

U.S. Navy

Hair Analysis

“Ur-ine Trouble” by Kent Holtorf, M.D.

	<p><i>Introduction</i></p>
	<ul style="list-style-type: none"><li>▶ <i>Gas Chromatography (GC) &amp; Mass Spectrometry (MS): -- An Effective Combination For Analysis</i></li><li>▶ <i>Objective: Demonstrate Tools For An Effective Attack Or Defense Of GC/MS Evidence</i></li><li>▶ <i>Process Must Be Understood To Effectively Use GC/MS Evidence</i></li></ul> <p>2</p>

**Drug Test Confirmation**

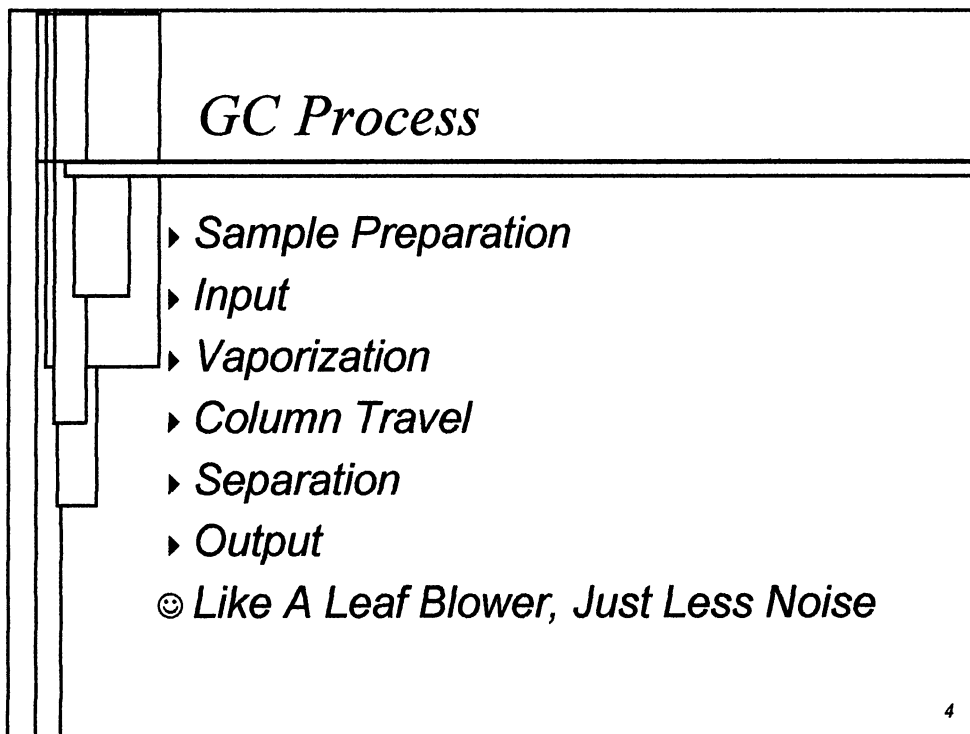
**Familiarity with GC/MS evidence May assist support or attack of evidence**

*Pedagogy*

- ▶ *Description Of Process*
- ▶ *How To Analyze Evidence*
- ▶ *Limitations Of Analysis*
- ▶ *The Least You Need To Know*

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"Least You Need To Know" -- GC/MS For Dummies!



Next, show transparency with diagram of process

Column Travel -- Show eddy current diagram

Talk about Detection

*Analysis Of GC Evidence*

☺ **Good Stuff**

- *Sharp Peaks*
- *Separate Peaks*
- *Smooth Peaks*
- *Steady Conditions*
- *Standard Comparison*

☹ **Bad Stuff**

- *Broad Peaks*
- *Connected Peaks*
- *Uneven Peaks*

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Show 2 transparencies showing Text Examples of Bad and Good Peaks before this slide

	<h2><i>GC Limitations</i></h2>
	<ul style="list-style-type: none"><li>▶ <i>Leftover Impurities In System -- Broad Peak</i></li><li>▶ <i>System Temperatures</i></li><li>▶ <i>Column Packing</i></li><li>▶ <i>Worn Septum</i></li><li>▶ <i>Carrier Gas</i></li><li>▶ <i>Response Factor</i></li></ul>
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Leftover impurities -- very important

Temps

Injection: Too High --> sample may decompose or change structure  
Too Low --> Sample doesn't vaporize. Poor separation or no peak.

Column: Too High --> Poor separation  
Too Low --> Substance may remain in system, no peak.

Carrier Gas: Thermal Conductivity Detector and carrier gas

Hydrogen --> May react, broad peak

Unstable Flow Rate --> broad peak

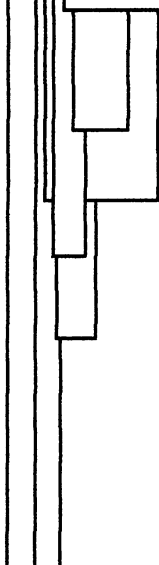
--> Drifting baseline

Impurities --> Change Filter

2 Different compounds May Have Same Retention Time (e.g. DDT & PCBs)

Response Factor -- Different Detectors respond differently for same number of molecules. Response factor varies over time.

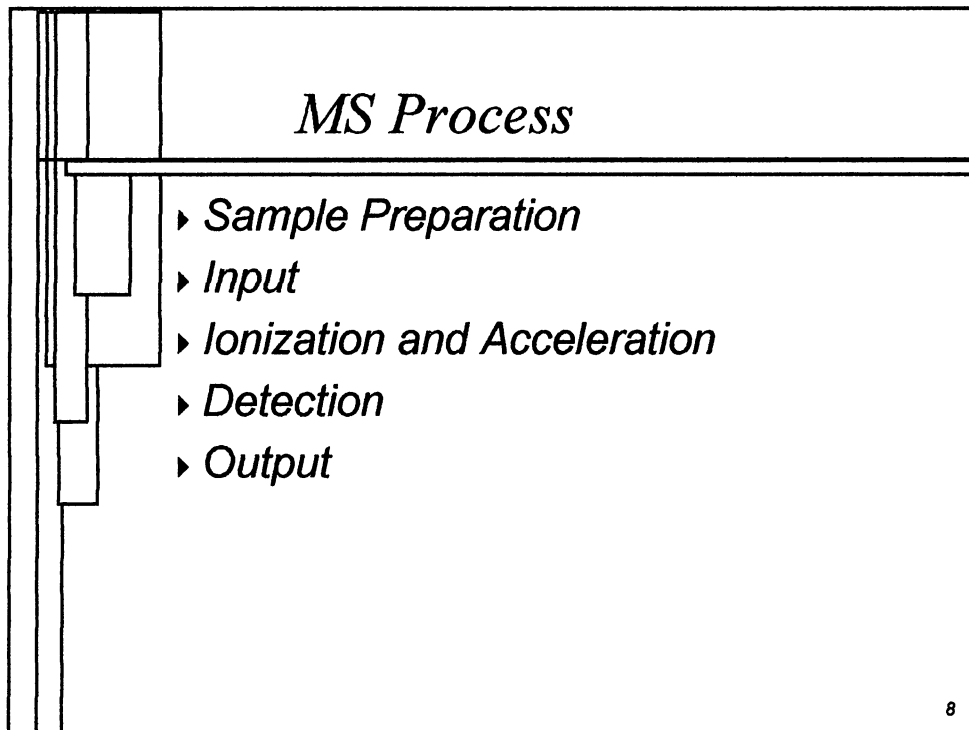
Cardinal Rule: Run Standard, sample, then standard again

<i>The Least You Need To Know About GC Evidence</i>	
	<ul style="list-style-type: none"><li>▶ <i>Process standard before and after processing sample</i></li><li>▶ <i>Verify Evidence With Tabulated Data</i></li><li>▶ <i>If Possible, Observe Procedure</i></li></ul>
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No competent scientist runs w/o standard

Observe analysis to record conditions

Tabulated data available from library, computer, or manufacturer.



Put transparency of text diagram of MS device after this slide.

After that transparency, show transparency of butanol mass spectrum.



*Analysis Of MS Evidence*

- ▶ *Molecular Weight*
- ▶ *Molecular Structure*
- ▶ *Parent Peak*
- ▶ *Electric Trace Current*

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Refer to puzzle analogy.

Parent Peak hard to determine usually.

<i>MS Limitations</i>	
▶	<i>Resolution</i>
▶	<i>Need Low Pressure</i>
▶	<i>Determining Parent Peak Difficult</i>
▶	<i>Competent Human Needed To Put Puzzle Together</i>
▶	<i>No Direct Confirmation Of Functional Groups -- Need FTIR</i>
▶	<i>High Speed Scanning Requires GC For Quantitative Analysis</i>

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Resolution -- high masses need high resolutions

Pressure -- Keep pressure low to prevent polymerization

Computer can't do job by itself, yet.

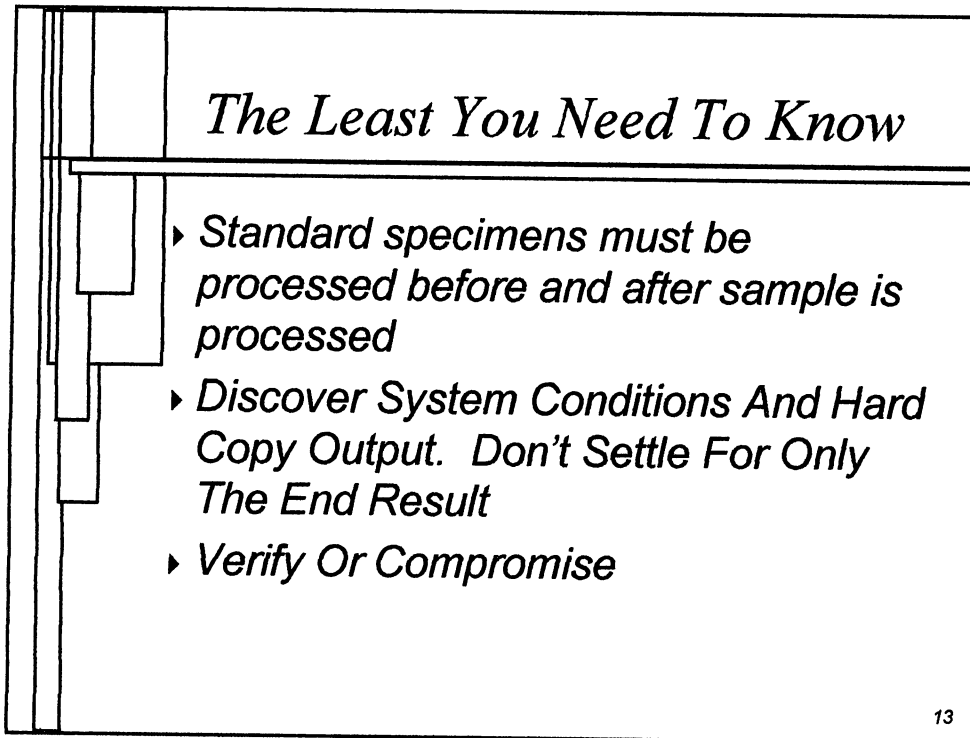
High speed scanning --> lower resolution, not a problem with quadrapole MS

<p><i>The Least You Need To Know About MS</i></p>
<ul style="list-style-type: none"><li>▶ <i>Process Standard Before And After Processing Sample</i></li><li>▶ <i>There Is Always Some Doubt</i></li><li>▶ <i>Verify Evidence With Tabulated Data</i></li></ul> <p>11</p>

Note that these caveats are similare to caveats for GC

	<h2><i>GC/MS Combination</i></h2>
	<ul style="list-style-type: none"><li>▶ <i>Complementary Relationship</i></li><li>▶ <i>Limitations</i><ul style="list-style-type: none"><li>• <i>Background Spectrum From Impure GC Effluent</i></li><li>• <i>Carrier Gas Entering MS</i></li><li>• <i>Computer Calculations</i></li><li>• <i>GC/MS does not sufficiently identify functional groups -- Need IR confirmation</i></li></ul></li></ul>
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Problems with GC will probably cause problems with MS



*The Least You Need To Know*

- ▶ *Standard specimens must be processed before and after sample is processed*
- ▶ *Discover System Conditions And Hard Copy Output. Don't Settle For Only The End Result*
- ▶ *Verify Or Compromise*

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Mention Arson-Murder Case