

Introduction to Forensic Toxicology

Introduction to Forensic Toxicology

Key concepts, scope, and practical applications

1. Definition & Scope

Aspect	Description
Forensic Toxicology	The scientific discipline that applies toxicology (the study of chemicals and their effects on living organisms) to legal investigations.
Primary Goals	- Identify presence of toxic substances - Quantify concentrations - Interpret findings in a legal context (e.g., cause of death, impairment, poisoning).
Typical Cases	- Death investigations (autopsy, post-mortem) - Driving under the influence (DUI) - Workplace exposure incidents - Drug-related crimes (trafficking, possession) - Environmental or food contamination events

2. Core Disciplines Integrated

- Analytical Chemistry** – Sample preparation, separation, detection (GC-MS, LC-MS/MS, immunoassays).
 - Pharmacology & Pharmacokinetics** – Absorption, distribution, metabolism, excretion (ADME) of drugs and poisons.
 - Pathology & Histology** – Correlation of toxic findings with tissue damage and cause of death.
 - Law & Ethics** – Chain-of-custody, admissibility of evidence, expert testimony standards.
-

3. Sample Types & Collection

Sample	Typical Matrix	Collection Considerations
--------	----------------	---------------------------

Introduction to Forensic Toxicology

Blood	Whole blood (serum, plasma)	Use anticoagulant (e.g., NaF/EDTA) to prevent degradation; keep refrigerated.
Urine	Urine	Often used for drug screening; may require creatinine normalization.
Hair	Hair strands (3cm)	Provides a retrospective timeline (1cm ~ 1month).
Vitreous Humor	Eye fluid	Stable post-mortem, useful for electrolytes, ethanol.
Tissues	Liver, kidney, brain, fat	Reflects chronic exposure; requires homogenization.
Breath	Exhaled air	Non-invasive; mainly for volatile substances (e.g., alcohol).
Other	Saliva, sweat, nails, gastric contents	Chosen based on case specifics and substance volatility.

Key principle: Maintain a strict **chain-of-custody** (documented transfer, storage temperature, labeling) to ensure legal admissibility.

4. Analytical Techniques Overview

Technique	Strengths	Typical Applications
Immunoassays (ELISA, FPIA, CEDIA)	Rapid, high-throughput screening; low cost	Preliminary drug screens in urine, blood.
Gas Chromatography-Mass Spectrometry (GC-MS)	High specificity, excellent for volatile & semi-volatile compounds	Confirmation of alcohol, opioids, cannabinoids, solvents.
Liquid Chromatography-Tandem MS (LC-MS/MS)	Handles non-volatile, thermally labile molecules; multi-analyte quantification	Comprehensive drug panels, novel psychoactive substances (NPS).
Headspace GC	Ideal for volatile compounds (ethanol, gases)	Post-mortem alcohol analysis, volatile solvent detection.
Fourier-Transform Infrared Spectroscopy (FT-IR) & Raman	Minimal sample prep; useful for solids/liquids	Preliminary identification of unknown powders.