

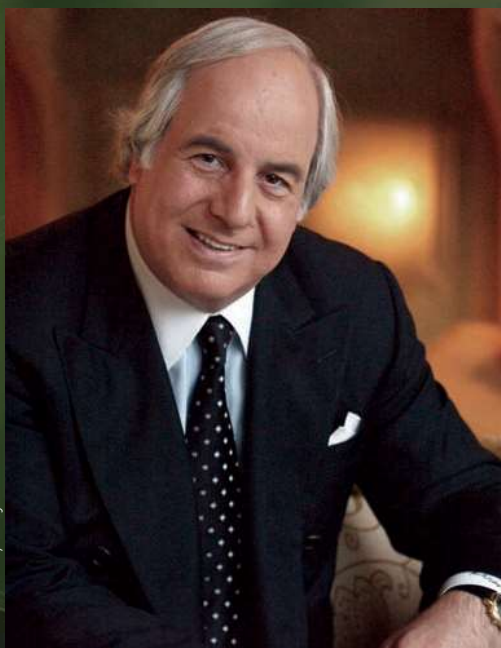
CHAPTER 10

Handwriting Analysis, Forgery, and Counterfeiting

MASTER FORGERS

Frank W. Abagnale, a reformed master forger, describes in his book, *The Art of the Steal*, how a visitor from Argentina was issued a parking ticket on a rental car in Florida. Although the fine was \$20, he placed \$22 in an envelope and mailed it to the Miami city clerk. On receipt of the money, the clerk issued a \$2 refund. On receiving the check, the man scanned it into his computer, changed the amount to \$1.45 million, and deposited the check into his account in a bank in Argentina. The check was cashed, and the money was transferred. He was never arrested, and the money was not recovered.

According to Abagnale, the Argentinean example is not uncommon. Stolen money is often not recovered, and thieves are not caught. Abagnale tells of his own life of forgery and fraudulence in the book *Catch Me if You Can*. He began his life of crime as a teenager, when he changed a number on his driver's license to make himself appear 10



Frank Abagnale, once a wanted forger, is now a leading consultant in the area of document forgery and fraudulence.

years older. After acquiring a small amount of money, he opened a bank account. He came up with the idea to print his account number in magnetic ink on deposit slips and return them to the bank counter. By the time the bank discovered his fraudulent scheme, he had made over \$40,000, and he had already changed his identity. Working with eight different identities, he passed more than \$2.5 million in fraudulent checks in 26 countries and throughout the United States.

Frank Abagnale is now a leading consultant in forgery, fraudulence, and secure documents. For more than 25 years, he has consulted with many financial institutions, corporations, and government agencies, such as the Federal Bureau of Investigation (FBI). Today, he teaches and lectures on how to detect forgery, avoid consumer fraud, and prevent crime. Abagnale says that the best way to deal with fraud is to prevent it from happening in the first place.

OBJECTIVES

By the end of this chapter, you will be able to

- ✓ Describe 12 types of handwriting exemplars that can be analyzed in a document.
- ✓ Demonstrate an example of each of the 12 exemplars of handwriting traits.
- ✓ Identify the major goals of a forensic handwriting analysis.
- ✓ Describe some of the technology used in handwriting analysis.
- ✓ Distinguish between the terms *forgery* and *fraudulence*.
- ✓ Identify several ways in which businesses prevent check forgery.
- ✓ Describe four features of paper currency that are used to detect counterfeit bills.

VOCABULARY

counterfeiting the production of an imitation of currency, works of art, documents, and name-brand look-alikes for the purpose of deception

document analysis the examination of questioned documents with known material for a variety of analyses, such as authenticity, alterations, erasures, and obliterations

document expert a person who scientifically analyzes handwriting

exemplar a standard document of known origin and authorship used in handwriting analysis

forgery the making, adapting, or falsifying of documents or other objects with the intention of deceiving someone

fraudulence when a financial gain accompanies a forgery

questioned document any signature, handwriting, typewriting, or other written mark whose source or authenticity is in dispute or uncertain



TOPICAL SCIENCES KEY

INTRODUCTION

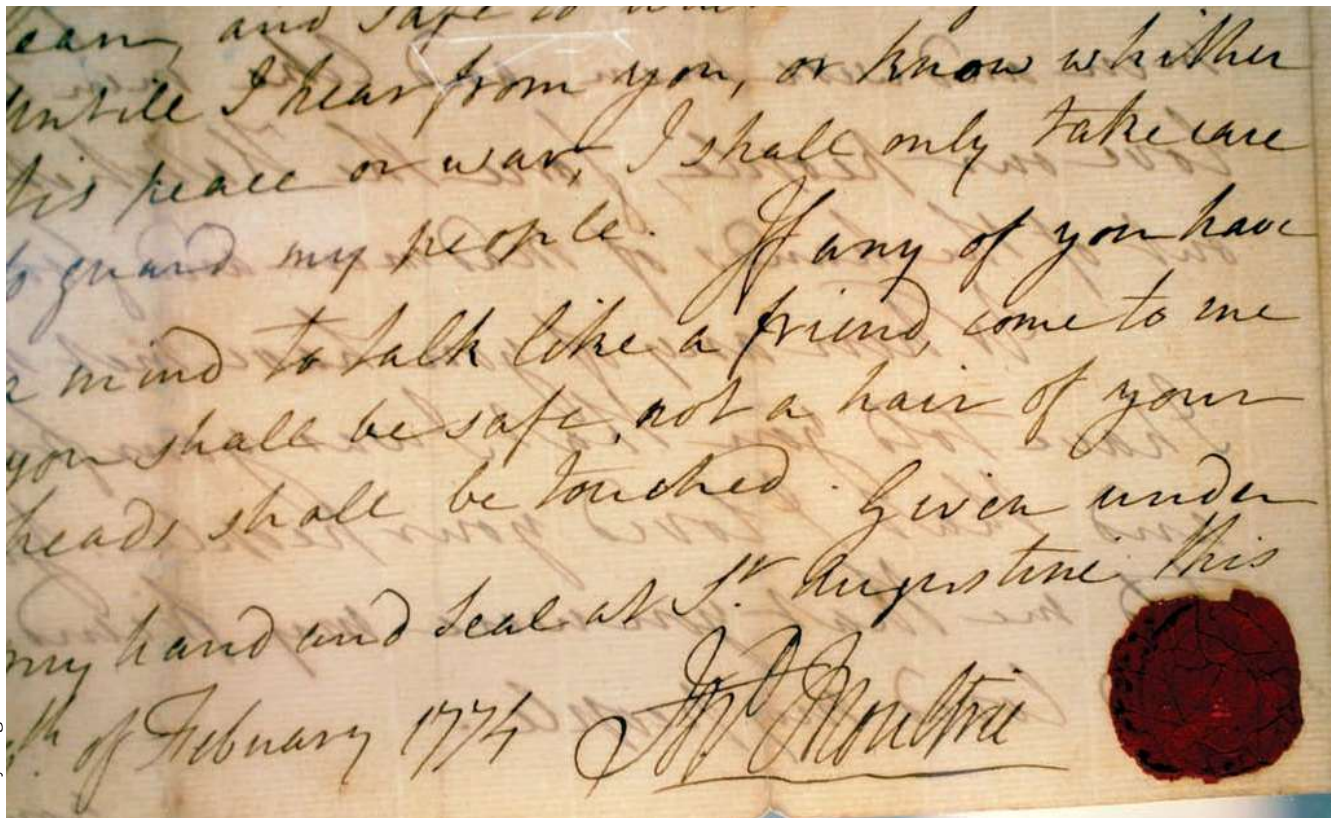
Document analysis, a very broad area in the field of forensics, is the examination and comparison of questioned documents with known material. Experts establish the authenticity of the documents and detect any changes, erasures, or obliterations that may have occurred. A **questioned document** is any signature, handwriting, typewriting, or other written mark whose source or authenticity is in dispute or uncertain. Checks, certificates, wills, passports, licenses, money, letters, contracts, suicide notes, receipts, and even lottery tickets are some of the questioned documents of interest. Experts in this field may examine handwriting, typewriting, commercial printing, paper material, and the type of ink in these documents. Figure 10-1 shows an example of a historical document.

A **document expert** is a specially trained person who scientifically analyzes handwriting and other features in a document. For example, a document expert may be called into a crime-scene area or to the lab to examine the handwriting of threatening notes, ransom notes, or suicide notes. Investigators analyze and compare various traits, such as the appearance of letters, of suspicious documents with known samples to help identify the author of the document. Investigators might also be asked to detect changes that may have occurred in an original document.

A document expert is different from a graphologist, who studies the personality of the writer based on handwriting samples. The study of graphology is not necessarily accepted as part of forensic science, but it can be used as a possible indicator of the writer's personality type. The scientific analysis of handwriting is the focus of this chapter.



Figure 10-1. Historical documents are often targets for forgers.



HISTORY OF FORENSIC HANDWRITING ANALYSIS

Like fingerprints, every person's handwriting is unique and personalized. Because handwriting is difficult to disguise and forge, handwriting analysis is a good tool for including or excluding persons when determining a match between known material, known as an **exemplar**, and a questioned document.

In the 1930s, handwriting analysis played an important forensic role during the trial of Bruno Richard Hauptmann for the kidnapping and murder of the son of world famous aviator Charles Lindbergh. Handwriting analysis of the many ransom notes, along with known handwriting samples and other evidence, led to Hauptmann's conviction and execution (Figure 10-2). Today, Hauptmann's involvement in the crime has come into question because of the manner in which samples were collected and how the evidence was handled.

The courts have not always accepted handwriting analysis as a creditable form of evidence. This changed in 1999, when the U.S. Court of Appeals determined that handwriting analysis qualified as a form of expert testimony. Handwriting evidence is admissible in court, provided that scientifically accepted guidelines are followed. Scientific analysis of handwriting is now an important tool for forensic document examiners. Scotland Yard, the F.B.I., and the Secret Service use handwriting analysis in solving important cases.

Figure 10-2. Comparative handwriting samples from Hauptmann used in the Lindbergh kidnapping case.

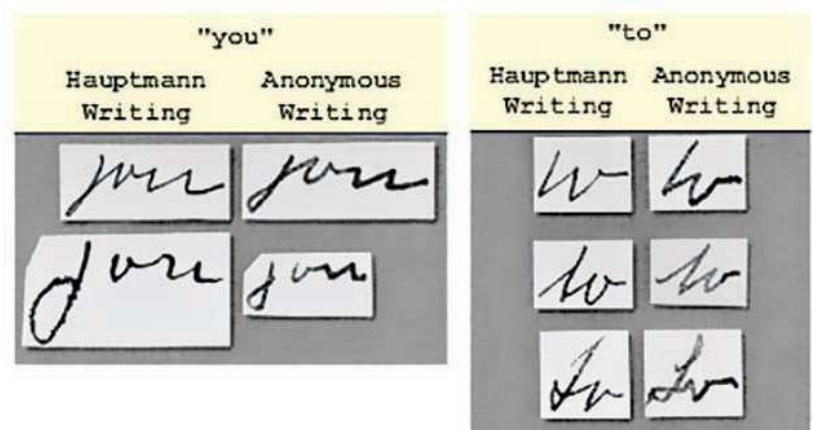


Photo courtesy FBI

INTRODUCTION TO HANDWRITING

Everyone's handwriting exhibits natural variation depending on several factors. The use of different types of writing instruments, such as a pen, pencil, marker, or crayon, can affect our handwriting. Our mood, our age, and how hurried we are all contribute to the differences we notice in our own handwriting.

Despite these minor variations in handwriting, each person has a unique handwriting style. Characteristics such as the slant and curl of the letters, the height of the letters, or even how the page is filled with text can distinguish our identity. This is because the brain is doing the writing! Adults show only slight variation in handwriting, because as children we learn to write through basically the same method. However, once a person starts writing subconsciously, with characters formed as a result of habit, unique handwriting is formed.

CHARACTERISTICS OF HANDWRITING

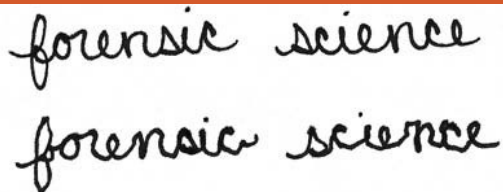
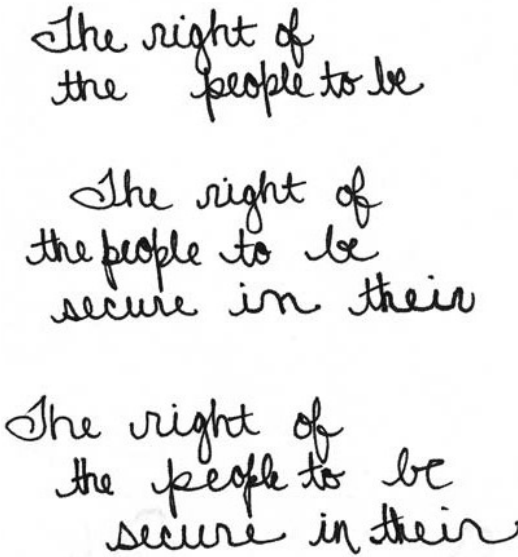
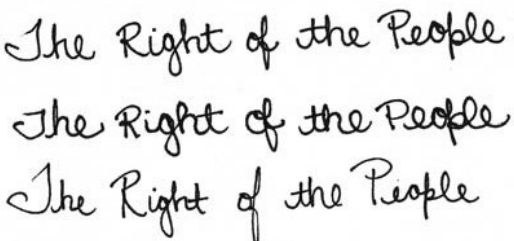
A person's handwriting exhibits unique characteristics that make it distinguishable from other samples. Handwriting experts examine 12 major categories of exemplars. These 12 characteristics are functions of letter form, line form, and formatting.

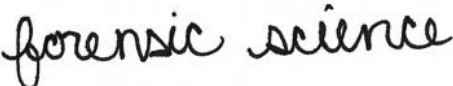
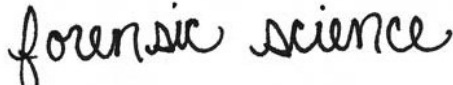



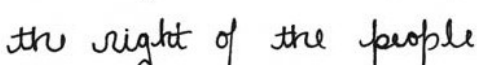

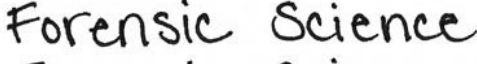




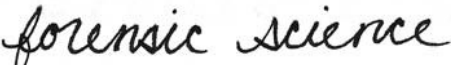
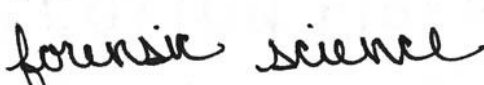




Letter form includes the shape of letters, curve of letters, the angle or slant of letters, the proportional size of letters, and the use and appearance of connecting lines between letters. It also includes whether letters are shown correctly, such as a dotted "i" and a crossed "t."

Line form includes the smoothness of letters and the darkness of the lines on the upward compared to the downward stroke. Line form is influenced by the speed of writing and the pressure exerted while writing. The choice of writing instrument can also influence line form.

Formatting includes the spacing between letters, the spacing between words and lines, the placement of words on a line, and the margins a writer leaves empty on a page. Some characteristics studied by handwriting experts are shown in Figure 10-3.

Figure 10-3. Characteristics of handwriting. (continued on the next two pages)

Specific Trait	Description	Example
Line quality	Do the letters flow or are they erratic or shaky?	
Spacing	Are letters equally spaced or crowded?	
Size consistency	Is the ratio of height to width consistent?	

Specific Trait	Description	Example
Continuous	Is the writing continuous or does the writer lift the pen?	 
Connecting letters	Are capitals and lower-case letters connected and continuous?	 
Letters complete	Are letters completely formed? Or, is a part of the letter missing?	 
Cursive and printed letters	Are there printed letters, cursive letters, or both?	  
Pen pressure	Is pressure equal when applied to upward and downward strokes?	  
Slant	Left, right, or variable?	  
Line habits	Is the text on the line, above the line, or below the line?	  

Specific Trait	Description	Example
Fancy curls or loops	Are there fancy curls?	Forensic Science
Placement of crosses on t's and dots on i's	Correct or misplaced? Are t's crossed, crossed in the middle, toward top, or toward the bottom? Are i's dotted, dotted toward the right, left, or centered?	right right right right

HANDWRITING EXAMINATION

The goal of forensic handwriting analysis is to answer questions about a suspicious document and determine authorship using a variety of scientific methods. Methods are based on the principle of identification in that “two writings are the product of one person if the similarities . . . are . . . [unique] and there are no fundamental unexplainable differences.” Document experts often compare handwriting characteristics of a questionable document to those of a known sample or *exemplar* to try to determine if the same person wrote the document. These analyses can also help detect forgeries. **Forgeries** are documents made, adapted, or falsified with the intention of deceiving someone.

ANALYZING A HANDWRITING SAMPLE

There are three basic steps in the process of analyzing a handwriting sample. First, the questioned document and the standards (exemplars) are examined and detectable characteristics are recorded. Obtaining a standard may require a suspected author to write a sample for the investigators under supervision. If possible, a handwriting sample should be obtained without first informing someone of the intention of comparison, such as asking for a written statement by the involved parties. The best exemplars tend to be letters, diaries, greeting cards, or personal notes. The obtained exemplar should also contain several of the words or letter combinations found in the questioned document. Next, the characteristics of the questioned item are compared with the known standard. For those samples that appear to be similar to the questionable document, there must be a thorough analysis addressing all of the handwriting characteristics in each document. Finally, experts determine which characteristics are valuable for drawing a conclusion about the authenticity and authorship of the questioned document (Figure 10-4).

Figure 10-4. A document expert scientifically analyzes the handwriting in a document.



If there are obvious differences between a standard and a questioned document, then it is likely that the documents have different authors. Those samples can be visually eliminated without even having to assess the list of handwriting characteristics. However, similarities do not necessarily guarantee common authorship, because it is possible that unique characteristics of a person’s handwriting may occur in another’s handwriting. Highly trained document experts must take into account a great number of factors and a statistically significant repetition of similarities in

their analyses. Professionals also have ways of determining whether a person has tried to disguise his or her handwriting or to copy someone else's handwriting, known as a conscious writing effort. Many things can be done to minimize this conscious writing effort, such as the following: (1) a suspect should not be shown the questioned document; (2) a suspect should not be given any instructions about punctuation or spelling; and (3) the pen and paper should be similar to that of the questioned document.

TECHNOLOGY USED IN HANDWRITING ANALYSIS

Initial comparisons of documents are done with the naked eye, a handheld lens, or a microscope. However, even more advanced technology available today can assist the examiner with more technical aspects of the writing and document. Specialized equipment can reveal minor details about how a document was changed. For example, examination using an infrared spectroscope can determine if more than one kind of ink was used on the document. This is because of the way that different inks may absorb or reflect different wavelengths of light such as infrared.

Biometric Signature Pads



The biometric pad, a new research tool, has been designed for identity authentication. The computerized pad recognizes your signature based on the speed, pressure, and rhythm of signing your name (Figure 10-5). Forgeries can be recognized by slight differences that are detected by the pad.

Computerized Analysis

Computerized analysis of handwriting samples has the advantage of being faster and more objective than analysis by an individual. For example, if the pen pressure is being reviewed, an examiner looking at the sample uses his or her subjective opinion. However, if the handwriting is first scanned into a computer, the pen pressure can be objectively analyzed by the shading in the pixels.



The Forensic Information System for Handwriting (FISH) is a computerized handwriting database used and maintained by the Secret Service (Figure 10-6).



Investigators scan in handwritten documents for a comparative analysis. Once the sample is scanned, it can be compared to other existing handwriting in the database. This system has verified that no two writers pen their words exactly the same, nor do they have the same combination of handwriting characteristics.

HANDWRITING EVIDENCE IN THE COURTROOM

After handwriting samples are scientifically analyzed, the expert handwriting witness prepares a written report of the analysis to present to a jury. Both the defense and prosecuting attorneys ask the handwriting expert questions about the analyses. The expert witness demonstrates how document comparisons were made and how they were used to indicate the suspect's guilt or innocence. The expert witness validates comparisons by showing the jury

Figure 10-5. Advanced technology today, such as biometric signature pads, allows for more accurate analyses of handwriting samples, even at the grocery checkout line.



ePad-i.d., Handwritten electronic capture device by Interlink Electronics, Inc.

Figure 10-6. The Forensic Information System for Handwriting (FISH) is a database of handwriting features that is categorical and quantifiable.



©Mikael Karlsson/Alamy

examples of similarities or dissimilarities that led to the final conclusion. In court, the expert must be able to defend his or her findings, because the defense will likely hire their own document examiner to refute the prosecution's expert witness.

SHORTCOMINGS IN HANDWRITING ANALYSIS

Although an experienced document expert can detect many cases of forgery, some may be missed. One limitation is that the quality of the standards obtained often determines the quality of a comparison analysis, and good standards may be difficult to obtain. For example, analysis errors have occurred in history when the standard documents that experts used in their comparisons turned out to be forgeries as well. Another limitation is the effects of mood, age, drugs, fatigue, and illness on a person's handwriting.

Because document analysis has become well accepted in forensics alongside other evidentiary types, programs have evolved to certify the training. The American Board of Forensic Document Examiners is one establishment that offers such a training program. Although it is still important that handwriting evidence be used in combination with other sources of evidence, handwriting analysis is considered a reproducible and peer-reviewed scientific process.

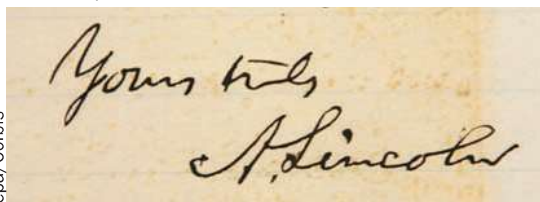
FORGERY

As discussed previously, forgery is the process used by criminals to make, alter, or falsify a person's signature or another aspect of a document with the intent to deceive another. Forged documents might include checks,

Figure 10-7. Martin Coneely forged Lincoln's writing and signature, but was caught and sent to prison.

employment records, legal agreements, licenses, and wills. When a material gain, such as money, accompanies a forgery, it is called **fraudulence**. Generally, the primary purpose of forging something is to profit from the fake or alteration. For example, Martin Coneely was a fraudulent forger in the United States in the 1900s. In 1937, after selling a forged Abraham Lincoln letter (Figure 10-7), Coneely was arrested and spent three years in prison. Ironically, his forgeries are collector's items today.

©Shawn Thew/
epa/Corbis



CHECK FORGERY

Americans write more than 70 billion checks a year. Approximately \$27 million in illegitimate checks are cashed each day. Criminals can alter or acquire checks in many ways, including:

- Ordering someone else's checks from a deposit slip
- Directly altering a check
- Intercepting someone's check, altering it, and cashing it
- Creating forged checks from scratch

PREVENTING CHECK FORGERY

Reformed master forger Frank Abagnale once said that the best way to deal with fraud is to prevent it from happening in the first place. How do com-

panies protect themselves against forgeries? Several techniques are used to protect businesses, banks, and the public from forged and altered checks, as shown in Figure 10-8. However, these are all aspects of the paper, and they require someone to be knowledgeable about these security features and willing to look for them. In their attempt to prevent check fraud, many banks hope to eventually eliminate checks altogether. In fact, many banks and credit unions encourage the use of their debit and check cards for this very reason.

Figure 10-8. Methods used to prevent check forgery.

Print checks on chemically sensitive paper
Use a large font size that requires more ink and makes alterations more difficult
Use high-resolution borders on the checks that are difficult to copy
Print checks in multiple color patterns
Embed fibers in checks that glow under different types of lights
Use chemical-wash detection systems that change color when a check is altered

LITERARY FORGERY

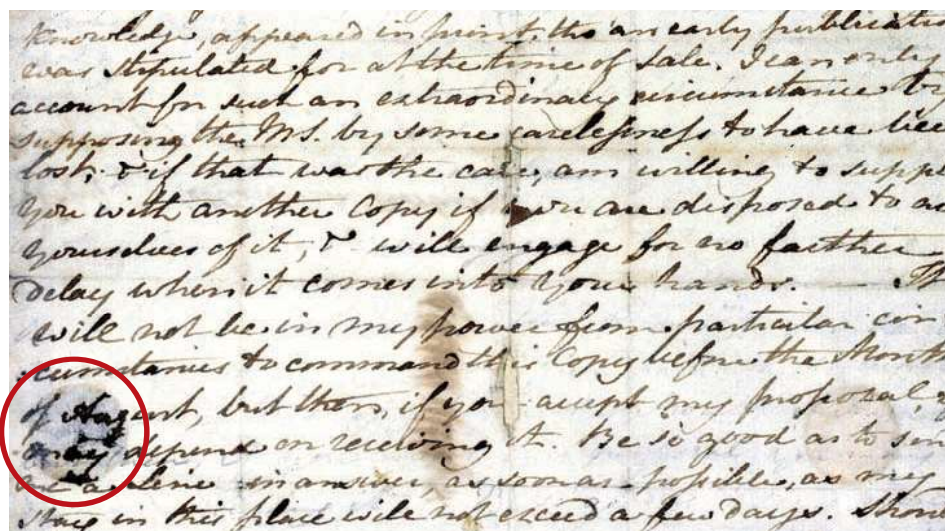
Literary forgery refers to forgery of a piece of writing, such as an historic letter or manuscript. Letters written by famous people are often valuable, especially if the writer was an important world figure, developed a famous theory, or was a notable writer. For example, a letter written by Adolf Hitler, Albert Einstein, or Charles Darwin would be treasured because it might provide insight into the thinking of the writer.

The best literary forgers try to duplicate the original document, so the materials used are similar to those used in the original document. They do this by collecting old paper or old books, from which they can cut out properly aged paper for their forgeries. Because the process of papermaking has changed, it is essential for forgers to use aged paper to pass the microscopic examination tests. Inks have also changed; so intelligent forgers must mix their own inks from material that would have been used at the time. Watermarks impressed in the paper when it was made also help to age a piece of paper as shown in Figure 10-9. Handwriting tools and styles of penmanship popular at the time of the printing are also considered.

Documents are sometimes chemically treated to make them look older. Chemicals may be added to the paper to age both



Figure 10-9. Forgers have used watermarks in the past to help age a document.



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Digging Deeper

with Forensic Science e-Collection

Do research on some of the early Shakespeare forgeries in 1875 by Englishman William Henry Ireland using the Gale Forensic Sciences eCollection on school.cengage.com/forensicscience. William Henry Ireland claimed that he had acquired an authentic handwritten manuscript of Shakespeare's known as the play *Kynges Leare*. Cite some of the evidence discovered by scholarly investigators that showed that this and other documents presented by William were only imitations. Discuss how William obtained the antique paper and ink to create the supposedly old manuscript. Find out how William evaluated the credibility of the paper and writings he produced.

Figure 10-10. An injured Mark Hofmann is arrested for murder.



©AP Photo/The Desert News

the paper and the ink. In the early 1980s, Mark Hofmann, a document dealer and master forger, created several hundred forged documents using this method. Besides forging documents, Hofmann also forged coins and banknotes. One of Hofmann's most significant forgeries was his creation of 116 pages of a supposedly lost Mormon document. He sold this document for a fortune to a Mormon collector. Hofmann also forged works attributed to Emily Dickinson, Abraham Lincoln, and Mark Twain. In 1985 Hofmann devised a plan to forge another collection of Mormon documents. Unable to produce the forgeries in time, he used a bomb to buy time and escape detection. His bombs killed an innocent Mormon business leader, Steven Christensen, and Kathy Sheets, wife of Christensen's business partner, Gary Sheets. A third bomb exploded unexpectedly in Hofmann's car, severely injuring him and attracting police attention. Hofmann was tried and convicted of forgery and murder and is currently serving his life sentence. Figure 10-10 shows Hofmann after his arrest, holding his injured hands.

COUNTERFEITING

When false documents or other items are copied for the purpose of deception, it is called **counterfeiting**. Travelers' checks, certain bonds, and currency are among the most often counterfeited items. Other examples of counterfeited items include coins, food stamps, postage stamps, and paper money. Counterfeiting of money is one of the oldest crimes. Under U.S. law, counterfeiting is a federal felony punishable with up to 15 years in prison. The U.S. Secret Service is the federal agency in charge of investigating counterfeit U.S. currency.

COUNTERFEIT CURRENCY

In the past, with access to a scanner and color printer, it was not very difficult to create counterfeit currency. Scanning could pick up the intricate lines and details found on currency. The Secret Service, with the aid of technology, has added features to paper currency that, when scanned, prevent the currency from being copied. If the currency was successfully scanned, a counterfeiter would still encounter difficulty printing it. The most sophisticated printers cannot reproduce this microscopic detail, because of the built-in security features of money (Figures 10-11 and 10-12). Counterfeit



U.S. law enforcement agencies forecast that companies lose approximately \$400 billion to \$450 billion annually to counterfeiters.

Figure 10-11. Different parts of paper money contain tiny, intricate lines and details that cannot scan well.



Figure 10-12. As you can see here, the tiny, intricate lines and details on paper money do not always print well in counterfeit bills.





In 2004, a woman tried to buy more than \$1,000 worth of items at Wal-Mart using a fake \$1 million bill. The U.S. Treasury does not make a \$1 million bill, so she was sent to jail.

money also feels different because real money is printed on special paper. In fact, the number-one way that people suspect fakes and scrutinize money is because it doesn't feel right. The paper itself is therefore the number-one security feature.

The government continues to change the design of paper money to make currency more difficult to copy and to prevent counterfeiting. The new series of currency changes began with a revision to the \$20 bill on October 9, 2003, followed by the \$50 bill on September 28, 2004, and the \$10 bill on March 2, 2006. More recently, the U.S. government announced that a redesigned \$5 note should be released in early 2008. In Activity 10-3 you will make observations about the newly designed bills.

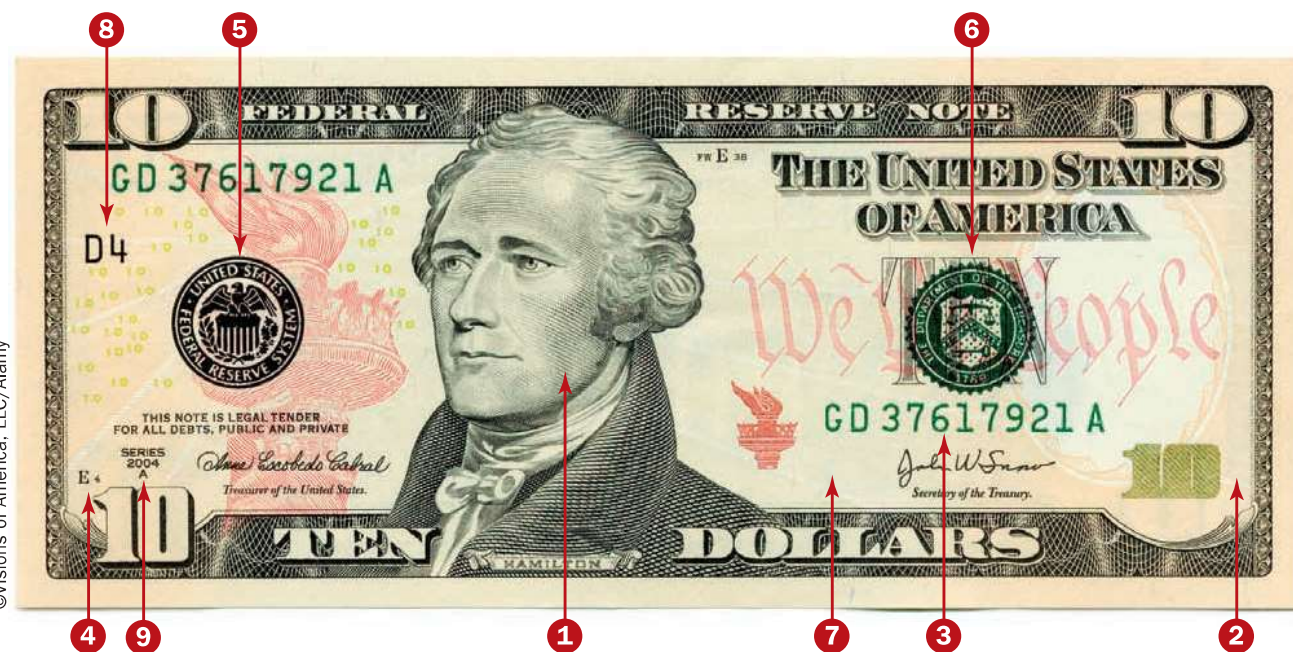
DETECTING COUNTERFEIT CURRENCY



It is relatively easy to detect counterfeit currency. Counterfeit-detecting pens are inexpensive special pens and markers containing the element iodine. When they come in contact with a counterfeit bill, the paper marked with the pen will change to a bluish-black color. The color change is caused by a chemical reaction involving starch, a compound found in regular printer paper. By contrast, real currency does not contain starch. Many currencies are also printed on paper containing a fiber. When real money is marked with the counterfeit-detecting pen, the pen will leave a pale yellow color on the bill, which fades within a very short time. Figure 10-13 shows features found in real currency.

Pen manufacturers claim the counterfeit-detecting pen is 98% effective. However, the U.S. government does not concede this level of effectiveness and uses additional criteria for judging whether currency is counterfeit. These criteria are important, because some counterfeiters actually bleach small bills to provide the correct paper for use. For example, a counterfeiter might bleach a \$1 bill for reprinting into a \$50 or \$100 denomination. This bill will pass the counterfeit-pen test, but not some of the other safety measures found on real currency. Furthermore, there is currently a global movement to change to polymer money, a type of plastic money. Plastic money is much more difficult to counterfeit and less expensive to print.

Figure 10-13. Features found in real currency: making counterfeiting money difficult.



Number	Some Features Found in Real Currency
1	Portrait stands out from the background and appears raised off the paper.
2	There is minute microprinting on the security threads, as well as around the portrait.
3	Serial number is evenly spaced and the same color as the Treasury seal.
4	Check Letter and Quadrant Number
5,6	Federal Reserve seal (5) no sharp points, and Treasury seal (6) with clear, sharp sawtooth points
7	Clear red and blue fibers are woven throughout the bill. Security thread is evident, consisting of a thin, embedded vertical line or strip with the denomination of the bill written in it.
8	Federal Reserve Number and Letter
9	Series
10	Check Letter and Face Plate Number
11	Watermark appears on the right side of the portrait of the bill in the light.
12	When a new series bill is tilted, the number in the lower right-hand corner makes a color shift from copper to green resulting from color-shifting ink.
13	Clear, distinct background details and lines
14	Clear, distinct border edge

SUMMARY

- Fraudulence is attempting to get financial or other gain from forgery.
- Handwriting analysis is the examination of questioned documents compared with exemplars by document experts to establish the authenticity and/or authorship of the documents.
- Document experts use scientific tools and protocols to compare handwriting characteristics of a questionable document to those of an exemplar to help identify authors and detect any alterations, erasures, and obliterations.
- Certain aspects of a person's handwriting style, such as letter form, line form, and formatting, can be analyzed to ascertain authenticity or authorship.
- Handwriting analysis has become an important tool, especially for forensic examiners. Handwriting experts help financial, legal, and governmental institutions, as well as the general public, detect and prevent forgery, counterfeiting, and other fraudulent crimes.
- Technological advances, such as the biometric signature pad and the use of the infrared spectroscope, have greatly enhanced the detection of forged documents.
- Countries continue to refine methods to protect their currency from counterfeiters.

CASE STUDIES

John Magnuson (1922)

A package mailed to the rural home of James Chapman exploded as it was unwrapped. James Chapman's wife actually opened the package, thinking it was a Christmas present. She was killed, and James was injured. John Magnuson, a neighbor, was a suspect because he had recently quarreled with Chapman over property drainage rights. John Tyrell was called in to analyze the handwriting on the package. He concluded that Magnuson's handwriting matched the handwriting on the package. In addition, many of the misspellings indicated a reliance on phonetic spelling and a person of Swedish ancestry. John Magnuson was the only person of Swedish descent (ancestry) in the area and lived less than four miles from Chapman's home. The pen point and ink mixture used on the bomb's label also matched supplies found at Magnuson's house. Magnuson was sentenced to life imprisonment.

The Hitler Diaries (1981)

In February 1981, three diaries supposedly written by Adolf Hitler were discovered. Document experts authenticated the documents by comparing them with forged samples. A bidding war followed, with the price of some of the manuscripts reaching \$3.75 million. Eventually, the paper on which the documents were written exposed the hoax. A paper whitener found in many of the pages of the documents had not been developed until nine years after the war ended and Hitler committed suicide. The inks used were also from the postwar era. It was determined that the documents had been written less than a year before their discovery. Konrad Kujau, the West German memorabilia dealer who had written and forged the diaries, was located and imprisoned for four years. The hoax was said to have cost more than \$16 million in lost revenues to those who had purchased the alleged diaries.

Digging Deeper

with Forensic Science e-Collection

Fraudulent secret diaries of Hitler's that spanned the years 1932 through 1945 were discovered in 1983. These fake diaries set the standard for literary hoaxes. The diaries were at best an amateur job by forger Konrad Kujau, when it comes to forgery standards. So, how did they acquire such worldwide fame? Go to the Gale Forensic Sciences eCollection on school.cengage.com/forensicscience and research the Hitler Diaries. Make your own investigation by reading the primary sources available on the web site. Write a summary of the case that covers (1) the motives of the forger, (2) the involvement of the German magazine *Stern*, (3) the errors that were uncovered in the analysis of the diaries, and (4) the information that was unveiled at the trial.



Think Critically You work at a bank. One of your customers has misplaced his or her checkbook. Write a letter to the customer explaining the safeguards that will protect him or her.

CAREERS IN FORENSICS

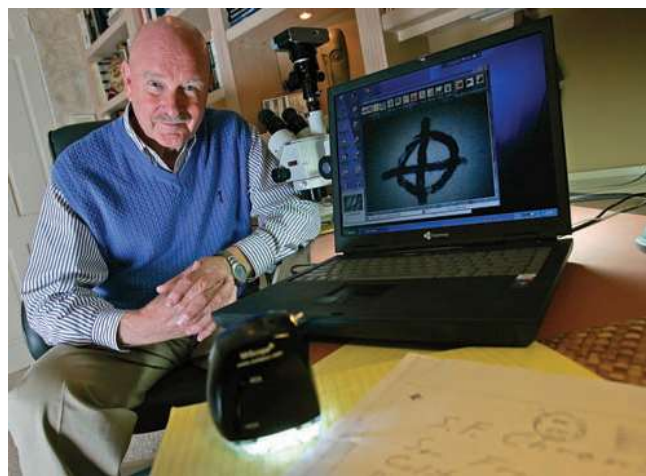


Lloyd Cunningham, Document Expert

Lloyd Cunningham is the world's leading handwriting expert of San Francisco's famous fugitive killer known as the Zodiac. In the 1960s, the Zodiac, a serial killer who was never identified, mocked the police with handwritten notes telling of his crimes. For more than 25 years, Cunningham has evaluated numerous documents potential suspects that are submitted each year by police officers, news reporters, and detectives. Cunningham carefully analyzes the handwriting of each submitted sample and compares it to Zodiac's original documents with hopes of finding clues and answers.

Lloyd Cunningham first became interested in the Zodiac case as a San Francisco police officer. In 1969, he was among the many police officers who came to Presidio Park following the shooting of cab driver Paul Stine, the last of the Zodiac's verified victims. Cunningham eventually trained with the U.S. Secret Service. In 1980, he became the U.S. Secret Service's first forensic document examiner. He began investigating Zodiac soon after he finished his forensic training. Since then, Cunningham has analyzed hundreds of famous documents, including the ransom letter in the JonBenet Ramsey case. He retired as a police officer in 1991, but has continued to work on the Zodiac case as a private consultant.

Over the years, Cunningham has memorized Zodiac's handwriting, including his unique letter formations and style of formatting. The mystery killer apparently crossed his "t" low on the vertical line and had large spaces between his lines. So, how does Lloyd Cunningham determine if a newly submitted Zodiac sample is just another hoax? Cunningham says, "There's a rhythm in writing;



© Jay Calderon

Lloyd Cunningham has become the world's leading handwriting expert of the Zodiac killer.

when people jot notes or sign documents, they write quickly and confidently. But if someone tries to copy or disguise their handwriting, it's no longer spontaneous, and an expert can see signs of the effort in the script." Cunningham explains about his lack of frustration in his continued efforts to investigate new samples because "Who knows? Maybe one of them is right."

There is not a specialized degree in forensic document examination. Although one is not required, many investigators start out with a degree in the sciences and the proper training in scientific analysis. Once a university degree is attained, skills in document examination can be acquired through job experience and certified training programs that are often found in government crime laboratories.



Learn More About It

To learn more about the work of a document expert or handwriting analysts, go to school.cengage.com/forensicscience.

CHAPTER 10 REVIEW

True or False

1. There are 10 major categories of handwriting characteristics.
2. To prevent forgery, some checks have embedded fibers that glow under special lights.
3. In handwriting analysis, a person's handwriting is compared to several exemplars.
4. A person's handwriting is so consistent that nothing alters it.
5. Some forgers now use chemicals to "age" paper.
6. A biometric pad measures the speed, rhythm, and pressure of your handwriting.
7. The Secret Service is charged with the security of U.S. currency.
8. Document experts analyze the paper and ink as well as the writing to determine authenticity.
9. Forgers rarely spend time trying to forge documents by famous people.
10. U.S. paper money has special thread embedded in it as a guard against counterfeiting.

Short Answer

11. Describe three different characteristics of handwriting that experts analyze during a forensic investigation.

12. Define an *exemplar*.

13. Summarize the three basic steps in handwriting analysis.

14. Describe some of the technologies used by document experts to analyze handwriting.

15. Distinguish between check forgery and literary forgery.

16. What are some methods used by criminals to make paper and ink appear old when forging a historic document?

17. List the features of money bills that are used to help distinguish genuine money from counterfeit money.

18. What type of change occurs when a counterfeit pen's ink comes into contact with counterfeit money, and why does this reaction not occur when the counterfeit pen is used on genuine money printed in the United States?

Connections

19. We now have handwriting databases of letters and handwriting samples. How can they be analyzed using mathematical methods?

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ACTIVITY 10-1

HANDWRITING ANALYSIS

Objectives:

By the end of this activity, you will be able to:

1. Describe the 12 different exemplars used in handwriting analysis.
2. Provide an example of the 12 different characteristics used in handwriting analysis.
3. Identify examples of the 12 different characteristics found in handwriting samples.
4. Analyze your own handwriting sample using the 12 exemplars.
5. Analyze the handwriting sample of a classmate's handwriting using the 12 different characteristics.

Time Required to Complete Activity: 40 minutes

Materials:

(per student)

pens or pencils and lined paper

colored pencils or highlighters

ruler (mm) or calipers

two handwriting samples of the Fourth Amendment provided by your partner

Safety Precautions:

None

Procedure 1: Analysis of Your Own Handwriting

1. Copy the Fourth Amendment from the overhead projector onto a lined sheet of notebook paper. Prepare two copies on separate sheets of paper. (Note this sample should be taken prior to the exercise. Students should not be aware that this sample will be used for handwriting analysis.)
2. Review the descriptions and examples of the 12 exemplars of handwriting traits.
3. Use Figure 10-3 to perform a handwriting analysis of your own handwriting (Fourth Amendment) by completing Data Table 1.
 - a. Begin by examining the handwriting for line quality. Answer the question, yes or no, on the Data Table. Include a description to qualify your answer.
 - b. Use highlighters or colored pencils to circle letters, words, or lines that demonstrate unusual characteristics or traits.
 - c. For some of the exemplars, it is important that you use a ruler or a caliper to measure the letters or spacing. For example, in exemplar 2, you will need to measure the spacing between words. Note if it is consistent. Note the size of the distance between words. Include your measurements under the description heading.
 - d. You will need to complete the entire Data Table 1 as you analyze the handwriting using the different exemplars.

Data Table 1: Analysis of Your Own Handwriting

Characteristic #	Yes	No	Comments (and measurements in mm) if required
1. Is line quality smooth?			
2. Are words and margins evenly spaced?			Margins: Words:
3. Is the ratio of small letters to capital letters consistent? What is the ratio?			
4. Is the writing continuous?			
5. Are letters connected between capitals and lowercase letters?			
6. Are letter formations complete?			(Be specific, which letters?)
7. Is all of the writing cursive?			(Be specific, which words?)
8. Is the pen pressure the same throughout?			
9. Do all letters slant to the right?			
10. Are all letters written on the line?			
11. Are there fancy curls or loops?			(which letters?)
12. Are all i's and t's dotted and crossed? (top, middle, or not)			i's t's

Procedure 2: Analysis of a Classmate's Handwriting

1. After completing the analysis of your own handwriting, exchange a handwriting sample with a classmate. (Be sure to give them a clean copy of your handwriting, not the copy that you just marked.)
2. Analyze a classmate's handwriting by completing Data Table 2. Be sure to use highlighters or colored pencils to mark any unusual traits. Include measurements where necessary.
3. After completing the analysis, answer the questions on the next page.

Data Table 2: Analysis of Your Partner's Handwriting

Characteristic #	Yes	No	Comments (and measurements in mm) if required
1. Is line quality smooth?			
2. Are words and margins evenly spaced?			Margins: Words:
3. Is the ratio of small letters to capital letters consistent? What is the ratio?			
4. Is the writing continuous?			
5. Are letters connected between capitals and lowercase letters?			
6. Are letter formations complete?			(Be specific, which letters?)
7. Is all of the writing cursive?			(Be specific, which words?)
8. Is the pen pressure the same throughout?			
9. Do all letters slant to the right?			
10. Are all letters written on the line?			
11. Are there fancy curls or loops?			(which letters?)
12. Are all i's and t's dotted and crossed? (top, middle, or not)			i's t's

Questions:

1. Were the handwritings samples of you and your partner similar, or could you easily tell that the two samples of handwriting were not from the same person by simply glancing at them? Explain your answer.
2. Review your Data Tables of the two handwriting analyses. Did the two handwriting samples have any characteristics that were the same? Explain your answer.
3. Review your Data Tables and state what characteristics of your own handwriting were very different from your partner's handwriting.
4. Reviewing your Data Tables, did any handwriting traits found in either of the two handwriting samples seem to be unique and could easily be used to help identify any other handwriting samples written by either you or your classmate? If so, describe the trait below:
5. Unique letter combinations is another characteristic that could be added to this list of the 12 exemplars used for handwriting analysis. For example, many people may have very distinctive ways of writing double Ls, such as in the word galloping. Other people may have a unique way of writing the letters "th," such as in the words *the*, *them*, or *their*. Describe a different example of an exemplar that you would like to see added to the 12 characteristics of handwriting used in handwriting analyses.
6. Why was it important to have your handwriting samples prepared in advance of this activity?

ACTIVITY 10-2

ANALYSIS OF RANSOM NOTE AND EXPERT TESTIMONY



Scenario:

Someone abducted a 10-year-old child from a well-to-do, private, residential school. His wealthy and famous parents received a ransom note requesting a large sum of money in exchange for the safe return of their son. They immediately contacted the police and gave them the ransom note.

The police got a lead implicating six members of a group, and all six young men were taken to the police station for questioning. The six young men were separated from each other so that they could not collaborate on their story. The first thing the police asked them to do was to write down their whereabouts for the past 48 hours. The police actually wanted a handwriting sample from each of the men. It was important not to tell them that a handwriting sample was being collected, because then the men might not write normally or spontaneously.

When the police obtained all six handwriting samples and the ransom note, they called in a renowned handwriting expert (you!) to analyze the ransom notes and the six suspect notes. Did any of the handwriting samples from the six men match the handwriting sample found in the ransom note?

Objectives:

By the end of this activity, you will be able to:

1. Act as the expert handwriting witness requested to testify that at least one of the suspect's handwriting samples matches the handwriting sample found in the ransom note.
2. Present your findings in a written report that will be submitted to the jury before your testimony at the trial.

Time Required to Complete Activity:

Two 40-minute periods are required to analyze the ransom note and the six suspect handwriting samples. Additional time is required to prepare the written report.

Materials:

(2 students/group)
6 different handwriting samples
1 ransom note in the handwriting of one of the above writers
1 six-inch mm ruler or calipers
several colored pencils or highlighters

Safety Precautions:

None

Procedure:

1. Study the ransom note provided by your instructor. Perform an analysis of the handwriting sample using the 12 exemplars (see Figure 10-3). Record your findings in Data Table 1.
2. Analyze the six suspects' handwriting samples.
 - a. If possible, visually eliminate some of the samples without using the list itemizing the characteristics. If you can eliminate any handwriting samples without performing the 12-exemplar handwriting analysis, you will need to write a statement showing evidence that the handwriting samples are obviously very different. Record this information on a separate sheet of paper using the Visual Elimination Format provided. If you eliminate the suspect by this visual inspection, you will not need to complete the 12-exemplar section of the Data Table.
 - b. For those samples that appear to be similar to the ransom note, perform a handwriting analysis using the 12 different handwriting characteristics. Record your results in separate Data Tables for each suspect's handwriting sample.
3. After analyzing both the ransom note and the six suspects' handwriting samples, determine which of the suspect's handwriting matches the handwriting of the ransom note. You will need to prepare your findings in a written report to be submitted to the jury. You will also need to testify at the hearing.

Written Lab Report

1. The purpose of the written report is to convince the members of a jury that you are an expert in the area of handwriting analysis.
2. You are able to analyze handwriting samples and show the jury evidence of how the samples are similar or dissimilar. Through your investigation, you have been able to conclude that one or more of the handwriting samples matches the handwriting of the ransom note.
3. Keep in mind that most juries have no knowledge of handwriting analysis. They may be highly educated, or they may have very little formal education. Therefore, any terms you use must be clearly defined.
4. Your report should be typed and spell-checked.
5. Print out a rough draft. Ask a partner to proofread your rough draft and help you edit your first copy. Your editor needs to sign the bottom of your rough draft after editing.
6. You should submit both the edited rough draft and your final copy.

The format for your written report to the jury is outlined as follows:

- I. Introduction (10 points)
 - a. State the purpose of your report.
 - b. No factual or detailed information should be in the introduction.
 - c. State how you analyzed the handwriting.
 - State how many different characteristics you used.
 - State if it was possible to prove someone wrote the note, or merely that the handwriting was similar.
- II. Several Body Paragraphs (at least six) (60 points)
 - a. One main idea or exemplar in each paragraph (at least six)
 - b. For each trait, you need to:
 - Describe the trait.

- Explain how the ransom note writer's handwriting matched or didn't match the trait you are describing.
- Remember that you need to explain these terms to the jury and convince them that your comparisons are correct.



Example: Exemplar 2

- Did you look at the spacing?
- Did you measure the spacing with a ruler?
- If so, what was the spacing?
- What is the ratio of lowercase letters to uppercase (capital) letters?
- Is the ratio consistent?
- Is the ratio the same in both the ransom note and the suspect's handwriting sample?

III. Conclusion (10 points)

- Summarize your findings.
- Do not repeat detailed information.
- How reliable is your conclusion?
- Is handwriting evidence enough to convict someone?
- Is this an important piece of evidence?

Data Table 1: Ransom Note Analysis

Characteristic #	Yes	No	Comments (and measurements in mm) if required
1. Is line quality smooth?			
2. Are words and margins evenly spaced?			Margins: Words:
3. Is the ratio of small letters to capital letters consistent?			
4. Is the writing continuous?			
5. Are letters connected between capitals and lowercase letters?			
6. Are letter formations complete?			(Be specific, which letters?)
7. Is all of the writing cursive?			(Be specific, which words?)
8. Is the pen pressure the same throughout?			
9. Do all letters slant to the right?			
10. Are all letters written on the line?			
11. Are there fancy curls or loops?			(Which letters?)
12. Are all i's and t's dotted and crossed?			i's t's

Data Table 2: Suspect # ____ Note Analysis

Characteristic #	Yes	No	Comments (and measurements in mm) if required
1. Is line quality smooth?			
2. Are words and margins evenly spaced?			Margins: Words:
3. Is the ratio of small letters to capital letters consistent?			
4. Is the writing continuous?			
5. Are letters connected between capitals and lowercase letters?			
6. Are letter formations complete?			(Be specific, which letters?)
7. Is all of the writing cursive?			(Be specific, which words?)
8. Is the pen pressure the same throughout?			
9. Do all letters slant to the right?			
10. Are all letters written on the line?			
11. Are there fancy curls or loops?			(Which letters?)
12. Are all i's and t's dotted and crossed?			i's t's

Visual Elimination Format:

If any of the suspects' handwriting can be quickly eliminated without performing a 12-character analysis, you will need to justify your elimination with a brief statement explaining why the handwriting is obviously not the same as the handwriting found in the ransom note. Use the following format:

Suspect # _____

Reasons for quickly eliminating this suspect:

1. _____
2. _____
3. _____
4. _____
5. _____

ACTIVITY 10-3

EXAMINATION OF U.S. CURRENCY: IS IT REAL OR A FORGERY?



Scenario:

Camille handed the cashier her \$50 bill. The cashier held it up against the light and looked at it. Perplexed, Camille asked the cashier why he held the \$50 bill up to the light. He told her that cashiers were required to examine all \$50 bills to be sure that they were legitimate and not counterfeit bills. Camille couldn't imagine how holding the bill up against the light could help him determine if it was a genuine-issue bill or a counterfeit bill. What was he looking for?

Objectives:

By the end of this activity, you will be able to:

1. Identify who is on the front of \$1, \$5, \$10, and \$20 bills.
2. Describe what images appear on the back of the bills.
3. Describe the seals, signatures, and images that appear on American currency bills.
4. Given a counterfeit-detecting pen, determine if a bill is genuine or a forgery.
5. Given U.S. paper currency, describe methods used to determine if the currency is counterfeit or legitimate.
6. Explain why it is difficult to counterfeit U.S. currency.

Time Required to Complete Activity:

Part A: Pre-test (5 minutes)

Part B: \$1 examination (30 minutes)

Part C: Hidden feature exploration (30 minutes)

Part D: \$10 bill analysis (30 minutes)

Part E: Internet tutorial (30 minutes)

Materials:

(students should work in pairs)

stereo or compound microscopes or hand lens

counterfeit-detecting pen (to share with other groups)

an assortment of various denominations of U.S. currency (\$1, \$10, \$20, \$50) to share

computers (optional)

digital camera (optional)

Safety Precautions:

None



Procedure:

1. Complete the pre-test questions in Part A
2. Complete Part B: \$1 bill examination
3. Complete Part C: Hidden feature exploration
4. Complete Part D: \$10 bill analysis
5. Complete Part E: Internet tutorial

If computers are available, examine the following web site:

<http://moneyfactory.gov/newmoney/main.cfm/learning/download>

Part A

Take the pre-test before starting the lab to determine how much you know about our paper currency. For this part of the lab, you should not be looking at any money but answering the questions from memory. *Record your answers on Data Table 1.*

Procedure:

Take the pre-test before starting the lab.

Pre-test:

1. Whose face appears on the front of a \$1 bill?
2. Whose face appears on the front of a \$5 bill?
3. Whose face appears on the front of a \$20 bill?
4. What building is pictured on the back of a \$5 bill?
5. What building is pictured on the back of a \$10 bill?
6. What building is pictured on the back of a \$20 bill?
7. What pictures appear on the back of a \$1 bill?
8. On the front of \$1, \$5, and \$10 bills, what words are written?
9. On the back of the \$1, \$5, and \$10 bills, what words are written?
10. Is the date the bill was issued printed on the front or back of the bill?
11. What seals appear on the front of a bill?

True/False:

12. The Secretary of the Treasury and the U.S. Treasurer are the same.
13. The serial number is printed in two places on the front of a bill.
14. Newer bills contain more colors than the older bills.
15. There is only one signature located on the front of a bill.
16. There is a picture of a building located on the back of \$1, \$5, \$10, and \$20 bills.
17. The White House appears on the back of the \$20 bill.
18. Because of the separation of church and state, no mention of a higher being or deity can be printed on the bills.
19. There are "hidden images" on the front side of a bill that can only be seen if you hold the bill up to the light.
20. On the back of \$10 and \$20 bills, small yellow numbers indicating their denominations is stamped in the area surrounding the picture.

Data Table 1: Pre-test

Question	Answer
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Part B: Observation of \$1 Bills

After reviewing your answers to the pre-test, you will be given some time to study a \$1 bill. To help guide you in your observations, answer the following questions and place your answer in Data Table 2. You will need to look at the bill using a hand lens or a stereomicroscope.

Front of the \$1 bill

1. Whose picture is on the front of the \$1 bill?
2. What is written across the very top of the front of the \$1 bill?
3. What is printed on the very bottom of the front of the \$1 bill?
4. What seal appears on the front, left-hand side?
5. What seal appears on the front, right-hand side?
6. Find the date on the \$1 bill. Record its date in Data Table 1.
7. Who was the Secretary of Treasury at the time this bill was issued?
8. Who was the U.S. Treasurer at the time the bill was issued?
9. Record the serial number for this bill.
10. How many places on the check is the serial number printed?

Back of the \$1 bill

11. What words are printed on the top line?
12. What words are printed on the bottom line?
13. What image appears on the back on the left side?
14. What image appears on the right side?
15. What reference to God appears on the back of the bill?

Data Table 2: \$1 Bill Examination

Question	Answer
Front	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Back	
11	
12	
13	
14	
15	

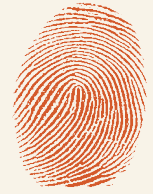
Part C: How Many Hidden Images Can You Find?



For this part of the lab, you will need new \$10 bills.

1. Form groups of four students each.
2. Each group should have a \$10 bill, hand lens, and stereomicroscope (optional).
3. Each team is to try to identify as many hidden images on the front and back of the \$10 bill. These will include images that can only be noticed by:
 - a. Holding the bill up against the light
 - b. Viewing the bill with a hand lens or stereomicroscope
 - c. Looking for numbers or words that cannot be seen without the aid of some type of magnification
4. Cooperative Learning Teams: Each team should assign one person to each of the following jobs:
 - a. *Recorder*: Person who will write down each of the discoveries as they are noted. Record the notes in Data Table 3.
 - b. *Presenter*: Person who has the job of reporting to the class what the team has discovered
 - c. *Light specialist*: Person who will hold the bill up against the light source and find hidden images

- d. *Magnification specialist*: Person who will use a hand lens (or stereomicroscope) to view hidden images that are visible only with increased magnification
5. Your team will be allowed a limited amount of time to discover the hidden images.
6. The team with the greatest number of discoveries reports to the entire class first. Any of the other teams will report any discoveries that were not already mentioned by the first team.



Data Table 3: Hidden Images on the \$10 Bill

Location	Images	Numbers
Front of the Bill		
Back of the Bill		

Part D: Analysis of a \$10 Bill

Using a hand lens or dissecting microscope, check your bill for the following:

1. The portrait appears flat on the genuine bills, but appears raised on counterfeit bills.
2. For newer \$10 and \$20 bills, the oval around the portrait is gone.
3. The background details of the portrait are clear and distinct on genuine bills.
4. The border edge of the genuine bill is clear and distinct.
5. Note the hidden numbers and words embedded in fine print.



6. On genuine bills, the Treasury seals have clear, sharp, sawtooth points.



7. On genuine bills, the serial number is evenly spaced and the same color as the Treasury seal.
8. Genuine paper currency has red and blue fibers woven throughout the bill. You may not be able to see these red and blue fibers without a hand lens or a stereo-microscope.
9. Counterfeit currency uses red and blue inks that are often blurred. This inking may be detected with a hand lens.
10. Examine a bill looking for the following:
- Security thread.* Hold the bill up to the light, and a thin line appears with the denomination of the bill written in it. The



- position of the thread varies from denomination to denomination but always runs from top to bottom.
- Color-shifting ink.* When the bill is tilted, the color of the left-corner 10 shifts from copper to green.
 - Watermark.* Appears on the right side of the face of the bill if it is held up to a light. The image also appears on the left side of the bill if viewed from the back of the bill.
 - Color.* The background color on both sides of the bill is enhanced.
 - Symbols of freedom.* A large, red image of the Statue of Liberty's flame is printed to the left of Hamilton, and a smaller, red metallic



Symbols of freedom

image is found to the right (\$10). Other seals are affixed to other denominations in the same position.

- f. *Enhanced portrait.* The oval border around the portrait has been removed, and the shoulder extends to the border of the bill. The portrait appears to be in front of the bill.
 - g. *Multiple 10s, 20s, 50s, etc.* Small yellow 10s, 20s, and 50s are printed on the front, back, or both sides of the bill designating its denomination.
11. Using a counterfeit-detecting pen, mark the edge of the bill and examine the color. A genuine bill will be pale yellow to tan, whereas a counterfeit bill will turn brown.

Part E: Internet Tutorial

Go to the following web site and click on Interactive Notes.

<http://moneyfactory.gov/newmoney/main.cfm/learning/download>

Questions:

1. Counterfeiters sometimes collect dollar bills and bleach them to remove the ink. Using a printer, they will print images of a higher-denomination bill on the bleached paper. What is the advantage of bleaching the dollar bill over just printing the higher-denomination bill onto clean paper?
2. Why has it been necessary to make so many changes to our paper currency in the past 30 years as compared to the last 100 years?
3. Of all the safeguards added to our higher-denomination currency, which do you consider the most important and why?
4. Counterfeiters try to pass off their counterfeit money at public events where many people gather. The Olympics held in Salt Lake City, Utah, employed many volunteers. These people are not necessarily trained in checking larger bills to see if they were genuine or counterfeit. Provide a list of four items to quickly and easily check the authenticity of a \$10 bill.

Enhanced portrait



The old \$10 note, front



The series 2001 \$10 note, front

