

Module 4

Trace Evidence

Forensic Science Teacher Professional Development

Module 4: Trace Evidence

Module 4 Description

This module will cover the classifications and characteristics of trace evidence and provide a fundamental understanding of microscope techniques for trace evidence examination. The microscopic examination of fibers, hair, paints, and glass will be introduced.

Module 4: Trace Evidence

Objectives

The primary objective of this module is to give students an overview of trace evidence and the use of the microscope for trace evidence examination. Completion of this module will advance students' knowledge in forensic trace evidence examination. Module objectives include the following.

- 1) Reviewing the historical perspective of trace evidence, the current stage of knowledge, and future developments in the field
- 2) Understanding the scientific interpretation of trace evidence
- 3) Familiarizing students with the current protocols and guidelines in the physical examination and the chemical analysis of trace evidence

Module 4A

The Scope of Forensic Trace Evidence Examinations

Forensic Science Teacher Professional Development



Trace Evidence

Lesson Introduction

The plan for this trace module is to cover the definition of trace evidence and various microscopic and instrumental examinations of trace evidence. In its broadest definition, trace evidence can include pattern evidence. You will be introduced to pattern evidence in a separate module.

In this module, we will focus on the transfer of material in trace evidence such as paint, fiber, glass, and hairs.

You will learn the fundamentals of forensic microscopy, the scope of trace evidence, the collection of trace evidence, and the examination of trace evidence.

Part 1 Scope of Forensic Trace Evidence Examinations

Forensic Science Timeline: <http://www.forensicdna.com/timeline.html>

In the field of trace evidence examination, many trace analysts call themselves criminalists.

This name may have been adopted from the Institute of Criminalistics at the University of Lyons, which was founded by Edmond Locard, a pioneer in criminalistics back in the 1910s.

Locard formulated the basic principle: “Whenever two objects come into contact with one another, there is an exchange of materials between them,” or simply “Every contact leaves a trace,” now known as Locard's Exchange Principle.



Figure 1 A picture of Edmond Locard

<http://forensicsciencecentral.co.uk/edmondlocard.shtml>

Part 1 Scope of Forensic Trace Evidence Examinations

History of Forensics, continued

- Locard's Exchange Principle is considered the fundamental principle in the field of trace evidence examination.
- The term criminalistics refers to the function of a crime laboratory. In some crime laboratories, the criminalistics section is responsible for the forensic examinations of trace evidence.
- In the 1940s, criminalistics was also known as police science.
- Currently, forensic science is a term that covers all the scientific disciplines that can be applied to answer questions in the courts of criminal and civil laws.

Part 1 Scope of Forensic Trace Evidence Examinations

History of Forensics, continued

Forensic science covers a broader range of disciplines related to the courts of law than criminalistics.

The National Academy of Sciences (NAS) report:

http://www.nap.edu/catalog.php?record_id=12589

Strengthening Forensic Science in the United States: A Path Forward

- DNA profiling, drug identification, and toxicological analysis have been considered as laboratory-based forensic science.
- Forensic examinations of trace evidence, such as fiber, hair, paint, and fire debris, have been considered expert interpretations of observed pattern-based forensic science.
- From the NAS 2009 report, we recognize there is plenty of room for scientific research in the field of trace evidence in order to make the trace/criminalistics field more relevant, valid, and reliable.

Part 1 Scope of Forensic Trace Evidence Examinations

Trace evidence commonly refers to a very small piece of physical evidence left at a crime scene that may be used to identify or link a suspect to a crime. Trace evidence also refers to a vestige, such as a pattern created by contact or contactless interaction between objects. Trace evidence can provide information to trace or reconstruct the past events.

You may read more about trace evidence at

http://www.profiling.org/journal/vol1_no1/jbp_ed_january2000_1-1.html

Part 1 Scope of Forensic Trace Evidence Examinations

The transfer mechanisms that can potentially create trace evidence may include the following:

1) Contact transfer of material

Example: automobile paint chip transfer at the impact site in a car crash or a hit-and-run case

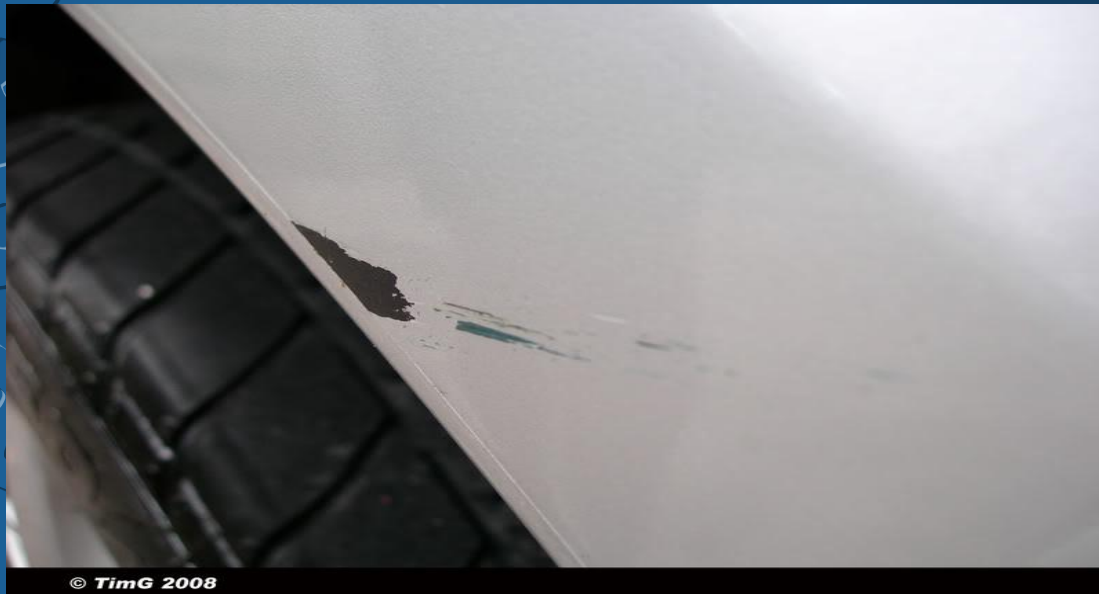


Figure 2 Automobile with paint chipped

Part 1 Scope of Forensic Trace Evidence Examinations

Transfer mechanisms, continued

2) Contactless transfer of material

Examples:

- Gunshot residue (GSR) particles land onto a shooter's hand.
- GSR particles land on the clothing of a person close to a discharged firearm.
- Glass shards land on the clothing of someone in the vicinity of breaking glass.



Part 1 Scope of Forensic Trace Evidence Examinations

Analyzing and comparing trace evidence can establish associations between objects, a suspect, a victim, and the crime scene.



Part 1 Scope of Forensic Trace Evidence Examinations

Trace Evidence Analysis and Comparison

The physical and chemical properties of trace evidence can be analyzed using a variety of instrumentation and visualization tools, including but not limited to the following.

- Stereomicroscopy
- Polarized Light Microscopy (PLM)
- Ultraviolet Light Microscopy
- Scanning Electron Microscopy/Energy Dispersive X-ray Spectroscopy (SEM/EDS, or SEM/EDX)
- Fourier Transform Infrared Spectroscopy (FT-IR)
- Gas Chromatography/Mass Spectrometry (GC/MS)
- Pyrolysis-Gas Chromatography (Py-GC)
- Ion Chromatography (IC)
- Microspectrophotometry

Part 1 Scope of Forensic Trace Evidence Examinations

Trace evidence is often insufficient on its own to make a case, but it may corroborate other physical evidence to prompt a confession during the investigative stage of a criminal investigation.

The following types of trace evidence are commonly encountered in a criminal investigation:

- Hairs
- Fibers
- Paints (automotive and architectural)
- Glass

Part 1 Scope of Forensic Trace Evidence Examinations

Depending on the size of a crime laboratory, different analytical services are offered in the trace unit/section.

At the trace evidence unit of the FBI, trace evidence analyses include the following:

- Human and animal hair
- Fibers
- Fabrics
- Feathers
- Wood
- Cordage
- Glass
- Soil
- Anthropological materials
- Building materials
- Gemstones

See more details from federal-level trace laboratory:

<http://www.fbi.gov/about-us/lab/trace>

Part 1 Scope of Forensic Trace Evidence Examinations

State Crime Laboratories

At a state-level crime laboratory such as the Texas Department of Public Safety (DPS), forensic examinations are offered on

- hair,
- fibers,
- paint,
- glass,
- gunshot residue (GSR),
- shoe prints, and
- tire impressions.

More details can be found from a state-level trace laboratory:

<http://www.txdps.state.tx.us/CrimeLaboratory/traceEvidence.htm>

Part 1 Scope of Forensic Trace Evidence Examinations

At the county level, such as the Harris County Institute of Forensic Sciences, the trace evidence laboratory offers analysis of gunshot residue and fire debris.

These trace analysts at the trace laboratory are board certified by the American Board of Criminalistics. A trace evidence collection team within the trace laboratory also closely examines bodies and collects trace evidence (such as hairs, fibers, glass, biological stains, and other evidence) that may be useful for a criminal investigation.

More details can be found from a county-level trace laboratory:

<http://www.hctx.net/ifs/clstrace.aspx>

Part 1 Scope of Forensic Trace Evidence Examinations

Case Study: Green River Killer

See how trace evidence assisted the investigation of the Green River Killer case:

[Flash video](#)

<http://projects.nfstc.org/trace/video/flv/day3/Day Three 01 Palenik-Trace Evidence.html>



End of Module 4A

Forensic Science Teacher Professional Development