Краснодарский университет МВД России



С. В. Борисова
В. А. Гончарова

ПРОФЕССИОНАЛЬНО ОРИЕНТИРОВАННЫЕ МАТЕРИАЛЫ ПО ПРИМЕНЕНИЮ ИНФОРМАЦИОННО-ТЕЛЕКОММУНИКАЦИОННЫХ ТЕХНОЛОГИЙ В СУДЕБНО-ЭКСПЕРТНОЙ ДЕЯТЕЛЬНОСТИ

ENGLISH PROFESSIAONAL TEXTS OF IT USAGE IN FORENSIC SCIENCES



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Б825 Профессионально ориентированные материалы по применению информационно-телекоммуникативных технологий в судебно-экспертной деятельности = English professiaonal texts of IT usage in forensic sciences : учебное пособие / С. В. Борисова, В. А. Гончарова. – Краснодар : Краснодарский университет МВД России, 2026. – 400 с.

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Содержатся современные аутентичные профессионально ориентированные материалы, способствующие углублению знаний обучающихся по темам: «Криминалистика и история ее развития», «Виды криминалистических экспертиз», «Трасология и трасологическая экспертиза», «Дактилоскопия и дактилоскопическая экспертиза», «Судебно-баллистическая экспертиза», «Методы идентификации личности», «Понятие и виды доказательств». Особое внимание уделяется лексике, которая закрепляется в разнообразных упражнениях и находит свое применение в дискуссиях. Предлагаются задания, стимулирующие формирование монологической и диалогической речи и ориентированные на обмен информацией между обучающимися.

Для профессорско-преподавательского состава, курсантов, слушателей образовательных организаций МВД России и сотрудников органов внутренних дел Российской Федерации.

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CONTENTS

Introduction ……..…..…….....…..….. 4

Unit I. Criminalistics and the history of its development…...…….... 8

Unit II. Types of forensic examinations ……..……..... 55

Unit III. Traceology and trace examination ……..….. 71

Unit IV. Dactyloscopy and fingerprint examination …….....….... 86

Unit V. Forensic ballistic examination ……..…..... 134

Unit VI. Personal identification methods …….……. 216

Unit VII. The concept and types of evidence …….…….. 239

Appendix I. Texts for annotation……..…...…….. 283

Appendix II. Topical Vocabulary ……...……..….. 289

Appendix III. Professional Vocabulary……...……...…….. 300

Appendix IV. Dictionary…… 338

Appendix V. English-English Forensic Vocabulary……. 347

Appendix VI. Tests for Self-Control…….. 354

INTRODUCTION
ПРЕДИСЛОВИЕ

Предлагаемое учебное пособие предназначено для курсантов, обучающихся по специальности 40.05.03 Судебная экспертиза.

Цель учебное пособие – обучить курсантов активному владению английским языком по теме «Применение информационно-телекоммуникативных технологий в судебно-экспертной деятельности», а также сформировать способность и готовность вести дискуссию по данным вопросам.

В пособие включены современные профессионально ориентированные материалы, которые углубляют знания обучающихся в указанной сфере. Пособие состоит из семи разделов: «Криминалистика и история её развития», «Виды криминалистических экспертиз», «Трасология и трасологическая экспертиза», «Дактилоскопия и дактилоскопическая экспертиза», «Судебно-баллистическая экспертиза», «Методы идентификации личности», «Понятие и виды доказательств».

Для будущих сотрудников органов внутренних дел представляется необходимым овладение всеми видами работы с текстами по специальности на английском языке с целью получения профессионально значимой информации, широко востребованой при решении ряда профессиональных задач.

Методические рекомендации для обучающихся по работе с профессионально ориентированными текстами.

Данные рекомендации призваны помочь системно и эффективно работать со сложными профессиональными текстами на английском языке. Задача обучающихся – не просто «перевести» текст, а научиться извлекать из него ключевую информацию, понимать логику изложения и активно использовать новые знания и термины в своей будущей профессиональной деятельности.

Основные принципы работы с текстом:

- **От общего к частному:** Сначала понять общую идею и контекст, затем углубляйться в детали.
- **Активное чтение:** Читать с карандашом в руке (или в цифровом формате с инструментами выделения). Цель – диалог с текстом.
- **Системность:** Работа с терминами и понятиями должна быть постоянной и организованной (глоссарий, карточки).

Поэтапная стратегия работы с профессиональным текстом

Этап 1. ДО ЧТЕНИЯ (Pre-Reading)

- **Проанализировать заголовок, подзаголовки, иллюстрации, графики.** Сформулировать для себя, о чем, вероятно, будет текст.
- **Просмотреть текст бегло (skimming):** Обратить внимание на первое и последнее предложения абзацев, выделенные слова? Записать 2-3 ключевых вопроса, на которые необходимо найти ответ.

Этап 2. ВО ВРЕМЯ ЧТЕНИЯ (While-Reading)

- **Маркировать текст:**

Цвет 1: Ключевые термины и их аббревиатуры.

Цвет 2: Основные идеи и тезисы.

Цвет 3: Примеры, иллюстрирующие теорию.

?: Непонятные места, требующие уточнения.

- Необходимо понять смысл предложения или абзаца целиком. Догадаться о значении незнакомых слов по **контексту**, **словообразовательным элементам** (приставки, суффиксы: e.g., *recover – recovery*, *malware* – malicious software) и по **сходству с международными словами**.
- **Использовать словарь правильно:** Сначала попробовать догадаться. Если не получается – найти значение в **англо-русском словарях, представленных в Приложениях.**

Этап 3. ПОСЛЕ ЧТЕНИЯ (After-Reading)

- **Проверить понимание:** Закрыть текст и устно или письменно изложить его **основную мысль** (1-2 предложения).
- **Заполнить/обновить профессиональный глоссарий.** Делать это не списком, а в структурированной форме:

Термин	**Транскрипция**	**Краткое определение**	**пример**	**перевод**
hash value	[hæʃ ˈvæljuː]	A digital fingerprint of a file or data set. Used to verify integrity.	*The **hash value** of the evidence image must match the original.*	**Хэш-сумма**, контрольная сумма файла.

- **Ответить на вопросы к тексту** (если они есть) или создать их самостоятельно (Who? What? Where? How? Why?).
- **Составить ментальную карту (mind map)** текста, отражающую его структуру и ключевые понятия.
- **Выполнить практическое задание:** Написать краткий отчет (summary), составить план.

4. Как развивать навыки на основе текстов

- **Для говорения:** Использовать новые термины и идеи из текста в обсуждениях. Объяснять понятие из текста **своими словами** (paraphrasing) на английском.
- **Для письма:** Использовать лексику и структуры из текста, написать свой короткий протокол, описать метода или выводы по гипотетическому случаю.
- **Для аудирования:** Найти видео на тему, близкую к прочитанному тексту. Обучающиеся смогут понимать гораздо лучше, так как уже владеют терминологией.

UNIT I. CRIMINALISTICS AND THE HISTORY OF ITS DEVELOPMENT



TEXT 1. THE FATHERS OF CRIMINALISTICS AND CRIMINOLOGY IN RUSSIA

The development of criminalistics (forensic investigation) and criminology (the study of crime's causes) in Russia followed a distinct path, combining European scientific influence with unique domestic innovations to form a robust, independent school of thought.

While influenced by European pioneers like Hans Gross, Russia produced its own foundational figures. A key early contributor was the Austrian **Hans Gross** himself. His seminal 1893 manual "Handbuch für Untersuchungsrichter" was translated into Russian and became the fundamental textbook, systematizing investigation methods and cementing the very term "criminalistics" in Russian legal science.

The true father of Russian *technical* criminalistics is considered to be **Evgeny F. Burinsky** (1849–1912). A pioneering forensic photographer in St. Petersburg, he founded the world's first **forensic photographic laboratory** in 1889. He developed advanced methods for deciphering faded

texts, analyzing forgeries, and revealing invisible evidence, establishing the core of Russian forensic document examination and material evidence analysis.

The theoretical and educational framework for the Soviet and later Russian system was solidified by **Ivan N. Yakimov** (1884–1954). His 1925 textbook "Criminalistics: A Guide to Criminal Technique and Tactics" became the cornerstone of the national curriculum. He successfully merged



criminalistics theory with the practical needs of investigative bodies, shaping the modern expert services of the Ministry of Internal Affairs and the Investigative Committee.

In criminology, early 20th-century scholars like **M.N. Gernet** and **A.A. Gertsenzon** made significant contributions to sociological and statistical studies of crime. However, the field was suppressed during the Stalinist era, only to be revitalized in the latter half of the century, with figures like **A.I. Dolgova** continuing to develop its modern Russian identity.

Thus, Russian forensic science was born from the synergy of adopted European systematics (Gross), groundbreaking technical genius (Burinsky), and pragmatic theoretical structuring (Yakimov), creating a enduring legacy for contemporary criminal investigation.”

EXERCISES



1. Match the Columns

Column A	**Column B**
1. Foundational figures	a) The fundamental building blocks or most important people in a field.
2. Seminal manual	b) A person who is one of the first to explore or develop a new area of knowledge.
3. To systematize	c) The basic structure or system of a particular field of study.
4. Pioneering	d) A crucial, highly influential book that serves as a foundation.
5. Forensic photographic laboratory	e) The main agency for criminal investigations in modern Russia (abbreviation).
6.Theoretical framework	f) The combination of different elements to produce a result greater than the sum of their parts.
7.Investigative Committee (SK)	g) To arrange something according to an organized system.

Column A	Column B
8. To be revitalized	h) A facility dedicated to using photography for scientific analysis in legal contexts.
9. Synergy	i) The long-lasting impact or influence left behind.
10. Enduring legacy	j) To be given new life or energy; to become active again.



2. True/False/Not Stated

1. Hans Gross was Russian by birth.
2. Evgeny Burinsky founded his laboratory in Moscow.
3. Ivan Yakimov's textbook was published before the October Revolution.
4. The text states that criminology in Russia developed without any foreign influence.
5. Burinsky's work focused solely on fingerprint analysis.
6. The Ministry of Internal Affairs (MVD) is mentioned as a body shaped by modern forensic services.
7. Gernet and Gertsenzon were active in the field of forensic ballistics.
8. Criminology was completely banned and erased during the Stalinist era.

9. Hans Gross's manual helped popularize the term "criminalistics" in Russia.

10. According to the text, Burinsky is considered the main father of Russian criminology.



3. Fill in the Blanks

(Change the word forms if necessary)

domestic, cornerstone, deciphering, foundational, synergy, suppressed, systematizing, revitalized, pragmatic, pioneering

1. Hans Gross played a _____ role by _____ investigation methods in his manual.

2. Burinsky was a _____ figure in forensic photography, known for _____ faded texts.

3. Yakimov's textbook became the _____ of the national curriculum for investigators.

4. Russian criminalistics combined European ideas with _____ innovations.

5. Yakimov was successful because of his _____ approach, merging theory with practice.

6. The field of criminology was _____ for a period but later _____.

7. The text concludes that modern Russian forensics is a result of the _____ of three key contributions.



4. Answer the Questions

1. What are the two main fields discussed in the text, and how are they defined?

2. What was the title of Hans Gross's influential manual, and why was it important for Russia?

3. What specific achievement is Evgeny Burinsky credited with?

4. Name three types of evidence analysis that Burinsky's methods advanced.

5. What was the title of Ivan Yakimov's key textbook, and when was it published?

6. Which two modern Russian institutions are mentioned as being shaped by these developments?

7. Name two early Russian criminologists mentioned in the text.

8. What historical period caused a setback for criminology in Russia?

9. According to the final paragraph, what three elements combined to create Russian forensic science?

10. What is the main point the text makes about the development of Russian criminalistics?



5. Paraphrase the Following

Цель: Улучшить понимание сложных конструкций и развить навык изложения информации своими словами.
Задание: Перепишите следующие предложения из текста, сохранив исходный смысл, но используя другие слова и грамматические структуры.

1. *"The development... followed a distinct path, combining European scientific influence with unique domestic innovations."*
2. *"His seminal 1893 manual... became the fundamental textbook, systematizing investigation methods..."*
3. *"He developed advanced methods for deciphering faded texts, analyzing forgeries, and revealing invisible evidence..."*
4. *"He successfully merged criminalistics theory with the practical needs of investigative bodies..."*
5. *"However, the field was suppressed during the Stalinist era, only to be revitalized in the latter half of the century..."*

TEXT 2. FOUNDATIONAL FIGURES IN EUROPE: THE BIRTH OF SCIENTIFIC CRIMINOLOGY

The birth of scientific criminology in 19th-century Europe marked a radical shift from reliance on confession and witness testimony to evidence-based investigation. This transformation was championed by pioneering figures who established the core principles of forensic science.

The Italian physician **Cesare Lombroso** is a controversial founding father. In his 1876 work *L'uomo delinquente* (Criminal Man), he proposed the theory of the "born criminal." Lombroso argued that criminals were biological throwbacks, identifiable by physical atavisms like sloping foreheads or large jaws. While his deterministic theory is now discredited, his significance lies in applying systematic observation and measurement—anthropometry—to the study of crime, seeking its root causes in the individual.

In stark contrast, the Austrian jurist **Hans Gross** provided the practical handbook for the emerging science. His 1893 manual *Handbuch für Untersuchungsrichter* (Criminal Investigation) earned him the title "father of criminalistics." Gross systematically detailed crime scene protocol, evidence



collection, and specialized fields like ballistics and fingerprint analysis. He emphasized meticulous documentation, logic, and the use of expert knowledge, moving focus from *why* someone commits crime to *how* to solve it scientifically.

The Frenchman **Edmond Locard** built upon these foundations in the early 20th century with his famous **Exchange Principle**: "Every contact leaves a trace." As director of the world's first police laboratory in Lyon, he demonstrated that microscopic evidence like dust, fibers, or soil could definitively link a suspect to a crime scene, proving contact through scientific analysis.

These European pioneers created the blueprint for modern forensics. They replaced speculation with system, superstition with science, and confession with trace evidence. While tools have evolved from magnifying glasses to DNA sequencers and AI, the foundational quest they began—to objectively establish truth through material evidence—remains the cornerstone of criminal justice worldwide.



1. Составьте словосочетания (Make word combinations)

Соедините слова из колонки A со словами из колонки B, чтобы получились устойчивые выражения из текста.

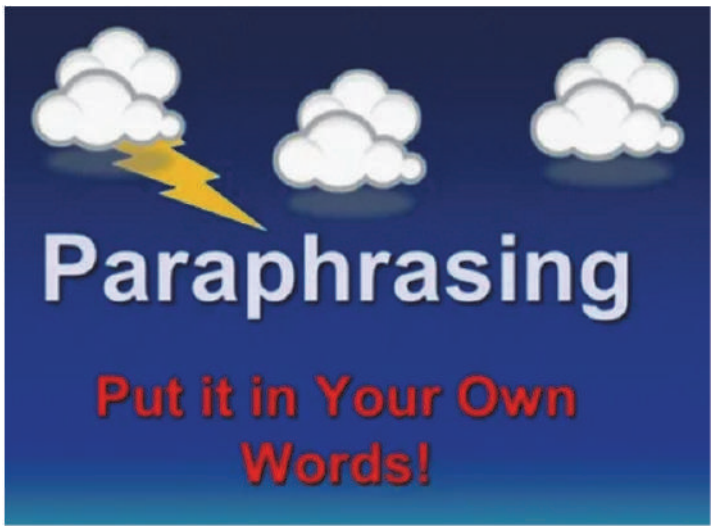
A	B
1. radical	a) investigation
2. evidence-based	b) throwbacks
3. biological	c) atavisms
4. physical	d) shift
5. crime scene	e) protocol
6. meticulous	f) evidence
7. expert	g) documentation
8. exchange	h) principle
9. trace	i) knowledge
10. material	j) analysis

2. Сопоставьте колонки (Match the columns)



Сопоставьте имя ученого (1-3) с его вкладом (a-c) и соответствующей концепцией (i-iii).

1. **Cesare Lombroso** 2. **Hans Gross** 3. **Edmond Locard**	a) Created a practical manual systematizing crime scene investigation. b) Proposed that "every contact leaves a trace." c) Argued that criminals are biologically predetermined.	i) "Father of criminalistics" ii) The Exchange Principle iii) Theory of the "born criminal"



3. Перефразируйте (Paraphrase the following)

Перепишите следующие предложения своими словами, сохранив исходный смысл.

Example:

The emergence of criminology as a science represented a dramatic change; instead of depending on confessions, investigations started to rely on physical proof.

1. The birth of scientific criminology marked a radical shift from reliance on confession to evidence-based investigation.
2. Lombroso's deterministic theory is now discredited.
3. Gross moved the focus from *why* someone commits crime to *how* to solve it scientifically.
4. Locard demonstrated that microscopic evidence could definitively link a suspect to a crime scene.
5. These pioneers replaced speculation with system.



4. Верно/Неверно/Не указано (True/False/Not Stated)

Определите, является ли утверждение верным (True), неверным (False) или информация не дана в тексте (Not Stated).

1. Cesare Lombroso was a French psychiatrist.
2. Hans Gross's manual was published in the 20th century.
3. Locard's Exchange Principle states that "every contact leaves a trace."
4. The first police laboratory was established in Paris.
5. Anthropometry is the study of crime causes.
6. Modern forensic tools include DNA sequencers.
7. Gross is known as the "father of criminology."
8. Lombroso believed criminals could be identified by their personality traits alone.
9. The text mentions that AI is used in modern forensics.
10. All pioneers mentioned in the text agreed with each other's theories.

5. Лишнее слово (One word is odd)

В каждом ряду найдите одно слово, которое не относится к общей тематической группе. Объясните свой выбор.

1. **confession, testimony, evidence, suspect, negotiation**.
2. **physician, jurist, director, biologist, teacher**.
3. **anthropometry, ballistics, fingerprint analysis, psychology, documentation**.
4. **dust, fiber, soil, weapon, hair**.
5. **speculation, system, superstition, science, protocol**.



6. Ответьте на вопросы (Answer the questions)

Ответьте на вопросы полными предложениями на основе текста.

1. What did the shift to scientific criminology move away from?
2. What is the name of Lombroso's most famous work?
3. According to Lombroso, what were "born criminals"?
4. Why is Lombroso still considered significant despite his discredited theory?
5. What title did Hans Gross earn and why?
6. Name two specialized fields detailed in Gross's manual.
7. What is the core of Locard's Exchange Principle?
8. What was Locard's key achievement as a director?
9. What, according to the text, is the "cornerstone of criminal justice worldwide"?
10. How have forensic tools evolved since the time of these pioneers?



7.Тема для обсуждения / Мини-эссе (Discussion/Essay Topics)

Выберите один из вопросов и подготовьте развернутый ответ (5-7 предложений) или обсудите в паре/группе.

1. **Сравнение подходов:** Contrast the legacies of Lombroso and Gross. How did one focus on the *cause* of crime and the other on the *method* of investigation? Which approach do you think is more relevant for a modern forensic expert?

2. **Принцип сегодня:** Provide a specific example from modern forensic practice (e.g., DNA transfer, digital footprints) that perfectly illustrates Locard's Exchange Principle.

3. **Этика и наука:** Lombroso's theory is called "controversial" and "discredited." Discuss the ethical dangers when forensic science tries to link physical appearance or biology directly to criminal behavior.

4. **От практики к теории:** Hans Gross emphasized "meticulous documentation." Why is documentation still the bedrock of any forensic investigation, and what might be the consequences of poor documentation?

5. **Эволюция инструментов:** The text states that tools evolved "from magnifying glasses to DNA sequencers and AI." In your opinion, what has been the single most important technological advancement in forensics, and why?

6. **"Отец" дисциплины:** If you had to choose *one* of the three pioneers (Lombroso, Gross, Locard) as the most important for the development of *your* specific field of expertise, who would it be and why?

7. **Система против догадок:** The text says pioneers replaced "speculation with system." Can there ever be a place for intuition or speculation in a modern, scientific investigation? If so, where and under what conditions?

8. **Глобальный уголок:** The principles are called the "cornerstone of criminal justice worldwide." Do you think the *application* of these principles is truly universal, or does it vary significantly in different countries and legal systems?

9. **Непрерывный поиск:** The "foundational quest" is to establish truth through material evidence. What are the biggest challenges or limitations to finding the "objective truth" in complex cases today?

10. **Урок для эксперта:** What is the key lesson a modern forensic expert can learn from studying the history and mistakes of early criminologists like Lombroso?

TEXT 3. THE GLOBALIZATION OF CRIMINALISTICS METHODS AND THE 20TH-CENTURY LABORATORY

The 20th century was a period of profound institutionalization for forensic science. The field transformed from a collection of methods reliant on individual expert authority into a globalized, laboratory-based discipline governed by scientific standards and international cooperation.

This institutional shift is often described through three successive models. The earliest model was based on **Embodied Authority**, where the credibility of evidence rested heavily on the personal reputation and experience of the individual expert, such as a celebrated pathologist. As legal systems demanded more reliability, this gave way to the model of **Comprehensive Method**. The focus shifted to standardized procedures, validated techniques, and rigorous crime scene protocols—exemplified by the systematizing work of pioneers like Hans Gross. The ultimate expression of this was the creation of the dedicated police laboratory.

The founding of the world's first police crime laboratory in 1910 in Lyon, France, by **Edmond Locard** was a watershed moment. This institutional home



provided a controlled environment where Locard's famous **Exchange Principle**—"every contact leaves a trace"—could be systematically tested and applied using microscopes and chemical analysis. The laboratory became the physical and symbolic center of the new forensic method, moving the practice from the crime scene and the courtroom into a dedicated scientific space.

Following World War II, the model of **Institutionalized Artistry** or **Flexible Problem-Solving** emerged. This recognized that while laboratories and methods were essential, complex cases required experts to synthesize multiple types of evidence and reasoning. This period also saw the beginning of true **globalization**. Techniques developed in one country were adopted and refined in others. To ensure consistency and reliability across borders, international networks began to form. Organizations like the **European Network of Forensic Science Institutes (ENFSI)** were established to harmonize methods, share best practices, and promote quality assurance among member laboratories.

However, this globalization and institutionalization also created challenges. Specialization led to the **fragmentation** of forensic science into sub-disciplines (like fibers, paint, or ballistics), sometimes at the expense of a holistic view of a case. Furthermore, the dominant "forensics" paradigm, focused primarily on serving court evidence, has been criticized for being too narrow, prompting calls for a broader, more robust scientific foundation for the entire discipline. The 20th-century laboratory, therefore, was not just a room with microscopes; it was the engine for a global project to standardize the scientific investigation of crime.

EXERCISES



1. Make Word Combinations

Combine a word from List A with a word from List B to form a key term or concept from the text.

List A:	**List B:**
1. Exchange	a) scene
2. crime	b) evidence
3. forensic	c) Principle
4. quality	d) authority
5. individual	e) assurance
6. standardized	f) science
7. international	g) procedures
8. trace	h) cooperation
9. scientific	i) standards
10. police	j) laboratory



2. Match the Columns

Match the historical model or concept (Column A) with its correct description (Column B).

Column A	**Column B**
1. Embodied Authority	a) A network promoting harmonized methods across European labs.
2. Comprehensive Method	b) Over-specialization into sub-disciplines, potentially harming a case overview.
3. Institutionalized Artistry	c) Credibility based on the personal reputation of an expert.
4. Fragmentation	d) The synthesis of multiple evidence types for complex problem-solving.
5. ENFSI	e) A focus on systematic protocols and validated techniques.



3. Paraphrase the Following

Restate these sentences from the text in your own words without changing the core meaning.

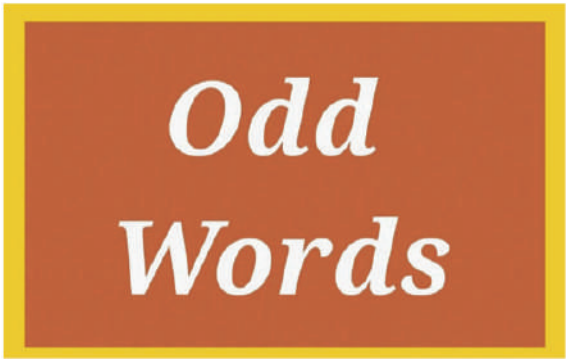
1. The field transformed from methods reliant on individual expert authority into a globalized, laboratory-based discipline.
2. This institutional home provided a controlled environment where Locard's famous Exchange Principle could be systematically tested.
3. Specialization led to the fragmentation of forensic science into sub-disciplines.
4. The dominant "forensics" paradigm has been criticized for being too narrow.
5. The 20th-century laboratory was the engine for a global project to standardize the scientific investigation of crime.



4. True / False / Not Stated

Determine if the statement is True (T), False (F), or if the information is Not Stated (NS) in the text.

1. Edmond Locard founded the first police lab in Paris.
2. The "Comprehensive Method" model values personal reputation over written protocols.
3. The text mentions that Sherlock Holmes was a real forensic pioneer.
4. Globalization helped spread forensic techniques between countries.
5. The "Institutionalized Artistry" model rejects the use of laboratories.
6. ENFSI is an organization focused on ballistic analysis only.
7. Hans Gross's work is associated with standardizing crime scene investigation.
8. The text states that DNA analysis ended all challenges in forensics.
9. Fragmentation is seen as an unquestionable benefit of forensic science.
10. The 20th-century shift aimed to make forensic investigation more objective.



5. One Word is Odd

Identify which word in each group does not thematically belong to the others and explain why.

1. **Expert, reputation, authority, microscope, experience**.
2. **Protocol, standard, procedure, intuition, method**.
3. **Fiber, paint, DNA, globalization, glass**.
4. **Laboratory, courtroom, crime scene, harmonization**.
5. **Synthesis, analysis, fragmentation, integration**.



6. Answer the Questions

Provide full-sentence answers based on the text.

1. What was the core of the "Embodied Authority" model?
2. Who founded the first police crime laboratory and where?
3. What is the main purpose of networks like ENFSI?
4. What is one negative consequence of overspecialization mentioned in the text?

5. According to the text, what has been the main criticism of the dominant "forensics" paradigm?



7. Match the Synonyms & Antonyms

For words 1-5, find the best synonym from the list. For words 6-10, find the best antonym from the list.

Word List:	**Synonym List:**
1. Profound	a) Combine
2. Credibility	b) Trustworthiness
3. Synthesize	c) Standardize
4. Harmonize	d) Confirm
5. Validate	e) Deep
6. Objective	f) Subjective
7. Holistic	g) Unsystematic
8. Standardized	h) Integration
9. Global	i) Local
10. Fragmentation	j) Narrow

TEXT 4. CRIMINALISTICS AND ITS GLOBAL HISTORICAL DEVELOPMENT

The history of criminalistics is a story of humanity's relentless pursuit of truth in the face of crime. From ancient intuitive methods to the sophisticated, science-based discipline of today, its development mirrors the progress of science, technology, and legal thought on a global scale.

The earliest roots can be traced to ancient civilizations. In **China**, the first known forensic text, *"Xi Yuan Lu"* (The Washing Away of Wrongs), was published in the 13th century by Song Ci. It detailed methods for examining wounds and determining cause of death, representing one of the first systematic approaches. For centuries, however, investigations in Europe and elsewhere relied heavily on oath-taking, trial by ordeal, and confession—often obtained under duress.

The true scientific revolution began in the 19th century, often called the "**Era of the Pioneers**." In **France**, **Alphonse Bertillon** (1853-1914) developed *anthropometry* (or "bertillonage"), a system of precise body measurements to identify repeat offenders. Although later supplanted, it introduced the crucial principle of systematic, quantitative identification. Simultaneously, the science of fingerprinting was crystallizing. **Sir William Herschel** in **India** and **Henry Faulds** in **Japan** noted the uniqueness and permanence of fingerprints. Their work was pivotal, but it was **Sir Francis Galton** and later **Sir Edward Henry** in **Britain** who created the first practical classification system, enabling the use of fingerprints in large-scale criminal databases.

Meanwhile, other foundational disciplines emerged. **Hans Gross**, an Austrian jurist, coined the very term "**criminalistics**" in his 1893 manual, systematizing crime scene investigation. In **France**, **Edmond Locard** formulated his famous **Exchange Principle** ("every contact leaves a trace") and established the world's first police laboratory in Lyon, laying the groundwork for trace evidence analysis.

The 20th and 21st centuries have been defined by explosive technological advancement. The development of **DNA profiling** in the 1980s, pioneered by **Sir Alec Jeffreys** in the **UK**, revolutionized personal identification with near-absolute certainty. **Ballistics** evolved from visual comparisons to integrated digital networks like the **National Integrated Ballistic Information Network (NIBIN)**. **Digital forensics** emerged to combat cybercrime, analyzing evidence from computers and smartphones.



Today, criminalistics is a global, high-tech enterprise. International cooperation and standards are paramount. Modern laboratories employ technologies like **mass spectrometry**, **3D laser scanning** for crime scene reconstruction, and **artificial intelligence** for pattern recognition. From the inked fingerprint to the genetic profile, the core mission endures: to objectively analyze material evidence and reconstruct the truth, thereby underpinning justice systems worldwide.

EXERCISES



1. Make Word Combinations

Combine a word from List A with a word from List B to form a key term or concept from the text.

List A:	**List B:**
1. trial	a) of death
2. cause	b) by ordeal
3. body	c) measurements
4. crime	d) scene
5. exchange	e) principle
6. trace	f) evidence
7. digital	g) forensics
8. DNA	h) profiling
9. ballistic	i) information
10. Artificial	j) intelligence



2. Match the Columns

Match the person (Column A) with their contribution (Column B) and their associated country (Column C).

Column A	**Column B**	**Column C**
1. Song Ci	a) Created a fingerprint classification system	i) China
2. Alphonse Bertillon	b) Wrote the first known forensic manual	ii) France
3. Sir Edward Henry	c) Systematized criminal investigation and coined its name	iii) Britain
4. Hans Gross	d) Developed anthropometry	iv) Austria
5. Edmond Locard	e) Formulated the Exchange Principle	v) France



3. Paraphrase the Following

Restate these sentences from the text in your own words without changing the core meaning.

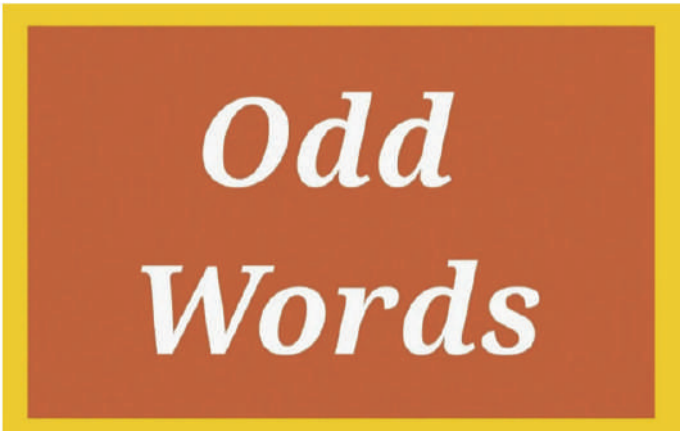
1. Its development mirrors the progress of science, technology, and legal thought.
2. It introduced the crucial principle of systematic, quantitative identification.
3. Their work was pivotal for the development of fingerprinting.
4. The 20th and 21st centuries have been defined by explosive technological advancement.
5. The core mission endures: to objectively analyze material evidence.



4. True / False / Not Stated

Determine if the statement is True (T), False (F), or if the information is Not Stated (NS) in the text.

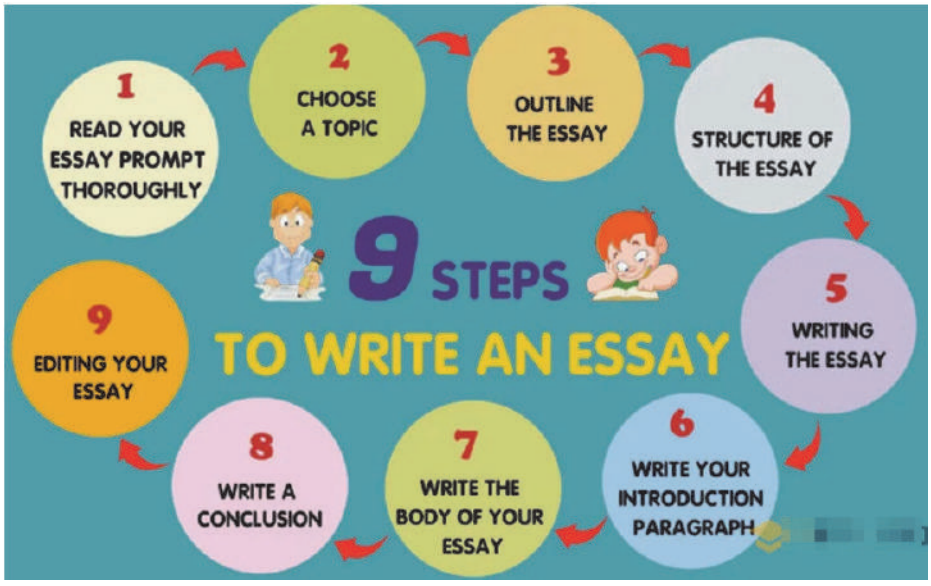
1. Song Ci's manual focused on the analysis of toxic substances.
2. Bertillon's system is still the primary method of identification used today.
3. Henry Faulds conducted his research on fingerprints while in Japan.
4. Hans Gross was the first person to use a microscope in an investigation.
5. Locard's principle states that every criminal leaves a weapon at the scene.
6. DNA profiling provides less certainty than fingerprint analysis.
7. Digital forensics deals with evidence from smartphones.
8. The text mentions that AI is used for forgery detection.
9. International cooperation is unimportant in modern criminalistics.
10. The first police laboratory was in Paris.



5. One Word is Odd

Identify which word in each group does not thematically belong to the others and explain why.

1. **oath, ordeal, confession, algorithm**.
2. **anthropometry, fingerprinting, profiling, alchemy**.
3. **Gross, Locard, Bertillon, Shakespeare**.
4. **DNA, fiber, soil, suspicion**.
5. **database, network, software, rumor**.





6. Answer the Questions

Provide full-sentence answers based on the text.

1. What ancient text is considered a foundation of forensic science and where did it originate?
2. What was the major drawback of investigation methods before the 19th century?
3. What was the name of Alphonse Bertillon's identification system?
4. What two properties of fingerprints did early researchers like Herschel and Faulds establish?
5. What is the full name of the principle formulated by Edmond Locard?
6. What technological breakthrough in the 1980s revolutionized identification?
7. What does the acronym NIBIN stand for and what does it analyze?
8. Name two analytical technologies used in modern forensic laboratories.
9. According to the conclusion, what is the enduring mission of criminalistics?
10. How would you describe the overall evolution of criminalistics in one phrase from the text?



7. Discussion & Mini-Essay Prompts

Choose a topic and discuss it in pairs or prepare a short written response (5-7 sentences).

1. **The Most Important Pioneer:** In your opinion, which historical figure from the text made the single most important contribution to the *global* development of criminalistics? Justify your choice by considering the longevity and universality of their contribution.

2. **From Bertillon to Biometrics:** Compare and contrast the systems of Bertillon (anthropometry) and Galton/Henry (fingerprinting). Why was one ultimately replaced by the other, and what does this tell us about the requirements for a successful identification system?

3. **Locard's Principle in the Digital Age:** Locard's Exchange Principle was formulated for physical evidence. How does this principle manifest in the realm of **digital forensics**? Provide a specific example of a "digital trace."

4. **The Double-Edged Sword of Technology:** The text highlights advances like AI and DNA databases. Discuss one potential **ethical challenge** or risk that arises from the increasing use of such powerful technologies in criminal investigations.

5. **A Universal Science?** The text states that modern criminalistics is a "global enterprise." Do you think the **principles and methods** are truly applied uniformly worldwide, or can legal and cultural differences create significant variations in practice?



TEXT 5. THE DIGITAL REVOLUTION IN FORENSICS

1. Introduction: A Paradigm Shift

The digital revolution has fundamentally transformed forensic science, creating a distinct and essential discipline known as digital forensics. This field is dedicated to the scientific **retrieval**, **analysis**, and **examination** of electronic data to serve as evidence in legal proceedings. It emerged from necessity in the 1980s with the rise of personal computers and computer-related crimes.

2. The Digital Forensics Process: A Standardized Methodology

A core principle is the adherence to a rigorous, standardized process to ensure evidence integrity. This typically involves:

- **Identification & Collection**: Recognizing and seizing relevant digital media (computers, smartphones, cloud storage).
- **Forensic Imaging**: Creating a precise, **bit-for-bit copy** of the original data using tools like write-blockers and imaging software. This preserves the original and allows analysis on a duplicate.
- **Analysis & Examination**: Scrutinizing the data for relevant artifacts—such as emails, chat logs, browser history, deleted files, and metadata—using specialized software tools.
- **Reporting**: Documenting the methodology, findings, and conclusions in a clear report suitable for court.

3. Key Challenges in the Digital Age

Investigators face significant hurdles, including:

- **Data Volume & Complexity**: The sheer amount of data from smartphones, computers, and the cloud can be overwhelming.
- **Encryption**: Strong encryption protects privacy but can make legally obtained data inaccessible to investigators.
- **Evolving Technology**: Rapid innovation in devices, apps, and cloud services constantly creates new evidentiary landscapes.
- **Legal & Privacy Standards**: Investigators must navigate complex laws governing data privacy and evidence admissibility while maintaining a clear **chain of custody**.

4. Modern Tools and Specialized Branches

The field has diversified into specialized branches, each with its own tools:

- **Computer & Mobile Device Forensics**: Analyzing data from computers, smartphones, and tablets.
- **Network Forensics**: Monitoring and analyzing network traffic for evidence of intrusion or crime.
- **Cloud & IoT Forensics**: Extracting evidence from cloud services and Internet of Things devices like smart home assistants.

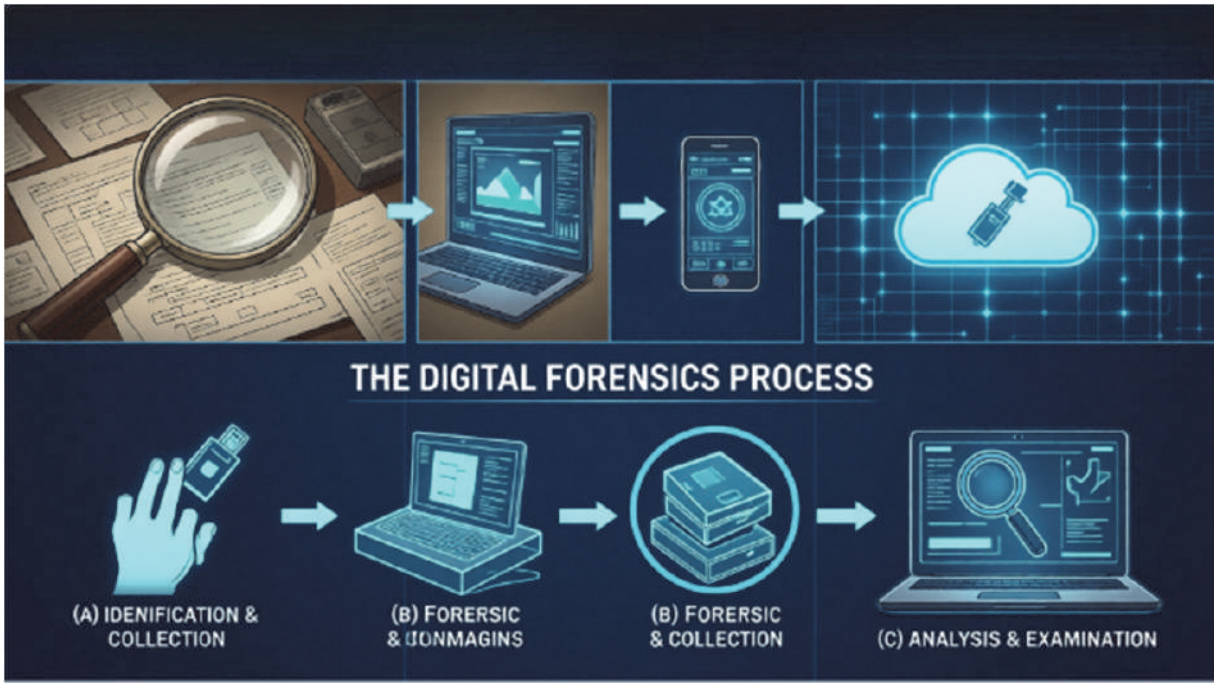
Modern case management systems and platforms aim to **streamline** these complex workflows, improve collaboration, and help manage the data deluge.

5. The Transformative Role of Digital Evidence in Court

Digital evidence has become pivotal, often providing crucial proof where traditional evidence is absent. It can establish timelines, verify or refute alibis, and reveal communications. Landmark cases, such as the trial of Alex Murdaugh, demonstrate its power, where data from cellphones placed a suspect at a crime scene despite their denial.

6. The Future: Integration, Intelligence, and AI

The future points toward **integrated forensic platforms** that connect field devices directly to laboratory systems, allowing for faster, on-scene analysis with remote expert oversight. Furthermore, **Artificial Intelligence (AI)** and **machine learning** are beginning to automate the analysis of massive datasets, helping uncover patterns and insights beyond human capacity, thereby accelerating investigations. This ongoing revolution ensures digital forensics remains a critical pillar of modern justice.



EXERCISES

Below are 7 different exercise types, each with 10 tasks based on the text above. They are designed to build technical vocabulary, reading comprehension, and professional communication skills.



Exercise 1: Make Word Combinations

Combine a word from List A with a word from List B to form a key term or phrase from the text.

List A:	**List B:**
1. digital	a) custody
2. chain of	b) copy
3. bit-for-bit	c) intelligence
4. personal	d) computer
5. integrated forensic	e) platform
6. specialized	f) forensics
7. artificial	g) proceedings
8. legal	h) storage
9. cloud	i) branches
10. mobile device	j) evidence



Exercise 2: Match the Synonyms

Match the technical term (1-10) with its closest synonym (a-j).

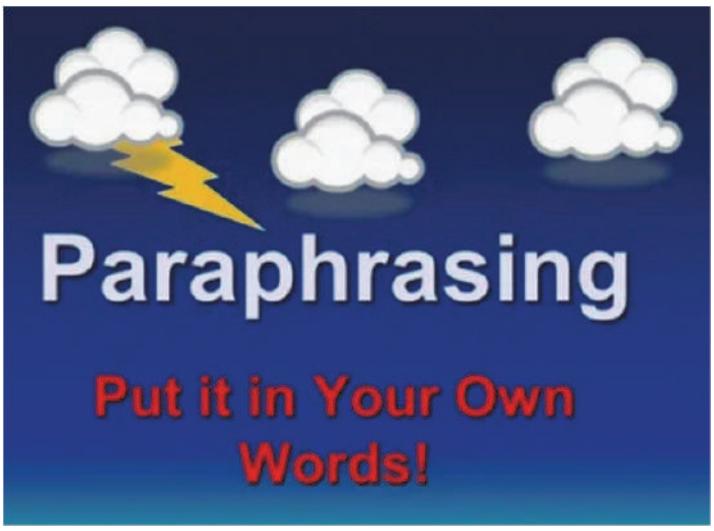
List A:	**List B:**
1. retrieve	a) examine closely
2. scrutinize	b) item of evidence
3. methodology	c) crucial
4. integrity	d) process
5. artifact	e) flood
6. pivotal	f) optimize
7. deluge	g) follow
8. streamline	h) recover
9. adhere to	i) specialize/vary
10. diversify	j) soundness

Exercise 3: Match the Antonyms

Match the term (1-10) with its most direct opposite in the context of the text (a-j).

List A:	**List B:**
1. original	a) copy
2. accessible	b) encrypted/inaccessible
3. manual	c) automated
4. denial	d) admission
5. absence	e) presence

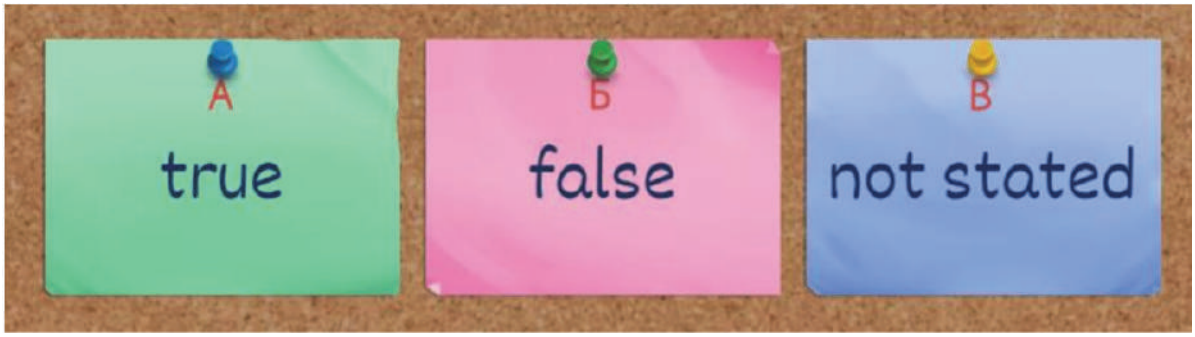
6. privacy	f) exposure
7. simple	g) complex
8. slow	h) accelerated/fast
9. separate	i) integrated
10. theory	j) practice/application



Exercise 4: Paraphrase the Following

Rephrase these sentences from the text in your own words.

1. Digital forensics is dedicated to the scientific retrieval, analysis, and examination of electronic data.
2. A core principle is the adherence to a rigorous, standardized process.
3. Strong encryption can make legally obtained data inaccessible.
4. Digital evidence has become pivotal, often providing crucial proof.
5. AI helps uncover patterns and insights beyond human capacity.



Exercise 5: True / False / Not Stated

Decide if the statement is True (T), False (F), or if the information is Not Stated (NS).

1. Digital forensics first became relevant in the early 2000s.
2. A "bit-for-bit copy" is made to preserve the original evidence for court.
3. Browser history is an example of a digital artifact.
4. The text states that all encryption is illegal in forensic investigations.
5. Network forensics primarily analyzes data stored on hard drives.
6. The Alex Murdaugh case showed digital evidence can contradict a suspect's statement.
7. Integrated platforms allow analysis only inside a laboratory.
8. The main challenge for the future is a lack of digital devices.
9. Machine learning can help manage large volumes of data.
10. The chain of custody is unrelated to legal standards.

Exercise 6: One Word is Odd

Identify the word that does NOT fit the thematic group and explain why.

1. **Group:** retrieve, analyze, examine, **witness**, report.
2. **Group:** smartphone, cloud, tablet, **bloodstain**, hard drive.
3. **Group:** volume, encryption, evolution, **clarity**, privacy.
4. **Group:** computer, mobile, network, **botanical**, IoT forensics.
5. **Group:** timeline, alibi, communication, **fingerprint**, location.



Exercise 7: Answer the Questions

Provide full-sentence answers based on the text.

1. What are the three core activities of digital forensics?
2. Why is a forensic image (bit-for-bit copy) created?
3. Name two challenges posed by encryption.
4. What is the purpose of a specialized "network forensics" branch?
5. How did digital evidence prove crucial in the Alex Murdaugh case?
6. What is one function of modern digital forensics case management systems?
7. What does "IoT" stand for and why is it relevant to forensics?
8. What future technology is highlighted for analyzing large datasets?
9. What must investigators maintain to ensure evidence is admissible in court?
10. In your own words, what is the "paradigm shift" mentioned in the introduction?

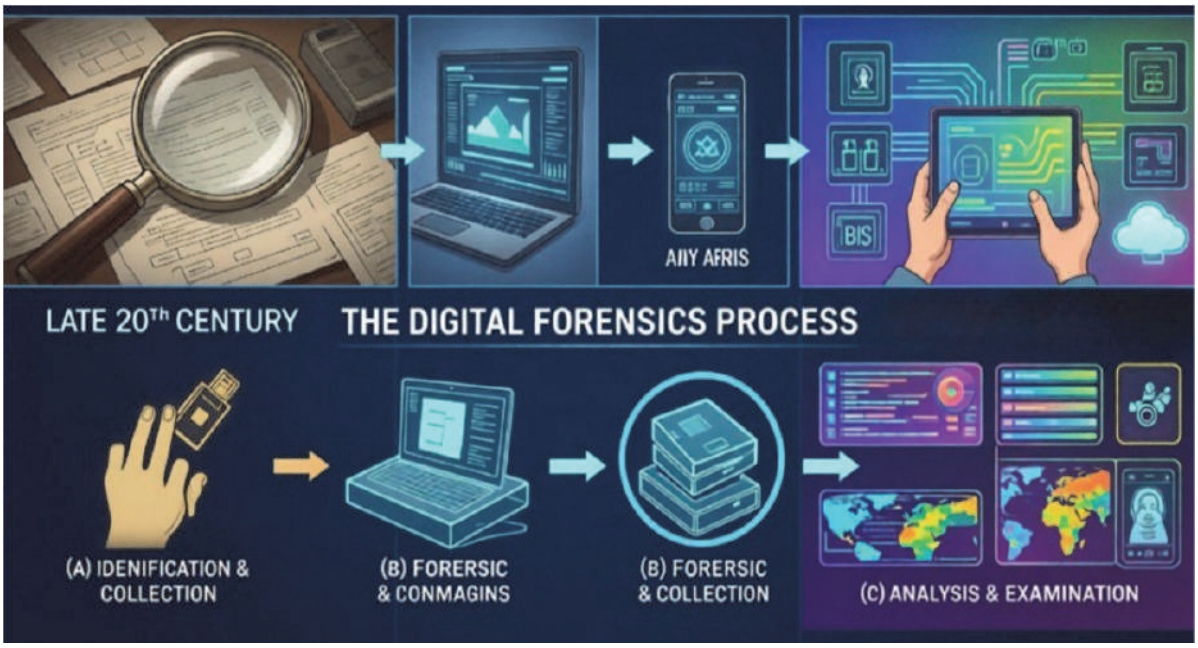
TEXT 6. The History of ICT Development in Investigating Crimes

The integration of Information and Communication Technologies (ICT) into criminal investigation represents one of the most profound transformations in the history of law enforcement. This evolution has moved from simple tools for communication to complex systems capable of predictive analysis and global data integration.

The **first wave (Late 19th - Mid 20th Century)** was defined by foundational communication and recording technologies. The **telegraph** and later the **telephone** revolutionized the speed of information exchange between police departments. The **typewriter** standardized official reports, while **photography** became crucial for documenting crime scenes and creating "rogues' galleries" of known criminals. The most significant administrative innovation was the **punched card system**, adopted from business, which allowed for the mechanical sorting and retrieval of criminal records by various parameters, laying the groundwork for digital databases.

The **second wave (Late 20th Century)** began with the advent of the **computer**. Initially, mainframe systems automated existing record-keeping, leading to the first centralized databases like the **National Crime Information Center (NCIC)** in the USA. The real breakthrough was the development of specialized forensic software and standalone expert systems: **Automated Fingerprint Identification Systems (AFIS)** replaced manual card searches, **ballistics imaging systems** like **IBIS** allowed for comparing bullet striations, and **digital case management systems** replaced paper files. The rise of the internet introduced new investigative domains, such as tracking cybercrime and analyzing early digital footprints.

We are now in the **third wave (21st Century)**, characterized by **integration, intelligence, and big data**. Modern ICT forms a unified ecosystem: mobile devices and body cameras stream real-time data, **cloud platforms** enable secure evidence storage and sharing across jurisdictions, and **integrated databases** link DNA, fingerprints, ballistics, and facial recognition. **Predictive policing software** uses historical crime data and algorithms to forecast potential hotspots. **Artificial Intelligence (AI)** and **machine learning** tools rapidly sift through vast volumes of digital evidence—from traffic camera footage to financial transactions—identifying



patterns and connections impossible for humans to detect unaided.

This journey—from the telegraph to AI—has fundamentally reshaped investigative work. While ICT has provided unprecedented power for solving crimes, it also poses ongoing challenges regarding data privacy, legal frameworks, and the ethical use of algorithmic tools. The core task remains: leveraging technology to enhance, not replace, human investigative judgement in the pursuit of justice.

EXERCISES



1. Make Word Combinations

Combine a term from List A with a term from List B to form a key concept from the text.

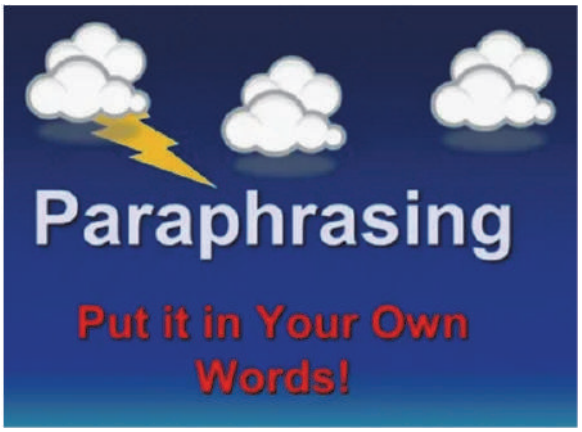
List A:	**List B:**
1. punched	a) scene
2. crime	b) card system
3. digital	c) learning
4. predictive	d) Identification System
5. Automated Fingerprint	e) data
6. body	f) policing
7. cloud	g) technologies
8. machine	h) platform
9. big	i) cameras
10. information and communication	j) footprints



2. Match the Columns

Match the historical phase (Column A) with its key technology (Column B) and its primary impact (Column C).

Column A:	**Column B:**	**Column C:**
1. First Wave	a) AFIS & Digital Case Management	i) Automation of specific forensic tasks and records
2. Second Wave	b) Telegraph & Photography	ii) Global data integration and predictive analysis
3. Third Wave	c) AI & Integrated Cloud Platforms	iii) Faster communication and evidence documentation



3. Paraphrase the Following

Restate these sentences from the text in your own words.

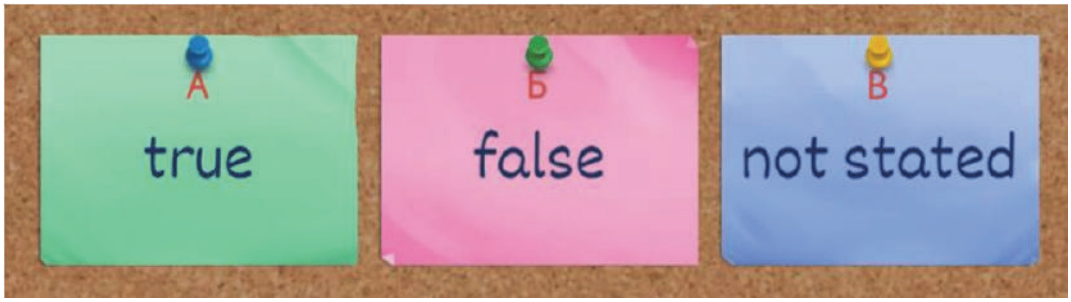
1. This evolution has moved from simple tools for communication to complex systems.

2. Punched card systems laid the groundwork for digital databases.

3. The real breakthrough was the development of specialized forensic software.

4. Modern ICT forms a unified ecosystem.

5. It also poses ongoing challenges regarding data privacy and legal frameworks.



4. True / False / Not Stated

Determine if the statement is True (T), False (F), or if the information is Not Stated (NS).

1. The telephone was important for creating "rogues' galleries."

2. NCIC is an example of an early ballistic imaging system.

3. The text states that AI can now replace detectives entirely.

4. Machine learning helps analyze financial transactions in investigations.

5. Punched card technology was originally developed for police work.

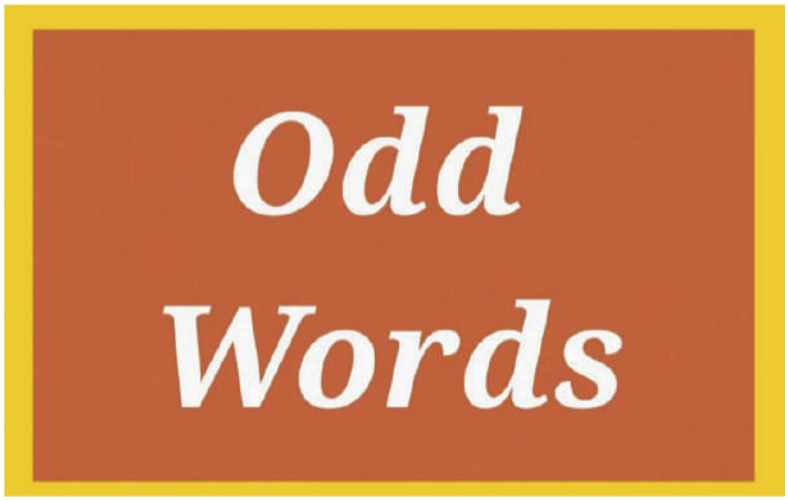
6. Cybercrime investigation emerged with the development of the telegraph.

7. Cloud platforms can complicate evidence sharing between jurisdictions.

8. The main challenge of the first wave was slow data processing.

9. Predictive policing uses algorithms to analyze historical data.

10. The core task is for technology to replace human judgement.



5. One Word is Odd

Identify which word in each group does not thematically belong and explain why.

1. **Telegraph, Typewriter, AFIS, Telephone**
2. **Database, Algorithm, Cloud, Filing Cabinet**
3. **Photography, DNA Sequencing, Body Camera, Predictive Software**
4. **Privacy, Ethics, Bandwidth, Legal Framework**
5. **IBIS, NCIC, AI, Instagram**



6. Answer the Questions

Provide full-sentence answers.

1. What was the main purpose of early ICT like the telegraph in policing?
2. How did punched card systems contribute to future developments?
3. What does AFIS stand for and what did it replace?
4. What new field of investigation did the rise of the internet create?
5. Name two features that characterize the "third wave" of investigative ICT.
6. How are cloud platforms used in modern investigations?
7. What is the role of predictive policing software?
8. Besides solving crimes, what issues does modern investigative ICT create?
9. What does the final sentence state as the "core task"?
10. In your own words, what is the overall journey described in the text?



7. Discussion & Role-Play Prompts

Discuss in pairs or small groups.

1. **The Biggest Leap:** Which of the three "waves" of ICT do you think brought the most significant change to *day-to-day* investigative work? Justify your choice.

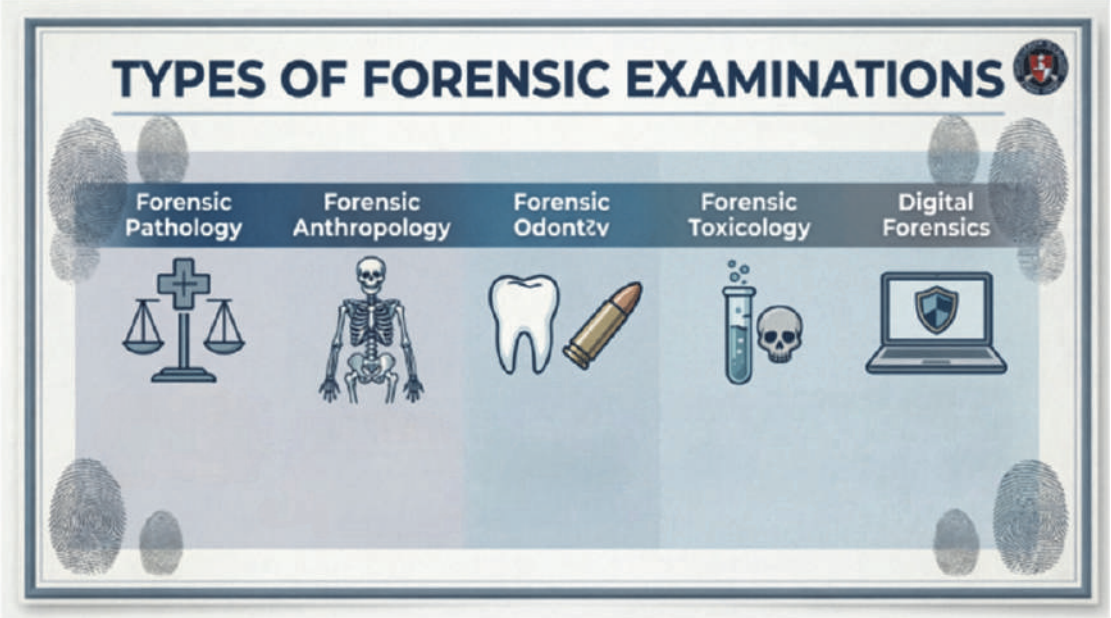
2. **Locard in the Digital Age:** How does Edmond Locard's principle ("Every contact leaves a trace") manifest in the context of modern ICT? Give an example of a "digital trace."

3. **The Double-Edged Sword:** Discuss a specific **benefit** and a specific **risk** associated with one of these technologies: predictive policing algorithms, integrated biometric databases, or AI evidence analysis.

4. **The Future Scene:** Imagine a crime scene in 2040. Describe how investigators might use ICT tools that are advanced versions of today's technologies.

5. **The Human Element:** The text concludes that technology should enhance, not replace, human judgement. Can you think of a situation in an investigation where human judgement would be *crucial* despite having advanced ICT tools? Why?

UNIT II. TYPES OF FORENSIC EXAMINATIONS



Text 1. Types of Forensic Examinations

Forensic science is a multidisciplinary field that applies scientific principles to legal questions. Various types of examinations are conducted on evidence to reconstruct events or establish links in an investigation. Here are some of the primary categories:

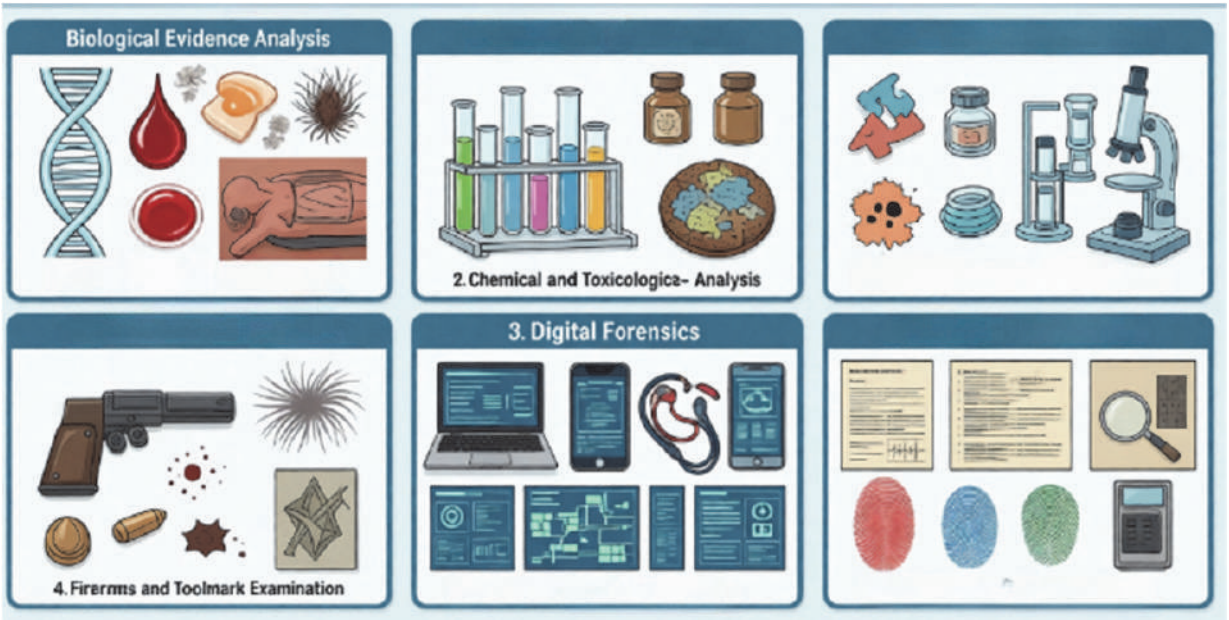
1. **Biological Evidence Analysis:** This involves the examination of materials of biological origin. The most common is **DNA analysis**, which can identify individuals with extremely high precision from blood, saliva, hair roots, or skin cells. Other areas include serology (body fluids) and forensic pathology (autopsies to determine cause of death).

2. **Chemical and Toxicological Analysis:** Forensic chemists analyze non-biological substances. This includes identifying **drugs and narcotics**, analyzing **explosives and their residues**, and examining **paint, glass, or soil** for comparative analysis. Toxicologists specifically test bodily fluids for the presence of **poisons, alcohol, or drugs**.

3. **Trace Evidence Analysis:** This discipline deals with microscopic or small-scale evidence that can be transferred between people, objects, or locations.

Experts examine **fibers** (from clothing, carpets), **hair** (for morphological comparison), **gunshot residue** (GSR), and other particulate matter.

4. **Firearms and Toolmark Examination:** Firearms examiners test weapons to determine if a particular bullet or cartridge case was fired from a



specific gun. They also analyze **toolmarks** left by screwdrivers, crowbars, or other instruments on surfaces at a crime scene.

5. **Digital Forensics:** This fast-growing field involves the recovery and investigation of data from **electronic devices** such as computers, smartphones, and GPS units. Experts recover deleted files, analyze internet history, and extract data to prove or disprove activity.

6. **Document Examination:** Questioned document examiners analyze the authenticity and origin of documents. This includes **handwriting and signature comparison**, analysis of paper and ink, detection of forgeries, and examination of indented writings.

7. **Fingerprint Analysis:** One of the oldest and most reliable forms of identification. Latent (invisible), patent (visible), or plastic (impressed) prints are recovered from scenes and compared against databases or prints from known individuals.

EXERCISES



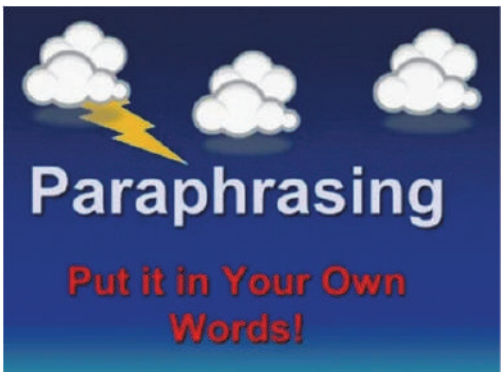
Exercise 1: Make Word Combinations (Match words from column A with words from column B to form terms from the text.)

List A:	**List B:**
1. biological	a) analysis
2. DNA	b) fluids
3. body	c) death
4. cause of	d) evidence
5. chemical	e) residue
6. gunshot	f) devices
7. electronic	g) forensics
8. digital	h) document
9. questioned	i) fingerprint
10. latent	j) and toxicological analysis

Exercise 2: Match the Columns (Connect the type of examination with its main subject.)

Column A:	**Column B:**
1. Biological Evidence Analysis	a) Analysis of drugs and explosives
2. Chemical Analysis	b) Examination of fibers and gunshot residue
3. Trace Evidence	c) Determining if a bullet came from a specific gun
4. Firearms Examination	d) Study of DNA and body fluids
5. Digital Forensics	e) Testing for poisons in blood

6. Document Examination	f) Recovery of data from smartphones
7. Toxicology	g) Handwriting comparison and forgery detection



Exercise 3: Paraphrase the Following (Rewrite the sentences in your own words.)

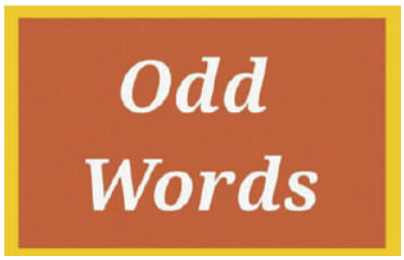
1. Forensic science applies scientific principles to legal questions.
2. DNA can identify individuals with extremely high precision.
3. Toxicologists test bodily fluids for the presence of substances.
4. Trace evidence can be transferred between people and locations.
5. Experts analyze toolmarks left by instruments on surfaces.
6. Digital forensics is a fast-growing field.
7. Examiners analyze the authenticity and origin of documents.
8. Fingerprint analysis is one of the oldest forms of identification.
9. An autopsy is performed to determine the cause of death.
10. Paint and glass can be examined for comparative analysis.



Exercise 4: True/False (Mark the statements as T or F based on the text.)

1. Forensic pathology is a part of biological evidence analysis.
2. Chemical analysis only deals with biological substances.
3. Hair analysis for DNA is part of trace evidence.

4. Toolmark examination is unrelated to firearms.
5. Digital forensics can involve recovering deleted files.
6. Document examination includes DNA testing.
7. Latent fingerprints are clearly visible to the naked eye.
8. Serology is the study of body fluids.
9. The main goal of toxicology is to analyze soil samples.
10. Comparative analysis can be done with materials like paint.



Exercise 5: One Word is Odd (Find and cross out the word that does not fit the category.)

1. *Biological evidence:* blood, saliva, explosive**,** hair root, skin cell.
2. *Digital devices:* computer, smartphone, screwdriver**,** GPS, tablet.
3. *Trace evidence:* fiber, DNA profile, autopsy**,** gunshot residue, hair.
4. *Examined by toxicologist:* alcohol, poison, drug**,** ink**,** narcotic.
5. *Types of fingerprints:* latent, plastic, forged**,** patent.
6. *Related to documents:* handwriting, signature, cartridge case**,** paper, ink.
7. *Duties of a firearms examiner:* test weapons, analyze toolmarks, compare fibers**,** match bullets.
8. *Chemical analysis subjects:* glass, soil, body fluid**,** paint, explosives.
9. *Synonyms for "examination":* analysis, investigation, transfer**,** study, inspection.
10. *Goals of forensics:* identify individuals, reconstruct events, commit crimes**,** establish links.



Exercise 6: Answer the Questions (Provide short answers based on the text.)

1. What is the main purpose of forensic science?
2. Name two substances a forensic chemist might analyze.
3. What kind of evidence is examined under "Trace Evidence Analysis"?
4. What do firearms examiners compare to link a bullet to a gun?
5. From which devices can digital forensics experts recover data?
6. What does a questioned document examiner study?
7. What are the three main types of fingerprints mentioned?
8. Which examination is used to determine the cause of death?
9. What does GSR stand for?
10. Which type of analysis provides the highest precision for personal identification?



Exercise 7: Close the Gap (Fill in the blanks with a suitable word from the text.)

A forensic 1) _____ is often called to a crime scene. He collects various types of evidence. If he finds a bloodstain, it will be sent for 2) _____ analysis to possibly identify a suspect. A piece of cloth with a strange fiber on it goes to the 3) _____ evidence department. A recovered bullet is crucial for the 4) _____ examiner. To check if the victim was poisoned, a 5) _____ will test his blood. The suspect's computer is seized for 6) _____ forensics to check his emails. A threatening note is given to the 7) _____ document expert for handwriting analysis. Finally, a 8) _____ fingerprint found on the window is lifted and run through the database. All these 9) _____ help to build a solid case for the 10) _____ process.

Text 2: Types of Forensic Examinations and ICT (Information and Communications Technology)

Forensic science has fundamentally expanded with the digital revolution, creating the specialized field of **digital forensics** or **digital forensic science**. This branch applies scientific principles and investigative procedures to the

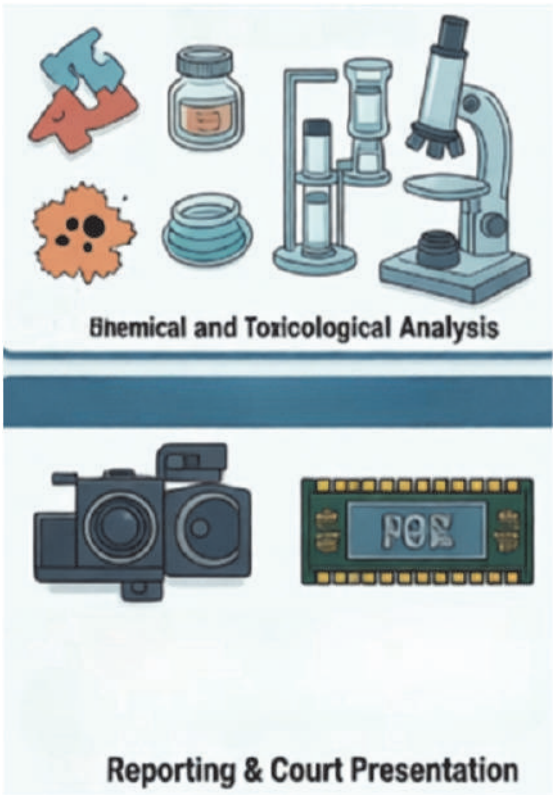
recovery and examination of material from digital devices, often in relation to computer crime or civil litigation.

In its strictest sense, digital forensics is the **application of science to the identification, collection, examination, and analysis of digital data while preserving its integrity and a strict chain of custody**. The field is commonly divided into several sub-disciplines based on the type of evidence or device involved:



- **Computer Forensics**: The examination of evidence found on computers, laptops, and traditional storage media.
- **Mobile Device Forensics**: The recovery of electronic evidence from mobile phones, smartphones, tablets, GPS devices, and similar gadgets.
- **Network Forensics**: The monitoring and analysis of network traffic and events to discover the source of security attacks, intrusions, or breaches.
- **Digital Image Forensics**: The analysis of photographic images to validate their authenticity by examining metadata and file history.
- **Digital Video/Audio Forensics**: The evaluation of sound and video recordings to establish whether they are original or have been tampered with.
- **Memory Forensics**: The recovery of evidence from the volatile RAM of a running computer system, also known as live acquisition.

The standard forensic process involves key phases to ensure evidence is handled correctly. It begins with the **identification** of potential evidence and



the **acquisition** or forensic imaging of data, often creating a **bit-by-bit copy** of storage media. This is followed by the **analysis** phase, where a "deep dive" is performed to interpret the data. Finally, findings are compiled in a detailed **report** and may be presented in court. Throughout this process, maintaining a verifiable **chain of custody** for all evidence is paramount.

The rise of complex cybercrime, cloud infrastructure, and the **Internet of Things (IoT)** ensures that ICT will remain a central and growing pillar of modern forensic practice.

Exercises for English Practice



Exercise 1: Match the Columns (Connect the digital forensics sub-discipline with its correct definition.)

Column A:	**Column B:**
1. Computer Forensics	a) Examining network traffic to find the source of a security breach
2. Mobile Device Forensics	b) Recovering evidence from smartphones, tablets, and GPS units
3. Network Forensics	c) Analyzing photos to check their authenticity via metadata
4. Memory Forensics	d) Investigating evidence on laptops and hard drives
5. Digital Image Forensics	e) Extracting data from the temporary RAM of a live computer



Exercise 2: Complete the Glossary (Fill in the blanks with the correct term from the list below.)

Terms: acquisition, chain of custody, forensic image, RAM, metadata, bit-by-bit copy, integrity, volatile, cloud infrastructure, analysis.

1. A _____ is an exact duplicate of a storage device used for examination.
2. The _____ is the documented history of who handled evidence and when.
3. The process of collecting digital data is called _____.
4. Data in _____ is lost when the computer is powered off.
5. _____ is the phase where recovered data is interpreted and understood.
6. _____ refers to background information about a file, like creation date.
7. Preserving evidence _____ means ensuring it is not altered.
8. Servers and applications hosted online are part of _____.
9. Another term for a forensic image is a _____.
10. Live acquisition often targets _____ for evidence of recent activity.



Exercise 3: Paraphrase the Following (Rewrite these sentences in your own words in English.)

1. Digital forensics is a branch of forensic science focusing on digital devices.
2. Evidence must be acquired in a manner that protects its integrity.
3. The analysis phase involves a deep dive into the collected evidence.
4. Mobile device forensics covers recovery from smartphones and tablets.
5. A chain of custody documents the handling of evidence.
6. Network forensics discovers the source of security attacks.
7. A forensic image is a copy of every sector on a storage device.
8. Digital video forensics establishes the authenticity of a recording.
9. The field evolved due to the rise of computer crime.
10. Reporting breaks down technical findings for the client.



Exercise 4: True or False? (Mark the statements as T (true) or F (false) based on the text.)

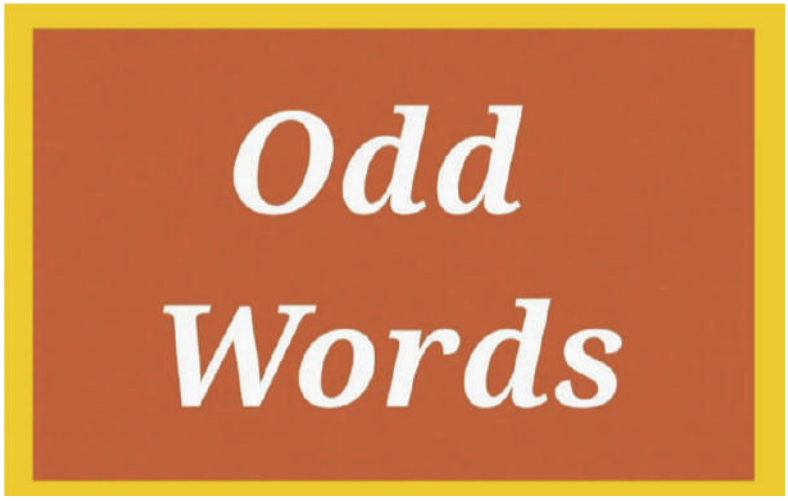
1. Digital forensics is only used for investigating cybercrime.
2. Computer forensics and mobile device forensics are identical disciplines.
3. Memory forensics deals with data from a computer's hard drive.
4. The chain of custody is an important legal concept for evidence.
5. "Acquisition" and "forensic imaging" refer to different processes.
6. Network forensics analyzes internet traffic patterns.
7. Metadata can help verify the history of a digital image.
8. Digital evidence is typically examined directly on the original device.
9. A report is the final phase of the digital forensic process.
10. Cloud servers can be a source of digital evidence.



Exercise 5: Scenario Analysis (Read the mini-case and answer the questions.)

A company, "Smith Co.", suffers a ransomware attack. Their files are encrypted, and a ransom note appears. The IT contractor finds that workstations, servers, and backups are locked. The company's insurer hires a digital forensics expert.

1. What is the main type of incident described?
2. Which digital forensics sub-discipline is most relevant here?
3. What might be the expert's first step regarding the encrypted servers?
4. Why would the expert also examine firewall and network switch logs?
5. What is the expert trying to determine by looking for "data exfiltration"?
6. Should the expert work on the original servers or a copy? Why?
7. What final product will the expert give to the insurance company?
8. Besides criminal intent, what other business obligation might this investigation address?
9. Name one type of sensitive data (PII) the expert might search for.
10. What principle requires the expert to document every action taken?



Exercise 6: Find the Odd One Out (In each group, cross out the term that is NOT directly related to the others.)

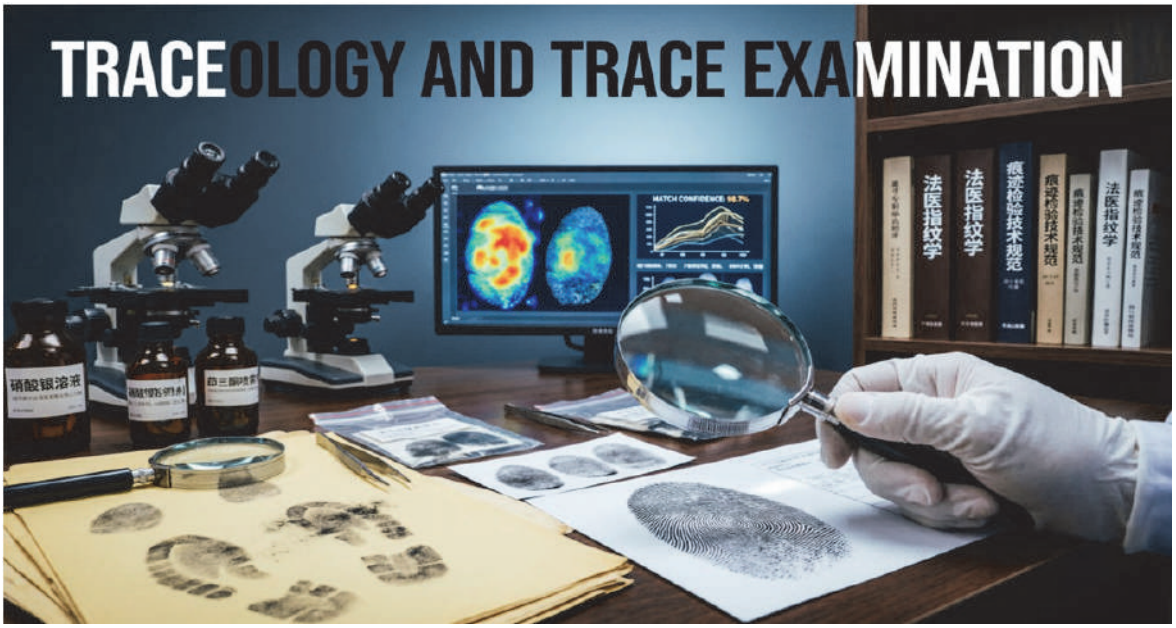
1. **Digital Forensics Sub-disciplines:** computer forensics, toxicology, network forensics, mobile forensics.
2. **Storage Media:** hard drive, RAM, USB stick, ransom note.
3. **Forensic Process Steps:** identification, acquisition, speculation, reporting.
4. **Network Evidence Sources:** firewall logs, server images, witness statement, proxy records.
5. **Related to Data Integrity:** chain of custody, write blocker, hashing algorithm, word processor.
6. **Types of Data:** email, spreadsheet, fingerprint powder, database log.
7. **Attack Types:** ransomware, malware, network breach, audio authentication.
8. **Cloud Examples:** Office 365, SAAS, local desktop application, IAAS.
9. **Mobile Devices:** smartphone, tablet, GPS, desktop server.
10. **Investigation Goals:** determine root cause, preserve evidence, alter data, create timeline.



Exercise 7: Word Combinations (Match a verb from List A with a term from List B to form a common phrase from digital forensics.)

Column A:	**Column B:**
1. preserve	a) the integrity
2. recover	b) a forensic image
3. analyze	c) digital evidence
4. maintain	d) the chain of custody
5. create	e) data from a phone
6. validate	f) network logs
7. examine	g) the authenticity
8. breach	h) a security
9. identify	i) potential evidence
10. collect	j) metadata

UNIT III. TRACEOLOGY AND TRACE EXAMINATION



Текст: "Traceology and Trace Examination"

1. Introduction: The Core of Forensic Investigation

Traceology is the forensic discipline dedicated to the scientific examination, analysis, and interpretation of material traces left by activities. These traces, often microscopic, form an "imperfect record" of past events and are central to reconstructing what happened. The field is fundamentally guided by **Locard's Exchange Principle**, which states that "every contact leaves a trace." This means when two objects or persons interact, a transfer of materials occurs. The goal of traceology is to analyze these transferred materials to establish links between people, objects, and locations involved in an incident.

2. The Vast Scope of Trace Evidence

Almost any material can become trace evidence. It is defined not by a specific substance but by its mode of transfer during a unique event. Examiners are versatile scientists who deal with a wide array of materials including:

- **Fibers and Hairs:** Textile fibers (natural or synthetic) and hairs, which can demonstrate contact.

- **Glass and Paint:** Fragments from windows, vehicles, or painted



surfaces.

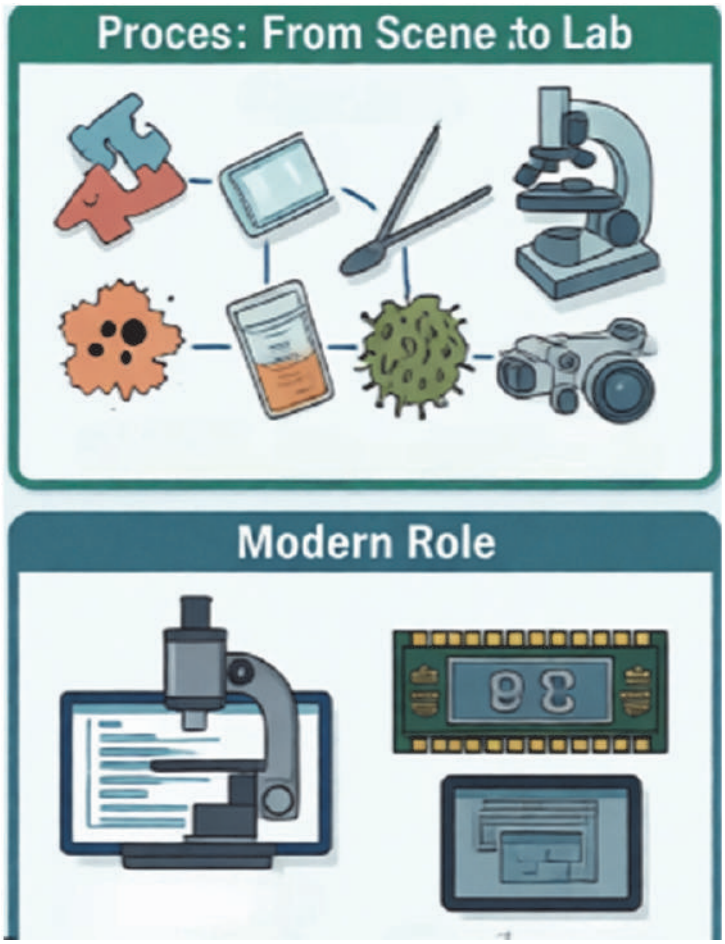
- **Gunshot Residue (GSR):** Particles containing elements like lead, barium, and antimony.
- **Soil, Pollen, and Botanical Materials.**
- **Polymers, Plastics, and Adhesive Tapes.**
- **Fractured Materials:** Where broken pieces can be physically matched back together.

3. The Process: From Scene to Laboratory

The value of trace evidence depends on the entire investigative process.

- **Recognition & Collection:** This is the most critical step, as traces can be invisible to the naked eye. Proper techniques are essential to prevent loss or contamination. Common methods include **tape lifting**, vacuuming, and manual picking with tools. Items should be packaged separately in sealed paper containers, not plastic bags, to preserve evidence.

- **Examination & Analysis:** In the lab, examiners use a hierarchy of methods, starting with microscopy. Key instruments include the stereomicroscope, comparison microscope, and polarized light microscope. Chemical analysis is performed using instruments like **Fourier Transform Infrared (FTIR) spectroscopy** and **Gas Chromatography-Mass Spectrometry (GC-MS)**.



- **Interpretation:** The final step involves interpreting results within the case context. An examiner may seek to identify a material's source, link multiple crimes, or evaluate how the evidence supports or contradicts an alleged sequence of events. The evidentiary value is higher for rare or unusual materials.

4. Modern Role and Relevance

Despite the prominence of DNA analysis, trace evidence remains a critical and often indispensable tool. It can be the sole link in cases with no biological evidence and is powerful for **crime scene reconstruction**, helping establish the sequence of events or the positions of individuals. Contemporary criminalistics aims to integrate traceology's holistic, scene-focused approach with modern analytical science to build robust and reliable evidence.



1. Make Word Combinations

Build technical vocabulary and common forensic phrases.

Match a word from List A with one from List B to form a term from the text.

List A:	**List B:**
1. Exchange	a) Principle
2. Trace	b) Evidence
3. Physical	c) Match
4. Crime scene	d) Reconstruction
5. Polarized light	e) Microscope



2. Match the Columns

Link related concepts, definitions, and examples.

Match the type of evidence (1-3) with its description (a-c).

Column A:	Column B:
1) Gunshot Residue	a) Can be physically matched to a source object.
2) Fractured Material	b) A particle often containing lead and barium.
3) Fiber	c) Can transfer between clothing during contact.



3. Paraphrase the Following

Practice explaining complex ideas in simpler or alternative English.

Rephrase these sentences:

"Locard's Exchange Principle states that every contact leaves a trace."

"The evidentiary value is higher for rare or unusual materials."



4. True / False / Not Stated

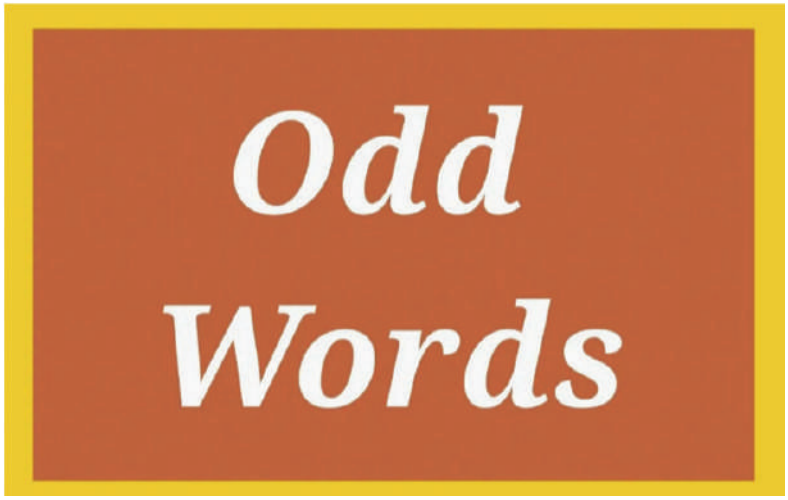
Develop careful reading and information verification skills.

Decide if each statement is T, F, or NS:

a) Trace evidence should always be packaged in plastic bags.

b) FTIR spectroscopy is a chemical analysis method.

c) All forensic laboratories use the same software for fiber analysis.



5. One Word is Odd

Refine understanding of thematic categories and professional logic.

Identify the unrelated word in each group:

Group: Stereomicroscope, GC-MS, Tweezers, Police Radio**.**



6. Answer the Questions

Improve information retrieval and formulation of full-sentence answers.

Q1: What is the main goal of trace evidence interpretation?

Q2: Name two methods for collecting trace evidence from a garment.



7. Discussion & Case Analysis

Develop spoken fluency, argumentation, and application of principles. Discuss in pairs or small groups:

"A single common fiber is found on a suspect. What factors would an examiner consider to assess its value as evidence?"

Text: The Use of Information and Communication Technologies (ICT) in Traceology and Trace Examination

Trace evidence—encompassing microscopic materials like fibres, glass fragments, paint, and gunshot residue—remains a cornerstone of forensic investigation, operating on the fundamental principle that "every contact leaves a trace". Today, information and communication technologies (ICT) are fundamentally transforming this discipline, revolutionizing how trace evidence is detected, analyzed, and interpreted at every stage.

Detection and Documentation. The initial, critical step of finding trace evidence has been dramatically enhanced by digital imaging tools. Studies show



that technologies like portable digital microscopes and alternate light sources (ALS) detect significantly more evidence on bodies and clothing than naked-eye observation alone. These tools allow examiners to see and document particles invisible under normal light. Furthermore, modern software suites enable the real-time capture of high-resolution images with features like calibrated measurement grids, allowing for precise digital documentation of an item's size, shape, and position.

Advanced Laboratory Analysis. In the laboratory, ICT integrates sophisticated hardware and software into modular analysis systems. Key techniques powered by ICT include:

- **Raman Spectroscopy:** Uses lasers to create a molecular "fingerprint" of substances like paint, drugs, or explosives, which can be compared against digital spectral libraries.
- **Glass Refractive Index Measurement (GRIM):** Automated systems measure the optical properties of glass fragments with high statistical accuracy, determining if samples could share a common source.

- **Microspectrometry:** Combines microscopy with spectrometry to objectively measure and compare the colour and chemical composition of tiny samples like fibres or hairs.

Data Analysis and Intelligence. ICT elevates trace evidence from simple observation to complex intelligence. Specialized software allows for side-by-side digital comparison of evidence samples, using features like image superimposition or subtraction to highlight similarities and differences. In the realm of **digital image forensics**, ICT techniques such as metadata analysis, error level analysis, and reverse image searching are used to authenticate images, detect manipulations, and trace the origins of digital visual evidence. Artificial Intelligence (AI) is emerging to assist in categorizing images and identifying patterns within vast datasets.

In conclusion, ICT is not merely an adjunct to traceology but is now integral to its practice. These technologies expand the limits of what is detectable, provide objective and quantifiable analysis, and enable the efficient management and comparison of complex data. They empower forensic scientists to extract maximum intelligence from minute traces, thereby strengthening the links between people, objects, and places in the pursuit of justice.

EXERCISES

Here are seven different exercise formats with ten tasks each, designed to reinforce the vocabulary and concepts from the text above.



1. Make Word Combinations

Combine a word from List A with a word from List B to form a key term or phrase from the text.

List A:	**List B:**
1. trace	a) evidence
2. alternate	b) light source
3. refractive	c) index
4. Raman	d) spectroscopy
5. digital	e) image forensics
6. gunshot	f) residue
7. artificial	g) intelligence
8. error level	h) analysis
9. calibrated	i) measurement grids
10. modular	j) analysis system

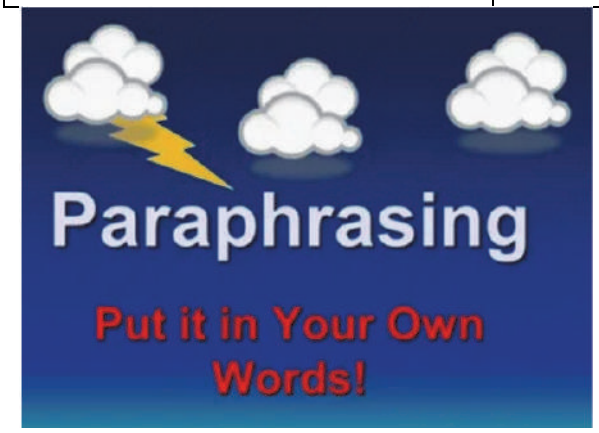


2. Match the Columns

Match the ICT tool or technique (Column A) with its primary function in traceology (Column B).

Column A:	**Column B:**
1. Portable Digital Microscope	a) Categorizes images and identifies patterns in large datasets
2. Raman Spectroscopy	b) Traces the online origin of a digital image
3. GRIM System	c) Creates a molecular fingerprint of a substance
4. Reverse Image Search	d) Examines recorded data (e.g., time,

	location) within a digital file
5. AI Software	e) Allows for the integration of multiple analytical techniques in one platform
6. Microspectrometer	f) Provides high-resolution magnification for detecting minute particles
7. Alternate Light Source (ALS)	g) Reveals evidence by causing materials to fluoresce under specific wavelengths
8. Metadata Analysis	h) Measures the optical properties of glass fragments
9. Calibrated Measurement Grids	i) Enables precise digital measurements of an object's dimensions
10. Modular Analysis System	j) Objectively measures the colour and composition of tiny samples like fibres



. 3. Paraphrase the Following

Restate these sentences from the text in your own words.

1. ICT is fundamentally transforming the discipline of traceology.

2. These tools allow examiners to see and document particles invisible under normal light.

3. ICT elevates trace evidence from simple observation to complex intelligence.

4. Specialized software allows for side-by-side digital comparison of evidence samples.

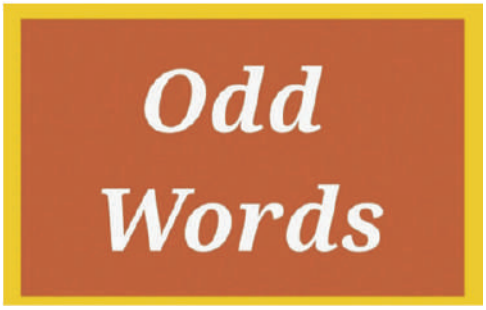
5. They empower forensic scientists to extract maximum intelligence from minute traces.



4. True / False / Not Stated

Based on the text, decide if each statement is True (T), False (F), or if the information is Not Stated (NS).

1. Naked-eye observation is more effective than an alternate light source for finding fibres on clothing.
2. Raman spectroscopy is used to analyze the molecular structure of paint chips.
3. GRIM stands for "Glass Refractive Index Measurement."
4. Error level analysis is a technique used to determine the age of a bloodstain.
5. AI can be used to sort through thousands of digital images to find relevant evidence.
6. All modern trace evidence laboratories use the exact same brand of software.
7. Portable digital microscopes performed best in a cited study comparing detection tools.
8. ICT tools only help in the laboratory analysis phase, not at the crime scene.
9. Digital measurement grids help document the exact size of a piece of evidence.
10. The primary goal of ICT in traceology is to replace human examiners entirely.



5. One Word is Odd

Identify which word in each group does not thematically belong to the others and explain why.

1. **Fibre, Glass, Testimony, Paint**.
2. **Microscope, Spectroscopy, GRIM, Handcuffs**.
3. **Detection, Analysis, Interpretation, Arrest**.
4. **Software, Algorithm, Database, Magnifying Glass**.
5. **Raman, ALS, JPEG, FTIR**.



6. Answer the Questions

Provide full-sentence answers based on the text.

1. What is the core forensic principle that trace evidence is based on?
2. Name two ICT tools mentioned that improve the detection of trace evidence at a scene or on a body.
3. What kind of "fingerprint" does Raman spectroscopy create for a substance?
4. What property of glass does a GRIM system measure?
5. How does microspectrometry help in analyzing fibres?
6. What are two specific techniques mentioned under the field of digital image forensics?
7. According to the text, how can Artificial Intelligence (AI) assist investigators?

8. What is one advantage of using software with calibrated measurement grids?

9. What is the main purpose of a modular analysis system in a lab?

10. What is the overall impact of ICT on the forensic scientist's work with trace evidence, according to the conclusion?

11. 7. Discussion & Case Simulation Prompts



Discuss these topics in pairs or prepare a short written response.

1. **Scene Strategy:** You are the first forensic expert at a burglary scene with a broken window. Which ICT tools for trace evidence detection would you prioritize using first and why?

2. **Tool Comparison:** Compare and contrast the roles of an Alternate Light Source (ALS) and a portable digital microscope. In what scenarios might one be more useful than the other?

3. **The Digital Dimension:** A suspect's phone contains a photo of stolen jewellery. How could techniques from **digital image forensics** (like metadata or reverse image search) be used as "trace evidence" in this investigation?

4. **Interpreting Data:** A Raman spectroscopy analysis shows a match between paint on a suspect's tool and paint from a vandalized door. What does this "match" scientifically mean, and what questions should an investigator still ask?

5. **The Human Element:** The text states that AI helps categorize images. What are the potential benefits and risks of relying on software to filter or prioritize evidence for human review?

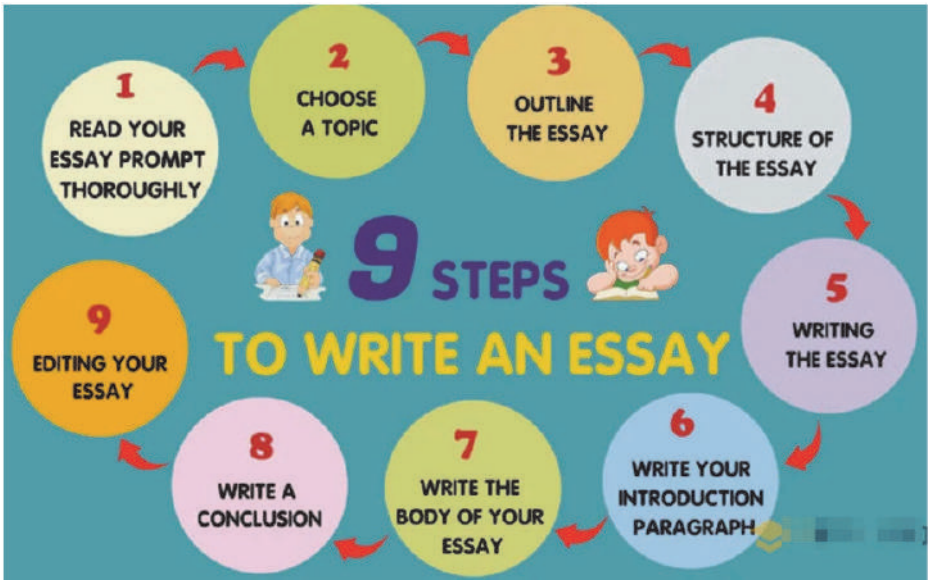
6. **Future Tech:** Based on current trends, what is one new ICT application you can imagine being used in traceology 10 years from now? Describe its potential function.

7. **Chain of Custody:** How can ICT tools (like software logs or digital metadata) help maintain and demonstrate the integrity of trace evidence from the scene to the courtroom?

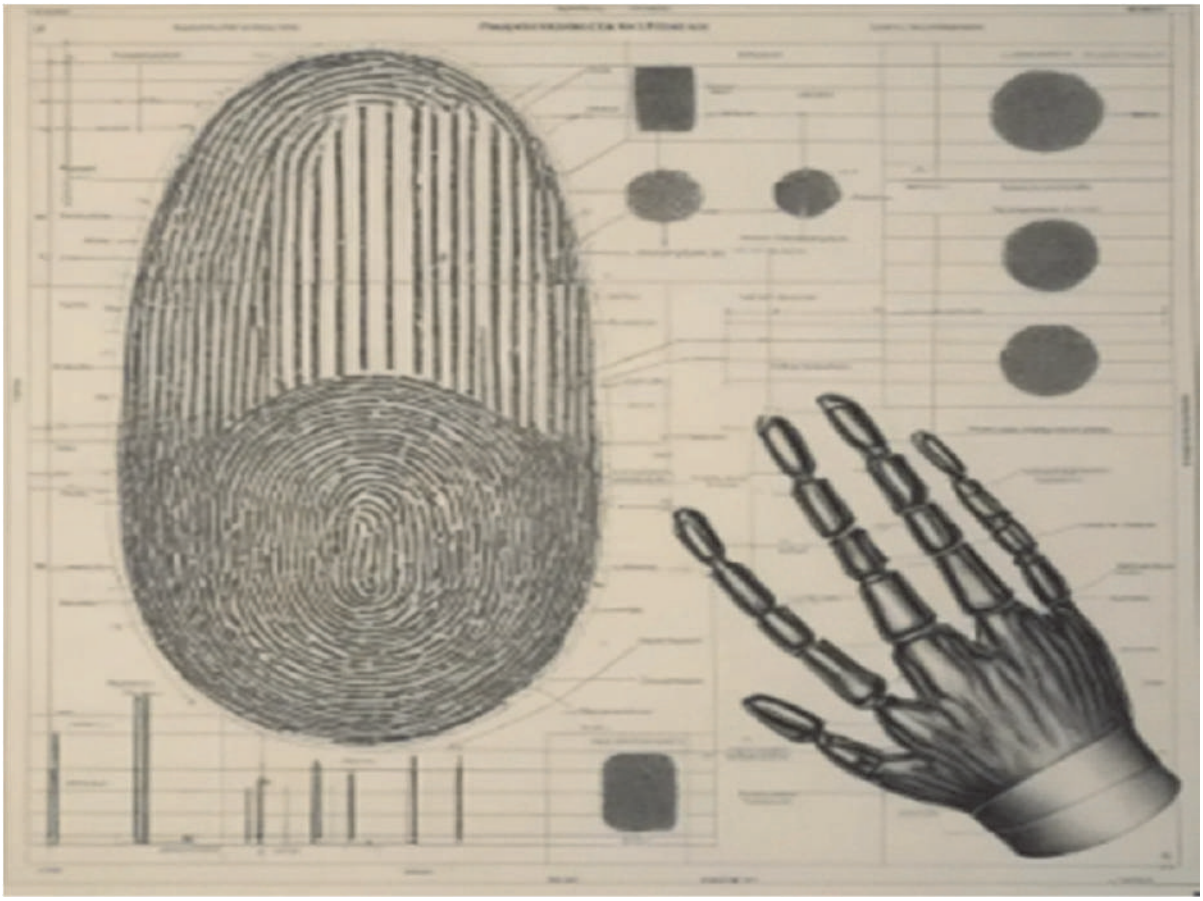
8. **Limits of Technology:** Consider a tiny, mixed debris sample containing soil, plant matter, and synthetic fibres. Which ICT techniques would be best to analyze it, and what might still require an expert's traditional microscopic skill?

9. **Justifying Investment:** A lab director must choose between funding a new GRIM module or hiring an additional technician. Using arguments from the text, make a case for the investment in ICT.

10. **Integrated Conclusion:** Explain in your own words how ICT transforms a single fibre from being just a "find" at a scene into a powerful piece of "intelligence" in a case.



UNIT IV. DACTYLOSCOPY AND FINGERPRINT EXAMINATION



Text 1: Dactyloscopy and Fingerprint Examination

Dactyloscopy is the science of fingerprint identification. Its fundamental principle is that the friction ridge patterns on human fingertips are unique, permanent, and can be systematically classified.

Fingerprints consist of raised **ridges** and depressed **furrows**. The overall patterns formed by these ridges are categorized into three primary types: **arches**, **loops**, and **whorls**. Loops are the most common pattern. For positive identification, experts analyze specific **minutiae**—unique ridge characteristics such as endings, bifurcations, or dots that are not visible to the naked eye.

Prints recovered from scenes are typically **latent** (invisible, made by sweat or oil), **patent** (visible, made by substances like blood or ink),

or **plastic** (three-dimensional impressions in soft materials). Latent prints require development using powders, chemicals like **cyanoacrylate** (super glue) fuming, or specialized light sources.

The examination process has distinct phases. The first is **analysis**, where a print's type, clarity, and suitability are assessed. The second is **comparison**, where it is meticulously compared against a known print, focusing on the sequence of minutiae. This may be done manually or through an **Automated Fingerprint Identification System (AFIS)**, a database that searches millions of digitized records. A human examiner must always verify any AFIS match.

Fingerprint experts must be detail-oriented and follow a strict scientific methodology. They also prepare evidence for court and may testify as expert witnesses.



EXERCISES FOR ENGLISH PRACTICE



Exercise 1: Match the Columns (Connect the term with its correct definition.)

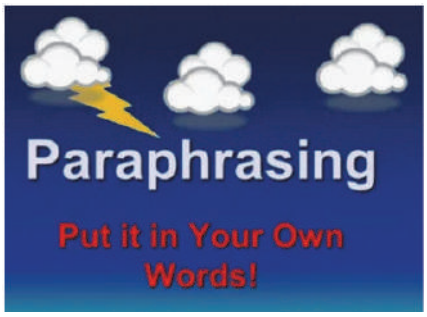
Column A:	**Column B:**
1. Dactyloscopy	a) A visible fingerprint left in a substance like blood
2. Minutiae	b) The primary component of super glue, used for fuming
3. Latent Print	c) The science of fingerprint identification
4. AFIS	d) A pattern where ridges form circular or spiral shapes
5. Cyanoacrylate	e) An invisible fingerprint made by natural skin secretions
6. Patent Print	f) A tool for counting the number of ridges between points
7. Furrow	g) The valley between two friction ridges
8. Whorl	h) A structure at the center of a fingerprint pattern
9. Ridge Counter	i) An automated system for searching fingerprint databases
10. Core	j) Unique ridge characteristics used for identification



Exercise 2: Word Combinations (Complete the phrases with a word from the list below.)

Words: identification, examination, database, custody, pattern, prints, scene, ridge, expert, witness.

1. friction _____
2. chain of _____
3. crime _____
4. loop _____
5. fingerprint _____
6. ten _____
7. automated _____
8. latent _____
9. expert _____
10. positive _____



Exercise 3: Paraphrase the Following (Rewrite the sentences in your own words.)

1. Dactyloscopy relies on the analysis of ridge patterns.
2. Latent fingerprints are not ordinarily visible.
3. An AFIS search can rapidly scan millions of records.
4. A human examiner must verify any computer match.
5. The uniqueness of minutiae allows for positive identification.
6. Patent prints may be left in blood or dirt.
7. The examination follows a strict scientific methodology.

8. Experts may need to present evidence in court.
9. Fingerprint patterns are permanent throughout life.
10. Chemical treatments are used to develop latent prints.



Exercise 4: True or False? (Mark the statements as T (true) or F (false) based on the text.)

1. Loops, whorls, and arches are the three main fingerprint pattern types.
2. Minutiae are clearly visible to the naked eye.
3. Dactyloscopy is another term for footprint analysis.
4. AFIS makes final identifications without human input.
5. A plastic print is a three-dimensional impression.
6. The core and delta are important features for classification.
7. Cyanoacrylate is used to develop prints on porous surfaces like paper.
8. Fingerprint evidence is rarely used in court proceedings.
9. The first phase of examination is the comparison of two prints.
10. Fingerprints can change significantly over a person's lifetime.



Exercise 5: Complete the Table (Fill in the blanks using the terms provided.)

Terms: loops, minutiae, latent, whorls, patent, arches, plastic, visible, dusting, cyanoacrylate.

Print Type	**Description**	**Common Development Method**
1. _____	Visible to the naked eye (e.g., in ink or blood).	Photography
2. _____	Invisible, made by sweat or oil.	3. _____ with powder or 4. _____ fuming.
5. _____	3D impression in soft material like clay or wax.	Photography
Main Pattern Types	**Description**	**Common Development Method**
6. _____	Ridges enter on one side and flow out the other with a rise in the center.	
7. _____	Ridges enter, curve, and exit on the same side. (Most common pattern).	
8. _____	Ridges form circular or spiral patterns.	
Key Feature for ID	**Description**	**Common Development Method**
9. _____	Unique ridge characteristics (endings, bifurcations).	Analyzed using a 10. _____ (tool).



Exercise 6: Answer the Questions (Provide short answers based on the text.)

1. What are the two main phases of a fingerprint examination?
2. What does the acronym AFIS stand for?
3. Name one chemical used to develop latent fingerprints.
4. What is the main purpose of a ridge counter?
5. Why is a "chain of custody" important for fingerprint evidence?
6. What is the difference between a radial loop and an ulnar loop?
7. According to the text, what must happen after AFIS proposes a match?
8. Name one characteristic, besides pattern type, that an examiner analyzes.
9. What is the valley between two friction ridges called?
10. What is the singular most important principle that allows fingerprints to identify individuals?

Exercise 7: Find the Odd One Out (In each group, cross out the term that does NOT fit the category.)

1. **Fingerprint Patterns:** loop, whorl, delta, arch.
2. **Print Types:** latent, plastic, patent, minutiae.
3. **Development Methods:** dusting, cyanoacrylate, photography, AFIS.
4. **Examiner's Tools:** magnifying loupe, ridge counter, ink pad, DNA sequencer.

5. **Database Types:** criminal records, eliminational, international, cyanoacrylate.

6. **Ridge Features:** core, bifurcation, island, fingerprint powder.

7. **Professional Skills:** attention to detail, knowledge of court procedures, ability to perform autopsies, patience.

8. **Evidence Context:** crime scene, mortuary, fingerprint card, pharmaceutical lab.

9. **Forensic Disciplines:** dactyloscopy, toxicology, DNA analysis, accounting.

10. **Pattern Sub-types:** plain arch, tented arch, central pocket loop, latent loop.

Text 2: The Role of Information and Communications Technology (ICT) in Dactyloscopy and Fingerprint Analysis

Dactyloscopy, the science of fingerprint identification, has been transformed by Information and Communications Technology (ICT). Modern systems have moved far beyond manual card catalogues and magnifying glasses, creating a



faster, more accurate, and globally connected discipline.

The cornerstone of this revolution is the **Automated Fingerprint Identification System (AFIS)**. An AFIS is a computerized database that stores, searches, and retrieves digital fingerprint images. It works by converting a

fingerprint's unique **ridge patterns** (loops, whorls, arches) and **minutiae points** (ridge endings, bifurcations) into a mathematical code or **template**. This allows the system to compare a **latent print** (one found at a crime scene) against millions of **ten-print records** (known fingerprints) in minutes, generating a shortlist of potential matches for a human examiner to verify.

ICT aids at every stage of the process:

- **At the Crime Scene**: Officers use **digital cameras** and specialized **portable scanners** to capture high-resolution images of latent prints without damaging the evidence.
- **In the Laboratory**: **Digital enhancement software** is used to clarify poor-quality latent prints. Experts can adjust **contrast**, apply **filters**, and digitally "lift" a print from a complex background to make ridge details more visible for analysis and comparison.
- **Identification and Verification**: After the AFIS proposes candidates, the examiner uses **comparison software** with side-by-side viewing, zoom, and measurement tools to make the final **identification** or **exclusion**.
- **Databases and Networking**: National and international AFIS databases can be linked, allowing for cross-border searches. **Biometric systems** at borders or for secure access often use fingerprint templates derived from the same ICT principles.

In summary, ICT has elevated dactyloscopy from a purely manual, localized craft to a high-speed, digital science that is essential for modern forensic investigation and global security.

EXERCISES FOR ENGLISH PRACTICE

Exercise 1: Make Word Combinations (Match a word from Column A with a word from Column B to form a key term from the text.)

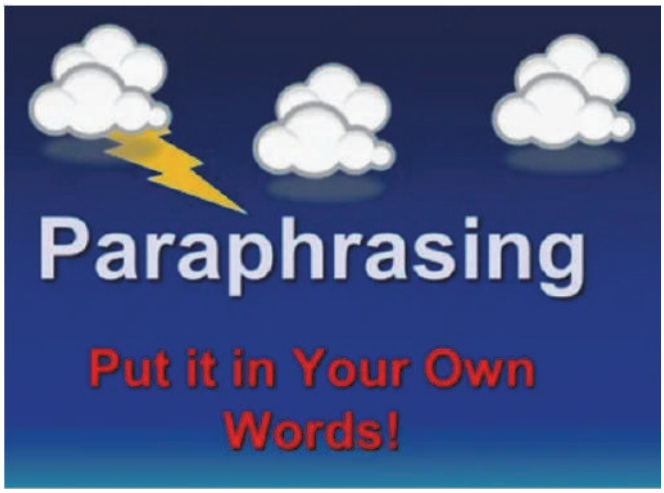
Column A:	**Column B:**
1. Automated	a) Template
2. Latent	b) Scanner
3. Ridge	c) Software
4. Minutiae	d) Fingerprint Identification System
5. Ten-print	e) Print
6. Digital	f) System
7. Biometric	g) Enhancement
8. Portable	h) Pattern
9. Comparison	i) Point
10. Mathematical	j) Record



Exercise 2: Match the Columns (Connect the ICT tool or concept with its correct function or description.)

Column A:	**Column B:**
1. AFIS	a) Used for secure access verification, often using fingerprints
2. Digital Enhancement Software	b) A database for storing and searching digital fingerprints

3. Portable Scanner	c) Features like ridge endings and bifurcations used for matching
4. Minutiae Points	d) Captures fingerprint images directly at a crime scene
5. Biometric System	e) Improves the clarity of a poor-quality latent print image



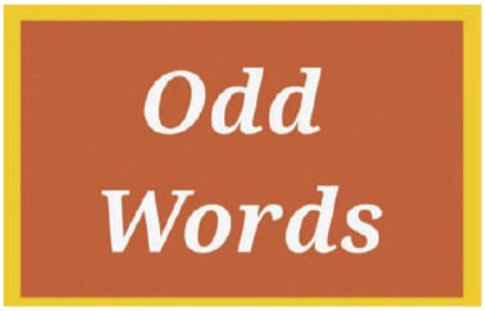
Exercise 3: Paraphrase the Following (Rewrite these sentences in your own words in English.)

1. Dactyloscopy has been transformed by Information and Communications Technology.
2. AFIS compares a latent print against millions of ten-print records.
3. Ridge patterns include loops, whorls, and arches.
4. A mathematical template is created from the fingerprint's unique features.
5. Digital cameras are used to capture images at the crime scene.
6. The examiner uses comparison software for the final verification.
7. National AFIS databases can be linked for international searches.
8. ICT has made fingerprint analysis faster and more accurate.
9. The system generates a shortlist of potential matches.
10. Manual card catalogues are now obsolete.



Exercise 4: True or False? (Mark the statements as T (true) or F (false) based on the text.)

1. AFIS stands for Automated Fingerprint Investigation Software.
2. A latent print is a known fingerprint taken from a person.
3. Minutiae points include ridge endings and bifurcations.
4. Digital enhancement software can adjust contrast and apply filters.
5. Portable scanners are used to analyze fingerprints in the laboratory only.
6. The final identification is always made by the AFIS computer without human input.
7. Biometric systems for border control may use fingerprint technology.
8. ICT has made fingerprint searching slower but more precise.
9. A ten-print record is a set of fingerprints taken from one individual.
10. Ridge patterns are not important for the AFIS matching algorithm.



Exercise 5: Find the Odd One Out (In each group, cross out the word or phrase that does NOT fit with the core topic of ICT in fingerprint analysis.)

1. **Core Technologies:** AFIS, Digital Camera, Magnifying Glass, Enhancement Software.
2. **Fingerprint Types:** Latent, Patent, Ten-print, Digital Template.

3. **Software Functions:** Adjust Contrast, Apply Filters, Dust for Prints, Zoom Image.

4. **Database Functions:** Store Records, Search Prints, Manually Compare Cards, Retrieve Templates.

5. **Analysis Features:** Ridge Pattern, Minutiae Point, Chemical Composition, Core.

6. **Equipment:** Portable Scanner, Comparison Software, Ink Pad, Biometric Reader.

7. **Process Stages:** Capture, Enhance, Analyse, Destroy Evidence.

8. **System Types:** National AFIS, Biometric System, International Database, Card Catalogue.

9. **Outputs:** Match List, Identification, Exclusion, Arrest Warrant.

10. **Key Concepts:** Speed, Accuracy, Digital, Handwriting Analysis.



Exercise 6: Answer the Questions (Provide short answers based on the text.)

1. What does the acronym AFIS stand for?

2. What are the two main unique features of a fingerprint that AFIS analyzes?

3. What is the purpose of digital enhancement software?

4. What is the difference between a *latent print* and a *ten-print record*?

5. Who makes the final decision on a fingerprint match: the AFIS or the human examiner?

6. Name one device mentioned that is used to collect fingerprints at a crime scene.

7. What is one advantage of linking national AFIS databases?

8. Besides forensics, where else are fingerprint-based biometric systems used?

9. What has ICT replaced in modern dactyloscopy?

10. What does ICT convert a fingerprint's features into for digital comparison?



Exercise 7: Complete the Process (Fill in the blanks with the correct terms from the box below to describe the modern fingerprint analysis workflow.)
Terms: AFIS, crime scene, comparison software, database, digital, examiner, enhancement, exclude, identify, latent, minutiae, portable scanner, ten-print.

A fingerprint is discovered at a 1) _____. It is collected using a 2) _____ or digital camera as a 3) _____ image. In the lab, 4) _____ software improves its quality. The print is entered into the 5) _____, which converts ridge patterns and 6) _____ points into a code to search its 7) _____ of known 8) _____ records. The system produces a list of possible matches. A human 9) _____ then uses 10) _____ to visually compare the prints and ultimately 11) _____ or 12) _____ a suspect

Fingerprints

Fingerprints as Evidence

Fingerprints as an evidence category is one of the oldest and most important in all forensic science. The use of these curious, highly individual **friction ridge skin** patterns on the end joint of the fingers as a means of personal identification dates back many centuries. Further, we

have reached a point where fingerprint individuality is an article of faith among the public, and is almost universally accepted among scientists and forensic scientists as well. Accordingly, a fingerprint match is widely accepted as certain evidence that identifies a particular person.

Physical evidence can be divided broadly into four major categories: drugs and chemicals (Chapters 5 and 23), trace (Chapter 17), biological (Chapters 14–16), and pattern evidence. The major members of the pattern group are fingerprints (this chapter), questioned documents (Chapter 22), tool mark and firearms evidence (Chapter 21), and other patterns such as footwear and tire impressions (Chapters 19 and 20). All of this kind of evidence consists of various patterns that might be called "individualization" patterns. Under favorable circumstances, individualization pattern evidence can be attributed to a unique source. It is thus potentially quite valuable in an investigation because it may uniquely associate an item or person with a scene or evidentiary item. There is another kind of pattern evidence that could be called "reconstruction" pat- terns. This consists mainly of patterns usually found at scenes, such as blood spatter (Chapter 12), which are often used to help reconstruct events. Reconstruction patterns could also include the investigation of structure failures, suspicious fires, and transportation accidents (Chapters 24–26).

Fingerprints as a Means of Identification

Because fingerprints are unique, they are used to identify people. In forensic science, we think of fingerprints as being used primarily to help locate, identify, and eliminate suspects in criminal cases. But fingerprints, along with dentition (Chapter 6), are also important in making unequivocal identifications of human remains when more conventional methods of postmortem identification cannot be used. Fingerprints may also be thought of as one member of a class of biometric identifiers that would also include retina or iris patterns, face thermography, and some others. As the

technology for rapid scanning and storage of these biometric patterns develops, they are becoming more important as security features to help avoid problems associated with forged identification documents.

The two features of fingerprints most important for their use as a means of personal identification are: (1) Every fingerprint is unique (to an individual), and (2) fingerprints do not change during a lifetime (unless there is damage to the dermal skin layer).

What Fingerprints Are

It has long been recognized that the fingers, palms of the hands, and soles of the feet of humans (and some other primates) bear *friction ridge* skin. These areas are characterized by a complicated pattern of "hills and valleys." The "hills" are called *ridges*, and the "valleys" are called *furrows*. On the end joint of the fingers a number of basic patterns are formed by the friction ridge skin. Within each basic pattern, there are numerous possible variations. The patterns form on these skin surfaces early in embryonic development, and remain constant throughout embryonic life, birth, and the life of the individual. An individual's genetic make-up probably plays a part in determining the sizes and basic shapes of the patterns and ridges, but it is not the only factor. We know this because identical twins, who come from the same fertilized egg and thus have identical genetic make-up, have different and distinguishable fingerprints.

Fingerprint Patterns

There are three basic fingerprint patterns: arch, loop, and whorl. Within these major classes, fingerprint examiners commonly recognize other categories. Arches, for example, can be plain or tented. Loops can be radial or ulnar, depending on whether the slope of the print pattern is in the direction of the inner arm bone (radius) or outer arm bone (ulna). Whorls are the most complex of finger- print patterns, and there are several whorl categories, such as central pocket, double loop, and accidental. Loop and

whorl patterns contain definable features called the core and the delta. These are important in ten-print fingerprint classification, and in comparisons. Figure 18.2 shows some of the additional fingerprint pat- terns. The core and delta of a fingerprint pat- tern are also indicated in one of the frames.

Within fingerprint patterns, there are a number of features called **minutiae**. Once evidentiary and reference (inked) fingerprints have been oriented and found to have the same general ridge flow or pattern type, these features are used to actually compare the finger- prints and decide whether they are or are not from the same source. The ridges of the finger- print form the minutiae by doing one of three things: ending abruptly (ending ridge), splitting into two ridges (bifurcation), and being short in length like the punctuation mark at the end of a sentence (dot). Combinations of these minutiae also have names. For example, two bifurcations facing each other form what is called an *island*. Some minutiae are shown in Figure 18.3. The process used in fingerprint identification is dis- cussed in more detail below

History of Fingerprints

The use of fingerprint and handprint patterns as means of personal identification dates back thousands of years. There are indications of this in artifacts recovered from archaeological excavations of ancient civilizations. Early potters may have used them to “sign” their work. There are records of using fingerprints and handprints as marks of authenticity in China at least 2000 years ago.

Development of fingerprint science in Europe dates back to the 17th and 18th centuries. The first scientist to describe fingerprint ridges was an English plant morphologist called Nehemiah Grew (1641–1712). He also published very accurate drawings of the ridge patterns. Another early pioneer was Johannes Evangelista Purkinje (1787–1869), a Czech physiologist known for a number of important anatomical and physiological discoveries, wrote in detail about friction ridges and described a number of fingerprint pat- terns in his thesis in 1823. Thomas Bewick (1753–1828) was

primarily known as a wood engraver whose engravings appeared in books, but he is often mentioned in connection with fingerprint history. First in a book published around 1800, and elsewhere, he "signed" his work with his own thumbprint. He apparently believed that his thumbprint was as unique as his signature.

Sir William Herschel (Figure 18.4) is often credited with being the first European to recognize the value of fingerprints as a means

of personal identification. Herschel was a British administrator who went out to work in Bengal, India, in 1853. He later joined the Civil Service of India. In his civil service capacity, he entered into a contract with a local businessman, and asked that the man put his right hand print on the back of the contract. Herschel would later say that this action rep- resented the first use of friction ridge impres- sions as a means of personal identification. It was apparently quite common, however, for parties to sign contracts in that area of India at that time by placing a hand or finger mark impression next to their signatures. And, as noted earlier, there is ample evidence that fingerprints were recognized hundreds of years earlier in China as means of identification. Herschel developed the use of fingerprints as a means of controlling fraud in contracts, false impersonations in government pension distributions, and other matters. He tried to convince others in the government to implement his practices but was unsuccessful. He nevertheless demonstrated the persistence of the ridge patterns in his own fingerprints taken periodically over a period exceeding 50 years.

Dr. Henry Faulds (Figure. 18.5), a Scottish physician by training and profession, went to India as a medical missionary in 1871. The next year, he traveled to Japan. By 1879, he is known to have been involved in the study of fingerprints. In 1880, Faulds wrote a letter to evolutionary theorist Charles Darwin, who forwarded the letter to Francis Galton. Around 1880, he noted that fingerprints could be classified, and that ridge

detail is unique. He further mentioned apprehending criminals by locating fingerprints at scenes. He appears to have been familiar with the Chinese and Japanese (perhaps even Egyptian) use of fingerprints. Many of his observations were recorded in a letter to the British journal *Nature* in 1880. There was some dispute between Faulds and Herschel over the priority of fingerprint use as a means of personal identification. In point of fact, neither of them could make such a claim. The originators of fingerprint science are lost in antiquity. It is

fair to say that Herschel and Faulds were very influential in introducing the idea of finger- prints to continental Europe of the later 19th century.

Thomas Taylor, a microscopist for the U.S. Department of Agriculture noted in a scientific journal article in 1877 that fingerprints and palm prints might be used as identification features, especially in criminal matters.

The first truly scientific method of criminal identification—called **anthropometry**— is due to Alphonse Bertillon. Today, we could look at anthropometry as an older kind of biometry. Bertillon is always mentioned in discussions of the history of fingerprint sciences, not because he contributed directly to fingerprints as an identification method, but because he laid down a foundation (with anthropometry) for the eventual acceptance of fingerprints as a scientific method for personal identification. Bertillon used his position in the Police Prefecture in Paris, where his duties included filling out and filing criminal information cards, as a means of developing his identification method. His father was an anthropologist and had spent considerable time thinking about individual differences in human physical features. It occurred to young Bertillon that these differences might have utility in uniquely identifying people in criminal records. Criminals at the time were skilled at avoiding identification by using disguises and aliases. Bertillon developed a biometric

system based on head size, finger length, and so forth, ultimately choosing 11 measurements. The information was carefully recorded on file cards and a system devised for organizing the files. His superiors initially thought he was merely eccentric, but the sys- tem soon proved its worth in identifying and helping to convict persons with prior arrest or conviction records. He went on to become director of the identification bureau of the Paris police, and police agencies in many places began using his system. Bertillonage was ultimately undone by unequivocal proof that different individuals could have the same anthropometric measurements. One of the most well known examples of chance duplication came at the Leavenworth Prison. A new prisoner named Will West was having his measurements taken when a staff member began to suspect that he had encountered this profile before. Upon checking the files, he discovered that the same measurements fit a William West who was already incarcer- ated at the prison (and unrelated to Will West though they looked a lot alike). The two did have different fingerprints. This incident and probably others came to convince police agency identification personnel that fingerprints rep- resented the basis for a superior method of personal identification.

One of the greatest scientists of the 19th century known for his contributions to many fields, Sir Francis Galton (Figure 18.6) became involved in the correspondence between Faulds and Darwin (Galton's cousin). A person of eclectic interests, he looked extensively at Bertillon- age, and even visited Bertillon in Paris. He also looked at fingerprints in detail, especially at Herschel's data, which had been shared with him. His book, *Finger Prints*, published in 1892, is regarded as a classic work. Around 1893, the British Home Office, the parent agency of the Metropolitan Police, commonly referred to as Scotland Yard, decided to add fingerprints to the Bertillon cards for criminals in the identification system. Soon the success of fingerprints overshadowed that of Bertillonage in criminal identification, and anthropometry was abandoned in 1901. Fingerprint minutiae are

sometimes called "Galton features" in recognition of his contributions.

Juan Vucetich (Figure 18.7) might be considered the western hemisphere's fingerprint pioneer. An employee of the police department in La Plata, Argentina, he became convinced of the value of fingerprints as a means of criminal identification and wrote a book on the subject in 1894. By 1896, the Argentine police had abandoned Bertillonage in favor of fingerprints in criminal records. The first recorded case in which fingerprints were used to solve a crime took place in Argentina in 1892. The illegitimate children of a woman named Rojas were murdered on June 18, 1892. She acted distraught and accused a man called Velasquez, who she said commited the act because he wanted to marry her and she had refused. Velasquez maintained his innocence and had an alibi. An investigator from La Plata, the provincial capital, assisting with the case found out that another of Rojas' boyfriends had made statements about being willing to marry Rojas except for the children. The investigator, a man named Alvarez, having been trained by Vucetich, found a bloody fingerprint at the scene and collected it. After comparing it to Rojas' fingerprints, the bloody print turned out to be of her right thumb. She confessed when confronted. Vucetich devised a classification system for fingerprints that was used in Argentina and throughout South America.

Sir Edward Henry (Figure 18.8) was in the British Indian Civil Service beginning around 1873. In 1891, he became Inspector General of Police for Bengal province, where they were using anthropometry. He became interested in fingerprints and read Galton's book. He corresponded with and later visited Galton in 1894. Galton shared everything he had about fingerprints with Henry, including materials he had obtained from Herschel and Faulds. Henry conceived of, and is widely known for, a fingerprint classification system that was adopted in British India. He presented it in the United Kingdom in 1899. He wrote a book titled *Classification and Uses of Fingerprints*. In 1901, he became assistant

commissioner of police for criminal identification at New Scotland Yard in London, and commissioner in 1903.

In North America, fingerprints were in use by the New York City civil service (to pre- vent impersonations during examination) by 1903, and fingerprints were introduced about the same time in the New York State prison system and at Leavenworth Penitentiary. A number of police departments began using fingerprints as identifiers in criminal records as well. The 1904 St. Louis World's Fair pro- vided the venue for a chance meeting between Inspector Edward Foster of the Royal Canadian Mounted Police and Detective John Ferrier of Scotland Yard. As a result of what he learned in St. Louis, Foster convinced his superiors in the

R.C.M.P. of the utility of fingerprints. In 1910, a man called Thomas Jennings was arrested in Chicago and brought to trial for murder. The primary evidence against him was finger- prints. The state wanted to try to insure that the fingerprint identification evidence would survive appeals to the Illinois Supreme Court, and they called Edward Foster as an expert witness. The defendant was convicted, the evidence did survive, and the Jennings case is considered a landmark fingerprint case in the courts.

Fingerprint Classification

It was apparent to the early fingerprint pioneers that a manageable, consistent classification system was necessary if large sets of fingerprint files were to be useful for criminal identification. In the United Kingdom and the United States, the classification systems are variants of the one developed by Sir Edward Henry. In Argentina and other South American countries, a different system based on the one developed by Vucetich has been used.

The modified Henry system as used in the United States is a scheme for the classifi- cation of ten-print sets, or a fingerprint card, for one

individual. Figure 18.9 shows a typi- cal fingerprint card of the kind long used by law enforcement and other agencies to main- tain fingerprint records. Use of the classifica- tion system enabled efficient searching of large files. Keep in mind, though, that classification is based on having all 10 prints. Thus, a 10-print card from a fingerprinted person can be classified and filed, but you would need all 10 prints from a person to use his/her classification to search in the large file. The system therefore allowed organized maintenance of the large files maintained by many law enforcement agencies, but the files could not easily be searched manually for a single print. It is typical to recover single prints, or sometimes even partial single prints, from crime scenes. Until the development of computerized fingerprint search systems, it was impractical to search large files for a single print because it took so much time. Partial prints could obviously be compared with prints from cards on file, but it was necessary to have a possible suspect or suspects first to know which cards to retrieve for manual comparison.

For years, the fingerprint classification of wanted suspects was shown on wanted post- ers distributed to police agencies and dis- played in public places such as post offices. Figure 18.10 shows such a wanted poster, and the fingerprint classification can be seen in small print.

The development and fairly widespread deployment of computerized fingerprint stor- age and retrieval systems has made search- ing large files for single and partial prints routine. It has also rendered classification largely unnecessary. At one time not long ago, all fingerprint examiners and identifi- cation personnel were extensively trained in fingerprint classification using the modified Henry system, as were many police officers. Figure 18.11 summarizes the modified Henry classification of a 10-print set as used by the FBI.

Computer storage and retrieval systems for fingerprints were originally developed for law enforcement applications. Efforts to develop these systems began in the early 1960s. In

Note the modified Henry fingerprint classification- long a feature on FBI wanted posters.

By the late 1980s, there were at least five operational AFIS, at least four of which had been commercialized. Most if not all, large jurisdictions had systems in place by the 1990s. Because different commercial vendors use different technologies, the systems are not intrinsically compatible with one another. Another important point about AFIS is that a given person's fingerprints may be in one sys- tem, but not in others. Depending on the cri- teria for including a set of prints in the files, a large city system could have someone's prints, but the corresponding state system might not have them, for example.

AFIS can be seen as one of the three sig- nificant classes of electronic databases for law enforcement purposes that are now a perma- nent part of the landscape. The other two are CODIS (Combined DNA Indexing System), which holds DNA profiles (Chapter 16), and NIBIN (National Integrated Ballistic Infor- mation Network), which holds searchable image information from fired bullets and car- tridge cases (Chapter 21). Generally it can be said that each of these databases holds two types of files or profiles. One type is the knowns. In the AFIS case, this file contains the prints of known individuals. Any questioned specimen, image or profile can be searched for in the "known" database, and if it is found, its source is thereby identified. The other type is often called the "forensic" file or database. It consists of images or profiles from unsolved cases, the sources of which are not known. In the AFIS case, for example, the forensic file contains images of developed latent single fingerprints from unsolved cases. The per- son whose fingerprints these are has not yet been identified. The file is valuable to inves- tigators, however, in that it allows cases to be

connected by the fingerprints that were not obviously related. Such connections can allow investigators to share information and leads, thus increasing the probability of apprehend- ing a suspect.

AFIS has become a successful tool in the apprehension of unknown offenders. Tradi- tionally any person arrested would have a 10-print card that is entered into the AFIS system. Many job applicants will also have a 10-print card in the system. The number of cases solved by AFIS in the United States is difficult to determine, but the national aver- age of latent prints entered into AFIS that will be deemed an identification by a latent print examiner is around 15%. This average of latent prints identified by AFIS can vary among jurisdictions. It is dependent on the knowledge and skill of the individual entering the latent or unknown impressions (usually forensic scientists), and also by the individu- als that submit and register the known fin- gerprint cards (usually technicians or police personnel).

The FBI has made their criminal database of known fingerprint cards available to other law enforcement agencies. This system is called the Integrated Automated Fingerprint Identification System, IAFIS. Using the IAFIS system, a latent print examiner can search unknown latent impressions in a neighbor- ing state or several states. This is the national criminal database maintained by the FBI of all of the 10-print cards received from all over the country. To date this system has been very successful in developing leads and sometimes solving unresolved cases.

Today, AFIS must be seen as part of a much larger picture that includes an array of auto- mated systems for human biometrics—the use of some type of body metric for identifica- tion. It may be fair to say that the Bertillon sys- tem of anthropometry described above was the first well-defined system of human biometry, leaving aside the pre-19th century uses of fin- gerprints as means of human identification.

While criminal identification and related law enforcement applications of automated fingerprint systems are obviously very impor-

tant, fingerprints along with other biometrics (such as retinal or iris patterns, voice recog- nition, hand geometry, etc.) have increasingly been incorporated into automated identifica- tion systems for other purposes. These sys- tems may control entry and/or access into computers or structures, identification of per- sons for security purposes, to prevent identity theft, and to help control welfare or social ser- vices fraud.

At crime scenes and/or on items of evidence, there are essentially three types of finger- prints that may be encountered: patent, plastic, and latent.

A patent (or visible) print is one that needs no "enhancement" or "development" to be clearly recognizable as a fingerprint. Such a print is often made from grease, dark oil, dirt, or even blood, rendering it visible and recog- nizable, and possibly even suitable for com- parison without additional processing.

A plastic print (might be called "impres- sion" or "indented" print) is a recognizable fingerprint indentation in a soft receiving sur- face, such as butter, silly putty, tar, etc. Such prints have distinct three-dimensional char- acter, are immediately recognizable and often require no further processing.

A latent print is one that by definition requires additional processing to be rendered visible and suitable for comparison. Processing of latent prints to render them visible, and hopefully suitable for comparison, is called development, enhancement or visualization. An enormous amount of literature has grown in this subject in the past 30 years or so. Many great strides have been made in the area due to clever applications of chemistry and physics principles coupled with better understandings of the composition of latent residues. In many ways, these advances are as impressive and important as the progress made in applying DNA typing

techniques to biological evidence, though they have not received even a fraction of the publicity that has been given to DNA.

Composition of Latent Print Residue

The starting point for understanding latent print development techniques is the fin- gerprint residue itself. Friction ridge skin (Figure 18.12), as found on the surfaces of the fingers, hands, and bottoms of feet, has pores through which small sweat glands can empty their contents onto the skin surface. These sweat glands, called eccrine, produce the watery-type sweat composition of which forms a basis for latent fingerprint residue. Another type of sweat gland called apocrine located in other parts of the body, produces sweat that contains organic molecules (lipids and proteins) and pheromones. This mate- rial can become part of the latent print resi- due from a person touching those areas of the body. In addition, an almost unlimited variety

Most methods for the development of latent prints were developed based on knowledge of the latent print residue composition. Usually, a method known to be capable of detecting or visualizing one of the compounds or elements present in latent residue has been applied to target that compound or element. For the application to be successful, it has to be possible to apply the method to eviden- tiary fingerprints on the variety of surfaces where they are found, and without destroying the integrity of the impression pattern. The methods commonly employed can be broadly divided into three groups: physical, chemical, and special illumination or a combination of these methods, many of which involve laser or narrow band pass illumination.

It should be noted here (and will be reiterated below) that fingerprints developed in situ at a scene must be photographed prior to any lifting or other collection effort. Prints developed in the laboratory or identification unit must also be photographed to document the results as well as the location of the print on the evidence item. Investigators often face difficult

decisions about whether to employ fingerprint enhancement procedures at a scene or seize the evidentiary item and submit it to the lab or identification unit. Many fac- tors will be involved in resolving the matter, including the training and experience of the investigator, how well equipped he/she is at the scene, and whether the evidentiary item can be readily seized and transported.

Physical Methods

Classically, physical methods are those that do not involve any chemicals or chemical reac- tions. They work by applying fine particles to the fingerprint residue where it adheres pref- erentially, thus creating contrast between the ridges and the background.

The most well known one is powder dust- ing—a mainstay of latent fingerprint detection for a century or more. Most common powdersare inorganic and come in several colors. There is also a large variety of fingerprint brushes available. The principle of powder dusting is simply that the powder particles adhere to the latent residue. Careful use of the proper brush and powder often results in the development of excellent prints. Black powders are gener- ally superior to the other colors. Black pow- ders are produced in a way that yields more uniform particle size and generally produces better results. The technique is illustrated in Figure 18.13. Also illustrated is the lifting of a developed latent impression using transparent lifting tape. The tape lift is mounted on a backing card with a color maximally contrast- ing to that of the powder (e.g., white backing for black powder). One-piece lifters also known as “hinge lifters” are commercially available for this purpose.

A variant of the simple brush and powder combination is the magnetic brush (Figure 18.15), the original trademark version of which is called the Magna Brush. Actually a small retractable magnet, not a real brush at all, the magnetic brush uses special magnetic powders that also can

be obtained in several colors. The principle of magnetic powder enhancement is the same as for conventional powder, namely adherence of the fine particles to fatty compo- nents of the residue. The magnetic brush tech- nique is more useful on some surfaces than conventional powder dusting, mainly because the magnetic wand can be used to remove any excess powder from the substratum. It also has the potential to be a gentler technique, in the sense that there is no brush, and thus no bristles, so it is less likely to damage the latent print ridges in the brushing process.

Another physical latent print developing procedure involves small particle reagent (SPR). Typically applied by spraying or immer- sion, the most common formulation of SPR is a fine suspension of molybdenum disulfide in a detergent solution. The particles adhere to the lipid components of the residue. SPR is most commonly used on evidence that has been for- merly wet.

Chemical Methods

The greatest progress in latent fingerprint vis- ualization techniques in the past quarter cen- tury has involved chemical and instrumental/ special illumination techniques.

Classically, the chemical techniques were silver nitrate, iodine fuming, and ninhy- drin. Silver nitrate is not used any longer because there are much better techniques available. The principle of its use lay in the reaction of the silver with the chloride in the fingerprint. The silver chloride was then pho- toreducible to silver, which contrasted with the background. A somewhat related method that still involves silver is called physical developer (PD), and is discussed below.

Elemental iodine is one of the compounds in nature that sublimes, that is, it can pass from solid to vapor without becoming liquid. Iodine sublimes easily with only moderate warming. The vapor is directed toward the fingerprint residue with a so-called iodine fuming gun (essentially a

plastic blowpipe con- taining some iodine), or an object to be fumed can be placed in a closed cabinet, which is then filled with iodine fumes. Even though it has long been placed under the "chemical meth- ods" category of latent print development, the iodine probably does not react with any of the components in the residue. It probably inter- acts with the lipid components in such a way that it is trapped in the residue, giving the ridge features a dirty-brown colored appear- ance. The iodine-developed color is not stable in the latent print, however, and iodine prints have to be quickly photographed. There are chemical methods for rendering iodine prints a permanent color that will not fade. The tra- ditional method involved using starch solu- tion for that purpose, but 7,8-benzoflavone (α-naphthoflavone) treatment is the preferred method today. Iodine fuming is used primarily on inherently valuable items precisely because of its impermanence.

Since around 1910, ninhydrin has been known to react with amino acids, forming an adduct called Ruhemann's purple (named for one of the original observers). In the mid- 1950s, Swedish scientists noted that ninhy- drin reacted with the amino acid components of latent fingerprint residue, and took out a patent on the process. Ninhydrin is applied by spraying, painting, or dipping. The ninhydrin reaction is slow unless accelerated by heat in the presence of humidity. The classical ninhy- drin preparation was made up in Freon 113 (1,1,2-trichlorotrifluoroethane). Concern over the effect of these compounds on the Earth's ozone layer culminated in the signing of the Montreal Protocol in 1987 in which many countries agreed to ban the use of chloroflu- orocarbons (CFCs) of which Freon 113 is an example. The most recent ninhydrin formula- tions have thus avoided Freon as a solvent.

Ninhydrin develops bluish-purple finger- prints (Figure 18.16), and is extremely use- ful on porous surfaces (such as paper), but occasionally the bluish-purple color may not show sufficient contrast with the background substratum. Ninhydrin is also useful as a pre- liminary treatment in a

sequential process fol- lowed by other chemicals and viewing under laser or alternative light source illumination. Another significant factor in ninhydrin use for latent prints has been the design, synthesis, and evaluation of a series of ninhydrin ana- logues, perhaps the most important of which is 1,8-diazafluoren-9-one (DFO). Treatment of ninhydrin-developed prints with ZnCl2 (zinc chloride) provides the basis for the use of laser and special illumination methods. The metal salt treatment converts Ruhemann's purple to another compound which can be excited by blue-green light using a laser or alternate light source to yield strong fluorescence. Many modifications of postninhydrin latent print treatments have been designed to maximize fluorescence under illumination by commer- cially available lasers or broadband pass fil- tered alternate light sources.

Figure 18.16 Visualization of latent fingerprints by various methods. (A) Ambient (oblique) white light illumina- tion; (B) physical developer; (C) ninhydrin; (D) cyanoacrylate ester (super glue); (E) super glue–developed print, post- treated with ardrox dye, under UV illumination; and (F) super glue–developed print, posttreated with Rhodamine 6G, under UV illumination.

There are a host of other chemicals that react with amino acids yielding colored or flu- orescent products. However, none have been as important in operational latent print work as ninhydrin (and posttreatments), and DFO. The most important other chemical proce- dure is treatment with cyanoacrylate esters ("super glue"). Super glue "enhancement" was first observed by Japanese scientists in the National Police Agency. The method quickly caught the attention of latent print examiners all over the world. In the early

1980s, fingerprint examiners working in the

U.S. Army Criminal Investigation Laboratory in Japan, and a little later in the U.S. Bureau of Alcohol, Tobacco and Firearms Laboratory, introduced alkyl-2-cyanoacrylate ester (super glue) fuming as a method for

latent print development in the United States

Super glue can be induced to fume, and the fumes will interact with latent fingerprint residue by polymerizing in situ, yielding a stable, even robust, friction ridge impression off-white in color (Figure 18.16). Items to be processed by glue fuming are usually placed into well-sealed cabinets where the glue is induced to fill the cabinet with vapors. The process requires a certain level of relative humidity, and a moisture source is always placed in fuming cabinets. Glue fuming can be accomplished in a closed cabinet or con- tainer without any "acceleration," but it is very slow. Typically, strong alkali or heat is used to accelerate fuming. The progress of latent resi- due development in the fuming cabinet can be monitored by placing a test latent print onto a piece of aluminum foil, or similar surface, and placing the object into the cabinet where it can be viewed during fuming. Latents under- developed with super glue can simply be fur- ther fumed. But overfumed latents may be ruined.

Like ninhydrin, glue fuming is an excel- lent method of developing latent fingerprints. But it may be most useful operationally as an initial step in protocols where the cyano- acrylate-developed prints are further treated and examined. The simplest enhancement of a cyanoacrylate-developed print is dust- ing it with powder. Other posttreatments of cyanoacrylate-developed prints include "dye stains," which induce luminescence or fluorescence in the residue when it is illumi- nated with laser or alternate light source at the appropriate wavelength. Gentian violet, Coumarin 540 laser dye, Ardrox (Figure 18.16), Rhodamine-6G (Figure 18.16), and other treat- ments have been used for the enhancement of cyanoacrylate-developed print luminescence under alternate light or laser illumination.

The last chemical method we will discuss is physical developer. In spite of the name, physical developer (PD) is a chemical method. It has become common in many laboratories to use PD as a follow-up method to ninhydrin or DFO on porous surfaces, such as paper. While ninhydrin or

DFO react with water-soluble components in the latent print residue, PD reacts with the lipid and other water-insoluble components (Figure 18.16).

PD is a photographic-type process based on the deposition of silver onto latent finger- print residue from a ferrous/ferric redox cou- ple and silver salt mixture in solution. There is a modified procedure developed at the U.S. Secret Service laboratory that employs colloi- dal gold in addition to silver salt

Combination/Special Illumination

Sometimes, a "latent" fingerprint can be visual- ized by simple oblique lighting (Figure 18.16). This technique might be considered physical, since it involves no chemicals or special light sources. A latent amenable to visualization by oblique lighting also illustrates that the defi- nition of a "latent" fingerprint is operational to large extent. Some kind of pattern was vis- ible in order to have prompted the observer to obliquely illuminate the surface, thus "enhancing" it.

Latent prints may also be viewed under alternate light (525 nm) or laser illumina- tion. Alternate light is generally superior to incident white light in revealing ridge detail. "Alternate light sources" are exceptionally bright (such as xenon arc) white light sources. White light is a mixture of wavelengths between about 300 and 800 nm on the electro- magnetic spectrum. Alternate light sources are supplied with colored filters, which serve to filter the source light so that the developed latent print can be viewed with light of a nar- row wavelength range. The filter is selected to induce illumination at the wavelength known to excite the chemical compounds used in the latent development procedure. Other filters may be used to view the luminescence result- ing from the alternate light source excitation. The luminesced light will be of longer wave- length than the excitation, and the filter may provide sufficient contrast between the back- ground and the luminescence of the latent print ridges to give a useful ridge detail image that can then be photographed and used for comparison. A

laser is also a very high inten- sity light source, but it emits light of a single wavelength (monochromatic light). There are several commercially available lasers. Methods have been developed over the years to take advantage of the excitation wavelengths afforded by these lasers. The undisputed pri- mary developer of laser methods for latent fin- gerprints has been Dr. E. Roland Menzel of

Texas Tech University. The most recent devel- opment in this context is development of lumi- nescent nanoparticles for latent fingerprint enhancement. Refer to the appendices of this volume for more background on the electro- magnetic spectrum, and the concepts of light absorption, luminescence and fluorescence.

Bloody Fingerprints and Other Special Situations

Latent fingerprints in blood or on certain unusual types of surfaces require special techniques, enhancement modalities or approaches.

Bloody fingerprints are almost by defini- tion not "latent." Some type of pattern is visible in the blood, and investigators may recognize that the pattern is probably a fingerprint (or palm or foot print), but that the ridge char- acteristics are not sufficiently well defined to make the print suitable for comparison. In these circumstances, the use of a bloody fin- gerprint enhancement reagent might be con- sidered. In this context, an investigator needs to think about whether it will be necessary to attempt to do DNA profiling of the blood that is forming the apparent ridge patterns. There is substantial published evidence that latent fin- gerprint chemical enhancement procedures, including those designed for bloody prints, do not interfere with subsequent DNA profiling by PCR for the now-universal (at least in the United States) CODIS core STR loci.

Bloody fingerprint enhancement reagents can be sprayed or squirted from a wash bottle. Some of the formulas result in a reagent that is not very stable in solution and, thus, has almost no shelf life. Therefore, they need to be prepared shortly before use. Further, there are serious chemical hazards

associated with some of the ingredients, so some training is required in the proper preparation and use of these reagents. Many bloody fingerprint enhancement reagents are based on the "per- oxidase reaction" chemicals (phenolphthalin, leucomalachite green, tetramethylbenzidine, etc.) commonly used as presumptive tests for blood (Chapter 14), tetramethylbenzidine along with hydrogen or sodium peroxide probably being the most common. There are also for- mulas and procedures based on general pro- tein staining dyes such as Amido Black 10B and Coomassie Blue R250. They are gener- ally less hazardous and easier to use than the "peroxidase reaction" chemicals.

Another special situation involves finger- prints deposited on tape, especially on the adhesive surface. Techniques involving stain- ing with crystal violet were traditionally used for this kind of latent impression. Today, the most commonly used method for developing this kind of impression is a material called "sticky side powder." This so-called powder is actually composed of lycopodium (a plant) pollen mixed with a detergent and water. The sticky side powder slurry is painted onto the adhesive side of the tape with a brush, and the tape then rinsed off with water. The pro- cess can be repeated until the desired contrast has been achieved, and it often yields identifi- able prints. Sticky side power can be used on almost any kind of tape, and works especially well on duct and electrical tape.

Yet another "special situation" deserving brief mention is the development of latent prints on human skin. A variety of different techniques has been tried, but with only mod- est success and even that in selected cases. A generally useful procedure has not emerged thus far.

Systematic Approaches

This concept is probably followed by most latent fingerprint examiners even if they do not identify it as such. The idea is to apply latent development techniques in a way that maximizes the number of identifiable

prints. The least destructive technique is applied first, and techniques are generally applied in a sequence that allows the maximum number to be used if necessary.

Systematic approaches vary according to the surface or substratum on which the latent is located. Porous surfaces, such as paper, for example, call for a different set of techniques applied in a different sequence than nonporous surfaces.

Fingerprints are among the best and most probative of all types of physical evidence for associating people with locations or objects. Accordingly, fingerprint evidence should be sought at any type of scene, and particularly at scenes of crimes committed by unknown perpetrators.

Recognition of fingerprint evidence at a scene is not unlike recognition of evidence in general (Chapter 9). It requires training and experience. Once recognized, the location of fingerprint evidence should be appropri- ately documented by photography, notes, and sketches as appropriate.

As a general rule, objects believed to have latent fingerprints on their surfaces should be collected intact and submitted to the labo- ratory's latent print section for examination. If collection of the object or surface is impossible or impractical, investigators must con- sider applying latent development techniques at the scene, or requesting assistance from personnel trained to do so. Sometimes, devel- oped prints may be collected using tape-lift or other methods. Other times, the developed print may have to be carefully photographed because the photograph will be the only permanent record of the evidentiary print. Like other evidence, collected fingerprint evidence such as lifts or photographs should be care- fully documented to preserve the chain of cus- tody from the scene to the courtroom.

Everything in this chapter so far—indeed, the reason there is a chapter on this subject at all—comes down to the use of fingerprints as a

means of identification of persons. As notedearlier, the uniqueness of fingerprints is a matter of common knowledge. Advertisements and commercials commonly use phrases like "… as unique as a fingerprint," etc. Even the term "DNA fingerprints," as undesirable and sometimes misleading as it is, was coined to reflect the notion that a DNA profile might be as individual as a fingerprint. Infrared spec- tra of pure compounds are sometimes called "chemical fingerprints." But most people have never given much thought to the process by which fingerprint identification is actually done.

David Ashbaugh, among others, has noted that fingerprint individuality, and there- fore fingerprint identification, rests on four premises:

1. Friction ridges develop during fetal growth before birth in their definitive form.

2. Friction ridges remain unchanged throughout life with the exception of permanent scars.

3. The friction ridge patterns and their details are unique and not repeated.

4. The ridge patterns vary within certain boundaries, which allows the patterns to be classified.

Fingerprint examiners are generally exten- sively trained and required to accumulate significant experience before being entrusted with the responsibility of making identifica- tions. Thus, in addition to the general principles and approaches used to make identifications, the knowledge, training and experience of the examiner also comes into play.

In a law enforcement context, identifica- tions are always made by trained, and often certified, examiners. Sometimes, inked prints from a person may be compared with a set of inked prints on file to determine if they came from the same individual. But more commonly, the examiner will be comparing a developed latent print with inked prints from a known

person or persons. AFIS searches can quickly narrow down the number of possible matches to a manageable size, but an examiner, not a computer, makes the actual identification.

In the case of latent examinations, perhaps the first issue that comes into play is determin- ing what is called "suitability" of the latent fingerprint for identification. Here, the examiner must decide if sufficient quality and quantity of the ridge detail is present in the latent to make it possible to compare with a known print. This determination also requires training and experience. Once a latent print is evaluated and determined to be suitable for comparison, it will then be compared to the known prints on fingerprint cards. Such knowns might be obtained through an AFIS search, or because certain persons are suspected and their prints are taken or are already on file.

The overall process an examiner uses has been described by Ashbaugh as "ACE-V," for the analysis, comparison, and evaluation that comprise the formal process, followed by verification. The examiner must first analyze the latent, determine its proper orientation, decide if there are any color reversals or other unusual circumstances, decide suitability, then proceed to the comparison. Comparison with the known takes place at several lev- els. The overall pattern and ridge flow (what Ashbaugh calls level I) must be examined. Next, the individual characteristics (minu- tiae) are compared as to type of features and their locations (what Ashbaugh calls level II). Finally another level of detail (Ashbaugh's level III), consisting of pore shape, locations, numbers, and relationships, and the shape and size of edge features, is compared. Any unexplained difference between the known and latent print during this process would result in the conclusion that the known is excluded as a source of the latent. This is one possible outcome of the evaluation decision. If every compared feature is consistent with the known, and there are enough features suf- ficiently unique when considered as a whole, the examiner concludes an

individualization. Since peer review is a feature of most scientific endeavors, Ashbaugh notes that verification of conclusions by an independent examiner is a necessary practice.

There has been considerable discussion in

the identification literature about defining the criteria for individualizing fingerprints. For quite a few decades, a "minimum number of points rule" was followed. This "rule" meant that if 12 points were required to make an iden- tification, the examiner had to find at least that many points of comparison before making the identification. Over time, it became clear that such an absolute rule was not a proper basis for making decisions in every situation. The International Association for Identification (IAI), the organization that, by and large, sets peer standards for the fingerprint community, adopted a resolution in 1973 that no minimum number of features is required for making a fingerprint identification. This position was reiterated in a slightly modified form in 1995. Most fingerprint examiners in most countries subscribe to this principle. Discussions of the criteria for making a fingerprint identification lead naturally into discussions of the basis for fingerprint individuality. Although the sub- ject has been discussed in the literature, it is well beyond the scope of this chapter.

Thus, the comparison of a latent with a known inked print could result in one of three possible conclusions: insufficient ridge detail to form a conclusion; exclusion; or individualization.

The process of comparing latent prints to knowns has occasionally resulted in an incor- rect identification, even when experienced examiners conducted the comparison. In 2004, suspected terrorists set off bombs on several commuter trains in Madrid, Spain. Spanish police recovered some latent prints from evi- dence believed to be closely associated with the bombers. Images of the latents were dis- tributed internationally to law enforcement agencies in an attempt to identify them. The FBI was one of

the agencies that examined the latents and searched its IAFIS files for potential matches. The FBI eventually identi- fied one of the latents as belonging to a man called Brandon Mayfield. Mayfield lived in Portland, Oregon, and was Muslim, although he was a U.S. citizen and had been in the Army. The fingerprint identification eventu- ally led to Mayfield's arrest. Later, it became clear that the latent print was not Mayfield's but from an Algerian national named Daoud. The incident resulted in an investigation by the

U.S. Department of Justice's Office of Inspec- tor General, which issued a report in March,2006. The FBI has taken steps to change and improve its internal procedures to prevent such an occurrence happening again.

In the past several decades, a number of trends have worked to professionalize finger- print examiners more than they have ever been in the past. People entering the profes- sion have more formal education today than was once true. The extraordinary progress in latent development and recovery methods noted above has demanded that fingerprint examiners understand much more chemis- try and physics than ever before. The IAI has been a positive force, through the facilitation of discussions, encouragement of research and scientific approaches, and through its profes- sional publication, the Journal of Forensic Identification. Journals are commonly and routinely the primary, peer-reviewed source of original research in scientific fields, and the IAI journal rose to fulfill that role for the fin- gerprint and identification sciences especially under the editorship of David Grieve. The IAI has also been the primary peer standard- setting group in the science of fingerprints. Today, there is a scientific working group on friction ridge analysis, study, and technol- ogy (SWGFAST) that started in 1995. Like all technical working groups, its purpose is to arrive at consensus standards for the pro- fessional area (or arena). In the 1990s, DNA typing and profiling became a major feature of forensic science. That,

coupled with the Supreme Court's Daubert v. Marion Merrell Dow et al. decision, has forced many forensic disciplines besides DNA to take a careful lookat their underlying assumptions and criteria for evaluating matches and identifications. These trends are likely to continue.

Fingerprint examiners today have a wide range of educational backgrounds. The SWGFAST recommends that trainees hired in 2005 and later should have a 4-year degree. There is also a considerable period of training involved in learning the fingerprint specialty. Individuals may be hired in some agencies, primarily as AFIS technicians, to maintain systems, scan images into the system, and so forth. They do not need the level of training required to be an independent latent print examiner. The IAI has a certification program for latent fingerprint examiners, and more and more employers are requiring that cer- tification as a condition of employment. The certification requires passing a challenging written test, demonstrating competency in latent print comparisons, and then maintain- ing a record of activity and continuing educa- tion during the certification period.

Although fingerprints may be the oldest of the forensic science disciplines, it is still one of the most interesting and exciting. More cases may be solved by fingerprints than by any other single type of physical evidence.

The opinions and conclusions offered in this chapter are those of the authors, and do not necessarily represent the views or official posi- tions of the U.S. Postal Inspection Service or the University of Illinois. Products and prod- uct names mentioned in the chapter are for information purposes, and do not constitute endorsements by the authors or by the organi- zations that employ them.



1. Match the columns A—B:

A	B
friction	ridge
identical	twins
embryonic	development
fingerprint	minutiae
latent	impressions
voice	recognition
archaeological	excavations
additional	processing



2. Translate words from English to Russian

English	Russian
physical evidence	вещественные доказательства
questioned documents	сомнительные документы
genetic make-up	генетический состав
personal identification	личная идентификация

bifurcation	раздвоение
arm bone	кость руки
dentition	зубная система
double loop	двойная петля



3. Translate words from Russian to English

Russian	English
брызги крови	blood spatter
люминесценция	luminescence
вдавленный отпечаток	indented print
отпечаток большого пальца	thumbprint
химические опасности	chemical hazards
человеческая биометрия	human biometrics
состав, рецептура	formulation
моющее средство	detergent



4. Determine which of the above statements correspond to the content of the text (True) and which do not (False)

Statements	True/False
Fingerprints are a major category of pattern evidence in forensic science.	True (Text "Fingerprints as Evidence", p. 355)
Drugs and Chemicals are not part of the four major categories in Physical Evidence.	False. Physical evidence can be divided into categories like drugs and chemicals, trace, biological, and pattern evidence. (Text "Fingerprints as Evidence", p. 355)
Fingerprints are only used in criminal investigations and have no other applications.	False. Fingerprints are used in forensic science to locate, identify, and eliminate suspects in criminal cases. (Text "Fingerprints as a Means of Identification", p. 355)
Humans have friction ridge skin on their fingers, palms, and soles of the feet.	True (Text "What Fingerprints Are", p. 356)
The three basic fingerprint patterns are arch, loop, and whorl.	True (Text "Fingerprint Patterns", p. 356)
Minutiae are the primary patterns in fingerprints, like arches and loops.	False. Minutiae are features within fingerprint patterns used for comparison. (Text "Fingerprint Patterns", p. 355)

Fingerprints are considered a biometric identifier, alongside things like retina or iris patterns.	True (Text "Fingerprints as a Means of Identification", p. 355)
Identical twins have identical fingerprints.	False. Identical twins have different and distinguishable fingerprints. (Text "What Fingerprints Are", p. 356)

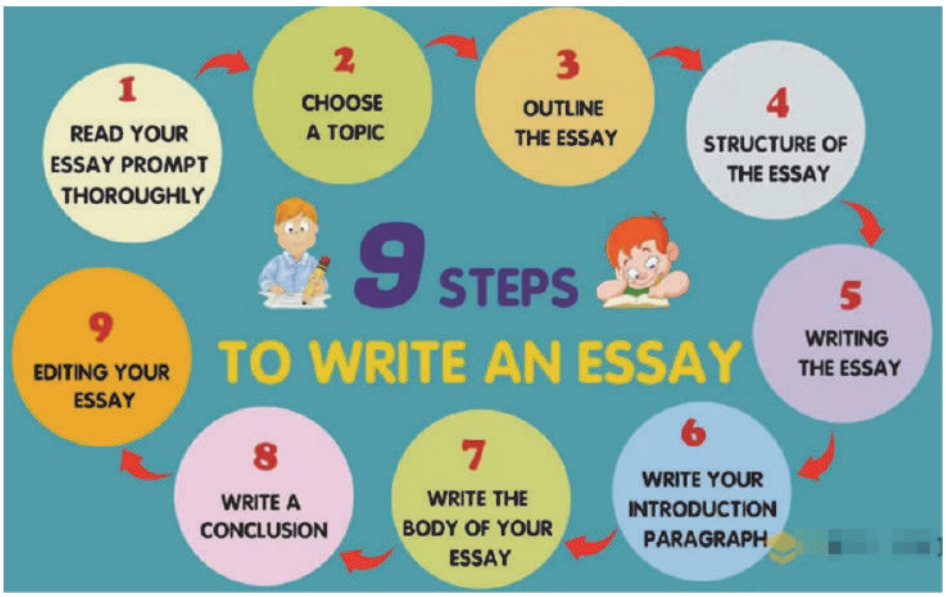


5. Answer to the questions:

Question	Answer
What are the four major categories into which physical evidence can be divided?	Physical evidence can be divided into four major categories: drugs and chemicals, trace, biological, and pattern evidence. (Text "Fingerprints as Evidence", p. 355)
Why can't genetics be the only factor that determines fingerprint patterns?	Genetics cannot be the only factor because identical twins, who have identical genetic make-up, have different and distinguishable fingerprints. (Text "What Fingerprints Are", p. 356)

What are the three ways in which the ridges of a fingerprint form minutiae?	The ridges of the fingerprint form the minutiae by doing one of three things: ending abruptly (ending ridge), splitting into two ridges (bifurcation), and being short in length like the punctuation mark at the end of a sentence (dot). (Text "Fingerprint Patterns", p. 356)
Why was the modified Henry system developed?	The modified Henry system was developed because a manageable, consistent classification system was necessary if large sets of fingerprint files were to be useful for criminal identification. (Text "Fingerprint Classification", p. 361)
What distinguishes a latent fingerprint from patent and plastic fingerprints?	A latent fingerprint requires additional processing to be rendered visible and suitable for comparison, while patent and plastic fingerprints are immediately recognizable without additional processing. (Text "Types of Evidentiary Fingerprints", p. 364)
What are the three broad categories into which the methods commonly employed for	The methods commonly employed for developing latent prints can be broadly divided into

developing latent prints can be divided?	three groups: physical, chemical, and special illumination (or a combination of these methods). (Text "Composition of Latent Print Residue", p. 364)
What is the principle behind powder dusting?	The principle behind powder dusting is simply that the powder particles adhere to the latent residue. (Text "Physical Methods", p. 365)
Why is iodine fuming used primarily on inherently valuable items?	Iodine fuming is used primarily on inherently valuable items precisely because of its impermanence. (Text "Chemical Methods", p. 367)



6. Write an essay:

I'd like to tell you about the fingerprints.

To begin with, that fingerprints are one of the oldest and most important categories of evidence in criminology. The use of unique finger patterns to identify a person dates back centuries. Personally, I think that today, society and scientists almost completely trust that a fingerprint match proves identity.

It's necessary to point out about the types of physical evidence. There are divided into four groups: drugs and chemicals, traces, biological materials, and pattern samples. Fingerprints, documents, tool marks, and vehicle marks occupy a special place among the patterns. These samples can point to a specific source, which makes them valuable for investigations. There are also "recovery" patterns, such as blood splashes, used to reconstruct events.

The main properties of prints are their uniqueness and lifelong stability. These patterns are formed early in embryonic development and remain unchanged despite various influences.

In conclusion, I can say that fingerprints are important not only for finding and excluding suspects, but also for identifying victims when other methods are not possible.

UNIT V. FORENSIC BALLISTICS EXAMINATION

СУДЕБНО-БАЛЛИСТИЧЕСКАЯ ЭКСПЕРТИЗА



📜 TEXT 1: FORENSIC BALLISTIC EXAMINATION

Forensic ballistic examination, often referred to as firearm examination, is a specialized branch of forensic science dedicated to analyzing evidence related to firearms, ammunition, and their effects. Its primary goal is to establish objective links between bullets, cartridge cases, a specific firearm, and, by extension, a suspect or a crime scene.

Core Principle and Examination Process



The fundamental principle is that manufacturing processes and subsequent use impart unique, microscopic markings—like a ballistic fingerprint—onto a firearm's barrel and internal parts. When a bullet is fired, the spiral **rifling** (lands and grooves) inside the barrel leaves parallel **striations** on the bullet. Similarly, parts like the firing pin, breech face, extractor, and ejector leave unique marks on the soft metal of the cartridge case. A forensic examiner cannot determine who pulled the trigger, but can state whether a specific bullet or cartridge case was fired from a particular firearm.

The examination process relies heavily on the **comparison microscope**. This instrument allows for the side-by-side analysis of two bullets or cartridge cases—typically one from the crime scene (evidence) and one test-fired from a suspect's weapon. By matching these unique striations and impressions, an examiner can provide a crucial link in an investigation.

Branches of Study

Forensic ballistics is broadly divided into specialized branches that study the bullet's entire journey:

- **Internal Ballistics**: Studies events inside the firearm from trigger pull until the bullet exits the muzzle (e.g., propellant ignition, pressure).
- **External Ballistics**: Studies the bullet's flight path through the air (e.g., trajectory, velocity, effects of gravity and air resistance).
- **Terminal Ballistics**: Studies the bullet's behavior and effects upon striking a target (e.g., wound ballistics, penetration, ricochet) .

Evidence, Techniques, and Modern Tools

Beyond bullet matching, examiners analyze various other elements:

- **Gunshot Residue (GSR)**: Chemical tests (like the Walker Test for nitrites or Sodium Rhodizonate for lead) can determine the muzzle-to-target distance or indicate if a person recently handled a fired weapon.
- **Toolmark Analysis**: This includes restoring obliterated serial numbers on firearms using chemical or magnetic particle techniques to trace the weapon's history.
- **Crime Scene Reconstruction**: By analyzing bullet trajectory (using lasers or string), shot patterns, and tissue damage, experts can reconstruct the positions of the shooter and victim.

Modern technology has revolutionized the field. Automated systems like the **Integrated Ballistic Identification System (IBIS)** allow labs to digitally image and compare bullet and cartridge case markings against vast national databases (e.g., NIBIN), linking crimes across jurisdictions. Other essential tools include stereomicroscopes, scanning electron microscopes (SEM-EDS) for GSR particle analysis, and high-resolution cameras.

Historical Context and Significance

The field's foundations were laid in the 19th and early 20th centuries. A landmark case in 1835 involved matching a bullet to a mold in a suspect's home. The invention of the comparison microscope in 1925 by **Calvin Goddard**—who is often called the "father of forensic ballistics"—modernized the science, as demonstrated in his famous work on the 1929 Saint Valentine's Day Massacre.

Today, forensic ballistic examination remains a cornerstone in investigating homicides, assaults, and other firearm-related crimes. It helps determine whether a shooting was an accident, suicide, or homicide, the sequence of shots fired, and ultimately provides critical, scientifically-backed evidence for court testimony.

EXERCISES FOR ENGLISH LANGUAGE PRACTICE

Here are seven different exercise formats, each containing ten tasks based on the text above.



1. Make Word Combinations

Combine a word from List A with a word from List B to form a key term from the text.

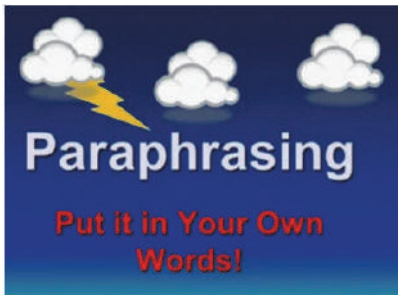
List A:	**List B:**
1. ballistic	a) residue
2. comparison	b) pin
3. gunshot	c) number
4. firing	d) microscope
5. lands and	e) fingerprint
6. terminal	f) distance
7. serial	g) ballistics
8. striations	h) grooves
9. rifling	i) marks
10. muzzle-to-target	j) meter



2. Match the Columns

Match the branch of ballistics (Column A) with its focus (Column B) and a related piece of evidence or tool (Column C).

Column A:	**Column B:**	**Column C:**
1. Internal Ballistics	a) Studies the bullet's flight path through the air.	i) Analysis of wound characteristics and tissue damage.
2. External Ballistics	b) Studies the bullet's effects on the target.	ii) Calculation of trajectory using lasers.
3. Terminal Ballistics	c) Studies events inside the firearm upon firing.	iii) Examination of propellant ignition and barrel pressure.



3. Paraphrase the Following

Rephrase these sentences from the text in your own words.

1. Its primary goal is to establish objective links between bullets, cartridge cases, a specific firearm, and, by extension, a suspect or a crime scene.
2. The fundamental principle is that manufacturing processes and subsequent use impart unique, microscopic markings onto a firearm's barrel.
3. By matching these unique striations and impressions, an examiner can provide a crucial link in an investigation.

4. Modern technology has revolutionized the field.

5. It helps determine whether a shooting was an accident, suicide, or homicide.



4. True / False / Not Stated

Decide if the statement is True (T), False (F), or if the information is Not Stated (NS) in the text.

1. Forensic ballistic examination can definitively identify who fired a weapon.

2. The comparison microscope allows for the side-by-side analysis of two bullets.

3. Terminal ballistics studies the chemical composition of gunpowder.

4. Calvin Goddard is credited with inventing the fingerprint powder used on firearms.

5. The Integrated Ballistic Identification System (IBIS) is a type of comparison microscope.

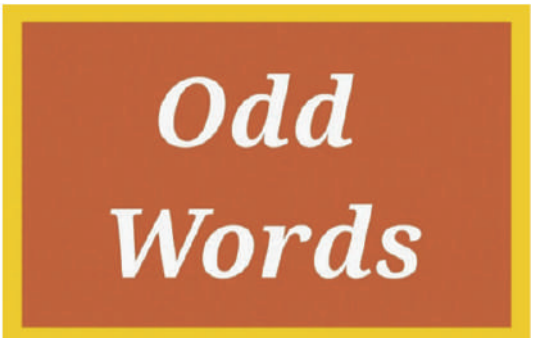
6. Gunshot residue analysis can only be performed on a shooter's hands.

7. Restoring a serial number is a form of toolmark analysis.

8. The first recorded use of ballistic evidence was in 1929.

9. External ballistics factors include air resistance and gravity.

10. A "ballistic fingerprint" refers to the unique pattern of lands and grooves in a barrel.



5. One Word is Odd

Identify which word in each group does not thematically belong and explain why.

1. **Firing pin, Breech face, Extractor, Propellant**
2. **IBIS, NIBIN, SEM-EDS, DNA**
3. **Striations, Trajectory, Ricochet, Caliber**
4. **Walker Test, Sodium Rhodizonate, Cyanoacrylate fuming, Griess Test**
5. **Homicide, Suicide, Accident, Ballistics**



6. Answer the Questions

Provide full-sentence answers based on the text.

1. What is the main objective of a forensic firearms examiner?
2. Name two firearm components that leave unique marks on a cartridge case.
3. What instrument is essential for comparing bullet striations?
4. Which branch of ballistics would study the effect of air resistance on a bullet?
5. What does GSR stand for and what can its analysis determine?
6. What historical case is Calvin Goddard famous for working on?
7. How can obliterated serial numbers on firearms be restored?
8. What type of evidence does "wound ballistics" refer to?

9. What is the purpose of automated systems like IBIS?

10. According to the text, what three things can ballistic examination help determine about a shooting incident?



7. Discussion & Mini-Essay Prompts

Discuss in pairs or prepare a short written response (5-7 sentences).

1. **The Examiner's Limitation**: The text states an examiner "cannot determine who actually fired a weapon." Why is this an important distinction? How does this affect the way ballistic evidence is presented in court versus how it might be perceived by a jury?

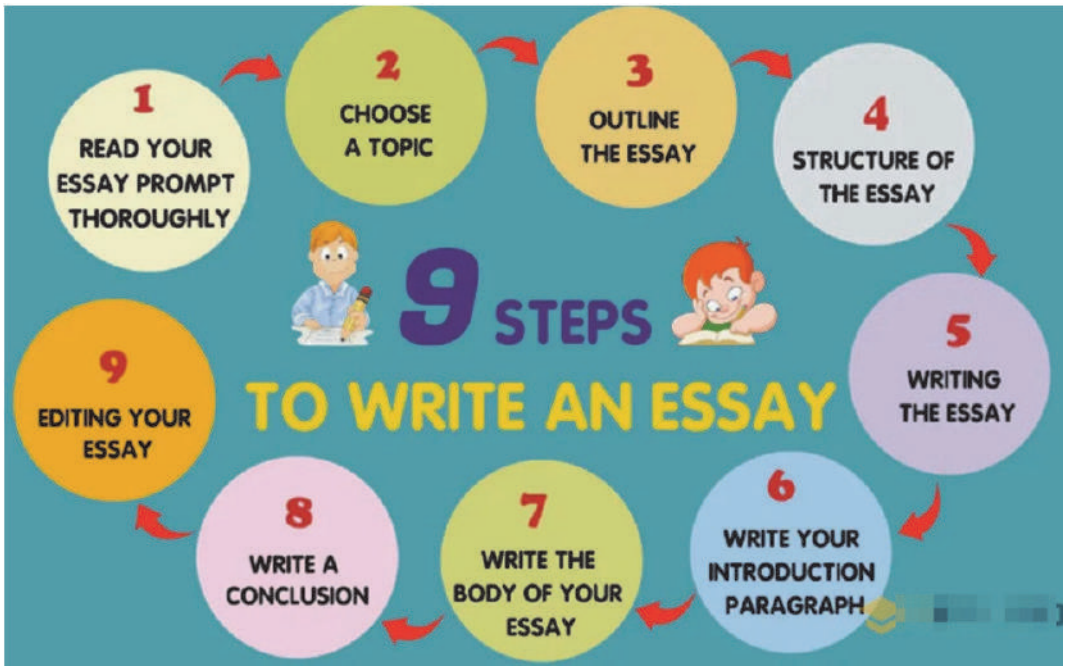
2. **Class vs. Individual Characteristics**: Explain the difference between class characteristics (e.g., caliber, number of grooves) and individual characteristics (e.g., unique striations) on a bullet. Why are both important, but only one can link a bullet to a specific firearm?

3. **Technology vs. Tradition**: Modern systems like IBIS use digital databases, but the core tool remains the comparison microscope. Argue for which you think is more critical to the field: the traditional, examiner-driven microscopy or the modern, computer-assisted database comparison.

4. **Beyond the Bullet**: Besides matching bullets to guns, the text lists other analyses like GSR testing and trajectory reconstruction. Describe a

hypothetical crime scene where these secondary analyses might provide more crucial investigative leads than the bullet match itself.

5. **Chain of Evidence**: Considering that trace evidence like GSR is fragile and ballistic markings can be altered, what specific steps must investigators take from the crime scene to the lab to ensure the evidence is admissible in court?



📝 TEXT 2: ICT IN FORENSIC FIREARM ANALYSIS

Forensic firearm analysis, often called forensic ballistics, is a core discipline in criminalistics focused on examining evidence from firearms, including the marks they leave on bullets and cartridge cases. For about a century, this work relied on visual comparison under a split-screen (comparison) microscope. An examiner would test-fire a suspect's weapon into a water tank, then compare the test-fired bullet or cartridge case to one recovered from a crime scene. This process involves examining unique microscopic imperfections left by the manufacturing process in the firearm's barrel or breech, which act like "ballistic fingerprints".

The integration of Information and Communication Technology (ICT) has revolutionized this traditional field. A key innovation is the development of **automated imaging and comparison databases**. Systems like the National Integrated Ballistic Information Network (NIBIN) allow laboratories to digitize images of cartridge cases and use algorithms to search vast databases for potential matches from other crime scenes. This has transformed ballistic evidence from a tool for connecting a suspect to one crime into a powerful means of linking multiple crimes across jurisdictions.

Beyond databases, ICT enhances the **precision of crime scene reconstruction**. Traditional trajectory analysis involves manually inserting rods into bullet paths. Modern digital tools include laser trajectory finders that incorporate digital angle finders and protractors for highly accurate measurements. More advanced is the use of **3D laser scanning (LIDAR)** and high-definition scanning to create precise three-dimensional maps of incident scenes. These digital models can be used to visualize and measure bullet trajectories with extreme accuracy, helping to demonstrate a shooting event in court.

The role of ICT is also critical in **objective analysis and standardization**. Historically, an examiner's "match" determination was an expert opinion without a statistical measure of certainty. Today, organizations like the National Institute of Standards and Technology (NIST) are developing



statistical methods and manufacturing precise "standard bullets" and "standard cartridge cases" with known characteristics. These standards allow crime labs to calibrate their instruments, ensuring accurate and comparable results, which helps examiners attach more objective, statistically meaningful metrics to their findings.

Furthermore, ICT is essential in specialized tasks like **serial number restoration**. Examiners use chemical etching and various imaging techniques to restore obliterated numbers on firearms. Digital imaging and photographic enhancement software have become vital tools in this process. Similarly, complex simulations for **long-range shootings** rely on software that models ballistic properties using scientific data on the ammunition, firearm, and environmental conditions to recreate incidents over great distances.

In conclusion, ICT has moved forensic firearm analysis from a largely manual, subjective discipline to a more automated, precise, and objective

science. It expands the investigative power of ballistic evidence, provides more robust scientific support for courtroom testimony, and enables accurate, data-driven reconstructions of complex shooting incidents. The modern forensic firearms examiner must be proficient not only in traditional microscopes but also in databases, 3D modeling software, and statistical analysis tools.

EXERCISES FOR ENGLISH LANGUAGE PRACTICE



1. Make Word Combinations

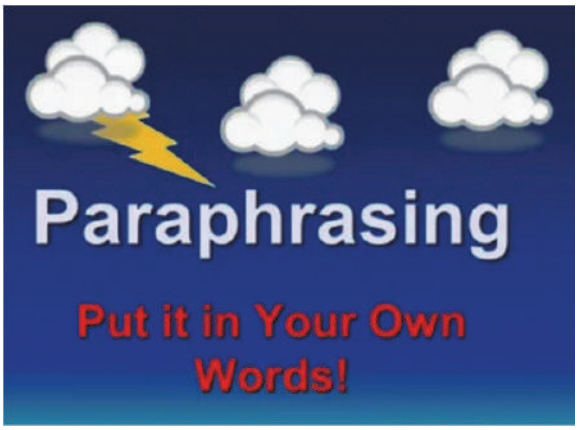
1. ballistic ___ (e.g., fingerprints/analysis)
2. cartridge ___
3. digital ___
4. comparison ___
5. serial number ___
6. crime scene ___
7. statistical ___
8. 3D laser ___
9. trajectory ___
10. automated imaging ___



2. Match the Columns

Match the term (1-5) with its correct definition (a-e).

List A:	**List B:**
1.Forensic Ballistics	a) A national database for digitized ballistic evidence.
2.NIBIN	b) A technology for creating precise 3D maps of a scene.
3.LIDAR	c) The discipline of examining firearms evidence.
4. Comparison Microscope	d) A tool for the visual side-by-side analysis of bullets.
5. Standard Bullet	e) A reference tool for calibrating forensic instruments.



3. Paraphrase the Following

Practice restating ideas in simpler English.

1. "Microscopic marks on bullets are like ballistic fingerprints."

2. "ICT has revolutionized the traditional field of firearm analysis."

3. "The examiner's determination was historically a subjective opinion."

4. "Trajectory analysis helps reconstruct a shooting event."

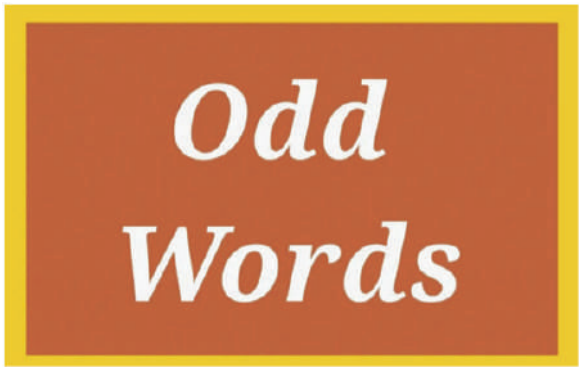
5. "Serial numbers are sometimes removed to conceal a firearm's identity."



4. True / False / Not Stated

Develop careful reading and verification skills.

1. A comparison microscope is used to examine DNA evidence.
2. NIBIN is a database for fingerprint records.
3. ICT helps provide statistical measures for ballistic matches.
4. Firearm examiners never restore serial numbers.
5. All forensic labs use the same brand of software for 3D scanning.



5. One Word is Odd

Refine understanding of thematic categories.

1. **Group:** *barrel, bullet, cartridge case, fiber*
2. **Group:** *microscope, database, algorithm, testimonial*
3. **Group:** *calibrate, measure, reconstruct, obliterate*



6. Answer the Questions

Improve information retrieval and sentence formation.

1. What are the two main types of ballistic evidence mentioned?
2. What is the purpose of test-firing a suspect's weapon?
3. Name one advantage of automated ballistic databases like NIBIN.
4. How does 3D laser scanning assist in reconstruction?
5. What role does NIST play in modern firearm analysis?



7. Discussion & Mini-Essay Prompts

1. Compare the advantages of traditional visual comparison vs. computer-aided ballistic analysis.

2. Describe the steps, using ICT, to link a cartridge case found at a new crime scene to a previous shooting.

3. Why is the objective, statistical analysis of tool marks an important development for forensic science?

4. How might 3D reconstructions of a shooting help both investigators and a jury?

5. Discuss a potential future application of ICT (e.g., Artificial Intelligence) in firearm examination.

Modern Firearms

Both firearm and tool mark examiners use microscopic comparisons of markings to associate an item of evidence with a particular source. In the case of firearms examinations, the marks made by a firearm on a fired bullet or cartridge casing are used to determine whether the bullet or casing was fired in a particular weapon. In tool mark examinations, the microscopic features of a tool mark are used to determine whether a particular tool made the mark. In addition to microscopic comparisons, firearms examiners conduct other examinations to further the investigation and prosecution of a crime. They examine bullets and cartridge cases to determine the make and model of the firearm that fired them; they test the functioning of firearms submitted to them for examination; they carry out serial-number restorations; and they reconstruct the circumstances of shooting incidents.

Types of Modern Firearms

Before surveying the types of firearms currently being manufactured, some comments on the mechanisms of automatic and semiautomatic firearms are in order. Automatic and **semiauto- matic weapons** function in one of three ways: blowback, recoil, or gas piston. In blowback weapons the fired cartridge pushes the **breechblock** backward against a spring; the expended cartridge is extracted by the moving breechblock and ejected from the weapon. The compressed spring then pushes the breechblock forward, removing a cartridge on the magazine and inserting it into the firing chamber. Most **submachine guns** use the blowback operation. In the recoil operating system, the barrel of the weapon and its breechblock recoil a short distance together; the breechblock then unlocks from the barrel and continues to recoil rearward against a spring. The compressed spring returns the breechblock to its original position, loading a fresh cartridge into the firing chamber. Iт gas-operated weapons, a small

amount of the propellant gases passes through a small hole in the barrel into a gas piston. The expanding gas forces the piston to the rear; a rod connects the piston to the breechblock so that the breechblock is also pushed to the rear.

The types of firearms currently available are summarized below.

Handguns

These are weapons designed to be held in and fired with one hand (although accurate shooting requires the use of two hands).

Revolvers

The cartridges are held in firing chambers in a rotating cylinder. Single-action **revolvers** are fired by manually cocking the hammer and then pulling the trigger. Cocking the hammer both rotates the cylinder to place one of the chambers under the hammer and cocks the firing mechanism. Double-action revolvers are fired by a long **trigger pull** that raises the hammer, indexes a firing chamber under the hammer, and then allows the hammer to drop, firing the cartridge.

Semiautomatic Pistols

These are also called autoloaders or self-loaders. Laypersons sometimes incorrectly refer to these weapons as automatic **pistols**. (Figure 21.1 shows a Beretta semiautomatic pistol.)

Figure 21.1 Beretta semiautomatic pistol.



In semiautomatic pistols, the cartridges are held in a magazine (usually removable) and are loaded sequentially into the pistol from the top of the magazine. The typical firing sequence is (1) a cartridge is chambered in the pistol (usually by manually moving the slide or breechblock to the rear, then allowing it to move forward and strip the top cartridge from the magazine) and simultaneously the firing mechanism is cocked; (2) the shooter pulls the trigger, firing the cartridge; (3) some of the energy produced by the fired cartridge is used to move the slide or breechblock to the rear, extracting the spent cartridge from the chamber, ejecting it from the weapon, and cocking the firing mechanism; and (4) a spring com- pressed by the rearward travel of the slide or breechblock pushes the slide or breechblock forward, stripping an unfired cartridge from the magazine and loading it into the firing chamber.

At the end of this cycle, the pistol is left loaded and cocked; it requires only the pull of the trigger to fire another shot. A true automatic pistol would continue to fire as long as its trigger was depressed and its magazine contained ammunition; however, only one truly automatic pistol, the Mauser Snell-feuerpistole, has been mass-produced. The various "**machine pistols**" manufactured in Nazi Germany during World War II (discussed below) were actually submachine guns.

Rifles

These are rifled firearms designed to be held in two hands when being fired from the shoulder. The different types of **rifles** currently available are listed below.

Lever and Slide Action Magazine Repeaters

In lever action rifles, a lever below the weapon's receiver is dropped to move the breechblock to the rear and cock the firing mechanism. Raising the lever chambers a fresh round in the rifle. In slide (or pump) action rifles, a slide under the barrel is moved to the rear to extract and eject the expended cartridge and cock the firing mechanism; pushing the sl forward chambers a fresh round. The magazine is a tube under the barrel.

Bolt-Action Magazine Repeaters

The two types of bolt actions are straight pull and turn-bolt. In a straight-pull, bolt-action rifle, the expended cartridge is extracted and ejected by drawing the bolt to the rear; moving the bolt forward strips a fresh cartridge from a magazine and inserts it into the rifle's chamber. Movement of the bolt also cocks the rifle. The turn-bolt action operates in a simi- lar fashion except that the handle of the bolt is turned downward to lock the bolt closed. The turn-bolt action was developed to permit the firing of more powerful cartridges. The U.S. Army Springfield 1903 rifle uses the Mauser turn-bolt system.

Single Shot Rifles

These are rifles into which rounds must be loaded one at a time; there is no magazine. Single shot rifles use rolling block, lever action, or bolt action.

Semiautomatic Rifles

Squeezing the trigger of a semiautomatic rifle fires one round. Some of the energy of the discharge is used to extract and eject the expended cartridge, load a fresh cartridge into the firing chamber, and cock the firing mechanism. Box magazines (either built into the weapon or detachable) are most common, although some semiautomatic rifles have drum and helical magazines. Most semiautomatic rifles operate on the gas piston principle, although blowback- and **recoil-operated** semiautomatic rifles are also encountered. The U.S. Army M1 Garand semiautomatic rifle was the first semiautomatic rifle adopted as the service rifle of a major army.

Other Rifles

Double rifles, or combination rifles, are sporting rifles with two rifled barrels or one rifled barrel and one shotgun barrel. The barrels may be over and under or side-by-side. Break- top actions are the most common.

Shotguns

These are smoothbore firearms designed like rifles to be held in two hands when fired from the shoulder. As will be discussed below, shot-guns are commonly used to fire pellet loads rather than single projectiles. The different types of shotguns currently available are dis- cussed below.

Slide and Lever Action

The shotgun is loaded and cocked by pumping a slide or lowering and raising a lever. The shotshells are loaded into a tubular magazine under the barrel.

Double-Barreled Shotguns

These are available in two configurations: over/ under shotguns, in

which the two barrels are aligned one above the other, and side-by-side shotguns. Double-barreled shotguns break open to eject fired shotshells and each barrel is loaded separately. In sporting double-action shotguns, the two barrels often have different **chokes**.

Bolt-Action and Single Shot Shotguns

Bolt-action shotguns use the turn-bolt action described above. Single shot shotguns may use rolling block or break-open actions.

Semiautomatic Shotguns

These use the same mechanisms as semiautomatic rifles.

Automatic Weapons

These are weapons that will continue to fire as long as the trigger is depressed and ammunition is available. A wide variety of **automatic weapon**s are currently available.

Machine Guns

These are military weapons that fire from a mount (e.g., a tripod) or have a bipod attached to the barrel to support the weapon when it is fired. **Machine guns** may also be mounted on vehicles (e.g., tanks and armored personnel carriers) or aircraft (e.g., military helicopters and fighter planes). The ammunition may be fed from a detachable drum or box magazine; however, machine guns are more commonly fed by a fabric belt or one composed of metal links. During World War I, ground forces used heavy machine guns and light machine guns. Heavy machine guns were mounted on tripods, wheels, or sleds; these weapons typically fire belted ammunition. Light machine guns were developed to give assault troops automatic supporting fire. These were usually equipped with bipod mounts and box magazines. Between the World Wars the German army

rethought its tactics and developed the concept of the general-purpose machine gun. Equipped with a bipod, it would be light enough to be carried and fired by one man. Mounted on a tripod, it also could be used in the role of a heavy machine gun. The German MG42 was the most widely used general purpose machine gun in World War II. After that war, the other major armies of the world adopted the same concept. The M60 is the U.S. Army's general-purpose machine gun.

Automatic Rifles

These are actually light machine guns that feed ammunition from a detachable box or drum magazine. The Browning **automatic rifle** (BAR), used by the U.S. Army before and during World War II, is an example of a military automatic rifle. Automatic rifles have been replaced in military use by general purpose machine guns.

Submachine Guns

These are automatic weapons that fire pistol ammunition fed from detachable drum or box magazines. Submachine guns were developed toward the end of World War I to give assault- ing infantry close-support automatic weapons. The famous Thompson .45-caliber submachine gun was developed at the end of World War I, but is better known through its use by 1930s gangsters in the United States. Submachine gun designs proliferated during World War II when both Germany and the Soviet Union tried to put as much firepower in the hands of the infantry as possible. Germany produced a whole family of so-called machine pistols, while the Soviet Union armed large infantry formations solely with submachine guns. Submachine guns are accurate only at close range.

Assault Rifles

These are automatic weapons that fire a reduced-charge rifle cartridge. They were first developed by the Germans during World War II to provide airborne troops with an automatic weapon that had better range and accuracy than the submachine gun. Modern armies have embraced the **assault rifle** as the principle weapon of the infantryman. The U.S. Army's M16 and the Soviet Kalashnikov AK47 are familiar examples of assault rifles.

Manufacture of Firearms

Firearm barrels can be rifled in a number of ways. A hook or **scrape cutter** can be used to shave away metal from the interior of the barrel to create grooves. The barrel is pre- pared for **rifling** by drilling out a metal bar and then reaming the interior of the barrel to smooth it. The barrel is placed on a frame, called a rifling bench, that rotates the barrel as the cutting tool is drawn through it. Hook cutters cut one groove of the rifling at a time; a scrape cutter that has cutting surfaces on both sides can cut two grooves at a time. After the rifling has been cut, the interior of the barrel may be polished by lapping: a soft metal plug is cast inside the barrel and then pushed up and down with rouge (a powder used to polish metal) to remove imperfections. Hook and scrape cutters are not the most efficient rifling methods for the mass production of firearms.

Most mass-produced firearms are rifled by broaching, **swaging**, hammer-forging, or **electrochemical etching**. When a barrel is broached, it is first drilled out to approximately the desired finished bore diameter and reamed to remove drill marks; then a gang **broach** (a long rod having a series of circular cutting tools on it) is forced by hydraulic pressure through the barrel. Each successive cutter on the broach cuts each grove of the

rifling a little deeper until the last cutter reaches the desired groove depth. A single pass of the gang broach is sufficient to rifle a gun barrel.

When a barrel is rifled by swaging, it is drilled out to a diameter less than the desired final bore diameter, reamed to remove the drill marks, and then swaged. A rifling button is forced through the barrel, simultaneously engraving the desired rifling pattern on the inside of the barrel, expanding the barrel to the desired bore diameter, and cold-working the interior of the barrel. Cold-working hardens the interior of the barrel and permits the use of cheaper mild steel. Many inexpensive small-bore weapons are rifled by swaging.

A hammer-forged barrel is produced by first drilling out steel bar stock to a diameter larger than the desired finished bore diameter. The barrel is slipped over a hardened steel mandrel on whose surface is a negative impression of the desired rifling pattern. The barrel is hammered down on the mandrel; the mandrel is then knocked out of the barrel. **Hammer forging** is used to produce barrels with polygonal rifling (e.g., those of Glock semiautomatic pistols).

Electrochemical etching is the newest method used to rifle barrels. In this process a piece of steel bar stock is drilled out, and the interior surface of the barrel is coated with strips of chemically resistant polymer. The polymer layers correspond to the lands of the rifling. A chemical etching solution is placed in the barrel and an electrode is inserted. A voltage is applied between the barrel and the electrode so that the barrel becomes the anode in an electrochemical cell. The passage of an electrical current through the cell eats away the metal on the interior of the barrel where there is no protective polymer layer, forming the grooves of the rifling.

Rifling produced by **hook cutting**, scrape cutting, and broaching is often referred to as **cut rifling**. Cut rifling tends to leave more

forensically useful marking inside the rifled barrel than do the other rifling methods.

The size of a firearm barrel may be designated in different ways. The most common is to specify its caliber. Caliber is defined as

the diameter (in hundredths or thousandths of an inch or in millimeters) of a circle that is tangent with the top of the lands of the rifling. Calibers are merely nominal; the actual bore diameter may be different. For example, a weapon designated as .45 caliber may have an actual bore diameter at the muzzle of .44 inches. The caliber of a weapon can be deter- mined with taper gauges that are inserted into the muzzle or from a sulfur cast of the interior of the barrel. Caliber determinations should be a routine part of the examination of a fire- arm because the barrel may have been altered from its original caliber (by being bored out), or a barrel with a different caliber may have been fitted to a firearm (such as a .45 caliber barrel mounted on a .38 Smith and Wesson Police Special frame).

A brand new firearm may or may not leave a unique pattern of markings on a fired bullet. Carefully lapped barrels may have too few microscopic imperfections to produce useful patterns of markings on fired bullets. In other cases, a new barrel may have a set of unique irregularities that mark fired bullets. In the 1920s and 1930s, several studies were done on the marks produced by sequentially rifled barrels. These were found to produce unique sets of marks on fired bullets. The best explanation for this observation is that rifling tools wear during the rifling operation so that in effect each barrel is rifled with a “different” tool. A study has also examined the markings made by electrochemically etched barrels and found them to be unique. Of course, once a barrel has been used extensively it will develop its own suite of unique irregularities: in some areas metal will have worn away (erosion) and in others, minute pitting will appear due to propellant combustion residues eating away at the metal of the gun barrel (corrosion).

Cartridge cases will be marked by a number of firearm components: firing pins will mark the primer cap of centerfire cartridges or the rim of the cartridge itself in **rimfire cartridges**; the breechblock or backing plate (in revolvers) may mark the primer cap or even the metal of the casing itself (if the cartridge is powerful enough); in self-loading or automatic weapons the extractors and ejectors will mark the base of the cartridge; and in weapons using magazines, the lips of the magazine may also mark cartridges. Firearms examiners consequently need an understanding of how components, such as firing pins, breechblocks, extractors, and ejectors, are made. Firing pins are finished by hand filing or by turning on a lathe. Breechblocks are hand filed, milled, or turned on a lathe. Extractors and ejectors are finished by hand filing. Wherever finishing operations involve a human operator (filing, milling, or turning on a lathe), the resulting patterns of marks are unique. In some makes of firearms the breechblock is painted so that it will not transfer markings to the primer cap.

The barrels of shotguns may be bored out of bar stock or drawn like tubing. A unique feature of shotgun barrels is the choke in the muzzle. This is commonly a constriction in the muzzle that serves to concentrate the shot pattern. Shotguns may have four degrees of choke: full choke (greatest choke), modified choke, improved cylinder, and cylinder-bore (no choke at all). A few shotguns have been produced with a reverse choke, which is a flaring at the muzzle intended to cause the pellet pattern to spread. The choke of a shotgun barrel may be changed using inserts or adjustable compensators. As a general rule, shotgun barrels do not leave identifiable markings on shot, **wads**, or shot columns. However, if a criminal has sawed off a shotgun's barrel (usually to facilitate concealment), metal burrs may be left at the muzzle; these may mark shot, wads, or shot columns in a unique fashion.

The diameters of shotgun barrels are customarily designated by the gauge of the shotgun. Gauge is defined as the number of spherical lead

balls having the diameter of the interior of the barrel that weigh one pound. For example, 12 lead balls having the diameter of the interior of a 12-gauge shotgun barrel (roughly .75 inches) would weigh 1 pound. The only exception to this rule is the .410 gauge, whose actual bore diameter is .410 inches. Rifle calibers were at one time designated using a similar system. Thus, one can still read of 4-bore or 12-bore gauge rifles. These were rifles produced in the 19th century for hunting dangerous game such as elephants.

Firearm Ammunition

Figure 21.2 shows the disassembled compo- nents of a typical rifle cartridge and a shot- shell. Firearms can fire a variety of projectiles. Bullets may be lead, lead-alloy, semi-jacketed, or full-metal jacket. Lead bullets are soft and readily deformable. Because the surface of a lead bullet can be easily stripped off by the rifling in the gun barrel, lead bullets are used in low-velocity firearms. Because lead is a ductile and malleable metal, lead bullets are easily marked by the rifling; such bullets may also undergo extreme deformation or even fragmentation when they strike a target. Lead alloy bullets contain a small percentage of an alloying element, such as antimony in com- mercially manufactured bullets or tin in home- made bullets. Lead alloy bullets are harder than lead bullets and are consequently used in weapons having higher muzzle velocities. Lead alloy bullets are sufficiently ductile and malleable to be easily marked by the weapon's rifling; they also readily deform on impact. Lead and lead alloy bullets may be plated with a thin layer of copper (e.g., Luballoy bullets). The copper layer reduces the friction between the bullet and the gun barrel. This layer readily flakes off the surfaces of fired bullets, taking with it the marks made by the rifling.

Figure 21.2 Disassembled rifle cartridge and shot- shell.



Semi-jacketed bullets commonly consist of a lead core covered with a thin jacket of brass. The brass typically covers the sides of the bullet, leaving the lead core exposed at the nose (as in hollow point bullets). Soft point bullets are semi-jacketed bullets in which a soft metal plug has been inserted in the nose of the bullet. Soft point bullets are used to hunt large game; the soft metal insert promotes the expansion of the bullet when it enters the tar- get animal. Explosive bullets are produced by inserting percussion caps in the hollowed-out noses of hollow point bullets. The jackets of hollow point and soft point bullets may separate from the lead cores when the bullets enter the body of a shooting victim. The treating medical personnel or the forensic pathologist must make every effort to recover the jacket because only the jacket bears markings made by the weapon's rifling. Full metal jacket bul- lets consist of a lead core covered with a brass jacket. The jacket covers the nose and side of the bullet and occasionally the base as well. Because the jacket of a semi-jacketed or full metal jacket bullet is harder than lead, these bullets are not as well marked by the rifling of the gun barrel as are lead or lead alloy bul- lets. Moreover, semi-jacketed and full metal jacket bullets are slightly smaller in diameter than lead or lead alloy bullets of the same caliber; they also expand less upon entering the rifling. As a consequence,

semijacketed and full metal jacket bullets may not be marked by contact with the bottoms of the grooves of the rifling.

Plastic can also be used to jacket bullets. Teflon coated bullets were developed for police use in barricade situations. The self- lubricating property of Teflon reduces the friction between the bullet and the barrel of the weapon and allows the bullet to reach a very high muzzle velocity. Because of their high velocities, Teflon-jacketed bullets can penetrate automobile engine blocks and also multiple plies of body armor. Nylon-clad bullets are also being marketed. Some European military forces have also produced training ammunition with plastic bullets.

Firearms examiners may also encounter a number of unusual or special purpose bullets. These include frangible bullets, open tubular rounds, and discarding sabot rounds. Frangible bullets consist of iron or copper particles for training, particles sim- ply pressed together or held together with an organic binder. Frangible bullets are used in shooting galleries and also for killing livestock in slaughterhouses. An open tubular round consists of an open tube of copper or brass with a plastic cap at the base to serve as a gas check. Open tubular rounds produce unusual wounding effects and, because of their low mass, can achieve much higher muzzle veloci- ties than conventional bullets. Brass open tubular rounds can pierce bulletproof vests; the Bureau of Alcohol, Tobacco, and Firearms (BATF) was able to prevent the sale of brass open tubular rounds in the United States. Discarding sabot rounds have been used in certain rifle ammunition (e.g., the Remington Accelerator .30-06 cartridge). The discard- ing sabot projectile consists of a .223-caliber (5.56-millimeter) soft point bullet inserted into a .30-caliber plastic cup or sabot. When this round is fired in a .30-caliber rifle, the plastic sabot acts as a gas check while the projectile is in the gun barrel; then it separates from the .223-caliber bullet. The sabot bears the rifling marks from the gun barrel, while the .223-caliber bullet (which would be recovered from the

target) never comes into contact with the rifling. Prefragmented bullets contain metal pellets embedded in plastic: when the bullet hits its target the thin outer jacket dis- integrates and the pellets disperse through- out the victim's body. The Glaser Safety Slug and the MagSafe Safety Bullet are examples of prefragmented bullets. These bullets are intended for use in situations where over-penetration of the target cannot be risked (airline hijackings). A variety of solid copper bullets have recently come on the market. They are available in a number of designs: solid pointed nose and round nose bullets, hollow point bullets and hollow point bullets with a central post.

Bullets are produced in a variety of shapes. Wadcutter bullets are flat-nosed, cylindrical bullets used for target shooting. Bullets may have round noses or may be pointed (spitzer bullets) to reduce aerodynamic drag or to facilitate target penetration. Hollow-point bullets have depressions in their noses: hollow points facilitate the expansion of the bullets when they enter tissue. The bases of bullets may be flat or they may be boat-tailed to reduce the turbulent wake of the bullet that contributes to drag. Bullets may have knurled grooves called cannelures engraved around their circumferences. Cannelures may contain lubricant, and the mouth of the cartridge may also be crimped into the bullet's cannelure to hold the bullet in the cartridge. Cartridge casings may also have cannelures. The cannelures in cartridges prevent the bullet from being accidentally pushed into the casing.

Cartridges may be either rimfire or centerfire. Rimfire cartridges have the primer composition in the rolled rim of the cartridge. These cartridges are fired by the weapon's firing pin striking the cartridge rim. A **center- fire cartridge** has a primer cap placed in the center of the cartridge base. In the United States, the Boxer cartridge is popular. This type of cartridge has a central vent hole, which communicates the flash of the exploding primer to the propellant inside the cartridge. The Boxer primer is a small cap made of

gilding metal. Inside is a small metal tripod oriented with its apex toward the metal sur- face of the primer cap. A small speck of primer mixture is placed between the apex of the tri- pod and the primer cap so that, when the firing pin strikes the primer, the primer mixture is crushed between the primer cap and the tripod. The open side of the primer cap is cov- ered with a thin sheet of treated paper or foil to keep out moisture. The Berdan cartridge and primer are used in Europe. The principal difference between the Boxer and Berdan primer systems is that the Berdan primer does not contain a metal tripod; instead, in the recess for the primer cap, the cartridge has a cone with three vents communicating with the interior of the cartridge.

Centerfire cartridges are produced in a wide range of shapes. These cartridges may be straight-sided or bottle-necked. The cartridges may be belted, rimmed, semirimmed, rimless, or rebated (with the cartridge base slightly recessed from the sides). Cartridge shapes may be divided into 12 types:

Rimmed bottleneck
Rimmed straight
Rimless bottleneck
Rimless straight
Belted bottleneck
Belted straight
Semirimmed bottleneck
Semirimmed straight
Rebated bottleneck
Rebated straight
Rebated belted bottleneck
Rebated belted straight

The shape of the cartridge reflects the shape of the weapon's firing chamber.

Shotguns can fire a variety of projectiles. The most common type of projectile is shot. Shot may be made of lead, lead alloy (chilled shot), or steel. The smaller shot sizes are produced by allowing molten metal to fall through the air down a shot tower. The mol- ten metal separates into spheres of varying diameter that cool and harden as they fall. The hardened shot are then sorted according to size and loaded into shotshells. The larger shot sizes (e.g., 00 buckshot) are individually molded. Modern shotshells are plastic with brass bases. A plastic or fiber disk, called a *wad*, separates the shot in the shotshell from the powder. A second wad may be placed over the shot and the mouth of the shotshell crimped over it to seal the shotshell. The shot may be enclosed in a plastic cup that protects the shot from deformation due to contact with the inside of the shotgun barrel. In some shot- shells the over-powder wad and the cup may be combined into a one-piece shot column. Wads and shot columns can act as secondary projectiles and may be recovered from within close-range shotgun wounds; they may also inflict superficial injuries adjacent to shotgun wounds. Shotguns can also fire loads containing a single large-caliber round ball or a single rifled slug. Foster-rifled shotgun slugs are round-nosed conical lead bullets with hollow bases and projecting fins on their sides. The fins are set at an angle so that when a rifled slug is fired it acquires a spin. If the shotgun barrel is choke-bored, the fins are forced into the hollow base as the slug exits the shotgun muzzle. Brenneke rifled slugs also have projecting fins; they are attached to wads or shot columns. The wounding effects of rifled shot- gun slugs are similar to those of the minié bullet used in the American Civil War.



Figure 21.3 Examples of cartridge headstamps.

The base of a cartridge and shotshell (called the *headstamp*) bears information such as the vendor of the ammunition (usually abbreviated, as F for Federal, Rem for Remington, R-P for Remington-Peters, or WIN for Winchester) and the gauge or caliber. The caliber or cartridge type may also be indicated in the headstamp: for example, ".30–06" means that the cartridge is a .30-caliber rim- less, bottleneck cartridge introduced in 1906. The headstamp may also consist of a logo (e.g., a diamond on .22-caliber Winchester rimfire cartridges). Figure 21.3 shows a selection of cartridge headstamps.

Smokeless Powder

Modern **smokeless powders** may be single base, double base, or triple base. In single base smokeless powders, nitrocellulose is the only energetic material. Double-base powders contain nitrocellulose and nitroglycerin, while triple base powders contain nitrocellulose, nitroglycerine, and nitroguanidine. Triple- base smokeless powders are used only as propellants in artillery ammunition.

The nitrocellulose used in smokeless powders is produced by the nitration of wood pulp or cotton lint. Gun propellant grades of nitro-cellulose have degrees of nitration between

13.15 and 13.25 percent. During the production of nitrocellulose, other characteristics, such as viscosity, particle size, purity, and stability, are carefully controlled. Scrap nitrocellulose and obsolete propellants are also used as sources of nitrocellulose. Obsolete propellant is recycled in this fashion because it is virtually impossible to dispose of such material. It cannot be burned without producing air pollutants, and few landfills will accept quantities of smokeless powder.

Nitroglycerine is manufactured by nitration of natural or synthetic glycerin. Nitro- glycerin is considered an energetic plasticizer. It softens the propellant granules, raises their energy content, and reduces their absorption of moisture. Smokeless powders used in small caliber ammunition typically contain a variety of other ingredients: stabilizers, plasticizers, flash suppressants, deterrents, dyes, opacifiers, graphite glaze, and ignition aid coatings. **Stabilizers** react with the acidic breakdown products of nitrocellulose and nitroglycerin (primarily the nitrogen oxides NO and NO_2). Diphenylamine is used as a stabilizer in single-base powder and in double-base powder with a nitroglycerin content of 20 percent or less. Ethyl centralite is used as the stabilizer in double base powders with nitroglycerin contents greater than 20 per- cent. Typical stabilizer concentrations range from 0.5 to 1.5 percent. Plasticizers soften the propellant granules and reduce the absorption of moisture.

Other plasticizers, such as ethyl centralite, dibutyl phthalate, dinitrotoluene, and triacetin, may also be used. Flash suppressants interrupt the free-radical chain reactions in the muzzle gases. Muzzle gases contain high concentrations of carbon monoxide, which can react with atmospheric oxygen. Low concentrations (0.5 to 2.5 percent) of alkali salts, such as potassium nitrate and potassium sul- fate, are used as flash

suppressants. Flash suppressants may be present within the pow- der particles or coated on them; flash suppressants may also be added to the smokeless powder as separate particles.

Deterrents are coatings on propellant grains that reduce their initial burning rate. The reduction in the initial burning rate broadens the pressure peak and increases the muzzle velocity. Deterrent coatings are either of the penetrating type or of the inhibitor ("candy shell") type. Penetrating deterrents include Herkote (Paraplex® G-54 polyester), ethyl or methyl centralite, dibutyl phthalate, and dinitrotoluene. The main inhibiting ("candy shell") deterrent is Vinsol® resin. Deterrent concentrations range from 1 to 10 percent. Dyes are added to powder grains to facilitate brand identification (e.g., Red Dot and Blue Dot smokeless powders). Opacifiers prevent radiant energy from penetrating the surface of the powder grains (and initiating burning within the grains). Carbon black is the most commonly used opacifier. Graphite glaze reduces sensitivity to static electric- ity, improves the flow of powder grains, and improves the packing density of the powder. An ignition aid coating improves the oxygen balance of the surfaces of the powder grains. Potassium nitrate is the most commonly used ignition aid coating.

The manufacturer of smokeless powder controls a number of characteristics of the pow- der. The energy of the powder is determined by the formulation of powder (i.e., whether the powder is single base or double base); it is primarily a function of the flame temperature and the average molecular weight of the muzzle gases. The linear burning rate depends on the composition and on the porosity of the powder grains. The surface area of the powder grain is determined by its geometry. Powder grains may be spheres, cylinders, disks, or flakes; the grains may also be perforated. The surface area of the powder grains is the major control

factor that the manufacturer uses to adjust the performance of a smokeless-powder product.

Smokeless powders are produced by one of two processes: the **extruded powder** process and the **ball powder** process. In the extruded powder process, the nitrocellulose and other ingredients are kneaded together with an organic solvent to form a dough-like mass. The dough is extruded through small openings in a steel die. A rotating blade cuts off lengths of extruded dough. The dimensions of the extruded grains are controlled by the size of the openings in the die, by the rate of extrusion, and by the speed of the cutting blade. The extruded powder grains are then coated and glazed with graphite. After drying to remove the solvent, the powder grains are screened to remove grains that are too large or too small. In the ball powder process, the nitrocellulose and other ingredients are mixed with solvent to make a lacquer. The lacquer is extruded through a steel die into hot water, where the nitrocellulose forms spherical grains. The solvent is removed by the hot water, and the grains are allowed to harden. The spherical grains are sorted by size, and particles in the desired size range are subjected to further processing. The grains are coated and may be passed between rollers to flatten them into disks or flakes. In both processes the final product is a mixture of several batches of smokeless powder. The batches are blended to create a powder with a specified burning rate.

Collection of Firearms-Related Evidence

Fired bullets may be difficult to recover at the scenes of crimes. They may be embedded in walls, ceilings, door frames, window frames, and the like. Only rubber-coated or heavily taped tools should be used either to probe for bullets or to extract them. It is generally best for the investigator to remove the section of the building structure that contains the bullet so that the forensic firearms examiner can carefully remove the

bullet in the laboratory. Some police agencies recommend that bullets be marked for identification by investigators on the nose or on the base. Under no circum- stances should such identification marks be placed on top of potentially useful markings on the bullet. Care must also be taken not to dislodge any trace evidence that may be on the bullet surface. As an alternative to marking the bullet for identification, some law enforcement agencies recommend placing the bullet in a sealed pillbox or plastic vial; the container and its seal are then marked for identification. An expended cartridge can be marked for identification inside its mouth. Some agencies recommend not marking expended cartridges but rather placing them in sealed and marked containers.

The serial numbers of all firearms seized should be recorded by investigators.

Investigators will generally mark firearms for identification only if they are being collected as evidence. Even then some common sense is in order; antique or highly engraved firearms should be carefully marked so that their value is not diminished. All removable parts of a fire- arm that can mark a fired bullet or cartridge should be marked for identification. Thus, a 9-millimeter semiautomatic pistol should be marked on the barrel, the slide, the receiver, and the magazine. A revolver having an inter-changeable cylinder and removable barrel should be marked on the cylinder, barrel, and frame. Weapons with removable bolts should be marked on the bolt, barrel, and frame.

For safety, loaded weapons should be unloaded before they are transported to the firearms laboratory. Magazines or clips should be carefully removed and marked for identification; live or expended cartridges should be removed from the firing chamber. Revolvers present a special problem. The investigator should scratch a small arrow on the rear face of the cylinder to indicate the chamber that was under the hammer when the revolver was collected as evidence. The chambers in the cylinder are

numbered in a clockwise manner (when viewed from the rear) with chamber #1 being the chamber under the hammer. Each chamber is then emptied, with the live or expended cartridge or its container marked with the number of the chamber.

In general, firearms should not be cleaned before they are shipped to the forensic science laboratory. However, if there is a lot of moisture in the weapon's barrel, it should be removed by passing a dry patch through the barrel. The investigator should note the cleaning in his or her notes and in the letter of transmittal to the forensic science laboratory. He or she should submit the patch as evidence along with the firearm. For shipment to the forensic science laboratory the weapon should be wrapped in a clean protective covering to protect it from contamination. If the firearm is to be processed for latent fingerprints, it should not be covered, but should be placed in a box or other container so that any latent fingerprints are not rubbed off by contact with the packaging.

All ammunition in the possession of a suspect in a shooting case should also be seized as evidence. The firearms examiner may have to estimate the range of fire from a powder pattern or shotgun pellet pattern. Such estimation requires ammunition from the same batch as that which produced the questioned powder or pellet pattern. Live ammunition cannot be sent through the United States mail. Therefore, the investigator may have to hand-carry live ammunition unloaded from a weapon or seized from a suspect to the forensic science laboratory or ship it through a private parcel service.

Laboratory Examinations

Microscopic Examinations

Figure 21.4 shows examples of fired bullets that might be submitted as evidence. Several of them show patterned markings or trace



evidence. Bullets should always be examined for the presence of trace evidence as well as patterned markings. Bullets may pick up textile fibers, traces of paint, or bits of concrete and brick from intermediate targets. Bullets may

Figure 21.4 Expended bullets that might be submit- ted for firearms examination. Upper left: deformed full metal jacket bullets. Upper right: core and detached jacket of hollow-point semijacketed bullet. Lower left: lead-alloy bullet that struck body armor. Lower middle: lead-alloy bullet that passed through window. (Note embedded glass particles.) Lower right: lead-alloy bullets that passed through plywood. (Note embedded wood fibers.)acquire patterned markings from clothing or window screens. In one case, a state police officer was shot during a traffic stop. One bullet passed

through the badge device on his uniform cap. When recovered, the bullet had the pattern of the badge embossed on its nose. In another case, a man was accused of shooting his neighbor to death. The defendant claimed that he had shot the victim during a quarrel in the victim's kitchen during which the victim had attacked him. The discovery of an impression on the nose of the fatal bullet that matched the window screen in the victim's kitchen window (along with an apparent bullet hole in the screen) refuted the self-defense claim.

The goal of the initial examination of a fired bullet is the determination of general rifling characteristics of the firearm that fired it. This information allows the forensic fire- arms examiner to narrow the possible makes and models of firearm that could have fired the bullet. The general rifling characteristics to be determined are:

- Caliber
- Number of lands and grooves
- Direction of twist of the rifling
- Degree of twist of the rifling
- Widths of lands and grooves

The caliber of a fired bullet can be determined in a variety of ways. If the bullet is not deformed, its diameter can be measured with a micrometer, or it can be compared with bullets fired from weapons whose caliber is known (i.e., so- called fired standards). With either method, allowance must be made for the fact that lead and lead-alloy bullets are larger in diameter than full-metal jacket or semijacketed bullets of the same nominal caliber. If a bullet is severely deformed, its possible caliber(s) may be determined by weighing it. The weight of the bullet will rarely pinpoint its caliber but will serve to eliminate a number of calibers from consideration. For example, a 72-grain bullet may be .32 caliber but it cannot be .22 caliber. If the bullet is fragmented, its possible caliber(s) can

be determined by combining the measured width of a land marking with that of an adjacent groove. Tables of combined land and groove widths have been prepared for a number of makes and models of firearms.

The number of lands and grooves is determined by inspection, as is the direction of twist of the rifling. Rifled firearms have either right twist (Smith and Wesson type) rifling or left twist (Colt type) rifling. The degree of twist of the rifling and the widths of the land and grooves can be determined by microscopic measurements of the rifling marks on the bullet. However, it is generally simpler to compare the questioned bullet to a set of fired standards—bullets fired from firearms having known rifling characteristics. The general rifling characteristics determined from a fired bullet can be used to search a database such as that prepared by the FBI. Both a text form and a computer-searchable form of the data- base can be downloaded from the Internet.

Class characteristics of firearms can also be determined from expended cartridges. The significant class characteristics are:

- Caliber
- Shape of firing chamber
- Location of the firing pin
- Size and shape of the firing pin
- Size of extractors and ejectors (if any)
- Geometrical relationship of the extractor and ejector

For the most part, these characteristics can be determined by inspection. Determination of the caliber and the size of the firing pin and extractor requires the use of a micrometer or a microscope equipped with a reticule for measurements. The class characteristics can be used to search the FBI database for matching makes and models of firearms.

Some care should be exercised in inferring the general class characteristics of a weapon from fired bullet or cartridge cases. A number

of devices are available that permit the firing of types of ammunition other than that for which the weapon was designed. For example, crescent-shaped metal clips can hold rimless pistol cartridges in the cylinder of a revolver. A barrel insert can convert a shotgun into a rifle. Subcaliber cartridges can be wrapped in layers of paper to facilitate loading into the cylinder of a revolver. It may even be possible to chamber and fire a larger caliber cartridge in a weapon. Rifling characteristics of barrels can be altered by reboring them.

If a questioned firearm has also been sub- mitted in a case, the forensic firearms examiner should conduct an initial examination for trace evidence that might be destroyed in the course of his or her testing. For example, blood or other tissue may have been blown back from a contact gunshot wound onto the exterior of the weapon or inside the barrel. There may be textile fibers on the weapon from the shooter's pants or jacket pocket. The weapon should also be processed for latent finger- prints before additional tests are undertaken. Next, the firearms examiner determines if the weapon's class characteristics are consistent with those found on the fired bullets or cartridges. Taper gauges can be used to verify the weapon's caliber; the number and lands and grooves and their direction and degree of twist can be determined with a helixometer. A sulfur cast of the interior of the barrel may also be used to determine all general rifling characteristics.

Once it has been determined that the class characteristics of the firearm and those of the fired bullets or cartridges are consistent, the weapon must be test fired to obtain bullets and cartridges for comparative microscopic examination. Before the weapon is test fired the examiner conducts examinations to deter- mine if the firearm's mechanism operates properly and if the weapon can be safely fired. These examinations are discussed below. If the weapon cannot be safely fired, the examiner may be able to replace damaged or missing parts from the laboratory's

firearm collection. To obtain test-fired bullets, the firearm is fired into a bullet trap. Most firearms laboratories use some type of water trap to catch fired bullets. A horizontal bullet trap consists of a steel tank filled with water. The firearms examiner fires the test shots through a self-sealing rubber membrane. After the test shots have been fired, the tank is opened and the fired bullets removed for subsequent micro- scopic analysis. A vertical bullet trap does not require a self-sealing membrane. A basket at the bottom of the tank is used to recover the

test fired bullets.

Bullets are mounted for microscopic comparison on a comparison microscope. A com- parison microscope consists of two compound microscopes connected by an optical bridge. It allows two specimens to be viewed side by side. Some examiners recommend first com- paring the test-fired bullets with each other to verify that the weapon's barrel consistently marks the bullets fired through it. If consistent marking does not occur (e.g., if the barrel is severely rusted), further comparison of the questioned bullet(s) and the test-fired bullets would be a waste of time. The comparison process is straightforward, albeit tedious. The examiner searches the surface of one bullet for a distinctive pattern of parallel striations and then rotates the other bullet slowly in an attempt to find a matching pattern. If a matching pattern is found, the bullets will be slowly rotated together to see if additional matching patterns of striations can be found. If no matching pattern is found, the examiner tries to find another distinctive pattern of striations on the first bullet and again tries to find a matching pattern on the second bullet. This process continues until matching striation patterns are found or the examiner exhausts all the distinctive striation patterns on the first bullet. Before the two bullets can be said to match, most firearms examiners require that identical patterns of three or more consecutive striations be found on each bullet. Not all striations on the two bullets must match. Particles of dirt in the weapon's

barrel may have made stray markings on the bullets, or the two bullets may have entered the rifling in slightly different ways. Figure 21.5 shows matching striation patterns within the land impressions of two bullets fired from the same semiautomatic pistol. Striation patterns in the groove impressions can also be examined; however, jacketed and semijacketed bullets may not expand sufficiently to fill the groove of the rifling.

Other marking on bullets have also been

compared from time to time. **Skid marks** are marks parallel to the axis of the bullet made when the bullet initially enters the rifling; the edges and surfaces of the lands will scrape along the bullet surface before the bullet is fully gripped by the rifling. The term skid mark is

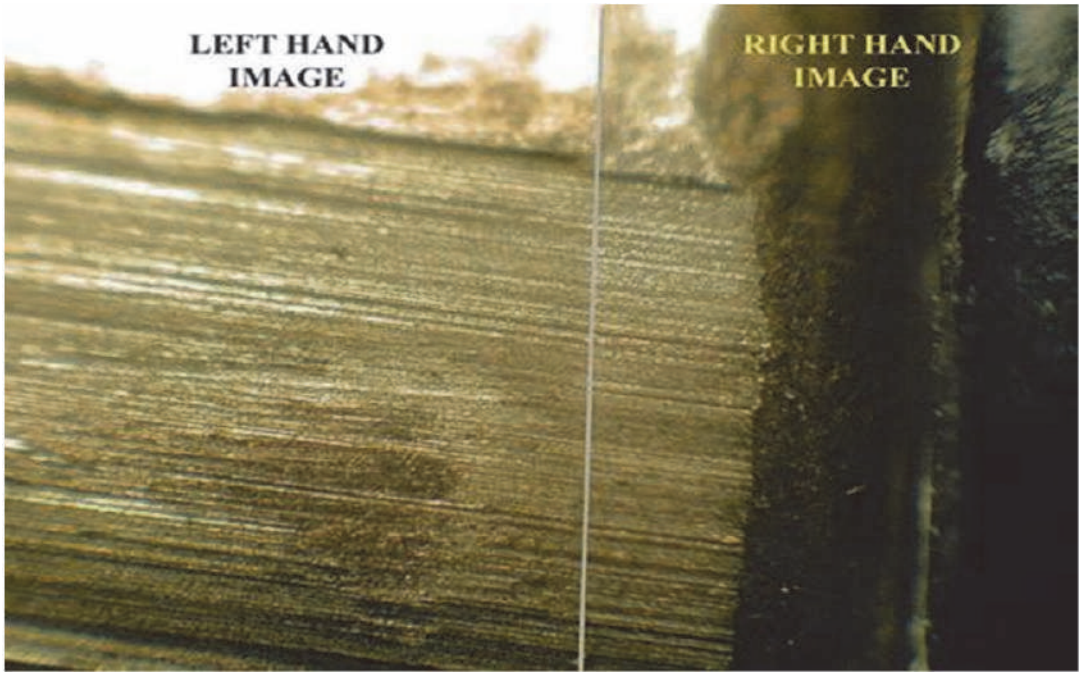


Figure 21.5 Microscopic comparison of striations in the land markings of two bullets fired from the same semiautomatic pistol.

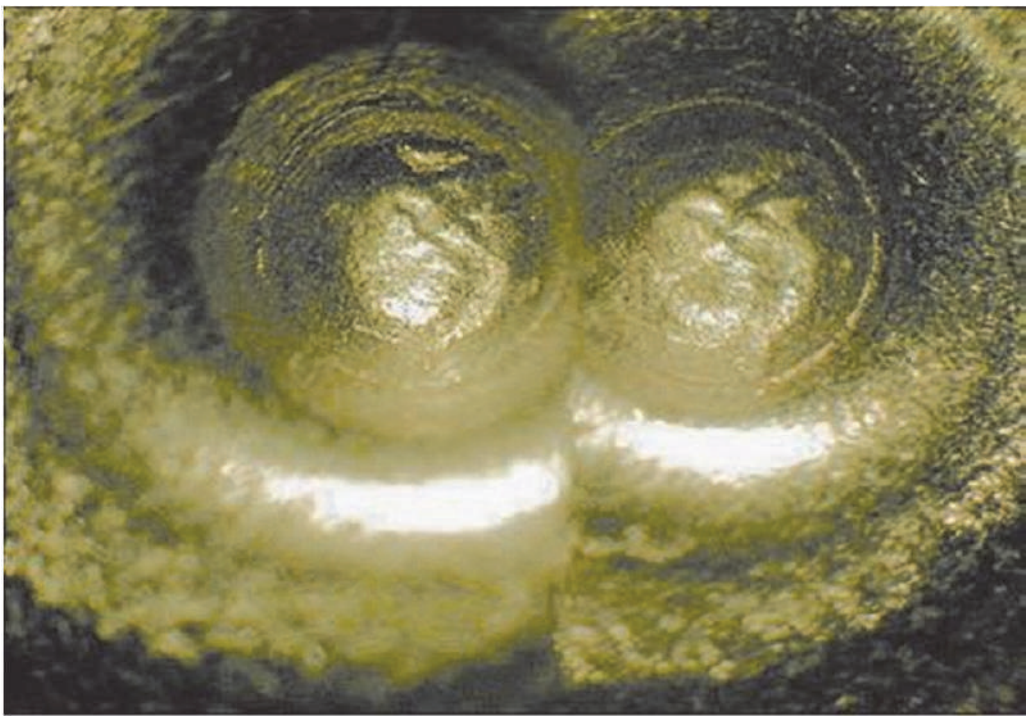


Figure 21.6 Microscopic comparison of firing pin impressions on two cartridges fired from the same semiautomatic pistol. also applied to marks near the nose of a bullet caused by contact with the **forcing cone** in the barrel of a revolver. The forcing cone is a flare at the breech end of a revolver barrel that is intended to guide the bullet into the rifling. Skid marks made by the forcing cone of a revolver are hard to reproduce; a number of bullets might have to be test fired before one strikes the same spot on the forcing cone as the questioned bullet. **Slippage** marks are made on a bullet when it slips along the tops of the lands without being gripped by the rifling. Slippage marks are the result of the barrel being worn or having been bored out. Slippage marks may also result if a subcaliber bullet is fired in a weapon. Slippage marks are hard to replicate in test firings.

A variety of markings on cartridges can be compared microscopically. There is a logical hierarchy to follow in conducting such comparisons. Firing pin impressions and breechblock markings (also called **bolt-face signatures**) should be compared first because they can only be produced by firing a cartridge in a firearm. Figure 21.6 shows the microscopic comparison of firing pin impressions on two cartridges fired from the same

semiautomatic pistol. Chambering, extractor, ejector, and magazine marks may be made by loading a cartridge in a weapon without firing it.

The following conclusions may be reached as a result of the comparison of bullets or cartridges:

- A *positive identification*. The class characteristics are consistent and individual characteristics match. This means that the likelihood that a firearm other than the firearm submitted for examination fired the questioned bullet or cartridge is so remote that it must be regarded as a practical impossibility.
- *Negative identification*. The questioned bullet or cartridge was not fired in the submitted weapon. This means that the class characteristics did not match. In this instance no microscopic comparison will have been undertaken.
- *Inconclusive*. This means either that there was too little information on which to base a conclusion or that while the class characteristics matched, sufficient individual characteristics to declare a match could not be found. The firearms examiner does not ren- der a negative identification in this last instance because the individual characteristics of the firearm may have been altered by further use. For example, there may have been bore erosion due to firing a large number of rounds through the weapon. The weapon may also have been deliberately altered by the shooter. Some weapons (e.g., Glock pistols) do not make usable striation patterns on fired bullets.

The microscopic comparison of bullets and cartridges is a very tedious and time-consuming process. Most law enforcement agencies keep open bullet and cartridge casing files where evidence from open criminal cases is kept for later comparison with test-fired bullets and cartridges from weapons recovered in sub- sequent investigations. However, the time required for such comparisons is such that they are attempted only when

information developed by investigators provides a link between a new case and an open case. The National Integrated Ballistic Information Network (NIBIN) was developed to facilitate linking firearms evidence in cases in different jurisdictions. The system consists of data-acquisition computer workstations and data-analysis computer workstations, all linked in a nationwide computer network. The data-acquisition computer workstation is used to scan and digitally capture images of bullets and cartridge cases. Each captured image has a mathematical signature that is placed in a database. Once a bullet or cartridge case is scanned and its image captured, the data- base can be searched for possible matches. The search of the database results in a list of potential candidate hits, and the NIBIN system operator can retrieve digitized images for visual comparison using the data-analysis computer workstation. Likely candidates for matches are referred to a firearms examiner for manual comparison of the actual items of evidence. The NIBIN system is designed to be operated by a technician with minimal skills, freeing the more highly trained firearms examiner for other duties. The image data-bases can be shared among firearms laboratories in different jurisdictions. The United States and Canada have agreed to share their image databases. In 2008 the United Kingdom launched its own version of NIBIN, the National Ballistics Intelligence Programme (NaBIP). NaBIP uses IBIS hardware and soft- ware, so that its database is compatible with those of the United States and Canada.

Two states, New York and Maryland, have

legally mandated the ballistic “fingerprinting” of new firearms. Before a semiautomatic pistol can be sold in these states, a cartridge case fired in it is scanned into a special data- base. Theoretically, if the weapon is subsequently used in the commission of a crime, an expended cartridge case from the crime scene can be scanned by a data-acquisition computer work station and matched to the image in the

database. Police investigators would then be led to the original purchaser of the handgun. After the expenditure of several million dollars, the Maryland ballistic finger- printing program has only solved one case. In 2005 an estranged husband was convicted of the murder of his wife with a .40 caliber hand- gun. The gun was never recovered; however, expended cartridges recovered at the murder scene were matched to a semiautomatic handgun purchased by the defendant. The New York ballistic fingerprinting program has shown a similar record of limited success in solving shooting cases. A low "hit rate" for ballistic fingerprinting it to be expected: most firearms are never used in the commission of crimes. There are also technical difficulties with the imaging and databasing systems. When California was considering a ballistic fingerprinting program similar to the Maryland and New York programs the state attorney general commissioned a pilot feasibility study. This study revealed a high rate of misses (38%). The hardness or soft- ness of the brass in the percussion caps of the centerfire pistol cartridges was identified as the likely culprit: if the brass is too hard, poor firing pin and breechblock impressions with limited detail result, and if it is too soft, the large amount of detail in the impressions con- fuses the image matching software algorithm. In 2008 the National Research Council (NRC) of the National Academy of Sciences released a study of the feasibility of a national data- base of images of markings made by new and imported weapons sold in the United States. This study concluded that given the currently available technology such a database would produce too many "matches" to be of helpful to police investigators. This NRC report also recommended further study of "microstamping," a process in which identifying information is engraved on firearm components such as firing pins and breechblocks. This information would be stamped on fired cartridge cases by the weapon's action; it could be read at the scene of a shooting by a police investigator with a

magnifying glass or low-power microscope. California has passed a law that would require microstamping on internal parts of new semiautomatic handguns sold in the state by 2010. The NRC report concluded that further research needs to be done on microstamping to determine the durability of the engraved marks as well as their susceptibility to tampering. The cost impact of micro- stamping for manufacturers and consumers also needs to be examined.

Microscopic comparisons of bullets do not make use of the three-dimensional profiles of the bullet surfaces. In the 1950s, firearm examiner John Davis developed the stria- graph, which used a system of levers to amplify the movement of a stylus as it was drawn over the surface of a fired bullet. The striagraph produced a circular graph that reflected the profile of the bullet surface. The striagraph was never widely used by firearms examiners. Recently, researchers have used laser surface profilers to capture the three-dimensional pro- files of the surfaces of fired bullets. The pro- files are digitized and placed in a computer, where some measure of similarity between two bullets (e.g., a correlation coefficient) can be calculated. In this way the matching of bullets might be made more objective. Methods for obtaining three-dimensional profiles from cartridges are also being explored.

Other Firearms Examinations

In addition to the microscopic examination and comparison of bullets and cartridges, firearms examiners must carry out other examinations on firearms. Before a firearm can be test fired, the examiner must verify that the weapon's action and safety devices work properly. If the weapon does not function properly, the examiner should note that fact and determine the reason for the malfunction. Critical components may be damaged or missing. Because meaningful microscopic comparisons of bullet and cartridges require that the weapon be fired, the examiner may have to

replace damaged or missing components with parts taken from the forensic laboratory's firearms collection. Many firearms have both passive and active safety devices; some firearms have no safety devices. Passive safety devices are features that the shooter does not have to set. Such devices include a half-cock position for the hammers of weapons with exposed hammers, a grip safety, and a firing pin catch or block. A half-cock safety is intended to prevent the hammer from accidentally falling far enough to discharge the weapon. If the hammer is released before it is fully cocked, it will fall to the half-cock position and be stopped. A grip safety is located on the back of the grip of a handgun. It prevents the trigger of the weapon from being squeezed unless the heel of the hand has depressed the safety. A firing pin catch or block prevents the firing pin from moving forward to strike the cartridge primer until the trigger has been squeezed. This prevents the weapon from accidentally discharging if it is dropped. Active safety devices are set by the shooter; they include trigger blocks, slide blocks, and safety decocking levers.

Trigger blocks prevent the trigger from being squeezed. Slide blocks prevent the slide of a semiautomatic handgun from being drawn to the rear and also block the trigger mechanism. A safety decocking lever prevents the trigger from being squeezed and rotates the rear section of a two-part firing pin so that the hammer cannot strike it. When the safety decocking lever is set, the cocked hammer of the weapon can be lowered without risk of an accidental discharge. The safety decocking lever prevents the weapon from being fired normally and also if it is dropped. The firearms examiner must verify that the weapon's safety devices work properly for his or her own safety when test firing the weapon, and because the defendant in a shooting case may allege that the weapon discharged accidentally.

Steel

40 milliliters of concentrated hydro- chloric acid, 30 milliliters of distilled water, 25 milliliters of ethanol, and 5 grams of cupric chloride; or

120 milliliters of concentrated hydro- chloric acid, 100 milliliters of dis- tilled water, and 90 grams of cupric chloride

Aluminum

20 percent (weight per volume) aqueous solution of sodium hydroxide; or 1 normal aqueous sodium hydroxide rinse, followed by 0.1 molar mercuric chloride in 0.1 normal hydro- chloric acid

Zinc alloys

Alternate applications of phosphoric acid–nitric acid (98:2) solution and 5 to 10 percent nitric acid

Ultrasonic cavitation works on a principle similar to chemical and electrochemical etching. The surface where the serial number has been obliterated is polished as described above and then the weapon is placed in an ultrasonic bath where it is subjected to high- frequency vibrations. Minute bubbles form on the metal surface (a process called *cavitation*). Cavitation causes etching of the metal sur- face. This same phenomenon causes pitting of high-speed marine propellers. In serial number restoration, the etching proceeds fastest where the metal structure has been disordered by stamping the serial number.

Firearm and tool mark examiners may be called upon to restore stamped serial numbers on other items, such as automobile engine blocks. A method has also been developed for the restoration of stamped serial numbers on plastic items (camera bodies, stereos, and computer equipment). Organic solvents are used to swell the plastic. Different types of plastics require the use of different organic solvents.

A serial number may be unrecoverable for a number of reasons. The filing or grinding may have removed too much metal. The criminal may overstamp the serial number with new numbers or letters or obliterate it by

attacking the metal surface with a metal punch. Methods have been proposed to pre- vent the removal of serial numbers from weapons. According to one such idea, a laser would be used to drill holes in the weapon's frame following a grid pattern. Each digit of the serial number would be represented by a hole drilled at a specific location in the grid; the serial number could be removed only by completely removing a section of the frame. No such scheme has ever been implemented.

Range-of-Fire Estimation from Powder and Pellet Patterns

Detailed reconstruction of shooting incidents requires knowledge of ballistics, the branch of physics that studies projectile motion. A bullet encounters four ballistic regimes on its journey from the firing chamber of the weapon to its final resting place in its target. The first regime is that of interior ballistics, where the chemical energy stored in the propellant is converted into the kinetic energy of the projectile. The second ballistic regime is that of transitional ballistics, through which the projectile passes as it moves from interior ballistics to exterior ballistics. In the transitional ballistic regime, a spinning projectile experiences both lateral and vertical jumps. In small arms these lateral and vertical jumps are negligible. In the regime of exterior ballistics, the projectile moves under the combined effects of a number of forces: gravity, frame-of-reference forces (Coriolis and the centrifugal forces), and aero- dynamic forces (drag, lift, the Magnus force, pitch damping, and the transverse Magnus force). Generally, the effects of the Coriolis force, pitch damping, and the transverse Magnus force are negligible for small arms. The centrifugal force is included as part of the net gravitational force at a given location.

The center of mass of a projectile will follow an approximately parabolic trajectory under the net effect of the gravitational force and aerodynamic drag. The combined effect of the lift force and the Magnus force is to make the **yaw angle** of the projectile (which is the angle

between the axis of symmetry of the projectile and the direction of flight) execute a com- plicated precessional and nutational motion. With a properly designed projectile, the yaw angle is initially very small; as the projectile moves farther from the weapon, the yaw angle may increase, so that at great distances the projectile may strike its target sideways. If the bullet encounters an intermediate target, the yaw angle may be abruptly changed.

In the reconstruction of shooting incidents, the range and direction of fire are of para- mount importance. Firearms examiners are frequently called upon to estimate the range from which a gunshot was fired by examining gunshot residue patterns on the victim's skin or clothing. Gunshot residue consists of particles from the gun barrel, particles from the bullet surface (lead, lead alloy, or brass), particles originating from the propellant (unburned or partially burned particles of smokeless powder as well as soot), and particles originating from the primer (lead, or lead, antimony, and barium). This residue is projected in a roughly conical cloud in the direction of the target. Because the gunshot residue particles are traveling through the air, they experience aerodynamic drag forces. The smaller particles are slowed more rapidly and consequently travel shorter distances than the larger particles. Some gunshot residue may also leak out of the weapon to be deposited on the shooter's hands, face, and hair. Gunshot residue may be seen on the hands of a shooting victim who is grappling for a weapon when it is fired. Revolvers in particular produce distinctive powder-burn patterns on the hands when they are gripped with the hand around the front of the cylinder.

The appearance of a gunshot wound may hold a clue to the range from which it was inflicted. Forensic pathologists usually place the range from which a gunshot wound was inflicted into one of several categories: distant shots, close-range shots, near-contact shots, and contact shots. Distant shots are fired from such a range that no detectable gunshot

residue reaches the skin or clothing of the victim. The gunshot wounds inflicted by distant shots consist of a circular or elliptical defect in the skin, which is surrounded by a **marginal abrasion** or contusion ring where the skin has been stretched and torn by the entry of the bullet. The marginal abrasion may be overlaid by a **grayring**; a ring of propellant combustion products, bullet lubricant, and metal from the bullet surface that has been wiped off onto the skin. The material comprising the gray ring is also termed **bullet wipe**. Bullet wipe may be found on any solid materials through which bullets pass, such as clothing, doors, and walls.

Close-range gunshot wounds are inflicted at ranges short enough for gunshot residue to reach the skin or clothing of the victim. Two types of gunshot residue deposition are seen with close-range shots: stippling (tattooing) or soot (smudging). The large propellant particles that produce stippling travel farther than the finer particles that comprise the soot. Consequently, as the range of fire for close- range shots decreases, the resulting gunshot residue patterns go from widely dispersed stippling to more concentrated stippling plus soot.

At a near-contact range, stippling and smudging are concentrated in a tight circle. The weapon's muzzle flash may tear clothing and char or melt clothing fibers. Woven fabrics typically tear apart along the warp and weft directions, producing a cruciate (cross-like) defect; knit fabrics usually show a circular area of damage. Natural fibers, such as cot- ton and wool, are charred by the muzzle flash, whereas manmade fibers (being composed of thermoplastic materials) are usually melted. If the gunshot wound is inflicted on a part of the body that is covered with hair, the hair will show characteristic singeing.

Loose-contact gunshots are fired with the weapon's muzzle just touching the target sur- face. Gunshot residue may be blown outward between layers of clothing. The muzzle flash will produce similar effects to those observed in near-contact gunshots. Tight-contact gun- shots over

bony plates, such as the vault of the skull or the sternum, produce a characteristic **stellate defect**: an irregular, blown- out entrance wound. This type of wound is caused by the propellant gases separating the soft tissue from the bone and creating a temporary pocket of hot gas between the bone and the muzzle of the weapon. If the gas pressure is high enough, the soft tissue and skin will tear, creating a jagged entrance wound. Blood and other tissue may be blown back into the muzzle of the weapon and onto the hand and forearm of the shooter. Firearms examiners should always check weapons for such trace evidence. The soft tissue may be forced back against the muzzle of the weapon hard enough to receive a muzzle impression. Carbon monoxide in the muzzle gases may also react with blood in the wound area to pro- duce carboxyhemoglobin.

Determination of the range of fire from a gunshot residue pattern requires the original powder pattern, the firearm used to fire the pattern, ammunition from the same lot as that used to fire the pattern, and a knowledge of the weather conditions at the time of the shooting. If the original powder pattern is on a garment, its preservation for examination is straightforward. The powder pattern may require chemical treatment or special imaging techniques to render it visible, particularly if the pattern is on dark-colored or blood-soaked clothing. If the powder pattern is on the victim's skin, scaled photographs may be the best method for the preservation of the original powder pattern. When the victim is deceased, the skin bearing the powder pattern may be excised and treated with preservatives. However, skin treated in this way may shrink or stretch, altering the dimensions of the powder pattern. The court may regard excised tissue as unnecessarily inflammatory evidence and consequently exclude it at trial. Some religious groups would regard the removal and preservation of a portion of the victim's body as extremely sacrilegious.

Determination of the range of fire from a powder pattern requires that the firearms examiner test fire powder patterns at various ranges until

he or she is able to reproduce the original pattern in size and density of gun- shot residue deposition. For the results of the tests to be meaningful, the firearms examiner must use the same weapon and ammunition as that used to fire the original pattern. The same weapon must be used because weapons vary in their leakage of gunshot residue. A weapon with a worn barrel, for example, might produce more gunshot residue than a weapon of the same type with a pristine barrel. Using ammunition from the same lot is likewise important. Ammunition manufacturers commonly change lot numbers when they exhaust a lot of one of the components (bullets, casings, primers, or propellant). Using ammunition from the same lot, therefore, ensures that critical components, such as primers and propellant, are the same for the questioned powder patterns and the test fired patterns. If police investigators seized any ammunition with the firearm, it may be used to fire the test patterns.

Weather conditions also affect the dispersal of gunshot residue. Wind and rain may disperse the plume of gunshot residue so that little or no residue reaches the surface of the target, even at very close range. Ambient temperature also affects the rate of burning of smokeless pow- der. While the effect of temperature on powder patterns has not been demonstrated, research has shown that temperature does affect the dispersal of shotgun pellets. Duplication of the weather conditions may not be feasible; in such a case, it may not be possible to estimate the range of fire.

Firearms examiners may need to use special techniques to visualize gunshot residue patterns on dark or bloodstained clothing. Infrared imaging technologies have proven to be useful for visualizing gunshot residue pat- terns obscured by blood. The hemoglobin and other proteins in blood are relatively trans- parent to certain wavelengths of infrared radiation, while graphite-coated propellant particles and soot strongly absorb infrared radiation. Chemical methods for visualizing gunshot residue patterns are also widely used. The original Walker test used undeveloped photographic

paper impregnated with sulfanilic acid and alpha-naphthylamine, which react with inorganic nitrites in gunshot residue. The Walker test for nitrites has been superceded by the Griess and Maiti tests. To perform the Griess test, the gunshot residue is transferred to a sheet of desensitized photographic paper or filter paper. The paper is dampened with dilute acetic acid and the gunshot residue is transferred to the paper by ironing or pressing the paper and article of clothing together. The photographic paper or filter paper is then immersed in the Greiss reagent. The powder pattern may also be lifted from a garment using a "peelable" low adhesive lifter; the use of a lifter avoids dam- age to heat-sensitive fabrics and the transfer of clothing dyes whose color may mask that produced by the reaction between nitrites and the Griess reagent. Several recipes for the Griess reagent are currently in use:

1. 3 percent sulfanilamide and 0.3 percent *N*-(1-naphthyl) ethylenediamine dihydrochloride are dissolved in 5 percent phosphoric acid.

2. 5 grams sulfanilic acid are dissolved in 1000 milliliters of 30 percent (volume per volume) acetic acid. 6 grams of alpha-naphthylamine are dissolved in 1000 milliliters of 30 percent (volume per volume) acetic acid. Fresh Griess reagent is prepared by mixing equal volumes of each of these solutions.

3. 80 grams sulfanilamide are dissolved in 1000 milliliters of 10 percent (volume per volume) phosphoric acid. 4 grams *N*-(1-naphthyl)-ethylenediamine are dissolved in 1000 milliliters of 10 per- cent (volume per volume) phosphoric acid. Fresh Griess reagent is prepared by mixing equal volumes of each of these solutions.

The Griess reagent reacts with inorganic nitrites in gunshot residue patterns to form an azo dye through a diazotization reaction. The Griess reagent will not react with inorganic nitrates or with the cellulose nitrate in the partially burned or completely unburned smoke- less powder particles in the powder pattern. Alkaline hydrolysis of cellulose nitrate causes a

disproportionate reaction that releases nitrites, enhancing the Griess reaction. The powder pattern is sprayed with a 2 percent alcoholic solution of potassium hydroxide and then heated in a laboratory oven at 100 degrees Celsius for 1 hour. Bloodstained clothing may develop unpleasant odors when treated in this fashion. Therefore, a "peelable" lifter should be used to remove the powder pattern for sub- sequent testing.

The Maiti test is an alternative test for the presence of nitrites in a gunshot residue pattern. When the original Walker test was applied to bloodstained articles of clothing, traces of blood were transferred to the test paper and obscured the orange-red color pro- duced by nitrites. The Maiti test paper is pre- pared in the following way.

Glossy photographic paper is soaked in photographic fixer, then washed and dried. The dried paper is then soaked in a solution of *p*-nitroaniline, alpha-naphthol, and magnesium sulfate (each 0.25 percent in 1:1 aqueous alcohol). The photographic paper is dried and stored until it is needed. The test is performed by placing the treated photographic paper on the laboratory bench with the emulsion side up. The article of clothing to be tested is placed with its front side in contact with the paper. A towel soaked in 10 percent ace- tic acid is placed over the article being tested and pressed with a hot iron. The photographic paper is removed and treated with 10 percent aqueous sodium hydroxide. The gunshot residue pattern appears as blue specks on a yellow background.

Other color tests are commonly used in conjunction with the Griess or Maiti tests. The sodium rhodizonate test is used to visualize the dispersal of lead (primarily from the cartridge primer) in the gunshot residue pattern. Lead residues are transferred from a garment to filter paper by pressing. The filter paper is then sprayed either with an aqueous tartaric acid and monosodium tartrate buffer solution (pH 2.8) followed by a saturated aqueous sodium rhodizonate solution (0.4 grams per 100 milliliters) or with a solution of sodium rhodizonate saturated in pH 2.8

aqueous tartaric acid and monosodium tartrate buffer. A scarlet color appears immediately if lead is present. To avoid false positives from other nonlead inorganic materials, the filter paper should be blotted with clean filter paper and dried with a hair drier. The filter paper is then sprayed with 5 percent aqueous hydro- chloric acid until the scarlet color is converted to blue. If the filter paper is again blotted with clean filter paper and dried with a hair drier, the blue color may be preserved indefinitely. If the garment is light colored, the sodium rhodizonate reagent can be sprayed directly on it. Figure 21.7 shows powder patterns that have been enhanced by sodium rhodizonate and also by the Griess test.

Cartridges containing lead-free primers have begun to reach the market. The gunshot residue produced by such ammunition does not contain either lead or barium.

It is also possible to use regression analysis to determine the range of fire and its confidence limits. If regression analysis is used, the firearms examiner must use some measure of the size of the pellet pattern. The following have all been used as measures of the sizes of pellet patterns:

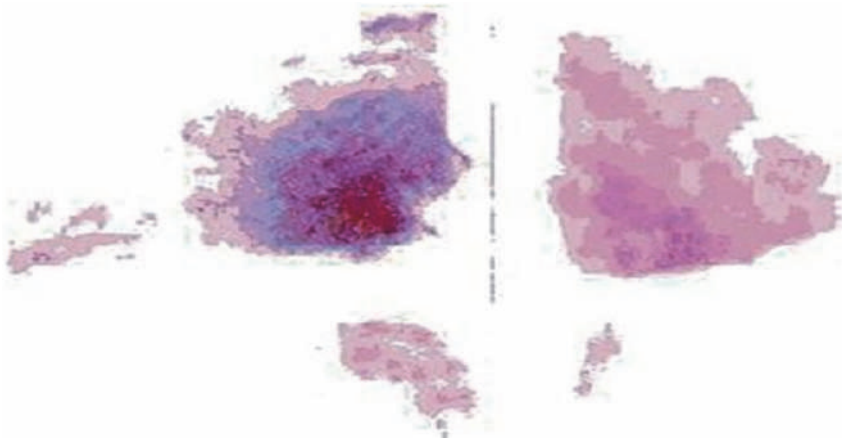


Figure 21.7 Powder patterns treated with sodium rho- dizonate (upper patterns) and modified Griess reagent (lower patterns). Patterns on the left are as originally test fired; patterns on the right have been laundered.

Sintox primers, for example, contain zinc peroxide and titanium metal.

Consequently, the sodium rhodizonate test cannot be used in the visualization of gunshot residue patterns pro- duced by lead-free cartridges. If the cartridge contains a Sintox primer, zincon reagent can be used to visualize the gunshot residue pat- tern. Zinc and titanium produce blue-colored compounds with the zincon reagent. Rubeanic acid has also proven useful in the visualization of gunshot residue patterns through its color reaction with copper. Copper in gunshot residue is derived from the jackets of full- metal jacket or semijacketed bullets and from the copper alloy comprising the primer cap. Rubeanic acid has proven to produce useful gunshot residue patterns even when lead-free, full-metal jacket ammunition has been used.

Firearms examiners also estimate ranges of fire from shotgun pellet patterns. When a shotgun is fired, the pellet mass spreads laterally. Thus, pellet patterns fired at different ranges have different sizes and different shot densities. A widely used rule-of-thumb is that the pellets spread 1 inch laterally for each yard down range. In order to determine the range of fire from a shotgun pellet pattern, the firearms examiner needs the original pellet pattern, the shotgun used to fire the pat- tern, ammunition from the same lot as that used to fire the pellet pattern, and a knowledge of the weather conditions at the time of the shooting. Typically, the firearms examiner then test fires the shotgun at various ranges until he or she obtains a pellet pattern similar in size and pellet density to the questioned pattern. It is also possible to use regression analysis to determine the range of fire and its confidence limits. If regression analysis is used, the firearms examiner must use some measure of the size of the pellet pattern. The following have all been used as measures of the sizes of pellet patterns

The radius of the smallest circle that will just enclose the pellet pattern

The area of the smallest rectangle that will just enclose the pattern

The arithmetic mean of the lengths of the sides of the rectangle

The geometric mean of the lengths of the sides of the rectangle

The firearms examiner fires a series of pellet patterns at selected ranges, measures their sizes, and then calculates the equation for the size of the pattern as a function of range of fire that best fits the data for the test-fired pellet patterns. The equation is then used to calculate the range of fire from the size of the questioned pellet patterns. Confidence limits for the range of fire estimate can be calculated by standard statistical methods.

The sizes of shotgun pellet patterns are affected by the choke of the shotgun barrel. Full-choke barrels fire smaller, denser pellet patterns than cylinder-bored barrels (i.e., barrels without any choke). Double-barreled shot- guns often have barrels with different chokes. A number of barrel inserts and adjustable compensators can also be placed in a shotgun barrel to change its choke. Thus, a firearms examiner may have to test fire pellet patterns using both barrels of a double-barreled shotgun and make range of fire estimates for both barrels. Likewise, if the shotgun has an adjustable compensator, the firearms examiner should test fire pellet patterns for the extreme settings of the compensator (greatest choke and least choke) and make range-of-fire determinations for both settings.

Sawing off the barrel of a shotgun may increase the size of the pellet patterns it will fire. However, this phenomenon depends on the type of shotshells fired. With some types of shotshell, little or no spreading is seen, even when the barrel is shortened to 6 inches.

The size of a shotgun pellet pattern can also be affected by the presence of an intermediate target (such as a window, window screen, or door). If the mass of shotgun pellets encounters a target that slows down the leading pellets in the mass, the trailing pellets will overtake and collide with them. The leading pellets will be deflected on new trajectories so that the pellet pattern produced in the final target will be larger than would be the case in the absence of the intermediate target. The shotgun

pellets may be marked by the intermediate target or pick up trace evidence from it.

The direction of fire can be determined

from a variety of phenomena. It can obviously be determined from the locations of entrance and exit wounds (with due allowance for the possible deflection of the bullet by bone). If the bullet passes through a bony plate, such as the vault of the skull, it will punch out a cone-shaped hole. The wider end of the cone indicates the direction the bullet was traveling. Coning or beveling is observed not only with bone but also with glass, wallboard, and wood. If a bullet strikes a long bone, such as a femur, it will punch out a wedge-shaped segment of bone; the wedge will be displaced in the direction the bullet traveled.

The paths of bullets are also frequently reconstructed at crime scenes. Because most shootings take place at short ranges, the paths of the bullets can be approximated by straight lines. An accurate reconstruction of the path of a bullet requires that the bullet mark two fixed objects within the crime scene. For example, a bullet might pass through (or perforate) the wall of a room, leaving an entrance hole (sometimes referred to as the in-shoot defect) in the wallboard on one side and an exit hole (or out-shoot defect) on the other. Rods, strings, or laser beams can be centered in each of the two holes to approximate the bullet's path. The farther apart the in-shoot and out-shoot defects are, the more accurate the reconstruction will be. If the bullet makes only a single hole at the crime scene, the bul- let's angle of impact can be estimated from the shape of the bullet hole. For an elliptical bullet, the ratio of the width of the hole to its length is approximately the sine of the angle of impact. This is the same method used to determine the angle of impact of a blood drop and is subject to the same uncertainties. Even if the path of the bullet cannot be accurately determined, it may be possible to define the general area that the bullet came from and limit the area that must be searched for expended cartridge cases and other evidence

of the shooter. If a bullet came through an open window to strike a victim all locations from which a fired shot would not reach the window can be eliminated as locations of the shooter. Suppliers of crime scene processing equipment now often also sell materials for bullet trajectory reconstruction.

Ricochet

Bullets may be deflected from their trajectories by ricochet. When a bullet strikes a target it either penetrates the target, disintegrates upon impact, or ricochets. Ricochets can occur from any surface, including water. For any particular target surface, there is a critical angle of incidence below which bullets will ricochet from the surface. For most surfaces this angle is around 5 or 6 degrees. The angle of ricochet is generally less than the angle of impact. Bullet shape and composition also affect whether ricochet will occur. Round- nosed bullets are more likely to ricochet than pointed bullets, and full metal jacket bullets are more likely to ricochet than semijacketed bullets or lead and lead alloy bullets. A ricochet causes a bullet to lose much of its kinetic energy so that it is more likely to inflict a penetrating rather than a perforating wound. Ricochet also upsets the yaw angle of the bullet so that it may produce a key-hole wound. A ricocheting bullet may pick up trace evidence, such as particles of concrete or brick, from the surface from which it ricochets.

Silencers

The acoustic phenomena associated with the discharge of a firearm also merit discussion. When the hot propellant gases encounter the atmosphere outside the firearm, they generate sound waves. Carbon monoxide in the propel- lant gases may also be ignited explosively. The muzzle of a firearm, therefore, acts as a point sound source from which sound waves radiate spherically. The bullet itself may also function as a sound generator. If its velocity exceeds the speed of sound, it will produce a

bow shock wave as it travels through the air. Firearms may be equipped with silencers to reduce the noise level of their discharges. No firearm can be completely silenced; sound can only be reduced. Two methods for silencing a firearm may be used: external and internal. An external silencer is a device that fits on the muzzle of the weapon. A commercial external silencer consists of a pressed steel shell that contains a series of baffles to break up and dif- fuse the muzzle gases. Steel wool packing can also be used. Internal silencing involves drill- ing ports in the weapon's barrel to vent the propellant gases. A steel sleeve packed with steel wool may surround the barrel. Criminals may improvise external silencers (from stacks of washers, for example) or modify a weapon to provide internal silencing. External silenc- ers may produce markings on the surfaces of fired bullets. Misaligned baffles may score the bullets' surfaces, even to the extent of effacing rifling marks. Internal silencing may leave burrs inside the barrel that will mark any bul- lets fired through it. The markings made by an external silencer or those produced by the burrs left inside the barrel when a weapon is internally silenced may be sufficiently repro- ducible to permit microscopic comparisons.

The sound waves generated by bullets can be eliminated by using ammunition with a muzzle velocity below the speed of sound. If the silenced firearm is commercially pro- duced, it may be designed around a cartridge with a subsonic muzzle velocity, or reduced velocity ammunition may be produced for it. However, the use of subsonic ammunition may require too much modification of the sighting of a weapon (e.g., a sniper rifle) to be feasible.

In World War I the sound and flash of artillery pieces were used to pinpoint their location for retaliatory counterbattery artillery fire. The observations of multiple observers were pooled to triangulate the position of the artillery pieces. This concept has been updated for law enforcement use. Several major cities (including Washington, D.C.) have deployed

arrays of microphones in neighborhoods with high levels of gun violence. Computer software can identify sounds as gunshots and provide responding officers with their approximate locations. The software has the capability of differentiating the sounds of different types of firearms so that it may be possible to deter- mine if multiple weapons were fired in a par- ticular shooting incident.

Firearms Examinations in the Investigation of War Crimes and Human Rights Violations

In the 20th and 21st centuries firearms have been used in the commission of a vast number of atrocities: the 1940 Katyn Forest massacre of 4000 Polish prisoners of war by the Soviet Union; the murders of over a million Jews by Nazi *Einsatzgruppen,* the 1944 massacres of Belgian civilians and American military personnel during the Battle of the Bulge, the 1968 My Lai Massacre (in which 300 to 500 Vietnamese civilians were killed by U.S. Army troops) and the ethnic "cleansings" in the Balkans in the 1990s. In the investigation of such incidents, firearms examination can pro- vide a wealth of useful information. The bullets and cartridges recovered at the scenes of the atrocities may of course be linked to weapons belonging or issued to specific individuals. Bullets and cartridges may also provide evidence as to who committed the atrocities. For example, an archaeological excavation of a mass grave in the Ukraine recovered numerous cartridges for German machine pistols. These artifacts confirmed that the dead were Jewish victims of one of the German execution groups that operated in the Ukraine during World War II (rather than victims of Soviet terror). The cartridges bore the dates 1939, 1940, and 1941, showing that the mass execution occurred no earlier than 1941 (when that part of the Ukraine was occupied by the German army). In this instance the dating of the incident was of critical importance because the archaeological excavations were undertaken in

support of Australian prosecutions of accused Nazi war criminals.

Firearms Examinations and Battlefield Archaeology

Battlefield archaeology uses the methods of archaeology to reconstruct human behavior on battlefields. The distribution of artifacts such as bullets, percussion caps, and cartridges can be used to locate battlefields (if the precise location of an engagement is unknown or disputed), to locate troop positions on the field, to provide estimates of the numbers of weapons of a particular type used in the battle and to chart the movements of weapons across the battlefield. Comparisons of firing pin impressions on cartridges excavated on the Little Bighorn battlefield (scene of Custer's Last Stand) allowed archaeologists to track the movement of a particular .45 caliber 1873 Springfield cavalry carbine from the hill where the initial onslaught of the Sioux and Cheyenne warriors overwhelmed several detached companies of Custer's force to Last Stand Hill, where Custer and the remnants of his command were wiped out. Microscopic comparisons of firing pin impressions on the large number of .44 caliber Henry cartridges recovered from the field enabled archaeologists to estimate how many Henry and Winchester repeating rifles were used by the Native American participants in the battle. The Sioux and Cheyenne warriors had more repeating rifles than was previously believed, and these weapons gave them a significant firepower advantage over the troopers of the 7th Cavalry, armed with single shot carbines and Colt revolvers.

The semi-arid environmental conditions of the American West seem to be the most conducive to the preservation of markings on soft copper percussion caps and cartridges. The most significant applications of microscopic firearms examinations have been to 19th century Indian Wars battlefields: Cieneguilla (1854), the Fetterman Massacre (1866), and Hembrillo Canyon (1880). Bullets and cartridges recovered from battlefields sometimes provide a vivid glimpse of the last moments of a soldier's life.

An expended .52 caliber cartridge excavated at the scene of the Fetterman Massacre (in which several thousand Sioux, Cheyenne, and Arapahoe warriors ambushed and killed 79 U.S. Army troops and two civilians) had two firing pin impressions made by different Spencer repeating carbines: the cartridge had misfired in one carbine and a desperate soldier had picked up the ejected cartridge and manually loaded it into another carbine.

Types of Tool Marks

The three categories of tool marks are com- pression (or indented) tool marks, sliding tool marks, and cutting tool marks. Compression tool marks result when a tool is pressed into a softer material. Such marks often show the outline of the working surface of the tool, so that class characteristics of the tool (such as dimensions) can be determined. The individual characteristics of the tool may be more difficult to discern in compression tool marks. Sliding tool marks are created when a tool slides along a surface; such marks usually consist of a pattern of parallel striations. Class characteristics are more difficult to determine from sliding tool marks. For example, screw- drivers, chisels, and pry bars could all make very similar sliding marks. Cutting tool marks are a combination of compression and sliding tool marks. The cutting tool indents the mate- rial being cut and, as it does so, the working surfaces of the tool slide over the cut surface.

The quality of a tool mark is very much affected by its substrate, the material on which the tool mark is made. In general, soft metals such as lead, copper, and brass are excellent recipients of tool marks. Many plastics are good surfaces for the retention of tool marks. Painted surfaces are also excellent substrates for tool marks because paint layers consist of a plastic vehicle or binder in which pigment particles are dispersed. Other sur- faces, such as raw wood and hard metal, are poor substrates for tool

marks. Raw wood is a poor substrate for sliding tool marks because its grain structure has the same dimensions as the striations in the typical tool mark. Hard metal surfaces are poor recipients of tool marks because their hardness prevents them from being marked by tools.

Processing of Tool Marks at Crime Scenes

Tool marks may be found on a variety of surfaces. Points of entry such as doors and windows should be examined for pry marks. Doors of safes and cabinets may also show pry marks. Cutting tool marks may be found on lock hasps, chains, and chain link fences. Once a tool mark is found, the crime scene technician must take care to prevent alteration of the mark. In particular, he or she should make sure that no one attempts to fit a suspect tool into a tool mark; to do so risks alteration of the mark and would vitiate the value of any transferred trace evidence on the tool.

Safe burglaries in particular provide a wealth of tool marks. Safes may be broken into in a variety of ways. For example, safes may be broken open with a cutting torch. While the cutting torch itself leaves no tool marks on the safe, there may be cutting tool marks on the hoses used to connect the oxygen and acetylene tanks to the cutting torch. Lightweight safes used in the home or by small businesses can be opened by prying open the door. This will leave tool marks on the edge of the door and the adjacent frame. The front plate of the safe door can be peeled away by insertion of a pry bar or similar tool between the front plate and the door's frame. Once the front plate is peeled away from the frame, the locking bars in the safe door may be forced back with the pry bar. In this case, tool marks will be found on the front plate and the locking mechanism. A hole may be pounded or chopped through the cladding of the safe. Two areas are usually attacked: the bottom or the front plate adjacent to the lock. If the bottom is the site of attack, the

hole will be pounded through into the safe and the valuables extracted through the hole. If the front plate is the site of the attack, the locking mechanism will be forced open to allow access to the interior of the safe. Such "pound" jobs leave indented tool marks at the point of attack. If a small hole can be made in the outer cladding of the safe, it may be enlarged by ripping the cladding. Tool marks will be found at the point where the hole was started in the cladding and on the edges of the rip where the cladding was pulled away with pliers.

Electric drills can also be used to attack safes. A high-torque drill may be used to drill through the locking bars in the safe door. A jig or metal frame will be attached to the front plate of the safe door to position the drill properly. The safebreaker usually draws layout lines on the front plate to ensure that the jig is attached in the right place. These layout lines are important evidence and should be care- fully photographed. A "drill" job leaves drill marks, both those made in the locking mechanism as well as those made in attaching the jig to the front of the safe. A core drill may also be used to drill a large hole in the side of the safe through which the safe contents can be removed. A jig is attached to the side of the safe to guide the core drill.

Most of the methods used to attack safes release safe insulation, which can be transferred to the perpetrator's clothing, footwear, or tools. Safe insulation may contain Portland cement, vermiculite, gypsum, diatomaceous earth, or sawdust. Microscopic examinations may associate the trace evidence removed from a suspect's clothes, shoes, or tools with the insulation in the safe. For such examinations to have value, the investigator must ensure that no cross contamination between the safe insulation and the evidence taken from the suspect can occur. The investigator must be sure to collect a representative sample of the safe insulation for comparison.

Once tool marks have been identified at the scene of a crime they should be documented in the usual manner with notes, sketches, and

photographs. The photographs should show the locations of the tool marks; however, even macrophotography will rarely show sufficient detail to allow the photographs to be used for laboratory comparisons. Photographs are often useful to the laboratory examiner as clues to how the crime scene marks were made. Once the documentation of the marks is completed, the tool mark evidence should be collected for subsequent laboratory examination. If the object bearing the tool mark can be transported, it should be collected and sent to the forensic science laboratory. The operative rule is that the thing itself is the best evidence. However, if the object cannot be transported, a cast of the tool mark should be made. The ideal casting medium for tool marks reproduces the microscopic detail of the tool mark and is dimensionally stable, easy to use at crime scenes, and inexpensive. A variety of casting materials have been used to make casts of tool marks: negative moulage, low-melting metal alloys (e.g., Wood's metal), and silicone rubber. The material that most closely meets the criteria of an ideal casting material is silicone rubber. It faithfully replicates the microscopic detail of a tool mark. It is dimensionally stable if is stored at room temperature (prolonged storage at 100 degrees Celsius may cause anisotropic expansion of the cast), and it is relatively inexpensive. Silicone rubber casting material is sold as a partially polymerized base with which a catalyst must be mixed to complete the polymerization. The base material is filled with gray or red pig- ment particles. Silicone rubber casting mate- rial is available in two different viscosities: one has the consistency of thick cream, the other the consistency of putty. The thicker material is especially useful for casting tool marks on vertical surfaces. After the catalyst has been kneaded into the mass of base material, the mixture can simply be pressed into the tool mark.

Laboratory Examinations of Tool Marks

In the forensic science laboratory, the tool mark examiner carefully examines the questioned tool mark along with any tools that have been submitted for examination. If the tool mark examiner concludes that the tool mark could have been made by a submitted tool, he or she will use the tool to prepare test tool marks for microscopic comparison. The making of such marks is the most time-consuming part of tool mark examination. For microscopic comparisons of the crime scene tool marks and the test marks to be successful, the test tool marks must be made using the same tool surface as that used to make the crime scene mark; more- over, the test tool mark must be made in the same way (particularly using the same angle of attack). The test tool marks are made using a malleable and ductile material such as lead, tin, or aluminum. These materials accurately reproduce the individual characteristics of the tool surface, but are soft enough that they will not damage the tool surface.

The tool mark examiner makes microscopic comparisons of the test tool mark and the questioned tool mark in order to match markings made by individual characteristics of the tool. Individual characteristics of tools result from manufacturing processes, from wear, and from damage due to misuse. For example, the cutting edges of bolt cutters and wire cutters are usually hand-ground on a grinding wheel. This process results in each cutting edge having a unique pattern of striations. This pattern of striations will in turn produce a unique pattern of markings in a tool mark. However, many modern manufacturing techniques can produce tools that when new do not possess sufficient individual characteristics to permit the tool marks they make to be distinguished from one another. Occasionally what appear to be individual characteristics on a tool are found to be class

characteristics. For example, a screwdriver used in a series of break-ins was found to have a pattern of striations on the side of the blade and ripple marks on the face of the blade. These features matched marks left at the crime scenes. However, the forensic tool mark examiner discovered that screwdrivers of the same brand and size purchased at local hardware stores exhibited the same features. The striation pattern on the side of the blade and the ripple marks were produced by the die used to stamp



Figure 21.8 Microscopic comparison of sliding tool marks made with the same screwdriver.

- *Positive identification*. The class char- acteristics (as far as they can be determined) are consistent and that individual characteristics match. This means that the likelihood that a tool other than the tool submitted for examination made the tool mark is so remote that it must be regarded as a practical impossibility.
- *Negative identification*. The tool mark was not made by the submitted tool. This means that the class characteris- tics did not match. In this instance no microscopic comparison will have been undertaken.
- *Inconclusive.* This means that the out the blades of the screwdrivers. This case emphasizes the need for tool mark examiners to be

familiar with the various techniques in the manufacture of tools. Confronted by tool marks made by an unfamiliar tool, the tool mark examiner may have to contact the tool manufacturer for information regarding pro- duction methods and even acquire examples of the different stages of tool manufacture. Figure 21.8 and Figure 21.9 show microscopic comparisons of sliding tool marks and cutting tool marks, respectively.

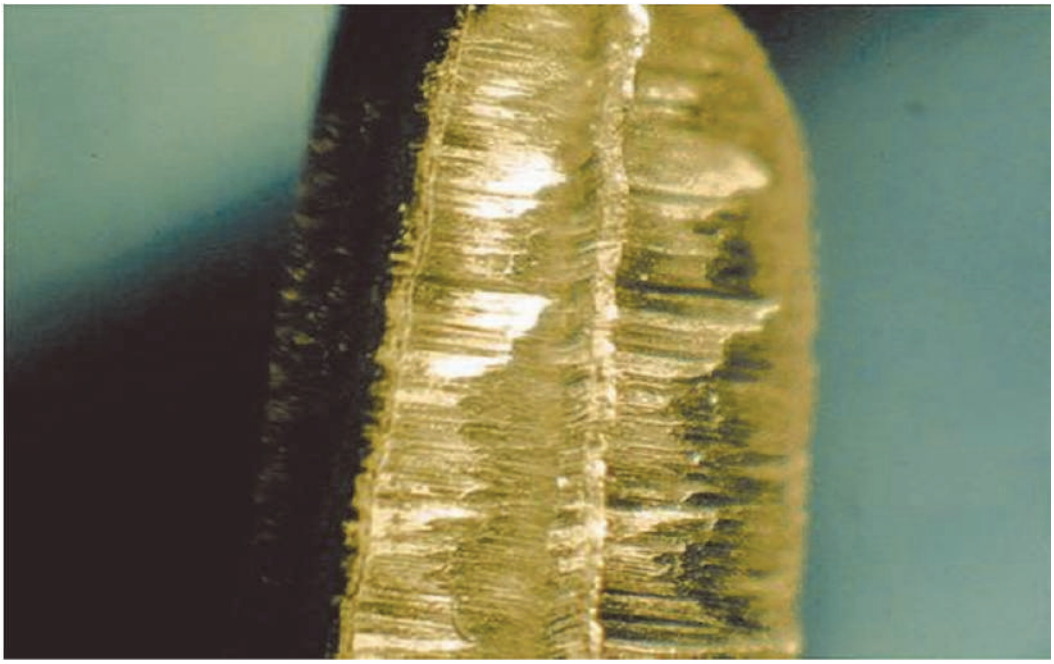


Figure 21.9 Microscopic comparison of cutting tool mark made with the same pair of shears.

As is the case with firearms examinations, tool mark examiners can reach one of three conclusions: class characteristics match but that sufficient individual characteristics to declare a match could not be found. The tool mark examiner does not render a negative identification in this instance because the individual characteristics of the tool may have been altered by further use between the time it left the marks at the crime scene and the time it was collected as evidence by investigators.

Tool Marks on Manufactured Items

Tool marks on manufactured items may also be useful in an investigation. For example, in the case of the kidnapping and murder of Charles Lindbergh's son, the planing marks on pieces of lumber used to fabricate the ladder used by the kidnapper led the investigation to the lumber mill in North Carolina where the boards had been cut; the lumber yard where the kidnapper bought the lumber was also identified. Unfortunately, the lumber yard did not keep records of cash transactions, so the identification of the kidnapper had to wait until he spent some of the ransom money.

The following examples of tool marks made during manufacturing have proven to be forensically useful:

1. Hammer marks on the heads of nails and brads
2. Extrusion marks on pipe
3. Machining marks on metal shavings
4. Extrusion marks (and manufacturing defects) in plastic film, plastic cling wrap, and plastic bags
5. Ream marks on sheets of flat glass
6. Punch defect marks on illicitly manufactured drug tablets

Plastic sheet may be produced by extrusion through a die followed by "calendaring" between large rollers. Plastic film and plastic bags are melt-extruded through a circular die (blown-bubble extrusion) and maintained in the form of an air-filled balloon as the hot plastic cools. When plastic film is produced, the balloon is pressed into a sheet between "nip" rolls. When plastic bags are produced, the balloon is allowed to collapse and a heat sealer seals the plastic layers together at

specific points rather than throughout their lengths. Both calendaring and extrusion pro- duce patterns of parallel striations on the plastic layers. The calendaring and extrusion processes, as well as the wind-up process, also cause the polymer molecules in the plastic layers to be oriented parallel to the direction of calendaring or extrusion, making the plastic layers **birefringent**. The calendaring and extrusion marks on plastic sheets, plastic film, and plastic bags can be visualized as shadow- graphs or by means of **Schlieren optics**. A polarization table can also be used to compare plastic sheets, plastic film, and plastic bags.

Illicitly manufactured drug tablets can be examined for tool marks left by the pressing process. Samples of seized drug tablets can be compared using a number of features: nature and quantity of the active ingredient (usually a hallucinogen such as LSD or a central nervous system stimulant such as amphetamine); the nature of any **diluent** or excipient (inactive substances such as lactose, maltose, corn starch, or calcium sulfate used to give the dosage bulk); the presence of impurities from the method used to synthesize the active component; physical features such as size and shape, color, and weight; and marks made by punch defects on pressed tablets.

Molded tablets encountered by law enforcement agencies are almost invariably illicitly manufactured. Molded drug tablets are used in the pharmaceutical industry for research purposes only. Molded tables are produced by making the diluent and active ingredient into a paste, pressing the paste into a mold, and allowing it to dry. Unless the molds used to produce the tablets have defects, molded tablets cannot be meaningfully compared, microscopically. Pressed tablets are produced by pressing a mixture of active component and diluent in a die between two punches. The faces of the punches are heat treated to harden them; however, careless handling can damage them so that tablets pressed in them bear microscopically comparable tool marks. The interpretation of

such microscopic comparisons must take into account marks on tablets that are not the result of punch defects. "Picking" is caused by the adherence of the drug mixture to the punch face (usually where the punch has a logo or letter on its face). Picking causes small cavities in the surface of the pressed tablets. "**Sticking**" is the result of fine particles sticking to the walls of the die; the particles score the edges of the pressed tablets as they are ejected from the die. The test tool marks used in the microscopic comparisons of pressed tablets are made not by pressing test tablets (a process likely to dam- age the punch faces if conducted by inexperienced persons), but by making impressions of the punch faces in a semiplastic material such as modeling clay. These microscopic comparisons can determine if a seized punch press made a particular tablet or batch of tablets, if a single punch press or a multistation punch press was used to make a batch of tablets, and if more than one **clandestine drug laboratory** made a particular type of illicit tablet.

Striation Matching for Personal Identification

Striation matching has also been used in personal identification. Human finger and toe nails have striation patterns on their upper and lower surfaces. The size and spacing of these striations is determined by the dermal ridges of the nail bed; the dermal ridges are comprised of dermal papillae, the same structures that also comprise the dermal ridges of fingerprints. It seems reasonable that the pattern of striations on the surfaces of a fingernail or toenail should be unique to a particular nail of a particular person. The limited number of studies of the striation patterns on the fingernails of identical twins have sup- ported this hypothesis. Nails are prepared for examination by pressing them between two flat surfaces, such as microscope slides. The ridges on the under surface of

the nail are examined; the ridges on the upper surface of the nail are usually worn smooth and show little detail. The ridges on the nail surface are best observed when the nail is rendered opaque by sputter coating the nail (a procedure commonly used to prepare specimens for scanning electron microscopy). Silicone rubber casts of the nail ridges can also be made and compared microscopically.

Challenges to Firearm and Tool Mark Examinations

In the wake of the 1993 Daubert decision and the extended struggle over the admissibility of DNA evidence, the so-called identification sciences (fingerprint identification, questioned document examination, shoe and tire track examination, and firearm and tool mark examinations) have come under increased scrutiny by the courts. Critics of firearm and tool mark examinations have claimed that these examinations are wholly subjective. Firearm and tool mark examinations are partially objective and partially subjective. The microscopic examinations carried out by examiners are objective; the examiners' interpretations of those examinations in terms of whether a particular firearm or tool made the marks examined microscopically do have a subjective component. However, courts have held that subjectivity does not render tests unscientific and inadmissible. Critics of firearm and tool mark examinations have also argued that markings on bullets and cartridges and in tool marks lack sufficient individuality for the examiner to assert that a questioned bullet or cartridge was fired in a particular firearm or that a particular tool made the questioned tool mark. And they have objected to firearms examiners testifying that their examinations absolutely identify the firearm or tool that made the evidentiary marks that have been microscopically examined. Some courts have agreed that the conclusions firearm and tool mark examiners should be limited to reason- able scientific certainty, rather than absolute certainty. Both the Association of Firearm and Toolmark Examiners

(AFTE) and the Scientific Working Group for Firearms and Toolmarks (SWGGUN) have adopted interpretive guidelines that permit examiners only to state that the likelihood that another firearm or tool made the marks is so remote as to be considered a practical impossibility. Critics have also asserted that the methods of firearm and tool mark used in the microscopic comparisons of bullets, cartridges, and tool marks have not been adequately validated. While the number of validation studies is not large, some large-scale studies have been per- formed (without error, it is important to note). Finally, critics have asserted that proficiency testing of firearm and tool mark examiners is inadequate. This charge has some merit. However, those forensic science laboratories that are accredited by the American Society of Crime Laboratory Directors–Laboratory Accreditation Board (ASCLD–LAB) are required to have all their laboratory examiners participate in frequent proficiency tests. Moreover, the examiners' reports and court- room testimony must also be monitored, to insure that the examiners' conclusions are well-grounded scientifically. The results of firearm and tool mark proficiency tests con- ducted by Collaborative Testing Service of McLean, Virginia (currently the only source of firearm and tool mark proficiency tests), have been examined to estimate the error rate for these examinations: for the two time periods whose test results were examined, the false identification rate ranged between 1.0 and 1.3 percent. To date, no challenge to the scientific basis of firearm and tool mark examination has been successful.

Case Study

Police were summoned to the apartment of two women where a shooting had occurred. One of the women was found dead of a perforating (through and through) gunshot wound of the chest. The decedent was wearing a short dress- ing gown at the time of the shooting. The other woman claimed that she and the decedent had had a lovers' quarrel and that she (the survivor) had attempted to commit suicide with a

.22-caliber pistol. A struggle for the gun had ensued, during which the pistol accidentally discharged, killing the decedent instantly. An examination of the garment worn by the decedent revealed two bullet holes: one with bullet wipe under the left arm and a second in the right chest area. No gunshot residue was found either by a visual examination or by chemi- cal tests. Test firings of the .22-caliber pistol with ammunition from the same lot as that with which the pistol was loaded at the time of the fatal shooting showed that the combina- tion of pistol and ammunition produced vis- ible gunshot residue deposits out to a range of 25 inches. Several conclusions could be drawn from these observations. First, the fatal bul- let traveled in a left-to-right direction through the victim's chest. Second, the shot was fired from a range greater than 25 inches—a dis- tance greater than the average adult woman's arm length. It was, therefore, highly unlikely that the decedent was struggling for control of the pistol. The surviving woman was charged with murder and subsequently convicted.

1. Match the colums:

cartridge casing	отдача
breechblock	протяжка
barrel	нарезной стенд
rifling bench	ствол
recoil	затвор
shotgun	винтовка, ружье
Rifle	Гильза
broaching	ружье, дробовик
swaging	ударник
firing pin	развальцовка

2. Translate from English to Russian:

Choke	
Assault rifle	
gunpowder	
trigger	
wad	
Shutter	
Return spring	
shotshell	
smokeless powders	
muzzle	

3. Translate from Russian to English:

Порох	
Винтовка	
Затвор	
Ударник	
Пыж	
Дробовик	
Ручное оружие	
Пуля	
Калибр	
Гильза	

4. False/true:

Cartridges can only be rimfire.	T / F
Plastic can also be used to jacket bullets.	T / F
Fired bullets may be difficult to recover at the scenes of crimes.	T / F
The rifling characteristics of the barrels cannot be altered by reboring them.	T / F
Automatic and semiautomatic weapons function in one of three ways: blowback, recoil, or gas piston.	T / F

5. Vocabulary:

6. Trigger – спусковой крючок

7. Gunpowder – порох

8. Assault rifle – штурмовая винтовка

9. Rifle – винтовка, ружье
10. Handgun – ручное огнестрельное оружие, пистолет
11. cartridge casing, shotshell– гильза
12. barrel – ствол
13. recoil – отдача
14. firing pin – ударник
15. muzzle – дуло
16. wad – пыж
17. Automatic weapon – автоматическое оружие
18. Semiautomatic weapon – полуавтоматическое оружие
19. Shotgun – дробовик
20. Bullet – пуля
21. Shutter – затвор

UNIT VI. PERSONAL IDENTIFICATION METHODS.



Text 1: Personal Identification Methods in Forensic Science

A fundamental goal of forensic science is to establish the identity of individuals connected to a crime, either as victims or perpetrators. This process, known as **personal identification**, relies on scientific principles to compare unknown evidence with known samples. The methods vary in their certainty, from **presumptive** (indicative) to **conclusive** (definitive). The key principle is that identification is based on both **class characteristics** (shared by a group) and **individual characteristics** (unique to a single source).

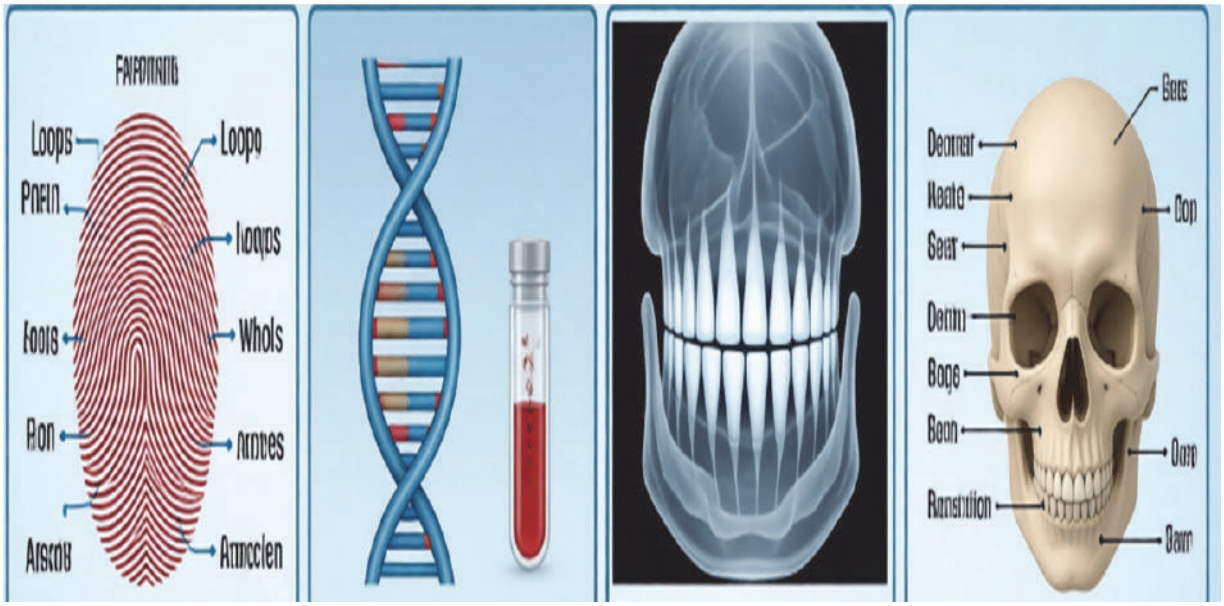
The most reliable methods are those that analyze unique biological or physical features:

- **Fingerprint Analysis (Dactyloscopy):** This is one of the oldest and most trusted methods. It is based on the permanence and uniqueness of **friction ridge skin** patterns (loops, whorls, arches) on fingers, palms, and soles. Latent (invisible), patent (visible), or plastic (impressed) prints are recovered and compared against databases.
- **DNA Profiling (Genetic Fingerprinting):** This is considered the gold standard for biological identification. It analyzes specific regions of an

individual's **deoxyribonucleic acid (DNA)**. Except for identical twins, every person's DNA is unique. Analysis can be performed on minute samples like blood, saliva, hair roots, or skin cells.

- **Dental Analysis (Forensic Odontology):** Teeth are extremely durable. This method involves the examination of dental records, X-rays, and unique dental work (fillings, crowns) to identify individuals, especially in cases of severe decomposition or mass disasters.

Other important methods include:



- **Anthropological Analysis:** Used primarily for skeletal remains. Forensic anthropologists determine **biological profile** characteristics such as sex, age, stature, and ancestry from bones. They also analyze individualizing features like healed fractures or unique bone structures.

- **Facial Recognition and Superimposition:** This involves comparing a photograph or video of an unknown person with a known suspect's image. **Craniofacial superimposition** is a technique where a skull is photographed and compared to an antemortem photo of a missing person.

- **Other Biometric Methods:** These include **iris or retina scanning**, **gait analysis** (study of walking patterns), and **earprint analysis**, which are more often used in security than in traditional crime scene work.

In practice, forensic experts often use a **combination of methods** to reach a positive identification, with the method chosen depending on the condition and type of evidence available.

EXERCISES FOR ENGLISH PRACTICE



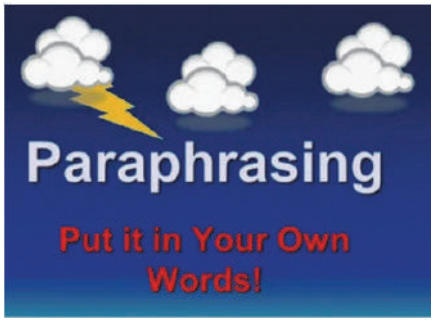
Exercise 1: Make Word Combinations (Match a word from Column A with a word from Column B to form a common forensic term from the text.)

Column A:	**Column B:**
1. friction	a. fingerprint
2. biological	b. profile
3. DNA	c. disaster
4. latent	d. odontology
5. mass	e. identification
6. class	f. ridge
7. forensic	g. characteristics
8. craniofacial	, h. photograph
9. antemortem	i. superimposition
10. positive	j. profiling



Exercise 2: Match the Columns (Connect the identification method with its primary subject of analysis.)

Column A:	**Column B:**
1. Dactyloscopy	a. Bones and skeletal remains
2. DNA Profiling	b. Teeth and dental records
3. Forensic Odontology	c. Skin ridge patterns
4. Forensic Anthropology	d. Skull and photographs
5. Craniofacial Superimposition	e. Blood, saliva, or hair roots



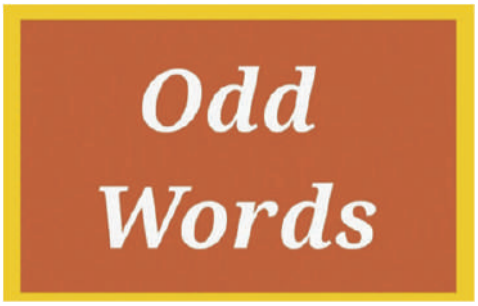
Exercise 3: Paraphrase the Following (Rewrite these sentences in your own words in English.)

1. Personal identification is a fundamental goal of forensic science.
2. Fingerprint analysis is based on the uniqueness of friction ridge skin.
3. DNA is considered the gold standard for biological identification.
4. Forensic odontology is crucial in cases of severe decomposition.
5. A biological profile includes estimates of sex, age, and stature.
6. Identification relies on both class and individual characteristics.
7. Latent prints are invisible to the naked eye.
8. Teeth are extremely durable and can survive extreme conditions.
9. Experts often use a combination of methods for conclusive results.
10. Gait analysis is the study of a person's walking pattern.



Exercise 4: True or False? (Mark the statements as T (true) or F (false) based on the text.)

1. All identification methods provide conclusive proof of identity.
2. Fingerprint patterns are unique even between identical twins.
3. DNA profiling can only be done with large samples of blood.
4. Forensic anthropology is used primarily for fresh corpses.
5. The term "antemortem" refers to something before death.
6. Class characteristics can uniquely identify a single person.
7. Plastic fingerprints are three-dimensional impressions.
8. Iris scanning is a common method at every crime scene.
9. Dental records are a form of known sample for comparison.
10. The main purpose is to link individuals to a crime scene or event.



Exercise 5: One Word is Odd (In each group, cross out the word or phrase that is NOT directly related to the core method.)

1. *Fingerprint Analysis:* latent print, whorl, DNA strand, arch, minutiae.
2. *DNA Profiling:* chromosome, saliva, blood, dental filling, hair root.
3. *Forensic Odontology:* molar, X-ray, femur, crown, enamel.
4. *Forensic Anthropology:* stature, ancestry, loop pattern, skull, pelvis.
5. *Types of Prints:* patent, plastic, latent, biometric.
6. *Biological Profile Components:* sex, age, shoe size, ancestry, stature.

7. *Related to Identification:* conclusive, presumptive, irrelevant, comparative.

8. *Sources of Known Samples:* criminal database, medical records, suspect's alibi, dental casts.

9. *Durable Evidence for ID:* teeth, bone, fresh fruit, hair with root.

10. *Forensic Specialists:* odontologist, anthropologist, dactyloscopist, chef.



Exercise 6: Answer the Questions (Provide short answers based on the text.)

1. What are the two main types of characteristics used in identification?

2. Name the three basic fingerprint pattern types.

3. Why is DNA profiling not useful for distinguishing between identical twins?

4. What kind of forensic expert would analyze a skeleton to determine its age?

5. What is the key difference between a patent and a latent fingerprint?

6. What does the term "biological profile" refer to?

7. Which identification method is most associated with mass disasters and why?

8. What is the purpose of craniofacial superimposition?

9. Name one biometric method mentioned other than fingerprints.

10. What is the ultimate goal of applying these methods in a forensic context?



Exercise 7: Gap-Fill Completion (Fill in the blanks with a suitable term from the text.)

When a 1) _____ is discovered, the first step is often to search for 2) _____. If a weapon is found, experts try to lift 3) _____ prints from its surface. For a degraded body, a forensic 4) _____ might be called to examine the teeth, while a forensic 5) _____ would analyze the bones. If tissue is available, a sample is sent for 6) _____ to generate a genetic profile, which can be compared to a missing person's 7) _____ sample (like a toothbrush). A 8) _____ identification can be made if multiple methods, like dental records and a unique skeletal feature, both point to the same individual. Throughout this process, the integrity of the evidence and the 9) _____ of custody must be maintained to ensure the findings are admissible in 10) _____.

Text 2: Biomedical Methods of Identification in Forensic Science

Forensic human identification is a systematic process that compares **postmortem** data from human remains with **antemortem** data from missing persons. Among the most reliable methods are biomedical techniques, which offer scientific, objective, and often highly individualizing evidence.

The primary, most definitive biomedical methods are:

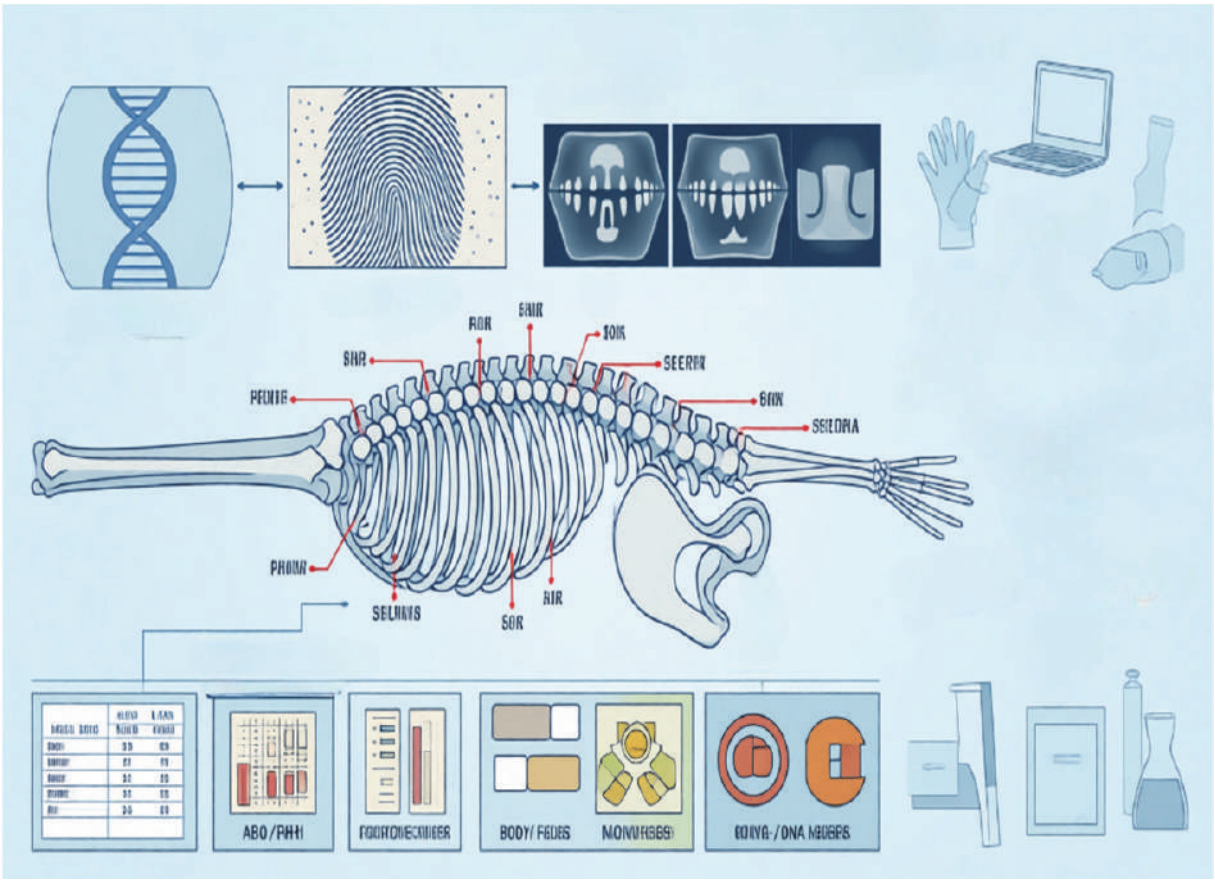
- **DNA Analysis**: Often considered the gold standard, DNA profiling compares genetic material from biological evidence—such as blood, saliva, semen, hair roots, bone, or teeth—to a reference sample. Techniques like Polymerase Chain Reaction (PCR) amplify specific regions, such as Short Tandem Repeats (STRs), to create a unique genetic profile. DNA is unique to each individual (except identical twins) and can provide a random match probability of less than one in a trillion.
- **Friction Ridge Analysis (Fingerprints)**: This method relies on the unique and persistent patterns of friction ridge skin on fingers, palms, and feet. The philosophy is based on the premises that these ridges form before birth, persist throughout life, and their patterns and details are unique and never repeated.
- **Forensic Odontology (Dental Analysis)**: Teeth are highly resistant to decomposition and extreme conditions. Identification is achieved by comparing **postmortem** dental radiographs, records of dental work, or unique dental features with **antemortem** dental records.

Other Biomedical and Analytical Techniques:

- **Blood Typing and Serology**: An earlier form of biochemical identification, it classifies blood based on the presence of antigens (e.g., ABO and Rh systems). While less discriminating than DNA, it can be used for exclusion.
- **Body Fluid Identification**: Presumptive and confirmatory tests identify the source of a biological stain (e.g., blood, saliva, semen) before DNA

analysis. Advanced methods like Raman spectroscopy can identify fluids without consuming the sample.

- **Advanced Molecular Analyses**: Emerging fields include the analysis of **microRNA (miRNA)** for estimating time since death or tissue



origin, and **DNA methylation** patterns for forensic age estimation.

The Identification Process & Evidence Handling: Identification involves meticulous **collection**, **preservation**, and **analysis**. Biological evidence must be collected using sterile techniques to avoid **cross-contamination**, air-dried, and packaged in paper—not plastic—to prevent degradation. The **chain of custody** must be meticulously documented. The analysis follows a standard flow: extraction, quantitation, amplification, separation, and interpretation. In cases of degraded or mixed samples, a **partial profile** may be obtained. A profile from a crime scene (a **questioned sample**) is compared to a **reference sample** from a suspect or victim, or searched against a database like the **Combined DNA Index System (CODIS)**.

EXERCISES FOR ENGLISH PRACTICE



Exercise 1: Make Word Combinations

Task: Combine a word from List A with one from List B to form a common term from the text.

List A:	**List B:**
chain	sample
antemortem	match probability
cross	contamination
friction	ridge
questioned	sample
random	tandem repeat
reference	custody
short	data
biological	evidence
postmortem	data



Exercise 2: Match the Columns

Task: Match the forensic method (1-10) with its primary characteristic or purpose (A-J).

List A:	**List B:**
1. DNA Profiling	**A.** Uses dental records and X-rays for identification.
2. Friction Ridge Analysis	**B.** A national system for storing and comparing DNA profiles.
3. Forensic Odontology	**C.** Technique to copy millions of copies of a specific DNA region.
4. CODIS Database	**D.** Analyzing DNA methylation patterns to determine age.
5. PCR (Polymerase Chain Reaction)	**E.** A documented history of who handled evidence.
6. Presumptive Test for Blood	**F.** Genetic material left behind from skin cells on touched objects.
7. Chain of Custody	**G.** The study of stable biomarkers for estimating time since death.
8. miRNA Analysis	**H.** Kastle-Meyer test to indicate the possible presence of blood.
9. Touch DNA	**I.** Based on the uniqueness and persistence of fingerprint patterns.
10. Forensic Age Estimation	**J.** Compares STR markers to provide an individual genetic profile.



Exercise 3: Paraphrase the Following

Task: Rewrite these sentences in your own words.

1. DNA is present in most nucleated cells of our body.
2. Friction ridges develop on the fetus prior to birth.
3. Teeth are highly resistant to decomposition.
4. Proper evidence collection is crucial to avoid contamination.
5. A random match probability is the chance of a random person matching the DNA profile.
6. The analysis of biochemical markers can provide insights into a suspect's physiological state.
7. A partial profile can occur if a DNA sample is degraded.
8. Mass spectrometry allows for precise identification of substances in biological samples.
9. Visual identification can be unreliable due to postmortem changes.
10. The integrative process of identification begins at the death scene.



Exercise 4: True or False?

Task: Indicate if the statement is true (T) or false (F) based on the text.

1. Mitochondrial DNA is inherited paternally.
2. Identical twins have different DNA profiles.
3. Plastic bags are recommended for storing dried biological evidence.

4. The ABO blood group system is more discriminatory than STR DNA analysis.

5. The "double-swab" technique is considered the most efficient for collecting touch DNA.

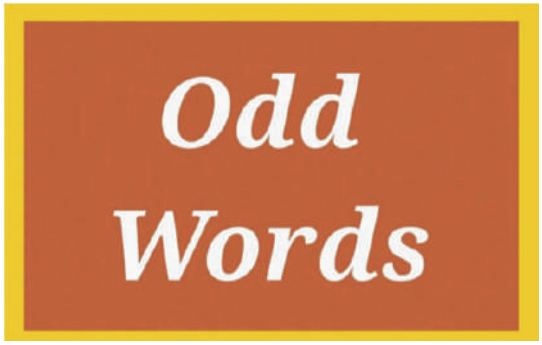
6. Next-Generation Sequencing (NGS) is becoming a new standard in forensic genetics.

7. Forensic odontology is only useful for identifying recently deceased individuals.

8. A locus is a specific location on a chromosome.

9. Circumstantial evidence like clothing is considered a primary scientific identifier.

10. Saliva can be a source of DNA for profiling.



Exercise 5: One Word is Odd

Task: In each line, find and cross out the one term that does NOT fit the category.

1. *Biomedical ID Methods:* DNA profiling, fingerprint analysis, toolmark analysis, forensic odontology.

2. *Sources of DNA:* bone, saliva, glass fragment, hair follicle, blood.

3. *Steps in DNA Process:* extraction, quantification, speculation, interpretation, amplification.

4. *Types of Fingerprints:* latent, plastic, forged, patent.

5. *Stored in CODIS:* convicted offender profiles, forensic unknowns, fingerprint cards, missing person profiles.

6. *Related to Evidence Integrity:* chain of custody, contamination, quick analysis, proper packaging.

7. *Body Fluids for Analysis:* semen, saliva, fiber, peripheral blood, vaginal fluid.

8. *Postmortem Changes:* rigidity, lividity, decomposition, vaccination scar.

9. *Used in Age Estimation:* dental wear, DNA methylation, blood typing, epiphyseal fusion.

10. *Biomarker Types:* protein markers, metabolic markers, fiber markers, genetic markers.



Exercise 6: Answer the Questions

Task: Provide short answers based on the text.

1. What are the three primary methods of human identification according to Interpol?

2. Why are teeth particularly valuable for identification in mass disasters?

3. What is the main purpose of the PCR technique in forensic DNA analysis?

4. What should an investigator do to prevent cross-contamination when collecting biological evidence?

5. What is the key difference between a *reference sample* and a *questioned sample*?

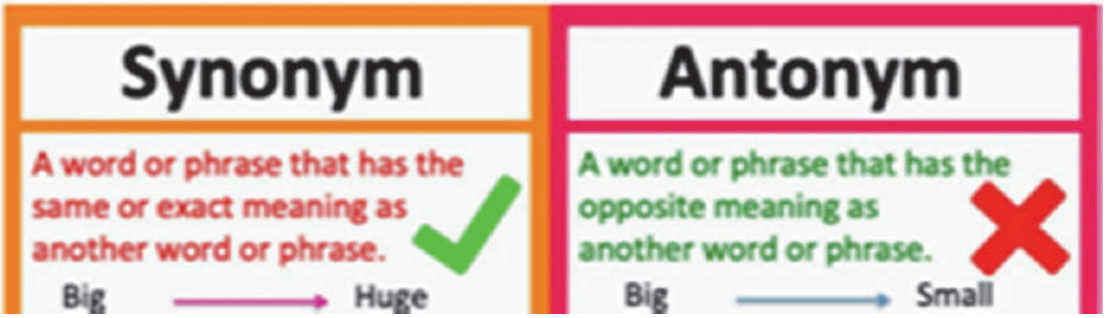
6. Name two advantages of using saliva for biochemical marker analysis.

7. What does STR stand for, and why is it used in forensics?

8. What is the principle behind friction ridge identification?

9. What might be the cause of obtaining only a partial DNA profile?

10. Besides identification, what other information can biochemical analysis from bodily fluids potentially provide?



Exercise 7: Match the Synonyms and Antonyms

Task: For words 1-5, find the synonym from the list. For words 6-10, find the antonym.

Words:	**Synonyms List:**
1. Postmortem	Definite
2. Unique	Durable
3. Degradation	Individualized
4. Confirmatory	Posthumous
5. Robust	Deterioration

Words:	**Antonyms List:**
6. Antemortem	Inclusion
7. Exclusion	Purity
8. Presumptive	Definite
9. Integrity	Postmortem
10. Contamination	Corruption

TEXT 3. ICT IN IDENTIFYING CRIMINALS AND VICTIMS

Information and Communications Technology (ICT) has fundamentally transformed the process of identifying both perpetrators and victims of crime. This transformation is powered by tools that analyze digital traces, biological evidence, and visual data, moving investigations from traditional methods to technology-driven precision.

1. Digital Evidence: The Electronic Witness

Digital evidence is information of value to an investigation that is stored on, received, or transmitted by an electronic device. This evidence is latent, like fingerprints or DNA, and can be found on computers, smartphones, and even modern appliances. Mobile device forensics, a critical subfield, involves extracting data like call logs, text messages, GPS locations, and deleted files from smartphones and tablets in a legally admissible manner. The process follows strict stages: seizure, acquisition (creating a forensic image), analysis, and reporting. This data can place a suspect at a scene, reveal criminal intent via communications, or establish a victim's last known movements.

2. Artificial Intelligence and Biometric Identification

Artificial Intelligence (AI) mimics human intelligence, with machine learning enabling systems to recognize complex patterns from large datasets. This capability is crucial for biometric identification.

- **Facial Recognition**: AI-powered facial recognition software (FRS) can rapidly match faces from surveillance footage or photos against databases. This is pivotal for identifying suspects in robberies, locating missing persons, and even resolving cold cases by matching old photographs to modern databases. AI algorithms can also analyze low-quality or obscured images, such as faces turned from the camera or partial license plates.



- **DNA Analysis**: AI assists in interpreting complex DNA mixtures, where evidence contains genetic material from multiple people. Machine learning algorithms can help "deconvolute" these mixtures to separate and identify individual profiles, generating critical investigative leads.

3. Integrated Platforms and Real-Time Analysis

A paradigm shift is occurring toward integrated forensic platforms that connect the laboratory to the crime scene. The goal is to perform robust, on-site analyses that yield court-admissible evidence in the critical "golden hours" after a crime.

This includes mobile DNA technologies and portable chemical analyzers. Furthermore, predictive policing algorithms use historical crime data to forecast where crimes might occur or who might be a victim, allowing for more efficient resource allocation. Gunshot detection systems use acoustic sensors to instantly locate firearm discharges, drastically reducing police response times.

4. Victim Identification and Recovery

ICT plays a profound role in identifying and protecting victims. Facial recognition can help identify victims of human trafficking or child exploitation who may be unable or unwilling to identify themselves. In missing persons cases, comparing images of found individuals against family photos or databases can lead to safe recovery. The analysis of a victim's own digital devices—their smartphone location history, social media activity, or communications—can be crucial in understanding their timeline and interactions before an incident.

Conclusion

From the micro-level of data bits on a phone to the macro-level of AI analyzing city-wide crime patterns, ICT provides an indispensable toolkit. It allows investigators to identify criminals with greater speed and accuracy and offers new avenues to find and safeguard victims, making the pursuit of justice more efficient and effective.

EXERCISES FOR ENGLISH PRACTICE



Exercise 1: Make Word Combinations

Match a verb from Column A with a term from Column B to form a common phrase from the text.

Column A:	Column B:
extract	forensic image
create a	intelligence
analyze	patterns
recognize	persons
establish	resources
locate missing	data
follow a	timeline
mimic human	data
allocate	chain of custody
recover deleted	files, evidence



Exercise 2: Match the Columns

Connect the ICT term with its primary application in identification.

Column A:	Column B:
1. Mobile Device Forensics	a. Matching faces from CCTV to a database.
2. Facial Recognition Software (FRS)	b. Separating genetic profiles from multiple contributors.
3. AI-Powered DNA Mixture Analysis	c. Analyzing text messages and call logs.
4. Predictive Policing Algorithms	d. Forecasting potential crime hotspots.
5. Gunshot Detection Systems	e. Pinpointing the origin of firearm discharges.
6. Digital Forensic Image	f. Understanding a victim's last movements.

7. Social Media Monitoring	g. A bit-by-bit copy of a hard drive for analysis.
8. GPS Location Data	h. Enabling on-site, admissible evidence collection.
9. Integrated Forensic Platform	i. Gathering open-source intelligence on activities.
10. Machine Learning	j. The ability of systems to learn from data patterns.



Exercise 3: Paraphrase the Following

Rewrite these sentences in your own words in English.

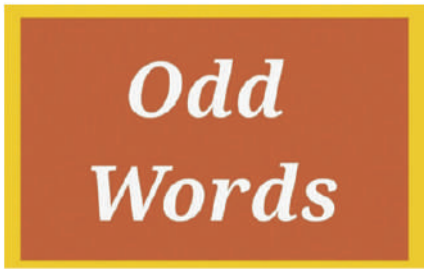
1. Digital evidence is information stored or transmitted in binary form.
2. Mobile device forensics extracts data in a forensically sound manner.
3. AI mimics human decision-making processes.
4. Facial recognition can help identify victims of human trafficking.
5. The chain of custody documents who handled evidence.
6. Predictive policing allows for efficient allocation of resources.
7. A forensic image is an exact copy of a storage device.
8. DNA mixture interpretation is a challenge for crime labs.
9. The "golden hours" are critical for an investigation.
10. Data can be recovered from deleted disk space.



Exercise 4: True or False?

Mark the statements as T (true) or F (false) based on the text.

1. Digital evidence can only be found on computers and smartphones.
2. The stages of mobile forensics include seizure, acquisition, and reporting.
3. Artificial Intelligence requires constant direct human intervention to work.
4. Facial recognition is useful only for identifying suspects, not victims.
5. AI can help analyze low-quality video footage.
6. A "forensic image" is a rough summary of a device's contents.
7. Predictive policing uses historical data to forecast crime.
8. GPS data from a phone cannot be used as evidence.
9. Machine learning helps computers recognize patterns.
10. Integrated platforms aim to move analysis solely into the laboratory.



Exercise 5: One Word is Odd

In each group, find and cross out the word that does not fit the category.

1. *Digital Evidence Sources:* smartphone, hard drive, witness statement, cloud storage.
2. *Mobile Forensics Stages:* seizure, speculation, analysis, reporting.
3. *Biometric Identifiers:* fingerprint, license plate, iris pattern, DNA.

4. *AI Applications:* facial recognition, DNA deconvolution, handwritten report, crime forecasting.

5. *Items extracted via forensics:* call log, GPS coordinate, murder weapon, text message.

6. *Related to Evidence Integrity:* chain of custody, hashing, fabrication, write blocker.

7. *Victim Identification Tools:* familial DNA search, suspect interrogation, facial recognition, missing persons database.

8. *Predictive Policing Inputs:* historical crime data, weather patterns, officer's horoscope, time of day.

9. *Components of an Integrated Platform:* portable analyzer, wireless communication, central database, typewriter.

10. *Types of Data Analysis:* statistical, predictive, random, comparative.



Exercise 6: Answer the Questions

Provide short answers based on the text.

1. What are the four main stages of the mobile device forensics process?

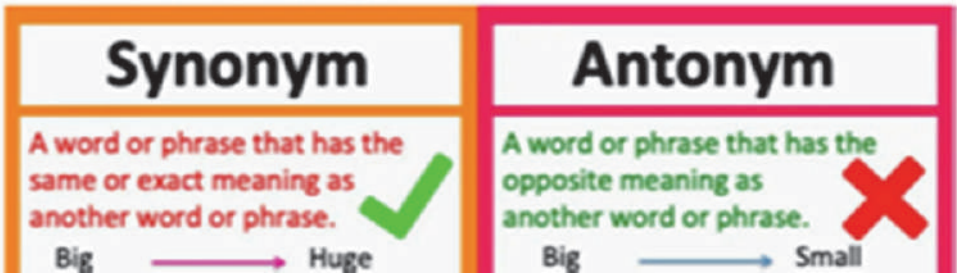
2. Name one way AI is used in DNA analysis.

3. How can facial recognition technology help in cold cases?

4. What is the main purpose of creating a "forensic image"?

5. Besides criminals, who else can be identified using facial recognition according to the text?

6. What does ICT stand for?
7. What is the "golden hour" concept in investigations?
8. What type of evidence is described as "latent," similar to DNA?
9. What is the goal of predictive policing algorithms?
10. Name one challenge that integrated forensic platforms aim to solve.



Exercise 7: Match the Synonyms & Antonyms

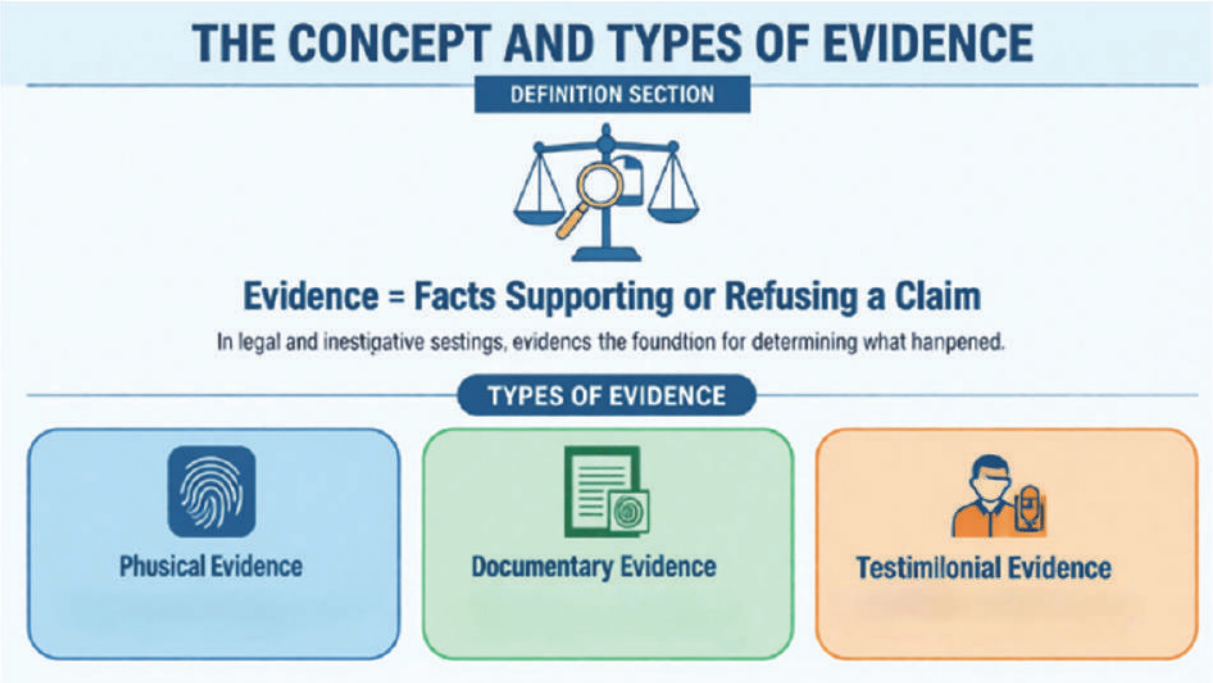
Part A (Synonyms): Match words from List 1 with their closest synonym from List 2.

Synonyms	
List 1	**List 2**
crucial	distribute
extract	offender
perpetrator	critical
admissible	remove
allocate	permissible

Part B (Antonyms): Match words from List 3 with their opposite from List 4.

Antonyms	
List 3	**List 4**
digital	innocent
efficient	analog
victim	lose
guilty	perpetrator
acquire	inefficient

UNIT VII. THE CONCEPT AND TYPES OF EVIDENCE



Text 1: Evidence in Criminalistics

1. The Core Definition

In criminal law, **evidence** refers to any material presented in court to prove or disprove alleged facts, ranging from physical items like a weapon to intangible elements like witness testimony. Fundamentally, evidence is any perceptible thing that tends to demonstrate, establish, or disprove a fact. It is the cornerstone upon which both prosecution and defense build their arguments in any criminal case.

2. Major Types of Evidence

Evidence is not a singular concept but is categorized based on its nature and relationship to the facts of a case.

- **Direct vs. Circumstantial Evidence**: This is a primary classification. **Direct evidence** directly proves a fact without requiring any inference, such as an eyewitness account of the crime or a clear security camera recording. In contrast, **circumstantial evidence** (or indirect evidence) suggests a

fact by implication. Finding a suspect's fingerprint at a crime scene does not prove they committed the crime but strongly implies their presence.



- **Physical Evidence**: Also called real evidence, this consists of tangible items collected from a crime scene, victim, or suspect. Examples include weapons, biological materials (DNA, blood), fibers, footprints, or documents.
- **Testimonial Evidence**: This is spoken or written statements given under oath by witnesses, victims, or experts.
- **Documentary Evidence**: This encompasses any relevant written or recorded material, such as contracts, financial records, emails, text messages, and official reports.
- **Digital Evidence**: Any data stored or transmitted electronically, including emails, social media posts, GPS data, and files from computers or smartphones.
- **Demonstrative Evidence**: This type includes objects, pictures, models, or animations used in court not as original evidence but to illustrate or

explain complex facts or testimony (e.g., an anatomical model, a crime scene diagram).

3. Forensic Classifications: Individual vs. Class Evidence

Forensic science further classifies physical evidence based on its identifying power. **Individual evidence** has physical qualities unique to a single, specific source. Examples include a fingerprint, a DNA profile, or the unique striation marks on a bullet fired from a specific gun. **Class evidence**, however, has qualities that can only be associated with a group of items, not a single source. Examples include a common blood type, the tread pattern of a popular brand of shoe, or the general make and model of a car. Class evidence is crucial for narrowing the pool of suspects or items.

4. The Critical Role of Admissibility

Not all collected material can be presented in court. For evidence to be **admissible**, it must be ruled so by a judge based on key criteria. The two most fundamental criteria are:

1. **Relevance**: The evidence must logically make a key fact in the case more or less probable.
2. **Lawful Collection**: Evidence must be obtained legally, respecting constitutional rights. Evidence gathered through an illegal search, for example, may be deemed **inadmissible** under exclusionary rules.

LANGUAGE LEARNING EXERCISES

Here are seven different types of exercises, each with 10 tasks based on the text above. Instructions for the teacher are included.



Exercise 1: Make Word Combinations

Goal: To build technical vocabulary and learn common forensic collocations.

Task: Combine a word from List A with a word

from List B to form a standard term from the text. Some words may be used more than once.

List A:	List B:
direct	evidence
circumstantial	characteristic
physical	collection
testimonial	witness
digital	source
documentary	recording
demonstrative	model
admissible	profile
individual	ruling
class	analysis

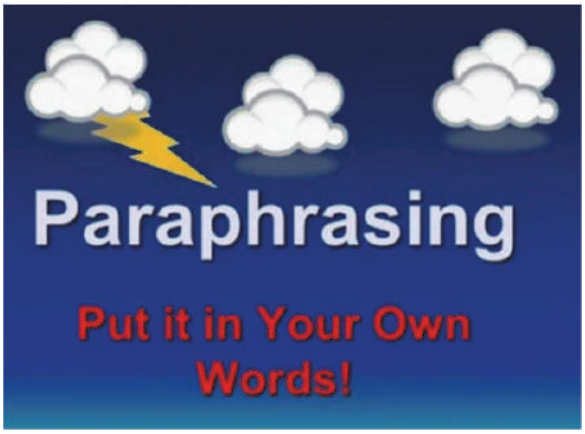


Exercise 2: Match the Columns

Goal: To link concepts with their definitions and examples. **Task:** Match the type of evidence (1-10) with its correct description (A-J).

Column A:	Column B:
1. Direct Evidence	A. A fingerprint, which is unique to one person.
2. Circumstantial Evidence	B. Blood type A, shared by many people.
3. Individual Evidence	C. A 3D model of a crime scene used in court.
4. Class Evidence	D. An eyewitness stating they saw the defendant commit the crime.

5. Testimonial Evidence	E. Text messages extracted from a suspect's phone.
6. Digital Evidence	F. A murder weapon collected from the scene.
7. Demonstrative Evidence	G. Evidence that has been ruled acceptable for presentation in court.
8. Admissible Evidence	H. A written contract that is relevant to the case.
9. Documentary Evidence	I. A statement given under oath by a witness.
10. Physical Evidence	J. Fingerprints found at the scene, implying presence but not guilt.



Exercise 3: Paraphrase the Following

Goal: To practice explaining complex ideas in simpler or alternative English.

Task: Rephrase these sentences from the text in your own words without changing the core meaning.

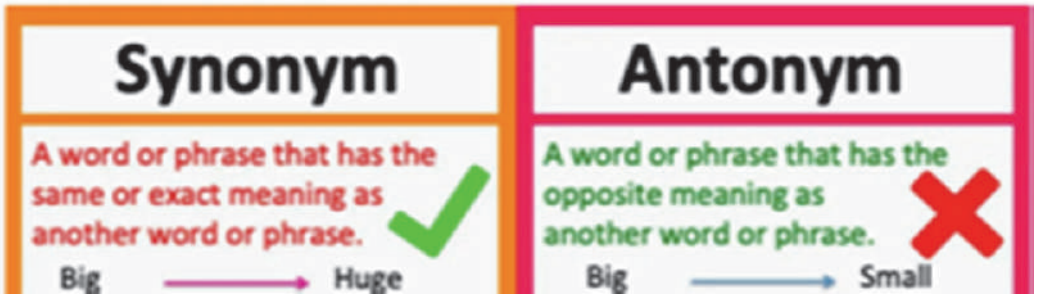
1. "Evidence is the cornerstone upon which both prosecution and defense build their arguments."
2. "Circumstantial evidence suggests a fact by implication."
3. "Individual evidence has physical qualities unique to a single, specific source."
4. "For evidence to be admissible, it must be ruled so by a judge."
5. "Digital evidence encompasses any data stored or transmitted electronically."



Exercise 4: True / False / Not Stated

Goal: To develop careful reading and information verification skills. **Task:** Read the statements below. Mark them as **True (T)**, **False (F)**, or **Not Stated (NS)** based on the information in the text.

1. All evidence collected by the police is automatically allowed in court.
2. A security camera video clearly showing a crime is an example of direct evidence.
3. Class evidence can conclusively prove that a specific person was at a crime scene.
4. The text states that digital evidence is becoming less important.
5. "Relevance" and "lawful collection" are criteria for admissibility.
6. A witness's spoken account in court is called documentary evidence.
7. Finding a suspect's common shoe tread at a scene is powerful individual evidence.
8. An expert witness provides testimonial evidence.
9. Demonstrative evidence is an original item from the crime scene.
10. The main purpose of evidence is to support or challenge facts in a case.



Exercise 5: Match the Synonyms & Antonyms

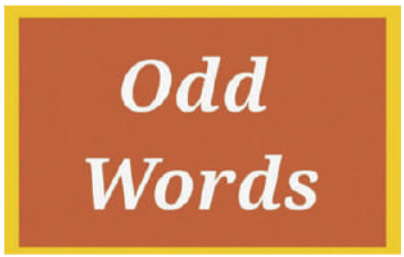
Goal: To expand vocabulary by finding words with similar and opposite meanings.

Task A (Synonyms): Match the forensic term with its closest synonym.

Synonyms	
Tangible	Suggest
Inadmissible	Definitive
Proof	Physical
Conclusive	Evidence
Imply	Excluded

Task B (Antonyms): Match the forensic term with its direct antonym.

Antonyms	
Direct evidence	Inadmissible
Individual characteristic	Disprove
Admissible	Circumstantial evidence
Prove	Innocence
Guilt	Class characteristic



Exercise 6: One Word is Odd

Goal: To refine understanding of thematic categories and professional logic.

Task: In each group of four words, identify which one does **not** thematically belong with the others and explain your choice.

1. Knife, DNA sample, Fiber, Eyewitness
2. Relevance, Weight, Color, Lawful Collection
3. Fingerprint, Striation mark, Blood type, Handwriting
4. Expert, Victim, Diagram, Bystander
5. Email, Contract, Text message, Footprint



Exercise 7: Answer the Questions

Goal: To practice information retrieval and formulating complete, accurate answers.

Task: Answer the following questions in full sentences based on the text.

1. What is the simple, core definition of evidence?
2. What is the key difference between direct and circumstantial evidence? Give an example of each.
3. What is another name for "physical evidence"?
4. Name three examples of digital evidence.
5. What is the purpose of demonstrative evidence?
6. How does "individual evidence" differ from "class evidence"?
7. What two main criteria must evidence meet to be "admissible"?
8. What might happen to evidence that was obtained illegally?
9. What type of evidence would a signed financial record be classified as?
10. Why is evidence described as the "cornerstone" of a criminal case?

Text 2: Evidence in Criminalistics and ICT Usage

The nature of evidence in criminalistics has undergone a fundamental transformation in the digital age. Modern investigations must now account for two complementary realms: the **physical world** of traditional forensic evidence and the **digital world** of electronic data. Today, it is estimated that digital evidence is a factor in about 90% of all criminal cases. The integration of Information and Communication Technologies (ICT) is not merely an addition to the forensic toolkit but a complete reimagining of how evidence is identified, collected, analyzed, and presented in court.

The Duality of Modern Evidence

Traditional physical evidence—such as fingerprints, fibers, or ballistic materials—remains crucial and is often analyzed with advanced technological instruments. However, digital evidence has become equally indispensable. Defined as any information stored or transmitted in binary form that may be relied on in court, it extends far beyond cybercrime. Digital evidence from emails, text messages, location history, and social media can prove intent, alibi, or relationships in almost any type of crime, from fraud to homicide.

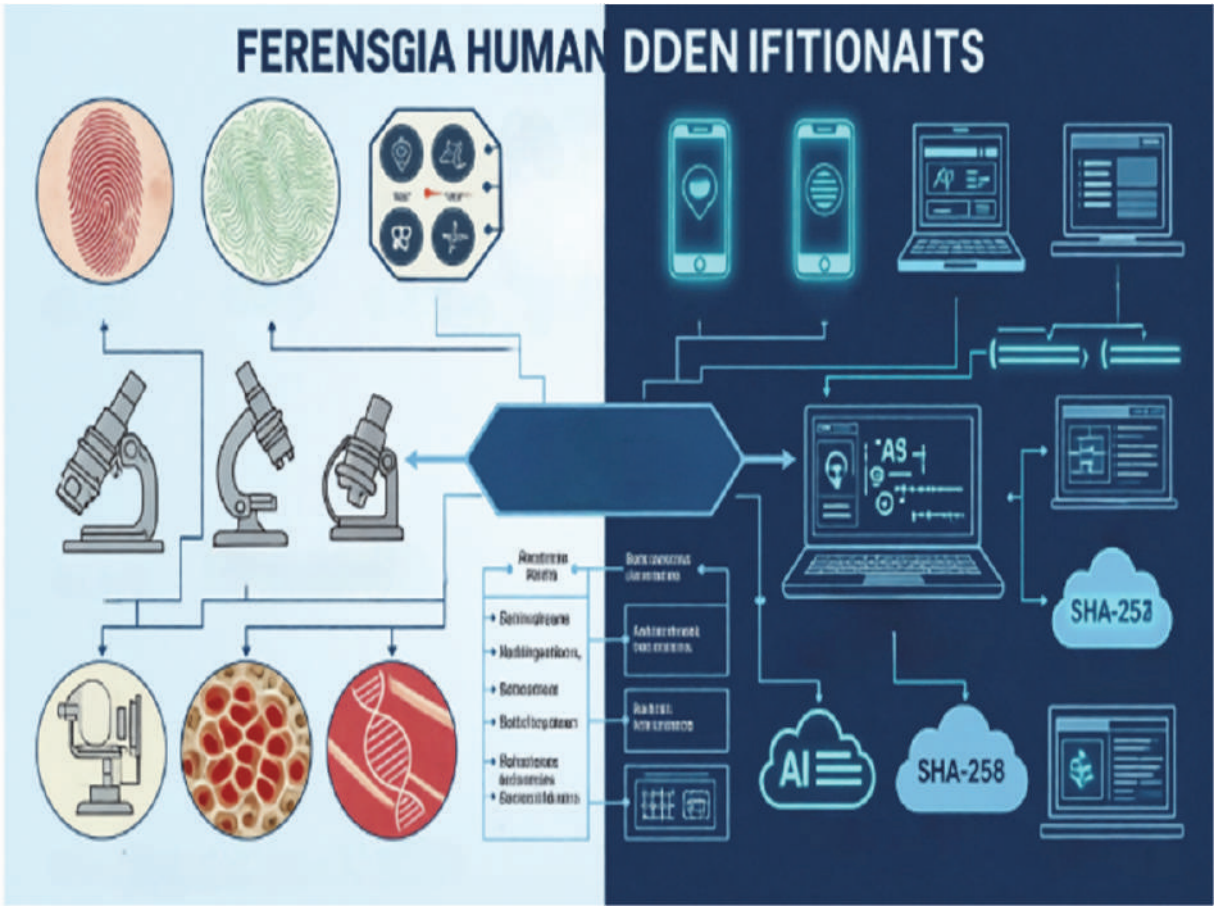
The Core of Digital Evidence and Forensics

Digital forensics is the disciplined process of recovering, preserving, and analyzing this electronic data. Unlike physical evidence, digital evidence is exceptionally fragile; it can be easily altered, deleted, or corrupted, whether accidentally or maliciously. Therefore, its handling follows strict protocols centered on **forensic soundness**. Key principles include:

- **Chain of Custody:** Meticulous documentation of every person who handles the evidence.
- **Integrity Verification:** Using hash algorithms (like SHA-256) to create a unique "fingerprint" of a digital file to prove it has not been altered.
- **Minimal Handling:** Analysts work only on forensic copies of the original data, created using **write blockers** to prevent any changes to the source material.

ICT Tools and Applications in the Investigative Process

ICT provides the specialized tools that make digital forensics possible and enhances traditional methods.



1. **Collection & Acquisition:** Tools like **Cellebrite UFED** or **Oxygen Forensics** are used to extract data from smartphones, including deleted files. **Forensic imaging software** (e.g., **FTK Imager**) creates a complete bit-for-bit copy of a hard drive.

2. **Analysis:** Analysts sift through vast amounts of data using software to find relevant evidence. This process is increasingly aided by **Artificial Intelligence (AI)** and **machine learning**, which can automatically categorize images, detect patterns, or analyze communications.

3. **Integration & Intelligence:** Modern **decision intelligence platforms** allow investigators to correlate digital evidence with other data sources (like financial records or communication logs) to uncover hidden connections and build a comprehensive picture of a case.

4. **Emerging Frontiers:** New fields like **IoT forensics** (data from smart devices) and **cloud forensics** (data from services like Google Drive) present both challenges and new sources of evidence.

Challenges and Legal Considerations

The reliance on ICT in evidence handling introduces complex challenges. Investigators face **encryption**, **jurisdictional issues** with cloud data, and the sheer **volume of data** to process. Furthermore, for digital evidence to be admissible in court, prosecutors must prove it was legally obtained, is authentic, and its integrity is preserved—a process often more complex than for physical evidence. A lack of specialized training for both investigators and legal professionals can be a significant hurdle.

In conclusion, ICT has moved from a supporting role to the very core of modern criminalistics. The future of forensic evidence lies in the seamless integration of physical and digital analysis, powered by sophisticated tools and guided by rigorous scientific and legal standards to uncover the truth.

EXERCISES FOR ENGLISH LANGUAGE PRACTICE



1. Make Word Combinations

Combine a word from List A with a word from List B to form a key term or phrase from the text.

List A:	**List B:**
1. digital	a) evidence
2. chain	b) of custody
3. hash	c) algorithm
4. physical	d) intelligence
5. forensic	e) forensics
6. write	f) blocker

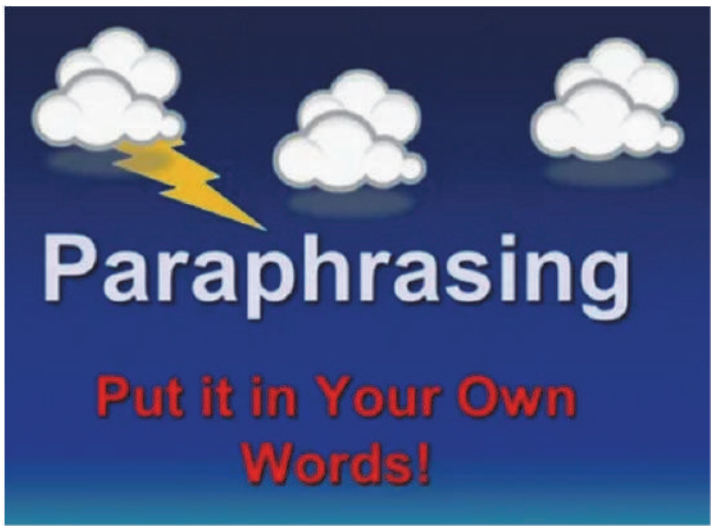
7. artificial	g) soundness
8. cloud	h) warrant
9. IoT	i) forensics
10. search	j) evidence



2. Match the Columns

Match the forensic concept (Column A) with its correct definition (Column B) and a related tool or principle (Column C).

Column A:	**Column B:**	**Column C:**
1. Digital Forensics	a) A process for recovering/preserving electronic data	i) SHA-256
2. Chain of Custody	b) A log tracking everyone who handled evidence	ii) FTK Imager
3. Hash Algorithm	c) A hardware tool to prevent data alteration during copying	iii) Detailed evidence log form
4. Write Blocker	d) A function creating a unique digital fingerprint for a file	iv) Cellebrite UFED.



3. Paraphrase the Following

Restate these sentences from the text in your own words.

1. Digital evidence has become equally indispensable.
2. Digital forensics is the disciplined process of recovering, preserving, and analyzing electronic data.
3. Analysts work only on forensic copies of the original data.
4. The reliance on ICT introduces complex challenges.



4. True / False / Not Stated

Determine if the statement is True (T), False (F), or if the information is Not Stated (NS).

1. Digital evidence is only relevant in cybercrime cases.
2. A hash algorithm can prove that a digital file has not been altered.
3. Traditional fingerprint analysis has been completely replaced by digital methods.
4. AI is used to help analyze large volumes of digital data.

5. "Cloud forensics" refers to investigating data stored on local servers only.

6. The text states that all police officers are experts in digital forensics.

7. Proper chain of custody is less important for digital evidence than for physical evidence.

8. A "write blocker" is used to speed up internet connectivity.

9. Encrypted data presents a challenge for investigators.

10. The percentage of crimes involving digital evidence is decreasing.

5. One Word is Odd

Identify which word in each group does not thematically belong.

1. **Fiber, Fingerprint, Email, Bullet casing.**
2. **Cellebrite, FTK Imager, Magnifying glass, Oxygen Forensics.**
3. **Preservation, Analysis, Alteration, Collection.**
4. **AI, Machine Learning, Blockchain, Typewriter.**
5. **Prosecutor, Analyst, Investigator, Suspect.**



6. Answer the Questions

Provide full-sentence answers based on the text.

1. What are the two main realms of evidence in modern criminalistics?
2. Why is digital evidence considered "fragile"?
3. What is the purpose of creating a "forensic copy" of digital data?
4. Name two examples of digital evidence mentioned in the text.
5. What does the acronym "IoT" stand for in "IoT forensics"?

6. What legal standard must digital evidence meet to be admissible in court?

7. According to the text, what is a major challenge caused by the volume of digital data?

8. How can AI assist in digital forensics?

9. What is the role of a "write blocker"?

10. What is the estimated percentage of crimes that involve digital evidence?



7. Match the Synonyms & Antonyms

*For tasks 1-5, match the word with its closest synonym. For tasks 6-10, match the word with its antonym.

Synonyms	**Options**
indispensable	acceptability
meticulous	essential
fragile	support
corroborate	delicate
admissibility	thorough
Antonyms	**Options**
integrity	destroy
preserve	fake
authentic	stable
volatile	corruption
comprehensive	partial

Forensic Digital Photo Imaging

INTRODUCTION

Crime scenes, evidence, victims, and suspects must be documented. This is accomplished by measurements, notes, diagramming, and photo imaging. The old adage "A picture is worth a thousand words" is very true; in fact, in some cases a picture is worth many thousands of words. Photo imaging, then, is a very important part of the documentation process. It provides the judge and jury with a realistic visualization of the conditions, and relative positions of evidence and items of interest, at a crime scene. In this chapter, we will be addressing digital photo imaging. More and more agencies are choosing this better technology over the film camera. However, the 35 mm film camera still remains a very viable tool in the CSI's arsenal.

THE CAMERA

The 35 mm film single lens reflex camera has for many years been the camera of choice for crime scene Investigators. It is versatile, relatively easy to use, and takes excellent images. Various types of film including black and white, color negative, and color positive, along with a wide variety of special films and film speeds allow the 35 mm film camera to be adapted to just about every situation. With technology ever moving forward, we are now living in the era of digital photo imaging. There are two basic types of digital cameras. The "point and shoot" and the SLR (single lens reflex). The digital camera uses a sensor, a CCD or charged coupled device, to "see" the image. The image is then recorded on a memory card instead of film. An advantage to the digital camera is the ability to review the picture that was taken immediately. If there was a mistake made, if the image is out of focus, or improperly exposed, another image can be taken that is correct. Remember, you may not erase or delete an

image taken at a crime scene, just as you cannot destroy the negatives of out-of-focus or bad pictures.

THE DIGITAL POINT-AND SHOOT CAMERA

The digital point-and-shoot camera is a good, basic, inexpensive camera. It is able to record digital images on internal memory, with most having the ability to record to a memory card of varying sizes. The camera has either a rangefinder-type aiming device or the camera may have a video display screen from which the image can be composed. Most cameras in this category have built-in flashes and are, for the most part, fully automatic. They produce an adequate image but lack the versatility of the digital single lens reflex (SLR). These cameras do not have the ability to use interchangeable lenses. The lens that comes with the camera is what you have. The ability to zoom in and out to your subject is limited. In some cases, the zoom feature is not optically driven but rather software driven. Some have what is alleged to be macro capabilities or settings; however, these are soft ware not optical functions.

THE DIGITAL SLR CAMERA BODY

The digital SLR is a single lens reflex camera. This means that the

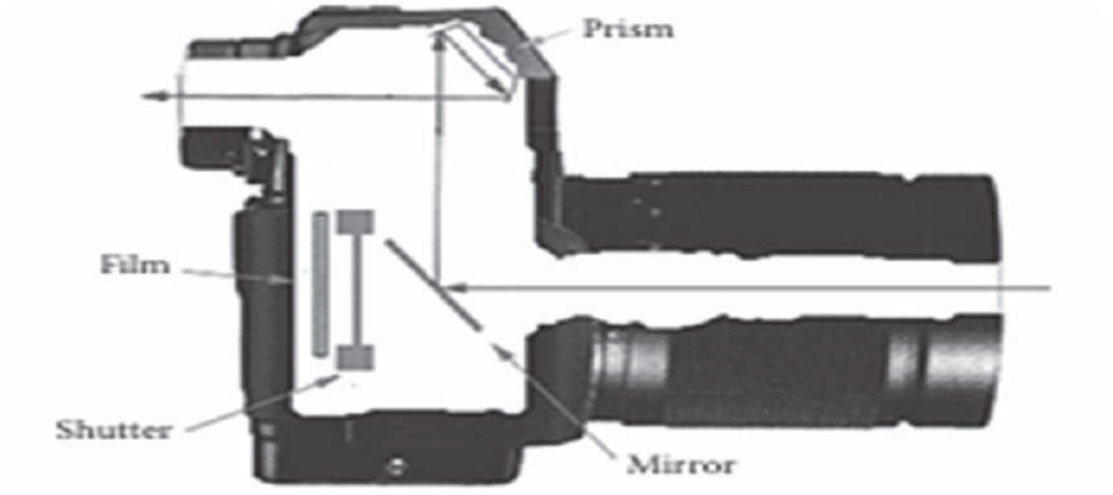


Figure 11.1 Single lens reflex (SLR) camera. When composing an image, the photographer looks through the viewer and the image is reflected off of a mirror, allowing him or her to see exactly what the camera sees.

viewfinder that is used to aim and compose the image uses the same lens through which the image is recorded. There is a viewing screen on the camera; however, it is not used to compose the image, but rather to view the image after it is taken and to view the menu setting for the camera. (See Figure 11.1.) The digital SLR camera body is similar to that of the 35 mm film camera. Most of the controls are located on the body. There is usually a screen on which the menu can be displayed and various options are available. There are many options that can be set from the menu. Some will be specific to the particular brand of camera, and some are generic to most or all digital SLRs (see Figure 11.2). Some of these options include:



Figure 11.2 SLR camera

- Image quality—You can set the quality • for high, medium, or low.
- White balance—This allows the image • taker to adjust to the type of light being used, i.e., fluorescent, daylight, incandescent, cloudy, or shade.
- ISO sensitivity—This allows the set-• ting of a "virtual film speed." Since there is no film used, this setting allows the setting in many digital SLRs from ISO 100 to ISO 1600.
- Multiple exposure—With some digital SLRs with this setting, it is

possible to make double, triple, and more exposures. Monochrome—This setting allows the camera to record images in black and white.

- File number sequence—When set to continuous, this will identify the image with a unique number. If not set to "continuous," each time you remove the memory card, the identifying number starts at one
- Image quality—You can set the quality • for high, medium, or low.

Aperture

An aperture is a hole or an opening through which light is admitted through the lens and onto the sensor. The size of the aperture can be made larger or smaller to accommodate a proper exposure. The smaller the number, the larger the opening. The larger the number, the smaller the opening. The numbers that identify these openings are called F stops (Figure 11.3).

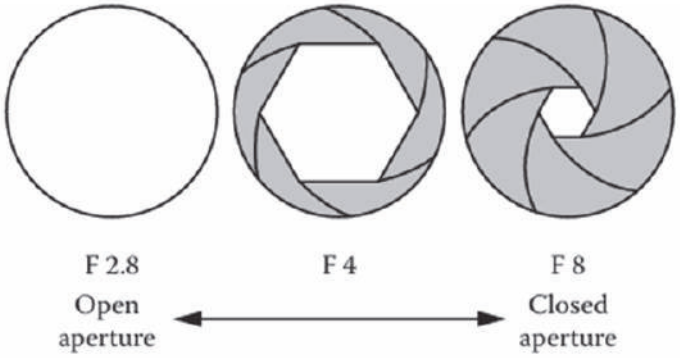


Figure 11.3 This drawing depicts the aperture of a lens. The settings are in increments of "stops" or F-stops. The larger the number the smaller the opening. The smaller the number the larger the opening. F-32 would be a small opening, while F-2.8 would be a large opening.

Shutter

A shutter is a device that allows light to pass for a determined period of time, for the purpose of exposing a light-sensitive electronic sensor to light to capture a permanent image of an object or of a scene. Image numbering Image numbering is a setting that can be set to Reset or Continuous. This setting should be set to Continuous. This is for several reasons. The photo image identifier should be unique. If set to continuous, it will assign a new number in successive

order, not repeating any one number previously used. If the reset setting is used, the camera will reset the photo image identifier each time the memory card is removed and reinserted or after each time the pictures are uploaded to the computer and deleted from the camera. If additional images were taken and uploaded to the same folder, the computer would advise that there are already images with those numbers. It will then ask if you want to overwrite (and destroy) the original images. The image file name/number could be changed, but this would not adhere to the rule that we do not change a photo image. For both of these reasons, set this setting to Continuous

DIGITAL PHOTO IMAGING

The terms digital imaging and photography are basically synonymous. They have the same meaning. They both can be defined as the act of recording light or reflected light, from an object or group of objects and recording that image on media. The media has traditionally been film, but in digital imaging it is a memory card. Very rarely is light directly recorded, for this would require the camera to be pointed directly at a light source such as the sun, a light bulb, or other visible spectrum light emitting source. While there may be a need for it in some specific instances, such as recording sun spots, the great preponderance of what we do in forensic digital imaging is the recording of reflected light.

Light from a source, a flash, light beam, or ambient light strikes an object or group of objects and is reflected off the objects and through the lens. The amount of light allowed through the lens is controlled by the aperture. The duration that the light is allowed through the lens is controlled by the shutter. The cam era then “sees” the light through its lens and allows it to continue to the sensor, the charged coupled device. It is then recorded or saved on media such as a memory card.

These memory cards are manufactured in many different configurations, depending on what type of memory card the manufacturer has decided to build into the camera design. The memory cards are not interchangeable, however, so

in order to share the images taken by the camera, you must upload them to a computer. Several types of memory cards include SD (secure digital), memory sticks, compact flash, xD-Picture Card, the RS-MMC (reduced size multimedia card), mini-SD card, and many more.

ISO NUMBER

ISO numbers indicate the level of sensitivity of the digital SLR camera to light. On a digital SLR, this sensitivity level is set from the menu. Each film for 35 mm film cameras has its own ISO number. It is necessary to set the film speed on the camera so the internal meter will compute the correct exposure. If you wanted to change ISO or film speeds, you would have to change film. In the digital SLR, one can change the ISO (virtual speed) at any time by accessing the menu. ISO stands for the International Organization for Standardization

EXPOSURE INDEX (EI)

Exposure index, or EI, refers to speed rating that you assigned to a particular photo imaging situation. Exposure index may or may not be the same as manufacturer's recommendation. A light meter can understate or overstate lighting conditions. In such cases one could adjust EI rating accordingly in order to compensate for these effects and consistently produce correctly exposed negatives. The digital SLR has a setting to compensate for extreme conditions by overriding the meter so that a proper exposure is obtained.

FORENSIC DIGITAL PHOTO IMAGING

Forensic is defined "as pertains to a court of law." So there is forensic digital imaging, forensic entomology, forensic physical anthropology, forensic engineering, etc.; all address the functioning of these fields in a legal context. The addition of "forensic" to digital imaging adds a number of layers to the correct practice of this discipline. Good digital imaging requires knowledge of the technical aspects of recording objects and locations. Forensic digital imaging requires knowledge of the technical aspects of recording objects and locations but also requires this to be done with a proper method, a set policy, and procedures all approved and accepted by law, the courts, and judicial decision

SCIENTIFIC WORKING GROUP ON IMAGING TECHNOLOGY (SWGIT)

The Scientific Working Group on Imaging Technology (SWGIT) was created to provide leadership to the law enforcement community by developing guidelines for good practices for the use of imaging technologies within the criminal justice system. It should be considered the guide for any questions involving how images should be taken, treated, and stored so that they may be used in legal proceedings. The complete SWGIT document is available in PDF format at http://www.theiai.org/guide lines/swgit and is periodically updated.

Technical photo imaging or technical photography is the recording of an object or group of objects in the best manner possible to accurately represent a scene or that object, on the day and time in question. Photo imaging or photography is the recording of an object or group of objects to make an image that is pleasing to the eye.

Evidence or lack of evidence must be documented at a crime scene. In order to understand what happened at a crime scene, it is necessary to reconstruct the scene and the scenario in order to investigate the crime and, if necessary, prosecute the perpetrator successfully.



Figure 11.4 **Used in the 40's, 50, and 60s the old 4X5" sheet film camera was used by police detectives and newsmen alike. Each exposure required the photographer to change the film holder, focus the camera, cock the shutter, and press the shutter. The operator would then have to remove the film carrier, flip it over, reinsert it into the camera, then focus the camera, cock the shutter, and press the shutter.**

We cannot just take several snap shots of a scene and expect those few images to be accept able. We must tell the story. For example, the St. Valentine's Day Massacre of 1929 is a very poorly documented scene. There were only approximately five images taken. The camera used was a Speed Graphic 4 x 5 in. sheet film camera (see Figure 11.4 to Figure 11.7). The images were taken by a news photographer. In fact, as the story goes, the photographer thought the image would look better with a hat on one of the victim's chests, so he (the photographer) placed it there. So much for the integrity of that crime scene.

Do the five or so images taken tell the story? Do they show the wounds? Do they show the correct positions of objects? Do they show the position of the victims in relation to the shell casings? Are the images distorted because of the angle of the camera? What about livor mortis? Were scales used to size objects in the scene? What did the other sides of the room look like? Where was the door or doors? Were there windows and how many were there? What were the victims looking at before they were killed? What direction is north? These may have been sensational newspaper photographs, but they certainly did not tell the story; they were not good technical images.

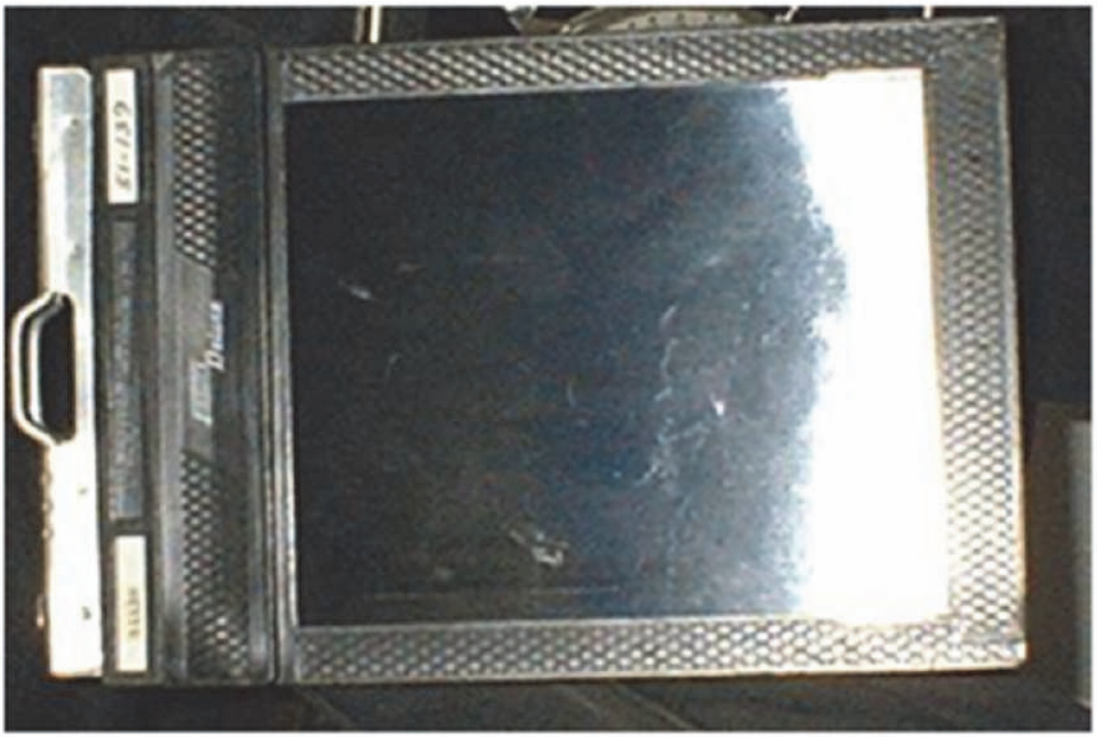


Figure 11.5 4 X 5 sheet film holder. Each holder had two sheets of film—one on each side.

PHOTO IMAGING THE SCENE

You must identify the case and location. You must record the overall area of the scene. You must image evidence and items of interest, and their perspective to each other. You must capture each piece of evidence, record it

correctly, scale it (show relative size), and you must do so without appearing to hide exculpatory evidence—evidence which could be used by the opposition in the case.

The use of a narrative to explain the condition, the exact location of items, and the existence of artifacts, of course, is also very important and necessary components of the overall documentation of a scene. They become a part of the case report.

Digital imaging allows us to visually recreate the scene for investigators, prosecutors, and jurors deciding the fate of individuals charged with a crime.

A picture is worth many thousands of words. If the narrative of a report states "The handgun was located on the table next to the phone," we can summon a visual picture in our mind. But as we look at the picture (see Figure 11.8), we observe that the image we conjured may be quite different from what was actually described. The image shows the location of the hand gun, which is a semiautomatic pistol with the slide open and locked to the rear position, indicating that the handgun does not have a cartridge in the chamber. The phone is a cell phone which may or may not belong at this scene. Since it is a cell phone, it may belong to anyone—the victim, a witness, an EMT, or even the perpetrator.

Documentation of a scene or of evidence requires us to document the documentation. Sounds redundant, but it is something that should be done. The images should be documented, and I strongly recommend that they be listed in the case report (see Figure 11.9).

The first thing that must be done is to identify the images. We want to identify them as unique or individual. As an example, when an object is analyzed in a laboratory we can sometimes identify it as belonging to a class. We can identify a handgun as a .38 caliber. But, to make it unique, the handgun is further examined and found to have a serial number. Now the handgun is unique, one of a kind. It is the same with digital images. Images belong to the class of "images of a scene." We must make them unique by specifically

identifying them. We do this by making our first image on the memory card, a color balance/ ID card, sometimes called a “gray card” (see Figure 11.10). On this card we place the case number, the image taker’s name, the date, and the agency. This is done so that if the CD, magnetic media or memory card is misfiled, it can be identified as belonging to a specific case. It also identifies the case and images at trial.

The ID/color balance card can be laminated. A dry marker can be used to print the appropriate information. It can then be reused by the CSI over and over again.

The second image on the roll of film or as the second digital image should be an image of the letter “N” for “north” (see Figure 11.11). This “N” can be held by an assistant or propped against the wall or an object. The important thing is that the north card is on the north side of the room or location. The image should include a good portion of the north wall or north side of the crime scene. This allows the CSI to document the north direction so that there is no confusion at trial. When cases go to trial, too often there is a large span of time between the time the images were taken and the actual trial. Sometimes years pass. This is compounded by the fact that since the CSI works many cases, this makes remembering which direction is north at a particular scene very difficult.

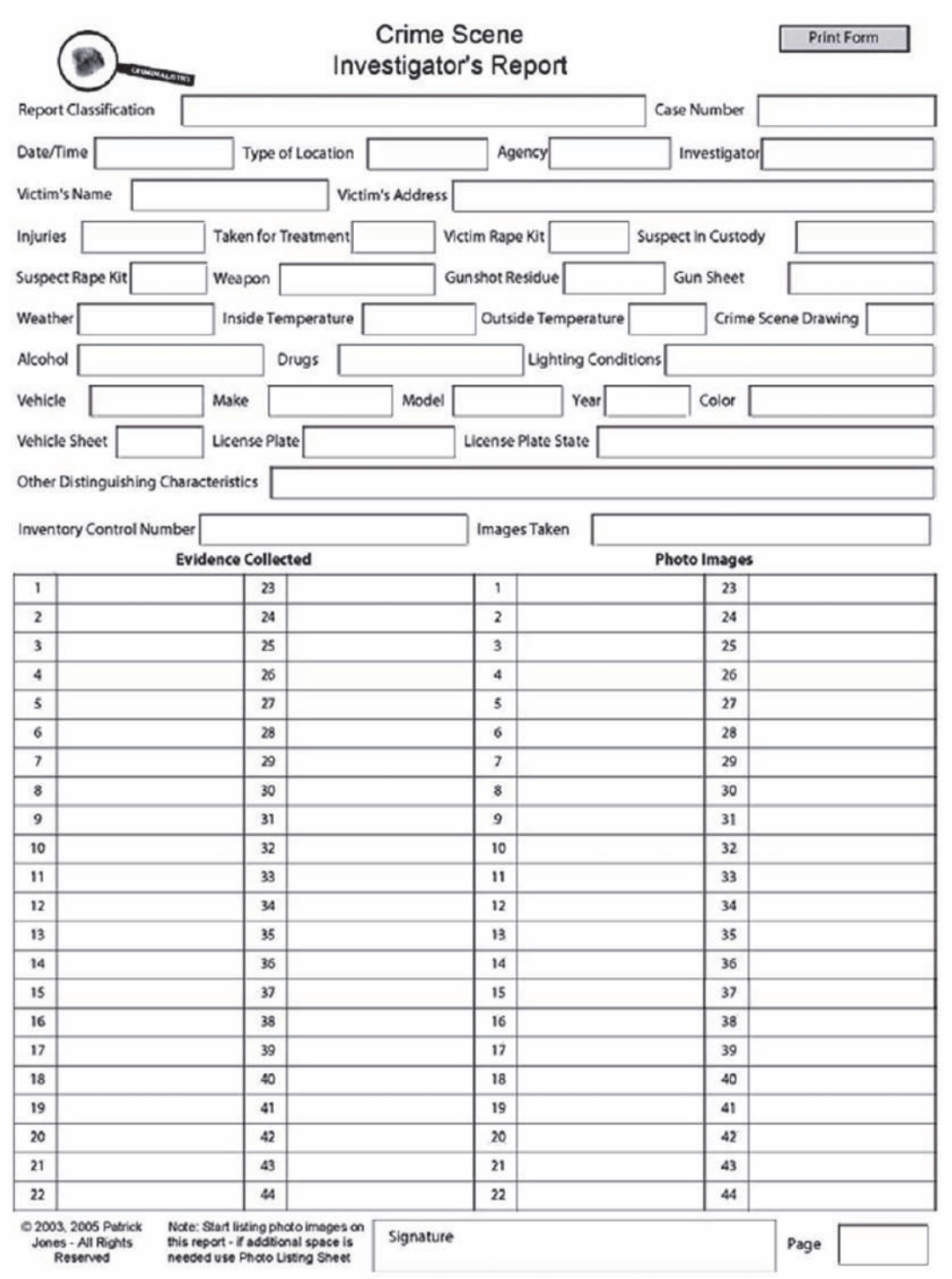
Images taken at a crime scene should be listed on the report form used by the CSI. If the amount of images exceeds the number of spaces on the report, an image continuation sheet can be used. The use of the log is a matter for each individual agency to set as its own policy and procedure. The FBI, for example advocates the use of the image log. There are advantages and disadvantages to the use of an image log. It is helpful for the prosecutor to have an inventory of the images available to him in order to prepare a solid case. It also eliminates any question as to whether all images taken were delivered to the defense during the discovery phase of the trial. It also identifies any images that may have been lost or misplaced.

The type of description placed on the log should be short but descriptive, such as: “gray card/image ID,” “north shot,” “handgun on end table,” “overall living room s/n.” Note: “s/n” is an abbreviation meaning from the south to the north. A disclaimer should be added to the report form, indicating that directions, such as s/n (south to north) are approximate and are stated as such for the purpose of identifying each image.

The disclaimer eliminates the potential for a defense attorney to nitpick the description, such as “Isn’t it true, detective, that the image log states that this image was taken south to north and the image taken was actually southeast to north west?” If the defense can call into question one image, he or she can then attempt to call all the images into question and move to have all images thrown out.



Figure 11.8 The description of the table in the living room may conjure an image in our mind that is remarkably different from what existed at the scene. This is why the photo image is so important. The gun could be a rifle or shot gun, the phone could be a landline or cordless phone, and the table may not be thought of as in the middle of the floor.



Crime Scene
Investigator's Report

Print Form

Report Classification | Case Number

Date/Time | Type of Location | Agency | Investigator

Victim's Name | Victim's Address

Injuries | Taken for Treatment | Victim Rape Kit | Suspect In Custody

Suspect Rape Kit | Weapon | Gunshot Residue | Gun Sheet

Weather | Inside Temperature | Outside Temperature | Crime Scene Drawing

Alcohol | Drugs | Lighting Conditions

Vehicle | Make | Model | Year | Color

Vehicle Sheet | License Plate | License Plate State

Other Distinguishing Characteristics

Inventory Control Number | Images Taken

Evidence Collected

1		23		1		23	
2		24		2		24	
3		25		3		25	
4		26		4		26	
5		27		5		27	
6		28		6		28	
7		29		7		29	
8		30		8		30	
9		31		9		31	
10		32		10		32	
11		33		11		33	
12		34		12		34	
13		35		13		35	
14		36		14		36	
15		37		15		37	
16		38		16		38	
17		39		17		39	
18		40		18		40	
19		41		19		41	
20		42		20		42	
21		43		21		43	
22		44		22		44	

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Note: Start listing photo images on this report - if additional space is needed use Photo Listing Sheet

Signature

Page

Figure 11.9 A sample case report with fields for listing photo images.

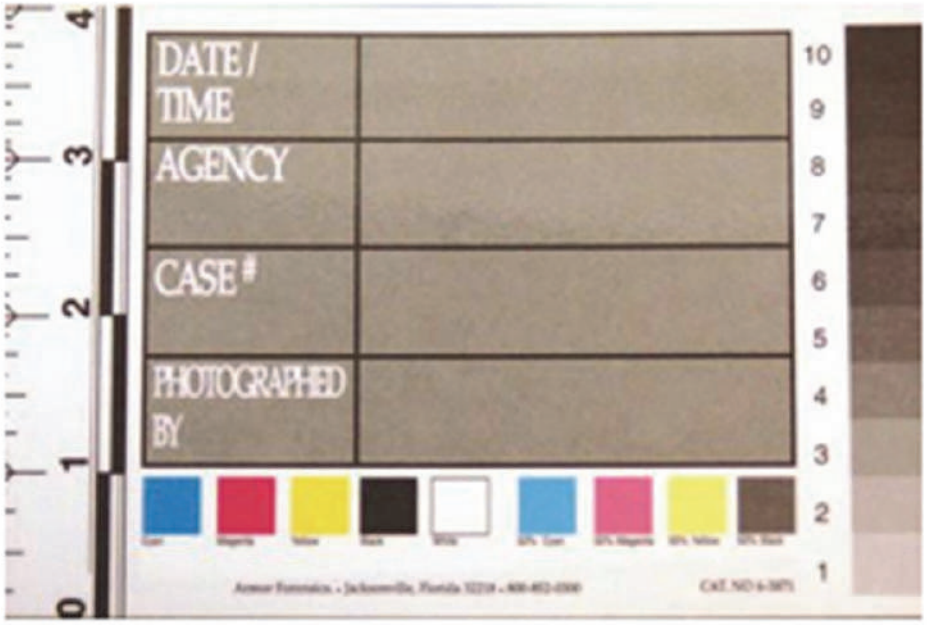


Figure 11.10 **A color balance/ID card, sometimes called a "gray card." On this card we place the case number, the image taker's name, the date, and the agency. This is done so that if the CD, magnetic media or memory card is misfiled, it can be identified as belonging to a specific case. It also identifies the case and images at trial.**

IMAGING THE SCENE

At a crime scene, photo images are taken of the scene. Many are overall images or perspective shots. Perspective shots are images that show one object in relation to another object. These shots are very important in telling the entire story. Is there a minimum number of photo images that can be shot at a scene? I would say yes with qualification. We try to shoot the "four points of the compass." From the center of the scene (or the most important object in the scene: North to South, South to North, East to West and West to East. Then from the outer perimeter of the scene shoot inward north to south, south to north, east to west, and west to east. The "north" card and the ID card should also be included. This is 10 shots. This is the absolute minimum. There are exceptions to this rule. You have to use some common sense. If there is evidence, you will be photo imaging each piece with and without scale. You may wish to take

additional perspective shots showing one piece of evidence in relation to another.

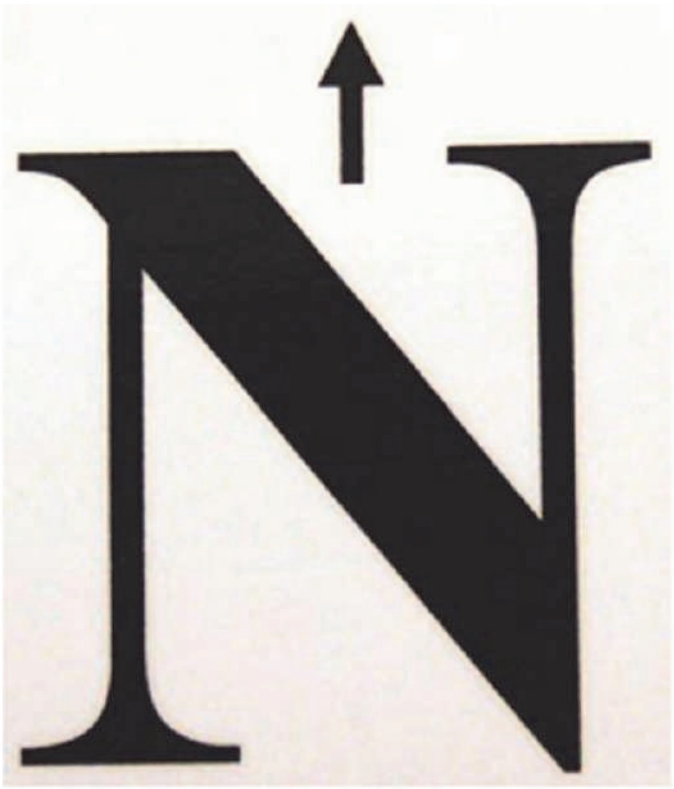


Figure 11.11 The "N" or north card. This is photo imaged in an overall photo image of the north wall or a view to the north (if exterior). This allows the image taker to acclimate him or herself to this and other images of a scene after a large amount of time has past, such as trial.

There may be a situation where a victim is on the floor in the center of an 8 x 8 ft bath room. If you tried to photo image using the four points of the compass, you would end up with eight images of the four walls. In this type of situation, take several overall images showing as much of the room as possible. Remember, 10 shots are the absolute minimum. Very rarely will you ever end up with just 10 photo images for a case.

PHOTO IMAGES AS EVIDENCE

Evidence is normally thought of as something that is placed in a bag, signed, sealed, and locked away. Digital photo images can also be evidence. There are procedures that must be followed. After the images are taken at the crime scene, they should be uploaded to a computer file. The images may not be changed, modified, or manipulated. Once they are on the computer, burn them to a CD. This will become your "master." Seal the CD in an envelope, and mark it as you would any other type of evidence. These images are like the negatives

from a film camera. They will never be manipulated or modified. This is your original and should not be opened unless you are directed to do so by the courts. If there is an issue concerning the images introduced as evidence, the master can be opened and a comparison can be made. Since the master is a digital copy of the images from the camera, they are identical. Any copies or printed photo images should be done from the file on the computer. What actually makes the photo images evidence? It is your testimony. Attorney: "Detective, do these digital photo images truly and accurately represent the crime scene on the date and time in question?" Detective: "Yes, they do." There is another issue of what are the "best images" or the "official photo images" of the crime scene. If 100 photo images are taken of the scene by the crime scene investigator 45 minutes after a news reporter took several photo images with a Polaroid camera, what are the best images? Unfortunately, the several Polaroid images that were taken by the reporter are the best images. This is because the photo images taken that are closer in time to the actual incident would more truly and accurately represent the crime scene on the date and time in question.

DELETING OF IMAGES FROM THE CAMERA

Digital cameras have many benefits. You can see the images immediately after they were taken. A single memory card (4 gigabyte) can hold over a thousand photo images. It also has some features that we may not use. Specifically, 202 Forensic Science: An Introduction to Scientific and Investigative Techniques we may not delete an image either because we didn't like it, it was improperly exposed, or it was out of focus. This is because it can be stated by the defense that the image erased may have shown exculpatory evidence. Defense attorney: "Detective, the digital photo images that have been introduced into evidence jumps from 1234.JPG to 1236.JPG. Where is 1235.JPG? This also occurs several more times throughout the images submitted as evidence in the case." Detective: I deleted them because they were out of focus and the lighting was not good in some." Defense attorney: "How do I know that the photo images deleted didn't show that my client is innocent?

Your, Honor, I move that all the photo images submitted by the prosecution be thrown out due to the fact that the missing images may contain exculpatory evidence."

EVIDENCE AND ITEMS OF INTEREST

Documenting the scene also includes recording items of evidence out of place. Items out of place are called artifacts. An artifact, in forensic science, can be defined as "an object that does not belong." Artifacts can be a bullet hole in a mirror or glass window. It could be a letter clutched in the hand of a victim. It could even be a VCR in the middle of the living room floor. An item out of place could be a fireplace poker in a bathroom. We must also document items which are not there. An example of this would be a table with one bottle of wine, one wine glass, and two wine glass rings on a glass table. Where is the second glass? Was it taken by the perpetrator? The two rings on the table should be imaged as well as the single glass, and an overall showing both. An area of dust on top of a shelf, with area that is dust-free could mean that there was a CD player there that was removed by the perpetrator (see Figure 11.12). What is else missing? Have the napkins been removed. Has an ashtray been emptied? It is very important to record negatives as well as positives. Items of interest must be documented. An item of interest is something that, by its position, location, or condition, may help in furthering an understanding of the story of the crime scene. An image of the toilet seat being in the up position in a home with only women in residence, a kitchen knife in the bedroom, and a tire iron in a living room are all items of interest. Remember, tell the story with your images. You can never take too many images. You can never go back to the original scene. Document, document, document.

PHOTO IMAGING EVIDENCE

At a crime scene, nothing should be picked up, moved, or collected until it has been properly documented (measurements taken) and photo-imaged. You cannot pick up an item, examine it, then replace it and photo-image it. In court, if asked if the photo image truly and accurately represents the scene at the date

and time in question, you would have to say no, due to the fact the object was lifted and replaced. This one small movement may cause all of your images to come uander question. Photo-image, then collect and examine.

Angle

When photo-imaging objects of interest and evidence at a crime scene, images must be taken at 90 degrees. This is extremely important. As an example, if you photograph a circle at 90 degrees, when you look at the photo image, you see a circle. If you photo image a circle at 45 degrees, when you look at the photo image, you see an oval. This is distortion. The circle is distorted by the lens because of the angle the camera and lens were placed relative to the circle a circle at 90 degrees, when you look at the photo image, you see a circle. If you photo image a circle at 45 degrees, when you look at the photo image, you see an oval. This is distortion. The circle is distorted by the lens because of the angle the camera and lens were placed relative to the circle.

Scale

A scale is nothing more than a small ruler, usually 6 in. in length. The scale is used to "size" items in the photo image. For example, if we photo-image a shoe print, and we fail to place a scale in the image, we have no idea if the shoe is a size 13 or a size 8. If a bite mark is photo imaged on a victim, if there is no scale, then a match cannot be accomplished because the measured distance between teeth cannot be measured on the photo image. Just as we photo image items with scales, we also photo image those same items without scales. This is done so that there can be no accusation that the photo imager was hiding evidence, either intentionally or accidentally, that would prove that the suspect is innocent. This type of evidence that could work for the other side is called exculpatory evidence.

Depth of Field

Depth of field (DOF) is the portion of a scene that appears sharp in the image or in focus. In Figure 11.17, the camera and lens are focused on boy A. Boy A is in focus, and boy B is in focus also. That is because of depth of field or

the depth of the field of view is in focus. The depth of field can be increased by closing down the aperture, making the aperture smaller. Remember the smaller the F-stop, the larger the opening of the aperture, and the larger the F-stop, the smaller the opening of the aperture. A rule of thumb can be used: when focused on an object, an area 1/3 in front of the object and 2/3 in back of the object will be in focus. “In focus” is sharp focus. What about boy C? He is in an area that is considered “acceptable focus.” “Acceptable focus” is not as sharp as “in focus” but is, well, acceptable. Boy C is in “acceptable focus” because of the hyperfocal distance of the lens and its specific lens setting (aperture). The hyperfocal distance is the closest distance at which a lens can be focused while keeping objects at infinity acceptably sharp. When the lens is focused at this distance, all objects at distances from half of the hyperfocal distance out to infinity will be acceptably sharp.

Light

With the exception of the camera, light is prob ably the most important factor in imaging. Without light, there would not be an image. The camera, with only a few exceptions, records the reflection of light rather than the light itself. Only when the object that is being imaged produces the light, such as a candle, a light bulb, or fire, does the camera record the light itself.

Ambient Light

Ambient light is another way of saying the light that exists or existing light. This is the level of light that will primarily affect your image. Many photographers shoot with ambient light only. They use it to convey a mood or an idea. As forensic photographers, we wish to record, document, and convey facts. If the existing or ambient light can do this, then we use it. If the ambient light will not do this, then we must use other light sources to augment the ambient light.

Ambient light can fall into many categories: incandescent (common light bulbs), florescent, halogen, sodium vapor, daylight, dawn, and dusk to name a few. Some of the more exotic light categories cause different hues of color to

change in your images. It is a good idea to indicate the type or types of ambient light present in your report form.

Combinations making up ambient light can also exist. An example is a scene in which daylight is streaming through a window but there are fluorescent lights on in the room. In this case there is a combination of light sources which make up ambient light.

Color temperature

A measure of the distribution of power in the spectrum of white, or colorless, light is stated in terms of the Kelvin temperature scale. The human eye is incredibly adept at quickly correcting for changes in the color temperature of light. Many different kinds of light all seem white to us. Photographic film is not so for giving; daylight film is made to be exposed at 5500 K light, while indoor film requires light with a color temperature of 3400 K. Photographs taken indoors with incandescent light on ordinary daylight film will come out orange; photographs on indoor film taken in sunlight will be blue, as will photographs taken outdoors in shade illuminated by blue sky.

While a digital camera is not as adept as the human eye at quickly correcting for changes in the color temperature of light, it does a much better job than that of film cameras. In digital photography, calibration of the white point is accomplished with either an automatic or manual setting. The assumed white point can vary depending on the light conditions; the concept of “white” is not an absolute thing. Most digital cameras let you specify whatever white point you want, usually by pointing the camera at a white object illuminated by the current light used by the imager. Some cameras also can detect the ambient light and determine the white point from that: automatic white balance.

Flash/Strobe

The strength of the flash is measured and documented as the Guide Number. As you get further away from a light source, the intensity of the flash drops off.

As you change the f stop of a lens, the intensity of the light at the film plane or sensor also changes. They change at the same rate, so this statement is always true: distance times f-stop equals a fixed number (called the "guide number"). Every combination of f lash and film speed has one guide number. Faster films and more powerful flashguns have higher guide numbers. Often manufacturers use the guide number as part of the model's name of a flashgun. You can figure out what f stop to use by dividing the guide number by the distance from the flash to the subject. If a flashgun has a guide number of 80; at 10 feet use f8 (80 divided by 10=8), at 5 feet use f16 (80 divided by 5=16), and at 20 feet use f4 (80 divided by 20=4).

4 (80 divided by 20=4). When the ISO setting on a digital camera is increased by a factor of 4, the guide number is doubled. If the guide number for ISO (speed of the film) 100 was 80, the GN for ISO 400 is 160. The increase as film speeds double is just like the 1.4 times increase in the f-stop numbers on your lens: f4, f5.6, f8, f11, f16.

Direct Flash

Direct flash is a flash that originates on or near the camera. This would be a camera's internal flash or an external one attached to the hot shoe on the camera body. This light lights the subject very well but it does create shadows.

In forensic photo imaging, our main job is to document, record, and identify. A directly lit shot will do this very well. However, if the image would be more clear in "telling the story" of the scene by a softer or less shadowed light, then there are other options available.

Indirect Flash

We can use indirect lighting. Indirect lighting is sometimes called "bounced lighting." We use this if we wish to eliminate or reduce shadows.

In order to use indirect or "bounce lighting" we do not aim the light source at the subject. We aim the light source or flash at the ceiling or wall and bounce the light off the ceiling or wall, then onto the subject. This lights the foreground and the background, reducing and often eliminating shadows.

Fill Flash

Fill flash is an additional light source used to highlight shadowed areas. This additional light source can be a second flash, a white reflecting board, or an incandescent light. In Figure 11.20 we see a cardboard box from our crime scene. As overall photo images are taken at approximately 10 feet, the box is lit with the flash on the camera (see Figure 11.18). Because this is direct light coming from the top of the camera the light does not bend around the corner to light the inside of the box. If we use a secondary light source to light the inside, and our camera mounted flash to light the top, we obtain a clear image of what we want to show: the gun in the box.

Macro Imaging

Macro imaging or macro photography is close up photography that does not involve the use of microscopes. True macro photography is generally considered to have a ratio of 1:1 or greater, and the lens used will be able to focus on an object less than 8 in. distant. Many digital cameras (specifically, point-and-shoot type cameras) identify the macro setting on the camera with an icon of a flower. This is a macro setting, and the camera does not have a macro lens.

Bench Imaging or Rephoto Imaging

Bench imaging is defined as close-up imaging, which may include macro imaging (1:1 ratio). This is usually done in the laboratory or at the CSI's office. Even though the evidence was photographed at the scene, additional imaging or rephoto imaging is sometimes desired.

The lab setting allows the imager much more control over the lighting, temperature, conditions, and posing of the object of evidence or interest. One example would be that of a handgun at the scene of a shooting. The scene is dark with relatively no ambient light. The gun was found at the base of a bush. Only three images were taken of the gun at the scene (one with and one without scale) and an additional image for perspective. Due to the brush, additional

images were impossible to obtain. Only one side of the gun was recorded at the scene.

Back at the lab, the gun can be "posed" under controlled conditions. Light can be manipulated to provide a perfect recording of the gun. Both sides of the gun can be imaged. Use of a macro lens can be employed to take 1:1 ratio images of scratches, marks, blood, the serial number and other artifacts. Remember to photo image negative aspects (missing parts), the absence of blood, or the area from which a serial number was removed.

There will be occasions in which you will wish to photo-image the inside of the barrel. This could be important if the wound was a contact wound or made at a very close range. In these instances there is "blowback." This a phenomenon occurring in contact and very close-range wounds made with a gun. Blood and tissue are "blown back" into the barrel of the gun. This can be documented by photo imaging.

The gun should be secured in a vice or with a clamp. If the gun is a semiautomatic, the slide should be opened and locked to the rear. If the gun is a revolver, the gun should be photo imaged with the cylinder opened. Using an additional clamp, secure a light source and aim it into the chamber of the gun so that the light shines through and out the end of the barrel. A battery powdered flash light with a "goose neck" type adjustable shaft works very well. In the picture, we are using a fiber optic light (dual source) with adjustable light intensity.

Disable the flash on the camera when working with moveable light sources. If you cannot disable the flash on the camera, temporally cover it with black electrician's tape. If the flash is not disabled, the flash will over light the area of interest, the barrel, and the blood and/or tissue will not be photo imaged clearly; you will observe that your image is a bright white blob.

Tool Marks

Tool marks are artifacts left when one object presses or is drawn against another. Often, on a door when it is "jimmied," an impression of the tool is left

on the door jam or striker plate. The best evidence is, of course, to take the striker plate or the door jam; however, some victims are not so inclined to permit. Photo imaging is next best choice. A macro lens is helpful due to many tool marks being very small. Oblique lighting (lighting from the side at approximately 45°) works well. This is because the light from the side creates tiny shadows in the "valleys" of the tool marks.

Markings on shell casings and on bullets are also tool marks. Examiners look at these items under comparison microscopes. Many of these very expensive microscopes have image capture capabilities. Some do not have these scopes and must rely on macro photo imaging. This is where the ability to use a good macro lens and adjustable lighting is very helpful.

Using a copy stand and with a macro lens set at F-32 or smaller, place the shell casings side by side using rope calk to secure them in place. Rope calk is a malleable clay-like sub stance available at most hardware stores. It allows the posing of items without damage to the item. Using a high intensity light source (a halogen desk lamp works well), set the focus to manual and use the copy stand rails to focus the camera by moving the camera up and down. Take several images, moving the light source each time. Use the best image for comparison.

Blood

The photographic documentation of blood stains and patterns has been discussed in Chapter 10, Crime Scene Investigation, and Chapter 12, Recognition of Bloodstain Patterns.

Extreme conditions

Extreme conditions are those that will cause a bad exposure when using the internal light meter of the camera. The camera's meter averages the amount of light it sees reflected from the object or objects to be photo-imaged. The three most important extreme conditions are snow, sand, and the aftermath of a fire. Snow is all white. White reflects almost 100%, since the camera is attempting to average the light. This "fools" the meter in the camera. In order to compensate,

if there is bright sunlight on snow, close down the aperture on the lens by three stops.

Sand reflects more than an average scene, but less than snow. Again, the camera is attempting to average the light, which “fools” the meter. If there is bright sunlight on sand, close down the aperture on your lens by one and a half stops.

The aftermath of a fire creates a scene where all the walls, ceilings, and floors are black with soot. Black absorbs light. Because the camera is trying to average the light, it is “fooled” again. In the scene of a fire, where there is 90% soot (black), open your aperture three stops. If you are using a camera-mounted f lash, set the flash to manual or full power. If you are using a flash or strobe, you may still have to make an adjustment. Remember, if you shoot a test shot, you may not delete or erase it from the camera. List it as a «test shot for lighting».

CONCLUSION

The goal of this chapter is to acquaint the reader with the basic contents of forensic digital photo imaging. While photography has been around for a while, digital imaging is relatively new. Although you can learn a lot from a book, photo imaging is a hands-on discipline. Read about a technique then try it with your own equipment. Experiment with tried-and true methods, then modify the technique and try again. The good news is that with digital photo imaging, you do not have the expense of film, film development, and printing. You can take hundreds of images, upload them to your computer, delete them from your memory card, then do it all over again. Practice makes perfect, the more you practice the better you will get.

1. Match the colums:

Digital camera	Сменные линзы
Interchangeable lenses	Карта памяти
Image quality	Воссоздать обстановку
memory card	Окружающее освещение
to recreate the scene	Цифровая камера
Ambient light	Фотографические доказательства
photo images evidence	Отраженный свет
bounce lighting	Качество снимка

2. Translate from English to Russian:

Flash	
Color temperature	
Light	
Snap shot	
Digital point-and-shoot camera	
ISO Number	

Device	
Zoom	
Depth of field	
Evidence	

3. Translate from Russian to English:

Цифровая фотокамера	
Линза	
Зеркало	
Чувствительность	
Вспышка	
Карта памяти	
Снимок	
Параметр экспозиции	
Отпечаток пальца	
Макросъёмка	

4. False/true:

The 35 mm film single lens reflex camera has for not many years been the camera of choice for crime scene Investigators.	T / F
The terms digital imaging and photography are basically antonymous.	T / F
ISO numbers indicate the level of sensitivity of the digital SLR camera to sound.	T / F
At a crime scene, different items should be	T / F

picked up, moved, or collected until it has been properly documented and photo-imaged.	
When photo-imaging objects of interest and evidence at a crime scene, images must be taken at 30 degrees.	T / F

5. Vocabulary:

Forensic photography — Судебная фотография

Crime scene — Место преступления

Evidence — Доказательство

Camera — Фотоаппарат / Камера

Lens — Объектив

Macro photography — Макросъёмка

UV photography — УФ-съёмка (ультрафиолетовая)

Infrared photography — Инфракрасная съёмка

Bloodstain — Кровяное пятно

Fingerprint — Отпечаток пальца

Shutter speed — Выдержка

Aperture — Диафрагма

Depth of field — Глубина резкости

Exposure — Экспозиция

Flash — Вспышка

Autopsy — Аутопсия / Вскрытие

Photogrammetry — Фотограмметрия

Scale — Масштабная линейка

Expert testimony — Экспертное заключение

Court — Суд

Shadow — Тень

6. Write an essa

ПРИЛОЖЕНИЯ

Appendix I

TEXTS FOR ANNOTATION

№1. CRIME SCENE INVESTIGATION INTRODUCTION

A body washes up on a lonely stretch of beach. A fire in a methamphetamine lab devastates an apartment building. A car accident claims the life of a driver during her trip home. These are all potential crime scenes.

By conducting a systematic examination of these areas, crime scene investigators uncover the physical evidence to help identify what happened and who was involved. This process must be conducted carefully and thoroughly to ensure that crucial evidence is collected and fragile evidence is not destroyed in the process.



At a scene, the case investigator and crime scene personnel work together to: define and secure areas that may contain evidence; examine and document the scene; collect physical evidence; and preserve, package and submit the evidence to the laboratory for analysis. With these key pieces of evidence, the investigator can attempt to reconstruct the elements of the crime.

The more thorough the crime scene team is at conducting its job, the more likely it is to accurately determine the facts of the case. The quality of the evidence and the manner in which it is handled will also impact the ability of the

attorneys to argue the facts of the case and ultimately the jurors' ability to come to conclusions regarding guilt or innocence. (1306 печ.зн)

Refer the article using the following:

1. The headline of the article is … .
2. It describes … .
3. The author considers differences … .
4. Much attention is given to … .
5. It is interesting to note, that … .
6. To make a conclusion I can

№ 2. DIGITAL EVIDENCE INTRODUCTION

Digital devices are everywhere in today's world, helping people communicate locally and globally with ease. Most people immediately think of computers, cell phones and the Internet as the only sources for digital evidence, but any piece of technology that processes information can be used in a criminal way. For example, hand-held games can carry encoded messages between criminals and even newer household appliances, such as a refrigerator with a built-in TV, could be used to store, view and share illegal images. The important thing to know is that responders need to be able to recognize and properly seize potential digital evidence.

Digital evidence is defined as information and data of value to an investigation that is stored on, received or transmitted by an electronic device[1]. This evidence can be acquired when electronic devices are seized and secured for examination. Digital evidence:

- Is latent (hidden), like fingerprints or DNA evidence
- Crosses jurisdictional borders quickly and easily
- Can be altered, damaged or destroyed with little effort
- Can be time sensitive

There are many sources of digital evidence, but for the purposes of this publication, the topic is divided into three major forensic categories of devices where evidence can be found: **Internet-based, stand-alone computers or devices**, and **mobile devices**. These areas tend to have different evidence-gathering processes, tools and concerns, and different types of crimes tend to lend themselves to one device or the other.

[1] *Electronic CSI, A Guide for First Responders, 2nd edition*, National Institute of Justice, April 2008

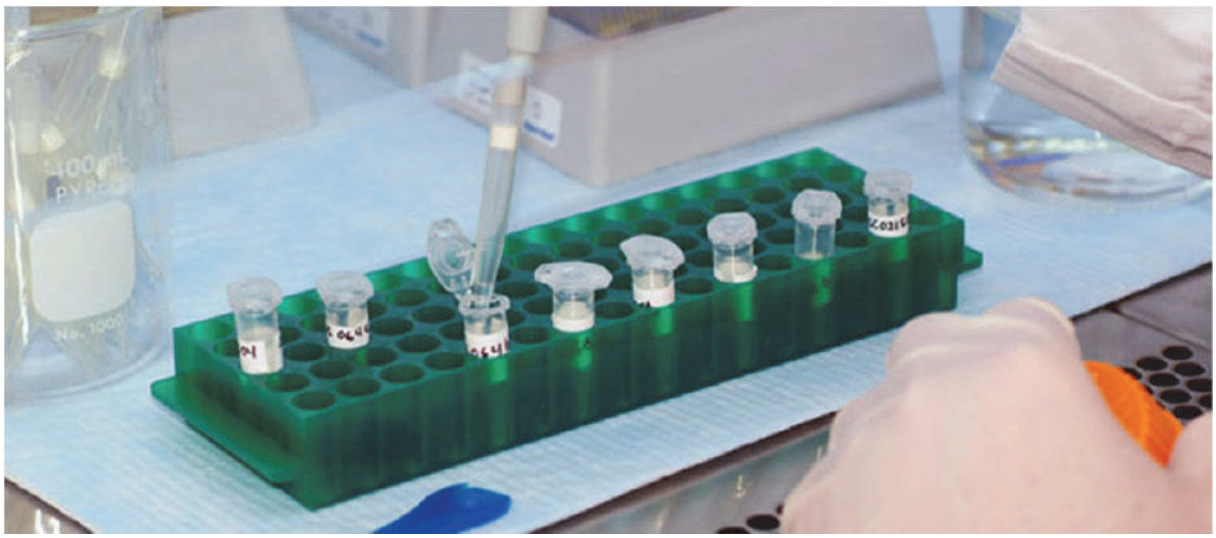
Refer the article using the following:

1. The headline of the article is … .
2. It describes … .
3. The author considers differences … .
4. Much attention is given to … .
5. It is interesting to note, that … .
6. To make a conclusion I can

№ 3. DNA EVIDENCE INTRODUCTION

The establishment of DNA analysis within the criminal justice system in the mid-1980s revolutionized the field of forensic science. With subsequent refinement of DNA analysis methods in crime laboratories, even minute amounts of blood, saliva, semen, skin cells or other biological material may be used to develop investigative leads, link a perpetrator or victim to a crime scene, or confirm or disprove an account of the crime.

Because of the accuracy and reliability of forensic DNA analysis, this evidence has also become an invaluable tool for exonerating individuals who have been wrongfully convicted.



The successes of DNA evidence in criminal trials has captured more than headlines, however—it has captured the public's imagination as well. Jurors now increasingly expect DNA evidence to be presented in a wider array of cases, even when other types of evidence may be more valuable to the investigation.

Refer the article using the following:

1. The headline of the article is … .
2. It describes … .
3. The author considers differences … .
4. Much attention is given to … .
5. It is interesting to note, that … .
6. To make a conclusion I can

№ 4. FINGERPRINT ANALYSIS INTRODUCTION

We touch things every day: a coffee cup, a car door, a computer keyboard. Each time we do, it is likely that we leave behind our unique signature—in our fingerprints.

No two people have exactly the same fingerprints. Even identical twins, with identical DNA, have different fingerprints. This uniqueness allows fingerprints to be used in all sorts of ways, including for background checks, biometric security, mass disaster identification, and of course, in criminal situations.



Fingerprint analysis has been used to identify suspects and solve crimes for more than 100 years, and it remains an extremely valuable tool for law enforcement. One of the most important uses for fingerprints is to help investigators link one crime scene to another involving the same person. Fingerprint identification also helps investigators to track a criminal's record, their previous arrests and convictions, to aid in sentencing, probation, parole and pardoning decisions.

№ 5. FIREARMS EXAMINATION INTRODUCTION

It's an all-too-common scenario: A person is found dead at a crime scene, the victim of a gunshot wound. Whether it's a cold-blooded robbery/homicide or a heated crime of passion, investigators must uncover the evidence and piece

together the clues that will lead to the murder weapon. And with solid detective work and a bit of good fortune, the weapon will hopefully lead to the shooter.

The field of forensic firearms identification, sometimes called ballistics, is at its heart the ability of a firearms examiner to determine if a particular bullet or cartridge case was fired from a specific firearm. This determination can be made thanks to small, often microscopic markings on bullets or cartridge cases that are unique to ammunition fired from that firearm. Although the examiner cannot



determine who actually fired a weapon, matching the ammunition to a weapon provides vital facts for the investigation.

In conjunction with this, the examiner has the ability to explain how a firearm functions and what safety features a firearm might have. This can have an impact on investigations of suicides, unintentional shootings and accidental firearm discharge.

Refer the article using the following:

1. The headline of the article is … .
2. It describes … .
3. The author considers differences … .
4. Much attention is given to … .
5. It is interesting to note, that … .
6. To make a conclusion I can

TOPICAL VOCABULARY

1. Criminalistics & Criminology: Historical Development

Vocabulary

1. **criminalistics** /ˌkrɪmɪnəˈlɪstɪks/: криминалистика; e.g.: Hans Gross is considered a father of modern criminalistics.

2. **criminology** /ˌkrɪmɪˈnɒlədʒi/: криминология; e.g.: Criminology studies the causes and prevention of crime.

3. **foundational figure** /faʊnˈdeɪʃənl ˈfɪgər/: основополагающая фигура; e.g.: Evgeny Burinsky is a foundational figure in Russian forensic photography.

4. **seminal manual** /ˈsemɪnl ˈmænjuəl/: основополагающее руководство; e.g.: Gross's seminal manual systematized investigation methods.

5. **to systematize** /tə ˈsɪstəmətaɪz/: систематизировать; e.g.: His work helped to systematize forensic procedures.

6. **forensic laboratory** /fəˈrensɪk ləˈbɒrətri/: судебная лаборатория; e.g.: The world's first forensic photographic laboratory was founded in 1889.

7. **to be suppressed** /tə bi səˈprest/: быть подавленным; e.g.: The field of criminology was suppressed during the Stalinist era.

8. **to be revitalized** /tə bi ˌriːˈvaɪtəlaɪzd/: получить новое развитие; e.g.: Later, the discipline was revitalized by new scholars.

9. **enduring legacy** /ɪnˈdjʊərɪŋ ˈlegəsi/: прочное наследие; e.g.: These pioneers left an enduring legacy for modern investigation.

10. **distinct path** /dɪˈstɪŋkt pɑːθ/: самобытный путь; e.g.: The development followed a distinct path, combining foreign and domestic ideas.

2. Digital Forensics

Vocabulary

1. **digital forensics** /ˈdɪdʒɪtl fəˈrensɪks/: цифровая криминалистика; e.g.: Digital forensics is essential for investigating cybercrime.

2. **retrieval** /rɪˈtriːvl/: извлечение; e.g.: Data retrieval from damaged devices can be challenging.

3. **bit-for-bit copy** /ˈbɪt fər ˈbɪt ˈkɒpi/: побитовая копия; e.g.: Investigators create a bit-for-bit copy of the hard drive for analysis.

4. **encryption** /ɪnˈkrɪpʃn/: шифрование; e.g.: Strong encryption can protect data from unauthorized access.

5. **cloud storage** /klaʊd ˈstɔːrɪdʒ/: облачное хранилище; e.g.: Evidence is often found in cloud storage accounts.

6. **chain of custody** /tʃeɪn əv ˈkʌstədi/: цепочка сохранности доказательств; e.g.: Maintaining a clear chain of custody is crucial for evidence admissibility.

7. **artifact** /ˈɑːtɪfækt/: артефакт, цифровой след; e.g.: Browser history and log files are important digital artifacts.

8. **to streamline** /tə ˈstriːmlaɪn/: оптимизировать, упростить; e.g.: New software aims to streamline the forensic workflow.

9. **Internet of Things (IoT)** /ˈɪntənet əv θɪŋz/: Интернет вещей; e.g.: IoT forensics involves extracting data from smart devices.

10. **machine learning** /məˈʃiːn ˈlɜːnɪŋ/: машинное обучение; e.g.: Machine learning helps analyze large datasets for patterns.

3. Trace Evidence & Traceology

Vocabulary

1. **trace evidence** /treɪs ˈevɪdəns/: микроскопические следы, вещественные доказательства; e.g.: Fibers and hair are common types of trace evidence.

2. **Exchange Principle** /ɪksˈtʃeɪndʒ ˈprɪnsəpl/: принцип обмена Локара; e.g.: Locard's Exchange Principle states that every contact leaves a trace.

3. **fiber** /ˈfaɪbər/: волокно; e.g.: A red fiber was found on the victim's clothing.

4. **gunshot residue (GSR)** /ˈgʌnʃɒt ˈrezɪdjuː/: следы выстрела; e.g.: GSR on the suspect's hands indicated he recently fired a weapon.

5. **to lift (evidence)** /tə lɪft/: изъять, снять след; e.g.: The technician used tape to lift trace evidence from the garment.

6. **Fourier Transform Infrared (FTIR) spectroscopy** /ˈfʊrieɪ trænsˈfɔːm ˌɪnfrəˈred spekˈtrɒskəpi/: ИК-спектроскопия с Фурье-преобразованием; e.g.: FTIR spectroscopy can identify the chemical composition of a paint chip.

7. **polarized light microscope** /ˈpəʊləraɪzd laɪt ˈmaɪkrəskəʊp/: поляризационный микроскоп; e.g.: The sample was examined under a polarized light microscope.

8. **crime scene reconstruction** /kraɪm siːn ˌriːkənˈstrʌkʃn/: реконструкция места преступления; e.g.: Trace evidence is vital for an accurate crime scene reconstruction.

9. **fragmentation** /ˌfrægmenˈteɪʃn/: фрагментация; e.g.: The bullet caused glass fragmentation at the scene.

10. **contamination** /kənˌtæmɪˈneɪʃn/: загрязнение; e.g.: To avoid contamination, examiners wear protective suits.

4. Ballistics & Firearm Examination

Vocabulary

1. **forensic ballistics** /fəˈrensɪk bəˈlɪstɪks/: судебная баллистика; e.g.: The forensic ballistics report matched the bullet to the suspect's gun.

2. **striation** /straɪˈeɪʃn/: штрих, бороздка; e.g.: The unique striations on the bullet were compared under a microscope.

3. **rifling** /ˈraɪflɪŋ/: нарезка (ствола); e.g.: The rifling inside the barrel imparts spin on the bullet.

4. **cartridge case** /ˈkɑːtrɪdʒ keɪs/: гильза; e.g.: The cartridge case found at the scene had a distinct firing pin impression.

5. **comparison microscope** /kəmˈpærɪsn ˈmaɪkrəskəʊp/: сравнительный микроскоп; e.g.: The examiner used a comparison microscope to analyze the two bullets side-by-side.

6. **trajectory** /trəˈdʒektəri/: траектория; e.g.: Laser pointers were used to determine the bullet's trajectory.

7. **muzzle-to-target distance** /ˈmʌzl tə ˈtɑːgɪt ˈdɪstəns/: дистанция выстрела; e.g.: GSR patterns help estimate the muzzle-to-target distance.

8. **Integrated Ballistic Identification System (IBIS)** /ˈɪntɪgreɪtɪd bəˈlɪstɪk aɪˌdentɪfɪˈkeɪʃn ˈsɪstəm/: Интегрированная баллистическая система идентификации; e.g.: The bullet image was entered into the IBIS database for a search.

9. **to restore (a serial number)** /tə rɪˈstɔːr/: восстановить (серийный номер); e.g.: Chemical etching was used to restore the obliterated serial number on the gun.

10. **terminal ballistics** /ˈtɜːmɪnl bəˈlɪstɪks/: конечная баллистика; e.g.: Terminal ballistics studies the effect of a projectile on its target.

5. Personal Identification Methods

Vocabulary

1. **dactyloscopy** /ˌdæktɪˈlɒskəpi/: дактилоскопия; e.g.: Dactyloscopy is the science of fingerprint identification.

2. **friction ridge** /ˈfrɪkʃn rɪdʒ/: папиллярная линия; e.g.: Fingerprint patterns are formed by friction ridges.

3. **minutiae** /mɪˈnjuːʃiː/: детали папиллярного узора; e.g.: Identification is based on the comparison of minutiae points.

4. **latent print** /ˈleɪtnt prɪnt/: невидимый след; e.g.: Latent prints on the glass were developed using powder.

5. **Automated Fingerprint Identification System (AFIS)** /ˈɔːtəmeɪtɪd ˈfɪŋgəprɪnt aɪˌdentɪfɪˈkeɪʃn ˈsɪstəm/: Автоматизированная система идентификации по отпечаткам пальцев; e.g.: The latent print was run through AFIS, which generated a list of potential matches.

6. **DNA profiling** /ˌdiː en ˈeɪ ˈprəʊfaɪlɪŋ/: ДНК-профилирование; e.g.: DNA profiling provided conclusive evidence of the suspect's presence.

7. **forensic odontology** /fəˈrensɪk ˌəʊdɒnˈtɒlədʒi/: судебная одонтология; e.g.: Forensic odontology was used to identify the victim through dental records.

8. **biological profile** /ˌbaɪəˈlɒdʒɪkl ˈprəʊfaɪl/: биологический профиль; e.g.: The anthropologist established a biological profile from the skeletal remains.

9. **craniofacial superimposition** /ˌkreɪniəʊˈfeɪʃl ˌsuːpərɪmpəˈzɪʃn/: краниофациальная суперпроекция; e.g.: Craniofacial superimposition compared the skull with a photo of the missing person.

10. **antemortem** /ˌæntiˈmɔːtem/: прижизненный; e.g.: Antemortem dental records are crucial for comparison.

6. Evidence in Criminalistics

Vocabulary

1. **direct evidence** /dɪˈrekt ˈevɪdəns/: прямое доказательство; e.g.: An eyewitness account is a form of direct evidence.

2. **circumstantial evidence** /ˌsɜːkəmˈstænʃl ˈevɪdəns/: косвенное доказательство; e.g.: The suspect's fingerprint at the scene is strong circumstantial evidence.

3. **physical evidence** /ˈfɪzɪkl ˈevɪdəns/: вещественное доказательство; e.g.: The knife was collected as physical evidence.

4. **testimonial evidence** /ˌtestɪˈməʊniəl ˈevɪdəns/: свидетельские показания; e.g.: The victim's statement in court is testimonial evidence.

5. **documentary evidence** /ˌdɒkjʊˈmentri ˈevɪdəns/: письменное доказательство; e.g.: Contracts and emails can be submitted as documentary evidence.

6. **demonstrative evidence** /dɪˈmɒnstrətɪv ˈevɪdəns/: наглядное доказательство; e.g.: A 3D model of the crime scene was used as demonstrative evidence.

7. **individual evidence** /ˌɪndɪˈvɪdʒuəl ˈevɪdəns/: индивидуализирующее доказательство; e.g.: A DNA profile is considered individual evidence.

8. **class evidence** /klɑːs ˈevɪdəns/: групповое доказательство; e.g.: The common blood type found was only class evidence.

9. **admissible** /ədˈmɪsəbl/: допустимый (в суде); e.g.: The judge ruled the evidence was admissible.

10. **chain of custody** /tʃeɪn əv ˈkʌstədi/: цепочка сохранности доказательств; e.g.: A break in the chain of custody can render evidence inadmissible.

1. Foundational Figures and Concepts

(History of Forensic Science & Criminology)

1. Vocabulary

- **criminalistics** /ˌkrɪmɪnəˈlɪstɪks/: криминалистика; e.g.: Hans Gross is considered a father of modern **criminalistics**.
- **criminology** /krɪmɪˈnɒlədʒi/: криминология; e.g.: **Criminology** studies the social and psychological causes of crime.
- **anthropometry** /ˌænθrəˈpɒmɪtri/: антропометрия; e.g.: Alphonse Bertillon's system of **anthropometry** was used for criminal identification before fingerprints.
- **Exchange Principle** /ɪksˈtʃeɪndʒ ˈprɪnsɪpəl/: принцип обмена (Локара); e.g.: According to Locard's **Exchange Principle**, every contact between a criminal and a scene leaves a trace.
- **born criminal** /bɔːn ˈkrɪmɪnəl/: прирожденный преступник; e.g.: Cesare Lombroso's theory of the **born criminal** is now widely discredited.

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2. Institutional Development

(Evolution of Forensic Methods & Laboratories)

1. Vocabulary

- **forensic laboratory** /fəˈrensɪk ləˈbɒrət(ə)ri/: судебная лаборатория; e.g.: Edmond Locard founded the world's first police **forensic laboratory** in Lyon.
- **institutionalization** /ˌɪnstɪˌtjuːʃənəlaɪˈzeɪʃən/: институционализация; e.g.: The 20th century saw the **institutionalization** of forensic science into standard laboratory practice.
- **standardized procedure** /ˈstændədaɪzd prəˈsiːdʒə/: стандартизированная процедура; e.g.: Reliable evidence depends on following **standardized procedures** for collection and analysis.
- **embodied authority** /ɪmˈbɒdɪd ɔːˈθɒrɪti/: персонифицированный авторитет (эксперта); e.g.: Early forensic science often relied on the **embodied authority** of a famous pathologist rather than standardized method.
- **globalization (of methods)** /ˌgləʊbəlaɪˈzeɪʃən/: глобализация (методов); e.g.: The **globalization of forensic methods** led to the creation of international networks like ENFSI.

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3. Historical Methods and Textbooks

(Key Tools and Publications)

1. Vocabulary

- **bertillonage** /bɜːˈtɪlənɪdʒ/: бертильонаж (антропометрическая система); e.g.: **Bertillonage** was eventually replaced by the more reliable method of fingerprinting.
- **fingerprint classification system** /ˈfɪŋgərprɪnt ˌklæsɪfɪˈkeɪʃən ˈsɪstəm/: система классификации отпечатков пальцев; e.g.: Sir Edward Henry developed a practical **fingerprint classification system** for police use.
- **manual / handbook** /ˈmænjuəl / ˈhæn(d)bʊk/: руководство / справочник; e.g.: Hans Gross wrote a seminal **handbook** that systematized criminal investigation.

- **cornerstone (text)** /ˈkɔːnəstəʊn/: краеугольный камень (труда); e.g.: Yakimov's textbook became the **cornerstone** of the Soviet criminalistics curriculum.
- **forensic document examination** /fəˈrensɪk ˈdɒkjʊmənt ɪgˌzæmɪˈneɪʃən/: судебно-почерковедческая экспертиза; e.g.: Burinsky pioneered techniques in **forensic document examination** and photographing evidence.

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4. The Digital Revolution

(Modern Digital Forensics)

1. Vocabulary

- **digital forensics** /ˈdɪdʒɪtl fəˈrensɪks/: цифровая криминалистика; e.g.: **Digital forensics** is essential for investigating cybercrime and analyzing smartphones.
- **forensic imaging** /fəˈrensɪk ˈɪmɪdʒɪŋ/: создание судебного образа (диска); e.g.: The first step after seizing a computer is to create a **forensic image** of its hard drive.
- **bit-for-bit copy** /bɪt fɔː bɪt ˈkɒpi/: побитовая копия; e.g.: A **bit-for-bit copy** ensures that every piece of data, including deleted files, is preserved for analysis.
- **chain of custody** /tʃeɪn əv ˈkʌstədi/: цепочка сохранности доказательств; e.g.: Maintaining a clear **chain of custody** is crucial for digital evidence to be admissible in court.
- **data volume** /ˈdeɪtə ˈvɒljuːm/: объем данных; e.g.: The main challenge for investigators is the overwhelming **data volume** from modern devices and cloud storage.
- **artifacts (digital)** /ˈɑːtɪfækts/: артефакты (цифровые); e.g.: Investigators search for digital **artifacts** like browser history, logs, and metadata.

Traceology and Trace Examination (Forensic Science)

1. Vocabulary

- **trace evidence** /treɪs ˈev.ɪ.dəns/: следы-микрообъекты, микроскопические вещественные доказательства; e.g.: **Trace evidence** like fibers and glass fragments can link a suspect to a crime scene.
- **Locard's Exchange Principle** /loʊˈkɑːrz ɪksˈtʃeɪndʒ ˈprɪn.sə.pəl/: принцип обмена Локара; e.g.: The investigation was guided by **Locard's Exchange Principle**, which states that every contact leaves a trace.
- **comparison microscope** /kəmˈpær.ɪ.sən ˈmaɪ.krə.skoʊp/: сравнительный микроскоп; e.g.: The examiner used a **comparison microscope** to analyze the microscopic striations on the bullets.
- **chain of custody** /tʃeɪn əv ˈkʌs.tə.di/: цепочка обеспечения сохранности вещественных доказательств; e.g.: Maintaining an unbroken **chain of custody** is crucial for evidence to be admissible in court.
- **GSR (Gunshot Residue)** /ˌdʒiː.esˈɑːr/: частицы выстрела; e.g.: Tests for **GSR** on his hands indicated he had recently fired a weapon or was near a firearm when it was discharged.

Forensic Firearm and Ballistic Examination (Forensic Science)

1. Vocabulary

- **ballistic fingerprint** /bəˈlɪs.tɪk ˈfɪŋ.gər.prɪnt/: баллистический отпечаток; e.g.: The unique markings inside the barrel create a **ballistic fingerprint** on every bullet fired.
- **striations** /straɪˈeɪ.ʃənz/: штрихи, бороздки (на пуле); e.g.: The **striations** on the recovered bullet matched those from the test-fired bullet.
- **IBIS / NIBIN** /ˈaɪ.bɪs/, /ˈnɪb.ɪn/: Интегрированная баллистическая система идентификации / Национальная интегрированная сеть баллистической информации; e.g.: The cartridge case was entered into the **NIBIN** database to search for links to other shootings.

- **toolmark** /ˈtuːl.mɑːrk/: след орудия взлома, инструмента; e.g.: The **toolmark** left on the window frame was consistent with the crowbar found in the suspect's car.
- **trajectory analysis** /trəˈdʒek.tər.i əˈnæl.ə.sɪs/: анализ траектории полета пули; e.g.: **Trajectory analysis** using lasers helped reconstruct the shooter's position.

Digital Forensics and ICT in Investigations (Forensic Science / ICT)

1. Vocabulary

- **digital evidence** /ˈdɪdʒ.ɪ.təl ˈev.ɪ.dəns/: цифровые доказательства; e.g.: **Digital evidence** from his smartphone placed him at the location at the time of the crime.
- **forensic imaging** /fəˈren.zɪk ˈɪm.ɪ.dʒɪŋ/: создание криминалистического образа (копии) носителя данных; e.g.: The first step was **forensic imaging** of the suspect's hard drive to preserve the original data.
- **metadata** /ˈmet.əˌdeɪ.tə/: метаданные; e.g.: The photo's **metadata** contained the exact time, date, and GPS coordinates where it was taken.
- **AFIS (Automated Fingerprint Identification System)** /ˈeɪ.fɪs/: автоматизированная дактилоскопическая информационная система; e.g.: The latent print was run through **AFIS**, which generated a list of potential matches.
- **predictive policing** /prɪˈdɪk.tɪv pəˈliː.sɪŋ/: прогнозная (предиктивная) полицейская деятельность; e.g.: **Predictive policing** software uses algorithms to analyze historical crime data and forecast potential hotspots.

Personal and Biomedical Identification (Forensic Science)

1. Vocabulary

- **individual characteristics** /ˌɪn.dəˈvɪdʒ.u.əl ˌker.ək.təˈrɪs.tɪks/: индивидуализирующие признаки; e.g.: DNA profiles and fingerprints are considered evidence with **individual characteristics**.
- **latent print** /ˈleɪ.tənt prɪnt/: невидимый (потожировой) отпечаток; e.g.: Investigators used cyanoacrylate fuming to develop **latent prints** on the glass.
- **DNA profile** /ˌdiː.enˈeɪ ˈproʊ.faɪl/: ДНК-профиль; e.g.: The **DNA profile** from the blood sample matched the suspect with a high degree of scientific certainty.
- **postmortem** /ˌpoʊstˈmɔːr.təm/: посмертный; e.g.: **Postmortem** dental records were compared with antemortem X-rays to identify the victim.
- **chain of custody** /tʃeɪn əv ˈkʌs.tə.di/: цепочка обеспечения сохранности вещественных доказательств; e.g.: The **chain of custody** document tracked everyone who handled the biological evidence from the scene to the lab.

Appendix III

Provessiaonal Vocabulary

1. Unit I. Criminalistics and the History of its Development

1. Vocabulary

- **criminalistics** /ˌkrɪmɪnəˈlɪstɪks/: криминалистика; e.g.: *Criminalistics is the scientific study of crime and evidence.*
- **forensic science** /fəˈrɛnzɪk ˈsaɪəns/: судебная наука; e.g.: *Modern forensic science began to develop in the 19th century.*
- **methodology** /ˌmɛθəˈdɒlədʒi/: методика; e.g.: *The investigation followed a strict methodology.*
- **Locard's exchange principle** /loʊˈkɑːrz ɪksˈtʃeɪndʒ ˈprɪnsəpəl/: принцип обмена Локара; e.g.: *Locard's exchange principle states that every contact leaves a trace.*
- **investigation** /ɪnˌvɛstɪˈgeɪʃən/: расследование; e.g.: *A thorough investigation is crucial for solving a crime.*
- **evidence** /ˈɛvɪdəns/: доказательства, улики; e.g.: *The detective collected all available evidence from the room.*
- **pioneer** /ˌpaɪəˈnɪər/: пионер, основоположник; e.g.: *Edmond Locard was a pioneer in forensic science.*
- **systematization** /ˌsɪstəmətaɪˈzeɪʃən/: систематизация; e.g.: *The systematization of knowledge helped advance the field.*
- **technique** /tɛkˈniːk/: техника, метод; e.g.: *New analytical techniques have revolutionized criminalistics.*
- **expert** /ˈɛkspɜːrt/: эксперт, специалист; e.g.: *The court called a forensic expert to testify.*
- **procedure** /prəˈsiːdʒər/: процедура; e.g.: *Standard procedures must be followed to avoid contamination.*

- **criminal investigation** /ˈkrɪmɪnəl ɪnˌvɛstɪˈgeɪʃən/: уголовное расследование; e.g.: *Criminalistics provides vital support to criminal investigation.*
- **development** /dɪˈvɛləpmənt/: развитие; e.g.: *The development of DNA analysis was a major breakthrough.*
- **microscope** /ˈmaɪkrəskoʊp/: микроскоп; e.g.: *Early criminalists used simple microscopes to examine evidence.*
- **archives** /ˈɑːrkaɪvz/: архивы; e.g.: *Historical archives contain records of early forensic cases.*
- **classification** /ˌklæsɪfɪˈkeɪʃən/: классификация; e.g.: *The classification of fingerprint patterns was a key step.*
- **landmark case** /ˈlændmɑːrk keɪs/: знаковое судебное дело; e.g.: *The Buck Ruxton case was a landmark in forensic pathology.*
- **science** /ˈsaɪəns/: наука; e.g.: *He applied science to the legal process.*
- **legal system** /ˈliːgəl ˈsɪstəm/: правовая система; e.g.: *Criminalistics bridges science and the legal system.*
- **anthropometry** /ˌænθrəˈpɒmɪtri/: антропометрия; e.g.: *Anthropometry was an early method of personal identification.*
- **codification** /ˌkoʊdɪfɪˈkeɪʃən/: кодификация; e.g.: *The codification of forensic methods improved their reliability.*
- **predecessor** /ˈpriːdɪˌsɛsər/: предшественник; e.g.: *Modern crime labs have their predecessors in 19th-century Europe.*
- **to evolve** /ɪˈvɒlv/: развиваться, эволюционировать; e.g.: *Forensic techniques continue to evolve rapidly.*
- **empirical** /ɛmˈpɪrɪkəl/: эмпирический, основанный на опыте; e.g.: *Their conclusions were based on empirical data.*
- **to establish** /ɪˈstæblɪʃ/: устанавливать, основывать; e.g.: *The first forensic laboratory was established in France.*

2. Unit II. Types of Forensic Examinations

2. Vocabulary

- **forensic examination** /fəˈrɛnzɪk ɪgˌzæmɪˈneɪʃən/: судебная экспертиза; e.g.: *A forensic examination of the document revealed forgery.*
- **expertise** /ˌɛkspɜːrˈtiːz/: экспертиза, компетенция; e.g.: *The question required specific chemical expertise.*
- **ballistics** /bəˈlɪstɪks/: баллистика; e.g.: *The bullet was sent for ballistics examination.*
- **autopsy** /ˈɔːtɒpsi/: аутопсия, вскрытие; e.g.: *The forensic pathologist performed an autopsy to determine the cause of death.*
- **toxicology** /ˌtɒksɪˈkɒlədʒi/: токсикология; e.g.: *Toxicology tests detected poison in the victim's blood.*
- **document examination** /ˈdɒkjʊmənt ɪgˌzæmɪˈneɪʃən/: почерковедческая или технико-криминалистическая экспертиза документов; e.g.: *The expert conducted a document examination to verify the signature.*
- **handwriting analysis** /ˈhændˌraɪtɪŋ əˈnæləsɪs/: исследование почерка; e.g.: *Handwriting analysis confirmed the note was written by the suspect.*
- **digital forensics** /ˈdɪdʒɪtl fəˈrɛnzɪks/: компьютерно-техническая экспертиза; e.g.: *Digital forensics experts recovered deleted files from the phone.*
- **pathology** /pəˈθɒlədʒi/: патология; e.g.: *Forensic pathology deals with examining deceased persons.*
- **biology** /baɪˈɒlədʒi/: биология; e.g.: *Forensic biology involves analyzing blood, hair, and other biological materials.*
- **chemistry** /ˈkɛmɪstri/: химия; e.g.: *Forensic chemistry can identify unknown substances found at a scene.*
- **psychiatry** /saɪˈkaɪətri/: психиатрия; e.g.: *A forensic psychiatry assessment evaluated the defendant's mental state.*

- **engineering** /ˌɛndʒɪˈnɪərɪŋ/: инженерно-техническая экспертиза; e.g.: *Forensic engineering analyzed the bridge collapse.*
- **phonoscopy** /fəˈnɒskəpi/: фоноскопическая экспертиза; e.g.: *Phonoscopy examined the voice recording for identification.*
- **appointment** /əˈpɔɪntmənt/: назначение (экспертизы); e.g.: *The judge ordered the appointment of an independent expert.*
- **commission** /kəˈmɪʃən/: комиссия; e.g.: *A commission of several experts reviewed the complex case.*
- **conclusion** /kənˈkluːʒən/: заключение (эксперта); e.g.: *The expert's conclusion was presented in court.*
- **to appoint** /əˈpɔɪnt/: назначать; e.g.: *The court will appoint a qualified specialist.*
- **to conduct** /kənˈdʌkt/: проводить; e.g.: *The laboratory will conduct a series of examinations.*
- **to analyze** /ˈænəlaɪz/: анализировать; e.g.: *The sample was analyzed for DNA.*
- **to compare** /kəmˈpeər/: сравнивать; e.g.: *The expert compared the tool marks with the suspect's tools.*
- **to identify** /aɪˈdɛntɪfaɪ/: идентифицировать; e.g.: *The main task was to identify the substance.*
- **non-destructive** /ˌnɒn dɪˈstrʌktɪv/: неразрушающий; e.g.: *They used non-destructive methods to examine the painting.*
- **reliable** /rɪˈlaɪəbl/: надежный, достоверный; e.g.: *The method must be scientifically reliable.*
- **comprehensive** /ˌkɒmprɪˈhɛnsɪv/: комплексный, всесторонний; e.g.: *A comprehensive examination included several types of analysis.*

3. Unit III. Traceology and Trace Examination

3. Vocabulary

- **traceology** /treɪsiˈɒlədʒi/: трасология; e.g.: *Traceology is the study of marks and traces.*
- **trace** /treɪs/: след; e.g.: *Footprints in the mud were a crucial trace.*
- **impression** /ɪmˈprɛʃən/: оттиск, отпечаток; e.g.: *A tire impression was found near the crime scene.*
- **toolmark** /ˈtuːlmɑːrk/: след орудия, инструмента; e.g.: *The burglar left a clear toolmark on the window frame.*
- **footwear impression** /ˈfʊtweər ɪmˈprɛʃən/: след обуви; e.g.: *The footwear impression matched the suspect's shoes.*
- **tire track** /ˈtaɪər træk/: след шины; e.g.: *Tire tracks led away from the house.*
- **fracture** /ˈfrækʧər/: излом, разлом; e.g.: *The fracture lines on the plastic pieces showed they were once joined.*
- **static trace** /ˈstætɪk treɪs/: статический след; e.g.: *A fingerprint is an example of a static trace.*
- **dynamic trace** /daɪˈnæmɪk treɪs/: динамический след; e.g.: *A scratch from a sliding tool creates a dynamic trace.*
- **to cast** /kɑːst/: снимать слепок; e.g.: *The investigator used dental stone to cast the footprint.*
- **moulage** /muːˈlɑːʒ/: слепочная масса; e.g.: *They used a special moulage to preserve the impression.*
- **comparative microscope** /kəmˈpærətɪv ˈmaɪkrəskoʊp/: сравнительный микроскоп; e.g.: *Toolmarks were compared using a comparative microscope.*
- **striation** /straɪˈeɪʃən/: штрих, бороздка; e.g.: *The striations on the bullet matched the gun's barrel.*
- **wear pattern** /weər ˈpætən/: рисунок износа; e.g.: *The unique wear pattern on the sole helped identify the shoe.*

- **contact** /ˈkɒntækt/: контакт; e.g.: *Every contact between objects can leave a trace.*
- **material** /məˈtɪərɪəl/: материал, вещество; e.g.: *Traces of foreign material were found under his nails.*
- **to transfer** /trænsˈfɜːr/: переносить; e.g.: *Fibers can transfer from a carpet to clothing.*
- **to preserve** /prɪˈzɜːrv/: сохранять; e.g.: *It is vital to properly preserve a trace for analysis.*
- **to link** /lɪŋk/: связывать; e.g.: *The trace evidence linked the suspect to the victim's car.*
- **individual characteristic** /ˌɪndɪˈvɪdʒuəl ˌkærəktəˈrɪstɪk/: индивидуальная характеристика; e.g.: *A unique scratch on a tool provides an individual characteristic.*
- **class characteristic** /klɑːs ˌkærəktəˈrɪstɪk/: групповая характеристика; e.g.: *The size of a screwdriver is a class characteristic.*
- **micromorphology** /ˌmaɪkroʊmɔːrˈfɒlədʒi/: микроморфология; e.g.: *Micromorphology studies the microscopic structure of trace surfaces.*
- **profile** /ˈproʊfaɪl/: профиль; e.g.: *The soil had a unique mineral profile.*
- **mechanism** /ˈmɛkənɪzəm/: механизм; e.g.: *Experts studied the mechanism of the trace formation.*
- **to individualize** /ˌɪndɪˈvɪdʒuəlaɪz/: индивидуализировать; e.g.: *The goal is to individualize the trace to a specific source.*

4. Unit IV. Dactyloscopy and Fingerprint Examination

(As per your example, this is the completed template.)

5. Unit V. Forensic Ballistic Examination

5. Vocabulary

- **ballistics** /bəˈlɪstɪks/: баллистика; e.g.: *Forensic ballistics is a branch of criminalistics.*
- **firearm** /ˈfaɪərɑːrm/: огнестрельное оружие; e.g.: *The recovered firearm was sent for examination.*
- **bullet** /ˈbʊlɪt/: пуля; e.g.: *The bullet was extracted from the wall.*
- **cartridge case** /ˈkɑːtrɪdʒ keɪs/: гильза; e.g.: *A spent cartridge case was found on the floor.*
- **caliber** /ˈkælɪbər/: калибр; e.g.: *The bullet was .45 caliber.*
- **barrel** /ˈbærəl/: ствол; e.g.: *The unique markings inside the barrel imprint on the bullet.*
- **rifling** /ˈraɪflɪŋ/: нарезка (в стволе); e.g.: *The rifling imparts spin to the bullet.*
- **lands and grooves** /lændz ənd gruːvz/: поля и нарезы; e.g.: *The pattern of lands and grooves is unique to each barrel.*
- **striation** /straɪˈeɪʃən/: штрих, бороздка; e.g.: *Comparative analysis matches striations on bullets.*
- **gunshot residue (GSR)** /ˈgʌnʃɒt ˈrɛzɪdjuː/: следы выстрела (СВ); e.g.: *GSR was detected on the suspect's hands.*
- **trajectory** /trəˈdʒɛktəri/: траектория; e.g.: *The experts reconstructed the bullet's trajectory.*
- **muzzle** /ˈmʌzl/: дульный срез; e.g.: *The distance was estimated by GSR patterns around the muzzle.*
- **breech** /briːtʃ/: затворная часть; e.g.: *The firing pin strikes the cartridge primer in the breech.*
- **firing pin** /ˈfaɪərɪŋ pɪn/: ударник; e.g.: *The firing pin leaves a mark on the primer.*

- **ejection** /ɪˈdʒɛkʃən/: экстракция, выбрасывание; e.g.: *Ejection marks are left on the cartridge case.*
- **to discharge** /dɪsˈʧɑːdʒ/: производить выстрел; e.g.: *The weapon was discharged at close range.*
- **to fire** /ˈfaɪər/: стрелять; e.g.: *He fired three shots.*
- **comparison microscope** /kəmˈpærɪsn ˈmaɪkrəskoʊp/: сравнительный микроскоп; e.g.: *The ballistic expert used a comparison microscope.*
- **test firing** /tɛst ˈfaɪərɪŋ/: экспериментальный отстрел; e.g.: *Test firing provided comparison samples.*
- **database** /ˈdeɪtəˌbeɪs/: база данных; e.g.: *The ballistic database contains data from thousands of firearms.*
- **jacket** /ˈdʒækɪt/: оболочка (пули); e.g.: *The bullet had a full metal jacket.*
- **primer** /ˈpraɪmər/: капсюль; e.g.: *The primer ignites the gunpowder.*
- **silencer** /ˈsaɪlənsər/: глушитель; e.g.: *A homemade silencer was attached to the pistol.*
- **wound ballistics** /wuːnd bəˈlɪstɪks/: раневая баллистика; e.g.: *Wound ballistics studies the effect of projectiles on tissue.*
- **identification** /aɪˌdɛntɪfɪˈkeɪʃən/: идентификация; e.g.: *The bullet was positively identified as being fired from that gun.*

Dactyloscopy and Fingerprint Examination
(Forensic Science)

1. Vocabulary

- fingerprints /ˈfɪŋgərˌprɪnts/: отпечатки пальцев
- evidence /ˈevɪdəns/: доказательство
- category /ˈkætɪgɔːri/: категория

• forensic science /fəˈrɛnsɪk ˈsaɪəns/: судебная экспертиза, криминалистика

• friction ridge skin /ˈfrɪkʃən rɪdʒ skɪn/: папиллярные узоры кожи

• patterns /ˈpætərnz/: узоры, образцы

• joint /dʒɔɪnt/: сустав, сочленение

• identification /aɪˌdentɪfɪˈkeɪʃən/: идентификация, установление личности

• individuality /ˌɪndɪvɪdʒuˈæləti/: индивидуальность

• article of faith /ˈɑːrtɪkl əv feɪθ/: предмет веры

• universally /ˌjuːnɪˈvɜːrsəli/: повсеместно, универсально

• accepted /əkˈseptɪd/: принятый, признанный

• match /mætʃ/: совпадение, соответствие

• certain /ˈsɜːrtən/: определенный, несомненный

• particular /pərˈtɪkjələr/: конкретный, особый

• physical evidence /ˈfɪzɪkl ˈevɪdəns/: вещественные доказательства

• drugs /drʌgz/: наркотики, лекарства

• chemicals /ˈkemɪklz/: химикаты

• trace /treɪs/: следы

• biological /ˌbaɪəˈlɒdʒɪkl/: биологический

• questioned documents /ˈkwestʃənd ˈdɒkjʊmənts/: сомнительные документы

• tool mark /tuːl mɑːrk/: след инструмента

• firearms /ˈfaɪərɑːrmz/: огнестрельное оружие

• footwear /ˈfʊtweər/: обувь

• tire impressions /taɪər ɪmˈpreʃənz/: отпечатки шин

• individualization /ˌɪndɪˌvɪdʒuəlɪˈzeɪʃən/: индивидуализация

• source /sɔːrs/: источник

• investigation /ɪnˌvestɪˈgeɪʃən/: расследование

• associate /əˈsoʊʃieɪt/: связывать, ассоциировать

• scene /siːn/: место происшествия

• evidentiary item /ˌevɪˈdenʃəri ˈaɪtəm/: предмет, имеющий доказательственное значение

• reconstruction /ˌriːkənˈstrʌkʃən/: реконструкция, восстановление

• blood spatter /blʌd ˈspætər/: брызги крови

• events /ɪˈvents/: события

• structure failures /ˈstrʌktʃər ˈfeɪljərz/: разрушения конструкций

• suspicious fires /səˈspɪʃəs ˈfaɪərz/: подозрительные пожары

• transportation accidents /ˌtrænspərˈteɪʃən ˈæksɪdənts/: транспортные происшествия

• identify /aɪˈdentɪfaɪ/ - идентифицировать

• suspects /ˈsʌspekts/ - подозреваемые

• criminal /ˈkrɪmɪnl/ - криминальный, уголовный

• dentition /denˈtɪʃən/ - зубной ряд, зубная система

• unequivocal /ˌʌnɪˈkwɪvəkəl/ - недвусмысленный, однозначный

• remains /rɪˈmeɪnz/ - останки

• conventional /kənˈvenʃənəl/ - обычный, традиционный

• postmortem /ˌpəʊstˈmɔːrtəm/ - посмертный

• biometric /ˌbaɪoʊˈmetrɪk/ - биометрический

• identifiers /aɪˈdentɪfaɪərz/ - идентификаторы

• retina /ˈretɪnə/ - сетчатка

• iris /ˈaɪrɪs/ - радужная оболочка

• patterns /ˈpætərnz/ - узоры, рисунки

• thermography /θɜːˈmɒgrəfi/ - термография

• scanning /ˈskænɪŋ/ - сканирование

• storage /ˈstɔːrɪdʒ/ - хранение

• security /sɪˈkjʊərəti/ - безопасность

• features /ˈfiːtʃərz/ - особенности, признаки

• associated /əˈsoʊʃieɪtɪd/ - связанный, ассоциированный

• forged /fɔːrdʒd/ - поддельный

• personal /ˈpɜːrsənəl/ - личный

- individual /ˌɪndɪˈvɪdʒuəl/ - индивидуум, личность
- lifetime /ˈlaɪftaɪm/ - жизнь (продолжительность жизни)
- damage /ˈdæmɪdʒ/ - повреждение
- dermal /ˈdɜːrməl/ - кожный
- skin /skɪn/ - кожа
- layer /ˈleɪər/ - слой
- fingers /ˈfɪŋgərz/ - пальцы
- palms /pɑːmz/ - ладони
- hands /hændz/ - руки
- soles /soʊlz/ - подошвы
- feet /fiːt/ - ступни
- primates /ˈpraɪmeɪts/ - приматы
- areas /ˈeəriəz/ - области
- complicated /ˈkɒmplɪkeɪtɪd/ - сложный
- pattern /ˈpætərn/ - узор, рисунок
- hills /hɪlz/ - холмы
- valleys /ˈvæliz/ - долины
- ridges /ˈrɪdʒɪz/ - гребни
- furrows /ˈfɜːroʊz/ - борозды
- embryonic development /ˌembriˈɒnɪk dɪˈveləpmənt/ - эмбриональное развитие
- constant /ˈkɒnstənt/ - постоянный
- individual /ˌɪndɪˈvɪdʒuəl/ - индивидуум, личность
- genetic make-up /dʒəˈnetɪk ˈmeɪk ʌp/ - генетический состав
- determining /dɪˈtɜːrmɪnɪŋ/ - определяющий
- sizes /ˈsaɪzɪz/ - размеры
- shapes /ʃeɪps/ - формы
- identical twins /aɪˈdentɪkəl twɪnz/ - идентичные близнецы
- fertilized egg /ˈfɜːrtɪlaɪzd eg/ - оплодотворенное яйцо
- distinguishable /dɪˈstɪŋgwɪʃəbl/ - различимый, отличающийся

- arch /ɑːrtʃ/ - арка
- loop /luːp/ - петля
- whorl /wɜːrl/ - завиток
- examiners /ɪgˈzæmɪnərz/ - эксперты
- plain /pleɪn/ - простой
- tented /ˈtentɪd/ - шатровый
- radial /ˈreɪdiəl/ - радиальный
- ulnar /ˈʌlnər/ - локтевой
- slope /sloʊp/ - наклон
- direction /daɪˈrekʃn/ - направление
- inner /ˈɪnər/ - внутренний
- arm bone /ɑːrm boʊn/ - кость руки
- radius /ˈreɪdiəs/ - лучевая кость
- outer /ˈaʊtər/ - внешний
- ulna /ˈʌlnə/ - локтевая кость
- central pocket /ˈsentrəl ˈpɒkɪt/ - центральный карман
- double loop /ˈdʌbl luːp/ - двойная петля
- accidental /ˌæksɪˈdentl/ - случайный
- definable /dɪˈfaɪnəbl/ - определяемый
- core /kɔːr/ - ядро
- delta /ˈdeltə/ - дельта
- comparisons /kəmˈpærɪsnz/ - сравнения
- additional /əˈdɪʃənl/ - дополнительный
- indicated /ˈɪndɪkeɪtɪd/ - указанный
- frames /freɪmz/ - рамки
- minutiae /mɪˈnjuːʃiː/ - детали, признаки
- evidentiary /ˌevɪˈdenʃəri/ - доказательственный
- reference /ˈrefrəns/ - эталонный, справочный
- inked /ɪŋkt/ - зачернённый, нанесённый чернилами
- oriented /ˈɔːrientɪd/ - ориентированный

- general /ˈdʒenrəl/ - общий
- ridge flow /rɪdʒ floʊ/ - направление гребней
- compare /kəmˈper/ - сравнивать
- abruptly /əˈbrʌptli/ - резко
- ending ridge /ˈendɪŋ rɪdʒ/ - конец гребня
- splitting /ˈsplɪtɪŋ/ - разделение
- bifurcation /ˌbaɪfərˈkeɪʃn/ - бифуркация, раздвоение
- length /leŋθ/ - длина
- punctuation mark /ˌpʌŋktʃuˈeɪʃn mɑːrk/ - знак препинания
- dot /dɒt/ - точка
- facing /ˈfeɪsɪŋ/ - обращённый лицом
- discussed /dɪˈskʌst/ - обсуждённый
- handprint /ˈhændˌprɪnt/ - отпечаток руки
- personal identification /ˈpɜːrsənəl aɪˌdentɪfɪˈkeɪʃn/ - личная идентификация
- dates back /deɪts bæk/ - восходит к
- archaeological excavations /ˌɑːrkiəˈlɒdʒɪkəl ˌekskəˈveɪʃənz/ - археологические раскопки
- ancient civilizations /ˈeɪnʃənt ˌsɪvəlaɪˈzeɪʃənz/ - древние цивилизации
- artifacts /ˈɑːrtɪfæktst/ - артефакты
- potters /ˈpɒtərz/ - гончары
- sign /saɪn/ - подписывать
- authenticity /ˌɔːθenˈtɪsəti/ - подлинность
- development /dɪˈveləpmənt/ - развитие
- centuries /ˈsentʃəriz/ - столетия
- scientist /ˈsaɪəntɪst/ - ученый
- describe /dɪˈskraɪb/ - описывать
- plant morphologist /plænt mɔːrˈfɒlədʒɪst/ - морфолог растений
- published /ˈpʌblɪʃt/ - опубликованный
- accurate /ˈækjərət/ - точный

- drawings /ˈdrɔːɪŋz/ - рисунки
- physiologist /ˌfɪziˈɒlədʒɪst/ - физиолог
- anatomical /ˌænəˈtɒmɪkl/ - анатомический
- physiological /ˌfɪziəˈlɒdʒɪkl/ - физиологический
- discoveries /dɪˈskʌvəriz/ - открытия
- thesis /ˈθiːsɪs/ - диссертация
- wood engraver /wʊd ɪnˈgreɪvər/ - гравер по дереву
- engravings /ɪnˈgreɪvɪŋz/ - гравюры
- mentioned /ˈmenʃənd/ - упомянутый
- connection /kəˈnekʃn/ - связь
- thumbprint /ˈθʌmprɪnt/ - отпечаток большого пальца
- signature /ˈsɪgnətʃər/ - подпись
- recognized /ˈrekəgnaɪzd/ - признанный
- value /ˈvæljuː/ - ценность
- Civil Service /ˈsɪvl ˈsɜːrvɪs/ - государственная служба
- capacity /kəˈpæsəti/ - должность
- represented /ˌreprɪˈzentɪd/ - представлять
- friction ridge impressions /ˈfrɪkʃən ˈrɪdʒ ɪmˈpreʃənz/ - отпечатки фрикционных гребней
- common /ˈkɒmən/ - распространенный
- parties /ˈpɑːrtiz/ - стороны
- placing /ˈpleɪsɪŋ/ - размещение
- mark /mɑːrk/ - знак
- impression /ɪmˈpreʃn/ - отпечаток
- ample evidence /ˈæmpl ˈevɪdəns/ - достаточно доказательств
- hundreds of years /ˈhʌndrədz əv jɪərz/ - сотни лет
- controlling fraud /kənˈtroʊlɪŋ frɔːd/ - борьба с мошенничеством
- false impersonations /fɔːls ɪmˌpɜːrsəˈneɪʃənz/ - ложные выдачи себя за другого

- government pension distributions /ˈgʌvərnmənt ˈpenʃən ˌdɪstrɪˈbjuːʃənz/ - государственные пенсионные выплаты
- implement /ˈɪmplɪment/ - внедрить
- practices /ˈpræktɪsɪz/ - практика
- demonstrated /ˈdemənstreɪtɪd/ - продемонстрированный
- persistence /pərˈsɪstəns/ - устойчивость
- exceeding /ɪkˈsiːdɪŋ/ - превышающий
- physician /fɪˈzɪʃn/ - врач
- medical missionary /ˈmedɪkl ˈmɪʃəneri/ - медицинский миссионер
- involved /ɪnˈvɒlvd/ - вовлеченный
- evolutionary theorist /ˌevəˈluːʃənəri ˈθɪərɪst/ - эволюционный теоретик
- forwarded /ˈfɔːrwərdɪd/ - пересланный
- classified /ˈklæsɪfaɪd/ - классифицированный
- ridge detail /rɪdʒ ˈdiːteɪl/ - детали гребня
- apprehending criminals /ˌæprɪˈhendɪŋ ˈkrɪmɪnlz/ - задержание преступников
- locating fingerprints /loʊˈkeɪtɪŋ ˈfɪŋgərˌprɪnts/ - обнаружение отпечатков пальцев
- familiar /fəˈmɪliər/ - знакомый
- observations /ˌɒbzərˈveɪʃənz/ - наблюдения
- recorded /rɪˈkɔːrdɪd/ - записанный
- dispute /dɪˈspjuːt/ - спор
- priority /praɪˈɒrəti/ - приоритет
- claim /kleɪm/ - претензия
- originators /əˈrɪdʒɪneɪtərz/ - основоположники
- antiquity /ænˈtɪkwəti/ - древность
- fair /fer/ - справедливый
- influential /ˌɪnfluˈenʃəl/ - влиятельный
- introducing /ˌɪntrəˈdjuːsɪŋ/ - представляющий

• microscopist /maɪˈkrɒskəpɪst/ - микроскопист

• scientific /ˌsaɪənˈtɪfɪk/ - научный

• journal article /ˈdʒɜːrnl ˈɑːrtɪkl/ - журнальная статья

• identification features /aɪˌdentɪfɪˈkeɪʃn ˈfiːtʃərz/ - признаки идентификации

• criminal matters /ˈkrɪmɪnl ˈmætərz/ - уголовные дела

• scientific method /ˌsaɪənˈtɪfɪk ˈmeθəd/ - научный метод

• contribute /kənˈtrɪbjuːt/ - способствовать

• identification method /aɪˌdentɪfɪˈkeɪʃn ˈmeθəd/ - метод идентификации

• foundation /faʊnˈdeɪʃn/ - основа

• acceptance /əkˈseptəns/ - принятие

• Police Prefecture /pəˈliːs ˈpriːfektʃər/ - полицейская префектура

• duties /ˈdjuːtiz/ - обязанности

• filling out /ˈfɪlɪŋ aʊt/ - заполнение

• filing /ˈfaɪlɪŋ/ - подача, архивирование

• criminal information cards /ˈkrɪmɪnl ˌɪnfərˈmeɪʃn kɑːrdz/ - карточки с криминальной информацией

• developing /dɪˈveləpɪŋ/ - разработка

• anthropologist /ˌænθrəˈpɒlədʒɪst/ - антрополог

• to spend considerable time /spent kənˈsɪdərəbl taɪm/ - проводить значительное время

• individual differences /ˌɪndɪˈvɪdʒuəl ˈdɪfərənsɪz/ - индивидуальные различия

• human physical features /ˈhjuːmən ˈfɪzɪkl ˈfiːtʃərz/ - физические особенности человека

• occurred /əˈkɜːrd/ - пришло в голову

• utility /juːˈtɪləti/ - полезность

• uniquely /juˈniːkli/ - уникально

• criminal records /ˈkrɪmɪnl ˈrekərdz/ - уголовные дела

- disguises /dɪsˈgaɪzɪz/ - маскировка
- aliases /ˈeɪliəsiːz/ - псевдонимы
- biometric system /ˌbaɪoʊˈmetrɪk ˈsɪstəm/ - биометрическая система
- head size /hed saɪz/ - размер головы
- finger length /ˈfɪŋgər leŋθ/ - длина пальца
- measurements /ˈmeʒərmənts/ - измерения
- carefully /ˈkerfəli/ - тщательно
- file cards /faɪl kɑːrdz/ - карточки
- devised /dɪˈvaɪzd/ - разработанный
- superiors /suːˈpɪəriərz/ - начальство
- initially /ɪˈnɪʃəli/ - изначально
- eccentric /ɪkˈsentrɪk/ - эксцентричный
- proved its worth /pruːvd ɪts wɜːrθ/ - доказала свою ценность
- convict /kənˈvɪkt/ - осуждать
- prior arrest /ˈpraɪər əˈrest/ - предыдущий арест
- conviction records /kənˈvɪkʃn ˈrekərdz/ - записи об осуждении
- identification bureau /aɪˌdentɪfɪˈkeɪʃn ˈbjʊroʊ/ - бюро идентификации
- police agencies /pəˈliːs ˈeɪdʒənsiz/ - полицейские управления
- Bertillonage /bərˌtɪlɑːˈnɑːʒ/ - система Бертильона
- undone /ˌʌnˈdʌn/ - разрушенный
- unequivocal proof /ˌʌnɪˈkwɪvəkəl pruːf/ - однозначное доказательство
- different individuals /ˈdɪfrənt ˌɪndɪˈvɪdʒuəlz/ - разные люди
- anthropometric measurements /ˌænθrəpəˈmetrɪk ˈmeʒərmənts/ - антропометрические измерения
- chance duplication /tʃæns ˌdjuːplɪˈkeɪʃn/ - случайное дублирование
- Leavenworth Prison /ˈlevənwɜːrθ ˈprɪzn/ - тюрьма Ливенворт
- prisoner /ˈprɪznər/ - заключённый
- staff member /stæf ˈmembər/ - штатный сотрудник
- encountered /ɪnˈkaʊntərd/ - столкнувшийся
- checking /ˈtʃekɪŋ/ - проверка

- fit /fɪt/ - подходить
- incarcerated /ɪnˈkɑːrsəreɪtɪd/ - заключённый в тюрьму
- unrelated /ˌʌnrɪˈleɪtɪd/ - не связанный
- incident /ˈɪnsɪdənt/ - инцидент
- convince /kənˈvɪns/ - убедить
- personnel /ˌpɜːrsəˈnel/ - персонал
- represented /ˌreprɪˈzentɪd/ - представлял
- superior method /suːˈpɪəriər ˈmeθəd/ - превосходящий метод
- greatest scientists /ˈgreɪtɪst ˈsaɪəntɪsts/ - величайшие учёные
- contributions /ˌkɒntrɪˈbjuːʃənz/ - вклады
- correspondence /ˌkɒrɪˈspɒndəns/ - переписка
- cousin /ˈkʌzn/ - кузен
- eclectic interests /ɪˈklektɪk ˈɪntrəsts/ - эклектичные интересы
- extensively /ɪkˈstensɪvli/ - обширно
- visited /ˈvɪzɪtɪd/ - посетил
- detail /dɪˈteɪl/ - подробно
- data /ˈdeɪtə/ - данные
- share /ʃerd/ - делиться
- British Home Office /ˈbrɪtɪʃ hoʊm ˈɒfɪs/ - Министерство внутренних дел Великобритании
- parent agency /ˈperənt ˈeɪdʒənsi/ - родительское агентство
- overshadowed /ˌoʊvərˈʃædoʊd/ - затмил
- abandoned /əˈbændənd/ - заброшенный
- fingerprint minutiae /ˈfɪŋgərprɪnt mɪˈnjuːʃiː/ - детали отпечатков пальцев
- Galton features /ˈgɔːltən ˈfiːtʃərz/ - признаки Гальтона
- recognition /ˌrekəgˈnɪʃn/ - признание
- western hemisphere /ˈwestərn ˈhemɪsfɪr/ - западное полушарие
- fingerprint pioneer /ˈfɪŋgərprɪnt ˌpaɪəˈnɪr/ - пионер отпечатков пальцев

- employee /ɪmˈplɔɪiː/ - сотрудник
- police department /pəˈliːs dɪˈpɑːrtmənt/ - полицейский департамент
- convinced /kənˈvɪnst/ - убеждён
- apparent /əˈpærənt/ - очевидный
- early fingerprint pioneers /ˈɜːrli ˈfɪŋgərˌprɪnt ˌpaɪəˈnɪrz/ - первые пионеры дактилоскопии
- manageable /ˈmænɪdʒəbl/ - управляемый
- consistent /kənˈsɪstənt/ - последовательный
- large sets /lɑːrdʒ sets/ - большие наборы
- fingerprint files /ˈfɪŋgərˌprɪnt faɪlz/ - файлы отпечатков пальцев
- criminal identification /ˈkrɪmɪnl aɪˌdentɪfɪˈkeɪʃn/ - уголовная идентификация
- based on /beɪst ɒn/ - основанный на
- modified Henry system /ˈmɒdɪfaɪd ˈhenri ˈsɪstəm/ - модифицированная система Генри
- scheme /skiːm/ - схема
- ten-print sets /ten prɪnt sets/ - наборы из десяти отпечатков
- fingerprint card /ˈfɪŋgərˌprɪnt kɑːrd/ - карточка отпечатков пальцев
- typical fingerprint card /ˈtɪpɪkl ˈfɪŋgərˌprɪnt kɑːrd/ - типичная карточка отпечатков пальцев
- maintain /meɪnˈteɪn/ - поддерживать
- fingerprint records /ˈfɪŋgərˌprɪnt ˈrekərdz/ - записи отпечатков пальцев
- enabled /ɪˈneɪbld/ - позволило
- efficient /ɪˈfɪʃənt/ - эффективный
- searching /ˈsɜːrtʃɪŋ/ - поиск
- large files /lɑːrdʒ faɪlz/ - большие файлы
- keep in mind /kiːp ɪn maɪnd/ - иметь в виду
- fingerprinted person /ˈfɪŋgərˌprɪntɪd ˈpɜːrsn/ - человек, у которого сняли отпечатки пальцев

- filed /faɪld/ - подшитый
- allowed /əˈlaʊd/ - разрешенный
- organized maintenance /ˈɔːrgənaɪzd ˈmeɪntənəns/ - организованное обслуживание
- maintained /meɪnˈteɪnd/ - поддерживаемый
- searched manually /sɜːrtʃt ˈmænjuəli/ - поиск вручную
- single print /ˈsɪŋgl prɪnt/ - один отпечаток
- recover /rɪˈkʌvər/ - восстанавливать
- partial single prints /ˈpɑːrʃl ˈsɪŋgl prɪnts/ - частичные отдельные отпечатки
- crime scenes /kraɪm siːnz/ - места преступлений
- computerized fingerprint search systems /kəmˈpjuːtəraɪzd ˈfɪŋgərˌprɪnt sɜːrtʃ ˈsɪstəmz/ - компьютеризированные системы поиска отпечатков пальцев
- impractical /ɪmˈpræktɪkl/ - непрактичный
- partial prints /ˈpɑːrʃl prɪnts/ - частичные отпечатки
- obviously /ˈɒbviəsli/ - очевидно
- compared with /kəmˈperd wɪθ/ - по сравнению с
- cards on file /kɑːrdz ɒn faɪl/ - карточки в архиве
- possible suspect /ˈpɒsəbl ˈsʌspekt/ - возможный подозреваемый
- retrieve /rɪˈtriːv/ - извлекать
- manual comparison /ˈmænjuəl kəmˈpærɪsn/ - ручное сравнение
- wanted suspects /ˈwɒntɪd ˈsʌspekts/ - разыскиваемые подозреваемые
- wanted posters /ˈwɒntɪd ˈpoʊstərz/ - плакаты о розыске
- distributed /dɪˈstrɪbjuːtɪd/ - распространенный
- police agencies /pəˈliːs ˈeɪdʒənsiz/ - полицейские управления
- displayed /dɪˈspleɪd/ - отображаемый
- public places /ˈpʌblɪk ˈpleɪsɪz/ - общественные места
- post offices /poʊst ˈɒfɪsɪz/ - почтовые отделения

• widespread deployment /ˈwaɪdspred dɪˈplɔɪmənt/ - широкое развёртывание

• computerized fingerprint storage /kəmˈpjuːtəraɪzd ˈfɪŋgərˌprɪnt ˈstɔːrɪdʒ/ - компьютеризированное хранение отпечатков пальцев

• retrieval systems /rɪˈtriːvəl ˈsɪstəmz/ - системы поиска

• routine /ruːˈtiːn/ - обычный

• rendered /ˈrendərd/ - визуализированный

• largely unnecessary /ˈlɑːrdʒli ʌnˈnesəseri/ - в значительной степени ненужный

• one time /wʌn taɪm/ - однажды

• fingerprint examiners /ˈfɪŋgərˌprɪnt ɪgˈzæmɪnərz/ - эксперты по отпечаткам пальцев

• identification personnel /aɪˌdentɪfɪˈkeɪʃn ˌpɜːrsəˈnel/ - персонал по идентификации

• extensively trained /ɪkˈstensɪvli treɪnd/ - широко обученный

• summarize /ˈsʌməraɪzɪz/ - подводить итоги

• criminal database /ˈkrɪmɪnl ˈdeɪtəbeɪs/ - криминальная база данных

• fingerprint cards /ˈfɪŋgərˌprɪnt kɑːrdz/ - карточки отпечатков пальцев

• Integrated Automated Fingerprint Identification System /ˈɪntɪˌgreɪtɪd ˈɔːtəmeɪtɪd ˈfɪŋgərˌprɪnt aɪˌdentɪfɪˈkeɪʃn ˈsɪstəm/ - Интегрированная автоматизированная система идентификации отпечатков пальцев (IAFIS)

• latent print examiner /ˈleɪtnt prɪnt ɪgˈzæmɪnər/ - эксперт по скрытым отпечаткам

• latent impressions /ˈleɪtnt ɪmˈpreʃənz/ - скрытые отпечатки

• neighboring state /ˈneɪbərɪŋ steɪt/ - соседнее государство

• national criminal database /ˈnæʃnəl ˈkrɪmɪnl ˈdeɪtəbeɪs/ - национальная криминальная база данных

• developing leads /dɪˈveləpɪŋ liːdz/ - развитие зацепок

• solving unresolved cases /ˈsɒlvɪŋ ˌʌnrɪˈzɒlvd ˈkeɪsɪz/ - решение нераскрытых дел

• larger picture /ˈlɑːrdʒər ˈpɪktʃər/ - более широкая картина

• array /əˈreɪ/ - множество

• automated systems /ˈɔːtəmeɪtɪd ˈsɪstəmz/ - автоматизированные системы

• human biometrics /ˈhjuːmən baɪˈɒmetrɪks/ - человеческая биометрия

• body metric /ˈbɒdi ˈmetrɪk/ - метрика тела

• well-defined system /ˌwel dɪˈfaɪnd ˈsɪstəm/ - четко определённая система

• human biometry /ˈhjuːmən baɪˈɒmətri/ - человеческая биометрия

• uses of fingerprints /ˈjuːzɪz əv ˈfɪŋgərˌprɪnts/ - использование отпечатков пальцев

• human identification /ˈhjuːmən aɪˌdentɪfɪˈkeɪʃn/ - идентификация человека

• criminal identification /ˈkrɪmɪnl aɪˌdentɪfɪˈkeɪʃn/ - криминальная идентификация

• related law enforcement applications /rɪˈleɪtɪd lɔː ɪnˈfɔːrsmənt ˌæplɪˈkeɪʃənz/ - соответствующие правоохранительные применения

• automated fingerprint systems /ˈɔːtəmeɪtɪd ˈfɪŋgərˌprɪnt ˈsɪstəmz/ - автоматизированные системы отпечатков пальцев

• retinal /ˈretɪnl/ - сетчатки

• iris patterns /ˈaɪrɪs ˈpætərnz/ - узоры радужной оболочки

• voice recognition /vɔɪs ˌrekəgˈnɪʃn/ - распознавание голоса

• hand geometry /hænd dʒiˈɒmətri/ - геометрия руки

• increasingly /ɪnˈkriːsɪŋli/ - всё больше

• incorporated /ɪnˈkɔːrpəreɪtɪd/ - включённый

• automated identification systems /ˈɔːtəmeɪtɪd aɪˌdentɪfɪˈkeɪʃn ˈsɪstəmz/ - автоматизированные системы идентификации

• purposes /ˈpɜːrpəsɪz/ - цели

• control entry /kənˈtroʊl ˈentri/ - контролировать вход

• security purposes /sɪˈkjʊərəti ˈpɜːrpəsɪz/ - цели безопасности

• prevent identity theft /prɪˈvent aɪˈdentəti θeft/ - предотвратить кражу личных данных

• control welfare /kənˈtroʊl ˈwelfeər/ - контроль социального обеспечения

• social services fraud /ˈsoʊʃl ˈsɜːrvɪsɪz frɔːd/ - мошенничество с социальными услугами

• computer storage /kəmˈpjuːtər ˈstɔːrɪdʒ/ - компьютерное хранение

• retrieval systems /rɪˈtriːvəl ˈsɪstəmz/ - системы поиска

• originally /əˈrɪdʒənəli/ - первоначально

• applications /ˌæplɪˈkeɪʃənz/ - приложения

• efforts /ˈefərts/ - усилия

• develop /dɪˈveləp/ - разрабатывать

• collaboration /kəˌlæbəˈreɪʃn/ - сотрудничество

• fingerprint database /ˈfɪŋgərˌprɪnt ˈdeɪtəbeɪs/ - база данных отпечатков пальцев

• National Bureau of Standards /ˈnæʃənəl ˈbjʊroʊ əv ˈstændərdz/ - Национальное бюро стандартов

• National Institute of Standards and Technology /ˈnæʃənəl ˈɪnstɪtjuːt əv ˈstændərdz ænd tekˈnɒlədʒi/ - Национальный институт стандартов и технологий

• law enforcement-based automated systems /lɔː ɪnˈfɔːrsmənt beɪst ˈɔːtəmeɪtɪd ˈsɪstəmz/ - автоматизированные системы для правоохранительных органов

• Automated Fingerprint Identification Systems (AFIS) /ˈɔːtəmeɪtɪd ˈfɪŋgərˌprɪnt aɪˌdentɪfɪˈkeɪʃən ˈsɪstəmz/ - автоматизированные системы идентификации отпечатков пальцев

• principal applications /ˈprɪnsəpəl ˌæplɪˈkeɪʃənz/ - основные приложения

• presence /ˈprezəns/ - присутствие

• developed latent fingerprints /dɪˈveləpt ˈleɪtənt ˈfɪŋgərˌprɪnts/ - проявленные скрытые отпечатки пальцев

• appropriate /əˈproʊpriət/ - подходящий

• storage technologies /ˈstɔːrɪdʒ tekˈnɒlədʒiz/ - технологии хранения

• computer algorithms /kəmˈpjuːtər ˈælgərɪðəmz/ - компьютерные алгоритмы

• trivial /ˈtrɪviəl/ - тривиальный

• commercialized /kəˈmɜːrʃəlaɪzd/ - коммерциализированный

• large jurisdictions /lɑːrdʒ ˌdʒʊrɪsˈdɪkʃənz/ - крупные юрисдикции

• commercial vendors /kəˈmɜːrʃəl ˈvendərz/ - коммерческие поставщики

• intrinsically compatible /ɪnˈtrɪnzɪkli kəmˈpætəbl/ - внутренне совместимый

• important point /ɪmˈpɔːrtənt pɔɪnt/ - важный момент

• given person /ˈgɪvn ˈpɜːrsn/ - данный человек

• prints in the files /prɪnts ɪn ðə faɪlz/ - отпечатки в файлах

• large city system /lɑːrdʒ ˈsɪti ˈsɪstəm/ - система большого города

• corresponding state system /ˌkɔːrɪˈspɒndɪŋ steɪt ˈsɪstəm/ - соответствующая государственная система

• electronic databases /ɪˌlekˈtrɒnɪk ˈdeɪtəbeɪsɪz/ - электронные базы данных

• law enforcement purposes /lɔː ɪnˈfɔːrsmənt ˈpɜːrpəsɪz/ - цели правоохранительных органов

• permanent part /ˈpɜːrmənənt pɑːrt/ - постоянная часть

• landscape /ˈlændskeɪp/ - пейзаж

• CODIS (Combined DNA Indexing System) /ˈkoʊdɪs/ - КОДИС (Объединенная система индексирования ДНК)

• NIBIN (National Integrated Ballistic Information Network) /ˈnaɪbɪn/ - НИБИН (Национальная интегрированная баллистическая информационная сеть)

• searchable image information /ˈsɜːrtʃəbl ˈɪmɪdʒ ˌɪnfərˈmeɪʃn/ - информация об изображениях с возможностью поиска

• fired bullets /ˈfaɪərd ˈbʊlɪts/ - выпущенные пули

• cartridge cases /ˈkɑːrtrɪdʒ keɪsɪz/ - гильзы

• generally /ˈdʒenərəli/ - в общем

• two types of files /tuː taɪps əv faɪlz/ - два типа файлов

• questioned specimen /ˈkwestʃənd ˈspesɪmən/ - изучаемый образец

• searched for /sɜːrtʃt fɔːr/ - разыскивается

• “known” database /noʊn ˈdeɪtəbeɪs/ - база данных "известных"

• found /faʊnd/ - найденный

• thereby identified /ˈðerbaɪ aɪˈdentɪfaɪd/ - тем самым идентифицирован

• “forensic” file /fəˈrenzɪk faɪl/ - "судебно-медицинский" файл

• unsolved cases /ˌʌnˈsɒlvd keɪsɪz/ - нераскрытые дела

• cases to be connected /keɪsɪz tuː biː kəˈnektɪd/ - дела, которые будут связаны

• share information /ʃer ˌɪnfərˈmeɪʃn/ - делиться информацией

• leads /liːdz/ - зацепки

• increasing /ɪnˈkriːsɪŋ/ - увеличивающий

• probability /ˌprɒbəˈbɪləti/ - вероятность

• apprehending a suspect /əˌpreˈhendɪŋ ə ˈsʌspekt/ - задержание подозреваемого

• successful tool /səkˈsesfl tuːl/ - успешный инструмент

• apprehension /ˌæprɪˈhenʃn/ - задержание

• unknown offenders /ˌʌnˈnoʊn əˈfendərz/ - неизвестные правонарушители

• arrested /əˈrestɪd/ - арестованный

• entered /ˈentərd/ - введённый

• job applicants /dʒɒb ˈæplɪkənts/ - соискатели

• solved /sɒlvd/ - решено

• determine /dɪˈtɜːrmɪn/ - определять

- vary /ˈveəri/ - варьироваться
- jurisdictions /ˌdʒʊrɪsˈdɪkʃənz/ - юрисдикции
- dependent /dɪˈpendənt/ - зависимый
- knowledge and skill /ˈnɒlɪdʒ ænd skɪl/ - знания и навыки
- latent or unknown impressions /ˈleɪtənt ɔːr ˌʌnˈnoʊn ɪmˈpreʃənz/ - скрытые или неизвестные отпечатки
- forensic scientists /fəˈrenzɪk ˈsaɪəntɪsts/ - судмедэксперты
- technicians /tekˈnɪʃənz/ - техники
- types of fingerprints /taɪps əv ˈfɪŋgərˌprɪnts/ - типы отпечатков пальцев
- patent /ˈpeɪtnt/ - видимый (патентный)
- plastic /ˈplæstɪk/ - пластичный
- latent /ˈleɪtnt/ - скрытый (латентный)
- visible print /ˈvɪzəbl prɪnt/ - видимый отпечаток
- enhancement /ɪnˈhænsmənt/ - улучшение
- development /dɪˈveləpmənt/ - проявление
- recognizable /ˈrekəgnaɪzəbl/ - узнаваемый
- grease /griːs/ - смазка, жир
- dark oil /dɑːrk ɔɪl/ - темное масло
- dirt /dɜːrt/ - грязь
- blood /blʌd/ - кровь
- rendering /ˈrendərɪŋ/ - делающий
- suitable for comparison /ˈsuːtəbl fɔːr kəmˈpærɪsn/ - пригодный для сравнения
- additional processing /əˈdɪʃənl ˈprɑːsesɪŋ/ - дополнительная обработка
- plastic print /ˈplæstɪk prɪnt/ - пластичный отпечаток
- indented print /ɪnˈdentɪd prɪnt/ - вдавленный отпечаток
- recognizable fingerprint indentation /ˈrekəgnaɪzəbl ˈfɪŋgərˌprɪnt ˌɪndenˈteɪʃn/ - узнаваемое углубление отпечатка пальца

• soft receiving surface /sɒft rɪˈsiːvɪŋ ˈsɜːrfɪs/ - мягкая принимающая поверхность

• tar /tɑːr/ - смола, деготь

• distinct three-dimensional character /dɪˈstɪŋkt θriːdɪˈmenʃənl ˈkærəktər/ - отчетливый трёхмерный характер

• immediately recognizable /ɪˈmiːdiətli ˈrekəgnaɪzəbl/ - немедленно узнаваемый

• require no further processing /rɪˈkwaɪər noʊ ˈfɜːrðər ˈprɑːsesɪŋ/ - не требуют дальнейшей обработки

• definition /ˌdefɪˈnɪʃn/ - определение

• requires additional processing /rɪˈkwaɪərz əˈdɪʃənl ˈprɑːsesɪŋ/ - требует дополнительной обработки

• rendered visible /ˈrendərd ˈvɪzəbl/ - сделанный видимым

• suitable for comparison /ˈsuːtəbl fɔːr kəmˈpærɪsn/ - пригодный для сравнения

• processing of latent prints /ˈprɑːsesɪŋ əv ˈleɪtnt prɪnts/ - обработка скрытых отпечатков

• development, enhancement or visualization /dɪˈveləpmənt, ɪnˈhænsmənt ɔːr ˌvɪʒuələˈzeɪʃn/ - проявление, улучшение или визуализация

• grown /groʊn/ - выросший

• clever applications /ˈklevər ˌæplɪˈkeɪʃənz/ - умное применение

• coupled with /ˈkʌpəld wɪθ/ - в сочетании с

• composition of latent residues /ˌkɒmpəˈzɪʃn əv ˈleɪtnt ˈrezɪdjuːz/ - состав скрытых остатков

• advances /ədˈvænsɪz/ - достижения

• impressive /ɪmˈpresɪv/ - впечатляющий

• applying DNA typing techniques /əˈplaɪɪŋ diːˌenˈeɪ ˈtaɪpɪŋ tekˈniːks/ - применение методов типирования ДНК

• biological evidence /baɪəˈlɒdʒɪkl ˈevɪdəns/ - биологические доказательства

- publicity /pʌˈblɪsəti/ - огласка
- residue /ˈrezɪdjuː/ остаток
- friction /ˈfrɪkʃ(ə)n/ трение
- ridge /rɪdʒ/ гребень
- skin /skɪn/ кожа
- pores /pɔː(r)z/ поры
- sweat /swet/ пот
- glands /glændz/ железы
- eccrine /ˈekrɪn/ эккринные
- composition /ˌkɒmpəˈzɪʃ(ə)n/ состав
- apocrine /ˈæpəkrɪn/ апокринные
- molecules /ˈmɒlɪkjuːlz/ молекулы
- lipids /ˈlɪpɪdz/ липиды
- proteins /ˈprəʊtiːnz/ белки
- pheromones /ˈferəməʊnz/ феромоны
- environment /ɪnˈvaɪrənmənt/ окружающая среда
- constituents /kənˈstɪtjuənts/ компоненты, составные части
- detecting /dɪˈtektɪŋ/ обнаружение
- visualizing /ˈvɪʒuəlaɪzɪŋ/ визуализация
- compounds /ˈkɒmpaʊndz/ соединения
- evidentiary /ˌevɪˈdenʃ(ə)ri/ доказательный
- integrity /ɪnˈtegrəti/ целостность
- employed /ɪmˈplɔɪd/ используемый
- illumination /ɪˌluːmɪˈneɪʃ(ə)n/ освещение
- photographed /ˈfəʊtəgrɑːft/ сфотографированный
- lifting /ˈlɪftɪŋ/ снятие
- collection /kəˈlekʃ(ə)n/ сбор
- document /ˈdɒkjʊmənt/ документировать
- seize /siːz/ захватить, изъять
- submit /səbˈmɪt/ предоставить, представить

- resolving /rɪˈzɒlvɪŋ/ разрешение
- equipped /ɪˈkwɪpt/ оборудованный
- transported /trænˈspɔː(r)tɪd/ транспортированный
- residue /ˈrezɪdjuː/ остаток
- adheres /ədˈhɪə(r)z/ прилипает, пристаёт
- preferentially /ˌprefəˈrenʃ(ə)li/ преимущественно
- powder /ˈpaʊdə(r)/ порошок
- dusting /ˈdʌstɪŋ/ опыление, напыление
- detection /dɪˈtekʃ(ə)n/ обнаружение
- century /ˈsentʃəri/ век, столетие
- inorganic /ˌɪnɔː(r)ˈgænɪk/ неорганический
- brushes /ˈbrʌʃɪz/ кисти, щётки
- proper /ˈprɒpə(r)/ правильный, подходящий
- uniform /ˈjuːnɪfɔː(r)m/ однородный
- transparent /trænsˈpeərənt/ прозрачный
- tape /teɪp/ лента
- mounted /ˈmaʊntɪd/ установленный
- backing /ˈbækɪŋ/ подложка
- lifters /ˈlɪftə(r)z/ подъемники, снимателя
- hinge /hɪndʒ/ шарнир
- magnetic /mægˈnetɪk/ магнитный
- trademark /ˈtreɪdmɑː(r)k/ торговая марка
- retractable /rɪˈtræktəb(ə)l/ выдвижной
- fatty /ˈfæti/ жирный
- substratum /ˈsʌbstreɪtəm/ основание, подложка
- bristles /ˈbrɪs(ə)lz/ щетина
- spraying /ˈspreɪɪŋ/ распыление
- immersion /ɪˈmɜː(r)ʒ(ə)n/ погружение
- formulation /ˌfɔː(r)mjʊˈleɪʃ(ə)n/ состав, рецептура
- suspension /səˈspenʃ(ə)n/ суспензия

- molybdenum /məˈlɪbdənəm/ молибден
- disulfide /daɪˈsʌlfaɪd/ дисульфид
- detergent /dɪˈtɜː(r)dʒ(ə)nt/ моющее средство
- solution /səˈluːʃ(ə)n/ раствор
- formerly /ˈfɔː(r)mə(r)li/ ранее, прежде
- wet /wet/ мокрый
- quarter /ˈkwɔː(r)tə(r)/ четверть
- silver /ˈsɪlvə(r)/ серебро
- nitrate /ˈnaɪtreɪt/ нитрат
- iodine /ˈaɪədiːn/ йод
- fuming /ˈfjuːmɪŋ/ обработка парами
- ninhydrin /nɪnˈhaɪdrɪn/ нингидрин
- chloride /ˈklɔːraɪd/ хлорид
- photoreducible /ˌfəʊtərəˈdjuːsɪb(ə)l/ фотовосстанавливаемый
- vapor /ˈveɪpə(r)/ пар
- liquid /ˈlɪkwɪd/ жидкость
- moderate /ˈmɒdərət/ умеренный
- warming /ˈwɔː(r)mɪŋ/ нагревание
- so-called /ˌsəʊ ˈkɔːld/ так называемый
- essentially /ɪˈsenʃ(ə)li/ по существу
- blowpipe /ˈbləʊpaɪp/ паяльная трубка, трубка для выдувания
- containing /kənˈteɪnɪŋ/ содержащий
- cabinet /ˈkæbɪnət/ шкаф
- fumes /fjuːmz/ пары
- trapped /træpt/ пойманный, запертый
- dirty-brown /ˈdɜː(r)ti braʊn/ грязно-коричневый
- colored /ˈkʌlə(r)d/ окрашенный
- fade /feɪd/ выцветать
- starch /stɑː(r)tʃ/ крахмал
- solution /səˈluːʃ(ə)n/ раствор

- treatment /ˈtriːtmənt/ обработка
- preferred /prɪˈfɜː(r)d/ предпочтительный
- inherently /ɪnˈherəntli/ неотъемлемо
- precisely /prɪˈsaɪsli/ точно
- impermanence /ɪmˈpɜː(r)mənəns/ непостоянство
- amino acids /əˈmiːnəʊ ˈæsɪdz/ аминокислоты
- adduct /ˈædʌkt/ аддукт
- dipping /ˈdɪpɪŋ/ окунание
- accelerated /əkˈseləreɪtɪd/ ускоренный
- heat /hiːt/ тепло
- humidity /hjuːˈmɪdəti/ влажность
- concern /kənˈsɜː(r)n/ беспокойство
- layer /ˈleɪə(r)/ слой
- chlorofluorocarbons /ˌklɔːrəʊˌflʊərəʊˈkɑː(r)bənz/ хлорфторуглероды
- recent /ˈriːs(ə)nt/ недавний
- bluish-purple /ˈbluːɪʃ ˈpɜː(r)p(ə)l/ голубовато-фиолетовый
- significant /sɪgˈnɪfɪkənt/ значительный
- synthesis /ˈsɪnθəsɪs/ синтез
- evaluation /ɪˌvæljuˈeɪʃ(ə)n/ оценка
- zinc /zɪŋk/ цинк
- blue-green /ˈbluː griːn/ сине-зелёный
- oblique /əˈbliːk/ косой
- amenable /əˈmiːnəb(ə)l/ поддающийся, восприимчивый
- revealing /rɪˈviːlɪŋ/ открытие
- exceptionally /ɪkˈsepʃənəli/ исключительно
- bright /braɪt/ яркий
- xenon /ˈziːnɒn/ ксенон
- mixture /ˈmɪkstʃə(r)/ смесь
- wavelengths /ˈweɪvleŋθs/ длины волн
- electromagnetic /ɪˌlektrəʊmægˈnetɪk/ электромагнитный

- spectrum /ˈspektrəm/ спектр
- supplied /səˈplaɪd/ снабжённый
- narrow /ˈnærəʊ/ узкий
- range /reɪndʒ/ диапазон
- induce /ɪnˈdjuːs/ вызывать
- excite /ɪkˈsaɪt/ возбуждать
- luminescence /ˌluːmɪˈnes(ə)ns/ люминесценция
- luminesced /lu:mi'nest/ люминесцирующий
- sufficient /səˈfɪʃ(ə)nt/ достаточный
- intensity /ɪnˈtensəti/ интенсивность
- monochromatic /ˌmɒnəʊkrəˈmætɪk/ монохроматический
- advantage /ədˈvɑːntɪdʒ/ преимущество
- afforded /əˈfɔː(r)dɪd/ предоставленный
- undisputed /ˌʌndɪˈspjuːtɪd/ бесспорный
- luminescent /ˌluːmɪˈnes(ə)nt/ люминесцентный
- nanoparticles /ˌnænəʊˈpɑː(r)tɪk(ə)lz/ наночастицы
- refer /rɪˈfɜː(r)/ относится
- appendices /əˈpendɪsiːz/ приложения
- volume /ˈvɒljuːm/ том
- absorption /əbˈsɔː(r)pʃ(ə)n/ поглощение
- fluorescence /ˌflʊəˈres(ə)ns/ флуоресценция
- require /rɪˈkwaɪə(r)/ требовать
- modalities /məʊˈdælətiz/ методы, способы
- approaches /əˈprəʊtʃɪz/ подходы
- recognize /ˈrekəgnaɪz/ распознавать
- pattern /ˈpæt(ə)n/ узор, рисунок
- palm /pɑː(r)m/ ладонь
- foot /fʊt/ стопа
- sufficiently /səˈfɪʃ(ə)ntli/ достаточно
- defined /dɪˈfaɪnd/ определённый

- suitable /ˈsuːtəb(ə)l/ подходящий
- profiling /ˈprəʊfaɪlɪŋ/ профилирование
- apparent /əˈpærənt/ очевидный
- published /ˈpʌblɪʃt/ опубликованный
- interfere /ˌɪntə(r)ˈfɪə(r)/ вмешиваться
- subsequent /ˈsʌbsɪkwənt/ последующий
- core /kɔː(r)/ основной
- sprayed /spreɪd/ распылённый
- squirted /skwɜː(r)tɪd/ выпрыснутый
- wash bottle /wɒʃ ˈbɒtl/ промывалка
- formulas /ˈfɔː(r)mjələz/ формулы
- shelf life /ʃelf laɪf/ срок годности
- prepared /prɪˈpeə(r)d/ приготовленный
- shortly /ˈʃɔː(r)tli/ вскоре
- chemical hazards /ˈkemɪk(ə)l ˈhæzə(r)dz/ химические опасности
- ingredients /ɪnˈgriːdiənts/ ингредиенты
- preparation /ˌprepəˈreɪʃ(ə)n/ приготовление
- peroxidase /pəˈrɒksɪdeɪz/ пероксидаза
- phenolphthalin /ˌfiːnɒlfˈθæliːn/ фенолфталеин
- leucomalachite green /ˌljuːkəʊˈmæləkaɪt griːn/ лейкомалахитовый зелёный
- tetramethylbenzidine /ˌtetrəmɛθɪlˈbɛnzɪdiːn/ тетраметилбензидин
- presumptive /prɪˈzʌmptɪv/ предположительный
- hydrogen /ˈhaɪdrədʒən/ водород
- sodium /ˈsəʊdiəm/ натрий
- peroxide /pəˈrɒksaɪd/ пероксид
- dyes /daɪz/ красители
- Amido Black 10B /ˈæmaɪdəʊ blæk ten biː/ амидо черный 10B
- Coomassie Blue R250 /kuːˈmɑːsiː bluː ɑː(r) tuːˈfɪfti/ Кумасси синий R250

- hazardous /ˈhæzə(r)dəs/ опасный
- deposited /dɪˈpɒzɪtɪd/ осаждённый
- adhesive /ədˈhiːsɪv/ клейкий
- crystal violet /ˈkrɪst(ə)l ˈvaɪələt/ кристаллический фиолетовый
- commonly /ˈkɒmənli/ обычно
- sticky side powder /ˈstɪki saɪd ˈpaʊdə(r)/ порошок для липкой стороны
- composed /kəmˈpəʊzd/ состоящий
- lycopodium /ˌlaɪkəˈpəʊdiəm/ ликоподий
- pollen /ˈpɒlən/ пыльца
- detergent /dɪˈtɜː(r)dʒ(ə)nt/ моющее средство
- slurry /ˈslɜːri/ суспензия
- rinsed /rɪnst/ промытый
- achieved /əˈtʃiːvd/ достигнутый
- identifiable /aɪˌdentɪˈfaɪəb(ə)l/ идентифицируемый
- duct /dʌkt/ клейкая
- deserving /dɪˈzɜː(r)vɪŋ/ заслуживающий
- mention /ˈmenʃ(ə)n/ упоминание
- tried /traɪd/ опробованный
- modest /ˈmɒdɪst/ скромный
- selected /sɪˈlektɪd/ избранный
- thus far /ðʌs fɑː(r)/ до сих пор
- examiners /ɪgˈzæmɪnə(r)z/ эксперты, исследователи
- destructive /dɪˈstrʌktɪv/ разрушительный
- sequence /ˈsiːkwəns/ последовательность
- fetal /ˈfiːtəl/ - эмбриональный, фетальный
- growth /grəʊθ/ - рост
- definitive /dɪˈfɪnətɪv/ - окончательный

6. Unit VI. Personal Identification Methods & ICT in Forensic Science

6. Vocabulary

- **identification** /aɪˌdɛntɪfɪˈkeɪʃən/: идентификация; e.g.: *Personal identification is a key task in forensic science.*
- **biometrics** /ˌbaɪoʊˈmɛtrɪks/: биометрия; e.g.: *Biometrics uses unique physical characteristics for identification.*
- **DNA profiling** /ˌdiːɛnˈeɪ ˈproʊfaɪlɪŋ/: ДНК-профилирование; e.g.: *DNA profiling provided conclusive identification of the victim.*
- **odontology** /ˌɒdɒnˈtɒlədʒi/: одонтология; e.g.: *Forensic odontology identifies individuals by dental records.*
- **anthropology** /ˌænθrəˈpɒlədʒi/: антропология; e.g.: *Forensic anthropology can reconstruct a face from a skull.*
- **portrait parle** /pɔːrˈtreɪ pɑːrˈleɪ/: "словесный портрет"; e.g.: *The system of portrait parle was developed by Alphonse Bertillon.*
- **composite sketch** /ˈkɒmpəzɪt skɛʧ/: композиционный портрет (фоторобот); e.g.: *A witness helped create a composite sketch of the suspect.*
- **database** /ˈdeɪtəˌbeɪs/: база данных; e.g.: *The suspect's profile was run through a national DNA database.*
- **algorithm** /ˈælgəˌrɪðəm/: алгоритм; e.g.: *A sophisticated algorithm matches fingerprint patterns.*
- **digital imaging** /ˈdɪdʒɪtl ˈɪmɪdʒɪŋ/: цифровая обработка изображений; e.g.: *Digital imaging enhanced the blurred photograph.*
- **automated fingerprint identification system (AFIS)** /ˈɔːtəmeɪtɪd ˈfɪŋgərˌprɪnt aɪˌdɛntɪfɪˈkeɪʃən ˈsɪstəm/: автоматизированная дактилоскопическая идентификационная система (АДИС); e.g.: *The print was searched in AFIS.*
- **3D scanning** /ˌθriːˈdiː ˈskænɪŋ/: 3D-сканирование; e.g.: *3D scanning of the crime scene created a virtual model.*

- **simulation** /ˌsɪmjʊˈleɪʃən/: моделирование, симуляция; e.g.: *Software allowed a simulation of the crime scenario.*
- **data mining** /ˈdeɪtə ˈmaɪnɪŋ/: интеллектуальный анализ данных; e.g.: *Data mining helps find patterns in large volumes of evidence.*
- **cyber forensics** /ˈsaɪbər fəˈrɛnzɪks/: киберкриминалистика; e.g.: *Cyber forensics investigates digital crimes.*
- **encryption** /ɪnˈkrɪpʃən/: шифрование; e.g.: *The experts had to break the encryption on the hard drive.*
- **metadata** /ˈmɛtəˌdeɪtə/: метаданные; e.g.: *The photo's metadata contained the time and location it was taken.*
- **to retrieve** /rɪˈtriːv/: извлекать (данные); e.g.: *They managed to retrieve deleted text messages.*
- **to analyze** /ˈænəlaɪz/: анализировать; e.g.: *The software analyzes speech patterns for voice identification.*
- **reliability** /rɪˌlaɪəˈbɪlɪti/: достоверность, надежность; e.g.: *The reliability of the identification method must be high.*
- **probability** /ˌprɒbəˈbɪlɪti/: вероятность; e.g.: *The match was presented with a high statistical probability.*
- **exclusion** /ɪkˈskluːʒən/: исключение; e.g.: *The primary goal is often to exclude innocent persons.*
- **verification** /ˌvɛrɪfɪˈkeɪʃən/: верификация, проверка; e.g.: *The result requires independent verification.*
- **biometric passport** /ˌbaɪoʊˈmɛtrɪk ˈpɑːspɔːrt/: биометрический паспорт; e.g.: *Modern passports contain biometric data.*
- **real-time** /ˈriːəl taɪm/: в реальном времени; e.g.: *Some systems allow for real-time facial recognition.*

7. Unit VII. The Concept and Types of Evidence

7. Vocabulary

- **evidence** /ˈɛvɪdəns/: доказательства; e.g.: *All evidence must be carefully documented.*
- **proof** /pruːf/: доказательство; e.g.: *The fingerprint was strong proof of his presence.*
- **testimony** /ˈtɛstɪməni/: показания (свидетеля); e.g.: *The witness testimony corroborated the physical evidence.*
- **exhibit** /ɪgˈzɪbɪt/: вещественное доказательство (предъявляемое в суде); e.g.: *The knife was marked as Exhibit A.*
- **real evidence** /ˈriːəl ˈɛvɪdəns/: вещественные доказательства; e.g.: *The murder weapon is real evidence.*
- **documentary evidence** /ˌdɒkjʊˈmɛntəri ˈɛvɪdəns/: письменные доказательства; e.g.: *Contracts and letters are documentary evidence.*
- **direct evidence** /dɪˈrɛkt ˈɛvɪdəns/: прямые доказательства; e.g.: *A video recording of the crime is direct evidence.*
- **circumstantial evidence** /ˌsɜːkəmˈstænʃəl ˈɛvɪdəns/: косвенные доказательства; e.g.: *Motive and opportunity are often circumstantial evidence.*
- **physical evidence** /ˈfɪzɪkəl ˈɛvɪdəns/: физические доказательства; e.g.: *Hair and fibers are types of physical evidence.*
- **biological evidence** /ˌbaɪəˈlɒdʒɪkəl ˈɛvɪdəns/: биологические доказательства; e.g.: *Blood and saliva are biological evidence.*
- **trace evidence** /treɪs ˈɛvɪdəns/: микроскопические следы, микроулики; e.g.: *Trace evidence can include glass or soil particles.*
- **demonstrative evidence** /dɪˈmɒnstrətɪv ˈɛvɪdəns/: наглядные доказательства; e.g.: *A chart or a model used in court is demonstrative evidence.*
- **hearsay** /ˈhɪəseɪ/: доказательства с чужих слов; e.g.: *Hearsay is generally not admissible in court.*

- **admissible** /ədˈmɪsəbl/: допустимый; e.g.: *The judge ruled the evidence was admissible.*
- **inadmissible** /ˌɪnədˈmɪsəbl/: недопустимый; e.g.: *Illegally obtained evidence is inadmissible.*
- **to collect** /kəˈlɛkt/: собирать; e.g.: *The crime scene unit collects evidence.*
- **to preserve** /prɪˈzɜːrv/: сохранять; e.g.: *The chain of custody preserves the integrity of evidence.*
- **to present** /prɪˈzɛnt/: представлять; e.g.: *The prosecutor will present the evidence to the jury.*
- **to corroborate** /kəˈrɒbəreɪt/: подтверждать, corroborate; e.g.: *The new finding corroborated the initial hypothesis.*
- **to contaminate** /kənˈtæmɪneɪt/: загрязнять (улики); e.g.: *Officers must not contaminate the evidence at the scene.*
- **chain of custody** /ʧeɪn əv ˈkʌstədi/: цепочка сохранности доказательств; e.g.: *A break in the chain of custody can ruin a case.*
- **weight** /weɪt/: доказательственная сила; e.g.: *The jury gives more weight to forensic evidence.*
- **materiality** /məˌtɪərɪˈælɪti/: относимость (доказательств); e.g.: *The evidence must have materiality to the case.*
- **relevance** /ˈrɛləvəns/: relevancy, значимость; e.g.: *The judge questioned the relevance of the evidence.*
- **conclusive** /kənˈkluːsɪv/: окончательный, неопровержимый; e.g.: *DNA evidence is often considered conclusive.*

Appendix IV

DICTIONARY

- **admissible** /ədˈmɪsəbl/: допустимый; e.g.: *For evidence to be admissible, it must be relevant and legally obtained.*
- **AFIS (Automated Fingerprint Identification System)** /ˈæfɪs/: автоматизированная дактилоскопическая идентификационная система (АДИС); e.g.: *The latent print was run through AFIS to find a potential match.*
- **ambient light** /ˈæmbiənt laɪt/: окружающее (естественное) освещение; e.g.: *The **ambient light** in the room was a combination of daylight and fluorescent bulbs.*
- **anthropology** /ˌænθrəˈpɒlədʒi/: антропология; e.g.: *Forensic anthropology was used to determine the age and sex of the skeletal remains.*
- **anthropometry** /ˌænθrəˈpɒmɪtri/: антропометрия; e.g.: *Alphonse Bertillon's system of anthropometry was an early method of identifying criminals.*
- **aperture** /ˈæpətʃər/: апертура, диафрагма; e.g.: *The **aperture** controls the amount of light entering the camera lens.*
- **artifact** /ˈɑːrtɪfækt/: артефакт, посторонний предмет; e.g.: *A fireplace poker in the bathroom was noted as an **artifact** at the scene.*
- **assault rifle** /əˈsɔːlt ˈraɪfəl/: штурмовая винтовка; e.g.: *The military-issue **assault rifle** fires a reduced-charge rifle cartridge.*
- **autopsy** /ˈɔːtɒpsi/: аутопсия, вскрытие; e.g.: *The forensic pathologist performed an autopsy to establish the cause of death.*
- **ballistics** /bəˈlɪstɪks/: баллистика; e.g.: *Forensic ballistics examines firearms, ammunition, and the marks they leave.*
- **ballistics** /bəˈlɪstɪks/: баллистика; e.g.: *Forensic **ballistics** is the study of projectiles and firearms.*

- **barrel** /ˈbærəl/: ствол; e.g.: *The unique markings inside the gun's barrel are transferred to the bullet.*
- **biometrics** /ˌbaɪoʊˈmɛtrɪks/: биометрия; e.g.: *Modern security systems often use biometrics like fingerprints or iris scans.*
- **Born criminal** /bɔːrn ˈkrɪmɪnəl/: прирожденный преступник; e.g.: *Cesare Lombroso's theory of the "born criminal" is now discredited.*
- **breechblock** /ˈbriːtʃblɒk/: затвор; e.g.: *The **breechblock** can leave unique markings on the primer of a cartridge case.*
- **bullet** /ˈbʊlɪt/: пуля; e.g.: *The bullet was recovered from the wall for ballistic examination.*
- **Burinsky, Evgeny F.** /bʊˈrɪnski/: Буринский, Евгений Ф.; e.g.: *Evgeny Burinsky founded the world's first forensic photographic laboratory in St. Petersburg.*
- **caliber** /ˈkælɪbər/: калибр; e.g.: *The spent cartridge case was from a 9mm caliber pistol.*
- **caliber** /ˈkælɪbər/: калибр; e.g.: *The **caliber** of the bullet was determined to be .45 inches.*
- **cartridge case** /ˈkɑːtrɪdʒ keɪs/: гильза; e.g.: *An expended **cartridge case** was found near the victim.*
- **chain of custody** /ʧeɪn əv ˈkʌstədi/: цепочка сохранности доказательств; e.g.: *Maintaining an unbroken chain of custody is vital for evidence to be admissible in court.*
- **chain of custody** /ʧeɪn əv ˈkʌstədi/: цепочка сохранности доказательств; e.g.: *A proper **chain of custody** is essential for evidence to be admissible in court.*
- **choke** /ʧoʊk/: чок (сужение ствола); e.g.: *The shotgun's full **choke** creates a tighter pellet pattern.*
- **circumstantial evidence** /ˌsɜːkəmˈstænʃəl ˈɛvɪdəns/: косвенные доказательства; e.g.: *The suspect's motive and opportunity are strong pieces of circumstantial evidence.*

- **class characteristic** /klɑːs ˌkærəktəˈrɪstɪk/: групповая характеристика; e.g.: *The brand of a shoe is a class characteristic shared by thousands of pairs.*
- **class characteristic** /klɑːs ˌkærɪktəˈrɪstɪk/: групповая характеристика; e.g.: *The number of lands and grooves is a* ***class characteristic*** *of a firearm's barrel.*
- **comparison microscope** /kəmˈpærɪsn ˈmaɪkrəskoʊp/: сравнительный микроскоп; e.g.: *Ballistic experts use a comparison microscope to match bullets.*
- **comparison microscope** /kəmˈpærɪsn ˈmaɪkrəskoʊp/: сравнительный микроскоп; e.g.: *The examiner used a* ***comparison microscope*** *to match the striations on two bullets.*
- **compression tool mark** /kəmˈprɛʃən tuːl mɑːrk/: след-оттиск (статический след орудия); e.g.: *The pry bar left a clear* ***compression tool mark*** *on the windowsill.*
- **criminalistics** /ˌkrɪmɪnəˈlɪstɪks/: криминалистика; e.g.: *Criminalistics applies scientific methods to investigate crime.*
- **cut rifling** /kʌt ˈraɪflɪŋ/: нарезка ствола резанием; e.g.: *Older barrels with* ***cut rifling*** *often leave more distinctive marks on bullets.*
- **Dactyloscopy** /ˌdæktɪˈlɒskəpi/: дактилоскопия; e.g.: *Dactyloscopy is the science of fingerprint identification.*
- **depth of field** /dɛpθ əv fiːld/: глубина резкости; e.g.: *A small aperture increases the* ***depth of field****, keeping more of the scene in focus.*
- **digital evidence** /ˈdɪdʒɪtl ˈɛvɪdəns/: цифровые доказательства; e.g.: *The suspect's text messages were key digital evidence in the case.*
- **digital forensics** /ˈdɪdʒɪtl fəˈrɛnzɪks/: компьютерно-техническая экспертиза; e.g.: *Digital forensics experts recovered deleted files from the suspect's laptop.*
- **direct evidence** /dɪˈrɛkt ˈɛvɪdəns/: прямое доказательство; e.g.: *A video recording of the crime is considered* ***direct evidence****.*

- **direct flash** /dɪˈrɛkt flæʃ/: прямой свет вспышки; e.g.: ***Direct flash*** *from the camera can create harsh shadows behind the subject.*
- **DNA profiling** /ˌdiːɛnˈeɪ ˈproʊfaɪlɪŋ/: ДНК-профилирование; e.g.: *DNA profiling conclusively linked the suspect to the crime scene.*
- **document examination** /ˈdɒkjʊmənt ɪgˌzæmɪˈneɪʃən/: почерковедческая экспертиза; e.g.: *A document examination revealed the signature was a forgery.*
- **ejector** /ɪˈʤɛktər/: эжектор; e.g.: *The* ***ejector*** *marks on the cartridge base help identify the type of firearm.*
- **evidence** /ˈɛvɪdəns/: доказательства; e.g.: *All physical evidence must be carefully collected and catalogued.*
- **Exchange Principle (Locard's)** /ɪksˈʧeɪnʤ ˈprɪnsəpəl/: принцип обмена (Локара); e.g.: *Locard's Exchange Principle states that every contact leaves a trace.*
- **exculpatory evidence** /ɪkˈskʌlpətɔːri ˈɛvɪdəns/: оправдательные доказательства; e.g.: *The defense argued that the deleted photo might contain* ***exculpatory evidence****.*
- **exhibit** /ɪgˈzɪbɪt/: вещественное доказательство; e.g.: *The murder weapon was entered into the court record as Exhibit A.*
- **extractor** /ɪkˈstræktər/: экстрактор; e.g.: *The* ***extractor*** *claw leaves a distinct mark on the rim of a cartridge case.*
- **fingerprints** /ˈfɪŋgərˌprɪnts/: отпечатки пальцев; e.g.: *A criminal left his fingerprints at the crime scene.*
- **firearm** /ˈfaɪərɑːrm/: огнестрельное оружие; e.g.: *The recovered firearm was sent for ballistic testing.*
- **firing pin impression** /ˈfaɪərɪŋ pɪn ɪmˈprɛʃən/: след ударника; e.g.: *The* ***firing pin impression*** *was compared microscopically to test-fired cartridges.*
- **firing pin** /ˈfaɪərɪŋ pɪn/: ударник; e.g.: *The impression of the* ***firing pin*** *on the primer is a key feature for comparison.*

- **forensic imaging** /fəˈrɛnzɪk ˈɪmɪdʒɪŋ/: создание судебного образа (копии данных); e.g.: *The first step in digital forensics is the forensic imaging of the hard drive.*
- **forensic science** /fəˈrɛnzɪk ˈsaɪəns/: судебная наука; e.g.: *Modern forensic science relies on advanced technology and rigorous methodology.*
- **general rifling characteristics** /ˈʤɛnərəl ˈraɪflɪŋ ˌkærɪktəˈrɪstɪks/: общие характеристики нарезов ствола; e.g.: *Determining the **general rifling characteristics** helps narrow down the possible firearm used.*
- **grip safety** /grɪp ˈseɪfti/: предохранитель на рукоятке; e.g.: *The pistol was equipped with a **grip safety** that had to be depressed to fire.*
- **Gross, Hans** /groʊs, hɑːns/: Гросс, Ганс; e.g.: *Hans Gross is often called the "father of criminalistics" for his systematic manual.*
- **guide number** /gaɪd ˈnʌmbər/: ведущее число вспышки; e.g.: *The **guide number** is used to calculate the correct aperture for flash photography.*
- **Gunshot Residue (GSR)** /ˈgʌnʃɒt ˈrɛzɪdjuː/: следы выстрела (СВ); e.g.: *GSR on the suspect's hands indicated he had recently fired a weapon.*
- **gunshot residue** /ˈgʌnʃɒt ˈrɛzɪdjuː/: следы выстрела; e.g.: **Gunshot residue** was collected from the suspect's hands for analysis.*
- **headstamp** /ˈhɛdstæmp/: маркировка на дне гильзы; e.g.: *The **headstamp** indicated the cartridge was manufactured by Winchester.*
- **ICT (Information and Communications Technology)** /ˌaɪ siː ˈtiː/: информационно-коммуникационные технологии (ИКТ); e.g.: *ICT has revolutionized evidence analysis, from AFIS to digital forensics.*
- **individual characteristic** /ˌɪndɪˈvɪdʒuəl ˌkærəktəˈrɪstɪk/: индивидуальная характеристика; e.g.: *The unique scratch on a bullet is an individual characteristic linking it to a specific gun.*
- **individual characteristic** /ˌɪndɪˈvɪdʒuəl ˌkærɪktəˈrɪstɪk/: индивидуальная характеристика; e.g.: *Unique striations on a bullet are **individual characteristics** that can identify a specific barrel.*

- **ISO sensitivity** /ˌaɪɛsˈoʊ ˌsɛnsɪˈtɪvɪti/: светочувствительность ISO; e.g.: *Increasing the **ISO sensitivity** allows for photography in lower light but can introduce digital noise.*
- **laboratory** /ləˈbɒrətəri/: лаборатория; e.g.: *Edmond Locard established the world's first police crime laboratory in Lyon.*
- **lands and grooves** /lændz ənd gruːvz/: поля и нарезы; e.g.: *The pattern of **lands and grooves** on a bullet is imparted by the rifling in the barrel.*
- **latent print** /ˈleɪtənt prɪnt/: невидимый (латентный) отпечаток; e.g.: *Latent prints on the glass were developed using cyanoacrylate fuming.*
- **Locard, Edmond** /loʊˈkɑːr, ˈɛdmənd/: Локар, Эдмон; e.g.: *Edmond Locard formulated the fundamental Exchange Principle in forensic science.*
- **macro imaging** /ˈmækroʊ ˈɪmɪʤɪŋ/: макросъемка; e.g.: ***Macro imaging** was used to photograph the fine detail of the tool mark.*
- **marginal abrasion** /ˈmɑːrʤɪnəl əˈbreɪʒən/: поясок осаднения; e.g.: *The entrance gunshot wound was surrounded by a **marginal abrasion**.*
- **memory card** /ˈmɛməri kɑːrd/: карта памяти; e.g.: *The digital images were stored on a 4-gigabyte **memory card**.*
- **minutiae** /mɪˈnjuːʃiː/: детали папиллярного узора; e.g.: *Fingerprint identification is based on the comparison of ridge minutiae.*
- **mobile device forensics** /ˈmoʊbaɪl dɪˈvaɪs fəˈrɛnzɪks/: экспертиза мобильных устройств; e.g.: *Mobile device forensics extracted crucial location data from the victim's phone.*
- **muzzle** /ˈmʌzl/: дульный срез; e.g.: *Gunshot residue patterns vary depending on the distance from the **muzzle** to the target.*
- **NIBIN (National Integrated Ballistic Information Network)** /ˈnɪbɪn/: Национальная интегрированная баллистическая информационная сеть; e.g.: *The cartridge case was entered into NIBIN, linking it to a shooting in another state.*

- **NIBIN** /ˈnɪbɪn/ (National Integrated Ballistic Information Network): Национальная интегрированная баллистическая информационная сеть; e.g.: *The cartridge case was entered into the **NIBIN** database to search for matches from other crimes.*

- **oblique lighting** /əˈbliːk ˈlaɪtɪŋ/: боковое освещение; e.g.: ***Oblique lighting** was used to highlight the striations in the tool mark.*

- **odontology** /ˌɒdɒnˈtɒlədʒi/: одонтология; e.g.: *Forensic odontology uses dental records to identify unknown remains.*

- **pathology** /pəˈθɒlədʒi/: патология; e.g.: *Forensic pathology focuses on determining cause and manner of death.*

- **perspective shot** /pərˈspɛktɪv ʃɒt/: перспективный снимок; e.g.: *A **perspective shot** showed the knife's position in relation to the victim.*

- **physical evidence** /ˈfɪzɪkəl ˈɛvɪdəns/: вещественные доказательства; e.g.: *Hairs and fibers are common types of physical evidence.*

- **primer** /ˈpraɪmər/: капсюль; e.g.: *The **primer** compound ignites when struck by the firing pin, setting off the propellant.*

- **ricochet** /ˈrɪkəʃeɪ/: рикошет; e.g.: *The bullet **ricocheted** off the concrete wall before striking the victim.*

- **rifling** /ˈraɪflɪŋ/: нарезка (в стволе); e.g.: *The rifling in the barrel imparts spin and unique markings to the bullet.*

- **rifling** /ˈraɪflɪŋ/: нарезы (в стволе); e.g.: *The **rifling** in the barrel imparts a spin to the bullet for stability in flight.*

- **sawed-off shotgun** /ˈsɔːd ɒf ˈʃɒtgʌn/: обрез (укороченное ружье); e.g.: *The suspect was found in possession of a **sawed-off shotgun**.*

- **scale** /skeɪl/: масштабная линейка; e.g.: *A **scale** was placed next to the footwear impression before it was photographed.*

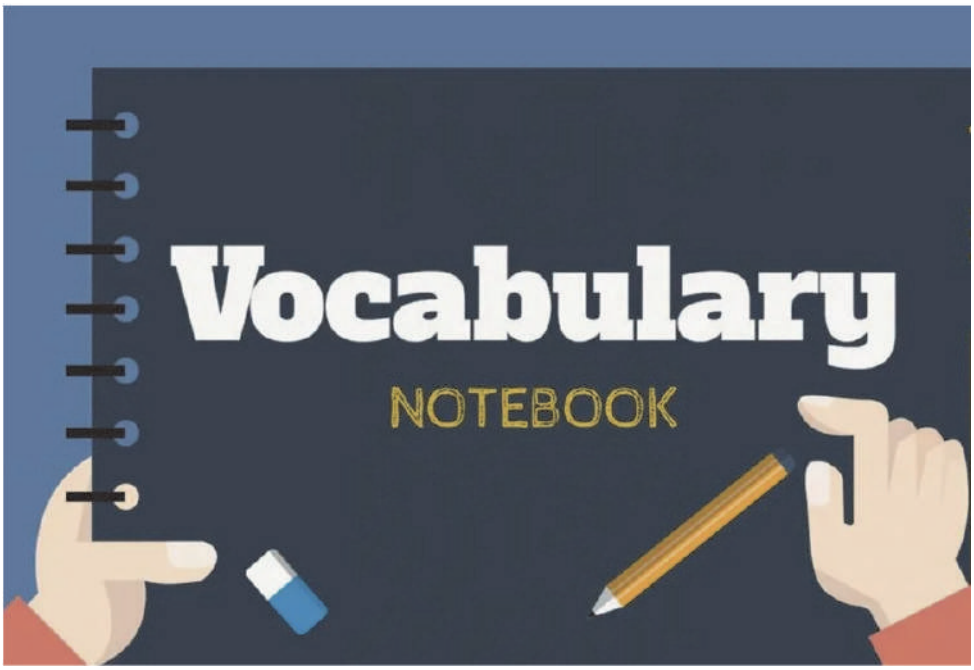
- **semiautomatic pistol** /ˌsɛmiˌɔːtəˈmætɪk ˈpɪstəl/: самозарядный пистолет; e.g.: *The recovered weapon was a 9mm **semiautomatic pistol**.*

- **silencer** /ˈsaɪlənsər/: глушитель; e.g.: *An improvised **silencer** was attached to the muzzle of the rifle.*

- **skid mark** /skɪd mɑːrk/: след проскальзывания (пули); e.g.: ***Skid marks*** *on the bullet occurred as it entered the rifling before engaging fully.*
- **sliding tool mark** /ˈslaɪdɪŋ tuːl mɑːrk/: след-трасса (динамический след орудия); e.g.: *The screwdriver left a* ***sliding tool mark*** *as it was forced across the metal surface.*
- **smokeless powder** /ˈsmoʊkləs ˈpaʊdər/: бездымный порох; e.g.: *Modern ammunition uses* ***smokeless powder*** *as a propellant.*
- **striation** /straɪˈeɪʃən/: штрих, бороздка; e.g.: *The matching* ***striations*** *on the two bullets confirmed they were fired from the same gun.*
- **submachine gun** /ˌsʌbməˈʃiːn gʌn/: пистолет-пулемет; e.g.: *The* ***submachine gun*** *is designed to fire pistol-caliber ammunition automatically.*
- **test firing** /tɛst ˈfaɪərɪŋ/: экспериментальный отстрел; e.g.: ***Test firing*** *the suspect's weapon provided known bullets for comparison.*
- **testimony** /ˈtɛstɪməni/: показания; e.g.: *The expert's testimony explained the ballistic evidence to the jury.*
- **tool mark** /tuːl mɑːrk/: след орудия; e.g.: *The* ***tool mark*** *on the door jamb was cast with silicone rubber.*
- **toolmark** /ˈtuːlmɑːrk/: след орудия; e.g.: *The toolmark on the window frame matched the suspect's crowbar.*
- **toxicology** /ˌtɒksɪˈkɒlədʒi/: токсикология; e.g.: *Toxicology screening found drugs in the victim's bloodstream.*
- **trace evidence** /treɪs ˈɛvɪdəns/: микроулики, следовые доказательства; e.g.: *Fibers and hair are common types of* ***trace evidence****.*
- **trace evidence** /treɪs ˈɛvɪdəns/: микроулики, следы-микровещества; e.g.: *Trace evidence like fibers and glass can link a suspect to a scene.*
- **Traceology** /treɪsiˈɒlədʒi/: трасология; e.g.: *Traceology is the study of marks and impressions left at a crime scene.*

- **Yakimov, Ivan N.** /jəˈkiːmɒf/: Якимов, Иван Н.; e.g.: *Ivan Yakimov's textbook became the cornerstone of the Soviet criminalistics curriculum.*
- **yaw** /jɔː/: рыскание (пули); e.g.: *The bullet's **yaw** angle can change dramatically after passing through an intermediate target.*

APPENDIX V



English-English Forensic Vocabulary

Abrasion – An injury to the skin that removes the epithelial layer.

Accused :- A person charged with a criminal offense. He is still not convicted of the crime.

Acquittal- A courtroom verdict in which a criminal defendant has not been found

AFIS—Automated Fingerprint Identification System

Algor Mortis – The reduction in body temperature after death.

Asphyxia – Death caused by suffocation as a result of the lack of oxygen and increase of carbon dioxide in the blood. Also known as apnoea.

Back spatter—blood directed back toward the source of energy or force that caused the spatter; often associated with entrance gunshot wounds.

Ballistic fingerprinting– Ballistic fingerprinting is a method used to analyze and compare the unique markings left on bullets and cartridge cases to identify the firearm used in a crime.

Blow flies—large metallic looking flies often attracted to a dead body immediately after death.

Cadaveric Spasm – The sudden rigidity of the muscles immediately after death.

Castoff pattern—bloodstain pattern created when blood is released or thrown from a blood-bearing object in motion.

Chain of Custody/Evidence- A continuous succession of persons responsible for the evidence with the purpose to ensure there is neither alteration nor loss of evidence: the documentation of the chain of custody is a record of times, places, and persons who have been responsible for the evidence. Transfers should be kept to a minimum and when transfers are made, they should be documented carefully. All transfers of custody of evidence must be logged with: the name of the persons transferring custody-the name of the persons receiving custody-and the date and time of each transfer: the documentation may be attached to the evidence envelope.

Circumstantial Evidence – Evidence from which a logical conclusion of a fact may be drawn.

CODIS – The Combined DNA Index System, the FBI database of genetic information

Contusion – A soft hemorrhage from a blunt trauma.

Corpus Delicti – The essential body of facts that suggest a crime has occurred. From the Latin 'body of crime'. All the parts of the crime scene are considered as corpus delicti.

Crime Scene Staging – The alteration or manipulation of a crime scene in order to reduce its evidentiary value or to misguide the investigator.

Criminal Profiling –The analysis of the crime scene and crime patterns to assign relevant characteristics to a perpetrator in order to aid law enforcement in narrowing the field of suspects.

Culprit:- One who is found guilty of an offence after the investigation. He/She is also called as the criminal, perpetrator or offender.

Direct evidence—information that established fact, for example, an eyewitness' testimony that the defendant fired the fatal shot.

Drip pattern—bloodstain pattern resulting from blood dripping into blood.

Electrocution - Death brought about by electricity.

Equivocal death—manner of death (homicide, suicide, accident) remains undetermined after a complete investigation.

Evidence – Any items, in any state of matter or in any form encountered at the scene of crime and are included in a legal investigation for the jury's or judge's consideration in the determination of an individual's guilt or innocence.

Exemplar—representative item usually in undamaged or less damaged condition to which a damaged item can be compared.

Expert Witness – An individual with a specialized knowledge of a certain field that can assist in the understanding of complicated information or offer an expert opinion in the court of law. Example: Forensic Expert, Ballistic Expert etc.

Expirated blood—blood propelled from the nose, mouth, or a wound as a result of air pressure and/or air flow.

Exsanguination—bleeding to death

Facial recognition– Facial recognition is a technology that uses algorithms to identify and verify a person's identity based on their facial features.

Facial Reconstruction - Reconstruction of unidentified human remains is done by modeling clay, representing muscle, tissue and skin, over the skull. On the forehead, margins of the eyes, cheekbones, bridge of the nose, above the lips, and the chin, facial shape is closely related to skull contour. However, the shape of the eyes and eyelids, the tip of the nose, and the lips cannot be predicted from the skull, and these are important features in facial recognition. Advances in 3-D computer modeling are aiding in and may soon replace a sculpted facial reconstruction.

Forensic anthropology– Forensic anthropology is the study of human remains to determine the cause of death, identify the individual, and provide evidence for criminal investigations.

Forensic archaeology– Forensic archaeology involves the excavation and analysis of buried human remains and associated evidence to aid in criminal investigations and provide historical context**.**

Forensic botany– Forensic botany is the use of plant evidence, such as pollen or plant fragments, to link suspects, victims, or crime scenes in criminal investigations.

Forensic entomology– Forensic entomology is the study of insects, their life cycles, and their behavior to estimate the time of death and provide evidence in criminal investigations.

Forensic entomology– Forensic entomology is the study of insects, their life cycles, and their behavior to estimate the time of death and provide evidence in criminal investigations**.**

Forensic geology– Forensic geology is the study of rocks, minerals, and soil to provide evidence and geological context in criminal investigations, such as identifying the origin of soil samples found at a crime scene.

Forensic linguistics– Forensic linguistics is the application of linguistic analysis and techniques to investigate and solve crimes, such as analyzing voice recordings or deciphering coded messages.

Forensic toxicology– Forensic toxicology is the analysis of bodily fluids and tissues to determine the presence of drugs, poisons, or other chemicals that may have contributed to a person's death or impairment.

Handwriting analysis - The examination and interpretation of handwriting to determine characteristics or personality traits.

Hanging—Suspension from a cord wound around the neck.

High velocity impact spatter—bloodstain pattern caused by a high velocity force or impact of approximately 100 feet or more per second, such as the force produced by a gunshot; the spatter is characterized by a mist-like dispersion; most mist-like droplets are usually 0.1 mm or smaller.

Homicide – Murder, a death caused by another person.

Hypostasis (Livor Mortis) – Also known as lividity. The pooling of blood at the lowest parts of the body. Usually commences between six and eight hours after death has occurred.

Hypothermia - This situation occurs when the core temperature of one's body falls below normal. It is the failure of the body to maintain adequate production of heat under conditions of extreme cold.

Hypoxia – Decrease in oxygen to the brain.

IBIS—Integrated Ballistics Information System—a database used for acquiring, storing, and analyzing images of bullets and cartridge casings.

Impact spatter—bloodstain pattern created when blood receives a blow or force resulting in the random dispersion of smaller drops.

Impression Evidence – The evidence left by anything that leaves a kind of impression at the scene or on an item, such as footprints, tire tracks, toolmarks, bite marks, fingerprints etc.

Incendiary fire—fire intentionally caused by human activity.

Indent – An impression left on paper caused by the force from a pen tip.

Junk DNA—the discovery that much of the DNA in every cell was repeated sequence DNA that doesn't code for proteins and led to speculation that the repeat sequence DNA had no function.

Laceration – The splitting or tearing of the skin.

Ligature strangulation—Strangulation without suspension using some form of cord-like object called a garrote.

Maggots - The larvae of flies and other insects that live on rotting food.

Manner of Death – The way in which death was caused; homicide, suicide, accidental, natural, or undetermined.

Manual strangulation—Strangulation using the fingers or other extremity

Mechanism of death—abnormality produced by the cause of death which is incompatible with life.

Medium velocity impact spatter—bloodstains produced when a blood source has been subjected to a medium velocity force (5-25 feet per second); beating usually produces this type of spatter .

NDNAD – National DNA Database, the UK's database of DNA profiles

Oblique lighting—lighting cast at angle almost parallel with an object to show detail by creating shadows. The light at any angle other than 90 degree is often called as oblique light.

PERK - The Physical Evidence Recovery Kit, or PERK, is a kit used to collect evidence.

Point of origin—three dimensional point or area from which the blood that produced a bloodstain originated; determined by projecting angles of impact or well-defined bloodstains back to an axis constructed through the point or area of convergence. It is also used for fire in cases of arson.

Polygraph – A lie detector test that measures physiological responses to determine truthfulness.

Rigor mortis - The stiffening of the body muscles after death.

Serial Killer – An individual who has murdered three or more people with a cooling-off period in between. This cooling off period can be in days or months.

Signature Crime – A crime scene bearing the individual 'stamp' of a particular offender. It is not a physical stamp, however a particular pattern opted by the criminal or a particular symbol left at the crime scene.

Skeleton bloodstain—bloodstain consisting only of an outer periphery after the central area is removed by wiping when the liquid was partially dry.

Strangling is compression of the neck that may lead to unconsciousness or death by causing an increasingly hypoxic state in the brain.

Strangulation - The condition of having respiration stopped by compression of the air passage.

Suicide – a death caused by same person (killing of self).

Suspect:- Person suspected of committing a crime. There can be one or more suspects in a crime or criminal activity. However, few of them can be accused or convicted as criminal.

Testimonial Evidence - statements or the spoken word from the victim(s) or witness(es).

Trace Evidence – Minute pieces of evidence found at the crime scene, including fibre, hair, glass, seed, and soil.

APPENDIX VI



TESTS for Self-Control

::Вопрос 1::Choose right definition for: money laundering

~торговля оружием

~денежный перевод

~отмывание денег

~прачечная

~денежный выкуп

::Вопрос 2::Someone who steals from a pocket or a handbag in public places.

~A kidnapper

~A hijacker

~A pickpocket

~A policeman

~A field-criminalist

::Вопрос 3::If a person breaks the law it means that he commits a _____

~crime

~investigation
~interrogation
~lesson
~hostage

::Вопрос 4::Choose right definition for: Drug trafficking _____
~is trading in illegal drugs such as heroin, cannabis, cocaine, LSD, etc.
~is the crime of betraying your own country by helping its enemies.
~is stealing small amounts of goods or things of little value, often over a long period of time.
~is a car accident in which the guilty driver does not stop to help.
~is the use of violence such as murder and bombing in order to obtain political demands or to influence a government

::Вопрос 5::A person who commits a criminal offence is called a criminal, or an_____.
~offender
~citizen
~witness
~resident
~policeman
::Вопрос 6::Everybody must study a _____language at school
~forgotten
~honour
~foreign
~different
~forgiven

::Вопрос 7::Crime _____ among youngsters is increasing.
~car

~police

~rate

~officer

~offence

::Вопрос 8::You must work hard to _____your knowledge

~move

~like

~improve

~make

~mean

::Вопрос 9::She’s much _____ her sister

~taller that

~more taller

~more tall than

~taller than

~more tall that

::Вопрос 10::I must _____ these sentences into English

~to translate

~translate

~translating

~translated

~translates

::Вопрос 11::In order to prevent a criminal suspect from escaping, police use_____

~gloves

~handcuffs

~perpetrators

~fingerprints
~Glasses

::Вопрос 12::The letter _____in pencil and it was difficult to read it.
~is writing
~has written
~was writing
~writes
~was written

::Вопрос 13::Do you know _____about him?
~somebody
~anybody
~anywhere
~somewhere
~anything

::Вопрос 14::My _____name is Mr. James Harris, said Mrs. Harris.
~daughter’s
~colleague’s
~animal’s
~husband’s
~passenger’s

::Вопрос 15::Last autumn he _____a student of our university.
~jumped
~finished
~invented
~became

~learned

::Вопрос 16::The police _____the car in the forest far from the town.

~threw

~found

~felt

~fought

~fired

::Вопрос 17::This book doesn’t _____much

~pay

~look

~cost

~watch

~look like

::Вопрос 18::Mark _____the shop and bought some new books.

~went

~offered

~joined

~touched

~entered

::Вопрос 19::The teacher can _____all the mistakes in our translations.

~to find

~finding

~find

~finds

~found

::Вопрос 20::The students _____in the country next summer.

~work

~were working

~are working

~will work

~have worked

::Вопрос 21:Our Constitution _____ many years ago

~has written

~was written

~was writing

~wrote

~writes

::Вопрос 22::Are the books in your room? Yes, my friend_____.

~puts them there

~put it there

~puts it there

~to put them there

~put them there

::Вопрос 23::The weather is better today, _____

~hasn’t it

~isn’t it

~doesn’t it

~to know

~aren’t it

::Вопрос 24::Shakespeare was born in 1564, he _____at the age of fifty-two

~entered

~decided

~found

~died

~called

::Вопрос 25::You must be _____when crossing the street.

~late

~slept

~careful

~besides

~real

::Вопрос 26::This room can _____as a classroom.

~use

~be used

~have used

~useful

~to go

::Вопрос 27::. Why _____you writing with a pencil?

~do

~have

~did

~had

~are

::Вопрос 28::These new houses _____two years ago.

~were built

~have built

~built

~builded

~building

::Вопрос 29::But the new school _____next year.

~will build

~will be built

~has built

~will have built

~will be building

::Вопрос 30::John _____his friend at the station.

~invented

~knew

~let

~met

~go

::Вопрос 31::The opposite of guilty is _____

~young

~criminal

~ arrested

~innocent

~wanted

::Вопрос 32::This policeman graduated from _____Moscow University.

~the

~—

~a

~an

~any

::Вопрос 33::This table is made _____wood.

~with

~by

~from

~of

~on

::Вопрос 34::I can't find his address _____.

~somewhere

~nowhere

~somebody

~anywhere

~nobody

::Вопрос 35::Give me _____to read, please.

~anything

~something

~somebody

~anybody

~somewhere

::Вопрос 36::She gave him _____water to wash his hands and face.

~many
~few
~a little
~a few
~a many

::Вопрос 37::The Thames is _____than the Volga.
~short
~ shortest
~shorter
~ more short
~more shorter

::Вопрос 38::This is the _____view I have ever seen in my life.
~beautiful
~most beautiful
~more beautiful
~beautifuler
~beautifulest

::Вопрос 39::I _____very busy yesterday.
{
~am
~is
~was
~were
~will be

::Вопрос 40::_____your sister go to school?
~do

~is

~are

~does

~am

::Вопрос 41::What is the official name of Britain?

~The United Kingdom of Great Britain and Northern Ireland

~ United Kingdom of Great Britain and Northern Ireland

~ The United Kingdom of the Great Britain and the Northern Ireland

~Great Britain

~England

::Вопрос 42::What parts does the United Kingdom consist of?

~England, Scotland, Wales

~England, Scotland, Wales, Ireland

~England, Scotland, Wales, Northern Ireland

~England, Scotland, Wales, Iceland

~England, Spain, Wales, Ireland

::Вопрос 43::What kind of state is Great Britain?

~a republic

~a parliamentary monarchy

~an absolute monarchy

~the presidential republic

~a constitutional republic

::Вопрос 44::Who is the head of the state of Great Britain de jure?

~the Parliament

~the Queen

~the Prime Minister

~the King

~the President

::Вопрос 45::When did the Queen Elizabeth II come to the throne?

~in 2012

~in 1897

~in 1952

~in 2019

~in 1900

::Вопрос 46::What are the Houses of British Parliament?

~The House of Lords and the House of Commons

~The House of Lords and the House of Commons and Senate

~Senate and the House of Lords

~Congress

~House of Representatives and State Duma

::Вопрос 47::Who heads the government of Great Britain de facto?

~The Queen

~the Prime Minister

~the President

~The King

~The Princess

::Вопрос 48::The USA is... a union of 50 states.

~a constitutional republic

~a presidential republic

~a federal republic

~a constitutional monarchy

~a republic

::Вопрос 49::The USA consists of_____

~49 states and the state of the Hawaii Islands

~50 states and the District of Columbia

~49 states and the District of Columbia

~51 states

~15 states

::Вопрос 50::The head of the American state and government is the President, elected for _____years

~five

~seven

~six

~four

~two

::Вопрос 51::The political system of the U.S. consists of _____branches

~two

~three

~Four

~Five

~seven

::Вопрос 52::The legislative body is the Congress consisting of _____.

~the Senate and the House of Representatives

~the House of Commons and the House of Representatives;

~the House of Commons and the Senate

~the House of Representatives and the President

~The Senates

::Вопрос 53::Who discovered America?
~Christopher Columbus
~George Washington
~The pilgrims
~John Glenn
~Abraham Lincoln

::Вопрос 54::Who was the first president of the USA?
~Abraham Lincoln
~George Washington
~Franklin D. Roosevelt
~Tomas Jefferson
~Christopher Columbus

::Вопрос 55::Which is the United States capital?
~New York City
~Los Angeles
~Washington, D.C.
~Chicago
~San Francisco

::Вопрос 56::The American flag has
~thirteen stripes
~thirty stripes
~fifty stripes
~fifteen stripes
~fifty - one stripes

::Вопрос 57::Washington, D.C., is a _____

~State

~Country

~District

~Town

~City

::Вопрос 58::Where does the President of the USA live and work?

~ in Congress

~in the White House

~in the Pentagon

~in the Empire State Building

~in the Supreme Court

::Вопрос 59::Russia is _____ largest country in area.

~world’s

~the world’s

~the worlds’

~a world’s

~the world

::Вопрос 60::The head of the Russian government is the _____

~President

~Prime Minister

~State Duma

~Federal Assembly

~the King

::Вопрос 61::Moscow _____ in 1147

~was founded

~is founded

~was found

~founded

~was founding

::Вопрос 62::_____ different climatic zones in our country

~There is

~This is

~There are

~It is

~This are

::Вопрос 63::Moscow was rebuilt, _____ it was destroyed by fire

~ so

~therefore

~because

~if

~while

::Вопрос 64::The _____ power is realized by the Federal Assembly

~executive

~judicial

~legislative

~federal

~civil

::Вопрос 65::The Upper Chamber of the Federal Assembly is called the Federation _____

~Duma

~Council

~Court

~State

~Senate

::Вопрос 66::Moscow is _____ capital of _____ Russia, our Motherland

~the, the

~a, —

~— , —

~the, —

~a, a

::Вопрос 67::The head of the state in Russia is the _____

~President

~Prime Minister

~State Duma

~Federal Assembly

King

::Вопрос 68::The Napoleon army in 1812 _____ Moscow by fire

~was destroyed

~is destroyed

~was destroy

~destroyed

~destroying

::Вопрос 69::In the north, _____ very cold

~there is

~there is

~there are

~it is

~it does

::Вопрос 70::The Russian Federation is situated _____ two plains

~between

~on

~in

~of

~ into

::Вопрос 71::The _____ branch of the Federal Government is represented by the Constitutional Court, the Supreme Court and regional courts

~executive

~judicial

~legislative

~federal

~ district

::Вопрос 72::The state _____ is the Lower Chamber of the Federal Assembly

~Duma

~Council

~Court

~Power

~Congress

::Вопрос 73::_____you written the letter to our teacher

~shall

~will

~have

~did

~having

::Вопрос 74::The police have _____evidence against this suspect

~nothing

~none

~no

~nobody

~everything

::Вопрос 75::He was_____ by the police outside a club in Chicago

~arrested

~understood

~gone

~built

~gone

::Вопрос 76::What _____nice day

~the

~a

__

~An

~some

::Вопрос 77::Dealing drugs behind a restaurant is an example of a_____

~behavior

~ pickpocket

~back-up

~street crime

~Study

::Вопрос 78::Another word for "theft" is_____

~murder

~felony

~stolen

~robbery

~cyber crime

::Вопрос 79::He _____a letter to his friend yesterday

~wrote

~will write

~is writing

~did write

~have written

::Вопрос 80::One of the first things detectives do at a crime scene is check for_____

~treasures

~cruisers

~fingerprints

~Felonies

~Gold

::Вопрос 81::Convicted offenders can be fined or given a _____ sentence

~Bar

~jail
~ cell
~ bail
~cage

::Вопрос 82::A car is driven faster than the limit
~traffic light
~speeding
~ drunk-driving
~ trafficking
~stopping

::Вопрос 83::A person throws a lit match into a building and it catches fire
~murder
~arson
~burglary
~domestic violence
~theft

::Вопрос 84::A terrorist group takes over an airplane and changes its course
~speeding
~vandalism
~trafficking
~hijacking
~robbery

::Вопрос 85::A man regularly assaults his wife and children
~burglary
~homicide

~domestic violence
~abduction
~fraud

::Вопрос 86::A dishonest lawyer charges a client for more hours of work than he really did
~theft
~burglary
~armed robbery
~fraud
~trafficking

::Вопрос 87::A police officer shoots and kills an unarmed teenager who refused to obey him
~robbery
~murder
~ terrorism
~ assault
~smuggling

::Вопрос 88::A thief goes into your house through a window
~forgery
~fraud
~burglary
~vandalism
~pick-pocketing

::Вопрос 89::A child steals a chocolate bar from a store
~trafficking
~assault

~kidnapping
~child abuse
~shoplifting

::Вопрос 90::An _____ is the crime of causing or threatening to cause physical harm to someone
~vandalism
~bruise
~assault
~bullet
~hazard

::Вопрос 91::To _____ is to obey orders
~burn
~carry
~comply
~charge
~rule
::Вопрос 92::_____ _____ is an item that can be used to kill someone or cause serious physical harm
~Disorderly conduct
~Equipment console
~Deadly weapon
~Aggravated assault
~Soft touch

::Вопрос 93::If something is _____, it can cause damage.
~horizontal
~clever
~harmful

~charge

~drunk

::Вопрос 94::_____ is the effort of a law enforcement department to discover the facts surrounding an incident

~Offence

~Airway

~Assault

~Excessive force

~Investigation

::Вопрос 95::_____ are a metal device placed around the wrists to immobilize the hands

~Watch

~K-9 unit

~Kits

~Handcuffs

~Weapons

::Вопрос 96::She was charged with giving false ____ in court

~alibi

~evidence

~innocent

~text

~money

::Вопрос 97::Ten _____ are expected to testify at the trial today

~innocent

~motives

~witnesses

~alibi

~killer

::Вопрос 98::Two sisters have been charged with _____.
~innocence
~murder
~motive
~guilty
~movie

::Вопрос 99::He firmly believes that she is _____ of the crime
~innocent
~evidence
~motive
~theft
~watch

::Вопрос 100::Why would she have killed him? She has no _____.
~dead
~murder
~motive
~handcuffs
~police

::Вопрос 101::A person who transports things illegally into a country is a_____
~mugger
~smuggler
~bandit
~killer
~teacher

::Вопрос 102::Paying a police officer to do something illegal is_____

~mugging

~bribery

~arson

~theft

~fraud

::Вопрос 103::A story that proves someone could not have committed a crime is_____

~an alibi

~a witness

~an evidence

~a robbery

~a test

::Вопрос 104::A person who attacks people in the street to steal is a _____

~burglar

~pickpocket

~mugger

~killer

~kidnapper

::Вопрос 105::Robbery is _____

~demanding money from a person or organization by threatening them

~stealing money or other things from a bank, shop etc

~deliberately killing someone

~playing cards on money

~leaving country illegally

::Вопрос 106::Blackmail is _____

~obtaining money in return for not revealing someone's secret

~following and watching someone over a period of time in an annoying way

~writing or printing untrue statements to damage someone's reputation

~writing love letters to celebrities

~making posts in the Internet

::Вопрос 107::Murder is _____

~receiving or handling stolen goods

~killing someone with a knife

~unpleasant or threatening behavior towards someone

~stealing jewelry

~damaging things, especially public property

::Вопрос 108::The police have _____ two men in connection with the robbery in the town centre yesterday

~armed

~cooked

~worked

~arrested

~wrote

::Вопрос 109::One main task of the police is to _____ criminals

~choose

~catch

~come

~carry

~calm

::Вопрос 110::Choose right definition for: Vandalism _____
~is bad or improper behavior by a person in a position of authority or trust, such as a doctor, dentist, police officer, etc.
~is stealing things from people's pockets or handbags, usually in crowds or in public places.
~is saying something untrue about someone with the intention of damaging his or her reputation.
~is deliberately damaging public buildings and other public property, usually just for the fun of it.
~is offering money or gifts to someone in a position of authority, e. g. a government official, in order to persuade him to help you in some way

::Вопрос 111::Choose right definition for: Smuggling _____
~is the crime of lying in court while giving evidence, when you have promised to tell the truth.
~is the crime of taking things or people illegally into or out of the country
~is murdering a public figure such as a king, a president, etc.
~is entering privately owned land or property without the permission of the owner.
~is attacking someone, usually in a public place, in order to rob him or her

::Вопрос 112::He has three children, _____he?
don't
~hasn't
~haven't
~has
~hadn't

::Вопрос 113::Choose the right term for the definition: the crime of deliberately setting fire to a building

~murder

~arson

~theft

~bribery

~Fraud

Вопрос 114::Choose the right term for the definition: the crime of breaking into a house, a flat, etc. in order to steal things

~kidnapping

~forgery

~rape

~murder

~burglary

::Вопрос 115::Last year she _____English lessons to a group of our students

~worked

~defended

~took

~drew

~gave

::Вопрос 116::The law can punish criminals in many different ways, but the worst is ___.

~fine

~life imprisonment

~death sentence

~jail

~home detention

::Вопрос 117::Choose the right form for the definition: money paid as a punishment

~tax

~wage

~cash

~fine

~credit card

::Вопрос 118::Young people who committed a crime are tried by a special court called _____

~the Royal Court

~the Juvenile Court

~the High Court

~the Crown Court

~the Criminal Court

::Вопрос 119::A sophomore is _____

~a first year student

~a second year student

~a third year student

~a fourth year student

~a fifth year student

::Вопрос 120::Правоохранительные органы

~Law enforcement agencies

~Peace-keeping activities

~Legal statutes

~Law organs

~Law enforcement activities

::Вопрос 121::The oldest British universities are _____

~Princeton and New York

~Moscow and Saint-Petersburg

~Oxford and Cambridge

~Paris and Berlin

~Cambridge and Glasgow

::Вопрос 122::Higher education in the USA is provided by_____

~schools and kinder gardens

~colleges and universities

~cinemas and cafes

~universities and laboratories

~colleges and schools

::Вопрос 123::I _____at the Krasnodar University of the Ministry of Internal Affairs of Russia

~get

~study

~investigate

~learning

~make

::Вопрос 124::The terrorists kidnapped the child and held him as a _____

~officers

~murders

~burglar

~hostage

~killer

::Вопрос 125::Choose the right translation of the term: International police cooperation

~преступления против личности

~международное сотрудничество полицейских

~компьютерная преступность

~международное преступное сообщество

~сотрудничество независимых государств

::Вопрос 126::Give the translation of the term: Угон воздушного средства

~cybercrime

~hijacking

~gambling

~drug trafficking

~theft

::Вопрос 127::When _____ her homework?

~Ella usually does

~does Ella do usually

~usually does Ella

~does Ella usually do

~do Ella usually do

::Вопрос 128::_____is someone who steals

~A thief

~An arsonist

~A hijacker

~Investigators

~Thieves

::Вопрос 129::He was arrested while trying to _____drugs into the country

~murder

~arson

~smuggle

~locate

~investigate

::Вопрос 130::What time _____ lunch?

~does Jack has

~do Jack have

~Jack has

~do Jack has

~does Jack have

:Вопрос 131::_____coined the term Criminalistics

~Alphonse Bertillon

~Hans Gross

~Edmond Locard

~Mathieu Orfilais

~Robert Peel

::Вопрос 132::In the 1880s Alphonse Bertillon created the first classification system called _____

~anthropometry

~toxicology

~sociology

~ecology

~criminology

::Вопрос 133::A medical expert states time of _____of a dead body

~birth

~marriage

~divorce

~death

~evidence

::Вопрос 134::A forensic expert works as a _____

~field-criminalist

~forest-criminalist

~river-criminalist

~lake-criminalist

~moon-criminalist

::Вопрос 135::A criminalist identifies people by their_____.

~cars

~fingerprints

~thoughts

~cases

~documents

::Вопрос 136::Give the right translation of the term: human trafficking

~кража интеллектуальной собственности

~отмывание денег

~торговля наркотиками

~экологические преступления

~торговля людьми

::Вопрос 137::Can he _____English?

~speaks

~speaking

~spoke

~speak

~to speak

::Вопрос 138::A person who commits a criminal offence is called a criminal, or an _____.

~ citizen

~witness

~offender

~ offenders

~investigator

::Вопрос 139::If you attack another person illegally you will be tried for unlawful _____

~damage

~punishment

~assault

~law

~testimony

::Вопрос 140::If the injury you cause in the attack is very serious it is called _____.

~manslaughter

~grievous bodily harm

~kidnapping

~pickpocketing

~murder

::Вопрос 141::The law can punish criminals in many different ways, but the worst is _____.

~freedom

~ life imprisonment

~death sentence

~5 year imprisonment

~30 year imprisonment

::Вопрос 142::Young people who committed a crime are tried by a special court called ____.

~the Juvenile Court

~death sentence

~5 year imprisonment

~30 year imprisonment

~freedom

::Вопрос 143::Name the types of financial crimes.

~fraud, embezzlement, forgery

~ financial scam, tax evasion, rape

~ money laundering, bribery, murder

~robbery, smuggling, slaughter

~manslaughter, kidnapping, forgery

::Вопрос 144::What is an identity theft?

~ theft of credit cards

~ theft of ideas

~theft of personal information

~car theft

~theft of art works

::Вопрос 145::What is Cybercrime?

~the use of robots for a crime

~the use of video and audio-means for a crime

~the use of mass media for a crime

~the use of any computer network for a crime

~the use of cybercrimes for a crime

::Вопрос 146::What of the following crimes are not Cybercrimes?

~trawl the web, hostile postings, burglary

~ vicious rumours, computer hacking, abusive messages

~ extortion, stalking and harassment

~cyberterrorism, computer hacking, extortion

~ phishing, email harassment, cyberstalking

::Вопрос 147::In what sphere are the white-collar crimes widespread?

~criminal law

~administrative law

~constitutional law

~economy

~philosophy

::Вопрос 148::What is the best method of identification of identical twins?

~fingerprinting

~DNA

~anthropometrical

~eyewitness identification

~physical appearance

::Вопрос 149::Which methods of identification are biometrical?
~ interrogation, footprints, ear shape
~iris scans, hand geometry, voice verification
~eyewitness identification, ear shape, body odour
~interviewing, brain fingerprinting, signature dynamics
~body odour, facial identification, interrogation

::Вопрос 150::_____ is something that is concrete, something that can generally be measured, photographed, analyzed, and presented as a physical object in court.
~Circumstantial evidence
~A latent print
~Physical evidence
~Corroborative evidence
~Invisible evidence
::Вопрос 151::The word investigate is derived from _____ vestigare meaning to
~a Latin word
~a French word
~a Russian word
~a Chinese word
~a

::Вопрос 152::_____ is something that is concrete, something that can generally be measured, photographed, analyzed, and presented as a physical object in court.
~Circumstantial evidence
~A latent print
~Physical evidence
~Corroborative evidence
~Invisible evidence

::Вопрос 153::The crime scene technician _____

~gives the first aid to a victim

~apprehends a criminal

~analyzes the situation

~takes fingerprints, footprints

~interrogates a suspect

::Вопрос 154::The interrogation is a _____ of an investigation

~part

~crime

~witness

~fingerprinting

~main

::Вопрос 155::Мне хотелось бы допросить подозреваемого сразу

~I’d like to interrogate the witness at ones

~I liked to interrogate the suspect at ones

~I’d like to interrogate the suspect at ones

~I’d like to interview the suspect at ones

~I’d like to interview the criminal at ones

::Вопрос 156::The line of distinction between an interrogation and an interview is very _____

~long

~big

~thin

~thick

~fat

::Вопрос 157::There are lots of _____ in this part of the city - put your money and phone somewhere safe

~pickpockets

~murderers
~smugglers
~counterfeiters
~kidnappers

::Вопрос 158::When I go out at night, I usually leave a light on in the house; I think it will stop _____ breaking into my house.
~eyewitnesses
~kidnappers
~drug dealers
~burglars
~killers
::Вопрос 159::A: Did he kill his wife? B: Yes, he's been charged with _____.
~manslaughter
~homicide
~murder
~killing
~all of the above answers

::Вопрос 160::This person _____ a crime last year.
~founded
~committed
~interrogated
~killed
~committing

::Вопрос 161::Prevention of juvenile _____ is one of the important tasks too.
~investigation

~delinquency
~keystone
~robbery
~entrance

::Вопрос 162::The crime of _____ is committed when anyone obtains money by violence.
~larceny
~extortion
~tax fraud
~fhishing
~slaughter
::Вопрос 163::A person who betrays his country to another state is a _____
~traitor
~thief
~terrorist
~pickpocket
~sky-jacker
::Вопрос 164::All articles found at the crime scene which help to prove a case are called _____
~eyewitnesses
~corpus delicti
~crime
~footprints
~physical evidence

::Вопрос 165::An imprint left by the criminal who cannot be seen without special techniques is called _____
~corroborative print
~powder

~fingerprint
~dust
~plaster casts

::Вопрос 166::A homicide that is neither accidental nor lawful and does not fall into the categories of manslaughter is called_____
~perjury
~housebreaking
~abduction
~fraud
~murder

::Вопрос 167::Criminal investigation is the key task of the _____ service.
~transport
~police
~crime
~interrogation
~medical

::Вопрос 168::The aim of any crime scene search is _____
~to destroy evidence
~to pack evidence
~to discover evidence
~to hide evidence
~to make plaster casts

::Вопрос 169::Eyewitness identification is widely used _____.
~in identification
~in taking fingerprints
~in collecting evidence

~in giving the first aid

~in telling the truth

::Вопрос 170::This method is used for victim identification in mass disasters

~DNA

~fingerprint

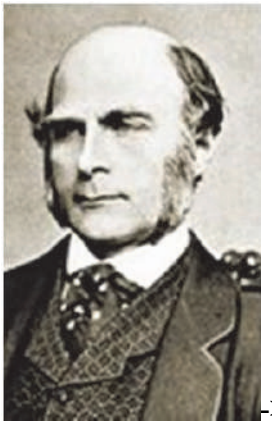
~dental records

~iris scan

~voice verification

::Вопрос1::Сопоставьте портреты криминалистов с их фамилиями:

{

=  -> Alphonse Bertillon

=  -> Mathieu Orfila

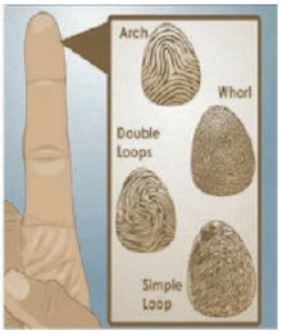
=  -> Francis Galton

=  -> Cesare Lombroso

=  -> Henry Folds

}

Тестовые задания с выбором краткого ответа.

::Вопрос 1::What is it? 

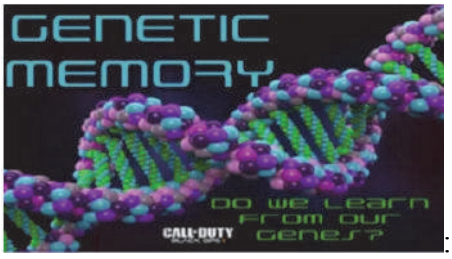
:

::Вопрос 2::What is it?  :

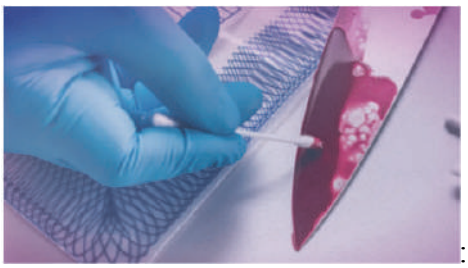
::Вопрос 3::What is it?  :

::Вопрос 4::What type of identification is it?  :

::Вопрос 5::What type of identification is it?  :

::Вопрос 6::What type of identification is it? 

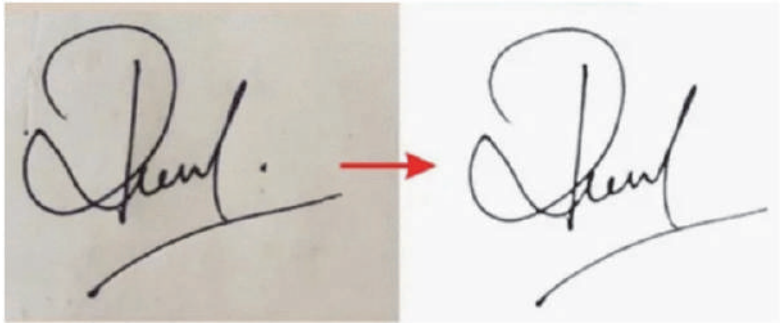
:

::Вопрос 7::What type of identification is it?  :

::Вопрос 8::What type of identification is it?  :

::Вопрос 9::What type of identification is it?  :

::Вопрос 10::What type of identification is it?

 :

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