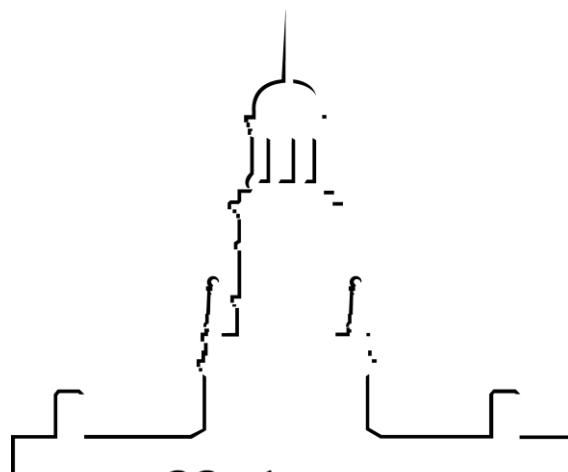


FOR 414W  
Chapter 1  
Course Introduction



Buffalo State  
*State University of New York*

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**Lecture (2 cr, 2 hr/week)**

1:00 PM – 1:50 PM, MW, SAMC223

**Lab & Demo (1 cr, 3hr/week)**

2:00 PM – 4:15 PM, M, SAMC223 or SAMC225

**Office Hour**

10:30 AM– 12:00 PM WF or by Appointment

# Course Description

1. Basic theory of analytical chemistry (concentration, calibration, etc) will be briefly reviewed.
2. Proper procedures of laboratory practice will be introduced (QA, QC, SOP, GLP, etc).
3. Principles and applications of various analytical techniques used in forensic laboratory will be introduced.
4. These techniques may include FTIR, UV/Vis, Raman, Chromatography (**GC**, HPLC, etc), MS (**GC/MS**, LC/MS, LC/MS/MS, etc), and so on.
5. Advantages and disadvantages of individual analytical technique for quantitative and qualitative chemical analysis will be discussed.
6. Classifications, laws, and chemistry of forensic related compounds (alcohol, drugs, etc) will be introduced
7. Selected applications of these techniques will be conducted/demonstrated using either unknown or known forensic-related samples.

See Your Syllabus

# Why Forensic Chemistry is Important?

Forensic investigation via instrumental chemical analysis is important to crime as well as various fields including health, pharmaceutical, environments, food, national security safety, energy, etc.



pharmaceuticals



forensics



health

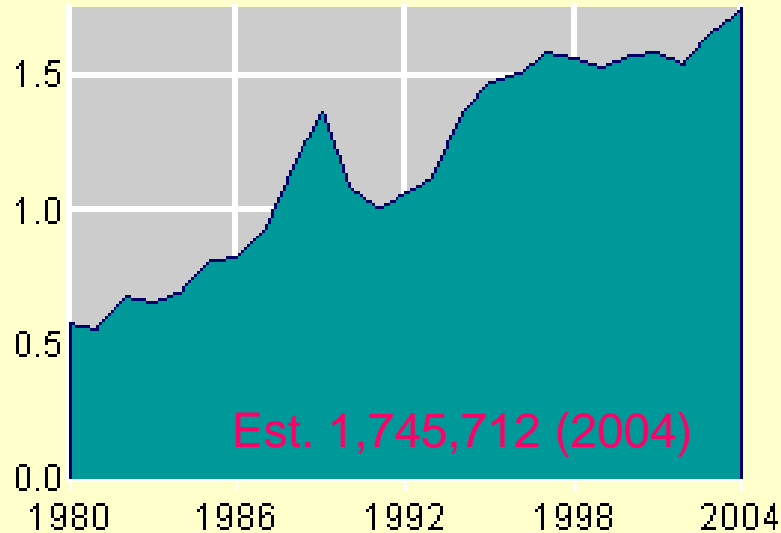


national  
security

# Drug-Related Crime Statistics

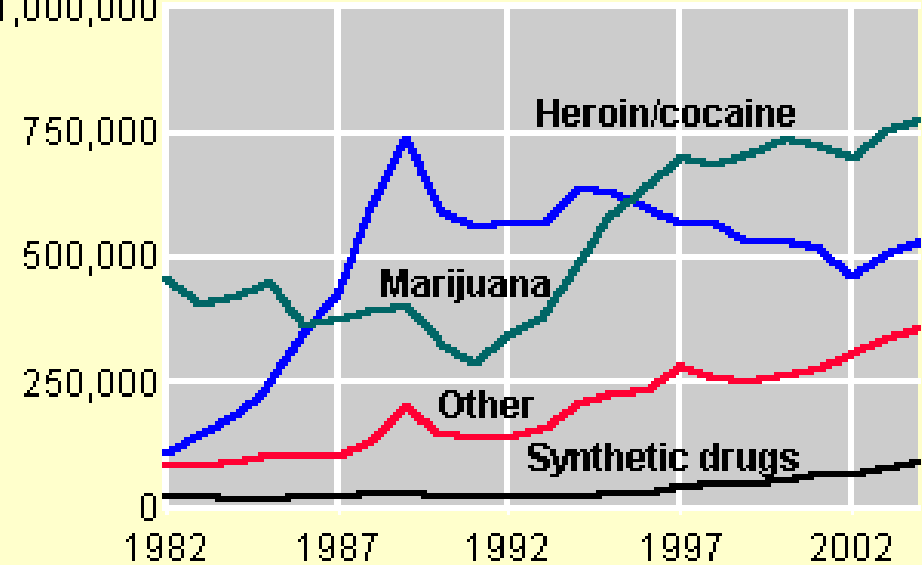
Drug abuse violation arrests, 1980-2004

Millions



Number of arrests, by drug type, 1982-2004

1,000,000



Federal drug control spending:

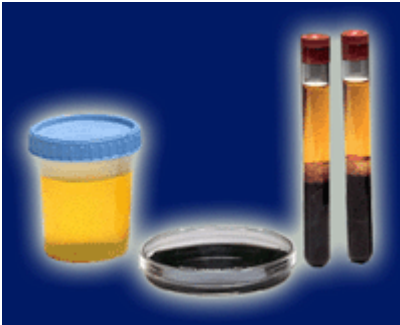
\$8,179M (FY 1988) and \$11,679M (FY 2004)

About 10,000 new job within 10 years estimated by the American Academy of Forensic Sciences (AAFS)

# Application of Forensic Chemistry: Drug Test

## a. in the laboratory

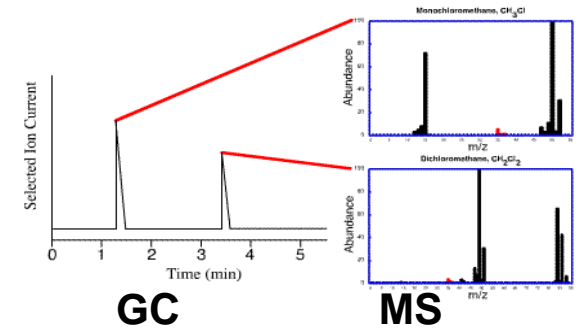
samples  
(urine, blood, hair, etc)



gas chromatography-  
mass spectrometry (GC-MS)



qualitative and quantitative  
analysis



## b. on site

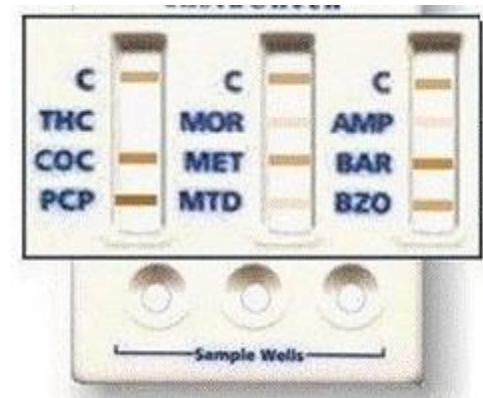


drug test kit



saliva, urine, sweat,  
hair, nail, or blood test

color change



protein and drug complex  
formation on the surface

# Goals in Forensic Chemical Analysis (e.g. Blood Test)

- ♣ Qualitative analysis: the determination of identities of drugs (or their metabolites) that are present in a blood sample.
- ♣ Quantitative analysis: the determination of the amount (concentrations) of drugs in a sample.



What drugs are in it? : cocaine and/or benzoylecgonine, etc

How much? : cocaine: 2  $\mu\text{g}/\text{mL}$ ,  
benzoylecgonine: 3  $\mu\text{g}/\text{mL}$ , etc



# Tools in Chemical Analysis

1. Spectroscopy (XPS, Auger, AA/AE, UV/Vis, IR, Raman, NMR, ESR, Mössbauer, etc)
2. Chromatography (GC, HPLC, IC, TLC, SFC, SEC, CE, etc)
3. Microscopy (SEM, TEM, AFM, FM, etc)
4. Diffraction (X-ray, Neutron, Powder, Single crystal, etc)
4. Mass spectrometry (GC/MS, LC/MS)
5. Light Scattering
6. Thermal analysis (DSC, TGA, DTA, etc)
7. Electroanalytical Methods (Potentiometric, Coulometric, Voltammetric, and Capacitance Measurements, etc)
8. SPR (Surface Plasmon Resonance), Ellipsometry, X-ray (Neutron) Reflectivity
9. QCM (Quartz Crystal microbalance)
10. CD (Circular Dichroism)
11. Neutron Activation Analysis
12. Magnetic Susceptibility

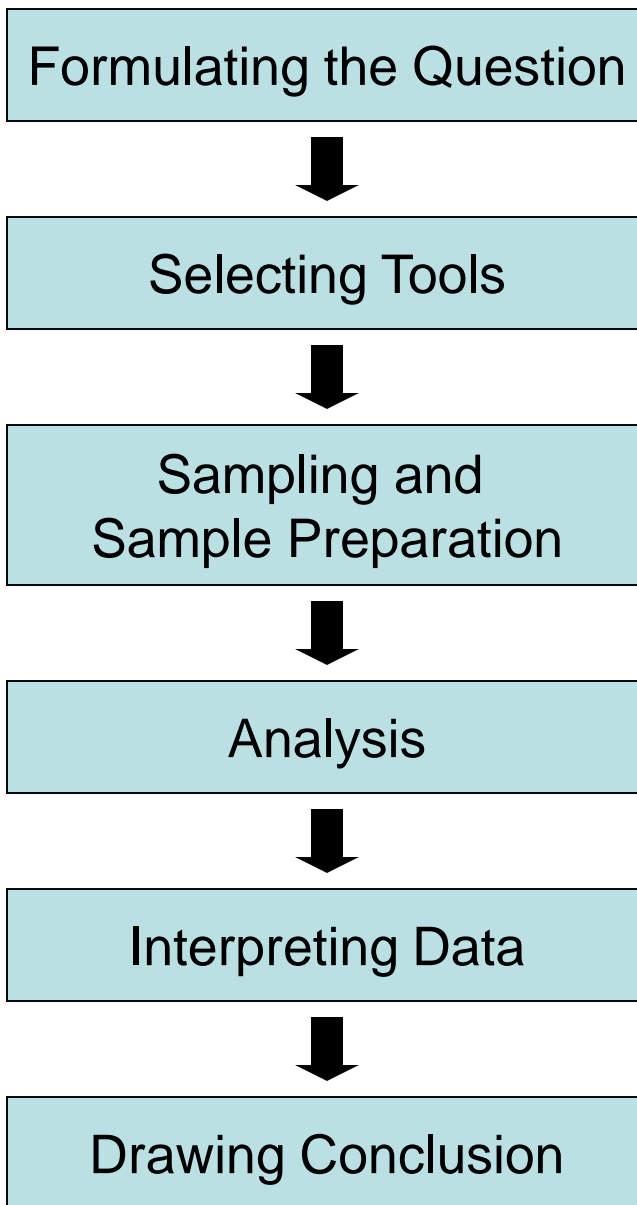
# Conclusion

No single technique is perfect and many complementary tools are required

# Factors To Be Considered for the Choice of Analytical Techniques

1. Sensitivity and selectivity
  - ♣ Sensitivity (LOD, LOQ)
  - ♣ Selectivity (no or less interference)
2. Size of sample and states (air, liquid, or solid)
  - ♣ Destructive analysis
  - ♣ Nondestructive analysis
3. Analysis time
4. Availability and cost
5. Feasibility and convenience
6. Safety

# General Steps in Chemical Analysis



# In Reality:

## How much cocaine in a urine sample?



# Why You Need Urine Drug Test

- Federal Workplace requirement (urine)
  - Confirm by mandate: (YR 1986)
    - Executive Order 12564 >> Drug-free Federal workplace
    - Tested in certified labs by Substance Abuse and Mental Health Services Administration (SAMHSA)
- Legal: Court requirement (urine)
  - Very strict by policy
- Forensic: Crime investigation (many samples)
  - Very strict by policy
- Medical/clinical (urine)
  - Verify drug dependency and monitor treatment progress

# More Issues To Be Considered

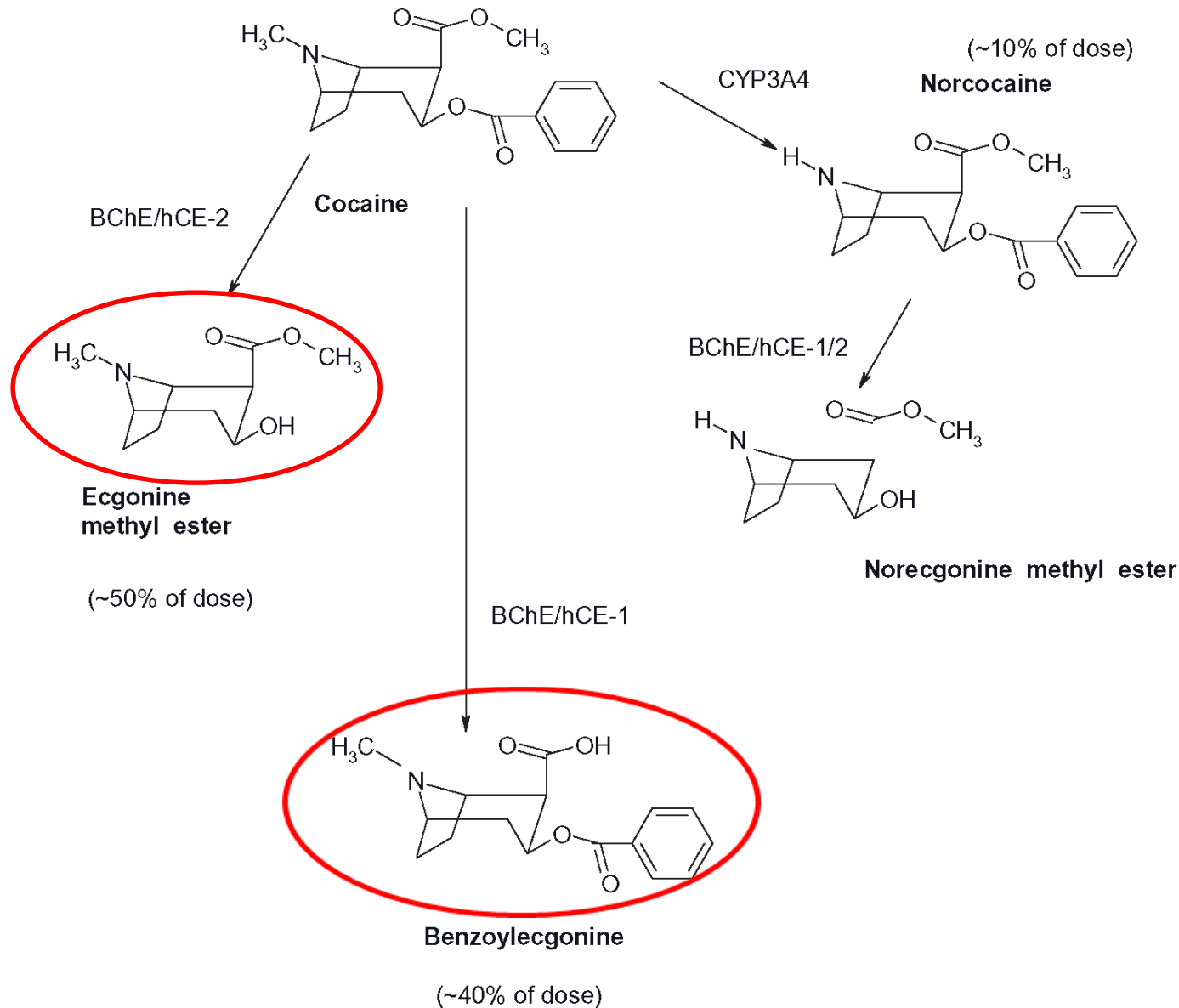
- Where do I get tested?
  - How do they test (sampling, analysis, and report)?
  - Can I trust their test results (accuracy, consistency)?
  - Who allowed them to conduct drug test (accreditation, licensing or permission)?
  - How authorities (gov or org) make them practice properly? (regular audit)
- >> more than chemistry issues

# Quality Management

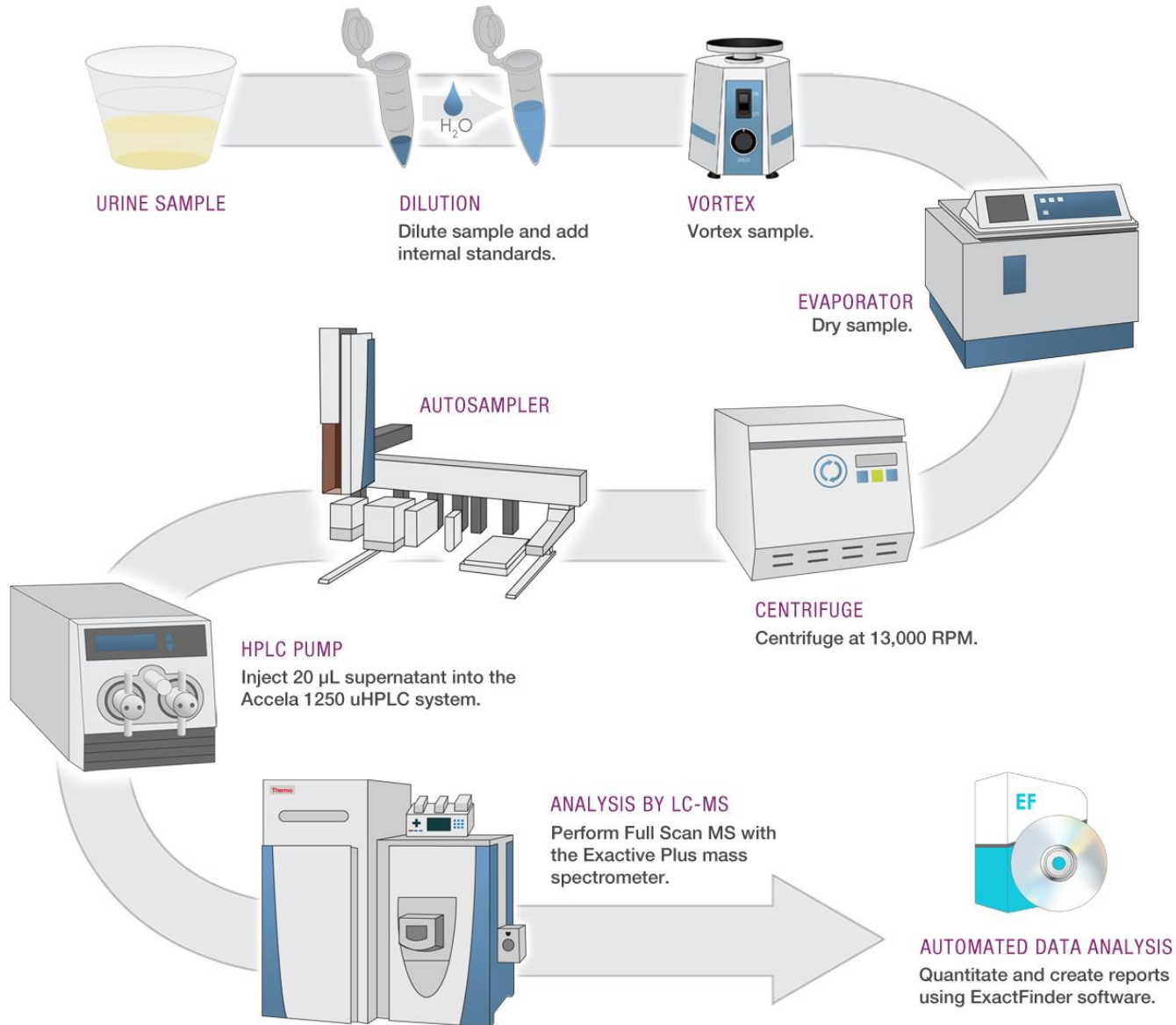
- Certified methods should be established by government or authorities.
  - Sampling
  - Analytical techniques
  - Procedures
  - etc
- Laboratory practice should follow these methods.
  - Licensing/permission
  - Accreditation/audit
  - etc



# Cocaine and Metabolites



# e.g. Analytical Procedure via LC-MS



# Questions