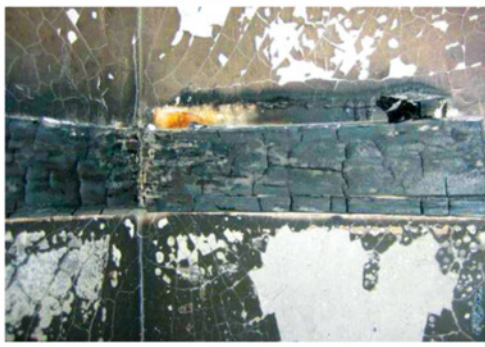
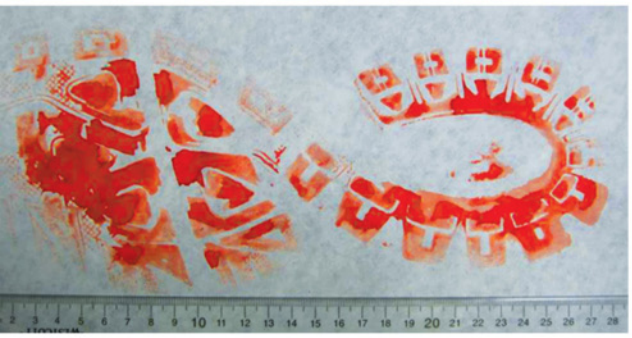
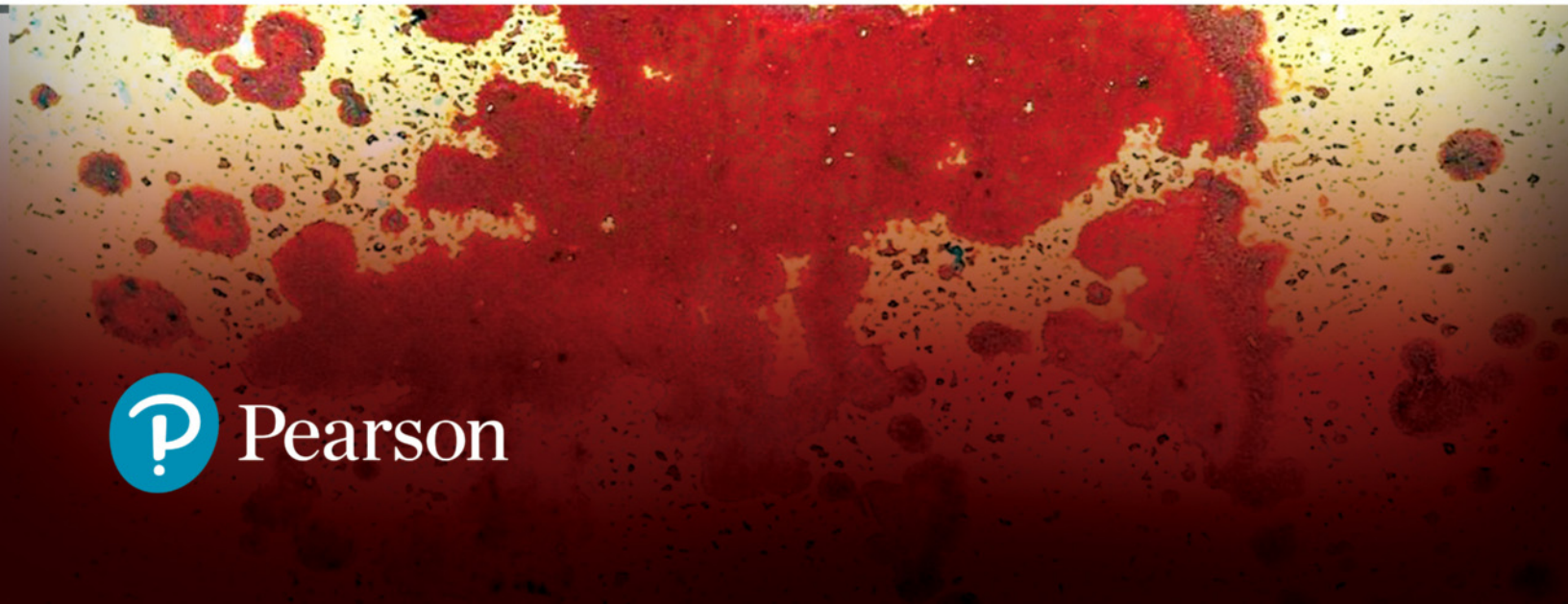
Fourth Edition

Crime Scene Investigation & Reconstruction

Robert R. Ogle | Sharon Plotkin







Pearson

Fourth Edition

Crime Scene Investigation and Reconstruction

Robert R. Ogle, Jr.

Sharon L. Plotkin

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CONTENTS

Foreword *xvii*
Preface *xix*

Chapter 1 INTRODUCTION TO PHYSICAL EVIDENCE 1

Key Words 1
Learning Outcomes 1
Introduction 1
Brief History of Forensic Science and the Examination of Physical Evidence 1
Types, Value, and Advantages of Physical Evidence 2
Categories of Physical Evidence 3
Laboratory Analysis of Physical Evidence 3
Types of Evidence 3
Direct evidence 3
Circumstantial evidence 3
Testimonial evidence 3
Physical evidence 4
Value of Physical Evidence 4
Reconstruction of the crime scene 4
Determines whether or not a crime occurred 4
Links an individual with another individual, a crime scene, or other crimes 5
Provides investigative leads to investigators 5
Provides facts to a jury to assist in determination of guilt or innocence 6
Provides evidence to link serial homicide or rape cases 6
Some Advantages of Physical Evidence 6
Major Categories of Physical Evidence 7
Class and Individual Characteristics of Physical Evidence 7
Laboratory Analysis of Physical Evidence 10
Comparative analysis process 10
Results of the comparison process 11
Comparison Standards and Controls 12
Ethical, Legal, and Scientific Requirements for Evidence Collection 13
Ethical requirements 13
Legal requirements 14
Scientific requirements 22
Summary 23 • Review Questions 24
Further References 24
Appendix 1-A ***Search and Seizure*** **25**
Fourth Amendment to the U.S. Constitution 25
General Exceptions to the Warrant Requirement 25
The Exclusionary Rule 26
Glossary of Cases 27

Appendix 1-B *Consent to Search and Completed Search Forms* **28**
Consent to Search Form 28
Completed Search Form 29
Appendix 1-C *Laboratory Analysis and Chain of Custody Examples* **30**

Chapter 2 CRIME SCENE SEARCH PRINCIPLES 33
Key Words 33
Learning Outcomes 33
Introduction 33
Department Orders Regarding Crime Scenes 34
Authority 34
Responsibility 34
First Responders at the Scene 34
Safety 34
Emergency care 34
Approaching the scene 35
Actions to be taken by the first responder 36
Crime Scene Investigator 37
The role of the crime scene investigator 37
Choice of crime scene investigator 38
Record pertinent data immediately 38
Contact the First Responder at the Scene 39
Obtain overview of circumstances known and observations made by the responding officer 39
Determine areas that can be crossed without destroying potential evidence 39
Tour the scene with the first responder 39
Establish a Command Center for the Operation 39
Establish a Plan for Processing the Scene 40
Data to be Compiled Before Collection Process 41
Crime Scene Search: Be Systematic! 42
Thorough notes of actions taken at the scene 42
Photography of the scene 42
Sketches of the scene 42
Crime scene search 43
Separate Areas/Collectors 45
Systematic Search Methods 45
Strip method 45
Grid method 46
Zone method 46
Spiral method 46
Finishing the Crime Scene Search: Debriefing 46
Final Survey of the Crime Scene 47
Summary 47 • Review Questions 48
Further References 48
Appendix 2-A *Sample Crime Scene Entry Log* **49**
Appendix 2-B *Customized Crime Scene Search Kits* **50**
Level of Crime Scene Search Kit Needed 50

Chapter 3 CRIME SCENE PHOTOGRAPHY 56

Key Words 56
Learning Outcomes 56
Introduction 56
Objectives of Crime Scene Photography 57
Number of Photographs at the Scene 57
Conditions at the Scene 57
Choice of Camera Type for Crime Scene Photography 58
Single-lens reflex (SLR) film camera 58
Digital single-lens reflex (DSLR) cameras 58
Videotaping of Crime Scenes 60
Suggested Systematic Approach 61
Log of All Photographs Taken 61
Types of Photographs of a Crime Scene 61
Overview/layout photographs (long-range) 61
Medium-range photographs 62
Close-up photographs 65
Point of view of witnesses 66
Photographs taken during the night 66
How to work with available light 66
Camera shake due to a slow shutter speed 68
Depth of field 68
Photography of latent impressions 69
Photography of wounds 70
Summary 71 • Review Questions 71
Further References 72
Appendix 3-A ***Basic Equipment List for Crime Scene Photography*** **73**
Appendix 3-B ***Common Photography Terminology*** **74**
Appendix 3-C ***Night Photography*** **79**
Supplies Needed 79
Procedure 79
Inverse Square Law 80
Appendix 3-D ***Luminol Photography*** **81**
Supplies Needed 81
Procedure 81

Chapter 4 CRIME SCENE SKETCHES 83

Key Words 83
Learning Outcomes 83
Introduction 83
Value of Sketches 83
Objectives of Crime Scene Sketches 84
Present a clear "mind's eye" picture of the crime scene 84
Complement the investigator's notes and photographs 84
Show the accurate location and relationships of the evidence items 84
Refresh the memory of investigators 84
Illustrate the testimony of witnesses 84

Provide factual data for crime scene reconstructions 84
Rules of Thumb for Sketches 84
Plan systematically for sketching the scene 84
First roughly show the overall layout of the scene 85
Prepare detailed sketches of pertinent area with measurements 85
Prepare blow-up sketches as necessary 85
Additional sketches 85
Additional Points to Keep in Mind 85
Show compass point on sketch 85
Make accurate measurements for all evidence items 85
Use equal accuracy for measurements for items on the same sketch 86
Use fundamental methods for measurements 86
Make sure that the tape is straight and does not sag when the measurement is taken 86
Avoid common errors such as the following 86
Have two individuals verify all measurements 86
Types of Sketches 86
Rough sketches at the scene 86
Finished sketches 89
Courtroom display sketches 90
Critical accuracy sketches (reconstruction, courtroom displays) 91
Three-dimensional computer-drawn sketches 92
Preparation of Sketches: Suggested Systematic Procedure 93
Measurement Techniques 94
Rectangular coordinates measurement method 94
Triangulation measurement method 95
Secondary reference points measurement method 95
Transecting baseline measurement 95
Polar coordinates measuring method 96
Personnel requirements 97
Equipment needed 98
Triangulation: using the compass 98
Summary 99 • Review Questions 99

Chapter 5 LATENT FINGERPRINT EVIDENCE 100
Key Words 100
Learning Outcomes 100
Introduction 100
Types of Fingerprints and Impressions 102
Inked fingerprints 102
Latent fingerprints 102
Patent prints 103
Age of the Latent Fingerprint 105
Nature of the Latent Print Deposit 105
Contributions from the skin glands 105
Contributions from contaminants 105

Development of Latent Prints 106
General Considerations for Latent Prints 106
Techniques Suitable for the Crime Scene 108
Laser light, alternate lights, and ultraviolet light 108
Development with powder and brush 108
Development with cyanoacrylate 110
Processing with iodine fuming 110
Processing with small particle reagent 112
Processing with ninhydrin, ninhydrin analogues, or DFO 113
Sequential Approaches to Latent Impression Detection and Collection 115
Wet Surfaces: Dry at Room Temp; Treat as for Dry Surfaces 116
Sequencing of Methods for Latent Development 116
All surface/latent deposit combinations 117
Nonabsorbent surfaces 117
Absorbent surfaces 119
Adhesive tapes 120
Fingerprints in blood 122
Latent and patent prints on skin 122
Submission of Latent Print Evidence to the Laboratory 122
Marking of evidence 122
Collection of elimination prints 123
Submission of inked fingerprints for comparisons 123
Preservation of evidence 124
Elimination prints 125
Courtroom presentation of latent print evidence 125
Special considerations 126
Summary 126 • Review Questions 128 Further References 128 • Glossary of Acronyms for Table 5-1 129
Appendix 5-A ***Safety Precautions for Latent Print Development*** **131**
General Guidelines for Safety 131
Guidelines for Safety at the Crime Scene 131
Safety Guidelines in the Laboratory 132
Guidelines for Biological Hazards 133
Guidelines for Safety at Autopsies 133

Chapter 6 TRACE EVIDENCE 134
Key Words 134
Learning Outcomes 134
Introduction 134
Hair Evidence 135
Introduction to hair evidence 135
Significant features of hair 136
Microscopic features of human hair 137
Other comparison characteristics in hair 139
Laboratory examinations of hair evidence 139

Collection of hair evidence 140
Standard/control specimens of hair 142
Laboratory reports concerning hair examinations 144
Fiber Evidence 146
Introduction to fiber evidence 146
Occurrence of fiber evidence 147
Laboratory examinations of fiber evidence 147
Collection of fiber evidence 148
Fiber comparison standards needed for laboratory analysis 149
Glass Evidence 150
Introduction to glass evidence 150
Laboratory examinations of glass evidence 150
Collection of glass evidence 151
Paint Evidence 152
Introduction to paint evidence 152
Hit-and-run cases: vehicle to pedestrian 152
Hit-and-run cases: vehicle to vehicle 153
Burglary cases 153
Laboratory examinations of paint evidence 153
Laboratory reports concerning paint evidence 154
Collection of paint specimens 154
Soil Evidence 156
Introduction to soil evidence 156
Laboratory examinations of soil evidence 156
Collection of soil evidence 158
Arson Accelerant Evidence 159
Introduction to arson investigations 159
Nature of volatile flammables 159
At the scene 160
Laboratory analysis of accelerant residues 163
Summary 164 • Review Questions 165
Further References 166

Chapter 7 BIOLOGICAL FLUID STAIN EVIDENCE: BLOOD, SEMEN, AND SALIVA 167
Key Words 167
Learning Outcomes 167
Introduction 167
Bloodstain Evidence 168
Introduction to bloodstain evidence 168
Genetic markers in bloodstains 168
Crime scene documentation of bloodstains 169
Collection of bloodstain evidence 173
Comparison standard samples for DNA typing 175
Blood samples from postmortem subjects 176
General comments 177
Laboratory analysis of bloodstains 177

DNA Analysis of Biological Stains 177
DNA analysis in the laboratory 177
PCR Analysis 177
Preservation of samples for DNA analysis 178
Semen Evidence 178
Introduction to semen evidence 178
Occurrence of semen evidence 179
Collection of semen evidence 179
Laboratory examinations of semen evidence 180
Comparison standards needed for DNA analysis of semen stains 181
Saliva Evidence 181
Introduction to saliva evidence 181
Occurrence of saliva evidence 181
Screening for saliva stains at the scene 181
Preservation of saliva evidence 181
Summary 182 • Review Questions 183
Further References 183
Appendix 7-A ***Safety Precautions for Blood and Biological Fluids*** **184**

Chapter 8 FIREARMS EVIDENCE 185
Key Words 185
Learning Outcomes 185
Introduction 185
Firearm Cartridges 185
Bulleted Cartridges 185
Characteristics of rifled barrels 187
Class characteristics of fired bullets 189
Field comparisons of bullet class characteristics 189
Field estimation of bullet caliber 190
Laboratory Examinations of Firearms Evidence 190
Identification of the firearm that fired a bullet or cartridge 190
Muzzle-to-target distance determinations 194
Gunshot residue identifications 194
Weapon functionality examinations 195
Bullet trajectory and/or sequence of firing determinations 195
Collection of Firearms Evidence 195
Introduction 195
Unloading revolvers 196
Unloading autoloading firearms (semiautomatics) 196
Trace evidence and fingerprints 196
Weapons found in water 196
Transportation to the laboratory 197
Note-taking and evidence marking 197
Recovery of Fired Ammunition Components 197
Bullets embedded in wood or plaster 197
Removal of bullets from deceased persons 198

Cartridge cases 198
Shot wads 198
Shot pellets 198
Live shotshells or cartridges 198
Gunshot Residues 198
Introduction 198
Gunshot residue analysis in the laboratory 199
Collection of gunshot residues 200
Summary 205 • Review Questions 206
Further References 206
Appendix 8-A *Class Characteristics for Some Handguns and Other Firearms* 208
Key to Firearm Type Codes in Table 208
Key to Table Column Headers 208
Metric Equivalents (CAL → MM) 209

Chapter 9 IMPRESSION EVIDENCE 222
Key Words 222
Learning Outcomes 222
Introduction 222
Laboratory Examinations of Impression Evidence 223
Examination of footwear impressions 223
Examination of tire tread impressions 224
Examination of toolmark impressions 224
Collection of Impression Evidence 226
Collection of footwear and tire tread impressions 226
Photography of footwear and tire tread impressions 227
Vehicle wheelbase and width measurements 229
Casting and lifting of impressions 229
Toolmark Evidence Collection 236
Special precautions for toolmark evidence 236
Documentation of toolmark evidence 236
Fracture Evidence 238
Laboratory examination of fracture evidence 238
Summary 240 • Review Questions 241
Further References 242

Chapter 10 DRUG AND ALCOHOL EVIDENCE 243
Key Words 243
Learning Outcomes 243
Drug Evidence 243
Introduction 243
DEA schedule of controlled substances 244
Collection of drug evidence 244
Field testing of drug evidence 245
Clandestine laboratories 245
Alcohol Evidence 247
Introduction 247
Tolerance to effects of alcohol 247

Evidence in driving under the influence cases 248
Collection and preservation of alcohol specimens 248
Laboratory analysis of blood alcohol specimens 249
Summary 249 • Review Questions 250
Further References 250

Chapter 11 DOCUMENT EVIDENCE 251

Learning Outcomes 251
Introduction 251
Functions of the Document Examiner 251
Handwriting comparisons 251
Typewriting comparisons 252
Examinations of photocopiers, printers, and fax machines 252
Alterations, erasures, and obliterations 252
Indented writings 252
Ink examinations and comparisons 252
Identification of document paper composition and manufacturer 253
Identification of the source of a torn paper 253
Collection of Document Evidence 253
Precautions for handling questioned document evidence 253
Latent fingerprints 253
Charred documents 253
Exemplar writings 253
Request exemplars: dictated, forms 254
Course of business exemplars 254
Packaging of questioned documents 254
Summary 255 • Review Questions 255
Further References 255

Chapter 12 VEHICLE SCENE INVESTIGATIONS 256

Key Words 256
Learning Outcomes 256
Introduction 256
General Automobile Processing and Search 257
Traffic Accident Investigations 258
Photographs at the Accident Scene 258
Overview photographs of the scene 258
Photographs of the point of impact 258
Photographs of the position where each vehicle came to rest 258
Photographs of damage to each vehicle 258
View each driver had while approaching the accident site 259
Point of view of each witness to the accident 259
Accident Scene Sketches 259
Accuracy of the measurements 259
Predesigned scene sketch forms 259
Types of sketches for the accident scene 259
Finished sketches 259

Hit-and-Run Investigations: Vehicle versus Pedestrian 260
Scene investigation 260
Suspect vehicles 260
Victim's garments and shoes 261
Injuries to the victims 262
Hit-and-Run Investigations: Vehicle versus Vehicle 262
Scene investigation 262
Vehicle Lights 262
Scene investigation 262
Collection and packaging 263
Laboratory examinations of lightbulb filaments 263
Summary 264 • Review Questions 264
Further References 264

Chapter 13 SEXUAL ASSAULT INVESTIGATIONS 265
Key Words 265
Learning Outcomes 265
Introduction 265
Development of Modern Sexual Assault Investigation 266
Role of Physical Evidence in Sexual Assault Investigations 266
Evidence from the Crime Scene 267
First responders 267
Crime scene investigators 267
Evidence from the Victim 270
Roles of evidence from the victim 270
Sexual assault evidence collection kits 270
Medical Examination of the Victim 272
Introduction 272
Standard identification data 273
Chain of custody data 273
Collection of clothing 273
Examination of body surfaces 274
Collection of dried or moist stains from the body 275
Collection of foreign materials from the victim's body 275
Procedures for bitemarks and bruises 276
Examination of body orifices and associated structures performed by designated staff at the rape treatment center or hospital 277
Collection of fingernail scrapings 279
Baseline test(s) for sexually transmitted diseases 280
Microscopic examinations 280
Evidence from the Suspect Collected in a Hospital/Incarceration Facility Setting 280
Male suspect evidence collection kit 281
Male suspect evidential examination 281
General physical examination 282
Examination for physical evidence 282
Examination of mouth 284

Examination of Adult Male Victim of Sexual Assault 284
Evidential examination by authorized medical personnel 285
Child Sexual Abuse Examination 286
Indications of Child Abuse 289
Physical abuse 290
Sexual abuse 291
Summary 293 • Review Questions 294
Further References 294
Appendix 13-A *Swab Drying Box 295*
Appendix 13-B *Chain of Custody Form 296*
Appendix 13-C *Seal on Chain of Custody Envelopes 297*

Chapter 14 HOMICIDE CRIME SCENE INVESTIGATIONS 298
Key Words 298
Learning Outcomes 298
Introduction 298
Homicide Investigation Response Team 298
Additional Personnel Often Needed at Homicide Crime Scenes 299
Criminalists and other forensic scientists 299
Pathologists 299
Prosecuting attorney (homicide on call) 299
Forensic anthropologists 299
Forensic entomologists 299
At the Homicide Crime Scene 300
Precaution 300
Condition of body/clothing/scene 300
Protection of the body during removal 301
Area beneath the body 302
Postmortem Examination (Autopsy) Guide 303
Preautopsy conference 303
Postmortem examination photography 303
Trace evidence 304
Procedures for nude bodies 304
Hair standard samples 305
Fingernail scrapings 306
Gunshot residues 306
Gunshot wounds 306
Condition of teeth/dentures 307
Fingerprints/palm prints/footprints 307
Sexual assault homicides 308
Vehicular homicides 308
Decomposed Remains 308
Body fluids and toxicology specimens 309
Wrap-up Conference 309
Summary 310 • Review Questions 312
Further References 312
Appendix 14-A *Safety Precautions for Homicide Crime Scenes 313*
Appendix 14-B *Safety Precautions for Postmortem Examinations (Autopsies) 314*

Chapter 15 CRIME SCENE RECONSTRUCTION 315

Key Words 315
Learning Outcomes 315
Introduction 315
Establishment of Expertise 316
Expertise development 316
Critical Thinking 318
Circular reasoning 319
Ignoring the question 319
Statistical fallacies 319
The "science" fallacy 319
Foundations for Crime Scene Reconstruction 319
Process of Crime Scene Reconstruction 320
Crime scene reconstruction components 320
Recognition and documentation of the physical evidence 322
Collection and examination of the physical evidence 322
Laboratory examinations of the physical evidence 322
Analysis of data from the crime scene 322
Synthesis of analysis data 323
Types of Reconstructions 323
Traffic accident reconstructions 323
Homicide reconstructions 324
Sexual assault reconstructions 324
Reconstructions Classified by Evidence Type Utilized 324
Reconstructions based on bloodstain pattern evidence 324
Reconstructions based on firearms evidence 324
Reconstructions based on other or more than one type of evidence 324
Reconstructions Based on Bloodstain Pattern Evidence 325
Information obtained from bloodstain pattern analysis 325
Bloodstains: shoe prints, tracks, and trails 330
Reconstructions Based on Firearms Evidence 331
Introduction 331
Information available from a shooting incident reconstruction 331
Bullet trajectories 334
Bullet ricochets 339
Bullet ricochets on vehicles 340
Identification of the firearm that fired each bullet or cartridge case 342
Gunshot residues on suspected shooters 343
Distance characteristics of target residues—stippling patterns 344
Laboratory analysis of firearm evidence for reconstructions 347
Reconstructions Based on Other Evidence Types 347
Direction of force in glass pane fractures 347
Sequence of firearm projectile impacts 349

Evidence showing which occupant of a vehicle was the driver 349
Reconstructions involving more than one type of physical evidence 350
Summary 352 • Review Questions 354
Further References 355
Appendix 15-A *Crime Scene Reconstruction Checklist 356*
At the Scene 356
Bloodstain Pattern Reconstructions 356
Firearms Shooting Incidents 356
Preparation for Reconstruction Effort 357

Chapter 16 ENTOMOLOGICAL EVIDENCE 358
Key Words 358
Learning Outcomes 358
Introduction 358
History 359
Subfields and Applications 360
Time of colonization 360
Entomology on Scene 362
Temperature 362
Collection kit 365
Collection procedures 367
Labeling 371
Entomology Analysis 371
Case report information 372
Conclusion 372 • Summary 372 • Review Questions 373
Further References 374

Appendix I Crime Scene Report Writing 375
Introduction 375
Accuracy 375
Brevity 376
Clarity 376
Sketches/Photo Logs/Evidence Lists 376
Appendix II Courtroom Testimony 379
Introduction 379
Courtroom Procedures 379
Helpful Hints for the Witness 380
Testimony Dos and Don'ts 381
Grand Juries 382
Courtroom Presentation and Demeanor and Checklist 382
Appendix III Forensic Science and Latent Fingerprint Texts 384
Appendix IV Physical Evidence Chart: Collection, Preservation, and Special Instructions for Physical Evidence 386
General Instructions 386
Appendix V Computer Evidence 390
Conducting the Search and/or Seizure 390
Glossary 391
Endnotes 401
Index 405

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FOREWORD

In 2004, I encouraged my late friend and colleague, Robert Ogle, to have Pearson Education publish what was then his self-published text, *Crime Scene Investigation and Physical Evidence Manual*. Those of us involved in forensic science education knew what a real gem this publication was. My judgment proved correct and Robert went on to publish three editions of his text. When Robert passed, I urged Pearson to bring on Sharon Plotkin as a coauthor. I know of no one as dedicated and proficient to the tasks of crime scene investigation as her. The issuance of the fourth edition of Robert Ogle's and Sharon Plotkin's *Crime Scene Investigation and Reconstruction* is a testimony to the high regard with which this textbook continues to be held by both active crime scene investigators (CSIs) and academic instructors who are tasked with the responsibility of educating a new generation of criminal investigators. This new edition builds on the features of its predecessors. Most of the chapters have been updated and the text is replete with new photographs to illustrate key points regarding crime scene investigation. The authors have added extensive information to the book regarding legal requirements for the collection of physical evidence.

Interest in the role of the modern CSI has been sparked not only by a spate of popular TV shows, but also grows out of the realization that new technology has increased the effectiveness of the crime scene investigator. Recent studies have shown dramatic increases in success rates associated with the solving of burglaries and other property crimes as a result of recovering DNA evidence that a perpetrator may have simply touched. This news is already reinvigorating police to pursue investigations of scenes that in the past were assigned a low priority.

The role of the CSI is demanding. He/she must be capable of comprehending the scope of the crime scene and skilled at rapidly planning a strategy to extract all useful information from the crime site. At the same time, the CSI must be thoroughly familiar with the science underlying the laboratory examination of physical evidence. For, in truth, no matter how sophisticated a forensic laboratory may be, or how well trained its scientists are, the failure of the CSI to recognize objects possessing evidential value at the crime scene and not knowing how these objects must be packaged and preserved for subsequent laboratory examination will prove fatal to the overall conduct of the investigation. Many horror stories can be cited to exemplify how botched efforts at the scene resulted in an unsolvable crime.

Merely reading this textbook will not in itself produce a competent CSI. This must come with proper education, appropriate training, and mentored experience. But documentation protocols, fundamental collection and preservation techniques, and laboratory analytical strategies are appropriately discussed in this text. The book concludes with insights into how best to pull together all data and observations collected from the crime scene investigation into a coherent view of the events that occurred during the commission of a crime. To these ends, *Crime Scene Investigation and Reconstruction* will prove to be a valuable resource and essential instructional tool for practitioners, instructors, and students of crime scene investigation.

Richard Saferstein, Ph.D.

Professor Sharon Plotkin brings a unique component to this book. Her perspective is unique, merging hands-on application with academia in and out of the classroom. She is a certified crime scene investigator from South Florida with twenty years of crime scene experience in the field. Sharon has handled cases ranging from burglary to complex death investigations utilizing crime scene techniques, including shooting and

bloodstain reconstruction and chemical enhancement as well as advanced photographic techniques. She has also taught in the field of forensic science. Her contributions to the field of forensic science are quite remarkable. In addition to her college level instruction, she has trained hundreds of law enforcement professionals throughout the United States and the Caribbean. Sharon Plotkin is innovative and stresses the importance of a thorough investigation.

Dr. Henry Lee

PREFACE

NEW TO THIS EDITION

Author Plotkin has been a crime scene investigator in North Miami for almost 20 years handling cases ranging from Burglary to all types of death investigations. Her perspective and knowledge has been presented here in this updated edition to provide real world hands on practical aspect to crime scene investigations.

Chapter 2

- updated information regarding evidence collection and processing methodology
- sample forms for crime scene searches

Chapter 3 Photography

- current digital photography information
- techniques for photography
- addition of challenging photographic technique such as chemical enhancement and hight photography

Chapter 4 Sketching

- updated sketching methodology
- addition of figures for different types of sketch examples

Chapter 5 Latent Fingerprinting

- current fingerprinting techniques with figures and photographs

Chapter 8 Firearms

- updated information, figures and photographs depicting shooting reconstruction techniques

Chapters 12–14

- updated lab standards for collection of evidence and submissions.
- updated information on scene documentation

Chapter 15 Crime Scene Reconstruction

- new and current information on current language used in bloodstain reconstruction, as well as additional information on reconstruction techniques and collection of evidence

Chapter 16 Entomology

- addition of a new chapter on the study and scene considerations of insects on crime scenes as they assist in criminal investigations.

INSTRUCTOR SUPPLEMENTS

Instructor's Manual with Test Bank. Includes content outlines for classroom discussion, teaching suggestions, and answers to selected end-of-chapter questions from the text. This also contains a Word document version of the test bank.

TestGen. This computerized test generation system gives you maximum flexibility in creating and administering tests on paper, electronically, or online. It provides state-of-the-art features for viewing and editing test bank questions, dragging a selected question into a test you are creating, and printing sleek, formatted tests in a variety of layouts. Select test items from test banks included with TestGen for quick test creation, or write your own questions from scratch. TestGen's random generator provides the option to display different text or calculated number values each time questions are used.

PowerPoint Presentations. Our presentations are clear and straightforward. Photos, illustrations, charts, and tables from the book are included in the presentations when applicable.

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eBooks This text is also available in multiple eBook formats. These are an exciting new choice for students looking to save money. As an alternative to purchasing the printed textbook, students can purchase an electronic version of the same content. With an eTextbook, students can search the text, make notes online, print out reading assignments that incorporate lecture notes, and bookmark important passages for later review. For more information, visit your favorite online eBook reseller or visit www.mypearsonstore.com.

ABOUT THE AUTHORS

Robert R. Ogle, Jr.

Robert Ogle attended the University of California in Berkeley, California, earning a Bachelor's degree in Letters and Science, with a major in Zoology. He attended several California State Universities as a graduate student in Biology and in Criminology. Mr. Ogle is the author of *O. J. Simpson: Not Guilty by Reason of Inanity;* and (with coauthor Michelle J. Fox) *Atlas of Human Hair Microscopic Characteristics*. He was a Criminalist with the Contra Costa County, California, Sheriff-Coroner and was a Criminalist and Managing Criminalist with the California Department of Justice before entering private practice as a forensic consultant. Also, he served as a forensic consultant for defense counsel in a number of homicide cases, including *People v. Randy Kraft* (the largest serial murder case tried in the United States). He was a guest instructor in crime scene investigation courses in California Community Colleges and Law Enforcement Training Centers. Mr. Ogle gave many papers to forensic meetings and published many articles in forensic journals and law enforcement publications.

Sharon L. Plotkin

Sharon Plotkin obtained her Masters of Science degree in Criminal Justice with a minor in Psychology from Florida International University. She obtained her Bachelor of Science degree in Social Work, also from Florida International University and an Associate of Arts degree in Psychology from Broward Community College.

Sharon Plotkin received her certification through International Association for Identification in 2006 and has been doing crime scene work for almost 20 years. She has handled thousands of cases ranging from burglaries to homicides and suspicious death cases.

Sharon has a passion for teaching and loves the opportunity to excite students in wanting to embark on a career in the law enforcement field. She has been teaching at the college level for almost 13 years. She is full-time faculty at the largest college in the nation that currently has 165,000 students enrolled, teaching in the crime scene technology degree program.

Sharon has received specialized training in various fields of crime scene investigations, including bloodstain reconstruction, photography, crime scene reconstruction, fingerprinting, and shoe wear casting. She has traveled throughout the United States and Taiwan attending crime scene conferences by highly notable crime scene experts such as Dr. Henry Lee, Dr. Michael Baden, Dr. Vincent DiMaio, Vernon Geberth, Dr. Bill Bass, Paul Kish, and Richard Saferstein.

Sharon has had the opportunity to be involved in casework with Dr. Henry Lee assisting in crime scene reconstruction. Some of her cases have appeared on court T.V.

Sharon taught courses for Dr. Henry Lee as well as throughout the United States. She has been a lecturer at several mystery writers' conferences as well as all over the country assisting them "to keep it real."

Sharon is also a member of DMORT (Disaster Mortuary Operational Response Team).

Sharon has five fabulous daughters and a grandson Noah. She loves approaching every classroom and crime scene as a new adventure and looks at each one from a new perspective. She loves not knowing what is waiting for her each day. She also feels that training students and law enforcement is her greatest inspiration.

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Robert Ogle
Forensic Scientist

There have been so many wonderful people who have shared my life journey with me and have made me the person and investigator I am today. I would like to acknowledge the following people who without their support and guidance would not have made this textbook possible.

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Sharon Plotkin
Certified Crime Scene Investigator

1 INTRODUCTION TO PHYSICAL EVIDENCE

Some circumstantial evidence is very strong, as when you find a trout in the milk.

From Unpublished Manuscripts, in Miscellanies, *Biographical Sketch*, Volume 10 by Henry David Thoreau.

Key Words: Locard exchange principle, criminalistics, comparative analysis, recognized, collected, preserved, reconstruction, linkage, linkage profile, investigative leads, physical nature, types of examinations, branch of examiners, fingerprints (friction ridge evidence), class characteristics, class only, individual characteristics, identification, individualization, comparative analysis process, questioned, unknown source, known source, comparison standards, reference standards, exemplar, controls, objective, curtilage, probable cause plus, chain of possession, contamination, linkage triangle.

LEARNING OUTCOMES

After studying this chapter, you should be able to:

- Define and list the types, value, and categories of physical evidence.
- Recognize the types of physical evidence.
- Describe the difference between class and individual characteristics of physical evidence.
- Explain the ethical, legal, and scientific requirements for evidence collection to include consent and the Exclusionary Rule.

INTRODUCTION

BRIEF HISTORY OF FORENSIC SCIENCE AND THE EXAMINATION OF PHYSICAL EVIDENCE

The inception of modern forensic scientific examination of physical evidence occurred in the field of toxicology (the scientific examination of poisons) in France, Sweden, Germany, and Spain, beginning in the 1770s through the early 1800s with the works of the Frenchman Fodere, the Swede Scheele, the German Ross, and the Spaniard Mathieu Orfila. Orfila's treatise on toxicology established forensic toxicology as a legitimate scientific endeavor.[1] In the mid-nineteenth century, microscopic procedures for identifying sperm, a presumptive test for blood, and a microcrystalline test for hemoglobin were developed.[2] In the late nineteenth century, Alphonse Bertillon in France developed what he termed *anthropometry*, a system of bodily measurements used for personal identification, which was later replaced by the simpler and more accurate method of fingerprinting.[3]

The scientific examination of physical evidence and its application to criminal investigation was first described in the publication in 1893 of *Handbuch fur Untersuchungsrichter als System der Kriminalistik* by Hans Gross, a prosecutor and judge in Austria (later published in English under the title *Criminal Investigation*).[4] The publication of this work by Gross marked the beginning of "criminalistics" and the various forensic sciences as *professions.*

In the twentieth century, the pace of the development of scientific methods for examination of physical evidence increased considerably.[5] A method for the identification of ABO blood types in bloodstains was developed by Dr. Leone Lattes in Italy. In France, Edmond Locard, director of the Institute of Criminalistics in Lyons, described the theory that when two objects came into contact, there would be a cross-transfer of traces of materials. His theory became known as the **Locard exchange principle**, a central theme in the forensic sciences, especially those dealing with trace evidence (hairs, fibers, soil, etc.). In America, U.S. Army Colonel Calvin Goddard advanced firearms identification extensively by developing the use of the comparison microscope to compare bullets from a crime to bullets fired through a suspect's firearm. The comparison microscope was later used to compare hairs, fibers, and other types of trace evidence.

One of the major influences on crime scene investigation and physical evidence examination was the publication of *Techniques of Crime Scene Investigation* in the 1930s by the Swedish workers Svensson and Wendel (edited for several editions and now authored by Barry Fisher,[6] currently in its eighth edition). Another textbook of importance to *crime* scene investigation and criminalistics, *An Introduction to Criminalistics*: *An Application of the Physical Sciences to the Detection of Crime*,[7] was authored by Charles E. O'Hara and James W. Osterburg in 1952. The textbook *Homicide Investigations* by Dr. Lemoyne Snyder (third edition in 1977[8]) offered considerable useful information to those crime scene investigators and other investigators whose duties included the investigation of homicides.

In the middle of the twentieth century, the forensic science specialty known as **criminalistics** achieved a watershed moment with the publication in 1953 of *Crime Investigation*[9] by Dr. Paul L. Kirk, a professor of biochemistry and criminalistics at the University of California at Berkeley, California. Dr. Kirk, called the "father of criminalistics," created the first generation of professional criminalists from his students at Berkeley. The professional field of criminalistics owes a debt of gratitude to Dr. Kirk (and his students) for the formation of the California Association of Criminalists (the first professional organization of criminalists), which has cultivated the ethical, moral, and scientific standards found in most professional criminalists and allied professionals today.

Subsequent to the publication of Kirk's textbook, many techniques were developed by forensic scientists for the determination of genetic markers in blood and semen stains, making a landmark leap with the development of DNA testing by Sir Alec Jeffreys in England. A further landmark in DNA testing was the development of the PCR technique to analyze forensic samples by Dr. Erlich, Dr. Higuchi of the Cetus Corporation, and Dr. Edward T. Blake of the Forensic Science Associates laboratory.[10] These leaps in the identification and individualization of blood and other body fluids were followed in the last part of the twentieth century by the development of computer techniques to compare latent fingerprints to a fingerprint database (AFIS) and DNA from bloodstains and other tissue stains from crime scenes to a database (CODIS) with blinding speed, two accomplishments thought entirely impossible at the midpoint of the twentieth century.

TYPES, VALUE, AND ADVANTAGES OF PHYSICAL EVIDENCE

Thoreau's quote in the beginning of this chapter embodies two types of evidence: (1) physical evidence (the trout) and (2) circumstantial evidence (the presence of the trout in the milk, which raises the presumption that the milk was diluted with creek water). Evidence is typically classified into (1) *direct evidence*, (2) *circumstantial evidence*, (3) *testimonial evidence*, and (4) *physical evidence*. These categories of evidence can overlap, as in the Thoreau quote mentioned earlier. The value of physical evidence comes from the data it provides for crime scene reconstruction, determining whether or not a crime occurred, linking an individual with another or with a crime scene, and investigative leads, and to link serial rapes, homicides, or burglaries. The advantages of physical evidence over other types of evidence include the factor that it is tangible, which means that a jury can view and touch the physical

objects and can take the object(s) into the jury room and that some cases cannot be solved without the physical evidence. Further, physical evidence cannot be distorted by the defendant, it is not subject to memory loss, and the defendant can have the evidence examined by an expert of his/her choosing. Taken together, these advantages demonstrate that physical evidence is an important component of modern criminal and civil investigations. The types, value, and advantages of physical evidence are detailed and explained in the appropriate sections to follow.

CATEGORIES OF PHYSICAL EVIDENCE

Physical evidence is classified into divisions based on either the types of examinations performed (chemical, physical, microscopical, etc.) or the type of material comprising the evidence (firearms, toolmarks, biological materials, etc.). In most jurisdictions, the forensic science laboratory is divided into sections based on the type of material examined, as described in the section on the major categories of physical evidence.

LABORATORY ANALYSIS OF PHYSICAL EVIDENCE

The laboratory analysis of physical evidence involves a wide variety of scientific methodologies, borrowed and adapted from the basic sciences, such as chemistry, physics, and biology. Laboratory examinations include the identification of the class and individual characteristics of the evidence from the victim, the suspect, and the crime scene. Typically, these methodologies are adapted to the **comparative analysis** (detailed later and in Figure 1-1) of the physical evidence; for example, comparison of the chemical analysis of the automotive paint found on a victim's clothing to the paint on a suspect's vehicle in a hit-and-run case, and the comparison of DNA from a suspect to DNA extracted from a vaginal swab from a rape victim. The laboratory analysis techniques for the various types of physical evidence are explained later and in the chapters for each of the physical evidence categories.

TYPES OF EVIDENCE

Evidence can be direct evidence, circumstantial evidence, testimonial evidence, or nontestimonial evidence, as in the case of physical evidence.

Direct evidence

Direct evidence is evidence that proves a fact without the necessity of an inference or a presumption that, when true, conclusively establishes that fact. An example is testimony by a completely credible witness that proves the fact stated in the testimony.

Circumstantial evidence

Circumstantial evidence involves a series of facts that, although not the fact at issue, tends, through inference, to prove a fact at issue. This type of evidence is usually a chain of circumstances from which a fair assumption can be made as to the validity of the fact at issue.

Testimonial evidence

Testimonial evidence is evidence given by lay or expert witnesses. The principal test for this type of evidence is the *credibility* of the witness. The trier of fact (judge or jury) in a court proceeding determines the credibility of the witness and thus the believability of the testimony given by the witness. This point cannot be overstated, since the testimony of a witness who is not credible can be (and often is) ignored by the trier of fact. This reality of testimony is the principal reason that law enforcement officers and expert witnesses must be diligent in establishing their credibility (see Appendix II, "Courtroom Testimony," at the rear of the book).

Physical evidence

Physical evidence consists of physical objects that are linked to the commission of a crime or tort. Virtually any type of physical object can become physical evidence in a criminal investigation. In this chapter, the major types of physical evidence encountered in criminal investigations are listed, but the investigator needs to remain alert to the possibility that physical objects not mentioned in this text or other texts relating to physical evidence may become valuable evidence in an investigation.

VALUE OF PHYSICAL EVIDENCE

Physical evidence can be defined as *physical objects associated with a crime or a tort*. Analysis and interpretation of the physical evidence may assist in the investigation of a crime or tort in a number of ways. However, in order to be of any value, it is critical that the physical evidence be **recognized** as potential evidence, **collected** in an *appropriate manner*, and **preserved** *properly* for transmittal to the laboratory (see Appendix IV at the end of the book for Collection, Preservation, and Special Instructions for Physical Evidence). Failure to recognize, collect, or preserve the physical evidence may compromise or destroy the evidence, thereby impeding the investigation. In the worst case scenario, the failure to preserve crucial evidence may lead to the erroneous conviction of an innocent party or the inability to convict a guilty party. The failure to collect the evidence may also hinder a subsequent civil action on behalf of an injured party.

Physical evidence may play a crucial role in many criminal investigations. The primary roles of physical evidence in the investigation of crimes include those that follow.

Reconstruction of the crime scene

Reconstruction of the crime scene is one of the *major purposes* for the collection of physical evidence. This procedure may involve the reconstruction of a single event, such as the determination of muzzle-to-target distance in a shooting, or it may involve the determination of the sequence of a series of events, such as the interpretation of bloodstain patterns at a crime scene. Reconstruction of the crime scene frequently allows the investigator to determine the accuracy of statements from witnesses: The statement of a witness may be corroborated by a reconstruction of the crime scene, or the statements of the witness may be shown to be false.

EXAMPLE

In a prison homicide case, several "witnesses" to the crime came forward and offered to testify in exchange for reduced sentences. The statements of each of the "witnesses" were proven to be false by reconstruction of the crime by using bloodstain pattern interpretation coupled with the laboratory typing results from the bloodstains. Each "witness" placed the two stabbing victims in areas where they could not have been during the assault. One "witness" indicated that the assaults took place at one end of the tier where no bloodstains were located (the bloodstain patterns proved that the assault occurred at the opposite end of the tier).

Determines whether or not a crime occurred

The physical evidence may also establish whether or not a crime occurred. For example, reconstruction of a shooting event can help establish whether the shooting was an accident, a suicide, or a homicide.

EXAMPLE

In a suspected homicide, a wife stated that while sitting downstairs reading, she heard a gunshot upstairs, ran upstairs to the bedroom, and found her husband in bed with a gunshot wound to the head. She indicated that with one hand she picked up the revolver next to her husband's head, transferred it to the other hand, placed it on the nightstand,

and then called the police. Tests for gunshot residue (GSR) on her husband's hands revealed a high level of GSR on the back of the husband's right hand but no residues on either palm or the back of the left hand. GSR tests on the wife's hands revealed medium levels of gunshot residue on each palm but no residues on the back of either hand. Experimental testing that duplicated the conditions as stated by the wife revealed GSR levels that were virtually the same as those found on the wife's hands and the hands of the deceased husband, confirming the statement of the wife and thus verifying that the death was a suicide.

Links an individual with another individual, a crime scene, or other crimes

Many types of evidence may be used to associate a suspect with the victim of a crime, with the crime scene where the crime occurred, or with other crimes committed by the suspect. These types of evidence are commonly referred to as "**linkage**," "associative," or "transfer" evidence. That is, the evidence may tend to show a contact between individuals, or between the suspect and the crime scene, that resulted in a transfer of evidence between the individuals involved or a transfer from an individual to a crime scene or vice versa. This process of the transfer of trace evidence follows the Locard principle described earlier. This transfer of evidence, which creates a linkage between a suspect, the victim, the crime scene, and other crime scenes is illustrated in Figure 1-1, which shows the **linkage profile** of the potential exchange of physical evidence between the suspect, the victim, the crime scene(s), and other crimes committed by the same suspect.

Provides investigative leads to investigators

An important function of the crime scene investigator is to provide **investigative leads** to the detectives and other investigators charged with the responsibility of investigating the crime. For example, the finding of a specific hair type in a homicide may provide information about the hair color and racial group[11] of the assailant. In one case known to the author, the racial characteristics of a single hair led to the rapid arrest of a suspect in a robbery homicide (see the following case example subsequently). Without this crucial investigative information, none of the additional critical evidence (currency bearing bloodstains from the victim in the possession of the perpetrator) would have been retrieved. Often, the initial examinations of physical evidence from the crime scene, although not conclusive evidence, may provide sufficient leads to the investigators such that the follow-up investigation will uncover conclusive evidence as to the identity of the perpetrator(s).

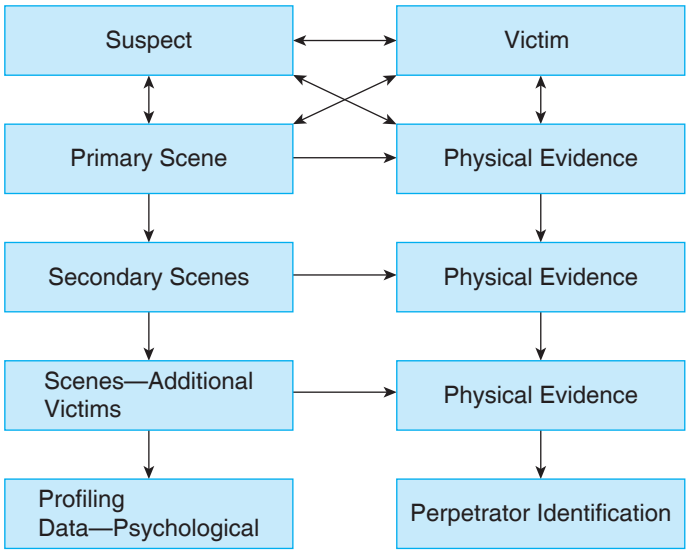

FIGURE 1-1 **Linkage Profile: Physical Evidence**

CASE EXAMPLE

"Caught by a Hair"

Criminalist John E. Murdock of the Contra Costa Sheriff's Criminalistics Laboratory was summoned to the scene of a robbery/homicide at a liquor store in Concord, California, later joined by Criminalist Mitosinka from the same laboratory. A thorough and systematic processing of the crime scene was conducted by Criminalists Murdock and Mitosinka and evidence technicians from the Concord Police Department. In order to avoid potential loss of trace evidence from the deceased during transport to the mortuary, Criminalist Murdock removed visibly adherent trace evidence from the body and clothing of the deceased. One item of special interest had the physical characteristics of a hair that had the typical appearance of a hair from an individual of African heritage.

The only person of African heritage associated with the liquor store's owner was a close acquaintance of his family. Concord detectives proceeded to this subject's residence for an interview. On their arrival, they were informed that the subject had left for Long Beach, California, in the early hours of the morning. This subject then became the prime suspect and preparations were made to prepare a search warrant for the suspect's vehicle. At the conclusion of the scene processing and attendance at the autopsy of the victim, Criminalists Murdock and Mitosinka returned to the criminalistics laboratory. A telephone conversation was had with the district attorney's office, where the search warrant for the suspect's vehicle was being prepared. The search warrant was obtained, and Concord detectives and Criminalist Mitosinka traveled to Long Beach to execute the search warrant. During the execution of the search warrant, currency from the robbery was recovered from the subject's vehicle that had fresh bloodstains with the same blood type as that of the victim. The suspect was arrested and subsequently convicted of the robbery/homicide at trial. Although the evidence hair could not be individualized, the determination of its racial type provided the investigative lead that led to the successful conclusion of this case.

Provides facts to a jury to assist in determination of guilt or innocence

Frequently in homicide, sexual assault cases, and other crimes, the analysis of physical evidence provides evidence of the guilt or innocence of an accused person. In one of the author's cases, the analysis of hair, semen typing, and latent fingerprint identifications led to the exoneration of an accused and the identification of the true rapist in a "serial rapist" case. The analysis of semen eliminated the accused person in three victims' cases, while hair analysis could have eliminated the accused in two of the cases. It was the identification of the latent fingerprint evidence in one of the victim's cases through an automated fingerprint system that ultimately identified the true rapist.

Provides evidence to link serial homicide or rape cases

In serial homicide or serial rape investigations, the physical evidence is often the strongest link between the series of crimes and the perpetrator. In homicides, firearms evidence and trace evidence often provide the link between the crimes and the perpetrator, as in the Wayne Williams case, in which fibers provided the link between the victims and the suspect. In serial rape cases, both trace evidence and semen typing (particularly DNA typing) may link the perpetrator to each of the crimes.

SOME ADVANTAGES OF PHYSICAL EVIDENCE

Physical evidence has a number of advantages over testimonial evidence because of the tangible nature of this type of evidence. These advantages include those that follow.

Provides a tangible object for the jury to see

Unlike testimonial evidence, the physical evidence can be seen by the jury and thus provides the added impact of the visual senses on the jury.

The physical evidence can be taken into the jury room

The impact of the physical evidence is carried into the jury room with the evidence and therefore continues its argument in the jury deliberations.

The defendant cannot distort the physical evidence

The physical evidence speaks for itself and cannot be misrepresented by the defendant. Often, the physical evidence will effectively rebut statements by the defendant and in some cases will prove that the defendant's statements are false.

Some cases cannot be solved without the physical evidence

In many crimes, the case is solved by the physical evidence that has been collected and analyzed in the case. Some cases may be solved by a single latent print collected

at the scene. This outcome has been especially true since the introduction of the Automated Latent Fingerprint Identification systems, which allow the latent fingerprint examiner to search a very large database for a match to the latent print.

Physical evidence is not subject to memory loss

One of the shortcomings of witnesses' testimony is the inevitable memory loss that occurs over time. The sometimes lengthy delays experienced before a case comes to trial may have a deleterious effect on the witnesses' memory and thus weaken the impact of their testimony. The proper collection and analysis of the physical evidence results in a permanent record that is immune to memory loss.

The evidence can be tested by an independent expert

One of the factors that adds to the credibility of physical evidence is the defendant's ability to have the evidence examined by an outside expert. It is rare for the defendant's expert to contradict the opinions of the prosecution's experts.

MAJOR CATEGORIES OF PHYSICAL EVIDENCE

Physical evidence can be categorized in several different ways. The evidence can be classified according to the **physical nature** of the evidence (e.g., blood, latent prints, firearms evidence, etc.), by the **types of examinations** performed on the evidence (e.g., microscopic, macroscopic, or instrumental), or by the **branch of examiners** who perform the examinations on the evidence (e.g., forensic chemist, document examiner, firearms examiner, etc.). The classification of evidence varies from one geographical area to another, but the majority of jurisdictions classify physical evidence according to the following outline:

- Fingerprints (friction ridge evidence)
- Firearms evidence (firearms, fired components, toolmarks)
- Biological evidence (blood, semen, other types)
- Trace evidence (microscopic, transfer, discharge residue)
- Document evidence (questioned handwriting, typewriting, papers, inks, etc.)
- Physical matching evidence (matching of items that have been broken apart)
- Toxicology evidence (drugs, poisons in body fluids and tissues)
- Drug evidence
- Other types (various evidence types not included in the preceding listing)

It is not unusual for the investigator to utilize many different types of evidence in order to investigate successfully a major criminal case. It may be necessary to use witness testimony, criminal profiling and victimology, physical evidence and suspect interrogation, and polygraph testing to solve a given case. It is the blending of these investigative approaches that provides both a challenge to the modern investigator and the ability to solve crimes that might otherwise go unsolved.

CLASS AND INDIVIDUAL CHARACTERISTICS OF PHYSICAL EVIDENCE

The concepts of "class" and "individual" characteristics must be understood by the crime scene investigator in order to interpret reports from the crime laboratory. **Class characteristics** are those characteristics shared by *all members* of a class. Since class characteristics are shared by all members of a class, those types of physical evidence having only class characteristics cannot be identified to a single source. These types of evidence are referred to as **class only** types of evidence. For example, the fibers from a garment would have only "class characteristics," since the fibers used to produce the garment are produced in very large quantities, as are the dyes used to dye the fibers. Human hair is another example of an evidence type with "class" characteristics only.[12] The characteristics in human hair that are used for comparison are under genetic control and thus are shared by large segments in some populations (hairs from Asian populations, for example), whereas in other populations, the hair characteristics are shared by much smaller populations (reddish-blond hair in European populations, for example). When the hair from a crime scene "matches" the hair from an individual, the examiner may state that the evidence hair "may have come from that individual," since other individuals in the population under consideration may also have

hair that matches the evidence hair. Class-only types of evidence may, however, be used conclusively to eliminate a suspected source. Reddish-blond hair, for example, could not have come from a specific Asian individual having only black hair. Class evidence can be used to quickly eliminate rather than identify.

Identity is defined as "the collective aspect of the *set of characteristics* [emphasis added] by which a thing is definitively recognizable or known."[13] This set of characteristics ("pattern") includes all the class characteristics of the class to which the object belongs and, additionally, those individual characteristics that serve to set the object apart from all other objects in its class. Thus, the pattern of class and **individual characteristics** establishes the individuality of a specific object. This pattern of class and individual characteristics of an object, when unique to only one member of a class, allows for the **identification** of the individual source of the evidence item, a process called "**individualization**." The questioned item is individualized when the examiner is able to "match" the set of class and individual characteristics found in the questioned item to the same set of characteristics in the *known sample* or its *exemplar* (see the section "Comparison Standards and Controls"). In many cases, the set of class and individual characteristics of an object is transferred to an evidence item, for example, the class and individual characteristics of a firearm's barrel interior are transferred to the surface of bullets fired in the weapon. The characteristics on the bullet are used to identify the weapon through comparison of these characteristics with those on a bullet known to have been fired in the suspect weapon, rather than attempting to compare the characteristics within the barrel directly with the characteristics on a bullet suspected of being fired in that weapon.

Those types of evidence that have individual characteristics can be identified to a single source, that is, can be "individualized." Latent fingerprints are an example of a physical evidence type that can be individualized. Although each characteristic (minutia) used to identify the source of the latent print is a class characteristic, the combination of the *occurrence* and the *spatial relationships* of the minutiae is considered to establish a unique pattern for a given area of friction ridge skin, thus allowing for the individualization of the latent print. *Note:* The terms "identification" and "individualization" are sometimes used interchangeably for certain types of evidence, such as fingerprints and firearms.

See Table 1-1 for examples of those types of evidence considered to have class only characteristics or those with individual characteristics that allow the examiner to identify the individual source of the evidence item.

Another type of evidence with individual characteristics consists of "physical matching" evidence. When an object is torn or broken apart, the fracture edges can often be matched by placing the parts together "jigsaw puzzle" style to illustrate the matching of the fractured or torn edges. Examples of these types of evidence include paint or glass fragments, adhesive tapes used as bindings, and broken pry bars.

Note: Some of the evidence types with class only characteristics may still be individualized through other means. Hair that has been pulled from a scalp may have the fleshy portion of the hair root adhering (the root "sheath") and may be analyzed for DNA type, and thus that hair may be individualized (although the DNA is technically a product of the scalp tissue rather than the hair itself). If there is no scalp tissue adhering to the

TABLE 1-1 Types of Evidence with Class and/or Individual Characteristics

Class Only Characteristics	Class and Individual Characteristics
Drugs	Fingerprints
Fibers	Fired bullets/cartridge cases
Hair	Toolmarks
Bloodstains (blood types)	Bloodstains (DNA)
Glass	Footwear impressions
Soil	Handwriting
Paint	

TABLE 1-2 Class and Individual Characteristics for Firearms

Division:	Firearms
Class:	38-caliber revolvers, 6 lands and grooves, right-hand twist
Family:	38-caliber revolvers, 6 lands and grooves, right-hand twist, having land and groove widths with the same measurements
Individual:	Striated markings imparted to the bullet by the barrel interior (the "signature" of the firearm)

root, the hair may still be analyzed for mitochondrial DNA. Other types, such as soil, may have a particular set of class characteristics in which the set of characteristics is so rare as to verge on being unique and thus be thought of as individual. In some drug seizures, the particular combination of the diluents used and the by-products of manufacture may constitute a "pattern" that allows the analyst to link the drug seizure to the larger source with varying degrees of confidence. Also, the class characteristics of a given item of evidence allow the examiner rapidly to screen suspected sources for the evidence item. If the class characteristics of the suspected source do not match those of the questioned item, then that suspected source is eliminated from further consideration by the analyst.

In some cases, a specific item of physical evidence in the "Individual Characteristics" column may have an insufficient number of the individual characteristics present to allow for a positive identification (smudged latent fingerprints or damaged bullets, for example). The analyst will usually note the lack of sufficient detail in the evidence item in the laboratory report. For example, the fingerprint examiner may state that the latent print recovered from a crime scene "lacks sufficient individual detail to allow for a positive identification." In this case, the examiner is indicating that there are insufficient individual details (points of comparison) in the latent print to allow for an unqualified opinion as to the source of the latent print (see Appendix III at the end of the book).

The classification of the various evidence types into class only and individual characteristics types is a simplification of the classification schemes for the different classes of evidence. The universe of physical evidence can be classified in a hierarchical scheme for all the evidence types, but at the present time, little work has been done to provide a comprehensive classification scheme for all physical evidence. Classification efforts heretofore have been limited to attempts by specialists in certain types of evidence, such as firearms evidence. Table 1-2 gives examples of some of the classification levels of firearms evidence. These classification levels and sublevels are generally of interest only to researchers in their respective specialties and have little effect on the investigator's understanding of class and individual characteristics. They are presented here only to acquaint the investigator with the terms that may be encountered in the literature of forensic science.

Table 1-3 lists some class and individual characteristics for some of the other types of physical evidence commonly encountered in crime scene investigations that have individual characteristics in addition to their class characteristics. *Note:* "Individual" characteristics for DNA patterns are based on statistical analysis of the patterns found in the evidence sample rather than on the aggregate experience of forensic serologists.

TABLE 1-3 Class and Individual Characteristics of Physical Evidence Types

Evidence Type	Class Characteristics	Individual Characteristics
Fingerprints	Basic patterns	Minutiae patterns
Toolmarks	Size of toolmark	Striations in marks
Bloodstains	ABO, enzyme types	DNA patterns
Footwear	Size, sole patterns	Wear damage to sole
Handwriting	Handwriting system	Variations from system