sampling

- Sample Container (Glass, Plastic, Special)
- Sample Type (Grab, Composite, Time or Flow Proportioned)
- Sample Equipment (correct device(s) to collect representative samples)
- Preservative
- Sample Technique (VOC, ultra low MDL's)
- Sample Labels
- Sample Log / Chain of Custody

QC in the field

- **QC is particularly critical in field data collection**
  - Data or sample collection from the designated time and place can be variable under the exact same conditions and setting. Because of this QA measures must be taken to assure the best possible (most reliable) set of data is obtained.

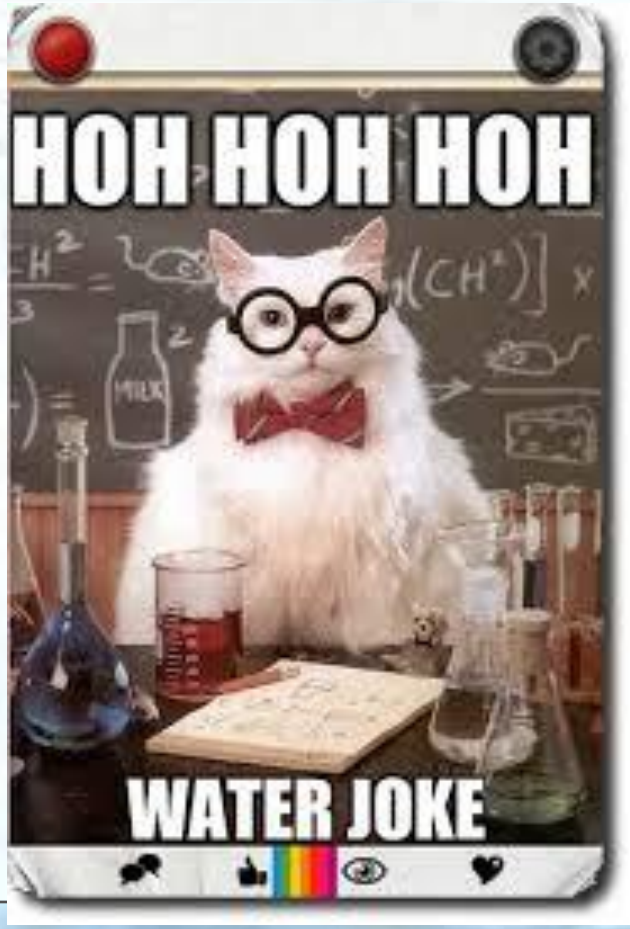
Laboratory Analysis and Processing

- Maintenance / Calibration / Sampling / Training Records
- LIMs
- Control Charts
- SOPs
- Chain of Custody Logs
- Calculations
- Standards
- Standards, Reagents, Chemicals
- Spikes, Duplicates, Blanks
- MDL's
- And More …

We need to be assured of the processes used in all areas of data assessment - from when, where & how the sample was collected; to the processes used by the analytical staff including; data interpretation, information reporting, & the documented level of accuracy

QC in the laboratory

- Data analysis, measurement & acquisition:
  - Chain of custody forms
  - Equipment calibration
  - Storage practices
  - Analytical methods
  - Holding times
  - MDLs



QC for environmental measurement

- Why do we need quality control?
  - To prevent errors from happening
  - To identify and correct errors that have taken place

QC is used to PREVENT and CORRECT ERRORS

QC: Internal vs. external measures

- Internal quality control
  - "controllable" by those responsible for undertaking the project or directly "involved in the program"
- External quality control
  - a "set of measures" established for and conducted by those people and organizations "outside of the program"

Quality control (QC): Internal

- **Internal Quality Control:**
  - Equipment calibration
  - Proper training and certification of participants
  - Proper sampling and containment techniques
  - Proper data documentation

Quality control (QC): External

- **External quality control:**
  - Performance audits
  - Split sample analysis
  - Replicate (duplicate) sample analysis

Data Evaluation And Assessment

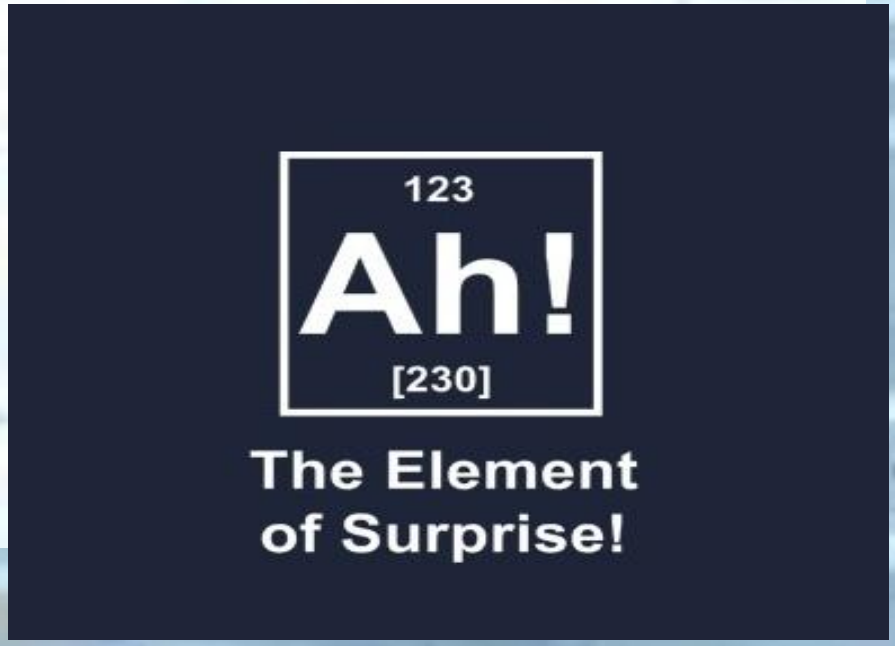
- Calculations
- Acceptance Limits
- Significant Figures
- Calibration Curves
- Dilutions
- Spike Recoveries
- Matrix Considerations

Reporting and Documentation?

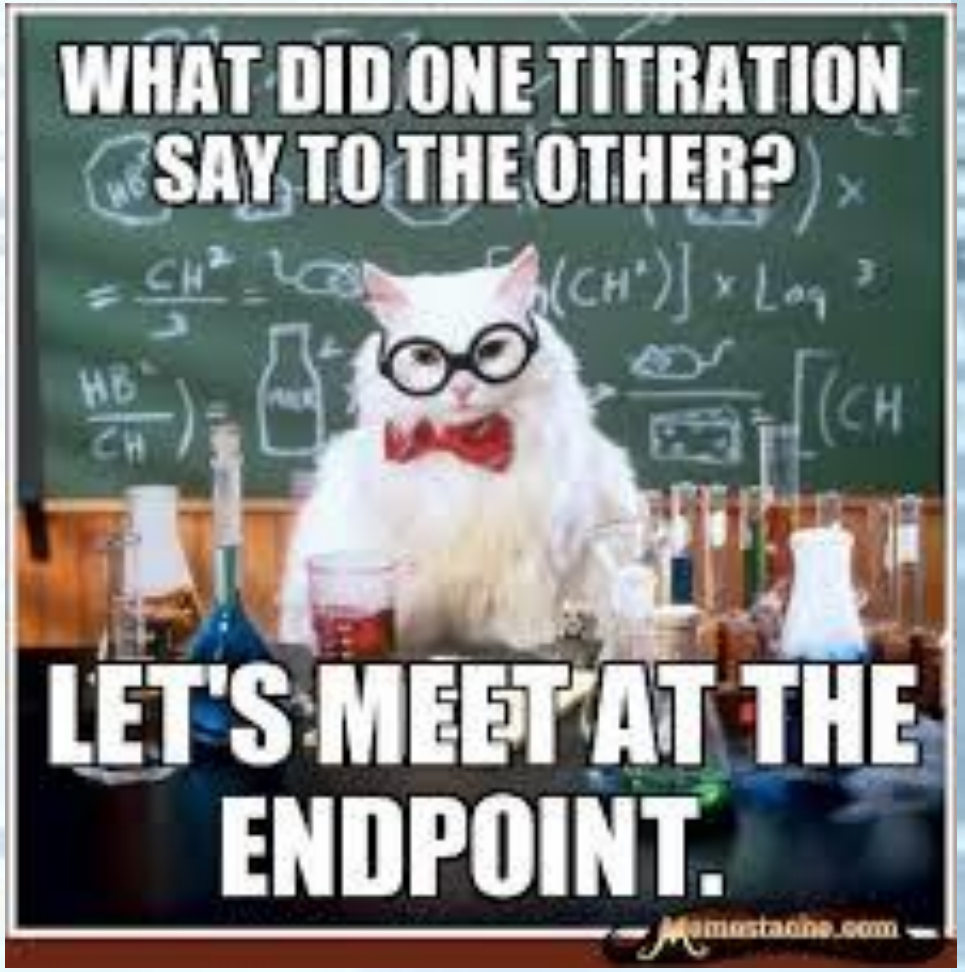
- Sample ID's
- CoC Documentation
- MDLs
- QA/QC Results
- Methods Used
- Out of Range Explainations (Ex: Increased MDLs due to Matrix Interference)

The Goal of a Good QA/QC Program

- QA
  - To make data reproducible over time & place
- QC
  - To ID, Correct & Prevent errors from happening
- To Avoid



QUESTIONS


WHAT DID ONE TITRATION SAY TO THE OTHER?
LET'S MEET AT THE ENDPOINT.
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