

Chapter Overview

Document analysis is an important area of forensics. Experts can tell if a document is authentic by examining the handwriting and the paper and ink used. Checks, historical documents, wills, passports, and money are a few of the items document examiners analyze to determine their authenticity. Handwriting analysis is an accepted form of evidence testimony that can be used in court. However, like other types of analysis, there is always a chance for human error.

The Big Ideas

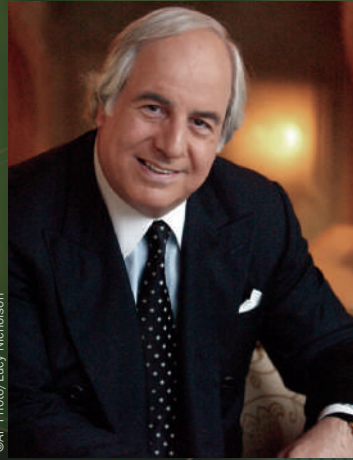
Document analysis is an area of forensics that compares questioned documents with known, authentic ones. One element that document experts look at is the handwriting in a document. These experts use 12 major categories of handwriting characteristics when examining a sample. These include shape of letters, angle or slant of letters, size of letters, and use of connecting lines between letters. Besides their expertise, document experts also use techniques such as infrared spectrometry and computerized handwriting analysis to determine the authenticity of a sample. Check forgery and counterfeit currency are growing problems. To prevent check forgery, banks are changing how they print checks, and some are trying to eliminate paper checks all together. The U.S. government has changed printing and paper-making techniques to try to stop counterfeiting.

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.



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

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

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.

SCENARIO

Lead the class in a discussion by asking these questions:

Do you think you can tell the difference between an authentic \$10 bill and a counterfeit?

With all of the available technology, do you think forgery is an increasing problem? Why or why not?

OBJECTIVES

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

- 10.1 Describe 12 types of handwriting exemplars that can be analyzed in a document.
- 10.2 Demonstrate an example of each of the 12 exemplars of handwriting traits.
- 10.3 Identify the major goals of a forensic handwriting analysis.
- 10.4 Describe some of the technology used in handwriting analysis.
- 10.5 Distinguish between the terms *forgery* and *fraudulence*.
- 10.6 Identify several ways in which businesses prevent check forgery.
- 10.7 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

KEY SCIENCE CONCEPTS

Biology: biometrics

Chemistry: chemically sensitive paper; chemically treated paper; using iodine to detect starch in paper

Psychology: graphology; how mood and other circumstances affect handwriting; subjectivity vs. objectivity; how historical letters and documents provide insight into the thinking of the writer

Mathematics: statistics; computerized handwriting analysis

Teaching Resources

- Instructor's Resource CD-ROM includes:
 - PowerPoint Presentation
 - Lesson Plan and extended Objective Sheets
 - Teacher Notes and Activities
 - Activity Forms
 - Rubric
- ExamView CD-ROM
- E-book on CD-ROM

Web site: school.cengage.com/forensicscience

Engage

Ask for a volunteer to write a statement on the board without the other students' knowledge. Then, ask the class if they can identify the person who wrote the statement from his or her handwriting? What clues gave it away?

Teaching Tip

Ask students to name some examples of possible forgery they know about (e.g., bathroom passes, illness notes from home, signed tests or report cards).

Science



Psychology

Graphology is a tool used to interpret personality from clues embedded in a person's handwriting. It is considered a branch of psychology and, while not generally accepted as a science, can provide information for investigators.

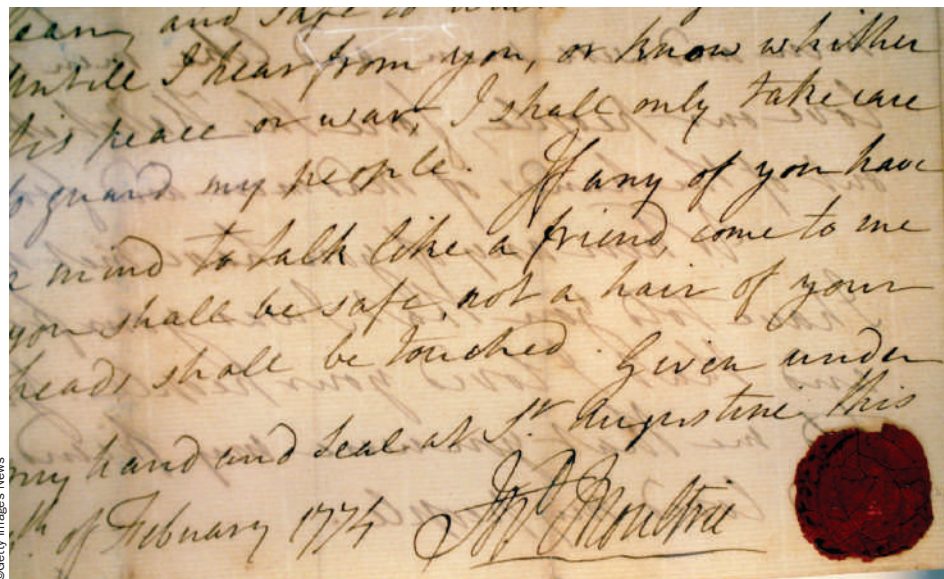


Document analysis, a very broad area in the field of forensics, is the examination and comparison of questioned documents with known material. Experts establish the authenticity of the documents and detect any changes, erasures, or obliterations that may have occurred. A **questioned document** is any 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.



278 Handwriting Analysis, Forgery, and Counterfeiting

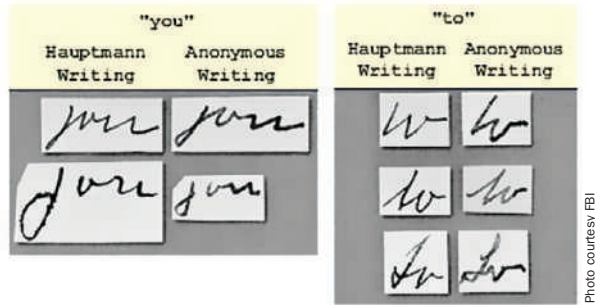
HISTORY OF FORENSIC HANDWRITING ANALYSIS

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.



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.

Science



Psychology

Personality traits revealed by a person's handwriting are based on similarities and patterns of writing by people who exhibit similar traits. For example, an "i" that is dotted closely to the top of the letter may indicate someone who pays close attention to detail.

Science



Psychology

Most master forgers are students of human nature. They know what documents and objects people want before starting to create them. They also learn to read their clients' body language as clue to possible detection.

Science



Psychology

Good students of human nature focus on the subtle, unconscious clues in body language. They pick up on an arched eyebrow, crossed arms, and similar behaviors.

Differentiated Learning



Teaching English Language Learners

English-language learners might not be familiar with the term "body language." Demonstrate some examples (pout, shrug of shoulders, downcast eyes), then ask them to offer examples they have observed.

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Evaluate

Ask students to review Figure 10-3 and then tell you which characteristics they think might be the easiest for investigators to use.

Obj. 10.1 and 10.2 CHARACTERISTICS OF HANDWRITING

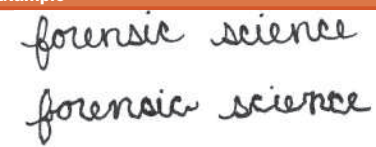
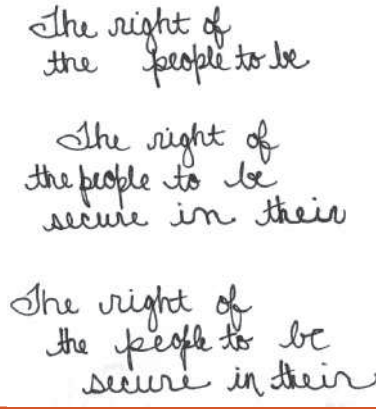
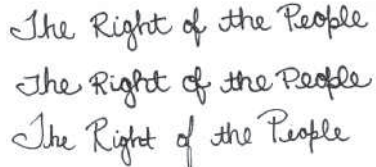
A person's handwriting exhibits unique characteristics that make it distinguishable from other samples. Handwriting experts examine 12 major categories of exemplars. These 12 characteristics are functions of letter form, line form, and formatting.

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?	forensic science forensic science
Connecting letters	Are capitals and lower-case letters connected and continuous?	The Right of the The Right of the
Letters complete	Are letters completely formed? Or, is a part of the letter missing?	the right of the people th right of the people
Cursive and printed letters	Are there printed letters, cursive letters, or both?	Forensic Science Forensic Science Forensic Science
Pen pressure	Is pressure equal when applied to upward and downward strokes?	forensic science forensic science forensic science
Slant	Left, right, or variable?	forensic science forensic science forensic science
Line habits	Is the text on the line, above the line, or below the line?	forensic science forensic science forensic science

Explore

Ask students to share times they wrote their signature or other writing differently than they normally do. Why did they do it? How did it look after they had written it?

Differentiated Learning



Teaching At-Risk Students

Some at-risk students might have handwriting problems. During discussions of handwriting and activities using samples, encourage students to accept differences among handwriting styles.

Specific Trait	Description	Example
Fancy curls or loops	Are there fancy curls?	<i>Forensic Science</i>
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?	<i>right right right rights</i>

Obj. 10.3 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).

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

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




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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 Obj. 10.4



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.



ePaol.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.



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Handwriting Analysis, Forgery, and Counterfeiting **283**

Explore

Infrared spectroscopy is a way to differentiate components used in making ink. As a beam of light is shown on the ink, the different components that make up the ink absorb the light differently. By matching the ink's "absorption fingerprint" to known standards, the ink can be identified.

Science



Biology

In 2000, Congress passed the Electronic Signatures in Global and National Commerce Act (ESIGN). The purpose of the law is to allow greater freedom and flexibility to implement electronic business transactions with electronic signatures. The legislation has also spurred development of technology for recognizing electronic signatures.

Science



Biology

What an electronic signature is differs slightly depending on the system used. This makes a big difference if the electronic signature is challenged in a court of law. Generally speaking, the pen data of the handwritten signature (the so-called biometric data) are captured. The most robust method captures pen events and position at a high rate of speed, encrypts the data, and binds it to the document to be signed. This method preserves the original forensic and biometric data.

Science



Psychology

Psychologists have categorized the motives of the literary forger as greed, piety, and a sense of fun. The first group seeks to sell their forgeries as the real item. The second write for a cause (e.g., church, organization) they hope to advance. The last seem to be looking for a laugh at the expense of the learned (and perhaps haughty).

Science



Psychology

Some psychologists claim there is an additional category of literary forger, one looking for notoriety or a platform to poke satire at a person or group. These forgers almost seek exposure to add to their voice.

Evaluate

Have students hypothesize why there are shortcomings in handwriting analysis. Ask: Do you think it is possible for two people to have handwriting so similar that it is impossible to differentiate?

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

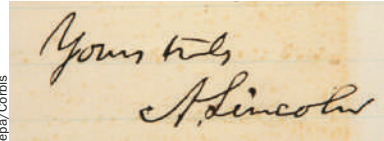
Although an experienced document expert can detect many cases of forgery, some may be missed. One limitation is that the quality of the standards obtained often determines the quality of a comparison analysis, and good standards may be difficult to obtain. For example, analysis errors have occurred in 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.

Obj. 10.5 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.



©Shawn Thew/
eps/Cortals

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.

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

Obj. 10.6 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

Differentiated Learning

Teaching At-Risk Students

At-risk students and visual learners may need to see various methods that are currently used to prevent forgery. Examples could include samples of old money versus new money with the threads embedded; driver licenses; credit cards; and checks held under an ultraviolet light to make hidden information visible. You might also look at checks with a magnifying glass or flex camera. Many of them have words printed where the signature is to be written.



companies 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

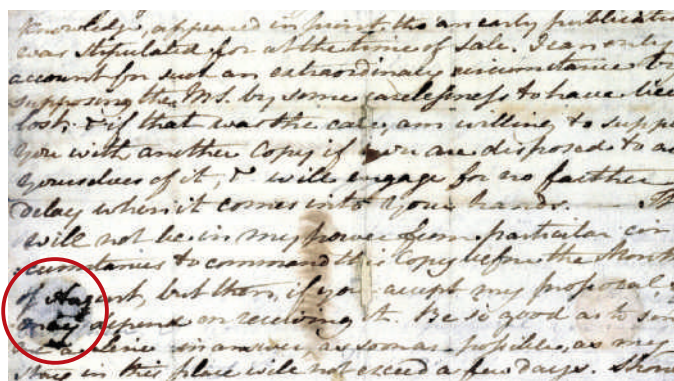
Literary forgery refers to forgery of a piece of writing, such as an historic letter or manuscript. Letters written by famous people are often valuable, especially if the writer was an important world figure, developed a famous theory, or was a notable writer. For example, a letter written by Adolf Hitler, 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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Handwriting Analysis, Forgery, and Counterfeiting 285

Explore

Perform a simple chromatography demonstration to help illustrate that ink is a mixture of different colors. Take a coffee filter and fold it in half. In the center of the fold, mark a visible dot using a felt-tip black marker. Pour 10 mL of rubbing alcohol into a 500-mL beaker. Place the coffee filter, fold side first, into the beaker with the rubbing alcohol. Make sure the dot is touching the surface of the alcohol. Tape the filter to the side of the beaker. After 20 minutes or so, you should see a rainbow of colors diffusing through the filter. These are the different color inks that make up the black marker. This demonstration could also be done by student groups.

Science



Chemistry

When someone attempts to alter a check that was created with chemically sensitive paper, spots and stains appear. This helps deter the perpetrator and alert the recipient of the check. Checks may also have erasure protection, which leaves a noticeable white spot if someone attempts to erase a signature or printing on the check.

Science



Chemistry

Investigators use several instruments to help them analyze the components of paper and ink. This analysis allows them to date the paper, easily discrediting a modern forgery posing as an older work.

Differentiated Learning

Teaching Gifted Students

Have students investigate pens that have been developed to prevent alteration. Ask them to report their findings to the class.



Digging Deeper

In Digging Deeper, students were asked to research the forgeries of William Henry Ireland. As an extension to this activity, ask students to compare the document analysis technology available at the time to the technology available today. To learn more about document analysis technology, go to the Gale Forensic Science eCollection at school.cengage.com/forensicscience.

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 *Kynge 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.

Obj. 10.7 COUNTERFEITING



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

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

Differentiated Learning



Teaching English-Language Learners

Ask students to discuss similarities and differences between paper currency from the United States and from their native country. Encourage them to bring in samples, if possible.

Differentiated Learning



Teaching English-Language Learners

Show students a new and an old \$20 bill on an overhead projector. Ask them to speculate why the new bills are more difficult to counterfeit.

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



©Visions of America, LLC/Alamy

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.



©Visions of America, LLC/Alamy

Differentiated Learning

Teaching Gifted Students

Ask students to design a new \$10 bill that would be difficult to duplicate. What safeguards do they think the bill should include?



Science



Chemistry

When iodine is mixed with a starch solution, the initial color of the mixture is the color of iodine, brownish-red. After a short time, the mixture undergoes a chemical reaction and changes its color to bluish-black.

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Science



Chemistry

When starch is mixed with iodine and water, iodine ions move into the structure of the larger starch molecule. Scientists think that the color change results from the changes in the electron orbitals of the starch and iodine. This reaction is very useful as an indicator in certain redox titrations, because the color change happens quickly and is easy to identify.

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Did You Know?
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.



288 Handwriting Analysis, Forgery, and Counterfeiting

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.

Close

Make copies or project the examples of handwriting characteristics from the textbook. Have volunteers point out the characteristic in each example. Then organize the students into groups. Give each group samples of handwritings you have collected (without names) and ask them to practice analyzing them. Have groups share their analyses with the class.

Digging Deeper

In Digging Deeper, students were asked to research the forged diaries of Adolf Hitler. Interested students may want to do further research to see if diaries of other famous or infamous people have been forged. For more information on the forged Hitler diaries and other literary forgeries, go to the Gale Forensic Science eCollection at school.cengage.com/forensicscience.



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

Being a document expert requires many skills. One skill studied in Chapter 1 of this text is the skill of observation. Patience and skill in identifying patterns is extremely important when analyzing a document. Ask students to do an Internet search on the term “document expert” to find out the kind of training they receive and their possible salaries.

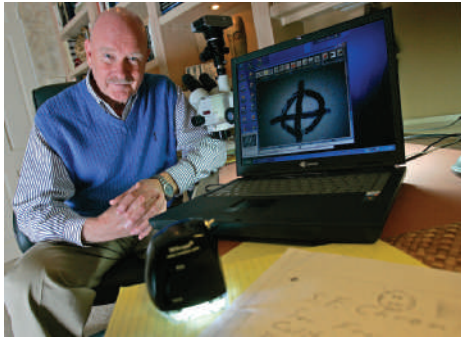
For more information on document experts go to school.cengage.com/forensicscience.

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.

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True or False

- 1. False
- 2. True
- 3. True
- 4. False
- 5. True
- 6. True
- 7. True
- 8. True
- 9. False
- 10. True

Short Answer

- 11. Sample answer: spacing between letters, whether letters flow or are erratic, and if the ratio of letter height to width is consistent.
- 12. Exemplar is the authentic document used when comparing questioned documents.
- 13. First, the questioned document and the exemplars are examined and detectable characteristics recorded. Next, the characteristics of the questioned item are compared with the known standard. Finally, experts determine which characteristics are valuable for drawing a conclusion about the authenticity of the document.
- 14. Sample answer: Biometric signature pads help authenticate signatures. Computerized handwriting analysis helps identify individual samples by using pen pressure comparisons.
- 15. Literary forgery is the forgery of a piece of historic writing, such as letters written by famous people. Check forgery can be altering an existing check, ordering checks belonging to someone else, cashing someone else's check, or creating a check from scratch.

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True or False

- 1. There are 10 major categories of handwriting characteristics. *Obj. 10.1*
- 2. To prevent forgery, some checks have embedded fibers that glow under special lights. *Obj. 10.6*
- 3. In handwriting analysis, a person's handwriting is compared to several exemplars. *Obj. 10.3*
- 4. A person's handwriting is so consistent that nothing alters it. *Obj. 10.1 and 10.3*
- 5. Some forgers now use chemicals to "age" paper. *Obj. 10.6 and 10.7*
- 6. A biometric pad measures the speed, rhythm, and pressure of your handwriting. *Obj. 10.4*
- 7. The Secret Service is charged with the security of U.S. currency. *Obj. 10.6 and 10.7*
- 8. Document experts analyze the paper and ink as well as the writing to determine authenticity. *Obj. 10.7*
- 9. Forgers rarely spend time trying to forge documents by famous people. *Obj. 10.5*
- 10. U.S. paper money has special thread embedded in it as a guard against counterfeiting. *Obj. 10.5, 10.6, and 10.7*

Short Answer

- 11. Describe three different characteristics of handwriting that experts analyze during a forensic investigation. *Obj. 10.1*

- 12. Define an *exemplar*. *Obj. 10.1*

- 13. Summarize the three basic steps in handwriting analysis. *Obj. 10.1*

- 14. Describe some of the technologies used by document experts to analyze handwriting. *Obj. 10.4*

- 15. Distinguish between check forgery and literary forgery. *Obj. 10.5*

16. What are some methods used by criminals to make paper and ink appear old when forging a historic document? *Obj. 10.5*
- _____
- _____
17. List the features of money bills that are used to help distinguish genuine money from counterfeit money. *Obj. 10.6 and 10.7*
- _____
- _____
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? *Obj. 10.6 and 10.7*
- _____
- _____

Connections

19. We now have handwriting databases of letters and handwriting samples. How can they be analyzed using mathematical methods? *Obj. 10.1, 10.2, and 10.4*
- _____
- _____

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16. Ink and paper can be made to appear old by adding chemicals to the ink or paper, or by making new ink or paper from materials and techniques used during a certain time period.
17. In real currency, portraits stand out from the background and appear to raise off the paper; there are clear red and blue fibers woven throughout the bill; there are clear, distinct background details and lines; there is a distinct border edge; the Federal Reserve and Treasury seals have clear, sharp saw tooth points; the serial number is evenly spaced and is the same color as the Treasury seal; and the watermark appears on the right side of the portrait of the bill, when viewed in the light.
18. When a counterfeit-detecting pen comes into contact with a counterfeit bill, a bluish-black spot will appear at the point of contact, caused by a reaction between the iodine in the pen and the starch used to make the counterfeit paper. The paper used to print real currency does not contain starch, so it will not react when it comes in contact with a counterfeit-detecting pen.

Connections

19. By applying statistical principles, by comparing them to the shaded pixels, and by looking for patterns.

ACTIVITY 10-1

Background

Have students familiarize themselves with examples of exemplars and use the 12 handwriting characteristics to evaluate their own handwriting and that of a classmate.

Safety Precautions

There are no safety precautions for this activity.

Procedures

1. Print, copy, and distribute Activity Sheet 10-1 from the IRCD.
2. Make sure students read all directions *before* beginning the activity.
3. The handwriting samples should be obtained in advance of this activity without the students' knowledge of how it will be used.
4. After obtaining a sample of student handwriting, have students copy a typed document. Students may unintentionally mimic the handwriting style they see.

ACTIVITY 10-1 *Ch. Obj. 10.1, 10.2, and 10.3* 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.

Answers

Check students' data tables.

Questions

1. Answers will vary.
2. Answers will vary.
3. Answers will vary.
4. Answers will vary.
5. Sample answer: the way different people write numbers.
6. Sample answer: to rule out bias.

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?

Further Research and Extensions

Interested students may want to try doing this activity with a brother, sister, or parent. Afterward, ask them to answer these questions:

- How does your handwriting compare to that of your family member?
- Do you think handwriting patterns are inherited or learned? Explain your answer.

ACTIVITY 10-2 *Ch. Obj. 10.1 and 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

ACTIVITY 10-2

Background

In this activity, students take part in a real-life scenario in which handwriting analysis of a document is crucial. They are required to write up their conclusions in a written report to a jury.

Safety Precautions

There are no safety precautions for this activity.

Teaching Tip

1. Prior to the activity, obtain six different handwriting samples, preferably from outside the class of students performing the activity.
2. Select one of the writers to prepare a ransom note.
3. Copy all seven documents and collate them into the number of sets you need.
4. Have multiple blank copies of Data Tables 1 and 2 and the Visual Elimination Form available for student use.

Procedures

1. Print, copy, and distribute Activity Sheet 10-2 from the IRCD.
2. Make sure students read all directions *before* beginning the activity.
3. Review the lab report outline with students and explain what you will be looking for when you grade their reports.
4. If time permits, students may want to do a mock trial using their testimony.
5. Remind students to use colored pencils or a highlighting pen to mark distinctive features in the handwriting samples.

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

Answers

Check students' data tables, visual elimination forms, and written reports. Lab reports should follow the outline given.

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:

- _____
- _____
- _____
- _____
- _____

Further Research and Extensions

Interested students may want to research and report their findings on court trials in which handwriting analysis was used as part of a prosecuting or defense attorney's strategy.

ACTIVITY 10-3 Ch. Obj. 10.6 and 10.7

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

ACTIVITY 10-3

Background

Students investigate real currency and outline characteristics that help identify counterfeit bills.

Teaching Tip

Use U.S. money early in the unit to demonstrate security features. Project the image onto the screen with an LCD projector and a flex cam to show the security features on our money. (Note: Many students already know about these features because people are very familiar with U.S. currency.) For the activity, use obsolete foreign currency, which is readily (and inexpensively) available from several sources. Students will be interested and intrigued, because they are unfamiliar with the currency. They will have to inspect the bills closely for security features.

Safety Precautions

Remind students to use both hands when carrying a microscope.

Procedures

1. Print, copy, and distribute Activity Sheet 10-3 from the IRCD.
2. Make sure students read all directions *before* beginning the activity.
3. Remember that currency cannot legally be copied at actual size. It must be enlarged or reduced to indicate it is obviously a copy.
4. It may be helpful for students to visit the following Web site: www.moneyfactory.gov/section.cfm/4.

Pretest

Answers

1. Washington
2. Lincoln
3. Jackson
4. Lincoln Memorial
5. U.S. Treasury
6. The White House
7. The Great Seal (pyramid with eye) and the Presidential Seal (with eagle)
8. United States of America, Federal Reserve Note, denomination amount
9. United States of America, In God We Trust, denomination amount
10. Front
11. Department of Treasury Seal, Federal Reserve Seal



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?

Answers

Front

1. Washington
2. Federal Reserve Note
3. One Dollar
4. Federal Reserve Seal
5. Treasury Seal
6. Answers will vary
7. Probably John Snow
8. Answers will vary
9. Answers will vary
10. 2

Back

11. The United States of America
12. One Dollar
13. Pyramid
14. Seal of the United States
15. In God We Trust

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?

Courtesy of
www.moneyfactory.gov



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.



Hidden numbers and letters

Written above Hamilton's name

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 stereomicroscope.



Serial number

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:

a. *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.

b. *Color-shifting ink*. When the bill is tilted, the color of the left-corner 10 shifts from copper to green.

c. *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.

d. *Color*. The background color on both sides of the bill is enhanced.

e. *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



Security thread



Color-shifting ink



Watermark



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



Answer

Check students' data tables.

Questions

1. Sample answer: Bleached paper will pass the counterfeit-pen test.
2. Advances in technology have made it easier to counterfeit currency.
3. Answers will vary.
4. Sample answer: Hold the bill up to a light to check if a thin line appears with the denomination of the bill written on it. See if the color of the left corner 10 shifts from copper to green when the bill is tilted. Hold the bill up to a light to check if a watermark showing the face of Alexander Hamilton appears on the right side of the face of the bill. Check if the bill has red and blue fibers woven throughout.

Further Research and Extensions

Invite local business owners to come and talk to the class about what devices they have, if any, to detect and prevent counterfeit bills used in business transactions. Also ask what type of training, if any, they provide to their employees to help them detect counterfeit currency.

Ask students to design a new \$10 bill incorporating methods to prevent counterfeiting.